Mitteleuropäische Biomassekonferenz

Central European Biomass Conference

Tagungsband Proceedings

15. bis 18. Jänner 2014, Graz, Österreich

15th to 18th January 2014 Graz, Austria

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4. Mitteleuropäische Biomassekonferenz

Eine Veranstaltung von:

Österreichischer Biomasse-Verband

lk landwirtschaftskammer steiermark

bioenergy2020+

klima+ energie fonds

In Kooperation mit:

messe graz

Premiumpartner der Veranstaltung:

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KOMPTECH TECHNOLOGY FOR A BETTER ENVIRONMENT

POLYTECHNIK Biomass Energy

Mit freundlicher Unterstützung von:

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4th Central European Biomass Conference

Organised by:

Österreichischer Biomasse-Verband
Austrian Biomass Association

lk landwirtschaftskammer steiermark

bioenergy2020+

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In cooperation with:

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Long versions of the abstracts can be found on the enclosed CD. After the conference, you will find videos, photos and presentations under www.cebc.at/en

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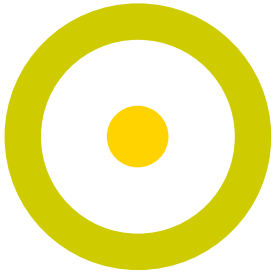
The biggest renewable energy source in the world: Mother Nature

Nature never runs out of energy. Flora and fauna renew themselves every day, creating bio mass as they do, which is wonderful for us to use to generate fuel, electricity and heat. Renewable raw materials, our sun, wind, water and energy efficiency, are the backbone of a sustainable and conscientious use of our resources. Talk to us about renewable energy – the most natural thing in the world.

RENEWABLE ENERGY

ING. LEO RIEBENBAUER



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Graz ist vier Tage lang Europas Biomasse-Hauptstadt

Auf dem Weg zur Erreichung ihrer Ausbauziele 2020 gemäß EU-Erneuerbaren-Richtlinie spielt die Bioenergie für die Nationen Europas eine entscheidende Rolle. Am Bruttoendenergieverbrauch der EU nimmt Biomasse unter den erneuerbaren Energien einen Anteil von 62 % ein. Auch der bis zum Jahr 2020 geplante Zuwachs um rund 2.200 PJ (+63 %) ist höher als bei allen anderen erneuerbaren Energieträgern zusammen. Entgegen den Plänen zum Ausbau der erneuerbaren Energien werden in der EU-Kommission derzeit die Subventionierung von Atomenergie und neue bürokratische Hürden für die Bioenergie-Produktion diskutiert.

Folgerichtig bildet die Energiepolitik in Europa einen der Schwerpunkte der 4. Mitteleuropäischen Biomassekonferenz. Daneben wird die volkswirtschaftliche Bedeutung der Bioenergie in den Mittelpunkt gerückt. Denn der Einsatz von Biomasse schafft nicht nur Arbeitsplätze, sondern hilft durch vermiedene Treibhausgasemissionen auch, die extrem hohen Folgekosten des Klimawandels einzudämmen.

Selbstredend liefert die 4. Mitteleuropäische Biomassekonferenz auch einen umfassenden Überblick über die technologischen Entwicklungen der energetischen Biomassenutzung in Europa. 15 Vortragsblöcke gewährleisten eine außergewöhnlich große thematische Bandbreite von Biowärme über Brennstofflogistik und -aufbereitung bis hin zu Energiepflanzen und neuen Märkten für Biomasse.

Seit 2000 hat sich die globale Pelletsproduktion verzehnfacht. Mit dem 1. Mitteleuropäischen Pelletstag am 15. Jänner 2014 sowie einem halbtägigen Workshop wird diesem Brennstoff besondere Beachtung zuteil. Auch zu Ascheverwertung und Torrefikation werden Workshops abgehalten. Ein weiteres Highlight ist ein eigener Biogastag. Bei sechs Exkursionen zu Biomasse-Vorzeigeprojekten stehen unter anderem Ernte, Aufbereitung und Veredelung von neuen biogenen Rohstoffen im Mittelpunkt. Während des Industrieforums präsentieren führende Hersteller ihre Neuentwicklungen.

Selbstverständlich ist die 4. Mitteleuropäische Biomassekonferenz auch eine hervorragende Plattform zum Austausch von Informationen und Erfahrungen sowie zur Vernetzung. Gelegenheit dazu bieten in besonderem Maße Workshops, B2B-Meetings und das Konferenzdinner. Für Unternehmen und Organisationen bietet das Matchmaking-Event eine eigene Kooperationsbörse (Biomass Business Talks).

Graz ist die Hauptstadt der Steiermark, des grünen Herzens Österreichs und einer Pionierregion für Bioenergie-Technologien. Vom 15. bis 18. Jänner 2014 wird Graz zum vierten Mal zur europäischen Biomasse-Hauptstadt. Wir erwarten mehr als 1.000 Teilnehmer aus über 50 Nationen.

Wir heißen Sie zur 4. Mitteleuropäischen Biomassekonferenz in Graz sehr herzlich willkommen.

Horst Jauschnegg
Vorsitzender des Organisationskomitees, Vorsitzender ÖBMV

Werner Brugner
Direktor der Landwirtschaftskammer Steiermark

Thomas Klein
Geschäftsführer der Bioenergy 2020+ GmbH

Ingmar Höbarth
Geschäftsführer Klima- und Energiefonds

Graz to become the biomass capital of Europe

Bioenergy has become very important to European countries in the achievement of their development goals for 2020 in compliance with the EU's Renewables Directive. Biomass accounts for a share of 62 % in the renewable energies used in gross end energy consumption within the EU. The planned growth of around 2,200 PJ (+63 %) by 2020 is higher than that for all other renewable sources of energy put together. But the EU commission is currently discussing the subsidisation of nuclear energy and new bureaucratic obstacles for the production of bioenergy, which run in opposition to plans to increase the use of renewables.

Energy policies within Europe will therefore appropriately be one of the topics that the 4th Central European Biomass Conference will be focusing on. The conference will also be concentrating on the significance of bioenergy to the European economy. Because the utilisation of biomass is not only creating jobs but will also help reduce the extremely high costs caused by climate change through the prevention of greenhouse-gas emissions.

The 4th Central European Biomass Conference will, of course, also be providing a comprehensive overview of technological developments in how biomass is utilised to generate energy throughout Europe. Fifteen presentation blocks will guarantee an extraordinarily broad scope of topics ranging from bioheating through the logistics and processing of fuel to energy plants and new markets for biomass products.

Global pellet production has increased tenfold since 2000. The 1st Central European Pellet Day, to take place on 15th January 2014, and a half-day workshop will be specifically dedicated to this fuel. Workshops focusing on the use of ash and torrefaction will also be held. A separate biogas day will constitute a special highlight. Six excursions to showcase biomass projects will focus, among other things, on the harvesting, processing and refinement of new biogenic raw materials. Leading manufacturers will also be presenting new developments at the Industry Forum.

The 4th Central European Biomass Conference will, of course, constitute an excellent platform for the exchange of information and experiences as well as for networking. The workshops, B2B meetings and the conference dinner will offer plenty of opportunities in this regard. The Matchmaking Event (Biomass Business Talks), for instance, is a cooperation exchange for companies and organisations.

Graz is the capital of Styria, the green heart of Austria and a region that is pioneering bioenergy technologies. It will become Europe's biomass capital for the fourth time from 15th to 18th January. We are expecting more than 1,000 participants from over 50 countries to attend the event.

We are looking forward to having the pleasure of welcoming you to the 4th Central European Biomass Conference in Graz.

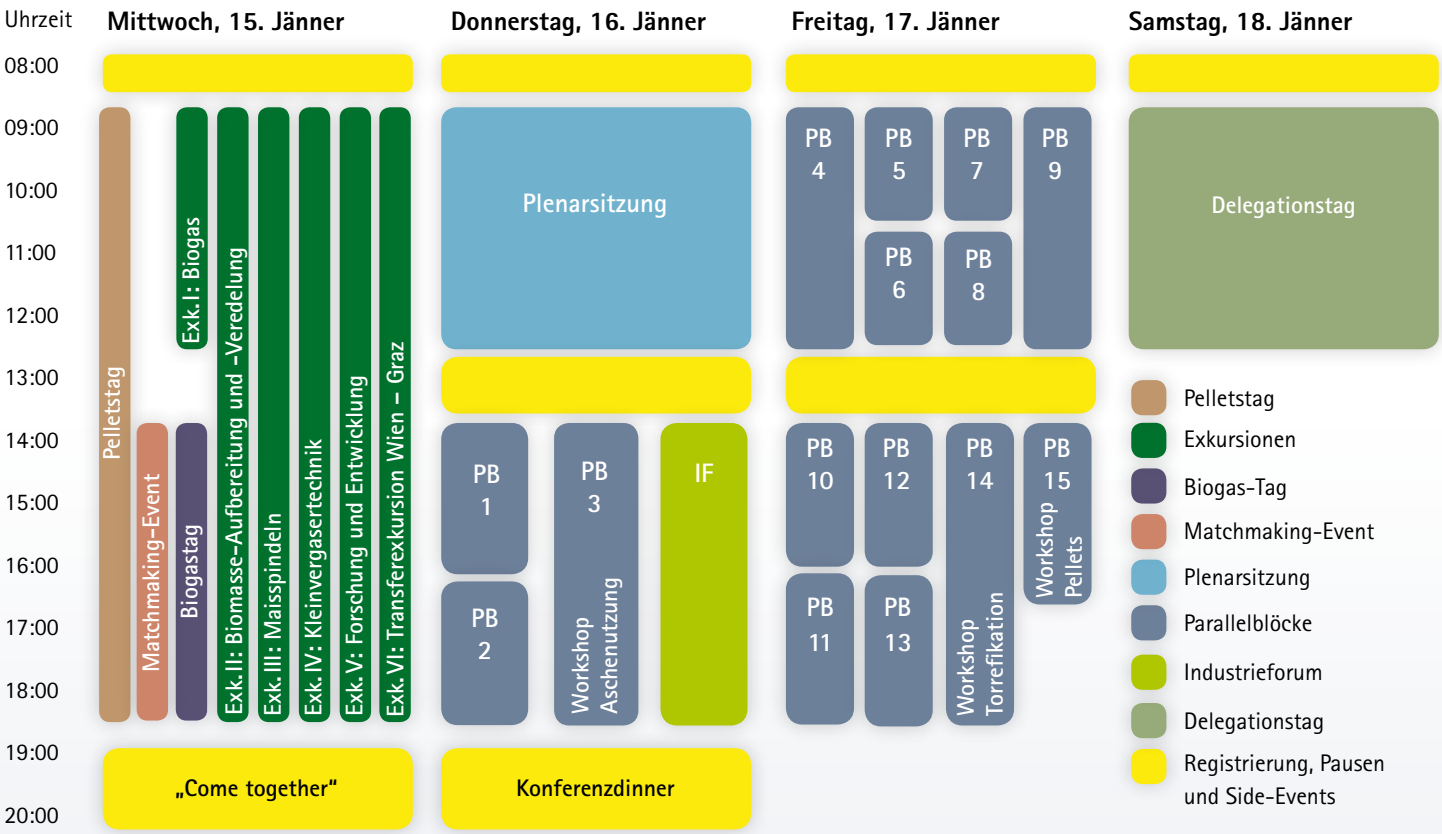
Horst Jauschnegg
Chairman of the ABA, Chairman of the Organising Committee

Werner Brugner
Director of the Styrian Chamber for Agriculture and Forestry

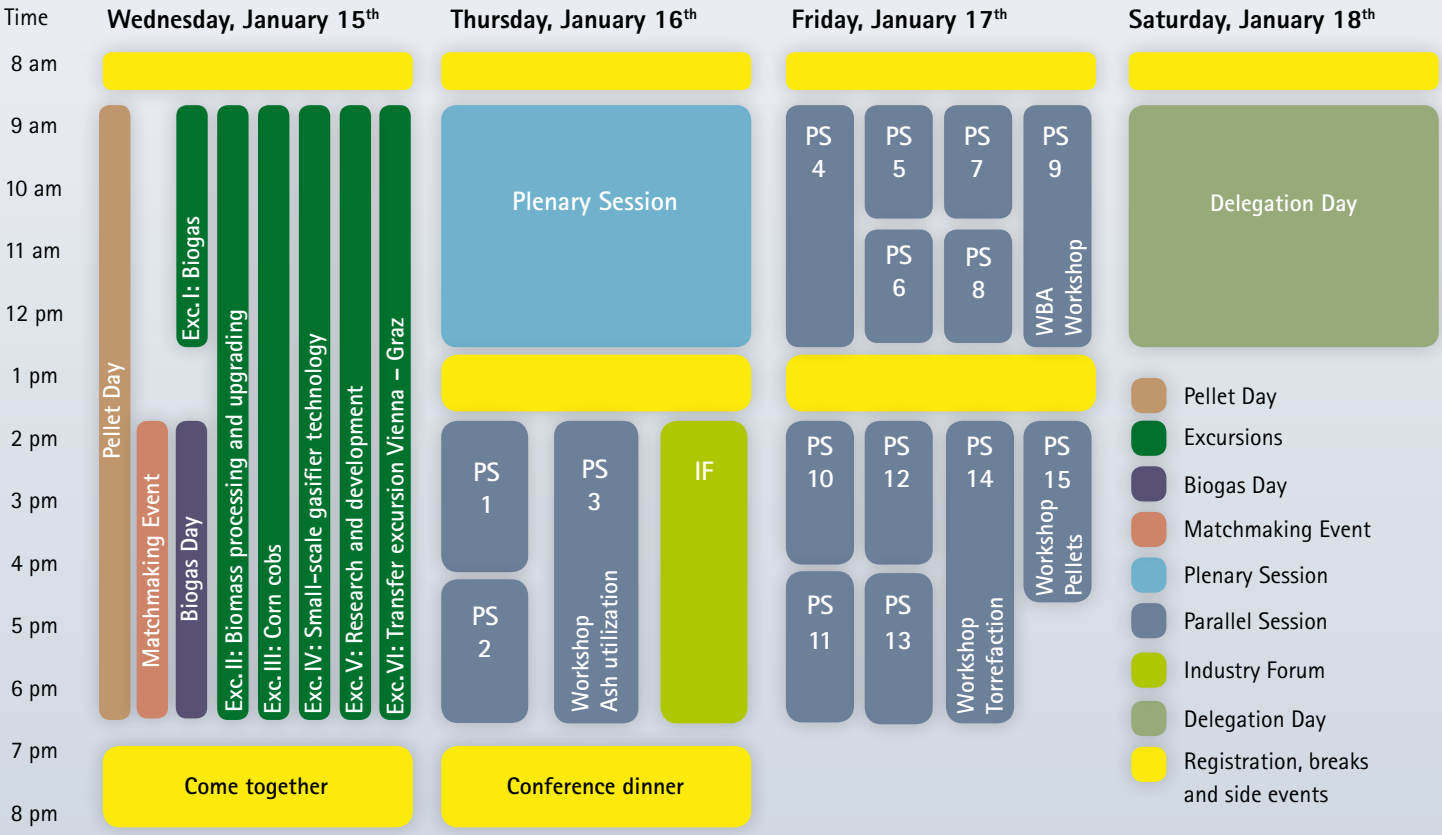
Thomas Klein
Managing Director of Bioenergy 2020+ GmbH

Ingmar Höbarth
Managing Director of the Climate and Energy Fund

Programm der 4. Mitteleuropäischen Biomassekonferenz 2014



Programme of the 4th Central European Biomass Conference in 2014



Programmübersicht

Mittwoch 15 Jänner

07:00–09:00 **Registrierung**

08:00–12:30 **Exkursion I**

08:00–18:30 **Exkursionen II–VI**

09:00–18:00 **1. Mitteleuropäischer Pelletstag**
Ressourcen treffen Märkte

12:00–13:00 **Registrierung**

14:00–18:00 **Biogastag**
Neue Wege und Wachstumsmärkte

14:00–18:00 **Matchmaking-Event**
Biomass Business Talks

18:30 „Come together"

Donnerstag 16 Jänner

07:30–09:00 **Registrierung**

09:00–12:30 **Plenarsitzung**
Energiepolitik in Europa

12:30–14:00 **Mittagspause** und **Posterpräsentation**

14:00–16:00 **Parallelblock 1**
Wärme aus Biomasse: Kleinanlagen

16:30–18:30 **Parallelblock 2**
Wärme aus Biomasse: Industrielle Anlagen

13:30–18:30 **Parallelblock 3**
Workshop Verwertung von Pflanzenaschen

14:00–18:30 **Industrieforum**
Biomasse, Biogas und Biotreibstoffe, anschl. Get-together

20:00 Konferenzdinner

Freitag 17 Jänner

08:00–09:00 **Registrierung**

09:00–12:00 **Parallelblock 4**
Strom aus fester Biomasse

09:00–10:30 **Parallelblock 5**
Bioraffinerie

11:00–12:30 **Parallelblock 6**
Biotreibstoffe

09:00–10:30 **Parallelblock 7**
Brennstofflogistik und Brennstoffaufbereitung

11:00–12:30 **Parallelblock 8**
Biowärme: Simulation und Effizienzoptimierung

09:00–12:30 **Parallelblock 9**
WBA-Workshop:
Weltweite Märkte für Biomasse

12:30–14:00 **Mittagspause** und **Posterpräsentation**

14:00–16:00 **Parallelblock 10**
Energiepflanzen

16:30–18:30 **Parallelblock 11**
Brennstoffcharakterisierung und Energiepflanzen

14:00–16:00 **Parallelblock 12**
Biomassepotenziale

16:30–18:30 **Parallelblock 13**
Biogas

14:00–18:30 **Parallelblock 14**
Workshop Torrefikation von Biomasse

14:00–16:30 **Parallelblock 15**
Workshop Pellets

Programme overview

Wednesday 15 January

7:00–9:00 am **Registration**

8:00 am–12:30 pm **Excursion I**

8:00 am–6:30 pm **Excursion II–VI**

9:00 am–6:00 pm **1st Central European Pellet Day**
Resources meet markets

12:00–1:00 pm **Registration**

2:00–6:00 pm **Biogas Day**
New paths and growing markets

2:00–6:00 pm **Matchmaking Event**
Biomass Business Talks

6:30 pm Come together

Thursday 16 January

7:30–9:00 am **Registration**

9:00 am–12:30 pm **Plenary Session**
Energy policy in Europe

12:30–2:00 pm **Lunch break** and **poster presentation**

2:00–4:00 pm **Parallel Session 1**
Heat from biomass: Small scale

4:30–6:30 pm **Parallel Session 2**
Heat from biomass: Industrial scale

1:30–6:30 pm **Parallel Session 3**
Workshop Biomass ash utilization

2:00–6:30 pm **Industry Forum**
Biomass, biogas and biofuels, following Get together

8:00 pm Conference dinner

Friday 17 January

8:00–9:00 am **Registration**

9:00 am–12:00 pm **PS 4**
Electricity from solid biomass

9:00–10:30 am **Parallel Session 5**
Biorefineries

11:00 am–12:30 pm **PS 6**
Biofuels

9:00–10:30 am **Parallel Session 7**
Fuel logistics and processing

11:00 am–12:30 pm **PS 8**
Biomass heat: Simulation and efficiency optimization

9:00 am–12:30 pm **PS 9**
WBA Workshop:
Global markets for biomass

12:30–2:00 pm **Lunch break** and **poster presentation**

2:00–4:00 pm **Parallel Session 10**
Energy plants

4:30–6:30 pm **Parallel Session 11**
Fuel characterisation and energy crops

2:00–4:00 pm **Parallel Session 12**
Biomass potentials

4:30–6:30 pm **Parallel Session 13**
Biogas

2:00–6:30 pm **Parallel Session 14**
Workshop Torrefaction of biomass

2:00–4:30 pm **Parallel Session 15**
Workshop Pellets

Die energetische Nutzung von Biomasse ist ein wichtiger Baustein für die Energieversorgung der Zukunft. Wir haben dazu innovative und nachhaltige Lösungen.

Viessmann ist auf die Zukunft perfekt eingestellt: unsere Holzheizsysteme sind eine natürliche, CO_2-neutrale Alternative mit hoher Energieeffizienz und Versorgungssicherheit. Gemeinsam mit unseren Spezialisten Köb und Mawera sind wir der Ansprechpartner für effiziente Holzheizsysteme und Holzfeuerungsanlagen in jedem Leistungsbereich – vom Pelletkessel für die Wärmeversorgung von Einfamilienhäusern bis hin zum komplexen Anlagenbau für die Wärme- und Stromerzeugung aus Biomasse. Stellen Sie sich auf die Zukunft ein und informieren Sie sich jetzt unter **www.viessmann.de/industrie**

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Nicer chipping:
The Chippo

Pure design:
The Topturn

The NEw MUStang:
The Nemus

Less fuel, more power:
The Crambo direct

Drum-roll:
The Cribus

Provides for fresh wind:
The Hurrikan

Screening with a star:
The Multistar

The end of the stone age:
The Stonefex

A real bigmouth:
The Axtor

Of course we´re not the only people helping to make the world a greener place. But we´re still very proud of our solutions for handling waste and biomass!

KOMPTECH
TECHNOLOGY FOR A BETTER ENVIRONMENT

Programm Teil 1

Programme Part 1

POLYTECHNIK Luft- und Feuerungstechnik GmbH

Hainfelderstrasse 69
A-2564 Weissenbach

Telefon: +43/2672/890-0
Telefax: +43/2672/890-13
E-Mail: office@polytechnik.at
Internet: www.polytechnik.com

The Austrian company, Polytechnik Luft-und Feuerungstechnik GmbH, is one of the most distinguished providers of firing systems for biological fuels and is well-known for designing and supplying turn-key systems. Its current export rate is more than 95 %.

The company provides these firing systems with a power range of 300 kW – 30,000 kW (single boiler output). Different firing systems, such as underfeed systems, underfeed combustion stokers and reciprocating stokers, are used, depending on the type and water content of the fuel. The medium carriers are warm water, hot water, steam and thermal oil.

The systems may be used for heating and process heating as well as for generating electricity (steam and ORC processes). Capacity ranges from 200 kW to 20,000 kW electrical power (current).

There are already more than 2,500 Polytechnik systems in operation globally.

In other industries and in the municipal sector, local and district heating plants are offered alongside the firing systems and combined heat and power plants. The company's broad service network facilitates top quality and highly efficient customer care.

Die österreichische Firma „Polytechnik Luft-und Feuerungstechnik GmbH" ist einer der bedeutensten Anbieter von Feuerungsanlagen für biogene Brennstoffe und ist bekannt für die Planung und Lieferung von schlüsselfertigen Anlagen. Die Exportrate beträgt derzeit über 95 %.

Das Unternehmen bietet diese Feuerungsanlagen in einem Leistungsbereich von 300 kW – 30.000 kW (Einzelkesselleistung) an. Je nach Art und Wassergehalt des Brennstoffes werden verschiedene Feuerungssysteme (System Unterschub, Unterschub-Ausbrandrost und Vorschubrost) eingesetzt. Medienträger sind Warmwasser, Heißwasser, Dampf oder Thermoöl.

Die Anlagen können für Heizungs- und Prozess-wärme sowie für die Stromerzeugung (Dampf- und ORC- Prozess) eingesetzt werden. Der Leistungsbereich reicht hierbei von 200 kW – 20.000 kW elektrische Leistung (Strom).

Weltweit sind bereits über 2.500 Polytechnik- Anlagen im Einsatz.

In der allgemeinen Industrie sowie im kommunalen Bereich werden neben den Feuerungs- und Kraft-Wärme-Kopplungsanlagen auch Nah- und Fernwärmeanlagen angeboten. Das weit verzweigte Servicenetz des Unternehmens ermöglicht eine optimale und rasche Kundenbetreuung.

Exkursionen

Mittwoch 15 Jänner

Exkursion I

Biogas

08:00 Abfahrt Graz
09:30 **Biogasanlage Uidl, Halbenrain**
- Einsatz und Aufbereitung von Maisstroh

12:30 Ankunft Graz

Exkursion II

Bereitstellung, Aufbereitung und Veredelung von Biomasse

08:00 Abfahrt Graz
09:00 **Pilotanlage Torrefikation Andritz, Frohnleiten**
10:45 **Komptech, Frohnleiten**
- Hersteller von Holzhackern, Kompostierern und Abfallzerkleinerern

13:00 **Mittagessen**
14:30 **Biowärme Leoben Hinterberg**
- Holzenergie-Contracting Brücklwirt Leoben

15:00 **Biomassehof Leoben, Niklasdorf**
- Qualitätssicherung, Logistik, Vertrieb
- Holzhacker im Einsatz

18:30 Ankunft Graz

Exkursion III

Maisspindeln

08:00 Abfahrt Graz
09:30 **Franz Tschiggerl, Halbenrain**
- Erntetechnik, Grundlagen
- thermische und stoffliche Maisspindelnutzung
- Saatguttrocknung mit Maisspindeln

11:30 **Verein Heu und Pellets**
- Heu- und Maisspindelpelletierung

13:00 **Mittagessen**
14:30 **Biomasseheizwerk Scheer**
- Einsatz von Maisspindeln und Hackgut

16:30 **Maisspindel-Pelletsverfeuerung mit Schneckenbrenner**
- thermische Nutzung von Maisspindelpellets

18:30 Ankunft Graz

Excursions

Wednesday 15 January

Excursion I

Biogas

8:00 am Departure Graz
9:30 am **Biogas plant Uidl, Halbenrain**
- Application and processing of maize straw

12:30 pm Arrival Graz

Excursion II

Provision, processing and upgrading of biomass

8:00 am Departure Graz
9:00 am **Torrefaction pilot plant Andritz, Frohnleiten**
10:45 am **Komptech, Frohnleiten**
- Producer of wood chippers, shredders and separators

1:00 pm **Lunch break**
2:30 pm **Biowärme Leoben Hinterberg**
- Wood energy contracting Brücklwirt Leoben

3:00 pm **Biomass courtyard Leoben, Niklasdorf**
- Quality assurance, logistics, sales
- Wood chipper in action

6:30 pm Arrival Graz

Excursion III

Corn cobs

8:00 am Departure Graz
9:30 am **Franz Tschiggerl, Halbenrain**
- Harvesting technology, basics
- Thermal and material use of corn cobs
- Seed-drying with corn cobs

11:30 am **Verein Heu und Pellets**
- Pelletizing of hay and corn cobs

1:00 pm **Lunch break**
2:30 pm **Biomass heating plant Scheer**
- Use of corn cobs and wood chips

4:30 pm **Corn cobs pellets combustion with a scroll burner**
- Thermal use of corn cob pellets

6:30 pm Arrival Graz

BIOMASSE

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Exkursionen

Mittwoch 15 Jänner

Exkursion IV

Kleinvergasertechnik, Holzgas-KWK-Anlagen

08:00 Abfahrt
09:00 **Holzgas-KWK Unterpremstätten**
- REP Christoph Group
- Holzgasheizkraftwerk mit 13kW$_{el}$ und 31kW$_{th}$

12:00 **Mittagessen**
13:30 **Cleanstgas® GmbH, St. Margarethen/Raab**
- Entwickler von Holzvergasungs-Kraftwerken im mittleren Leistungsbereich

15:30 **KWB - Kraft und Wärme aus Biomasse GmbH, St. Margarethen/Raab**
- Hersteller von Biomasseheizungen für Pellets, Hackgut und Stückholz

18:30 Ankunft Graz

Exkursion V

Forschung und Entwicklung

08:00 Abfahrt Graz
09:00 **Sattler AG, Rudersdorf**
- Speicherkonzepte für Biogas-, Gülle- und Gärrestlagerung

12:00 **Mittagessen**
13:30 **Firma Josef Binder Maschinenbau- und HandelsgesmbH., Bärnbach**
- Hersteller von Biomassefeuerungen

14:30 **ICON – Rauchgaskondensation in Kombination mit einer Industriewärmepumpe, BIOS/Scheuch/Ochsner/AIT, Bärnbach**
16:00 **Bioenergy 2020+ GmbH, Institut für Prozess- und Partikeltechnik, TU Graz & BIOS Bioenergiesysteme GmbH, Graz**
18:30 Ankunft Graz

Exkursion VI

Transferexkursion Wien – Graz

08:00 Abfahrt Flughafen Wien-Schwechat
08:30 **Energiepark Bruck an der Leitha**
10:30 **EVM Energie Versorgung Margarethen am Moos GmbH**
13:00 **Mittagessen**
14:30 **Polytechnik, Weissenbach**
- Erzeuger von modernen Biomassekesseln
- Biomasse-KWK

18:30 Ankunft Graz

Organisatorisches: Die Abfahrt für die Exkursionen I bis V erfolgt vom Parkplatz, Messe Graz
Die Abfahrt für die Exkursionen VI erfolgt vom Flughafen Wien-Schwechat bei den Bussteigen im Bereich Ankunft/Ebene 0

Excursions

Wednesday 15 January

Excursion IV

Small gasifier technology, wood gas CHP

8:00 am Departure Graz
9:00 am **Wood gas CHP Unterpremstätten**
- REP Christoph Group
- Wood gas power plant with 13kW$_{el}$ and 31kW$_{th}$

12:00 pm **Lunch break**
1:30 pm **Cleanstgas® GmbH, St. Margarethen/Raab**
- Developer of medium-scale wood gasification power plants

3:30 pm **KWB - Kraft und Wärme aus Biomasse GmbH, St. Margarethen/Raab**
- Manufacturer of biomass heating systems for pellets, wood chips and firewood

6:30 pm Arrival Graz

Excursion V

Research and development

8:00 am Departure Graz
9:00 am **Sattler AG, Rudersdorf**
- Storage concepts for residues from biogas, manure and fermentation

12:00 pm **Lunch break**
1:30 pm **Josef Binder Maschinenbau- und HandelsgesmbH., Bärnbach**
- Manufacturer of biomass boilers

2:30 pm **ICON – Flue gas condensation in combination with an industrial heat pump, BIOS/Scheuch/Ochsner/AIT, Bärnbach**
4:00 pm **Bioenergy 2020+ GmbH, Institute for Process and Particle Engineering, TU Graz & BIOS Bioenergiesysteme GmbH, Graz GmbH, Graz**
6:30 pm Arrival Graz

Excursion VI

Transfer excursion Vienna – Graz

8:00 am Departure Vienna International Airport
8:30 am **Energy park Bruck an der Leitha**
10:30 am **EVM Energie Versorgung Margarethen am Moos GmbH**
1:00 pm **Lunch break**
2:30 pm **Polytechnik, Weissenbach**
- Producer of modern biomass boilers
- Biomass CHP

6:30 pm Arrival Graz

Attention: The excursions I to V start from the parking lot at Messe Graz
Excursion VI starts at Vienna International Airport, bus platform arrivals/level 0

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1. Mitteleuropäischer Pelletsstag

Der Pelletstag ist das erste Event, das einen Kontakt zwischen Geschäftspartnern aus den rohstoffreichen Ländern Osteuropas und den Pelletsmärkten in Deutschland, Österreich und Italien herstellt.

Christian Rakos, Präsident des European Pellet Council & Geschäftsführer von proPellets Austria

Moderator: Christian Rakos

Aktuelle Lage und Prognosen für die Pelletsproduktion und den Pelletsverbrauch in Mittel- und Osteuropa

09:00 **Eröffnung**

09:20 **Pelletsmarkt in Polen**
Ludmila Wach, *Baltic Energy Conservation Agency, Danzig, Polen*

09:40 **Pelletsmarkt in Tschechien**
Vladimír Stupavský, *Präsident Tschechischer Pelletscluster, Tschechien*

10:00 **Pelletsmarkt in Ungarn**
Illés Jancsó, *Vizepräsident Ungarischer Pelletsverband, Ungarn*

10:20 **Pelletsmarkt in Kroatien**
Marijan Kavran, *Generalsekretär Kroatischer Holzcluster, Delnice, Kroatien*

10:40 **Kaffeepause**

11:15 **Pelletsmarkt in Serbien**
Branko Glavonjic, *Universität Belgrad, Forstliche Fakultät, Belgrad, Serbien*

11:35 **Pelletsmarkt in der Ukraine**
Tetiana Ignatenko, *Generalsekretär Ukrainian Pellet Union, Kiew, Ukraine*

11:55 **Pelletsmarkt in Rumänien**
Dorin Sfaca, *Präsident des Rumänischer Pellets- & Holzbrikettverbandes, Bukarest, Rumänien*

Mittwoch 15 Jänner

12:15 **Pelletsmarkt in Bulgarien**
Vasil Zlatev, *Energieagentur von Plovdiv, Plovdiv, Bulgarien*

12:35 **Pelletsmarkt in Griechenland**
Ioannis Eleftheriadis, *Centre for Renewable Energy Sources and Saving, Biomass dept., Pikermi Attiki, Griechenland*

13:00 **Mittagspause**

Aktuelle Marktlage in den wichtigsten Verbrauchermärkten

14:00 **Pelletsmarkt in Deutschland**
Martin Bentele, *Geschäftsführender Vorsitzender Deutscher Energieholz- und Pellet-Verband e.V. (DEPV), Berlin, Deutschland*

14:20 **Pelletsmarkt in Österreich**
Christian Rakos, *Präsident des European Pellet Council & Geschäftsführer von proPellets Austria, Wolfsgraben*

14:40 **Pelletsmarkt in Italien**
Annalisa Paniz, *Italian Agriforestry Energy Association Legnaro (AIEL), Padua, Italien*

15:00 **Kaffeepause**

Qualitätsanforderungen und die ENplus-Zertifizierung

15:30 **Qualitätsanforderungen für Pellets und Folgen für die Pelletsproduktion**
Martin Englisch, *Geschäftsführer BEA Bioenergy Anlagenplanung GmbH, Wien*

16:00 **Das ENplus-Zertifikat – Wie lässt man sich zertifizieren? Verfahren, Kosten und Nutzungsrechte**
Gilles Gauthier, *Geschäftsführer European Pellet Council & Bioenergie-Experte AEBIOM, Brüssel, Belgien*

16:30 **Pellets-B2B-Meeting**

English only
Alle Vorträge werden auf Englisch gehalten ohne Simultanübersetzung.

1st Central European Pellet Day

„The Pellet Day is the first international event dedicated to establishing contacts between businesses in Eastern European countries with significant resources for pelletizing and major consumer markets."

Christian Rakos, President of the European Pellet Council & General Manager of proPellets Austria

Chairman: Christian Rakos

Current situation and outlook for pellet production and use in Central and Eastern Europe

9:00 am **Opening**

9:20 am **Pellet market in Poland**
Ludmila Wach, *Baltic Energy Conservation Agency, Gdansk, Poland*

9:40 am **Pellet market in Czech Republic**
Vladimír Stupavský, *Chairman Czech Pellets Cluster, Czech Republic*

10:00 am **Pellet market in Hungary**
Illés Jancsó, *Vice-president Hungarian Pellet Association, Hungary*

10:20 am **Pellet market in Croatia**
Marijan Kavran, *Secretary General Croatian Wood Cluster, Delnice, Croatia*

10:40 am **Coffee break**

11:15 am **Pellet market in Serbia**
Branko Glavonjic, *University of Belgrade, Faculty of Forestry, Belgrade, Serbia*

11:35 am **Pellet market in Ukraine**
Tetiana Ignatenko, *Secretary General Ukrainian Pellet Union, Kiev, Ukraine*

11:55 am **Pellet market in Romania**
Dorin Sfaca, *President of Romanian Pellet & Wood Briquettes Association, Bucharest, Romania*

Wednesday 15 January

12:15 pm **Pellet market in Bulgaria**
Vasil Zlatev, *Energy Agency of Plovdiv, Plovdiv, Bulgaria*

12:35 pm **Pellet market in Greece**
Ioannis Eleftheriadis, *Centre for Renewable Energy Sources and Saving, Biomass dept., Pikermi Attiki, Greece*

1:00 pm **Lunch Break**

Current market situation in major consumer markets

2:00 pm **Pellet market in Germany**
Martin Bentele, *General Manager German energy wood and wood pellet association (DEPV), Berlin, Germany*

2:20 pm **Pellet market in Austria**
Christian Rakos, *President European Pellet Council & General Manager proPellets Austria, Wolfsgraben, Austria*

2:40 pm **Pellet market in Italy**
Annalisa Paniz, *Italian Agriforestry Energy Association Legnaro (AIEL), Padua, Italy*

3:00 pm **Coffee break**

Quality requirements and ENplus certification

3:30 pm **Quality requirements for pellets and consequences for pellet production**
Martin Englisch, *General Manager BEA Bioenergy Anlagenplanung GmbH, Vienna, Austria*

4:00 pm **The ENplus Certification – How to get certified? Procedures, costs and license rights**
Gilles Gauthier, *Secretary General European Pellet Council & Bioenergy Expert, AEBIOM Brussels, Belgium*

4:30 pm **Pellets B2B Meeting**

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Biogastag

„Die Kombination aus Theorie und Praxis macht den Biogastag zu einer hervorragenden Gelegenheit, um moderne Techniken im Einsatz zu sehen und die Entwicklungen am Biogassektor mitzuverfolgen."

Norbert Hummel, Stellvertretender Obmann der ARGE Kompost & Biogas Österreich

Moderator:
Bernhard Stürmer, *ARGE Kompost & Biogas Österreich, Wien*

14:00 **Eröffnung**
- Horst Jauschnegg, *Vorsitzender Österreichischer Biomasse-Verband, Wien*
- Norbert Hummel, *Stellvertretender Obmann, ARGE Kompost & Biogas Österreich, Wien*

14:10 **Landwirtschaftliches Reststoff-Potenzial für Biogas – technische Umsetzungs- und Handlungserfordernisse**
Andreas Gronauer, *Institut für Landtechnik, Universität für Bodenkultur Wien (BOKU), Wien*

14:30 **Biogas aus Zwischenfrüchten: erzielbare Erträge und praktische Umsetzung**
Manfred Szerencsits, *Ökocluster, Hitzendorf*

14:50 **Vergärung von Biomasse aus Mikroalgen**
Markus Gruber, *Bioenergy2020+ GmbH, Graz*

15:10 **Behandlung von organischen Abfällen: eine Fallstudie**
Doris Thamer, *Andritz AG, Graz*

Mittwoch 15 Jänner

15:30 **Vorbehandlungsmethoden für Biogasanlagen**
Günther Bochmann, *Universität für Bodenkultur Wien (BOKU), Tulln*

15:50 **Kaffeepause**

16:20 **Die Verwertung von Bioabfällen zur Biomethanerzeugung in fünf europäischen Städten – the Urban Biogas Project**
Dominik Rutz, *WIP - Renewable Energies, München, Deutschland*

16:40 **Biomethan – Treibstoff der Zukunft**
Peter Stiegler, *Energiewerkstatt, Friedburg*

17:00 **Wirtschaftlichkeit von Biogas in der flexiblen Stromerzeugung**
Sebastian Auburger, *Universität Hohenheim, Hohenheim, Deutschland*

17:20 **Effiziente und nachhaltige Düngestrategien mit Gärrückständen**
Beate Formowitz, *Technologie- und Förderzentrum (TFZ) im Kompetenzzentrum für Nachwachsende Rohstoffe, Straubing, Deutschland*

17:40 **Benchmarking von Biogasanlagen – der österreichische Ansatz**
Bernhard Stürmer, *ARGE Kompost & Biogas Österreich*

arge kompost & biogas

Biogas Day

„The combination of theory and practise is a great opportunity to watch modern techniques in the field and to follow the latest developments in the sector of biogas."

Norbert Hummel, Vice-Chairman of ARGE Compost & Biogas Austria

Chairman:
Bernhard Stürmer, *Bernhard Stürmer, ARGE Compost & Biogas Austria, Vienna, Austria*

2:00 pm **Opening**
- Horst Jauschnegg, *Chairman of the Austrian Biomass Association, Vienna, Austria*
- Norbert Hummel, *Vice-Chairman of ARGE Compost & Biogas Austria, Vienna, Austria*

2:10 pm **Potentials for biogas from agricultural solid waste – requirements for technical implementation and operation**
Andreas Gronauer, *Vienna University of Natural Resources and Applied Life Sciences, Division of Agricultural Engineering, Vienna, Austria*

2:30 pm **Biogas from intercropping: achievable returns and practical implementation**
Manfred Szerencsits, *Ökocluster, Hitzendorf, Austria*

2:50 pm **Fermentation of biomass from micro algae**
Markus Gruber, *Bioenergy2020+ GmbH, Graz, Austria*

3:10 pm **Organic waste treatment: a case study**
Doris Thamer, *Andritz AG, Graz, Austria*

Wednesday 15 January

3:30 pm **Pretreatment methods for biogas plants**
Günther Bochmann, *Vienna University of Natural Resources and Applied Life Sciences, Vienna, Austria*

3:50 pm **Coffee break**

4:20 pm **Biowaste utilisation for the production of biomethane in five European cities – the Urban Biogas Project**
Dominik Rutz, *WIP - Renewable Energies, Munich, Germany*

4:40 pm **Biomethane – fuel for the future**
Peter Stiegler, *Energiewerkstatt, Friedburg, Austria*

5:00 pm **Economic efficiency of biogas in the flexible electricity generation**
Sebastian Auburger, *University of Hohenheim, Hohenheim, Germany*

5:20 pm **Efficient and sustainable fertilization strategies with digestates**
Beate Formowitz, *Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ), Straubing, Germany*

5:40 pm **Benchmarking for biogas plants – the Austrian approach**
Bernhard Stürmer, *ARGE Compost & Biogas Austria, Vienna, Austria*

In German only
The presentations will be held in German only without simultaneous translation.

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Matchmaking-Event: Biomass Business Talks

Neben den politischen, technischen und wirtschaftlichen Vorträgen sowie dem Exkursionsprogramm werden im Rahmen der 4. Mitteleuropäischen Biomassekonferenz „bilaterale B2B-Meetings" organisiert. Dieses Matchmaking-Event bietet die Möglichkeit, Kontakte zu Geschäftspartnern, Bioenergie-Experten und Forschungseinrichtungen herzustellen. Nutzen Sie die Chance sich mit erfolgreichen Technologieunternehmen zu vernetzen, und Know-how auszutauschen. In individuellen Einzelgesprächen können Sie folgende Themen diskutieren:

- **Geschäftskooperationen**
- **Gemeinsame Technologieentwicklungen**
- **Forschungs- und Know-how-Transfer**
- **Lizenz-, Geschäfts- und Finanzvereinbarungen**

Sie bieten oder suchen innovative Technologien, F/E-Projekte oder Know-how-Profile? Registrieren Sie sich einfach und bequem via Internet und füllen Sie Ihr Unternehmensprofil sowie Ihre Angebote bzw. Nachfragen im Webformular aus. Alle Profile werden online gestellt und können von jedem Teilnehmer des Matchmaking-Events gebucht werden. So ist bereits vor der Veranstaltung klar, mit wem Sie sprechen werden und wer sich gerne mit Ihnen unterhalten würde.

Ablauf

Matchmaking-Event: 15. Jänner 2014, 14:00–18:00 Uhr

Details

www.b2match.eu/energydaysgraz2014
www.cebc.at

Mittwoch 15 Jänner

Freier Eintritt!
Die Teilnahme am Matchmaking-Event ist kostenlos. Es ist keine Eintrittskarte für die Konferenz erforderlich.

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Matchmaking Event: Biomass Business Talks

The 4th Central European Biomass Conference is an international conference on political and technical developments in the field of bioenergy. After very successful bilateral B2B meetings in 2011 involving 80 companies and research institutes from 16 countries, a Matchmaking Event will again be organised as part of the programme for this high level experts' congress. This Matchmaking Event for technology, expertise and business cooperation is an opportunity to meet business partners, bioenergy experts or research institutions and to conduct individual meetings on topics such as:

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- **Joint technology development**
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- **Licence, commercial and financial agreements**

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Date

Matchmaking Event: 15 January 2014, 2:00–6:00 pm

For more details please visit

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Wednesday 15 January

Free entrance!
Participation in the Matchmaking Event is free of charge. An admission ticket for the CEBC is not necessary.

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Plenarsitzung
Energiepolitik in Europa

Donnerstag 16 Jänner

Moderator:
Ingmar Höbarth, *Klima- und Energiefonds, Wien*

09:00 **Begrüßung und Eröffnung**
- Siegfried Nagl, *Bürgermeister der Stadt Graz, Graz*
- Johann Seitinger, *Landesrat, Graz*
- Franz Titschenbacher, *Präsident der Landwirtschaftskammer Steiermark, Graz*

09:15 **Die Bedeutung der Bioenergie für Klimaschutz und Volkswirtschaft**
Andrä Rupprechter, *Bundesminister für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien*

09:50 **Energiewende in Bedrängnis?**
Franz Alt, *Journalist und Buchautor, Baden-Baden, Deutschland*

10:15 **Reiseflughöhe erreicht! Reiseziel offen – der jüngste Klimabericht des IPCC**
Georg Kaser, *Universität Innsbruck, Institut für Meteorologie und Geophysik & Mitautor des IPCC-Berichtes*

10:45 **Kaffeepause**

11:15 **Die Rolle der Bioenergie im Kontext von „100 % erneuerbar"**
Gustav Melin, *Vorsitzender Europäischer Biomasse-Verband, Stockholm, Schweden*

11:40 **Stoffliche versus energetische Biomassenutzung?**
Horst Jauschnegg, *Vorsitzender Österreichischer Biomasse-Verband, Wien*

12:05 **Erneuerbare Energie dank ökosozialer Steuerreform**
Stephan Pernkopf, *Landesrat, St. Pölten, & Präsident des Ökosozialen Forums, Wien*

12:30–14:00 **Mittagspause und Postersession**

Plenary Session
Energy policy in Europe

Thursday 16 January

Chairman:
Ingmar Höbarth, *Climate and Energy Fund, Vienna, Austria*

9:00 am **Welcome and Opening**
- Siegfried Nagl, *Mayor of the city of Graz, Graz, Austria*
- Johann Seitinger, *Member of the Provincial Government, Graz, Austria*
- Franz Titschenbacher, *President of the Styrian Chamber for Agriculture and Forestry, Graz, Austria*

9:15 am **The importance of bioenergy for climate protection and the national economy**
Andrä Rupprechter, *Federal Minister for Agriculture and Forestry, Environment and Water Management, Vienna, Austria*

9:50 am **Change to renewable energies in difficulties?**
Franz Alt, *Journalist and author, Baden-Baden, Germany*

10:15 am **We have reached cruising altitude! Destination is yet to be defined – the latest climate report of the IPCC**
Georg Kaser, *University of Innsbruck, Institute of Meteorology and Geophysics, & coauthor of the IPCC report, Innsbruck, Austria*

10:45 am **Coffee break**

11:15 am **The role of bioenergy in the context of „100 % renewables"**
Gustav Melin, *Chairman of the European Biomass Association, Stockholm, Sweden*

11:40 am **Material versus energetic use of biomass?**
Horst Jauschnegg, *Chairman of the Austrian Biomass Association, Vienna, Austria*

12:05 pm **Renewable energy thanks to ecosocial tax reform**
Stephan Pernkopf, *Member of the Provincial Government, St. Pölten, Austria & President of the Ecosocial Forum, Vienna, Austria*

12:30–2:00 pm **Lunch break and poster session**

Parallelblock 1
Wärme aus Biomasse: Kleinanlagen

Moderator:
Hans Hartmann, *Technologie- und Förderzentrum (TFZ) im Kompetenzzentrum für Nachwachsende Rohstoffe, Straubing, Deutschland*

14:00 **Die Rolle der Biomasse für die Erreichung der EU-Ziele im Bereich Raumwärme und -kühlung**
Lukas Kranzl, *Technische Universität Wien, Wien*

14:25 **Feinstaub-Emissionen aus der häuslichen Holzverbrennung – Messmethoden und Harmonisierung**
Volker Lenz, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Deutschland*

14:50 **BioCat – Clean-Air-Technologie für Kleinanlagen**
Christoph Schmidl, *Bioenergy 2020+ GmbH, Wieselburg-Land*

15:15 **Kohlenmonoxidbasierte Verbrennungsregelung von Kleinfeuerungsanlagen**
Jan Bischof, *Universität Stuttgart/Institut für Feuerungs- und Kraftwerkstechnik – IFK, Stuttgart, Deutschland*

15:40 **Stroh als Brennstoff – technische Herausforderungen gelöst**
Jan Habart, *CZ Biom, Prag, Tschechische Republik*

Parallelblock 2
Wärme aus Biomasse: Industrielle Anlagen

Donnerstag 16 Jänner

Moderator:
Jaap Koppejan, *IEA Task 32, Procede Biomass BV, Enschede, Niederlande*

16:30 **klima:aktiv-Auszeichnung für Heizwerke, Planer und Qualitätsbeauftragte**

17:00 **Betriebserfahrungen aus Österreichs erster Klärschlamm-Monoverbrennungsanlage im mittelgroßen Leistungsbereich**
Andreas Glatzer, *KALEGO Anlagenbau GmbH, Leobersdorf*

17:20 **Verbrennung fester Biomasse in stationären Wirbelschicht- und Rostfeuerungen – ein Praxisvergleich**
Thomas Strasser, *Josef Bertsch GmbH & Co. KG, Bludenz*

17:40 **Optimierung der Wärmerückgewinnung von Biomasseanlagen durch Integration von Wärmepumpen**
Kenneth Hoffmann, *GEA Refrigeration Technologies, EE 's-Hertogenbosch, Niederlande*

18:00 **Optimierte Fernwärmenetznutzung und Effizienzsteigerung durch dezentrale Wärmespeicherung**
Erwin Reisenhofer, *BIOS Bioenergiesysteme GmbH, Graz*

18:20 **Nachhaltigkeitssteigerung in der Stahlproduktion durch den Einsatz von Biokohle**
Tim Reichel, *RWTH Aachen, Aachen, Deutschland*

Parallel Session 1
Heat from biomass: Small scale

Chairman:
Hans Hartmann, *Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ), Straubing, Germany*

2:00 pm **The role of biomass in achieving the EU's objectives in space heating and cooling**
Lukas Kranzl, *The Vienna University of Technology, Vienna, Austria*

2:25 pm **Particulate matter emissions from residential wood combustion – measurement methods and harmonization**
Volker Lenz, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Germany*

2:50 pm **BioCat – Clean air technology for small-scale combustion systems**
Christoph Schmidl, *Bioenergy 2020+ GmbH, Wieselburg-Land, Austria*

3:15 pm **Carbon-monoxide-based combustion control of small-scale firing systems**
Jan Bischof, *Institute of Combustion and Power Plant Technology – IFK, Stuttgart, Germany*

3:40 pm **Straw as a fuel – technical challenges that have been solved**
Jan Habart, *CZ Biom, Prague, Czech Republic*

Parallel Session 2
Heat from biomass: Industrial scale

Thursday 16 January

Chairman:
Jaap Koppejan, *IEA Task 32, Procede Biomass BV, Enschede, Netherlands*

4:30 pm **klima:aktiv award for heating plants, planners and quality controllers**

5:00 pm **Operating experience from Austria's first sewage sludge mono combustion plant**
Andreas Glatzer, *KALEGO Anlagenbau GmbH, Leobersdorf, Austria*

5:20 pm **Solid biomass combustion in bubbling fluidized bed and grate furnaces – comparison based on practical experiences**
Thomas Strasser, *Josef Bertsch GmbH & Co. KG, Bludenz, Austria*

5:40 pm **Optimizing heat recovery from biomass plants by integrating heat pumps**
Kenneth Hoffmann, *GEA Refrigeration Technologies, EE 's-Hertogenbosch, Netherlands*

6:00 pm **Optimized district heating network utilization and increased efficiency through decentralized heat storage**
Erwin Reisenhofer, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

6:20 pm **Increasing the sustainability of steel production by using biochar**
Tim Reichel, *RWTH Aachen, Aachen, Germany*

09:00–18:00 Uhr

1. Mitteleuropäischer Pelletstag

9:00 am–6:00 pm

1st Central European Pellet Day

1st Central European Pellet Day – Pellet resources meet consumers markets

European pellet markets are now in a phase of dynamic expansion. Increasing prices and high demand characterise the current situation. Some countries are at the same time beginning to notice that raw materials are becoming scarce. Central and Eastern Europe still possess reserves of raw materials and the mobilisation of these is creating interesting commercial prospects.

The 1st Central European Pellet Day has been organised to provide participants with an overview of the current state of pellet production and pellet utilisation in Central and Eastern Europe. A presentation of how the most important Central European markets for wood pellets – Germany, Austria and Italy – are doing at the moment will also to be given.

Special attention will also be paid to the demands on quality and ENplus certification, which constitute decisive market-entry requirements for Central and Eastern European producers. The conference will conclude with a business matchmaking event and dinner designed to encourage the creation of business contacts between producers and dealers, suppliers of heating boilers and wood burners, machine suppliers and other companies in the value chain.

The 1st Central European Pellet Day will be taking place as part of the 4th Central European Biomass Conference (CEBC) to be held in Graz, Austria, from 15th to 18th of January 2014. This Conference will be an excellent platform for the exchange of information and experiences as well as for networking. The workshops, B2B meetings and the conference dinner will offer plenty of opportunities in this regard.

14:00–18:00 Uhr

Biogastag

2:00–6:00 pm

Biogas Day

Biogas potential of agricultural wastes – technical implementation and operative requirements

Alexander Bauer, Susanne Frühauf, Andreas Gronauer
Institut für Landtechnik, Universität für Bodenkultur
Peter-Jordan-Straße 82
1190 Wien, Österreich
alexander.bauer@boku.ac.at
www.nas.boku.ac.at/ilt.html

Biogas production as a renewable energy source is of major importance for the sustainable use of agrarian biomass. The technical level of biogas production is high. Nevertheless, the whole process needs to be optimised, for example by using agricultural by-products and intercrops, by pre-treating lignocellulosic biomass or by developing adapted logistic concepts.

Biogas production can be based on energy crops and agricultural by products such as straw from cereals, corn, rapeseed and sunflower, as well as of manure. The technical potential of straw lies about 2.4 million t DM (dry matter) per year in Austria. In the EU 27, the technical potential of straw per year is approximately 131 million t DM. Straw is often an unused substrate within agricultural production. After pre-treatment, e.g. with steam explosion technology, biomass can be used as substrate for the production of biogas. The methane yields from steam exploded wheat straw are about 20 % higher as compared to untreated material. Manure shows a high potential for use as an input for biogas production. The technical potential per year of this residue for Austria is approximately 2.4 million t DM and for the EU 27 about 204 million t DM. This corresponds to a methane potential of 442 million Nm^3 for Austria and 36,141 million Nm^3 for the EU 27 respectively.

The high water content of the input materials used in the biogas production as well as in its fermentation residues increase the transportation costs of the process. However, the water content of fermentation residues can be reduced by separation. After separation, the residues can be easily transported, stored, and marketed at a competitive price. To ensure sustainable recycling management, fermentation residues should be applied to the agricultural fields from which the agricultural inputs were taken. Aside from the nutrient content of fermentation residues, the humus content is also highly important for healthy and sustainable plant growth.

In summary, there are different possibilities to optimise the production of biogas. Sustainable biogas production includes the cultivation of well-balanced intercrops, which are adapted to their location. Furthermore, all organic residues and by-products should be used for biogas production. They can substitute raw materials that still compete with food and feed production. An optimal pre-treatment of lignocellulosic biomass can further increase biogas production. Energy production as a whole could be further enhanced by using bio-refinery systems and by implementing local concepts.

Biogas aus Zwischenfrüchten: erzielbare Erträge und praktische Umsetzung

Dr. Manfred Szerencsits
Ökocluster
Steinberg 132
8151 Hitzendorf, Österreich
manfred.szerencsits@oeko-cluster.at
www.oeko-cluster.at

Co-Autoren: Siegfried Legath, Josef Höckner, Dr. Maximilian Kuderna, DI Christine Weinberger, DI Astrid Allesch, DI Franz Feichtinger, Johann Dorner, Mag. Stephan Maier, Prof. Dr. Michael Narodoslawsky, Dr. Eva Erhart, Dr. Wilfried Hartl, DI Karin Mottl, Hannes Raser, DI Christoph Zirngast, Raimund Brandstetter MSc., Dr. Georg Dersch, Dr. Michael Tauber

Zwischenfrüchte (ZF) ermöglichen die Biogaserzeugung ohne Flächenkonkurrenz bei gleichzeitiger Verringerung der Risiken des Ackerbaus für Wasser, Boden, Natur und Klima. Die erzielbaren Potenziale und Wirkungen werden im Rahmen von Syn-Energy* ermittelt.

Sommer-ZF: Das Ertragsniveau ist vom Anbauzeitpunkt und Witterungsverlauf abhängig. ZF-gemenge, deren Mischungspartner unterschiedliche Klimabedingungen bevorzugen sind empfehlenswert (z. B. BIOGASMIX mit Sudangras, Sonnenblume, Futtererbse, Klee, Ackerbohne, Wicke, Platterbse, Phacelia). Sind Leguminosen enthalten, kann die Düngung minimiert und als Zusatznutzen Stickstoff fixiert werden. Durch möglichst frühzeitigen Anbau nach der Ernte von Gerste oder Raps können Erträge von 6–7 t Trockensubstanz (TS) pro ha erreicht werden. Bei Anbau nach Weizen Mitte bis Ende Juli liegen die Erträge Anfang Oktober bei ca. 5 t TS/ha. Bei ungünstigem Witterungsverlauf oder Anbau im August verringert sich die Ertragserwartung entsprechend auf 2 t TS bzw. die Bestände sind unter Umständen nicht erntewürdig. Der Anbau sollte in der Regel unmittelbar nach Beerntung der Hauptkultur erfolgen. Mulchsaattechnik ermöglicht Stoppelsturz, Anbau und ggf. Gülleeinarbeitung in einem Arbeitsgang und damit höhere Schlagkraft. In Gebieten mit kürzerer Vegetationsperiode oder bei biologischer Bewirtschaftung sind Klee- oder Gras-Untersaaten im Getreide eine Alternative zum ZF-Anbau. Bei guter Entwicklung können auch mit Untersaaten 5 t TS/ha erzielt werden.

Winter-ZF: Das Ertragsniveau und die Auswirkungen auf die nachfolgende Hauptkultur werden entscheidend von der Frühjahrsdüngung und dem Erntetermin der ZF bestimmt. Bei Ernte in der ersten Maiwoche sind Erträge von 6 t TS/ha möglich. In der letzten Aprilwoche können 3–5 t TS/ha erzielt werden. Bei nachfolgendem Mais ist in der Regel eine höhere Düngegabe erforderlich als nach Schwarzbrache, damit in der Jugendentwicklung kein Nährstoffmangel auftritt. Dann können wie bei Soja und Kürbis auch bei Anbau Anfang Mai Ertragseinbußen vermieden werden.

Beerntung: Mähtechnik mit Aufbereiter und Kollektor und Beräumung mit Kurzschnittladewagen reduzieren sowohl die Kosten als auch das Risiko von Bodenverdichtungen. Hierfür ist jedoch die Aufbereitung der Biomasse im Einbringsystem der Biogasanlage erforderlich. Die Aufbereitung in der Anlage hat den Zusatznutzen, dass auch Maisstroh, Pferdemist oder Gras als Ergänzung zu ZF verwertet werden können.

Energieertrag: Bei durchschnittlich 4–5 t TS / ha und Methangehalten von 295 Nl/kg TS können ca. 1300 Nm^3 Methan/ha brutto erzeugt werden. Abzüglich des Energiebedarfs für Erzeugung und Aufbereitung verbleiben netto ca. 1000 Nm^3 Methan/ha z. B. für die Treibstoffnutzung. Mit einem gasbetriebenen Pkw können damit ca. 20.000 km zurückgelegt werden. 8–15 % dieses Energieertrags sind auch ausreichend, um nicht nur Bodenbearbeitung, Anbau, Düngung, Pflege, Ernte und Transport der ZF, sondern auch der Hauptkultur zu decken. Eine energieautarke, umwelt- und klimafreundliche Landwirtschaft ohne Einschränkung der Ernährungssicherheit wird möglich.

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Anaerobic digestion of microalgal biomass

Mag. Markus Gruber
Bioenergy 2020+ GmbH
Research Facility Tulln
Konrad-Lorenzstr. 12
A-3430 Tulln, Österreich
markus.gruber@bioenergy2020.eu
www.codigestion.com
www.ifa-tulln.ac.at

Co-Authors: MBA Elad Zohar, Mag. Jacqueline Jerney, DI Dr. Günther Bochmann, Mag. Dr. Michael Schagerl, Dr. J. P. Obbard, DI Dr. Werner Fuchs, DI Dr. Bernhard Drosg

There are several reasons why microalgae are emerging in environmental biotechnology applications. Microalgae are photosynthetic microorganisms that convert light energy and inorganic nutrients into organic biomass at relatively high productivities. Further, microalgae lack the production of stems and leaves which possess ligno-cellulosic compounds. Some microalgae strains are of particular interest due to their short doubling times, and can synthesize and store a wide range of interesting compounds such as fatty acids, carbohydrates, proteins, vitamins, and antioxidants. Production of these compounds can be controlled by selecting suitable strains and/or controlling cell culture conditions e.g. nutrient levels, pH, irradiance levels and metabolic stress. In several studies, scientists have already reported the potential of microalgae to enhance biogas production in the anaerobic digestion (AD) process. As a sustainable resource, biogas is CO_2 neutral, can be produced from waste and reduces the consumption of fossil fuels. Nowadays, biogas has a broad range of uses e. g. heat and electricity generation, fuel or as substitute for natural gas.

In this study, two green-algal strains, namely *C. vulgaris* (SAG 211-1b) and *S. obliquus* (SAG 276-1) were grown in sleeve-bag photobioreactors, and subsequently harvested for measurement of total proteins, carbohydrates and lipids content. Microalgal suspensions were centrifuged to yield final volatile solid-concentrations of 79.36 g L^{-1} (*C. vulgaris*) and 68.96 g L^{-1} (*S. obliquus*). Characterization revealed higher lipid contents in *C. vulgaris* (31.1 % TS^{-1}) compared to *S. obliquus* (25.7 % TS^{-1}), but protein contents were similar (44.0 % and 45.1 % TS^{-1}). Thermally pre-treated biomass (T = 140° C and T = 160° C) was tested for biochemical methane potential (BMP) measured relative to untreated biomass. The highest CH_4-productivities were achieved using untreated *C. vulgaris* biomass (293 Nm^3 t^{-1} $VS_{untreated}$) and untreated *S. obliquus* biomass (286 Nm^3 t^{-1} $VS_{untreated}$). The higher CH_4 yield derived from anaerobic digestion of *C. vulgaris* biomass may be a result of higher lipid contents. Thermally pre-treated biomass resulted in a decreased CH_4 productivity, i. e. *C. vulgaris* biomass CH_4 production per unit $VS_{untreated}$ (T140° C = -20.8%; T160° C = -9.2%) and *S. obliquus* biomass (T140° C = -31.1%; T160° C = -4.4%). CH_4 productivities per unit $COD_{treated}$ of *C. vulgaris* was lower (T140° C = -20.8%; T160° C = -9.2%) compared to their untreated counterparts. For *S. obliquus*, a slight increase in CH_4 production per unit $COD_{treated}$ was measured using 160° C-pre-treated biomass i.e. +2.0%. The outcome of this study is in contrast with previous works where it was suggested that thermal pretreatment of microalgal biomass led to an increased CH_4-productivity of between 11 and 62% Microalgal cell wall degradation seems likely to be a key issue for successful anaerobic digestion of biomass, and an alternative biomass pre-treatment method will be investigated.

Treatment of organic waste digestates: a practical case study

Dr. Doris Thamer
Separation
Andritz AG
Stattegger Str. 18
8045 Graz, Austria
doris.thamer@andritz.com
www.andritz.com

Christian Dousset
Separation
Andritz SAS
Chateauroux 36000, France
christian.dousset@andritz.com
www.andritz.com

The treatment of organic waste by anaerobic digestion producing biogas and digestates is a well established process already. With an increasing number and capacity of AD plants to treat various organic feedstock streams, digestate enhancement is gaining more attention.

Specific Dewatering as well as drying of organic waste digestates can significantly increase the value and secure use of digestates and optimize the overall plant reliability.

Two practical case studies will be presented, covering operational experiences for excellent dewatering of manure residues and advanced drying of biodegradable waste digestion residues.

A detail overview will be given on the specific plant parameters and the product output qualities for

1) Centrifuge dewatering of digested manure residues in a bio-methane plant in France
2) Drying of digested biodegradable waste residues in an organic waste plant in Germany

Both case studies describe

- Pretreatment of feedstock
- Process overview: Input and output data
- Application of Centrifuges and Dryers
- Advantages and Sustainabiliy criteria of enhanced product

Pre-treatment technologies for biogas plants

Dr. DI Günther Bochmann
IFA-Tulln Universität für Bodenkultur Wien and Bioenergy 2020+ GmbH
Konrad Lorenz Straße 20
3430 Tulln, Austria
guenther.bochmann@boku.ac.at
www.co-digestion.com; www.boku.ac.at

Co-Authors: Lucy Montgomery MSc; Prof. Dr. Werner Fuchs

Anaerobic digestion is a well established process for renewable energy production in which biomass is broken down and converted to biogas (a mixture of methane, carbon dioxide and traces of other gases) by microorganisms.

Popular substrates for biogas production include industrial waste such as dairy waste, agricultural waste such as fodder residue and manure, and energy crops such as maize. The ability to make biogas out of many different substrates is one of the main advantages of anaerobic digestion over other processes like ethanol production. However, some substrates can be very slow to break down because

- they contain chemicals that inhibit the growth and activity of the microorganisms,
- they create physical problems like floating, foaming or clumping and block impellors and pipes, or
- their molecular structure is poorly accessible to microorganisms and their enzymes(highly crystalline structure, low surface area)
-

Sometimes all these problems occur at once. Pre-treatment can be used to overcome some of these problems. This work should give an overview on different pre-treatment technologies and point out their advantages or disadvantages. The presented pre-treatment technologies can be divided into physical, chemical, biochemical and combined processes.

Principle	**Technique**		
Physical	Mechanical	Thermal	Ultrasonic / Electrochemical
Chemical	Alkali	Acid	Oxidative
Biological	Microbiological	Enzymatic	
Combined processes	Steamexplosion	Extrusion	Thermochemical

Municipal solid waste for biomethane in 5 European cities – the UrbanBiogas Project

DI Dominik Rutz M.Sc.
WIP Renewable Energies
Sylvensteinstr. 2
81369 München, Deutschland
dominik.rutz@wip-munich.de
www.wip-munich.de
www.urbanbiogas.eu

Co-Authors: Dr. Rainer Janssen, Rita Mergner M.A. (both WIP Renewable Energies)

The simultaneous energetic use of organic waste, such as municipal solid waste (MSW) and catering/food waste, and the creation of a closed nutrient cycle is one of the main advantages of anaerobic digestion (AD) biogas plants as they turn waste materials to “desirable” feedstock. However, in many European regions waste management is still a large problem and only few biogas plants use organic waste for biogas production. At the same time, European countries have to comply with the Landfill Directive 1999/31/EC and with the Waste Directive 2006/12/EC to reduce land filling of the biodegradable part of MSW to 35 % within the next five to ten years. They also have to comply with the Renewable Energy Directive (RED) 2009/28/EC.

Biogas production from waste has the potential to contribute to the European targets of the above mentioned directives. Adjacent upgrading to biomethane quality and grid injection in the natural gas distribution network is an opportunity to efficiently use renewable energy in urban areas. This approach, Waste to Biomethane (WtB), is promoted by the UrbanBiogas project (Urban waste for biomethane grid injection and transport in urban areas; www.urbanbiogas.eu) which is supported by the Intelligent Energy for Europe Programme of the European Union.

The objective of the UrbanBiogas project is to prepare 5 European target cities for the production of biomethane from urban waste which is will be fed into the natural gas grids and optionally used for transport: City of Zagreb (Croatia), Municipality of Abrantes (Portugal), City of Graz (Austria), Cities of Rzeszów and Gdynia (Poland), and City of Valmiera (Latvia). Core of the project is the implementation of more than 130 events, including workshops, working group meetings, study tours and city exchange visits in order to elaborate five WtB concepts for the target cities.

The present paper will give an overview on options for the use of organic waste for biogas production and present the intermediate results in the target cities to promote the WtB concepts.

Impacts of a flexible biogas production on power production costs and earnings in Germany

Sebastian Auburger
Universität Hohenheim, Institut für Landwirtschaftliche Betriebslehre (410b)
Schloss Osthof-Süd
D-70593 Stuttgart, Deutschland
sebastian.auburger@uni-hohenheim.de
www.uni-hohenheim.de

Co-Author: Prof. Dr. Enno Bahrs

Not only in Germany fossil based power production changes to renewable sources. Because of given site conditions in Germany it's necessary to install extensive capacity of fluctuating power sources like wind or photovoltaic to accomplish aims which were set by government. As a consequence power grid stability suffers in times of high wind and photovoltaic power production.

Especially biogas power production is able to offer balancing power which is one method to stabilize power grids. At least a marked orientated power production the opposite of a basic load production helps integrating renewable power sources in German power market. Both cases require a flexible mode of operation of biogas plants which enables biogas plants to intercept power production in times of low demand.

This paper aims to calculate additional power productions costs and earnings of a flexible biogas production in Germany. Currently gas storage systems and an enlarged capacity of power and heat generation units proved to be a realizable way to introduce a flexible operation mode of biogas plants. A flexible power production mode of biogas plants needs additional power and heat generation units, gas storage systems, technical modifications and in cases of existing external heat supply as well as short power production intervals also heat storage systems.

In order to set up a range of different sizes of biogas plants and also different modes of operation three case studies were calculated. Original sizes of biogas plants are specified to 250, 500 and 1000 kW. Power production duration is set to 12 and 8 hours a day, which means doubled and tripled capacity of power and heat generation units. Calculations of additional power production costs for case studies indicate a range from 0,015 Euro/kWh to 0,028 Euro/kWh. Profit calculations which take German bonus system for renewable energies and additional earnings from power marked into account result in higher benefits for case studies with tripled installed power in flexible mode. Sensitivity analysis was used to assess impact of investment costs on additional power production costs. They are mainly affected by investment costs of power and heat generation units.

Efficient and sustainable fertilization strategies with biogas digestates

Dr. Beate Formowitz
Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ)
Schulgasse 18
94315 Straubing, Germany
beate.formowitz@tfz.bayern.de
www.tfz.bayern.de

In the nation-wide research project “Development and Comparison of Optimized Cropping Systems for Agricultural Production of Energy Crops under Different Site Conditions in Germany (EVA)” different crop rotations were established in various typical agrarian regions of Germany. In satellite project biogas digestates are tested for their capacity to substitute mineral fertilizer.

In experiment 1 maize, sorghum, rye grass and winter triticale were cultivated on an annually changed field. N-fertilization consisted of four N-rates for all crops (100 % mineral; 75 % digestate-N; 100 % digestate-N; 125 % digestate-N) and 3 additional N-rates for maize (no N; 50 % digestate-N; 200 % digestate-N) at the 3 assessment sites of the cooperation project “Potentials to reduce the release of climate relevant trace gases at the cultivation of energy crops for biogas production” (GHG-project). In experiment 2, a crop rotation was established starting with maize in rotation A in 2009 and rotation B in 2010. N-treatments consisted of pure mineral N-fertilization (min), mixed N-fertilization (50/50 mineral-/digestate-N; “mix”) and pure organic fertilization (100 % digestate-N; “org”).

In all years, organic treatments in experiment 1, except the 50 % digestate-N treatment for maize, reached comparable yields to pure mineral fertilization. Even though yields varied per site and were strongly influenced by weather conditions, the 100 % and 125 % digestate-N treatments convinced for winter triticale and rye grass. For maize and sorghum this was already the case for the 75 % digestate-N treatment, while higher N application did not further increase yields. Ensuing from the calculation approach chosen in this project it seems that N fertilization rates for maize and sorghum in this case could be reduced. Additionally the reduction of N application rates would lower the risk of nitrate leaching over winter especially for maize where the highest mineral N values were measured after harvest compared to the other crops throughout the whole duration of the experiment.

In experiment 2, especially the mixed N-treatment proved to be a good opportunity to enhance crop production through the combination of directly available N (mineral and digestate-N) and slowly released N from the organic fraction (digestate-N). The directly available part promotes predominantly the young growth phase while the organically bound nitrogen provides N supply during the whole vegetation period. Furthermore, partial application of mineral N can be given to a later stage than organic fertilizer thus contributing to quality assurance. First results of the NH_3 measurements evaluated by the Christian-Albrechts-University zu Kiel (CAU Kiel), partner in the GHG-project, underline the importance of an immediate incorporation of digestates after application with drag hoses to the soil surface which was the main cause for higher ammonia emissions in Dornburg (Dbg) compared to Ascha in 2011. This is backed through findings in 2012 where N-fertilization with injection as it was done in Gülzow showed the lowest NH_3 losses. Furthermore, digestates used in Dornburg contained higher pH (7.8) and higher NH_4 fractions of total N (65 %) than the digestates used in Ascha (pH = 7.5; NH_4 = 41 %) which additionally contributed to the higher NH_3 losses.

Energy balances calculated by the Leipniz Centre for Agricultural Landscape Research (ZALF) make clear that energy outputs strongly depend on crop specific yields but are mainly influenced by the energy input. Compared to low energy inputs for the production of seeds and crop protection agents the production of mineral fertilizer (especially N and lime) require the highest energy inputs. Thus the fertilization with digestates can drastically reduce the use of energy leading to highest energy balance of pure organic followed by the mixed fertilizer treatment.

EVA-Project partners:
Thuringian State Institute for Agriculture (TLL), State Research Centre for Agriculture and Fishery Mecklenburg-Western Pomerania (LFA), Saxon State Office for Environment, Agriculture and Geology (LfULG), Center for Agricultural Technology (LTZ) and Chamber of Agriculture Lower Saxony (LWK NS); Leibniz Centre for Agricultural Landscape Research (ZALF)

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Benchmarking von Biogasanlagen – der österreichische Ansatz

DI Dr. Bernhard Stürmer
ARGE Kompost & Biogas Österreich
Franz-Josefs-Kai 1
1010 Wien, Österreich
stuermer@kompost-biogas.info
www.kompost-biogas.info

Co-Autor: Ing. Franz Kirchmeyr

Die Erhebung von produktionstechnischen und wirtschaftlichen Daten und deren Aufbereitung ist ein wesentlicher Bestandteil zur Kontrolle und nachhaltigen Verbesserung des wirtschaftlichen Erfolgs einer Biogasanlage. In der Beratung hat sich diesbezüglich der Betriebsvergleich als effizientes Instrument erwiesen, da durch Vergleiche zu anderen Anlagen Verbesserungspotentiale aufgezeigt werden können. Dies bedingt eine einheitliche Datenerfassung und -aufbereitung damit die notwendigen (vor allem wirtschaftlichen) Kennzahlen vergleichbar und aussagekräftig sind. Seit 2008 führt die ARGE Kompost & Biogas Österreich ein Monitoring und in weiterer Folge ein Benchmark bei rund 2/3 der österreichischen Biogasanlagen durch. Hauptfokus dabei ist die Beratung und Weiterbildung von Biogasanlagenbetreiber in sogenannten Arbeitskreisen aufgrund dieses Benchmarks. Diese Maßnahme wird durch das BMLFUW, die Länder und die EU kofinanziert.

Die Aufgaben in den Arbeitskreisen sind: (i) Sammlung von Produktions- und Bilanzdaten, (ii) Kontrolle und Korrektur der gesammelten Daten, (iii) Erstellung eines Benchmarks, (iv) arbeiten mit den abgeleiteten, anlagenspezifischen Kennzahlen und deren Vergleiche, (v) Diskussion der Ergebnisse zwischen den teilnehmenden Anlagen und (vi) die Ergänzung der Informationen in den Teil- und Problembereichen durch Spezialisten. Dabei wird geachtet, dass die Gruppengröße nicht über 15 Teilnehmer liegt, damit die Diskussionen auch dementsprechend sinnvoll gestaltet werden können. So wurden in den letzten Jahren viele Teilbereiche in den Diskussionen behandelt: Wartungsverträge bei BHKWs, Wärmenutzungskonzepte, alternative Substrate, Neuerungen bei relevanten Gesetzen und Verordnungen, Fermenter- und Gülleanalysen, Motorenschulungen, etc., etc.

Dieser Beitrag soll die Tätigkeiten und Ergebnisse der letzten Jahre genauer erörtern. Außerdem wird ein erster vertikaler Zeitvergleich über die Jahre 2010 bis 2012 vorgestellt. Anhand ausgewählter Kennzahlen wird die Entwicklung österreichischer Biogasanlagen aufgezeigt und mögliche Potentiale und deren Hemmnisse zur Diskussion gestellt.

9:00–12:30 Uhr

Plenarsitzung

Energiepolitik in Europa

9:00 am–12:30 pm

Plenary Session

Energy policy in Europe

Auf der Sonnenseite – warum uns die Energiewende zu Gewinnern macht

Dr. Franz Alt
Redaktion HA FS Kultur und Gesellschaft
Zum Keltenring 11
76530 Baden-Baden, Deutschland
franzalt@sonnenseite.com
www.sonnenseite.com

Es gibt kein Energieproblem. Die Evolution oder Gott haben alles gut geregelt. Allein die Sonne schickt uns jede Sekunde unseres Hierseins 15.000mal mehr Energie als alle Menschen brauchen. Hinzu kommen Wind- und Wasserkraft, Bioenergie und Geothermie, Wellen- und Strömungsenergie der Ozeane. Mit einer raschen Umstellung von der heutigen atomar-fossilen Energieerzeugung auf 100 % Erneuerbare Energie können wir den Klimawandel noch stoppen und ein ökologisches Wirtschaftswunder mit Millionen neuen Arbeitsplätzen und ohne Kriege um Öl organisieren.

Die heutige Energieversorgung ist zentralisiert und von wenigen Großkonzernen abhängig. Die Energieversorgung von morgen ist eine dezentrale und ein gutes Geschäft für Millionen Hausbesitzer, Handwerker, Mittelständler und Bauern. Ich zeige in meinem Vortrag an positiven Beispielen aus der ganzen Welt, dass und wie der 100 %-ige Umstieg auf Erneuerbare und umweltverträgliche Energie in 20 Jahren möglich ist.

Schon jetzt hat die Energiewende Deutschland zum Vorreiter bei der Nutzung alternativer Energiequellen gemacht. 360.000 neue Arbeitsplätze sind entstanden. Doch warum sind wir immer noch von Öl, Kohle, Gas und Atomkraft abhängig? Warum stehen die alten Energielobbyisten noch immer unter dem Schutz von Regierungen? Ich werde aufdecken, wer die Energiewende bremst und warum sie dennoch alternativlos, ja sogar die Überlebensfrage der Menschheit, ist – wie auch Kanzlerin Angela Merkel sagt.

Die alte Energieversorgung bedeutet immer höhere Energiepreise, unvorstellbare Kosten des Klimawandels, Ressourcenkriege und Millionen Klimaflüchtlinge. Die entscheidende politische Frage des 21. Jahrhunderts heißt: Kriege um Öl oder Frieden durch die Sonne? Deshalb ist jede Biogasanlage, jedes Windrad und jede Solaranlage ein Zeichen des Friedens. Jene Industriegesellschaft, die diese Zusammenhänge als erste begreift, zeigt der ganzen Welt einen Weg in eine bessere Zukunft. Wir müssen das Energiethema endlich zu einem Gewinner-Thema machen.

We have reached cruising altitude – destination is yet to be defined

Georg Kaser
Institute of Meteorology and Geophysics, University of Innsbruck
Innrain 52, 6020 Innsbruck
Georg.Kaser@uibk.ac.at
http://imgi.uibk.ac.at/

Our climate is changing. Consequences are mainly detrimental. Human activities are the main reason. Limiting climate change will require substantial and sustained reductions of greenhouse gas emission. The 5th Assessment report of the Working Group 1 of the Intergovernmental Panel on Climate Change shows these results built on observed evidence, comprehensive process understanding, and powerful modeling. The presentation will introduce the principle functioning of the climate system, explain our state of understanding, show the detected changes with the respective attribution to causes, and draw a series of realistic scenarios.

Material versus energetic use of biomass[1]

Dr. Horst Jauschnegg
Austrian Biomass Association, President
Franz-Josefs-Kai 13
A-1010 Vienna, Austria
Jauschnegg@biomasseverband.at
www.biomasseverband.at

Along with the developments related to renewable energy sources and the implementation of the Renewable Energy Directive, the EU debate on forestry and bioenergy has been influenced by a new tendency: the obligation to use wood raw material in a certain order of priority according to the cascade principle. The Austrian Biomass Association (ABA) fully supports resource efficiency. However we are of the view that the cascade principle should not be made legally binding, as there is no economic or practical justification that such provisions will promote the competitive and sustainable use or supply of wood. Instead, more efforts should be made to increase wood mobilisation in Europe.

Wood energy definitively has a value
According to the cascade principle, wood should be used in the following order of priority: wood-based products, re-use, recycling, bioenergy and disposal. The energy use is therefore considered as the least valuable option among several uses. Wood, as a renewable, domestic and climate friendly resource, is essential for reducing greenhouse gas emissions and dependency on fossil fuels. Therefore, one could wonder why bioenergy which replacing fossil fuels with biomass should be considered as a low value product. Wood energy has a value that should be clearly acknowledged and the EU should not hinder the use of its growing forest resource to tackle the challenges of climate change, energy poverty and increasing fossil fuel prices.

The wood energy sector does not use high value roundwood as a raw material
The main reason is that in Europe biomass producers cannot compete with the sawn timber sector. The interest of European forest owners is to manage their forests under a multiple-product approach where the raw material used for energy is derived from industry residues (sawdust, chips); harvesting residues (tops, branches, crowns); thinning material and low-quality wood. This is the case today and will be the case in the foreseeable future as markets ensure that high-value saw logs are not used as raw material in the energy sector.

Competition is good for the forest sector
From a market perspective, competition has contributed to new markets for the forest sector and has strengthened active forest management and has enhanced investments. This is essential in order to ensure the good growing conditions of European forests to also produce high-value roundwood for future uses. Overall, the wood-working industry and wood energy should not be seen as alterative choices, but rather as complementing branches supporting active forest management and providing multiple benefits.

Non-practical principle
In practice, the functionality of a legally binding cascade principle is highly questionable. National and regional circumstances vary greatly regarding forest resources, as do their development, industry capacity, wood markets, and energy systems. Therefore determining “low-value” or “appropriate” use of wood at EU level would go against the market economy principle and would not guarantee resource efficiency. Biomass suppliers (including forest owners) must continue to have the possibility and freedom to decide to whom they sell their product.

An essential common issue: wood mobilisation
We should focus our attention on the real challenges of the sector, such as wood mobilisation, which is in the interest of the whole forest sector. This should be a priority for the sector taking into account that forest resources of Europe are continuously growing as around 60 % of the annual increment is being harvested. Mobilisation of more wood in Europe would be beneficial for increasing renewable energy production and for providing additional raw material and in order to maintain the competitiveness of the forest-based industries and to foster economic prosperity in rural areas. Therefore ABA consider that instead of considering a possible legally binding cascade principle, the EU institutions should support positive actions at EU and national level that will improve infrastructure, promote active forest management and enhance research and technological development in the field of forest production, mobilisation and harvesting technologies and wood utilisation.

[1] Based on the „Joint Statement on cascade use of wood“ from AEBIOM, CEPF, COPA-COGECA, EIPS, ELO, EUSTAFOR

Europa braucht die Energiewende

Dr. Stephan Pernkopf
Präsident Ökosoziales Forum Europa
Landesrat für Umwelt, Landwirtschaft und Energie in Niederösterreich
www.oekosozial.at

Es findet in Österreich und Europa keine ehrliche Debatte über die wirtschaftliche Notwendigkeit und die Chancen der Energiewende statt. Wie zentral wichtig den deutschen Nachbarn die Energiefrage ist, zeigt deren neue Regierung: Sie hat einen „Superminister" für Wirtschaft und Energie vorzuweisen – den weltweit ersten „Energiewende-Minister"! Deutschland will mit dem Ausbau der Erneuerbaren Wirtschaftsmotor in Europa bleiben – und das ist gut so, denn Österreich profitiert massiv davon.

Warum braucht Europas Wirtschaft die Energiewende?
Versorgungssicherheit muss uns etwas wert sein. Es ist für den Wirtschaftsstandort wichtig, die Abhängigkeit von Erdöl- und Erdgasimporten zu reduzieren. Alleine die Schweiz hat im Jahr 2012 8,2 Mrd. Euro für Energieimporte ausgegeben. In Österreich waren es im selben Jahr 12,8 Mrd. Euro. Deutschland muss im Schnitt rund 100 Mrd. Euro pro Jahr für Öl und Gas ausgeben – Devisen, die dem Wirtschaftsstandort verloren gehen und die Außenhandelsbilanz massiv verschlechtern.

Die deutsche Ökonomin und Beraterin der Bundesregierung, Claudia Kemfert, hat errechnet, wie viel es die Deutschen kosten würde, die Energiewende abzusagen: 2 Billionen Euro in 10 Jahren! Also die unvorstellbare Summe von 2.000 Mrd. Euro bis 2023 – bis zu dem Jahr, in dem Deutschland erstmals wieder frei von Atomkraft sein soll.

Fossile Strohfeuer
Der ständig steigende Devisenabfluss für fossile Energie schwächt den Wirtschaftsstandort Zentraleuropa. Nochmals zum Vergleich: 2003 kostete der Energieimport Österreich rund 4 Mrd. Euro – heute reden wir vom Dreifachen, also mehr als 12 Mrd. Euro pro Jahr. Europas Energie-Kommissar Günther Oettinger stellt in seinen Reden fest: Die Verfügbarkeit von billiger Energie wird entscheiden, ob wir in Zukunft von den „G2" oder den „G3" sprechen werden. Die „G2" sind die Wirtschaftsmächte USA und China. Europa laufe Gefahr den Anschluss zu verlieren. Oettinger plädiert daher dafür, die Option für Schiefergas in Europa offen zu halten. Ich halte das für den falschen Weg – und Schiefergas wie Schieferöl für ein Strohfeuer, das uns von den eigentlichen Aufgaben nur ablenkt! Der Umstieg auf ein nachhaltiges Energiesystem ist das Fundament dafür, um auch wirtschaftlich nachhaltig an der Weltspitze mithalten zu können.

Apropos Nachhaltigkeit
Es war der sächsische Förster Carl von Carlowitz, der im Jahr 1713, also vor 300 Jahren, den Begriff der Nachhaltigkeit geprägt hat – heute in der Forstwirtschaft eine Selbstverständlichkeit. Holz wird vielfältig und intensiv genutzt. Alleine der Energieträger Holz schafft 2,8 Mrd. Euro Umsatz in Österreich pro Jahr. Die Wälder sind gepflegt und gesund. Der Holzvorrat ist in der vergangenen Dekade sogar um 2,3 % angewachsen. Diese Nachhaltigkeit ist etwas, das die Heizöl-Lobby nie nachweisen wird können. Daher sage ich ein klares NEIN zu jeder Form der Öl-Kessel-Förderung!

Chancen nutzen
5,5 Mrd. Euro Umsatz erwirtschaftet der Bereich der Erneuerbaren Energie 2013 in Österreich. Wir sind schon heute Energiedrehscheibe und grüne Batterie Europas: Wir erzeugen nur 2,1 % der europaweiten Strommenge, verfügen aber über 17 % der Pumpspeicher und 9 % der Gasspeicher in der EU. Und es werden neue Speicherformen hinzukommen – Stichwort Windgas und Biomethan. Wir sagen klar NEIN zu Atomkraft – dann müssen wir aber auch klar JA sagen, zu allen Formen der Erneuerbaren Energie:

- JA zu einem europaweiten Bekenntnis für mehr Ökologie und Erneuerbare
- JA zum nachhaltigen Umbau des Energiesystems

Ich bin überzeugt, Österreich und Europa haben beste Voraussetzungen! Nehmen wir die Nachhaltigkeit in der Forstwirtschaft als Vorbild. Wir brauchen eine mutige und intelligente Umsetzung der Energiewende – sie ist eine wirtschaftliche Notwendigkeit. Die Energiewende bringt den Menschen und der Wirtschaft sichere, saubere und leistbare Energie für eine gedeihliche Zukunft.

14:00–16:00 Uhr

Parallelblock 1

Wärme aus Biomasse: Kleinanlagen

2:00–4:00 pm

Parallel Session 1

Heat from biomass: Small scale

The role of biomass for achieving RES-H/C targets in EU Member States

Lukas Kranzl
Vienna University of Technology, Institute of Energy Systems and Electrical Drives
Gusshausstraße 25/370-3
1040 Vienna, Austria
Lukas.Kranzl@tuwien.ac.at

Co-Authors:
Veit Bürger (Oeko-Institut e.V. – Institute for Applied Ecology), Judit Kockat and Jan Steinbach (Competence Center Energiepolitik und Energiemärkte, Fraunhofer-Institut für System- und Innovationsforschung ISI), Andreas Müller and Agne Toleikyte (Vienna University of Technology, Institute of Energy Systems and Electrical Drives)

The 2020 targets of the EU regarding energy efficiency, CO2-reduction and renewable energy require substantial growth of all RES-technologies and sectors. This includes the heating sector which is addressed in different directives: the renewable energy directive (RED), the energy performance of buildings directive (EPBD) and the energy efficiency directive (EED). Biomass currently clearly holds the highest share of all RES-H/C systems (about 95 %) in EU-27. The national renewable energy action plans (NREAP) of the different European countries show that biomass is expected to show a considerable growth in the heating sector. In order to realize these targets, it will require appropriate, ambitious support policies.
The core objectives of this paper are:

- to analyse the role of biomass in residential and service buildings for achieving RES-H/C targets for selected EU member states in various scenarios up to 2030
- to analyse the impact of different support policies for biomass heating in these countries
- to identify the interaction of biomass heating with other RES-H/C technologies and efficiency improvement and
- to derive conclusions regarding the further development of policies for biomass heating in the context of the different EU directives (RED, EPBD, EED).

The analysis is focused on the following EU countries: AT, BG, CZ, DE, ES, FI, FR, IT, RO. The methodological approach will include the following steps:

- Comparative analysis of policy measures in place, targets and NREAPs with respect to the role of biomass heating for residential and service buildings
- Modeling of space heating and hot water preparation in these countries. For this purpose we will use the model Invert/EE-Lab, a bottom-up simulation tool modeling the decision for the investment in different heating technologies and thermal renovation measures of buildings.
- Simulation of the impact of different support policies and comparative analyses of different policies in different scenarios in different countries. In particular, this will include the investigation of the impact of investment subsidies, use obligations, tax incentives, renewable heat incentives etc.
- Deriving conclusions and recommendations regarding the design of biomass heating support policies.

The results show a huge variety within the investigated countries, mainly due to the big differences in the current role of biomass in the heating sector in buildings. The share of biomass in the heating sector in residential and service buildings that could be achieved in ambitious policy scenarios varies between below or about 10 % in 2020 and 2030 extending to potential penetrations of more than 35 % (PL) or even 60 % (LT) in 2020 and nearly 60 % (PL) and 80 % (LT) in 2030. There is a huge variety of impact factors that explain the different penetration of biomass heating systems. These include energy prices and other economic conditions, the structure of the heating market, the historical role and tradition of biomass heating, the role of district heating and the role of biomass in the district heating sector, the know-how and awareness of stakeholders and the availability of biomass resources. The uptake of nearly-zero-energy-buildings (nZEB) according to the EPBD might have a strong potential impact on the role of different RES-H technologies and biomass in particular. However, due to the low rates of new building construction and renovation, the penetration of RES-H/C can be much faster than the impact of nZEB. In particular, the paper shows that effective and efficient policies can have a crucial impact on the penetration of biomass heating systems. Moreover, it provides recommendations for the design of such policy instruments.

The paper is based on the work in the Intelligent Energy project ENTRANZE (www.entranze.eu).

Particulate matter emission from residential wood combustion, measurement methods and status of harmonization efforts within the national funding program “Biomass energy use”

Torsten Schröder
DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Straße 116
04347 Leipzig, Germany
torsten.schroeder@dbfz.de
www.dbfz.de

Co-Authors: Volker Lenz & Diana Pfeiffer

Historically, combustion of wood has been one of the main energy forms employed for providing domestic heat requirements in the household, and may be seen as the earliest technological development of human beings (Barbetti 1986). During the last few decades the technological advancements in small biomass furnaces have led to a large variety of domestic heating systems. Major improvements have been made in relation to scaling and standardizing the fuels suitable for use in such furnaces, as well as increased precision in testing the efficiencies and emissions of furnaces, all of which have contributed to the present state of technology.

However, despite the positive technological developments, there are still several types of furnaces emitting high concentration of dust. This contributes to local air pollution and hence does not help to promote wood combustion as a CO_2 neutral energy system, which is a fundamental characteristic for a future biofuel in order to combat climate change.

Within the German funding program “Biomass energy use”, which has been running since April 2009, 8 out of 90 current projects are conducting research on emission reduction, in order to support environmentally friendly and sustainable biomass combustion. Moreover, several new projects have commenced recently with some of the projects performing emission measurements on the dust released from residential wood combustion. Indeed, the measurement procedures applied in the various projects deviate depending on the equipment available for the projects and therefore different results will be observed. This leads to a poor comparability of measurement results between different projects. In fact, various basic instructions for the determining the PME in exhaust gas flows are described in standard procedures like VDI 2066-1 or DIN EN 13284-1. However, due to different measurement challenges in the projects, these procedures are also used in combination with other methods, such as particle counting systems. The boundary conditions within the projects are also quite different and consequently the measurement procedures applied also differ. For this reason one of the goals of the funding program is to determine the comparability, reproducibility and general acceptability of these differently applied methods. The essential requirement for that was the establishment of networking structures and knowledge transfer among the project partners with common research approaches. Finally the applied methods should be compiled and compared in a measurement collection book for particulate matter.

In order to achieve this goal and to harmonize methods, several measurement workshops were organized under the funding program between 2010 and 2012. The aim of these workshops was to investigate the deviations observed between the different methods and instruments used for testing the particulate emissions in the flue gas of domestic furnaces. The critical points leading to the deviations and sensitivities in the results were discussed thoroughly within the organized workshops and meetings. As a result of these activities in a measurement method collection on particulate matter (Lenz et al. 2013) the methodological differences of the PME- and flue gas measurements within the various projects of the funding program are summarized and evaluated. The aim of the publication of the method collection is to allow other projects to avoid certain pitfalls in the future, which were identified during the harmonization process. Settings and parameters can be investigated easily and will not have to be adapted permanently. With regard to the European efforts determining harmonized measurement procedures, the process of harmonization of dust measurement methods from domestic biomass heating in the German funding program “Biomass energy use” is especially important. More information on the funding program is available on: www.energetische-biomassenutzung.de.

BioCat – Clean air technology for small-scale combustion systems

DI (FH) Gabriel Reichert
Bioenergy 2020+ GmbH
Inffeldgasse 21b
A-8010 Graz, Austria
Gabriel.Reichert@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: DI (FH) Dr. Christoph Schmidl, DI Dr. Walter Haslinger, DI (FH) Stefan Aigenbauer, Ing. Mag. (FH) Franz Figl, Jens-Michael Kirchhof M.Sc., Bernd Rieger M.Sc., Ing. Mag. (FH) Bernhard Voglauer, Marius Wöhler M.Sc.

Introduction & Objectives
The EU climate and energy strategy for 2020 relies on a significant increase of biomass share in household energy production. Small-scale firewood residential heating appliances are a perfectly suited, climate friendly and cost effective solution for these requirements. However, such appliances cause high fractions of gaseous and particulate emissions[1] which can seriously affect public health. Wood combustion has been identified to be a major source for local air pollution especially in the winter half year in Europa. Within the European R&D project BioCat a combination of primary and secondary optimization was applied in order to achieve significant emission reduction. Therefore four commercial and one newly developed small-scale combustion systems were primary optimized and subsequently equipped with an integrated catalyst system. Therefore the project BioCat aimed the following objectives:

- Evaluation of status- quo of five small scale combustion systems as basement for primary optimization development
- Primary optimization of each combustion system
- Integration of oxidative honeycomb catalysts into primary optimized prototypes
- Final system analysis of primary and secondary optimized combustion systems

Approach
Within the BioCat project four existing and one newly developed firewood and briquette stoves were primary optimized. Extensive tests were performed to correlate the emission level of the initial stoves and the primary optimized units to identify the limits of primary optimization measures. In a second step a secondary emission abatement technology, in this case an oxidation catalyst was integrated. The integration step was prepared by a characterization of the catalytic material[2] and study of the temperature profiles of the combustion units. Finally tests have been performed to study the effects of secondary measures on the emission level as well as to evaluate the effect of the integrated catalyst on the primary combustion conditions.

Results
Significant emission reductions for each combustion appliance were achieved. By primary optimization emission reductions up to 78 % were reached. By catalyst integration considerable reductions for CO, OGC as wall as TSP emissions were observed. The emission measurements for final assessment by standard type tests ranged between 64 – 568 mg/m³ for CO emissions and 8 – 54 mg/m³ for TSP emissions (at STP conditions at 13 vol.-% O_2).

Conclusions
Small-scale firewood residential heating appliances show significant improvement potential to reduce gaseous and particulate emissions due to the consequent implementation of primary measures and integration of secondary measures such as oxidation catalysts. This new generation of room heating appliances is performing highly efficient at lowest emissions and therefore they can be a major technology to support energy and climate policy without raising air quality concerns.

Acknowledgement
The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under Grant Agreement n° 286978.

[1] Schmidl et al. Particulate and gaseous emissions from manually and automatically fired small scale combustion systems, Atmospheric Environment 45 (2011) 7443-7454
[2] Wöhler et al. Operation characteristics of a bulk catalyst in a test stand under similar conditions to a firewood stove. In proceedings of World Sustainable Energy Days 2013

A new CO-based controller for small-scale biomass combustion

DI Jan Bischof
Institute of Combustion and Power Plant Technology, University of Stuttgart
Director: Prof. Dr. Günter Scheffknecht
Pfaffenwaldring 23
70569 Stuttgart, Germany
Jan.Bischof@ifk.uni-stuttgart.de

Co-Author: Günter Baumbach

In the last years, governmental subsidy programs and developments in automatic feeding systems with a strong increase of convenience and performance of boiler, contributed to an increasing number of small-scale biomass firing systems for household heating and warm water production.

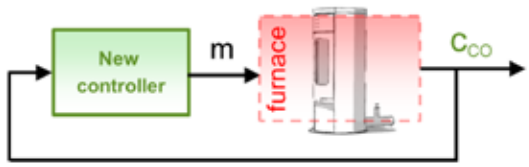


***Figure 1**: Block diagram of a CO-controller without a predetermined set point*

Typically, the combustion control of these small-scale biomass boilers is more difficult than for larger boilers or even plants. Simple linear oxygen-based controllers are used to control the combustion by a lambda probe. But these oxygen-based controllers involved the drawback of a predetermined and fixed set point for the excess air ratio λ, whereas the actual optimal set point of λ is time-dependent and strongly dependent on numerous influencing factors.

New Control systems based on the carbon monoxide are able to compensate this disadvantage and the author will illustrate the core idea and main advantages of a new control system. Additionally, experiments on a market-available pellet stove demonstrate that a carbon-monoxide-based combustion control is able to find the emission-optimal working point and is able to increase the combustion efficiency through an online-estimation of the furnace-specific CO-characteristic.

Straw as a fuel – technical challenges which have been solved

Ing. Jan Habart, Ph.D.
CZ Biom – Czech Biomass Association
and Czech university of Life science Prague
U čtyř domů 1201/3
140 00 Praha 4, Czech Republic
habart@biom.cz
www.biom.cz

Some regions of central and eastern Europe have high portion of arable land but forest areas are almost missing. Thus main source of biomass is straw from cereals and rape. Compared with wood or wood chips straw as a fuel poses technical and logistic difficulties mainly due to low ash melting point, light weight, low energy density and water absorption. In the Czech Republic all those problems have been successfully solved.

Utilization of straw started approx. in 1995. From technological perspective it can be divided into four main approaches: straw pellets combustion (from 25 kW), bails combustion in medium scale 0,5–20 MW and straw pellets co-firing. Largest straw bales installations needs up to 80,000 tons of straw per year, which means big logistic challenge and need proper and careful planning to avoid soil degradation due to the lack of soil organic matter.

Crucial in straw harvesting is the short time window. There is usually grown winter rape or other winter plant after cereals (rye, barley, wheat) which are the main source of straw. Combined with weather condition, there are usually few days for collection straw in the particular farm. Thus farmers as well as customers are contracting 20–30 % of straw production. The remaining part is shred and left on the fields.

Existing legal conditions required at least 20 % or cereals to be harvested without straw collection.
Storage and logistic is very important. Straw needs to have maximum 20 % water content when turned into energy. In large-scale installation, it practically means big storage halls (formal hey storage), but also new dedicated multibale rotowrap are in use (see picture).
Low ash melting point need dedicated boilers unit with cooled combustion chamber.

Straw contain high portion of nutrients. In the straw ash potassium and phosphorus prevail. Straw ash is commonly use replacing conventional fertilized. Nutrients value of straw ash is about 90 EUR/ton.

Legal framework
The Czech Republic has feed-in tariff for electricity production from biomass, which is a very common tool across Europe. As a target is to reallocate usage of biomass from electricity production to heat or combined heat and power production new bonuses has been adopted for heat producers above 200 kW installed heat power.

Straw “sausage” for storing

16:30–18:30 Uhr

Parallelblock 2

Wärme aus Biomasse: Industrielle Anlagen

4:30–6:30 pm

Parallel Session 2

Heat from biomass: Industrial scale

Operational experiences from Austria´s first medium sized sewage sludge mono-incineration plant in Großwilfersdorf / Austria

Dr. Andreas Glatzer
IE Intelligente Energie-Systeme GmbH
Westbahnstraße 8
A-1070 Vienna, Austria
andreas.glatzer@ie-systeme.at
www.ie-systeme.at

Co-Author: DI Hermann Schild
KALOGEO Anlagenbau GmbH
Aredstraße 13
A-2544 Leobersdorf, Austria
www.kalogeo.at

After a tedious approval process lasting several years the sewage sludge mono-incineration plant was constructed for the company Biomasseverwertung Großwilfersdorf GmbH between autumn 2010 and end of 2011 in Großwilfersdorf/Austria and afterwards commissioned and put in operation.

The plant consists of the following main parts:
A reception for the mechanically dewatered sewage sludge delivered by trucks, attached storage area incl. sludge handlig equipment; a sewage sludge drying plant using a contact dryer, where only a part of the sludge is dried. The dried sludge is mixed together right before entering the stationary fluidized bed reactor with the wet sludge pumped directly to the mixer (to avoid the sticky phase). The stationary fluidized bed is able to burn the mixture of dried and wet sludge stable already with an average lower heating value as low as 3,8 to 4 MJ/kg. The heat released in the combustion process is recovered via a thermal oil boiler downstream the fluidized bed; part of this heat is used by the contact dryer. The flue gas is cleaned by cyclone and quench followed by a dry sorption system with bag house filter to meet the required emission values. Additionally to utilize also the heat of the water vapors of the contact dryer these are condensed and together with the excess heat of the thermal oil boiler supplied to a neighbouring industrial plant for prefabricated concrete parts for drying and heating purposes.

The plant has a capacity of processing 30.000 t of sewage sludge per year with appr. 25 % dry matter (i.e. appr. sludge from 300.000 population equivalents) and a thermal capacity of 2,2 MW.

The first part presents the system and the installed technology, gives a short comparison to the older plant in Bad Vöslau/Austria (the first of this kind) and explains the experiences as well as problems and the resulting made adaptions during the first year of operation since commissioning of the plant.

The second part summarizes the general economic parameters for sewage sludge mono-incineration plants in the medium-size range and gives a short outlook for such plants for the future – especially under the focus of future requirements of phosphor-recycling from the ashes of sewage sludge mono-incineration plants.

Verbrennung fester Biomasse in stationären Wirbelschicht- und Rostfeuerungen – ein Praxisvergleich

DI Thomas Strasser, eMBA
Josef Bertsch Gesellschaft m.b.H. & Co. KG
Herrengasse 23
6700 Bludenz, Austria
thomas.strasser@bertsch.at
www.bertsch.at

Co-Autor: Dr. Arno Kolbitsch

Der Rohstoff Holz ist einer der bedeutendsten nachwachsenden Rohstoffe und soll für die verschiedensten Anwendungsbereiche bereitgestellt werden. Der Ablauf der Holzverbrennung und in weiterer Folge die Stromerzeugung aus Holzbrennstoffen wird durch die Brennstoffeigenschaften und angewandten Technologie maßgeblich beeinflusst. Brennstoff-Wassergehalt, Energiedichte, Stückigkeit und die Holzqualität hinsichtlich Aschegehalt und Verunreinigungen entscheiden letztendlich auch über Wahl der Anlagentechnik und infolge über die nachhaltige Wirtschaftlichkeit der Gesamtanlage.

Die Kraftwerkstechnologie in der mittleren Leistungsklasse (15–80 MWth) zur thermischen Verwertung von Holzbrennstoffen wurde in den vergangenen Jahren sehr stark von Rostfeuerungen geprägt. Aufgrund der äußerst positiven Betriebserfahrungen hinsichtlich Verfügbarkeit und Emissionswerte an realisierten Wirbelschichtanlagen in der Schweiz und Deutschland, hat diese Technologie zukünftig das Potential, vermehrt zum Einsatz zu kommen.

Ein Vergleich zwischen den beiden, im Lieferprogramm der Fa. Bertsch befindlichen, Technologien lässt sich daher sehr gut anstellen. Vor allem Holzbrennstoffe, die starke Verunreinigungen aufweisen, wie z. B. Landschaftspflegematerialien, oder auch Altholz, können in Wirbelschichtanlagen problemloser, kostengünstiger und effizienter verbrannt werden als in Rostsysteme.

Trotz dieser hervorragenden Eigenschaften von stationären Wirbelschichtfeuerungen wurden in Österreich und Deutschland in der Vergangenheit vermehrt Rostfeuerungen realisiert. Die überwiegend vorherrschende Meinung BFBs haben höhere Invest- und Betriebskosten führte sogar dazu, dass schon zum Zeitpunkt der Ausschreibung die Technologie mit der Rosttechnologie fixiert war, ohne fundierte Wirtschaftlichkeitsbetrachtungen und technische Gegenüberstellungen durchzuführen.

Die BERTSCHenergy realisierte innerhalb eines Zeitraumes von zehn Jahren vier stationäre Wirbelschichtanlagen im mittleren Leistungsbereich. Neben Wirbelschichtanlagen realisierte man auch mehrere Rostfeuerungen in der gleichen Größenordnung.

Dieser Vortrag gibt die Betriebserfahrung realisierter Anlagen zur Verbrennung von Holzbrennstoffen auf Basis der Wirbelschicht-technologie wieder. Schlagwörter wie Verfügbarkeit, TOC, Emissionswerte, Teillastverhalten werden dabei abgehandelt.

Optimising heat recovery from biomass plants by integrating heat pumps

Kenneth Hoffmann M.Sc
Heating Application Manager
GEA Refrigeration Technologies
De Beverspijken 7a
5221 EE 's-Hertogenbosch, The Netherlands
kenneth.hoffmann@gea.com
www.gea.com

Today most of the world's electricity production is generated without recovering the heat from the flue gas. Efficient electricity production from biomass plants are around 25–40 %, if the heat is also recovered it is possible to have energy efficiencies close to 100 %. With Biomass becoming a limited fuel resource with already half the EU consumption being imported from outside EU it is essential to get as much energy as possible out of each tonnes of biomass.

Heat recovery from CHP plant is normally using the return heating water and re-heating it to the desired temperature. For wet fuels like biomass with up to 50 % water content a lot of the energy in the flue gases is latent energy and only by cooling it below the dew point it is possible to get a significant amount of energy out of the gasses. Without condensing the flue gasses it is only possible to recover around 80 % of the heat energy. The last 20 % of heat recovery can be achieved by a condensing the flue gasses and cooling them down to less than 30 °C–35 °C and then using a mechanical heat pump to boost the low temperature condensate to high temperature valuable heat. A wet economiser system also reduces the toxic emissions to meet EU emission requirement.

For optimised performance of a heat pump it is important to incorporate it correctly into the heat recovery system, the heat pump should be in series with the boilers, so the full water flow goes through the heat pump before being heated in the boiler. By optimising the installation carefully payback of less than two years can be achieved.

Optimierte Fernwärmenetznutzung und Effizienz-steigerung durch dezentrale Wärmespeicherung

DI Erwin Reisenhofer
BIOS Bioenergiesysteme GmbH
Inffeldgasse 21b
A-8010 Graz, Österreich
reisenhofer@bios-bioenergy.at
www.bios-bioenergy.at

Co-Autoren: Prof. Univ.-Doz. DI Dr. Ingwald Obernberger, BIOS Bioenergiesysteme GmbH
DI Hermine Saurwein-Rainer, Ing. Hermann Unsinn, TIWAG-Tiroler Wasserkraft AG
Reinhard Wilhelmer, Stadtwärme Lienz Produktions- und Vertriebs-GmbH
Martin Tschurtschenthaler BA, Fachhochschule Kufstein Tirol Bildungs GmbH

Beweggründe, Aufgabenstellung und Zielsetzung
Beim Biomasse-Fernheizkraftwerk der Stadtwärme Lienz musste nach mehrmaliger Kapazitätserweiterung und zahlreichen Ausbaustufen des Fernwärmenetzes 2011 ein Anschlussstopp für neue Fernwärmekunden ausgesprochen werden, da das bestehende Netz an seine Kapazitätsgrenze angelangt ist. Um neue Fernwärmeabnehmer mit erneuerbaren Energieträgern zu versorgen und Einzelheizungen, die großteils mit fossilen Brennstoffen betrieben werden, ersetzen zu können, werden für das Fernwärmenetz der Stadtwärme Lienz durch einen integrierten Ansatz mittels dezentraler Wärmespeicherung sowie kundenseitiger Optimierungsmaßnahmen zusätzliche Potentiale hinsichtlich des Anschlusses neuer Fernwärmekunden geschaffen und die Effizienz der Energieversorgung erhöht. Das Projekt wird aus Mitteln des Klima- und Energiefonds gefördert und im Rahmen des Programms „NEUE ENERGIEN 2020“ durchgeführt. Das Projektkonsortium besteht aus der TIWAG-Tiroler Wasserkraft AG, der Stadtwärme Lienz Produktions- und Vertriebs-GmbH, der BIOS Bioenergiesysteme GmbH und der Fachhochschule Kufstein Tirol Bildungs GmbH. Die Projektlaufzeit reicht vom 01.10.2011 bis 30.09.2014.

Vorgangsweise
Aufbauend auf einer Bewertung der derzeitigen Abnehmer und der Erstellung eines Entwicklungsszenarios hinsichtlich der langfristigen Entwicklung des zukünftigen Wärmebedarfs werden dezentrale Wärmespeicherlösungen und Optimierungsmaßnahmen erarbeitet und durch Simulationen des Fernwärmenetzes begleitend bewertet. Als weitere Basis für die Initiierung der Demonstration der Maßnahmen werden Finanzierungs- und Vertragsmodelle für die kundenseitigen Maßnahmen entwickelt. Nach deren schrittweisen Umsetzung werden diese einem detaillierten Monitoring unterzogen. Im Projekt werden durch einen systematischen Ansatz Werkzeuge, Verfahren und Konzepte (z. B. Auswertungsprogramme, optimierte hydraulische Verschaltungen, auf den Verschaltungen aufbauende Regelungskonzepte, Finanzierungskonzepte,..) zur nachträglichen optimierten Implementierung von dezentralen Wärmespeichern in Fernwärmesysteme und zur systematischen Optimierung von Wärmeabnehmern entwickelt und im Zuge der Monitoringphase auf Ihre Tauglichkeit hin überprüft und bewertet. Dies stellt die Basis für eine nachhaltige langfristige schrittweise Optimierung des Fernwärmenetz Lienz und eine wichtige Grundlage für die weitere Nutzung bei anderen Fernwärmeprojekten dar.

Bisherige Ergebnisse, Ausblick und Schlussfolgerungen
Die Arbeiten bezüglich Erstellung von Entwicklungsszenarien hinsichtlich des zukünftigen Wärmebedarfes und der Ausbaupotentiale des Fernwärmenetzes der SWL zeigen, dass Effekte aus der thermischen Sanierung von Gebäuden einen merklichen Einfluss auf die Wärmeabnahme haben, und dass ohne Neuanschlüsse der Wärmeverkauf im Fernwärmenetz Lienz zukünftig spürbar abnehmen würde. Zur Bewertung der derzeitigen Wärmeabnehmer wurde ein Auswertungsprogramm entwickelt, das für jede der ca. 900 im Fernwärmenetz Lienz installierten Wärmeübergabestationen eine automatisch generierte Auswertung hinsichtlich Optimierungspotentialen, Pufferspeicher-Vordimensionierung und Optimierungsprioritäten liefert. Diese Auswertungen wurden und werden erfolgreich zur sekundärseitigen Optimierung von Wärmeabnehmern eingesetzt. Unter Berücksichtigung der speziellen Anforderungen der Fernwärmeversorgung wurde eine hydraulische Verschaltung bezüglich der dezentralen Wärmespeichereinbindung und ein entsprechendes Regelungskonzept erarbeitet. Das neue Pufferspeicherkonzept wurde zu Testzwecken im Frühjahr 2013 bei einem ausgewählten Wärmeabnehmer implementiert. Die ersten Ergebnisse aus dem Anlagenmonitoring der dezentralen Wärmespeichereinbindung stehen im Winter 2013/2014 zur Verfügung. Ein wesentlicher Erfolg der bisherigen Arbeiten ist, dass aufgrund der ersten Ergebnisse, die wesentliche Optimierungspotentiale aufgezeigt haben, bereits 2012 der Anschlussstopp beim Fernwärmenetz Lienz aufgehoben werden konnte. Weiters konnte entsprechend der Monitoringergebnisse vom Winter 2012/2013 die Fernwärme-Rücklauftemperatur bei Spitzenlast um rund 2°C gesenkt und zusätzliche Anschlusspotentiale von rund 2,4 MW geschaffen werden.

Increasing the sustainability of the steel production in the electric arc furnace by substituting fossil coal with biochar

Tim Reichel, M.Sc.
RWTH Aachen, Department for Industrial Furnaces and Heat Engineering (IOB)
Kopernikusstr. 10
52074 Aachen, Germany
reichel@iob.rwth-aachen.de
www.iob.rwth-aachen.de

Co-Authors: Thorsten Demus, M.Sc.; Dr.-Ing. Thomas Echterhof; Prof. Dr.-Ing. Herbert Pfeifer

During the last decades, different methods have been developed for steel making. In the present state of the art, especially two methods have been implemented in industry: In addition to the blast furnace converter route, the electric steelmaking in electric arc furnaces (EAF) is an important steel production process. The global share of electric steelmaking in terms of crude steel production in 2011 is about 29 % – the trend is rising.

In electric steelmaking steel scrap is charged into the furnace and melted down with electrical energy. Fossil coal is used as an additional source of chemical energy and contributes to foaming the process slag. The average specific consumption of coal in an electric arc furnace is about 12 kg per ton of produced steel. This makes up 40 to 70 percent of the total direct emissions of an electric arc furnace, which is about 60 to 100 kg CO_2/t_{Steel}. Due to these facts, the aim of this study is to replace fossil coal by biochar. Biochar is a product of the carbonization process of biogenic residues and classified as CO_2-neutral by the EU. Therefore an additional purchase of emission certificates is not required.

The Department for Industrial Furnaces and Heat Engineering (IOB) of RWTH Aachen runs an electric arc furnace at pilot scale. In melting experiments fossil coal was substituted by biochar to investigate the influence on the process and the produced steel. Fossil anthracite coal was used as reference material. Especially the offgas analysis, the analyzing of steel composition as well as the calculation of mass balances is important for the evaluation of using biochar in the electric steelmaking process.

So melting experiments with fossil coal and biochar were carried out and evaluated. In general, it was observed that the melting time could be shortened by the use of biochar. This can be explained by the higher reactivity of biochar compared to fossil coal. The evaluation of the offgas analysis proves a faster combustion behavior which is indicated by the increased CO concentration in the offgas shortly after starting the process. The analyzing of steel composition leads to the conclusion that the use of biochar does not influence the final steel product in a negative way. The calculation of mass balances confirmed these observations. Especially the concentration of unwanted elements such as sulfur and phosphorus is at a same level as in the experiments with anthracite coal. From a technical point of view the use of biochar in electric steelmaking is possible and has no negative effects on the final product steel. Thus biochar can be an ecological and sustainable alternative to fossil coals in electric steelmaking.

13:30–18:30 Uhr

Parallelblock 3

Workshop

Verwertung von Pflanzenaschen

1:30–6:30 pm

Parallel Session 3

Workshop

Biomass ash utilization

Überblick über die Pflanzenascheverwertung in Österreich

DI (FH) Rainer Handl
Fachverband der Holzindustrie Österreich
Schwarzenbergplatz 4
A-1037 Wien, Österreich
handl@holzindustrie.at
www.holzindustrie.at

Die energetische Nutzung von holzartiger Biomasse in österreichischen Heizkraftwerken hat in den letzten Jahren deutlich zugenommen. Dadurch kommt der Fragestellung nach einer sinnvollen und kosteneffizienten Verwertung der Holzasche noch größere Bedeutung zu. Derzeit werden die anfallenden Holzaschen meist deponiert. Die Tatsache, dass Holzasche einen wertvollen Sekundärrohstoff mit dünge- und bodenverbessernder Wirkung bzw. mit vorteilhaften mechanischen Eigenschaften darstellt, ist nun auch ausreichend wissenschaftlich belegt. Daher ist die Endlagerung als unbefriedigend anzusehen. Volkswirtschaftlich betrachtet jedenfalls eine Fehlentwicklung!

Das vom FFG geförderte Projekt "Holzasche" beschäftigt sich gezielt mit der Untersuchung mehrerer innovativer Aschennutzungsmöglichkeiten. Je nach lokalen Rahmenbedingungen muss eine sinnvolle Nutzungsoption angeboten werden. Die bereits vor Projektende vorliegenden Ergebnisse sind sowohl aus technischer, wirtschaftlicher und ökologischer Sicht positiv zu bewerten.

Seit Ende 2009 forschen die Universität für Bodenkultur, Wien, die Bioenergy 2020+ GmbH, die BIOS Bioenergiesysteme GmbH sowie die Landwirtschaftskammer Steiermark im Auftrag der FHP (Kooperationsplattform Forst-Holz-Papier) an Verwertungsmöglichkeiten für Holzasche, die viele positive Nutzungseigenschaften aufweist. Das Projekt wird unter der wissenschaftlichen Leitung von Prof. Univ.-Doz. Dipl.-Ing. Dr. Ingwald Obernberger von BIOS Bioenergiesysteme GmbH GmbH durchgeführt. 13 Partner aus der Forst-, Holz- und Papierindustrie sind an dem Projekt beteiligt.

Das Ziel des vom Fachverband der Holzindustrie abgewickelten Branchenprojektes ist es, auf Basis des aus vorangegangenen Forschungsprojekten gewonnenen Wissens, ökologisch sinnvolle, in der Praxis gut anwendbare und kosteneffiziente Verwertungsmöglichkeiten für Holzasche zu erforschen bzw. zu optimieren. Konkret werden dabei die Nutzung von Holzaschen auf Energieholzflächen, in der Kompostierung, im Straßen- und Wegebau bzw. zur Bodenstabilisierung sowie die Ausbringungstechnik im Forst untersucht. Neben der Durchführung von Labortests und praktischen Versuchen wurde für alle Verwertungsschienen die gesamte Prozesskette (Ascheaustrag, Ascheaufbereitung, Aschemanipulation, Aschelagerung, Aschetransport und Nutzung) ökologisch als auch ökonomisch untersucht und bewertet, um so technisch ausgearbeitete Verfahrensketten für die Aschenutzung zu erarbeiten und die Rahmenbedingungen für entsprechende Nutzungsrichtlinien zu schaffen.

In Österreich fielen in Biomasseheiz(kraft)werken im Jahr 2007, vor der Projekt-Einreichung, insgesamt 295.000 Tonnen Biomasseaschen an. Etwa 170.000 Tonnen davon wurden deponiert. Bei Entsorgungskosten zwischen 70 und 200 Euro/Tonne ergeben sich somit jährliche Kosten von rund 17 Mio. Euro für die Deponierung (Annahme: durchschnittliche Deponiekosten 100 Euro/Tonne), die von den Betreibern von Biomasse-H(K)Ws getragen werden müssen. Bei erfolgreichem Abschluss des Projektes wird erwartet, dass durch die Entwicklung neuer Nutzungsverfahren für Holzasche ein Großteil der anfallenden Mengen zukünftig einer ökologisch sinnvollen Verwertung zugeführt werden kann.

Durch die Demonstration der technischen Machbarkeit und der ökologischen Verträglichkeit neuer Aschenutzungsverfahren werden mittelfristig die Möglichkeiten einer sinnvollen stofflichen Aschenutzung deutlich erweitert, wodurch sich deutliche wirtschaftliche Vorteile mit einem großen volkswirtschaftlichen Nutzen ergeben. Jetzt liegt es in den Händen der politischen Entscheidungsträger auch die nötige umweltrechtliche Basis zu schaffen.

Biomass ash utilization as a binder in road construction

DI Klaus Supancic
BIOS Bioenergiesysteme GmbH
Inffeldgasse 21b
A-8010 Graz, Austria
supancic@bios-bioenergy.at
www.bios-bioenergy.at

Co-Author: Prof. Univ.-Doz. DI Dr. Ingwald Obernberger

Purpose of the work
In recent years, the promotion of energy production from biomass in Austria and the European Union has led to a strong increase in the amount of combustion residues, i.e. ashes. At present, a large fraction of the wood ashes produced are disposed of in landfills. Finding ways to utilise these ashes in an environmentally and economically efficient manner is thus an important goal throughout Europe.

In December 2009, a 4-year R&D-project on ash utilization was initiated in Austria with the utilisation of wood ash as a binding material for soil stabilisation in road construction as one of the main topics. The general chemical properties of wood ash (wood ash consists of up to 50 %, mass fraction CaO in the dry material) as well as their latent hydraulic properties indicate that wood ash can be used as a substitute for burnt lime (CaO), which is used as a binding material for soil stabilisation. Based on the results of comprehensive analyses as well as lab-scale and field tests performed within the project, a guideline for the proper use of wood ashes as a binding material for soil stabilisation shall be developed in order to promote this promising utilisation strategy in the near future.

Approach
The investigation of the utilisation of wood ashes as a binding material in road construction followed a two-step approach. In a first step the suitability of wood ashes from grate and bubbling fluidised bed furnaces was evaluated by performing wet chemical analyses and different mechanical lab-tests (water permeability test, pressure resistance test). The results were compared with the chemical and mechanical properties of burnt lime, which is the standard binding material for clay and silt soils. Based on the results of these tests and considering permit obligations of the local authorities the most suitable ash fractions from each furnace type were selected and the optimal ash/soil mixing ratios were identified for application in a field test.

In a second step a field test at a road construction project was established in October 2010. A total of three road sections with ashes from grate furnaces, ashes from bubbling fluidised bed furnaces and burnt lime as a binding material for the road base were built. Each section is equipped with 4 leachate collection points, where the leachate through the road structure was collected and sampled regularly. During and after the construction of the road base comprehensive measurements (water permeability tests, bearing capacity tests) and wet chemical analyses of the stabilised road base material (mixture of ash or burnt lime with soil) and the leachates collected were performed. The field test ended in late 2013.

Results and conclusions
The results of the lab-scale and field tests show that if the proper ash/soil mixing ratio is applied, the same binding effect and increase in the bearing capacity of the road base as with burnt lime can be achieved. As a conclusion, wood ash is a suitable substitute for burnt lime as a binding agent for soil stabilisation. The results regarding the ecological evaluation (leaching tests of the ash/soil mixtures and analysis of the leachates collected) show that under consideration of the appropriate mixing ratio an environmentally sound ash utilization is possible.

Untreated wood ash as a structural stabilizing material in forest roads

Gerald Bohrn
Institute of Forest Engineering, University of Natural Resources and Life Sciences, Vienna
Peter Jordan Straße 82/3
1190 Vienna, Austria
gerald.bohrn@boku.ac.at
www.boku.ac.at/forstt

Co-Author: Karl Stampfer

Due to the euphoric use of “green” energy produced by biomass power plants up to 350,000 tons of ash are accumulated as a waste product every year in Austria and the estimated costs for landfilling are 1.7 million € per year. For this reason utilization methods for wood ash must be found. One solution is the application as a stabilizing material in forest roads. The pozzolanic characteristic of ash is used to bind the gravel in the road base. Expected performance of wood ash could minimize the requirement of gravel on forest roads with a simultaneous enhancement of load bearing capacity.

Two different untreated wood ashes were applied in two mixture ratios, each on a 50 meter long forest road section to investigate the load bearing capacity. The ashes had been selected by their different properties; high lime and low heavy metal content, their emergence in Austrian biomass power plants with varying furnace technologies and monetary disposal costs. Mixing depth was 0.50 m and the road base was covered by a 0.10 m thick surface layer. Elastic moduli of these sections were measured before the application, and repeated monthly by using a light falling weight deflectometer.

After the first vegetation period the mean elastic modulus of the sections mixed with dry bed ash showed an improvement. The increase of the initial mean load bearing capacity of 32.0 MNm-2 was 65 % for 15:85 mixture and 76 % for 30:70 mixture. The results for the fluidized bed ash sections fell short of expectations. Only 95 % of the initial value could be reached for both mixing values.

Keywords: wood ash, utilization, forest road, load bearing capacity, stabilization

Assessing the environmental impact of the use of wood ash in forest road construction

Dr. Eva Oburger
University of Natural Resources and Life Sciences,
Department of Forest and Soil Scienece,
Institute of Soil Research,
Konrad-Lorenzstraße 24
A-3430 Tulln, Austria
eva.oburger@boku.ac.at
www.boku.ac.at

Co-Authors: Prof. Walter Wenzel, Anna Jäger, Alexander Pasch, Dr Alex Dellantonio, DI Gerald Bohrn, Prof. Karl Stampfer

The use of wood biomass for energy production has significantly increased over the past decades, further reducing Austria's dependency on fossil fuels. Despite the benefit of a CO_2 neutral energy budget, significant amounts of combustion residues (i.e. wood ash) are produced during the incineration process of which the majority is currently deposited on landfills at high costs. Up to date, limited knowledge about the behavior of wood ash and wood ash components applied to environmental systems is the major factor impeding new recycling strategies of wood combustion residues being put into practice. To close this knowledge gap, we investigated innovative approaches of wood ash recycling including the use in paved and forest road construction with particular focus on ecological safety.

Soils play an important role in controlling the bioavailability of pollutants, as their filter and buffer functions govern pollutant leaching into the groundwater as well as their entry into the food chain via plant uptake. Consequently a major focus was set on investigating the buffer capacity of soils when exposed to wood ash or ash leachate. A range of laboratory studies were carried out investigating biogeochemical interactions of different ashes and soil types, always testing a set of 32 environmentally relevant characteristics. In addition, in a unique pioneer field study, seepage water and surface runoff of different forest roads test tracks, built in Upper Austria using different types and rates of wood ash applications, have been monitored over a periods of up to 4 years to assess the potential risk of soil and groundwater contamination *in-situ*.

Results show that for the majority of investigated elements, less than 1 % are leached into the groundwater per year, however for some elements, an initial flush release (max. 12 %) was observed in the first year. Nevertheless, calculations demonstrate that groundwater quality will not be negatively affected, even if wood ash is applied to 100 % of forest roads within one catchment area.

By linking laboratory experiments with 1:1 field studies of wood ash use in (forest) road construction, we deliver exciting new insights into the behavior of wood ash in natural systems. Our results will provide a sound scientific basis for a legal frame work supporting environmentally safe recycling of wood ash, further enhancing the economical sustainability of renewable energy production.

Fly ash utilisation in high level roads in Finland

Pentti Lahtinen
Ramboll Finland Oy
Vohlisaarentie 2 B
36760 Luopioinen, Finland
pentti.lahtinen@ramboll.fi
www.ramboll.fi

Biofuel fly ashes have been utilised in roads and other infrastructure construction sites successfully in Finland since 1990's.

The applications have been different types of roads, fields and seaports. Fly ashes have been used as massive construction material in order to improve load bearing capacity and frost insulation. Fly ashes have also been used as binder or as component in binder mixtures for layer stabilisation or for mass stabilisation of soft soils. Diversified technical and environmental tests have been performed in these projects. This paper describes the details of one of these cases that was constructed in central Finland in Jämsä.

At the moment there is also a research project in progress where the technical durability properties are tested from the test sites after 5-10-20 years after construction.

Wood ash recycling – an appropriate measure to close nutrient cycles in forests

Klaus v.Wilpert[1], Bernhard Bösch[1], Heike Puhlmann[2] and Dietmar Zirlewagen[3]
Forest Research Institute Freiburg, Klaus.wilpert@forst.bwl.de[1]
Institute of hydrology, Univ. Freiburg, heike.puhlmann@hydrology.uni-freiburg.de[2]
INTERRA, Bureau for Environmental Survey and Research, d.zirlewagen@interra.biz[3]

Actually an increasing demand on biomass harvest exists for regenerative energy production. Nutrient export will be predominantly high for fuel-wood harvest. Thus sustainability gets a crucial question. However nutrient export with harvest is not the only and unambiguously dominant threat for nutrient sustainability, since soils in Central Europe are widely afflicted by acid deposition. Thus the biomass potential as well as nutrient budgets must be reliably, and at landscape level quantified, in order to direct increased harvesting intensity in a responsible way and maintain soil sustainability.

We present results of a study in a growth-region in SW-Germany with 140,000 ha forests. We derived from National Forest Inventory (NFI) the harvested biomass and from Forest Environmental Monitoring (FEM), input with deposition and weathering, as well as exports with seepage and harvest. FEM data had to be transferred to NFI sites by means of regionalized maps, based on multiple linear regression models which predicted soil properties with landscape-related predictors, explaining around 70 % of their variance.

Following results will be presented: the endurable fuel-wood-potential corresponds to a permanent wattage of ca. 200 MW. The mean base-cation balance (Ca+Mg+K) displays without technical compensation a deficit of 0.3-0.6 $kmol_c ha^{-1} a^{-1}$, depending on harvesting strategy. Element budgets are available also for micro-nutrients. If nutrients would be quantitatively brought back to forest sites through wood ash recycling, nutrient balances can be balanced. We developed an organizational strategy and a standardized product of a mixture between dolomite rock powder and wood-ash to be used for soil protective liming.

Fly ash for remediation and stabilisation of historic mine waste

Lotta Sartz
Bergskraft Bergslagen AB
Harald Olsgatan 1
714 31 Kopparberg, Sweden
lotta.sartz@oru.se
www.bergskraft.se

Co-author: Mattias Bäckström, Bergskraft Bergslagen AB/Man-Technology-Environment Research Centre, Örebro University

Heavy metal pollution from mining is a growing environmental issue. Continuous contamination of land and watercourses receiving drainage from mine areas widely affect conditions for animal wildlife, fish and eventually humans. The major part of the contamination consists of acid mine water with high trace element (copper, zinc, lead) concentrations. By adding an alkaline material to the sulphidic (acidic) mine waste, the chemical environment is changed: pH increases, which in turn decreases trace element mobilization.

As old mine sites hold immense cultural and historical values, it is of great importance that the area becomes as little visually affected as possible after a remediation. Application of alkaline materials *in situ* is therefore suitable at distinct zones, e.g. by mixing in top layers or added by slurry injection. By injecting the material as a slurry the historical values can be preserved to a greater extent since the visual appearance is not changed.

Since by-products, like ashes, are considered waste and contain some elements that could be environmentally harmful, it is of great importance to examine and be aware of environmental impacts from these materials. A very unpleasant scenario when conducting remediation of mine polluted areas would be to make the situation worse, i.e. adding new pollutant-problems to the environment. Characterization and leaching tests that determine short and long-term behavior are therefore vital.

In a pilot study, the suitability of fly ash for slurry injection into oxidized historic waste rock deposits was examined. Ten different ashes from facilities in mid Sweden were chosen and both chemical and physical properties of the fly ashes were considered (for instance free lime content). pH is a crucial parameter for trace element mobility and have been studied in previous stabilization experiments (mixtures of fly ash and historic mine waste).

Three of the ashes showed difficulties with keeping an injectable suspension, all of these had been moistened prior to the injection. Two other pre-moistened ashes showed some difficulties with keeping the fly ash slurries in suspension, but with some gentle stirring there was no problem with the injection. Chemical parameters were measured in the leaching solutions and it was found that in amended samples pH were at least three units higher than in the reference consisting of only mine waste. Trace element leaching from the mine waste decreased accordingly. However, some elements leaching from the ashes could be of concern, for instance chromium, vanadium and zinc. Summarizing, slurry injection of fly ash to weathered mine waste seems to be a promising remediation method, it is vital though that trace element leaching from both waste´s is controlled.

Bio ash as raw material for cement manufacturing

Bjarte Øye
SINTEF Materials and Chemistry
Sem Sælands veg 12
NO 7465 Trondheim, Norway
bjarte.oye@sintef.no
www.sintef.no/home

Portland cement clinker production at Heidelberg Norem Brevik amounts to about 1.4 Mt/y. The typical main source of calcium is calcium carbonate. The calcining of $CaCO_3$ emits 78.6 wt% CO_2 of the CaO produced, or about 50 % of the total clinker mass. Of the total emission of CO_2 from the manufacturing of cement clinker, ca 60 % origins from the calcining of $CaCO_3$ and 40 % from the fuel.[1]

Thus, replacing calcium carbonate raw meal with calcium sources not containing CO_2 is a very efficient way of reducing the overall CO_2 emission. Fly ash from coal power plants are widely used and mixed together with the clinker during grinding. These ashes activated by the Portland cement, becoming hydraulic.

Bio ashes from coniferous wood have a composition which makes them suitable for Portland cement manufacturing, especially bottom ashes enhanced on non-volatile elements like calcium. Typical composition range of some portland cement clinker and approximate composition of birch and spruce bottom ashes from Southern Norway found by Reimann et al[2] are shown in the table below:

Compo-nents	**Portland cement clinker**	**Birch ash**	**Spruce ash**
SiO_2	17 – 24	-	-
Al_2O_3	4 – 7	-	-
Fe_2O_3	1.5 – 5	0-1	0-1
CaO	60 – 67	34	60
MgO	1 – 5	14	9
SO_3	0.5 – 3.5	12	11
Na_2O+		1	1
K_2O	0.2 – 1.5	26	16

The spruce bottom ash has calcium content about the same as cement clinker, thus making it a good potential calcium source. The other constituents of the ash are also compatible with the clinker. Presumable the ash composition will vary according to the combustion technology chosen, fly/bottom ash separation. The ash can substitute $CaCO_3$ as raw meal, thus becoming a part of the clinker, or be added to the clinker together with coal fly ashes. The latter however depends strongly on the mineralogy of the bio ashes. Burnt lime, free CaO, is not desired in the cement, so the ash calcium has to be bound.

The amount of ash residue from combustion varies widely, between 0.2 % up to over 3 % according to fuel (wood, bark, twigs) and combustion technology. An increase in energy production from wood of about 6 TWh per year equals 2–3 mill. tons of biomass from wood, wet basis. The amount of ash produced would be about 2.5 wt% of the biomass, about 60 000 tons per year.

Compared to an yearly production of 1.4 million tons cement per year at the Brevik plant – corresponding to about 2.1 million tons of raw meal – the bio ash in question could at most make up 4.3 % of the clinker or 2.9 % of the raw meal.

[1] Approx. figures from Heidelberg Norcem Brevik
[2] C. Reimann , R.T: Ottesen, M Andersson, A Arnoldussen, F. Koller, P Englmaier: "Element levels in birch and spruce wood ashes – green energy?", Science of the Total Environment 393 (2008) 191 – 197.

Conversion and leaching characteristics of biomass ashes during outdoor storage

DI Klaus Supancic[1,], Prof. Univ.-Doz. DI Dr. Ingwald Obernberger[1,2,3], DI Norbert Kienzl[3], Ing. Anton Arich[3]*
[1] BIOS Bioenergiesysteme GmbH
Inffeldgasse 21b
A-8010 Graz, Austria
**Corresponding author: supancic@bios-bioenergy.at*
www.bios-bioenergy.at

[2] Institute of Process and Particle Engineering – Graz University of Technology
Inffeldgasse 13/III
A-8010 Graz, Austria

[3] Bioenergy 2020+ GmbH
Inffeldgasse 21b
A-8010 Graz, Austria

Purpose of the work
In recent years, the promotion of energy production from biomass in Austria and the European Union has led to a strong increase in the amount of combustion residues, i.e. ashes. The utilisation of the nutrient rich and rather heavy metal poor wood ash fractions (bottom and coarse fly ash) for fertilising and soil improvement purposes is already implemented in several European countries. The utilisation path, however, implicates logistic challenges for many biomass plant operators, since the main part of the ash is often produced during the winter season whereas ash application usually takes place during warmer periods. As the ash has to be stored for several months, it seems reasonable to take advantage of the storage period and facilitate the self-hardening process by adding water. The most important reaction of the hardening process is the transformation of CaO to $Ca(OH)_2$ and further into $CaCO_3$ which lowers the calcium leaching rate significantly and can lead to a reduction of the pH-level. Additionally, dust formation can be reduced significantly.

Approach
The investigation of outdoor ash storage included two laboratory storage tests over 16 weeks with ash samples from different combustion technologies (fluidised and fixed bed combustion), which were stored dry and with different water mixing rate as well as an outdoor storage test with ashes from the same plants over 6 months.

Results and conclusions
The results of the lab-scale tests showed that the self-hardening process over the first 16 weeks of storage is mainly driven by the hydration of CaO with water to $Ca(OH)_2$, which mainly takes place within the first week of storage, while the carbonatation of $Ca(OH)_2$ with CO_2 to $CaCO_3$ plays only a minor role. The evaluation of the leaching behaviour of the ashes stored showed that the leaching of Ca and Mg decreases and the leaching of K and Na increases over storage time. The results of the outdoor storage test showed significant differences between the outside layer of the piles and the area inside the piles in terms of the trends of pH-level, electric conductivity, carbonate content as well as leaching rates for Ca and K over the storage period, while the outside layer showed generally lower values except for the carbonate content, which was higher in the outside layer. Generally, the ashes from grate furnaces (bottom ash and mixtures of bottom ash and coarse fly ash) featured a stronger and more positive change of physical and chemical properties compared to ashes from fluidised bed furnaces (bottom ash and coarse fly ash). The results of the storage tests also showed that the Ca content of the ashes is a good indicator for the determination of the optimal water mixing rate.

As a conclusion, the ageing of ashes (facilitated by adding water) during outdoor storage can be recommended for ashes from grate furnaces, while a pre-treatment of ashes from fluidised bed furnaces with water does not show significant positive effects during storage. A minimum storage time of 8 to 12 weeks is recommended if a reduction of the solubility of Ca and a reduction of the pH-level and the electric conductivity is desired.

Nährstoffrücklieferung aus Holzasche zu Energieweiden und -pappeln im Kurzumtrieb

Dr. Heinrich Holzner
Landeskammer für Land- und Forstwirtschaft Steiermark
Hamerlinggasse 3
8010 Graz
heinrich.holzner@lk-stmk.at
http://stmk.lko.at/

Nach der „Richtlinie für den sachgerechten Einsatz von Pflanzenaschen zur Verwertung auf land- und forstwirtschaftlich genutzten Flächen“ (Holzner, et al., 2011) soll in Österreich auf landwirtschaftlichen Böden, die zur Energiepflanzenproduktion im Kurzumtrieb genutzt werden, eine unkomplizierte Rückführung jener Aschenmenge möglich sein, die durch die Ernte entzogen wird. Das Ziel dieser Bestimmung ist, dass die in der Asche enthaltenen Nährstoffe in einem möglichst engen Kreislauf geführt werden können. Auf diese Wiese soll die Verwertung der Asche sowohl für das Heizwerk als auch für den Landwirt ökonomisch interessant und gleichzeitig ökologisch verträglich sein.

In diesem Zusammenhang sind zu beachten:
1) Rechtliche Voraussetzungen (Beispiel: Österreich)
2) Der erforderliche qualitative Zustand der Asche
3) Logistische Anforderungen
4) Mengen und zu erwartende Auswirkungen

Im Bereich der Energiehölzer im Kurzumtrieb gibt es zum vierten Punkt noch keine Erfahrungen. Im Jahr 2010 sind daher in Sinabelkirchen (Steiermark) zwei Versuche angelegt worden, in denen die Weidensorte „Inger“ und die Pappelsorte „AF 2“ jeweils a) ohne Düngung, b) mit Holzasche und c) mit Mineraldüngern gedüngt worden sind. Dabei ist darauf geachtet worden, dass die verabreichten Gesamt-Nährstoffmengen der Varianten b) und c) gleich hoch gewesen sind und der Menge der zu erwartenden Nährstoffentzüge entsprochen haben.

Das Ziel dieses Versuchs ist, die Auswirkungen der unterschiedlichen Düngevarianten auf den Zuwachs und die Aufnahme von Nährstoffen und Schwermetallen in die Weiden und Pappeln zu untersuchen und aus der Bilanzrechnung die „Restbelastung“ für den Boden zu ermitteln. Die bisherigen Zuwachsmessungen zeigen keine signifikanten Unterschiede zwischen den Varianten. Es besteht allerdings ein Trend, der - für die Weiden etwas deutlicher als für die Pappeln - einen Vorteil für die Handelsdüngervarianten anzeigt.

Es wird jedoch erst die Ernte des ersten Aufwuchses Ende November 2013 zeigen, inwieweit die tatsächlichen Erntemengen mit den auf der Basis von Wuchshöhen, Brusthöhendurchmesser, Pflanzenzahl und Verzweigung geschätzten Volumenzuwächsen korrelieren und wie sehr die Düngungsvarianten die Nähr- und Schadstoffstoffaufnahme durch die Bäume beeinflusst haben.
Der Versuch soll ab 2014 über eine weitere Aufwuchsperiode geführt werden, um noch mehr Erkenntnisse über die Nährstoffaufnahme, vor allem auch in Hinblick auf die zu erwartende stärkere Verzweigung der Pflanzentriebe zu erlangen.

Literatur

Holzner, H., Obernberger, I., Berger, T., Danzer, M., Humer, J., Jurik, P., et al. (2011). Richtlinie für den sachgerechten Einsatz von Pflanzenaschen zur Verwertung auf land- und forstwirtschaftlich genutzen Flächen. 66. (U. u. Bundesministerium für Land- und Forstwirtschaft, Hrsg., & A. Baumgarten, Redakteur) Wien, Wien, Österreich: Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft.

Roll pelletizing of ash

Linnéa Lövgren, M.Sc., senior consultant
Pöyry Sweden AB,
Box 306, SE-791 27 Falun, Sweden,
linnea.lovgren@poyry.com
www.poyry.com

Roll pelletizing of ash has in earlier studies shown to be a cost efficient method to prepare ash from the combustion of forest biomass for recycling of minerals and acid-neutralizing lime components back to forest. Roll pelletizing is an automatized method requiring fewer man-hours and allowing for fewer handling steps, and is therefore less costly compared with other ash preparation techniques, for example the most used method today as being crushed self-hardened ash. Roll pelletizing can become an even more efficient technique when accelerated carbonatation is being integrated with the automatized pelletizing of the ash product and will then also claim less land area for the ash product preparation.

Roll pelletizing is recommended for fly ashes from CFB and BFB boilers having low content of unburnt organic matter and slags and with high content of oxides. Ashes with comparable high content of unburnt organic matter can be mixed with burnt lime/quicklime or fly ash with high oxide content to improve its agglomeration properties. High content of organic matter is known to hamper agglomeration. Slags and other hard ash particles will wear the machinery.

In our laboratory study in 2011 we showed that also wet bottom ash from a biomass-fired inclined grate boiler can be roll pelletized if mixed with electrostatically precipitated fly ash. The effect on mineralogy, pH, electric conductivity, acid neutralization capacity and leaching properties were analysed. It was shown that accelerated carbonatation in humid atmosphere had improved the degree of hardening of the treated ash products.

In current Swedish legislation, wood-ash recycling onto fresh clear-wood-felling sites is not recommended unless a well-stabilized ash product is used. Nevertheless, wood-ash recycling onto fresh fellings offers better logistics, lower risk for damages on the stand, and a more pedagogic coupling between bio-fuel extraction and nutrient recycling.

A three-year forest field trial was performed in 1999–2002 with roll-pelletized wood ash directly spread onto a fresh felling and compared with spreading in a middle-aged Scots pine stand in Sweden in a randomized block design, comprising three blocks each. Moreover, roll-pelletized ash with an admixture of either green-liquor-sludge or lime sludge, both being by-products from the forest industry, were tested along with a conventional crushed self-hardened ash. The addition of the various ash products was compared to conventional felling and whole-tree harvesting. On the felling experiment the focus was on soil and soil-water chemistry, while at the closed forest the study was focused on soil chemistry and floristic effects.

The largest effects were found after addition of crushed self-hardened ash with increased pH and higher amounts of calcium (Ca), potassium (K) and magnesium (Mg) in the humus layer while the effect from the roll-pelletized ash was not significantly different from the control. On the clear felling, the crushed ash caused increased levels of potassium in the mineral soil, while the effect from the roll-pelletized ash did not differ from the controls. Initial damages on field- and bottom layer vegetation could be observed already two weeks after all he wood-ash additions. However, these damages had disappeared one year later. In conclusion, the measurements of the soil-water chemistry have not indicated any larger changes as an effect of the addition of roll pelletized wood ash.

Summaries of our experiences from forest field trials with roll pelletized ash show slow and long-lasting leaching properties fulfilling requirements from the Swedish Forestry Agency. The trials also showed that the pellet preparation method was cost efficient compared with crushed self-hardened ash. In addition, the experiences also show short hardening times, even if not used with accelerated carbonatation, minimum of dust generation during handling, easy spreading properties since it is free flowing like gravel without clogging the spreading equipment.

Keywords: Forest fertilization, roll pelletizing, hardening, carbonatation (carbonation), fly ash, bottom ash

14:00–18:30 Uhr

Industrieforum

Biomasse, Biogas und Biotreibstoffe anschl. Get-together

2:00–6:30 pm

Industry forum

Biomass, biogas and biofuels following Get together

Company profile

The ANDRITZ GROUP at a glance

International technology Group ANDRITZ, headquartered in Graz, Austria, employs approx. 23,800 people worldwide. It is a globally leading supplier of plants, equipment, and services for:

- Hydropower stations / ANDRITZ HYDRO
- Pulp and paper industry / ANDRITZ PULP & PAPER
- Metalforming and steel industry / ANDRITZ METALS
- Solid/liquid separation in municipal and industrial sectors / ANDRITZ SEPARATION

In addition, ANDRITZ offers technologies for certain other sectors including automation, the production of animal feed and biomass pellets, pumps, machinery for nonwovens and plastic films, steam boiler plants, biomass boilers and gasification plants for energy generation, flue gas cleaning plants, plants for the production of panelboards (MDF), thermal sludge utilization, and biomass torrefaction plants.

Die ANDRITZ-GRUPPE auf einen Blick

Der internationale Technologiekonzern ANDRITZ mit Sitz in Graz, Österreich beschäftigt weltweit rund 23.800 Mitarbeiter. Er ist einer der weltweit führenden Lieferanten von Anlagen, Ausrüstungen und Serviceleistungen für:

- Wasserkraftwerke / ANDRITZ HYDRO
- Zellstoff- und Papierindustrie / ANDRITZ PULP & PAPER
- Metall verarbeitende Industrie und Stahlindustrie / ANDRITZ METALS
- Kommunale und industrielle Fest-Flüssigtrennung / ANDRITZ SEPARATION

Darüber hinaus bietet ANDRITZ weitere Technologien an, unter anderem für die Bereiche Automatisierung, die Produktion von Tierfutter- und Biomassepellets, Pumpen, Anlagen für Vliesstoffe und Kunststofffolien, Dampfkesselanlagen, Biomassekessel und Gasifizierungsanlagen für die Energieerzeugung, Rauchgasreinigungsanlagen, Anlagen zur Produktion von Faserplatten (MDF), thermische Schlammverwertung sowie Biomasse-Torrefizierungsanlagen.

Komptech GmbH

Name, Vorname, Titel:	Kunter, Andreas, Dipl.-Ing.
Firma/Institution:	Komptech GmbH
PLZ, Ort:	8130, Frohnleiten
Straße und Hausnr.	Kühau 37
E-Mail:	a.kunter@komptech.com

Das Unternehmen Komptech
Komptech ist ein führender internationaler Technologieanbieter von Maschinen und Systemtechnik für die mechanische und mechanisch-biologische Behandlung fester Abfälle und für die Aufbereitung holziger Biomasse als erneuerbarer Energieträger. Die Produktpalette umfasst mehr als 30 unterschiedliche Maschinentypen, die die wesentlichen Verfahrensschritte der Abfallbehandlung und der Biomasseaufbereitung abdecken. Modularer Aufbau mit unterschiedlichen Leistungsklassen vereinfacht die Kombination zu kompletten Systemen und Anlagen.

Aufbereitung von Biomasse
Die Bereitstellung von Energie aus erneuerbaren Energieträgern ist ein Gebot der Stunde, um negativen Umweltauswirkungen wie etwa Klimawandel und Treibhauseffekt entgegen zu wirken. Komptech liefert hierfür Maschinen zur Aufbereitung von Holz in seinen unterschiedlichsten Erscheinungsformen, von Stammholz über Waldrestholz und kommunalem Grünschnitt bis hin zu Altholz, die alle für eine energetische Verwendung aufbereitet werden können.
Die Leistungen von Komptech reichen von der notwendigen Zerkleinerungstechnik bis zu weiterführenden Separationsschritten wie der Siebung und der Abtrennung von Störstoffen.
So kann aus holzigem Grünschnitt durch Zerkleinerung mit schnell oder langsam laufenden Schreddern ein Brennstoff von gröberer Struktur erzeugt werden. Eine anschließende Separation durch Sternsiebe oder Trommelsiebe bringt eine deutliche Qualitätssteigerung – Feinteile gehen in die Kompostierung und Störstoffe werden mittels Steinseparator, Magnetabscheidung oder Windsichtung abgetrennt. Abnehmer dieser Brennstoffe sind Biomasseheiz(kraft)werke, die damit ein in Bezug auf Heizwert und Korngröße maßgeschneidertes und kostengünstiges Produkt bekommen.

Entsprechend unserem Slogan „Technology for a better environment“ sehen wir es als unsere Aufgabe, für diese Herausforderungen die richtigen Konzepte und die wirtschaftlichsten Maschinen zu entwickeln. Denn gerade bei der Aufbereitung von holziger Biomasse zu Brennstoff lautet die Zielsetzung: minimaler Energieeinsatz – maximale Brennstoffausbeute.

Unternehmenskennzahlen
Gruppenumsatz 2012: ca. 101 Mio. €
60% des Umsatzes in Europa (ca. 10% in Osteuropa), Rest insbesondere in USA, Iran, Japan und Australien
6 Unternehmen an 5 Standorten in 4 Ländern weltweit (Österreich, Deutschland, Slowenien, USA)
Mitarbeiter: ca. 550

Tätigkeitsbereiche Neuson Ecotec GmbH:
Biomasse, Kompostierung und Forst

Unternehmenspräsentation:
Neuson Ecotec GmbH ist ein österreichisches Unternehmen mit über 20 Jahre Erfahrung im Bereich von mobilen Umwelt- und Forstmaschinen. Alle Maschinen sind 100% „made in Austria“.

Das Unternehmen präsentiert im speziellen den innovativen Hacker CH 1266. Die Einzigartigkeit der Maschine ergibt sich durch die universelle Einsatzbarkeit. Von Stammholz bis Wurzelstöcke kann mit dieser Maschine alles gehackt werden. Dies wird durch ein Rotor-Tauschsystem möglich.
Der CH 1266 ersetz Hacker, Vorzerkleinerer und Nachzerkleinerer.

Vortragender:

Mag. (FH) Christian Richter, MSc, MBA
Geschäftsführung / CEO

Neuson Ecotec GmbH
Actualstraße 32
A-4053 Haid/Ansfelden

Mobil: +43 (0)664 / 619 70 54
Tel.: +43 (0)7229 / 78 000 – 205
Fax: +43 (0)7229 / 78 000 – 200
Email: c.richter@neuson-ecotec.com
www.neuson-ecotec.com

BERTSCHenergy

Lösungen für die Energiewirtschaft

BERTSCHenergy – mit Hauptsitz in Bludenz, Österreich – ist ein führendes Unternehmen im Bereich der Kessel- und Energietechnik. Mehr als 250 Mitarbeiter, davon 50% in der eigenen Fertigung in Bludenz-Nüziders entwickeln, produzieren und errichten Kessel- und Energieerzeugungsanlagen.

BERTSCHenergy fertigt Kessel für flüssige, gasförmige und feste Brennstoffe sowohl in Wasserrohr- als auch in Rauchrohrbauweise für Dampf- und Heißwasser mit Leistungen bis 200 to/h, Drücken bis 120 bar, und Heißdampftemperaturen bis über 500°C. Spezialgebiete sind die Errichtung kompletter Biomassekesselheizkraftwerke sowohl mit Rost- als auch Wirbelschichtfeuerungen, Abhitzekessel nach Gasturbinen sowie Abhitzekesselanlagen in verfahrensintegrierten Systemen und nach verschiedensten Wärmeerzeugungsprozessen.

Ein weiterer Produktionsbereich ist der Behälter- und Apparatebau. Hier werden vor allem für die chemische und petrochemische Industrie sowie für die Papier- und Zelluloseindustrie verschiedenste Arten von Druckbehältern, Lagertanks Groß- und Sonderapparate, Kolonnen, Wärmetauscher usw. aus legierten und unlegierten Werkstoffen mit Stückgewichten bis 120 t gefertigt.

Unsere Geschäftsfelder im Überblick:

Feststoff-Kesselanlagen
Strom und Wärme aus Biomasse
Gasturbinen-Kesselanlagen
Strom und Wärme aus Gas und Öl
Abhitze-Kesselanlagen
Dampf aus Abhitze in Industrieprozessen
Prozessabhitzesysteme und Apparate
Dampf, Wärme und Ausrüstung für verfahrenstechnische Anlagen
Service
Optimale Wartung und Instandhaltung

Josef Bertsch Gesellschaft m.b.H. & Co KG
Herrengasse 23
A-6700 Bludenz
Tel.: 0043 / 5552 6135 0
Fax: 0043 / 5552 66 359
E-Mail: office@bertsch.at

Sprecher: DI Thomas Strasser

Unternehmenspräsentation Schmid energy solutions GmbH

Firmenname / Adresse:

Schmid energy solutions GmbH
Hans Thalhammer Straße 4
8501 Lieboch / Österreich

Vortragende:

Josef Strohmeier Geschäftsführer
Tel.: 03136 61580 Mobil: 0664 5101 494
Mail: josef.strohmeier@schmid-energy.at

Bernd Hörzer Geschäftsführer
Tel.: 03136 61580 Mobil: 0664 91 90 556
Mail: bernd.hoerzer@schmid-energy.at

Inhalt der Kurzpräsentation:

- Vorstellung Schmid AG Schweiz / Schmid GmbH Österreich
- Leistungsportfolio der Schmid GmbH Österreich
- Produktportfolio
- USP´s der Schmid- Produkte
- Referenzen Österreich

POLYTECHNIK, Luft-und Feuerungstechnik GmbH
Hainfelderstrasse 69, A-2564 Weissenbach
Tel. +43/2672/890-0, Fax: +43/2672/890-13,
Internet: www.polytechnik.com
E-Mail: office@polytechnik.at

The Austrian company "Polytechnik Luft- und Feuerungstechnik GmbH" is one of the most important suppliers of firing systems for biogenic fuels in the timber industry, and is famous for planning and providing turnkey systems and installations. The current export rate is about 98 % worldwide.

The company offers these firing systems in a performance range from 300 kW – 30,000 kW (individual boiler output). Depending on the type and water content of the fuel, a variety of firing systems are used (underfeed system, underfeed-burn-out grate, and hydraulic grate system), with media carriers being warm water, hot water, steam, or thermal oil.

The systems can be used for heating and process heat as well as for power generation (steam and ORC process). The performance range extends from 200 kW to 20,000 kW of electrical power (current).

More than 2,600 Polytechnik systems are already in use worldwide. In the timber and wood industry, Polytechnik suction extraction systems, filters, spraying chamber equipment, shredders, and spark quenching systems also have a fine reputation for quality. In other sectors of industry, as well as in the public domain, as well as firing installations and combined heat and power systems, local and district heating systems are also provided, while the company's worldwide service network ensures that the best possible customer service is provided rapidly.

Unternehmenspräsentation Viessmann Deutschland Industrie GmbH:

Viessmann Deutschland Industrie GmbH
Viessmannstraße 1
35107 Allendorf/Eder

Referent:
Thomas Krause (Geschäftsführer)
Tel: 06452/70 2834
Fax: 06452/70 5834
Email: KrsT@viessmann.com

Vorstellung:
Die Viessmann Group ist einer der international führenden Hersteller von Heiztechnik-Systemen. Das 1917 gegründete Familienunternehmen beschäftigt rund 10.600 Mitarbeiter.

Viessmann ist technologischer Schrittmacher für effiziente Energiesysteme. Aufeinander abgestimmte Komponenten und Systeme werden individuell für den Kunden aus einer Hand entwickelt und durch ein umfassendes Dienstleistungsangebot ergänzt.

Steigende Kosten für fossile Energie und ein wachsendes Umweltbewusstsein haben zu einer stetig zunehmenden Nachfrage nach regenerativen Energieformen geführt. Eine moderne Holzheizung ist eine umweltfreundliche und wirtschaftliche Alternative (oder Ergänzung) zu herkömmlichen Heizungsanlagen für fossile Brennstoffe.

Neben Unternehmen der Holzindustrie entscheiden sich immer mehr Kommunen, Kontraktoren und andere kommerzielle Energiebereitsteller für Biomasse als Brennstoff. Dieser ist geringeren Preisschwankungen unterworfen als fossile Brennstoffe und leistet nicht zuletzt durch Nachhaltigkeit und CO_2-Neutralität einen entscheidenden Beitrag für eine lebenswerte Zukunft.

Tätigkeitsbereiche:
- Biomassekessel von 4 bis 50.000 kW
- Biogasanlagen ab 50 kWel
- Energiesysteme für Ein-/Zweifamilienhäuser, Mehrfamilienhäuser, Industrie, Gewerbe, Kommunen, Nahwärmenetze
- Energieträger: Biomasse, Öl, Gas, Solar, Luft-/Erdwärme

Referenz:
Am 4. Juli 2007 wurde das E.ON-Biomasse-Heizwerk in Markt Schwaben in Betrieb genommen. Rund 60 Wohn- und Geschäftsgebäude in Markt Schwaben werden nun mit Fernwärme versorgt. Die Viessmann Gruppe lieferte nicht nur die Biomassekessel der Tochterfirma Köb und einen Großkessel Vitomax 300, sondern wird das Heizkraftwerk gemeinsam mit E.ON als Muster- und Schulungsanlage für die Biomassenutzung einsetzen.

REGAWATT

Hocheffiziente Energiesysteme nach Maß.

ReGaWatt ist Ihr Spezialist für schlüsselfertige Energiesysteme. Mit unserem langjährigen Knowhow in der dezentralen Energieversorgung entwickeln und erstellen wir hocheffiziente Energieanlagen, die exakt nach Kundenwunsch geplant und modular gebaut werden.

Mit dem **Kombi Power System®** hat ReGaWatt die Zukunft der dezentralen Energieversorgung entwickelt. **Das Kombi Power System®**

- ist der der neue Effizienzbenchmark
- ist führend bei den Emissionswerten
- ist für jeden Bedarf individuell anpassbar

Das ReGaWatt-Team arbeitet bei den Kernkomponenten komplexer Energiesysteme ausschließlich mit namhaften Herstellern qualitativ hochwertiger Maschinen zusammen. Die für Ihren individuellen Bedarf bestmöglichen Technologien fügen wir unter Einbindung professioneller Handwerksbetriebe und Anlagenbauer aus dem regionalen Umfeld zu Ihrem **Kombi Power System®** perfekt zusammen.

Wir handeln und entscheiden transparent, verantwortungsvoll und in enger Abstimmung mit unserem Auftraggeber – die Basis für die erfolgreiche „EnergieZukunft" für Ihr Unternehmen.

Wir liefern beste Qualität zum günstigsten Preis. Haben wir Ihr Interesse geweckt? Lernen Sie uns kennen.

WWW.REGAWATT.DE

Spanner HOLZ-KRAFT-Anlagen

> 200 Anlagen europaweit in Betrieb

> 2 Mio. Vollbetriebsstunden insgesamt absolviert

> 30.000 Vollbetriebsstunden mit ersten Anlagen erreicht

Die Spanner Re^2 GmbH ist der führende Hersteller von kleinen, dezentralen Kraft-Wärme-Kopplungsanlagen für feste Biomasse. Spanner HOLZ-KRAFT-Anlagen erzeugen gleichzeitig Strom und Wärme aus Holzhackschnitzeln. Es ist das erste Produkt dieser Art, das in Serie produziert wird und sich bereits in großer Zahl über mehrere Jahre bewährt hat. Spanner HOLZ-KRAFT-Anlagen werden in der Land- und Forstwirtschaft, dem Hotel- und Gaststättengewerbe und bei Nahwärmenetzen eingesetzt. Die hohe Energieeffizienz, die Nutzung lokal nachwachsender Energieträger und die attraktive Einspeisevergütung selbst erzeugten Stroms sind die wesentlichen Vorteile dieser Anlagen. Spanner Re^2 hat ebenfalls langjährige Erfahrung in der Produktion von Biomasse-Heizungen und ist auditierter Systemlieferant für Bosch/Buderus. Die Spanner Re^2 ist ein schnell wachsendes Unternehmen mit über 100 Mitarbeitern und gehört zur Spanner-Gruppe.

Bild: Serienfertigung von Spanner-Holzvergasern in Neufahrn i. NB.

Die Otto Spanner GmbH ist ein 1951 gegründetes, metallverarbeitendes Familienunternehmen, dass traditionell Automobilhersteller wie BMW und Porsche beliefert. In den vergangenen Jahren hat das Unternehmen erfolgreich in Wachstumsmärkten wie den erneuerbaren Energien und der Elektronik expandiert. Die Spanner-Gruppe besteht heute aus insgesamt vier Unternehmen, die zusammen über 360 Mitarbeiter beschäftigen.

Vortragender: Dipl. Ing. Thomas Bleul (Geschäftsführer)
Spanner Re^2 (Renewable Energy Experts) GmbH
Telefon: +49 8773 / 70798-288
Fax: +49 8773 / 70798-299
info@holz-kraft.de
www.holz-kraft.de

Scheuch GmbH
The Best Solution – Technically and Economically

For the market sectors Energy Industry, Metals Industry, Wood Processing Industry, Wood Based Panel Industry and Industrial Minerals, Scheuch offers a complete line-up of economical cleaning systems for exhaust gases and flue gases, along with efficient dedusting and pneumatic transport equipment. Scheuch keeps the state of technology in this sector on the move with innovative, patented technologies.

Excellent understanding of the biomass-to-energy process, know-how that spans a variety of industries, years of experience and a comprehensive service program enable Scheuch in each case to configure the optimal plant concept for its international industrial clients.

As an independent, family-owned company since 1963, Scheuch is active worldwide and currently employs a staff of 620 at its headquarters in Aurolzmünster/Austria. Scheuch GmbH has developed into the market and technological leader in many industry sectors in Europe.

Tailor-made Solutions for Biomass to Energy

Scheuch's ongoing program of innovative developments and improvements builds on nearly 40 years of experience with extraction and dedusting equipment and the challenges of cleaning exhaust and flue gases. Scheuch is responsible for developing new solutions that are redefining the state of this technology, especially in the area of flue gas cleaning for biomass-fired plants and waste incineration installations.

The plants from Scheuch fulfill the increasingly strict environmental requirements and have emission levels significantly lower than mandated limits. The rated capacity of these units ranges from a few thousand to several hundred thousand cubic meters of flue gas per hour. In the field of biomass to energy, Scheuch focuses on three main technologies: electrostatic precipitators, bag filters and heat recovery.

Electrostatic Precipitator

Over the last 10 years, roughly 600 of these electrostatic precipitators have been used to remove dust from plants that burn biomass.

Bag Filter with dry sorption

Bag filter systems are used to separate and collect extremely fine dust in concentrations up to < 5 mg/Nm^3.

Heat Recovery (ERCS)

Only through the use of suitable heat recovery systems - usually in the form of flue gas condensation systems - is it possible to use this energy and reduce fuel consumption.

Contact

Ing. Mag. Franz Söllhinger MBA
Phone: +43 / 7752 / 905 -175
E-Mail: f.soellhinger@scheuch.com
www.scheuch.com

Schräder
ABGASTECHNOLOGIE

Seit den 1980er-Jahren entwickelt und produziert Schräder Abgasleitungen aus Edelstahl und ist heute einer der führenden Hersteller von Schornsteintechnik aus Edelstahl in Deutschland.

Im Jahr 2008 hat Schräder die Themen Luftreinhaltung und Energieeffizienz aufgegriffen:

Mit den von Schräder entwickelten Feinstaubfiltern für die Holzverbrennung wird eine Reduktion der Staubemissionen von bis zu 90 % erreicht. Damit werden die ab 2015 geltenden Grenzwerte der 1. BImSchV bereits heute eingehalten.

Beim Thema Energieeffizienz konzentriert sich Schräder auf Wärmerückgewinnung aus Abgasen. Schräder Wärmetauscher stellen die aus dem Abkühlungsprozess gewonnene Energie zur weiteren Nutzung bereit. Klassische Einsatzmöglichkeiten sind die Raumheizung oder die Warmwasserbereitung.

Zurzeit beschäftigt Schräder ca. 90 Mitarbeiter in Kamen (Nordrhein-Westfalen) und in Badrina (Sachsen).

The name SCHRÄDER stands for advanced flue gas technology in stainless steel.

In recent years, Schräder has been involved in secondary measures related to heat recovery and exhaust gas treatment manufacturing heat exchangers and fine particle filters

The term energy efficiency is constantly gaining significance in the industrial sector. With consistent ongoing development Schräder offers tailored, cost-effective solutions in this market segment: The Schräder heat exchangers are designed for selective heat extraction from production systems such as annealing furnaces or baking ovens and their flues.

Schräder fine-particle filters systems are based on the principle of corona discharge. They can be used on biomass treating applications with an output from 15 to 1.000 kW.

ENERGY EFFICIENCY
made in Germany

OekoSolve

OekoSolve AG
Schmelziweg 2
CH-8889 Plons
info@oekosolve.ch
www.oekosolve.ch
Tel. 0041 (0)81 511 63 00
Fax 0041 (0)81 511 63 01

Referent: Herr Daniel Jud, Geschäftsführer
Inhalt Referat: **Feinstaubfilter für Holzfeuerungen**




Bezeichnung	OekoTube	U-Filter	OekoAlTop	FilterBox
Leistung	Bis 40 kW	40 - 150 kW	100 – 300 kW	300 - 800 kW
Reinigung	Manuell	Automatische Abreinigung	Automatische Abreinigung	Automatische Abreinigung
Abscheidegrad	75 - 95%	Bis 70%	65 - 85%	Bis 90%
Kurzbeschrieb	Der elektrostatische Feinstaubfilter OekoTube ist für alle Holzfeuerungen mit einer Leistung bis 40 kW geeignet und wird am Kaminende montiert. Der abgeschiedene Feinstaub sammelt sich an der Kaminwand an und wird vom Schornsteinfeger bei der regulären Reinigung entfernt.	Der U-Filter zeichnet sich durch seine einfache Bauform aus und wird direkt nach dem Heizkessel montiert. Wie alle Filter von OekoSolve scheidet der U-Filter den Staub elektrostatisch aus dem Rauchgas ab. Die Ablagerungen im Innern der Rohre werden automatisch gereinigt.	Der OekoAlTop ist für Holzheizungen bis 300 kW geeignet. Die elektrostatisch abgeschiedenen Partikel haften auf der Chromstahl-schüttung im Innern des Filters bevor sie automatisch abgereinigt werden.	Mit der FilterBox können Heizungen bis 800 kW (max. 2'500m^3/h) ausgerüstet werden. Als Abscheideoberfläche dient eine Chrom-stahlschüttung, auf welcher die abgeschiedenen Partikel haften.

OCHSNER Wärmepumpen GmbH (Zentrale/Werk)
A 3350 Haag, Ochsner-Straße 1
Tel. +43 (0)504 245-8, Fax +43 (0)504 245-349
Partner-Hotline A: +43 (0)820 201020
Partner-Hotline D: +49 (0) 1805 832840
htiwp@ochsner.at

OCHSNER Wärmepumpen GmbH (Firmenbuch)
A 4020 LINZ, Krackowizerstrasse 4
Landesgericht Linz, FN 85708t
kontakt@ochsner.at, www.ochsner.at

OCHSNER
WÄRMEPUMPEN

Dipl.-Ing. ETH Karl Ochsner
Karl.Ochsner@ochsner.at
Tel. +43 (0) 5 04245 – 110

Die Firma Ochsner ist ein führender europäischer Hersteller von Wärmepumpen mit einem breiten Produktionsprogramm. In den letzten Jahren wurden Hochtemperatur-Prozess-Wärmepumpen bis zu einer Leistung von ca. 1000kW entwickelt, welche Heizungs-Vorlauftemperaturen bis zu 98°C bereitstellen können. Dadurch ist es nunmehr möglich Großbauten mit konventionellen Wärmeverteilsystemen auch mit erneuerbarer Umgebungswärme zu heizen.

Hochtemperatur-Prozess-Wärmepumpen können auch für die Steigerung der Energieeffizienz von Biomasseheizwerken, Biomasse-Heizkraftwerken oder Fernwärmeanlagen eingesetzt werden:


Biomasse-Heizwerk


Fernwärme-Anlage

Wärmerückgewinnung während Rauchgaskondensation
Als Wärmequelle dient ein Rauchgaswärmetauscher, welcher einerseits die Nutzung zusätzlicher Kondensationswärme möglich macht und andererseits als Wärmequelle daraus Hochtemperatur-Nutzwärme gewinnt, welche direkt in den Vor- oder Rücklauf des Fernwärmenetzes eingespeist werden kann.

Erweiterung der Kapazitäten bestehender Fernwärmenetze
Hier wird der Rücklauf von Fernwärmesystemen als Wärmequelle genutzt und ein Wärme-Temperaturniveau erzeugt, welches die Nutzkapazität des Fernwärmesystems erweitert.

Gezeigt werden einige Referenzen in Industrieanlagen sowie großvolumigen Bauten.


Plansee Reutte, Industrielles Fernheiznetz, Nutzung von Abwärme aus dem Fertigungsprozess
OCHSNER Hochtemperatur-Industriewärmepumpe IWHS 400 R3

Sämtliche Wärmepumpen bis zu einer Leistung von 100kW können auf den Prüfständen der Firma OCHSNER gemessen, optimiert und vom Kunden unter zukünftigen Feldbedingungen abgenommen werden.

Energiecomfort macht Biomasse rentabel

Der Energiedienstleister Energiecomfort hat ein „Tuning" für Biomasse-Anlagen entwickelt. Effekt: Mit weniger Brennstoffeinsatz kann mehr Wärme erzeugt werden. Viele weniger rentable, aber ökologisch sinnvolle Ortswärmenetze können damit wieder profitabler geführt werden.

Energiecomfort, führender Spezialist für Energieeffizienz, kann durch Feinabstimmung bestehender Anlagen mehr Leistung um weniger Geld herausholen. Das neue „Tuning-Produkt" wird heftig nachgefragt, da viele Energieversorger Schwierigkeiten haben, positive Betriebsergebnisse mit Biomasseanlagen zu erzielen.

Größter Effekt ist die Rentabilität
Die Erfahrungen aus den sechs eigenen Biomassewerken von Energiecomfort in Österreich und im benachbarten Bayern sind in die Entwicklung des „Biomasse-Tunings" eingeflossen. Große Effizienzsteigerungen konnten bei unterschiedlichen Baumodellen von Kesseln und Reglern erreicht werden.

Der Brennwertvergleich
Zum Vergleich: Der theoretische Wärmeinhalt für einen Schüttraummeter trockenen Waldhackgut liegt bei rund 1.200 Kilowattstunden. Betreiber gut eingestellter Anlagen erreichen mit handelsüblicher Biomasse 50-60 % Wärme nach Kessel eine bereits passable Energieausbeute. Energiecomfort hingegen holt aus derselben Rohstoffmenge im Schnitt bis zu einem Viertel mehr Energie heraus: Aktuell sind das rund 70-80 % bis zum Spitzenwert von über 88%. Damit kann Energiecomfort nicht nur die eigenen Heizwerke profitabel führen, sondern auch anderen Bertreibern helfen, ihre Anlagen zu optimieren.

Das „Biomasse-Tuning"
Das Tuning startet mit einer detaillierten Analyse der bestehenden Hardware und Software. Dann wird ein Prüfstand mit neuen und vertrauten Hardwarekomponenten für die sogenannten Kalttests eingerichtet. Im Versuch werden alle Anlagenfunktionen systematisch durchgespielt und die neu programmierte Software aufgesetzt. Die Techniker von Energiecomfort begleiten den gesamten Prozess der Inbetriebnahme der neuen Regelungsanlage und Feinjustierung in einer mehrwöchigen Optimierungsphase.

Mit der neuen Steuerung haben Betriebsführer Zugriff auf tiefere Programmebenen und einen wesentlich erweiterten Einstellbereich. Die Zuschaltung des Spitzenlastkessels wird neu ausgelegt. Die Bandbreite des Hauptkesselbetriebes kann damit bis unter 20 Prozent der Nominalleistung erweitert werden. Eine spezielle Regelung der Rücklaufanhebung und erweiterte Gestaltungsmöglichkeiten des Glutbettes werden als zusätzliche Funktionen implementiert.

Wien|Graz, Jänner 2014

Rückfragen Energiecomfort:
Ing. Thomas Hartner
E-Mail: thomas.hartner@energiecomfort.at
www.energiecomfort.at

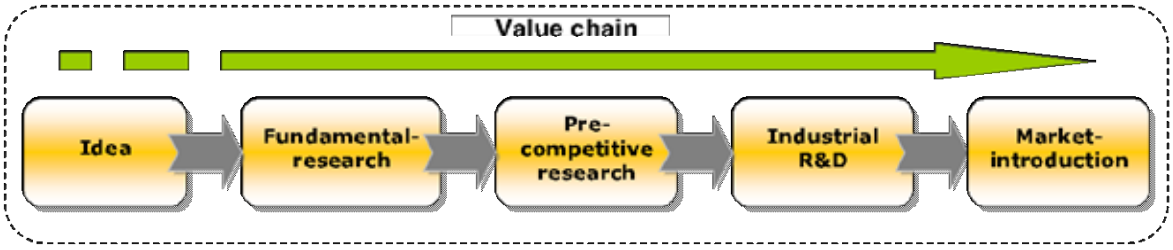
Christian Call
E-Mail: christian.call@energiecomfort.at
Fon: 01/313 17 - 36611

BIOENERGY 2020+ GmbH – the Austrian centre of competence in bioenergy research

One-Stop-Shop in bioenergy RTD – the service portfolio of BIOENERGY 2020+

The **BIOENERGY 2020+ GmbH (BE2020)** is a merger of Austrian Bioenergy Centre and Renet Austria. It is the privately organized national centre of competence in the field of **energy from biomass** funded within the national **COMET** (competence centres for excellent technologies) programme. BE2020 works at three locations Graz (headquarters), Güssing, and Wieselburg, where internationally recognized, industry driven research is performed by about **100 researchers and engineers** in the following fields: **sustainable biomass supply and value chains, biomass combustion systems** – from small to industrial scale, **biomass cogeneration systems** – from micro to large industrial scale, **biomass gasification systems**, production of **synthetic biofuels**, **biogas**, **modelling and simulation**, and **automation and control**.

Our vision is to become a world leader in bioenergy research and to best possibly support Austrian industry to maintain and extend its position as technology leader worldwide. To do so, the concept of a **one-stop-shop in bioenergy RTD** has been developed aiming to provide services along the whole value chain – from the basic idea to the market introduction of the developed product or technology.



Our services therefore include	Our national and international clients are

• Cooperative research
• Contract research
• Consultancy and technical services
  ○ Fuel and technology assessment
  ○ Gas quality determination
• Trainings and seminars
• National and international networking
	• Technology providers
	• Plant operators
	• Investors
	• Scientific institutions
	• Public bodies and institutions

Contacts

Mag. DI Dr. Thomas K. Klein
General Manager
thomas.klein@bioenergy2020.eu
+43 (316) 873-9201

DI Dr. Walter Haslinger
Area Manager
walter.haslinger@bioenergy2020.eu
+43 (7416) 52238-20

BIOENERGIESYSTEME GmbH

Research, Development and Design of Plants for Heat and Power Production from Biomass

Inffeldgasse 21b A-8010 GRAZ, AUSTRIA
TEL.: +43 (0)316-481300; FAX: +43 (0)316-481300-4
EMAIL: OFFICE@BIOS-BIOENERGY.AT
HOMEPAGE: HTTP://BIOS-BIOENERGY.AT

The company was founded in 1995 as a Graz University of Technology spin-off in the form of a business partnership. In 2001 the legal status of the company was changed to a limited liability company due to the increasing annual turnover and the integration of senior staff members. The present staff of BIOS BIOENERGIESYSTEME GmbH comprises 30 persons, 28 of them are university graduates (process, energy and environmental engineers). The turnover volume amounted to approximately 4.0 million Euros in 2012.

BIOS BIOENERGIESYSTEME GmbH is active in research, development, planning and optimisation of processes and plants designed to generate heat and power from biomass.

The BIOS team of engineers has many years of comprehensive experience in the design and operation of plants for energetic biomass utilisation and can refer to a wide range of project implementations and successful developments. Furthermore, BIOS has established close contacts to national and international scientific institutions and companies by participating in national and international R&D and demonstration projects, which ensure direct access to the latest developments and innovations in this area.

Prof. Obernberger, the managing director of BIOS BIOENERGIESYSTEME GmbH, is head of the research group “Energetic Biomass Utilisation” at the Graz University of Technology as well as Austrian representative in the IEA Bioenergy Agreement, Task 32 "Biomass Combustion and Co-firing".

BIOS BIOENERGIESYSTEME GmbH performs long-term monitoring for several biomass heating and CHP plants. This allows BIOS engineers to gain direct access to all plant data and gather comprehensive experience in the optimisation of biomass to energy plants. Moreover, BIOS BIOENERGIESYSTEME GmbH is an industrial partner and via the association of companies a shareholder of the Bioenergy 2020+ GmbH. The Bioenergy 2020+ GmbH is a centre of competence within the Austrian COMET-Programme, where R&D projects in the field of energetic biomass utilisation are performed in close cooperation between scientific and industrial partners. This secures direct access to relevant infrastructure and knowledge concerning R&D in the field of thermochemical biomass conversion (access to laboratory and pilot plant facilities for test runs, to comprehensive and modern analysis and measurement equipment as well as to latest results of R&D projects).

The experience gained in projects that have already been implemented, as well as detailed knowledge in the planning and design of thermal biomass conversion systems guarantee that solutions provided by BIOS are at the cutting edge of technology and meet the highest standards of cost effectiveness and environmental compatibility.

BIOS BIOENERGIESYSTEME GmbH is an experienced and reliable partner for all fields of energetic biomass and industrial waste heat utilisation. The solutions offered take account of all the latest developments and innovations in this sector and meet the most demanding requirements.

References (planned and/or realised plants):

- Industrial waste heat utilisation (3 plants, 3 – 16 MW_{th} and 2 plants 300 and 800 kW_{el})
- Biomass district heating plants (13 plants, 0.6 – 30 MW_{th})
- Biomass combined heat and power plants based on ORC, steam turbine, screw type engine and Stirling engine processes as well as biomass gasification plants (30 plants, 35 kW_{el} – 26.3 $MW_{el,}$)
- Pellet production plants (3 plants)
- Cooling plants and cooling supply systems as well as heat pump integration concepts (3 plants)
- CFD based design of furnaces, gasifiers, stoves, boilers and flue gas cleaning systems (more than 20 references in the range from 5 kW_{th} to 50 MW_{th})
- Plant monitoring and optimisation (6 biomass CHP plants, 1 biomass CHCP plant, 4 biomass district heating plants and 1 biogas CHP plant)

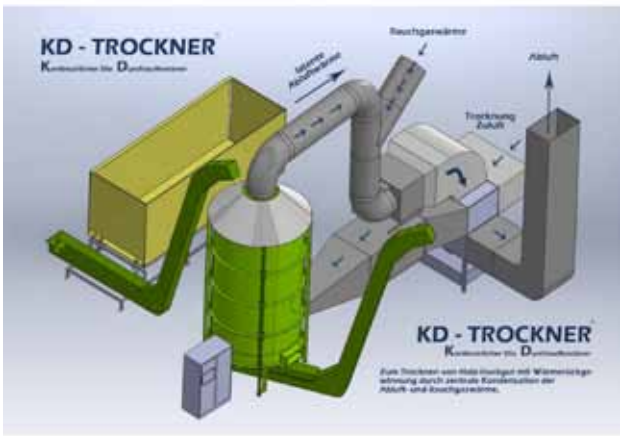
„Das REDOX – Holzgaskraftwerk mit dem KD – Trockner für Biomasse – Hackgut“

Dipl.- Ing. Walter Sailer
SW-EnergieTechnik – SWET GmbH, A - 9220 Velden / Wörthersee, Beethovenallee 3
E-Mail: office@swet.at Homepage: www.swet.at & www.redox-vergaser.com & www.kd-trockner.com

Die patentierte Erfindung des **REDOX – Holzgaskraftwerkes** mit dem integrierten 2– stufigen Reduktionsvergaser ist die gewinnbringende Erzeugung von Ökostrom und Wärme mit einem nahezu teerfreien Holzgas im KWK – Motorheizkraftwerk mit einem Brennstoffnutzungsgrad von über 87 % inkl. der maximalen Wärmenutzung.
Bei diesem REDOX - Holzvergasungsverfahren wurden die bislang anstehenden Problembereiche der Vergasung von Holz technisch und wirtschaftlich gelöst.
Dies ist vor allem die gesicherte Trocknung des Vergaserbrennstoffes – Hackgutes im KD–Trockner und das Cracken der Teere bzw. Kohlenwasserstoffketten in der 2–stufigen Verbrennung & Vergasung im ALL-IN-ONE-Reaktor.
Der besondere Vorteil ist die Erzeugung eines nahezu teerfreien Holzgases, das mit minimalem Reinigungsaufwand von Stäuben (Holzasche, Kohlenstaub) z.B. im Standard - Heißgasfilter gereinigt und anschließend gekühlt im Gasmotor zur Gewinnung von Ökostrom & Wärme verbrannt wird.
Ein wichtiger Bestandteil zur Einhaltung des thermochemischen autothermen Holzvergasungs-prozess im REDOX – Holzgaskraftwerk ist die gesicherte Trocknung des erntefrischen – gasreichen – grobstückigen Vergaserbrennstoffes aus Hackgut mit einer maximalen Feuchte von ca. 12 %.

Diese Besonderheit ist die patentierte Erfindung des **KD – Trockner** mit der Doppelwirkung (Kontakt- und Konvektionstrocknung) mit Niedertemperatur – Trocknungsluft zur Steigerung des Heizwertes bei schonender, sanfter und kontinuierlicher Entfernung des Wassers und Erhalt der brennbaren Gasbestandteile im Hackgut.
Durch Nutzung der KWK - Abwärme – anstelle der Notkühler - aus Biogasanlagen oder Biomasse Heiz- und Kraftwerken - sowie durch Rückgewinnung der Rauchgasabwärme (Vollbrennwert) die „Gratis Abwärme vom Kamin„ wird der Heizwert & Mehrwert der Holzenergie durch die Entfernung des Wassers bzw. Wasserverdampfung im KD – Trockner gesteigert.
Die maximale Energieeffizienz durch die Nutzung der Rauchgasabwärme im KD – Trockner ermöglicht eine Brennstoff- und CO2 - Einsparung bis zu 35 % und ein Reduktion der Feinstäube & Aerosole bis zu 90 % im Rauchgaskondensationswäscher (Feinstaubkiller).
Weitere Vorteile der kontinuierlichen Trocknung von frischem Hackgut sind die Vermeidung von Substanzverluste des Heizwertes im Hackgut und die Kapitalbindung durch zu lange Lagerung von Baumstämmen oder Hackgut im Freien.
Die Holzenergie - Effizienzsteigerung im KD – Trockner ist ein Gewinn für die Umwelt und dem Betrieb, der sich bei gegebenem Hackgutpreis mit kurzer Amortisation rechnet.

Die Anwender der Erfindung der effizienten Hackguttrocknung sind die Biomasse – Heiz- & Kraftwerke, Biogasanlagen, Pelletsproduzenten, Holzvergaser, Brennstoffhändler, Biomassehöfe, die einerseits Abwärme zur Verfügung haben und anderseits hochwertiges – gasreiches getrocknetes Hackgut zur Energienutzung benötigen.



Siemens AG

Die Siemens AG ist ein weltweit führendes Unternehmen der Elektronik und Elektrotechnik und steht seit über 160 Jahren für technische Leistungsfähigkeit, Innovation, Qualität, Zuverlässigkeit und Internationalität.
Siemens entwickelt innovative und effiziente Lösungen, die auf die besonderen Anforderungen der Biokraftstoffproduktion und der Energiegewinnung aus Biomasse zugeschnitten sind.

Modulare Lösungen in Automatisierung und Energiemanagement für die Biomasse-/ Biokraftstoff-Industrie

Modulare Lösungen für maximale Produktivität
Mit einem perfekt abgestimmten Portfolio können wir maßgeschneiderte Lösungen für den gesamten Produktionsprozess realisieren, ganz unabhängig vom eingesetzten Rohstoff, von der Größe der Anlage oder dem eingesetzten Verfahren. Ein gewisser Grad an Automatisierung gibt die nötige Transparenz für eine relativ gleichmäßige und damit wirtschaftliche Produktion – von Biomasse, Biogas, Bioethanol oder Biodiesel.
Auf Basis von Totally Integrated Automation (TIA) und Totally Integrated Power (TIP) bieten wir die optimale Integration zwischen Automatisierung und verfahrenstechnischem Prozess. Der hohe Integrationsgrad von TIA und TIP und das optimale Zusammenspiel aller eingesetzten Komponenten ermöglichen eine schnelle Inbetriebnahme und einen reibungslosen, ökonomischen Betrieb der Anlage. Im Bereich der Automatisierung reicht unser Angebot von der Feldebene bis hin zur Leitebene. Dieses wird auf der Ebene des Energiemanagements optimal ergänzt durch ein breites Spektrum an Lösungen von Dampfturbinen, über Nieder- und Mittelspannungsanlagen bis zum einzelnen Schaltschrank**.**

Globales Branchen-Know-how
Biomasse-/Biokraftstoff-Anlagen werden häufig unter großem Kosten- und Zeitdruck errichtet. Das funktioniert nur mit einem erfahrenen, global und lokal agierenden Partner. Weltweit haben wir über Jahre hinweg sehr viel Erfahrung in unterschiedlichen Branchen der Prozessindustrie gesammelt. Dieses branchenübergreifende Wissen ist die Basis für leistungsstarke Automatisierungs- und effiziente Energiemanagementlösungen. Dank unserer Branchenkompetenz sind wir bestens mit lokalen Normen und Richtlinien vertraut und können so ein entsprechend angepasstes Produktportfolio bieten. In Zusammenarbeit mit Industriepartnern sind das die besten Voraussetzungen für eine reibungslose globale Projektabwicklung.
Sowohl bei Planung als auch bei Inbetriebsetzung verzahnen wir die Aktivitäten unterschiedlichster Partner, unabhängig davon, ob es sich um kleine bäuerliche, genossenschaftliche oder größere industrielle Anlagen handelt. Dabei arbeiten wir sehr eng mit Anlagenbauern und Systemintegratoren zusammen. In Summe ergeben sich Vorteile wie niedrigere Installationskosten und kürzere Installationszeiten für Anlagenerrichter und Anlagenoptimierung und einfache Betriebsanalyse für Anlagenbetreiber.

Referenzen:
Biomassehof Achental, Agnion, Grassau, Deutschland
Inbicon A/S (Dong Energy), Zweite Generation Ethanol, Fredericia, Dänemark
Biogasanlage Weyberhöfe, Bio Power e.K. Sailauf, Deutschland
Südsprit Biodiesel GmbH, Schrobenhausen, Deutschland
Bioethanolanlage der Usina Alto Alegre Group, Santo Inácio, Brasilien
National Corn-to-Ethanol Research Center, USA
Jilin Fuel Ethanol Co. Ltd, Jilin, China

Weitere Informationen unter: www.siemens.com/biofuels

Siemens AG
Sektor Industry
Chemicals
76181 KARLSRUHE
DEUTSCHLAND

Valmet Corporation is a leading global developer and supplier of services and technologies for the pulp, paper and energy industries. Our 11,000 professionals around the world work close to our customers and are committed to moving our customers' performance forward – every day. Our services cover everything from maintenance outsourcing to mill and plant improvements and spare parts.

Valmet will focus on delivering technology and services globally to industries that use bio-based raw materials. Valmet's vision is to become the global champion in serving its customers, and its mission is to convert renewable resources into sustainable results.

Valmet's main customer industries are pulp, paper, and energy. All of these are major global industries that offer growth potential for the future. Valmet will complement its core business by applying its technology and know-how to industries beyond biomass, particularly in the energy sector.

Valmet's product and service portfolio consists of productivity-enhancing services, plant upgrades and rebuilds, new cost-efficient equipment and solutions for optimizing energy and raw material usage, and technologies increasing the value of its customers' end products.

Valmet is an established market leader and has a strong market position in all its businesses.

Services Business Line provides customers with mill improvements, roll and workshop services, spare parts, fabrics, and life-cycle services. Valmet serves over 2000 pulp and paper mills globally. This means that annually more than half of the world's 3 800 pulp and paper mills buy services from Valmet.

Pulp and Energy Business Line provides technologies and solutions for pulp and energy production as well as for biomass conversion. The pulp projects range from process equipment deliveries to complete pulp mills. Valmet's energy solutions include e.g. biomass based energy boilers and their rebuilds. In addition, Valmet continuously develops new biomass conversion technologies.

Paper Business Line delivers complete board, tissue and paper production lines and machine rebuilds. Board, tissue and paper are used in a number of end products such as packaging, handkerchiefs, toilet paper and hand towels as well as printing and writing papers.

Contact information:

Dr. Markus Bolhàr-Nordenkampf

Director CEE

Valmet GesmbH, Erdbergstraße 52-60/2/3/Top12, 1030 Wien

markus.bolhar@valmet.com

“Thermaflex – your smart partner for energy solutions”

Artur Klos, Business Development Director
Thermaflex-Flexalen Rohr- und Isoliersysteme GmbH

Thermaflex is an international group active in energy efficient heating and cooling networks for buildings and district energy systems.
Our philosophy is: minimize the waste of energy, maximize the use of renewables.
We develop and produce smart solutions for thermal distribution using state-of-the-art flexible pre-insulated piping systems that are applied in residential areas, offices, hotels, public buildings and industrial sites across the globe. In line with our energy and environment saving mission, we strive to achieve full sustainability. Therefore, we place a high priority on efficient and renewable energy sources for our own production processes. Consequently, we select (raw) materials for our products that meet the highest health and safety standards and are both energy efficient and recyclable. In order to be sustainable, the long life-cycles and recyclability of the materials we use provide significant benefits.

Thermaflex currently has production companies and sales offices in Europe, Russia, Asia and Latin America. Our solutions are available in close to 50 countries.

Smart and innovative energy saving
The market for Combined Heat & Power generation (CHP) from biogas has developed rapidly over the past years especially in making use of the rest heat from the CHP process for district heating. But not only the generation of heat, but also the distribution should be green; an innovative and sustainable approach in network design has been applied. Flexalen network engineering provides the most effective network with the lowest carbon footprint.

Long history and individual approach
One of the pioneers in the Austrian Biomass District Heating scene, the Abbey of Heiligenkreuz, is celebrating its 30 years anniversary in 2013. In 1983 the decision was taken to establish a 3,8 MW central heating plant at the sawmill in Heiligenkreuz. Gradually extensions were developed, so that today the abbey does not only supply heat to their wood dryers and own buildings, but also all communes´ public buildings as well as single-family houses with district heating – by using state-of-the-art flexible, pre-insulated Flexalen pipe systems.

Over the last 30 years Thermaflex has gained vast experience and recognition in the field of Bioenergy by active participation in hundreds of projects all over Europe. Sharing this know how to support new projects in achieving highest efficiency is our ambition.

Thermaflex-Flexalen
Rohr- und Isoliersysteme GmbH
Siebenhirtenstraße 17
A-1230 Wien

Artur Klos
Business Development Director
Tel.: 01/523 26 25.14
Fax: 01/523 26 25.24
E-Mail: a.klos@thermaflex.com

Ihr Spezialist für Industriearmaturen

Die umfangreiche Produktpalette beinhaltet **Industriearmaturen von international führenden Herstellern** für nahezu alle Anwendungsfälle und Einsatzgebiete. Unsere Leistungsumfang beinhaltet die Planung, die Produktauswahl, die Inbetriebnahme sowie Schulungen und After-Sales-Service. Vom **umfangreichem Lager** unseres Hauptstandortes Graz aus, sind wir in der Lage, unseren Kunden **kurze Lieferzeiten** zu garantieren.
Unser Vertriebsgebiet erstreckt sich neben **Österreich, über den gesamten Süd-Ost-Europäischen Raum** mit technischen Ansprechpartnern vor Ort.

Nutzen Sie den Service und die kompetente Beratung die Flowtec Ihnen bietet!

SOMAS

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- Temperaturen bis 750°C

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- Druckbereich bis PN100

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IHRE ANSPRECHPARTNER:

Peter PAURITSCH
M +43 664 9656609
E peter.pauritsch@flowtec.at

Michael GLUDOWATZ
M +43 664 9215233
E michael.gludowatz@flowtec.at

Flowtec Industrietechnik GmbH | Stattegger Strasse 179 | 8046 Graz | www.flowtec.at

Kurzpräsentation Clariant

Clariant ist ein weltweit führendes Unternehmen der Spezialchemie mit Hauptsitz in Muttenz bei Basel/Schweiz. Am 31. Dezember 2012 beschäftigte das Unternehmen über 21 000 Mitarbeiterinnen und Mitarbeiter. Im Geschäftsjahr 2012 erzielte Clariant einen Umsatz von umgerechnet rund fünf Milliarden Euro (6,038 Milliarden Schweizer Franken). Die fortgeführten Aktivitäten umfassen die folgenden sieben Geschäftseinheiten: Additives, Catalysts, Functional Materials, Industrial & Consumer Specialties, Masterbatches, Oil & Mining Services und Pigments. Die Unternehmensstrategie von Clariant beruht auf vier strategischen Säulen: Rentabilität der Kerngeschäfte, Forschung und Entwicklung sowie Innovation, dynamisches Wachstum in Schwellenmärkten und Repositionierung des Portfolios.

Clariant Catalysts ist ein weltweit führender Katalysatorhersteller mit einem vielfältigen Produktportfolio für Prozesse in der Chemie sowie der Treibstoffherstellung. Unsere Produkte ermöglichen es, alternative Rohstoffe wie Erdgas, Kohle oder Biomasse zu nutzen. Außerdem leisten unsere Kataysatoren zur Abgasreinigung bei Industriellen Prozesse und in Verbrennungsmotoren wichtige Beiträge zum Umweltschutz.

Produktbereiche:

- Katalysatoren zur Produktion von Ammoniak, Methanol, Wasserstoff und synthetischem Erdgas (SNG) und zur Verwendung in Prozessen zur Produktion von Kraftstoffen aus alternativen Quellen wie Gasverflüssigung (GTL), Kohleverflüssigung (CTL) und Biomasseverflüssigung (BTL).
- Petrochemiekatalysatoren zur Produktion und Reinigung von Olefinen, Aromaten und Derivaten.
- Oxidations- und Hydrierkatalysatoren für die Produktion von Basis- und Spezialchemikalien.
- Katalysatoren zur Abgasreinigung für Industrieanlagen und für Verbrennungsmotoren.
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Kontaktdaten:
Clariant Produkte (Deutschland) GmbH
Beate Arendt
Waldheimer Str. 15
83052 Bruckmühl
Tel. +49 8061 4903 517
Email: beate.arendt@clariant.com

Mission & Vision von GE-PROVI

GE-PROVI strebt an, ein Marktführer für die innovative kompakte und kosteneffiziente Kompaktenergieanlage für die Landwirte zu werden. Dies erreichen wir durch innovative, nachhaltige und effiziente Lösungen, um der Welt zu mehr "grün" zu helfen.
Wir werden mit unseren Kunden, Lieferanten und Partnern gemäß des Grundsatzes des gegenseitigen Vertrauens und mit einem klaren Ziel, einen echten Mehrwert bieten zu können. Unsere Unternehmenskultur basiert auf harter Arbeit, persönlicher Verantwortung, Professionalität, gegenseitigem Respekt, Selbst-Motivation, persönlichem Fortschritt, gerechter Entschädigung und Behandlung - wir betrachten unsere Mitarbeiter als wertvolles Kapital der Organisation.

Gesellschaft

GE-PROVI (wird eine Inkorporation – Aktiengesellschaft sein), die aus 3 Gesellschaftern und ein paar Unternehmen bestehen wird und haben sich für den Zweck die innovative Kompaktenergieanlage zu entwickeln und zu vertreiben organisiert. Unser Hauptsitz wird sich in Graz, Österreich befinden.

Produkt

GE-PROVI hat eine Kompaktenergieanlage konzipiert die in Österreich unter der Nr. AT 508 614 B1 2012-03-15 patentiert ist. Weitere Patente sind in Österreich angemeldet: A72/2013, A76/2013, A77/2013. Die Kompaktenergieanlage hat eine Größe von einem 20”-Container. Das System ist in der Lage, automatisch und kontinuierlich (24 Stunden x 365 Tage) landwirtschaftlichen Reststoffe, in Strom-, Wärme-und Dieselkraftstoff in DIN-Qualität zu verwandeln.

BETARENEWABLES

COMPANY PROFILE

Beta Renewables is a joint venture established in 2011 between Biochemtex, part of the Mossi Ghisolfi Group of companies and global private equity firm TPG. In late 2012 Novozymes, the world leader in bioinnovation, acquired a 10% share in Beta Renewables for $ 115 million (€ 90M).

Biochemtex belongs to the "green chemistry" business of the Mossi Ghisolfi Group. The Group, through M&G Chemicals, is one of the world's leading producers of PET resin. The Mossi Ghisolfi Group has operations in Brazil, Mexico, China, India, the USA and Italy. The company has a track record of 60+ years in process development and industrial innovation, successfully commercialized in hundreds of plants worldwide.

Beta Renewables has invested over $200 million (€ 150million) in the development of the Proesa™ process. The company designed and built the world's first commercial-scale cellulosic ethanol facility in Crescentino, Italy, that started operations at the beginning of 2013.

WHAT PROESA™ DOES

The Proesa™ process is a second-generation cellulosic biomass technology. It takes non-food biomass, like energy crops (such as giant reed, miscanthus or switchgrass) or agricultural waste (such as sugarcane bagasse and straws) and turns it into high-quality, fermentable C5 and C6 sugars.

These sugars can then be used to produce biofuels and other petrochemical replacements with a smaller environmental footprint than fuels and chemicals made from oil or natural gas.

The patent-pending Proesa™ process is designed to minimize both capital expenditures and operating costs. This allows for more profitable production by partners that license our technology and a faster market adoption in the marketplace.

HEADQUARTERS AND AFFILIATES

Beta Renewables headquarter is located in Tortona, Italy, in the heart of Northern Italy's "business triangle" between Milan, Turin and Genoa.

EXECUTIVE MANAGEMENT

- Guido Ghisolfi, President and CEO
- Dario Giordano, Chief Technology Officer
- Pablo Aubert, Chief Financial Officer
- Michele Rubino, Sales & Marketing

KEY FIGURES OF THE WORLD'S LARGEST CELLULOSIC ETHANOL PLANT

150 MLN €: 5 year investment in R&D

150 MLN €: investment for the plant construction

20 MLN GAL/year: production of second generation bioethanol

Please visit **www.betarenewables.com**

Beta Renewables S.p.A. . Strada Ribrocca, 11 . 15057 Tortona (AL) . P.iva/C.f. IT 02232720066 . T +39 0131 810.1 . F +39 0131 811 759 .

09:00–12:00 Uhr

Parallelblock 4

Strom aus fester Biomasse

9:00 am–12:00 pm

Parallel Session 4

Electricity from solid biomass

SUNSTORE 4: CHP plant based on a hybrid biomass and large scale solar system – results after monitoring

DI Alfred Hammerschmid
BIOS Bioenergiesysteme GmbH
Inffeldgasse 21b
A-8010 Graz, Austria
hammerschmid@bios-bioenergy.at
www.bios-bioenergy.at

Co-Author: Prof. Univ.-Doz. DI Dr. Ingwald Obernberger / BIOS Bioenergiesysteme GmbH

Purpose of the work
Within the European demonstration project "SUNSTORE 4" (started in summer 2010; coordinator, erector and operator of the plant is Marstal Fjernvarme; partners from Denmark, Sweden, Germany, Austria, Belgium, Czech Republic and Italy are participating) an innovative, multi-applicable and cost efficient large-scale district heating system based on hybrid solar and biomass with a long-term heat storage and an Organic Rankine Cycle (ORC) for green electricity production was constructed and put in operation in the second half of 2012. In order to get a deep insight and understanding of the system and component behaviour as well as to optimise the whole system, its control strategy and the components comprehensive measurements and a long-term monitoring for 2 years is ongoing.

Approach
Based on an existing district heating system (heat produced mainly with bio-oil boilers and partly with solar) in Marstal a large-scale solar field with a long-term pit heat storage was integrated. The second main renewable heat source is a biomass CHP plant based on an ORC fired with wood chips. In order to increase the efficiency and to reduce the specific costs of the solar system a compressor driven heat pump using CO_2 as refrigerant forms a part of the heat production system. The large-scale district heating system with a heat demand of 32,000 MWh/a will be supplied based on balanced ratio of solar and biomass energy. The new plant consists of a 15,000 m^2 solar system, a biomass CHP plant based on a thermal boiler and an ORC with 3.2 MW heat and 750 kW_{el} electric output, a 75,000 m^3 pit heat storage and a 1.5 MW_{th} heat pump with CO_2 as refrigerant. The biomass system will manage the differences between the overall heat demand and the solar production mainly from autumn to spring. The operation of the heat pump takes place mainly at the end of the winter season to optimise the solar efficiency and the solar yields. The aim of the measurement and monitoring phase is to derive improvements for the system design and to demonstrate the efficiency and the feasibility of the plant based on long-term monitoring results.

Scientific innovation and relevance
The main innovation of this project is the system integration and optimised interaction of the solar panels, the heat pump, the biomass CHP plant and the long-term pit heat storage. Especially the technical and functional reliability of the long-term heat storage is of big importance in order to avoid problems with the liners and the cover. Already in the design phase the measuring and data evaluation programme and the sensor placing plan were defined in order to achieve a high quality and efficient plant monitoring. The objective of the measurements is to get the knowledge of the dynamic and transient interaction of the subsystems (as input for system optimisation) and on the other hand to achieve mid and long-term energy balances. The following is and will be measured and monitored:

- Efficiency and energy balance of the solar collector field, of the biomass boiler and of the ORC
- Complete mass and energy balances and emissions from the biomass boiler plant within a dedicated one week test-run with accompanying measurements and analyses
- COP and energy balance of the heat pump
- Temperatures, stored energy, energy balance and heat loss rates of the storage system.

Furthermore all relevant economic parameter will be recorded during the monitoring phase in order to calculate the heat production costs of the individual components and of the entire system.

Expected results and conclusions
After start-up the plant has been operated in a test and demo mode for one year (since beginning of 2013) in order to obtain maximum information on the subsystems and the system as a whole in as many as possible operation modes. First results (within a 9 months evaluation period) have shown that the plant and the subsystems will meat the targets of the design parameters. Especially the solar production seems to exceed the original expectations. In the second year the plant will be operated as much as possible in a regular operation mode in order to receive representative energy balances. Especially the next winter period will demonstrate the efficiencies and the interaction of the biomass CHP plant with the other units. Based on the findings from the data evaluation, the operator, the consultants as well as all component suppliers carry out system, component and control strategy optimisations. The main optimisation focuses on the first year of operation. Based on the monitoring results of the SUNSTORE 4 plant and its individual components various feasibility studies for potential locations of the different regions of Eastern, Southern, Central, Northern and Western Europe are under way as relevant item of the dissemination activities of the project.

Theoretical analysis of the potential of hybrid biomass-solar CHP-plants in Austria

DI (FH) Roland Sterrer, MSc.
Technikum Wien GmbH
Giefinggasse 6
1210 Vienna, Austria
roland.sterrer@technikum-wien.at
www.technikum-wien.at/fh/institute/erneuerbare_energie

Co-authors: DI Olaf Schwandt; Mag.a Dr.in Susanne Schidler; Johannes Burgholzer, BSc.; DI Alfred Hammerschmid[1]

In this paper the results of the thermodynamic process simulation, the economic analysis and the climate impact assessment of an emerging hybrid combined heat and power (CHP)-technology comprising power production from biomass and concentrated solar power (CSP) are presented for two different sites in Austria. The study was conducted in course of the research project BIOconSOLAR, which was funded by the climate fund of the Austrian government. The assessment is based on the technical design and economical conditions of an existing biomass CHP-plant with nominal electrical power output of 1.5 MW, which is located in the city Salzburg. The solar thermal energy provided by a parabolic trough collector field is primary used for electric power production using the Organic-Rankine-Cycle (ORC)-technology in order to reduce biomass consumption, hence to reduce operation costs. The solar thermal energy is fed into the ORC-power cycle at a temperature level of 260°C. If the temperature level of the solar thermal energy is not sufficient for supply to the ORC-power cycle, the solar thermal energy is used to boost the thermal energy supply of the district heating. A transient simulation model of both the biomass CHP-plant and the parabolic trough field was created in IPSEpro. Based on the results of the thermodynamic process simulation the economic performance was assessed by conducting a dynamic investment calculation.

The analysis shows that the retrofit of biomass CHP-plants with a concentrating solar plant is a promising option to improve the economic performance of biomass CHP-plants with ORC-technology in Austria. Despite the uncertainty of the economic analysis, in particular of the costs of the concentrating solar thermal plant and the financial conditions, the operation in the city Salzburg is considered economically unfeasible. But an implementation in southern Austria e.g. Klagenfurt at higher direct normal irradiance (DNI) is realistic, on conditions that a combined funding including a feed-in-tariff for solar thermal electricity in the same order of magnitude as for photovoltaic and an investment funding of 30 % is guaranteed by law. Additionally, a life-cycle analysis (LCA) was conducted in order to assess the climate impact of the hybrid biomass-solar CHP-plant using the Global Emission Model for Integrated Systems (GEMIS). The assessment of the climate impact of the hybrid biomass-solar CHP-plant shows no deterioration in comparison to the existing biomass CHP-plant. Although a huge amount of energy intensive materials like concrete, steel and glass are used for the concentrating solar thermal field of about 10,000 m^2.

[1] BIOS Bioenergiesysteme GmbH, Inffeldgasse 21b, 8010 Graz, Austria

Markteintritt und Demonstration der gestuften Biomassevergasung

DI Dr. Helmut L. Timmerer
Cleanstgas GmbH
Industriestraße 12
A-8321 St. Margarethen/Raab, Austria
tim@cleanstgas.com
www.cleanstgas.com

Co-Authors: DI Gerald Rath, DI Andreas Ebner, DI Gerhard Salchinger, Ing. Erich Stelzhammer, Johannes Mastbroek, DI (FH) Christine Temnitzer, Ing. Wolfgang Torschitz

Purpose of the work
This paper presents the latest developments in demonstration and market introduction of Cleanstgas – biomass CHP plants, which are based on staged gasification for low and medium scale of power, i.e. 125–500 kW electric. Cleanstgas is short for clean staged gasification. Good results in low tar content (< 25 mg/m^3) and high efficiency (28 % electric) were shown in numerous prior publications, e.g. [1-5]. The focus of the present paper is to present 1) the novel demonstration plant, after the scale-up of the process to 250 kW electric, 2) experimental results of the 125 and 250 kW electric demonstration plants, and 3) latest experimental efforts with respect to gasification of ash-rich biofuels (lab-scale gasification plant 75 kW fuel).

Approach
R&D on the staged gasification technology was continued in strong cooperation with our mother companies 1) Ebner Industrial Furnaces Ltd., manufacturer of industrial furnaces for heat treatment, and 2) KWB - Kraft und Wärme aus Biomasse GmbH, a manufacturer for small-scale biomass boilers. Two pilot plants are currently under experimental investigation: 1) 150 kWel, start of operation in summer 2012 and 2) 250 kWel, brought into operation in February 2013. Two demonstration plants will commence operations by the end of 2013, respectively both are situated in Austria at costumers' site. Construction and scale-up were accompanied by further experimental R&D work on the 75 kW fuel laboratory test rig, where ash rich biofuels (short rotation crops, straw etc.) are being tested.

Scientific innovation and relevance
It is well known that staging the gasification process results in a low tar producer gas by primary measures to approx. 25 mg/m^3_n [1-5]. As problems of organic contamination can be regarded as solved, present work focuses on process optimization and on the long-time availability of the plant concept, where problems may derive from corrosion caused by inorganic pollutants as chlorine and sulphur, as known from biomass combustion. Organic (tars) and inorganic compounds (H_2S, NH_3, etc.) can be analysed online with gas chromatography by the house-own laboratory.

Results
In the past scale-up of former single fixed bed gasification plants had often proven to be a very troublesome issue. Staging the process makes things easier, since the reaction steps that have to be scaled up (i.e. drying, pyrolysis, partial oxidation, and reduction) are conducted in physically separated reactors. This paper presents plant design and the first experimental results from the scale up of the original 80 kWel plant [1] to the new modular design of the series for 150 and 250 kWel. The new modular plant configuration is low in required space (approx. 13.5 x 6.5 m) and reduces the amount of on-site fabrication and installation significantly. Additionally, first results for the use of different ash rich biofuels are shown. These are promising fuels for the coming years, due to their lower costs.

Conclusion
This paper presents latest efforts and lab results of the Cleanstgas staged gasification process -being an efficient CHP technology for the decentralized energy production, safe in operation and economically advantageous.

2 million operating hours experience with wood gas CHP units produced in series

DI Thomas Bleul
Spanner Re^2 GmbH
Niederfeldstr. 38
D-84088 Neufahrn i. Ndb.. Germany
info@holz-kraft.de
www.holz-kraft.de

Spanner Re^2 GmbH is a leading producer of small, decentralized CHP plants for solid biomass. Spanner HOLZ-KRAFT cogeneration plants produce heat and power at the same time from wood chips. They are the first successful serial product and have proven their value in many years of operation in a broad variety of applications with electrical power levels between 30 and 900 kW.

>200 plants in operation
>2 Million cumulated operating hours
>30.000 operating hours reached by first plants

Spanner wood cogeneration plants are used in local heating networks, hotels, forestry and agriculture. Their excellent energy efficiency, their use of regional renewable resources, and the attractive feed-in remuneration are the plant's main advantages. Spanner also offers complete and automatic system solutions including biomass conditioning.

Spanner Re^2 has long experience and expertise in the production of biomass heating systems and is audited systems supplier for leading European heating manufacturers and brands like Bosch/Buderus. Spanner Re^2 is a fast growing company with more than 100 employees and part of Spanner group.

About the Spanner Group
Founded in 1951, Otto Spanner GmbH is a metal working family business supplying partners in the automotive industry, e.g. BMW and Porsche. Over the past few years the Company has successfully expanded into growth markets like renewable energies and electronics. The Spanner group today consists of four individual companies employing a total of over 360 people.

Series production of Spanner wood gasifiers

Vergleichbarkeit von Feldmessdaten zur technischen Bewertung von Biomassevergasern – Erfahrungen aus dem Bundesmessprogramm

DI André Herrmann
DBFZ - Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Str. 116
04347 Leipzig, Deutschland
Andre.Herrmann@dbfz.de
www.dbfz.de

Co-Autoren: Dipl.-Wi.-Ing. (FH) Martin Zeymer [a)], DI (FH) Roman Schneider [b)], M. Sc. Patric Heidecke [c)], DI (FH) Florian Volz [d)], DI (FH) Franz Heigl [e)], DI Reinhold Egeler [e)]

Für die Charakterisierung und Optimierung von Biomassevergasungsanlage ist eine technische Bewertung zwingend notwendig. Die entscheidende Grundlage dafür bilden vergleichbare Stoff- und Energiebilanzen der Anlagen. Zur Aufstellung dieser ist die messtechnische Erfassung von Massenströmen, Gaszusammensetzungen und Energieströmen vor Ort an den realen Anlagen erforderlich. Die Messunsicherheiten und Vergleichbarkeit dieser Daten haben in Bezug auf die Genauigkeit der Bilanzierung und die Aussagfähigkeit der technischen Bewertung einen entscheidenden Einfluss.

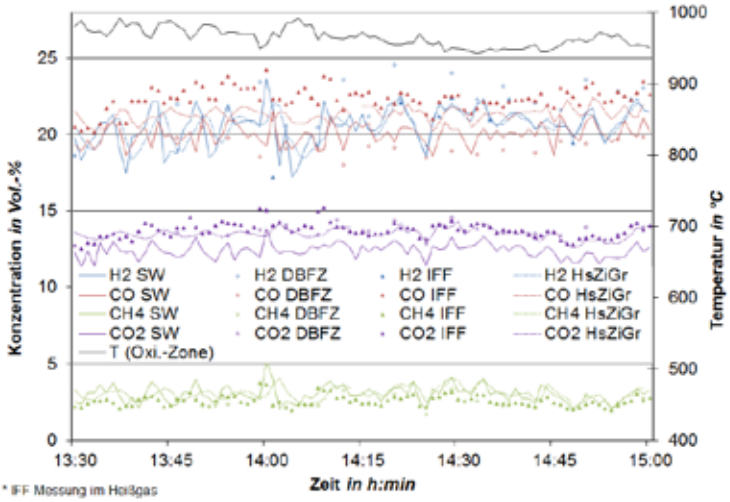


Abb. 1 Ergebnisse der verschiedenen Messgeräte im Vergleich

Im Rahmen des Bundesmessprogramm[1] wurde am Biomassevergaser der Stadtwerke Rosenheim ein Messworkshop zur Bestimmung der Vergleichbarkeit verschiedener Messverfahren durchgeführt. Dabei standen die Komponenten CO, H_2, CO_2 und CH_4 sowie Wasserdampf im Fokus. Bei der Analyse des Produktgases hinsichtlich der Teerbeladung spielte sowohl die absoluten Beladung in g/m^3_N als auch die Zusammensetzung der Teere eine wichtige Rolle. Bei der Analyse der Teerzusammensetzung wurden die Proben aufbereitet und zur Analyse an zwei externe Labore gegeben.

Bei der Permanentgasmessung zeigte sich, dass die Ergebnisse der eingesetzten Messverfahren vergleichbar sind. Bei deren Auswertung sind aber verschiedenen Aspekte wie z. B. die Messgastemperatur-/ feuchte, die Kalibrierung der Komponenten, Querempfindlichkeiten und Messzeiten zu beachten. Im Gegensatz dazu gibt es bei der Bestimmung der Teerbeladung und -zusammensetzung des Brenngases nur das Teerprotokoll als Standardverfahren. Dieses ist für die praktische Anwendung an kommerziellen Anlagen nur bedingt geeignet, weshalb es in der Praxis mehrere Verfahren gibt, die dem Teerprotokoll angelehnt oder Eigenentwicklungen sind. Es hat sich gezeigt, dass eine Vergleichbarkeit der Teermessergebnisse mit Hinblick auf Beladung und Zusammensetzung sehr schwierig ist. Dies betrifft Ergebnisse von unterschiedlichen Teermessverfahren und Teerprotokollmessungen untereinander. Die Fehlerquellen liegen bei der Probenahme und -aufbereitung sowie der Probenanalyse. Um vergleichbare Teermessergebnisse zur erhalten ist eine Harmonisierung der Teermessmethoden erforderlich.

[1] Weitergehende Informationen zum Projekt, den Partner sind dem Endbericht des DBFZ zu entnehmen. Online verfügbar unter http://edok01.tib.uni-hannover.de/edoks/e01fb13/741107678.pdf

[a)] Deutsches Biomasseforschungszentrum gemeinnützige GmbH (DBFZ), Torgauer Str. 116, 04347 Leipzig,
[b)] Hochschule Zittau/Görlitz, Fak. Maschinenwesen, Kraftwerks-/ Energietechnik (HsZiGr), Schwenninger Weg 1, 02763 Zittau
[c)] Fraunhofer-Institut für Fabrikbetrieb und -automatisierung (IFF), Sandtorstr. 22, 39106 Magdeburg,
[d)] Bayrisches Zentrum für angewandte Energietechnik (ZAE), Walter-Meißner-Str. 6, 85748 Garching
[e)] Stadtwerke Rosenheim (SW), Färberstraße 47, 83022 Rosenheim

Measuring the performance of biomass small-scale gasification plants by implementing mass and energy balances

Stergios Vakalis
Free University of Bozen-Bolzano, Faculty of Science and Technology
Piazza Università 5
39100 Bolzano, Italy
stergios.vakalis@natec.unibz.it
www.unibz.it/en/sciencetechnology

Co-Authors: Dario Prando, Francesco Patuzzi, Tanja Mimmo, Andrea Gasparella, Werner Tirler, Stefano Dal Savio, David Chiaramonti, Matteo Prussi and Marco Baratieri

GAST is the abbreviation 'Experiences in biomass GAsification in South-Tyrol: energy and environmental assessment'. The aim of the project is the environmental and energy assessment of biomass small gasification installations which have been recently developed in the region of South Tyrol (Italy). This is a unique opportunity in Italy to monitor biomass small gasification plants which operate in real conditions. The gasification plants may have various configurations and sets of processes and the feedstock characteristics show not negligible variability. Except from the type of the gasifier, other processes as syngas filtration or energy production units vary and this results to different potential output streams. The efficiency and the performance of the overall process are significantly dependent on the above factors.

The results and the analysis that are presented in this paper are derived from an experimental campaign that took place this year on a small scale plant located in the area of St. Leonhard in Passeier in South Tyrol. The measures onsite were performed in agreement with the corresponding technical standards and the new technical recommendation CTI 13 which was recently issued by the Italian Committee of Thermal engineering. The on-site measurements, in correlation with data provided onsite by the manufacturer and also with literature data have been used to assess the overall system performance. Mass and energy balances were implemented along with an exergy analysis. The main aim of the present work is to investigate the suitability of these methods and to figure out operational thermodynamic parameters of small-scale autothermal biomass gasifiers.

Keywords: Biomass gasification, cogeneration, efficiency, mass and energy balances, exergy analysis

Technisch-ökonomisch-ökologische Bewertung von kleintechnischen Biomassevergasern

Dipl.-Wi.-Ing. (FH) Martin Zeymer
DBFZ - Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Str. 116
04347 Leipzig, Deutschland
Martin.Zeymer@dbfz.de
www.dbfz.de

Co-Autoren: DI André Herrmann, DI Katja Oehmichen (DBFZ)

Vor dem Hintergrund einer umweltverträglichen Energiebereitstellung aus biogenen Festbrennstoffen wird die thermochemische Vergasung als sehr vielversprechend eingeschätzt. Die Verschaltung kleintechnischer Biomassevergaser mit effizienten Gasmotoren ermöglicht durch eine gekoppelte Strom- und Wärmeerzeugung eine hohe Ausnutzung der wertvollen Brennstoffe. Insbesondere gegenüber der im kleinen Leistungsbereich etablierten Verbrennung zur monovalenten Wärmeerzeugung besitzt die thermochemische Biomassevergasung durch die gleichzeitige Bereitstellung von Wärme und elektrischer Energie deutliche ökologische Vorzüge. Während der Projektlaufzeit des Bundesmessprogramms zur Weiterentwicklung der kleintechnischen Biomasseversagung[1] von 2009 bis 2012 konnte einen deutlicher Anstieg von Anzahl und Leistung der Inbetriebnahmen in Deutschland besonders in den Jahren 2011/ 2012 festgestellt werden.

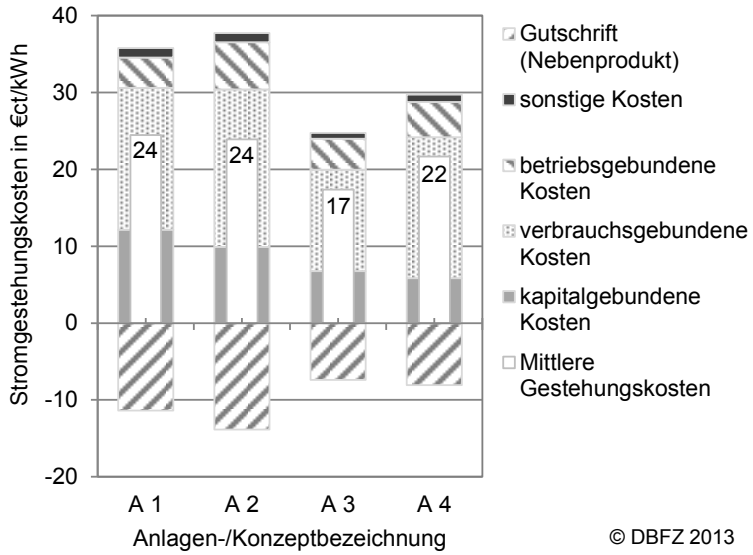


Abb. 1 Stromgestehungskosten (wärmegeführt, eigene Berechnung)

Damit wurde eine Phase der Stagnation beendet, in der sich Zubau und Stilllegung fast die Waage hielten. Zudem soll nach Angaben der Hersteller die Anzahl der sich in Betrieb befindenden Anlagen in 2013 weiterhin deutlich ansteigen. Die Entwicklung unterscheidet sich signifikant von der Situation in den Jahren 2005 bis 2007, in denen ebenfalls viele neue Anbieter in den Markt eintraten.

Dennoch bleiben Anlagen abhängig von einer ausreichenden Vergütung. In Abb. 1 sind zur groben Orientierung die Stromgestehungskosten von kleintechnischen Biomassevergasungsanlagen im wärmgeführten Betrieb dargestellt. Diese liegen damit über der derzeitigen EEG-Vergütung, wobei bei den Rohstoffpreisen durchaus hohes Kostensenkungspotenzial besteht. Sofern jedoch politische Einigkeit besteht, effiziente und ökologisch nachhaltige Technologien zu fördern, sollte der Marktdurchbruch aufgrund folgender Entwicklung gelingen:

- Der überwiegende Teil des Zubaus auf hocheffizienten Anlagen im Leistungsbereich < 250kW$_{el}$, der vor allem von zwei Anbietern mit einer Serienproduktion getragen wird.
- Aus technischer Sicht erscheint eine Vielzahl der Anlagen robust. Probleme mit ungenügender Gasqualität sind beim Einsatz geeigneter MSR beherrschbar und somit mehr als 7.000 Volllaststunden jährlich erreichbar. Im Leistungsbereich < 250 kW$_{el}$ erscheinen die absteigende Gleichstromvergasung und Systeme mit Vollwartungsvertrag marktfähig.
- Die Serienproduktion ermöglicht Anlagenkosten von 3.000 bis 3.500 €/kW$_{el}$ für Anlagen > 150 kW$_{el}$. Ein wirtschaftlicher Betrieb ist damit unter derzeitigen Rahmenbedingungen möglich. Kleinere Anlagen benötigen hingegen aufgrund höherer spezifischer Anlagenkosten, des geringeren el. Gesamtwirkungsgrades tendenziell günstigere Rohstoffpreise und eine höhere Wärmevergütung, um einen kostendeckenden Betrieb zu gewährleisten.
- Bei einer optimierten Anlagenauslegung und einem hohen Wärmenutzungsgrad können die THG-Vermeidungskosten mittelfristig unter 100 g$_{CO2Äq.}$/kWh$_{el}$ sinken.

[1] Weitergehende Informationen zum Projekt, den Partner sind dem Endbericht des DBFZ zu entnehmen. Online verfügbar unter http://edok01.tib.uni-hannover.de/edoks/e01fb13/741107678.pdf

Economics and potential of wood gasification CHP plants in the Austrian sawmill industry

DI Dr. Gerald Kalt
Austrian Energy Agency – Österreichische Energieagentur
Mariahilfer Straße 136
1150 Vienna, Austria
gerald.kalt@energyagency.at
www.energyagency.at

Motivation
As a by-product of sawnwood production, large amounts of wood chips, shavings, bark etc. accrue in the sawmill industry. In Austria, the total heating value of industrial wood residues is estimated 17 TWh/a (average of 2009–2012). These quantities are either used for energy generation or material uses in the paper, pulp or wood board industry. Currently, energy generation in company-owned combined heat and power plants (CHP plants) is practically limited to large-scale sawmills. However, due to recent technological and market developments in the field of small to medium-scale wood gasification CHP plants ("wood gas plants"), combined heat and power generation is also becoming a feasible option for comparatively small sawmills. Furthermore, relatively high feed-in tariffs were established for "highly-efficient" biomass plants with a rated power up to 500 kW_{el} in Austria in 2012.

Research questions
The core questions of this paper are: Can wood gas plants be considered an economic option for the Austrian sawmill industry? What crucial aspects and success factors need to be considered? To what extent can wood gas plants in the sawmill industry contribute to the establishment of a renewable-based electricity supply in Austria?

Results
The economics of wood gas plants have been analysed on the basis of five model cases: three downdraft gasification plants with power ratings of 50, 150 and 500 kW and two plants based on stationary fluidised bed gasification with 1.5 and 3 MW. Representative technology and cost data have been determined through comprehensive literature research and data provided by (primarily Austrian and German) suppliers of wood gas plants.[1]

Based on rather conservative assumptions regarding investment and operation costs, fuel costs (opportunity costs) of 20 Euro/MWh_{Hu}, heat revenues of 30 Euro/MWh_{therm} and under the assumption of 7.000 full load hours per year, the power generation costs of these model plants are in a range of 18 to 25 cent/kWh_{el}. This is considerably higher than electricity purchase costs of the industry and relevant feed-in tariffs in Austria, which range from 10.73 (3 MW-plant) to 14.93 cent/kWh_{el} (up to 500 kW_{el}), if industrial wood residues are used as fuel (tariffs as of 2013). Economic operation of wood gas plants may only be achieved under very favourable conditions or if additional investment subsidies are granted.

Still, due to relatively high electrical efficiencies (especially for small-scale plants), wood gasification CHP is usually considered to be a very promising technology. It is a key technology to open up currently untapped segments for CHP generation. The widespread use of wood gas plants in the Austrian sawmill industry (in small to medium-sized sawmills) may provide an additional 450 GWh_{el} of green electricity per year. About 10 % of the total fuel potential of industrial wood residues from Austrian sawmills would be required to achieve this annual generation.

Acknowledgements
This paper is based on the results of the project „Potentials and economics of renewable power generation in the Austrian sawmill industry with a special focus on small companies and wood gasification CHP plants", financed by the Association of the Austrian Wood Processing Industries.

[1] It needs to be stressed that no model case is entirely based on data provided by a certain supplier. Hence, the calculations may not be considered as profitability analyses for realised or actually offered plants.

09:00–10:30 Uhr

Parallelblock 5

Bioraffinerie

9:00–10:30 am

Parallel Session 5

Biorefineries

The possible role of biorefineries in a BioEconomy – activities of IEA Bioenergy Task 42 “Biorefining”

DI. Dr. Gerfried Jungmeier
Joanneum Research Forschungsgesellschaft mbH
Elisabethstraße 18
A-8010 Graz, Austria
gerfried.jungmeier@joanneum.at
www.joanneum.at

Co-Authors from IEA participating countries: René van Ree (NL), Ed de Jong (NL), Heinz Stichnothe (G), Isabella de Bari (I), Henning Jorgensen (Dk), Maria Wellisch (Ca), Kirk Torr (NZ), Kazunori Habu (J), Gil Garnier (AUS), Jim Spaeth (USA)

IEA Bioenergy Task 42 “Biorefining“ has formulated the following definition: “Biorefining is the sustainable processing of biomass into a spectrum of bio-based products (food, feed, chemicals, materials) and bioenergy (biofuels, power and/or heat)”. “Energy-driven” biorefineries and “product-driven” biorefineries are distinguished. A classification system for biorefinery was developed to describe each biorefinery by the following four features: 1) platform e.g. syngas, 2) feedstock, 3) products and 4) processes, e.g. “A 3-platform (lignin, C6&C5 sugar, electricity&heat,) biorefinery using wood chips for bioethanol”. Based on the activities of the 11 participating countries (A, AUS, CA, DK, FR, G, I, J, K, NL, US) the task identifies and assesses the current status and development potential of “energy-driven” biorefineries and “product-driven” biorefineries for a biobased economy. As a first step the 14 most interesting “energy driven” biorefinery concepts by 2025 and their value chains, including the integration and deployment options in existing industrial infrastructures, were analysed. These concepts produce the following road transportation biofuels: biodiesel, bioethanol, FT-biofuels, biomethane from upgraded biogas and synthetic natural gas (SNG) from the following feedstocks: oilseed crops, oil based residues, sugar and starch crops, wood chips, straw, grass, manure, saw mill residues, pulping liquor and algae. The state of technological development varies significantly between these concepts. Finally four commercial scale energy driven biorefineries, five demonstration scale energy driven biorefineries and five conceptual energy driven biorefineries (feasible by 2025) are identified.

An assessment based on a “full value chain approach”, covering raw material issues, conversion processes and final product applications in an integrated approach is done. The framework for this assessment of these biorefinery systems is described to evaluate and document the sustainability of these concepts by analysing economic, environmental and social aspects in comparison to conventional processes and products. As the development status and the perspectives for implementation and development of these energy driven biorefineries in a BioEconomy are different the IEA task developed a “Biorefinery Fact Sheet” for the uniform description of the key facts and figures of the different biorefinery concepts. Based on a technical description and the classification scheme the mass and energy balance is calculated for the most reasonable production capacity for each of the selected biorefineries. Then the three dimensions – economic, environmental and social - of sustainability are assessed for each biorefinery and documented in the compact form in the “Biorefinery Fact Sheet”. The “Biorefinery Fact Sheet” assists various stakeholders in finding their position on biorefining in a future biobased economy. The “Biorefinery Fact Sheets” are available for the 15 most interesting “energy driven biorefinery systems” identified by IEA Bioenergy Task 42.

The IEA Task 42 “Biorefining” deals with the analysis and distribution of strategic relevant information of value chains of biorefineries. Based on this information the implementation of a BioEconomy is supported with a focus on:

- Assessing the major market deployment aspects for integrated biorefineries
- Supporting the industry by setting their position in a future BioEconomy
- Analysing optimal sustainable biomass valorisation approaches for Food and Non-Food applications
- Preparing policy advice on needs for implementation

Further information: http://www.iea-bioenergy.task42-biorefineries.com/

Green Chemistry Belt: an integrative concept for the use of bio-based raw materials in the Danube region and their increasing importance for Europe's chemical industry

Thomas Schleker, PhD
BioCampus Straubing GmbH
Europaring 4
D-94315 Straubing, Germany
thomas.schleker@biocampus-straubing.de
www.biocampus-straubing.de

Co-Authors: Mag[a]. Claudia Kirchmair MSc., Prof. Dr. Raimund Brotsack, Dipl.-Oec. Andreas Löffert

The necessary shift from the use of fossil towards the use of renewable resources is a central challenge of the 21st century and will induce an increasing demand for biomass as feedstock in industrial production. In particular, the chemical industry with its sophisticated mass flows and process technology is dependent upon a secure and continuous supply of raw materials. Historically, this led to the establishment of the coal-based chemical industry near coal mines at the Rhine, followed by the development of the petroleum-based chemical industry along the Rhine. The petroleum-based chemical industry sites correlate the value of their products and follow the course of the Rhine: from the bulk and petrochemicals industry (e.g. Rotterdam), over the specialty chemicals industry (e.g. Leverkusen and Ludwigshafen) to the pharmaceuticals industry (e.g. Basel). With the change from petroleum-based to bio-based feed-stocks in the chemical industry choosing the right sites for industrial production and the fitting supply chains will become in the near future again a crucial factor for economic success within the chemical industry. However, additional novel factors must be considered when using bio-based instead of fossil feed-stocks: their lower energy density, regional and seasonal differences in quantity and material quality and harvesting from a big area with limited infrastructure.

The BioCampus Straubing GmbH is addressing these challenges with its Green Chemistry Belt-Project and is developing concepts for regional bio-economy production sites. Focusing upon the European bio-economy, the Danube macro region with its fertile alluvium areas and adjacent forest regions can supply as Green Chemistry Belt a huge amount of biomass to the European chemical industry. To use best possible these feedstocks, their potential value should be exploited in bio-refineries along the Danube in an economically, ecologically and socially sustainable way. Therefore, a multi-step approach with local picking, regional conversion and central refinement of bio-based feedstocks and including the transport of renewable raw materials and intermediate products by inland navigation will be necessary. The Green Chemistry Belt tries to meet these multifaceted requirements as an interdisciplinary and transnational cooperation network of many economic sectors and value chains. Its basic idea is to create synergies in the use of biomass by integrating innovative technologies, sustainable bio-refinery concepts and market strategies. Its mission is to permit its members to reach innovative leadership within the bio-economy value chain of the Danube region, while ensuring sufficient and secure supply of bio-based feedstocks for Europe's new "green chemicals" industry.

Importantly, also the existing chemical industry sites at the Rhine could be supplied with bio-based platform chemicals, intermediates and products by inland navigation via the Rhine-Main-Danube Canal. In this scenario the Green Chemistry Port in Straubing could be in future an important link between the huge amounts of biomass-producing Danube macro region and the feed-stocks-requiring chemical industry in the Rhine area.

Biomass gasification for production of CHP and valuable gases

Dr. Reinhard Rauch
Bioenergy 2020+ GmbH
Außenstelle Güssing
Wiener Str. 49
7540 Güssing, Austria
Reinhard.Rauch@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: K. Bosch, H. Hofbauer, S. Fail, N. Diaz, M. Motz, M. Hackel

Introduction
Biomass gasification is one method to produce heat and electricity with high efficiency and gives also the option to gain high valuable products like advanced biofuels or valuable gases from biomass. In Oberwart the second dual fluid steam gasifier was build and started operation in 2008. This CHP is similar to the first one in Güssing, but has several improvements, like an integrated biomass drying system, or an organic rankine cycle in addition to the gas engines for a higher electric efficiency.

Results on the biomass CHP Oberwart
After optimisation, the biomass CHP reaches now an excellent operation performance and availability. The gas engines have a maximum electric output of 1080kW and the typical daily average production is between 1070 and 1080kW. This shows that the whole gas production, gas treatment and also the control strategy works very well. The availability is now after optimisation (mainly flue gas heat exchangers and biomass feeding) above 90% and more than 7500 hours of integrated operation per year are reached.

Results on production of hydrogen for PEM fuel cells
In the polygeneration project the aim is to separate ultra clean hydrogen from the product gas and to use it in a PEM fuel cell. Here the aim is not to have only hydrogen as product, but to have the optimal combination of a biomass CHP based on gasification with the production of hydrogen.

In spring 2013 the whole chain including usage of the hydrogen in a PEM fuel cell was in operation. The whole chain consist of water gas shift, to convert CO to H_2 and CO_2, a membrane separation to increase the hydrogen content and finally a pressure swing adsorption (PSA) to purify the hydrogen to a level, that it can be used in a PEM fuel cell. The final hydrogen concentration is 99.95vol% and the only impurities are nitrogen and oxygen in ppm level. CO, CO_2 and hydrocarbons are removed by this gas treatment to below 1ppm level. At the moment the optimisation of the whole chain is going on, with the aim to simplify the process.

Results on sulphur resistant catalysis
In the simple SNG project the aim is to have a simple system, to convert biomass into SNG. Therefore the main focus of the project is to find poisoning resistant catalysts, which are able to survive the harsh conditions of the raw product gas after the filter.

Different catalysts were investigated till now, but no optimal catalyst was found. So the focus of the project was modified, to broaden the R&D. Now the focus is not only on SNG production, but also on conversion of tars and sulphur components at medium temperature of 300–500°C. As catalyst actually a water gas shift is used and this works very well. In the first experiments a tar conversion of more than 50% was achieved and this gives an optimistic outlook for this process.

Conclusion
The biomass CHP Oberwart is now in excellent operation with a very good availability. More than 7000 full load operating hours per year are achieved, which is excellent for a gasification based CHP. In addition very promising results of ongoing R&D projects are available, where hydrogen in a PEM fuel cell quality was produced and also a new medium temperature tar conversion is investigated. All this work was done by cooperation of the industrial partners Energie Burgenland, Binder, cts and Air Liquide and the scientific partners Vienna, University of Technology and Bioenergy 2020+. The funding of the R&D projects by the COMET programme and the Austrian Climate and Energy fund is highly appreciated.

KACELLE: Ökonomische und ökologische Bewertung einer lignozellulosebasierten Ethanolanlage mit Inbicon-Technologie

Konstantin Zech
Deutsches Biomasseforschungszentrum gGmbH
Torgauer Straße 116
04347 Leipzig, Germany
konstantin.zech@dbfz.de
dbfz.de

Co-Autoren: Andrè Brosowski, Kathleen Meisel, Franziska Müller-Langer,.Lars Villadsgaard Toft (DONG Energy, Denmark)

Ziel des KACELLE-Projekts (Kalundborg CELLulosic Ethanol plant) ist es, die patentierte Inbicon-Technologie zur Erzeugung von Bioethanol aus lignozellulosehaltiger Biomasse in einen industriellen Maßstab zu überführen und damit zur Marktreife zu bringen. Innerhalb des Arbeitspaketes 13 des KACELLE-Projekts, wird eine Ethanolanlage mit der Inbicon-Technologie, die in der Demonstrationsanlage im dänischen Kalundborg installiert ist, hinsichtlich ökonomischer und ökologischer Faktoren analysiert und bewertet. Dies geschieht unter Zuhilfenahme verschiedener Szenarien, um einen Rahmen zu finden, in dem die Inbicon-Technologie mit dem geringsten ökonomischen Risiko und den niedrigsten Treibhausgasmissionen etabliert werden kann. Die Parameter, die innerhalb der Szenarien variiert werden, umfassen das genutzte Rohmaterial (Getreidestroh, Maisstroh, Miscanthus), den Ort innerhalb Europas (West, Ost, Süd), die Verwendung der Pentosen (Viehfutter, Bioethanol, Biogas), die Bereitstellung der Prozessenergie (Steinkohle, Erdgas, Lignin) sowie die Lage der Enzymproduktion (zentral, dezentral). Zusätzlich werden ein ökonomisches und ein ökologisches Präferenzszenario untersucht. Aus den Ergebnissen wird ein paretooptimales Szenario abgeleitet, das ökonomische und ökologische Zielsetzungen vereint.

Innerhalb der ökologischen Bewertung werden für die verschiedenen Szenarien Lebenszyklusanalysen durchgeführt. Die Durchführung erfolgt nach der in der europäischen Richtlinie 2009/28/EG definierten Berechnungsmethodik. Das heißt, dass ausschließlich die durch die Ethanolproduktion verursachten Treibhausgasemissionen betrachtet werden.

Innerhalb der Wirtschaftlichkeitsbetrachtung werden die Gestehungskosten des Ethanols anhand der VDI-Richtlinie 6025 ermittelt. Dies umfasst Kapital-, Verbrauchs-, Betriebs- und sonsitge Kosten, sowie Erlöse aus den erzeugten Nebenprodukten (Viehfutter, Biogas, Ligninpellets). Weiterhin werden Sensitivitätsanalysen durchgeführt und die Treibhausgasminderungskosten ermittelt.

Die nötigen Daten stammen von den Projektpartnern, insbesondere Inbicon und DSM, sowie aus Marktbeobachtungen und DBFZ-eigenen Modellen zur Analyse von Bereitstellungsketten von Biomasse.

11:00–12:30 Uhr

Parallelblock 6

Biotreibstoffe

11:00–12:30 am

Parallel Session 6

Biofuels

First commercial-scale production of pyrolysis oil for substitution of natural gas in an industrial boiler

Gerhard Muggen
Managing Director BTG Bioliquids BV
PO Box 835, 7500 AV
Josink Esweg 34, 7545 PN
Enschede, The Netherlands
gerhard.muggen@btg-btl.com
www.btg-btl.com

Pyrolysis is the thermochemical decomposition of biomass through rapid heating in absence of oxygen. Our technology applies this process on an industrial scale to convert lignocellulosic (non-food) biomass into a dark-brown liquid best known as pyrolysis oil. After briefly introducing our technology our presentation will explain the Empyro project. In the Empyro project biomass will be converted into pyrolysis oil at a rate of 5 tons/hour and transported via tank truck to a nearby industrial consumer. This project has reached financial close in November 2013, with the help of the province of Overijssel (EFO), the Dutch government (TKI) and the EU (FP7). The rest of the presentation will answer questions on the production, properties and present and future applications of pyrolysis oil.

Application of the pyrolysis oil produced at Empyro
Empyro's customer is one of the largest dairy producers in the world with an annual turnover of several billion euros and making their production more efficient and more sustainable is a core part of their strategy towards 2020. For their new to be constructed production site in the Netherlands they have decided to substitute a considerable part of their natural gas consumption with pyrolysis oil. This enables them to reduce their CO_2 emissions at this site by 10 % while using a boiler that is only slightly modified with respect to their natural gas boilers.

After the conversion of the solid biomass into the liquid pyrolysis oil it is first stored briefly in a storage tank at the Empyro site. A local transport company with experience in liquid bulk transportation then transports the oil to a storage tank on the dairy production site. There the pyrolysis oil is combusted in the boiler to produce steam for the production of milk powder. A significant part of the challenge in using biomass to substitute fossil fuels in industrial applications lies in availability. Because pyrolysis oil is stored in liquid form on site it can instantly meet the power demand of this industrial process.

Current and future commercial applications for pyrolysis oil
There are several possible applications for pyrolysis oil, including Heat and Power, Chemicals, Automotive fuels and Bio Refinery Applications. At the moment these are in varying stages of development, with only Heat & Power having been demonstrated at a commercial scale. The long-term vision is to focus more on the biorefinery concept where pyrolysis oil is (one of the) biobased raw materials for green chemicals (phenols, acid) and transport fuels.

Transport fuels can be derived from pyrolysis oil by direct upgrading, co-refining in existing oil refineries or through synthesis gas and subsequent synthesis processes such as Methanol, Fischer-Tropsch diesel and DME. However, several years of supplementary research are required before transport fuels can be derived from pyrolysis oil on a commercial scale. Currently these technologies are in the research and small pilot stage.

Direct upgrading of pyrolysis oil is subject on several (European) projects. Research in these projects has demonstrated on laboratory scale that up to 20 % of upgraded pyrolysis oil can be co-refined in a standard refinery.

A biorefinery based on pyrolysis oil is designed much like a traditional refinery. First biomass is converted into pyrolysis oil which can be a de-central process. Second**,** pyrolysis oil from different installations is collected at the biorefinery where it will be divided into different fractions. Each fraction can be upgraded with a different technology to finally derive the optimal combination of high value and low value products from the pyrolysis oil.

BioBoost: Biomass based energy intermediates boosting bio-fuel production

Andreas Niebel and BioBoost-Consortium
Karlsruhe Institute of Technology (KIT)
– Institute of Catalysis Research and Technology (IKFT) -
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen, Germany
andreas.niebel@kit.edu
www.ikft.kit.edu

Abstract
In order to increase the share of biomass for renewable energy in Europe conversion pathways that are economic, flexible in feedstock and energy efficient, are needed.

The BioBoost project (http://www.bioboost.eu) concentrates on dry and wet residual biomass and wastes as feedstock for de-central conversion by fast pyrolysis, catalytic pyrolysis and hydrothermal carbonization to the intermediate energy carriers oil, coal or slurry. Based on straw, the energy density increases from 2 to 20-31 GJ/m³, enabling central GW scale gasification plants for bio-fuel production. The catalytic pyrolysis reduces oxygenates in the oil, enabling power and refinery applications. The fast pyrolysis and HTC processes of demo-size are optimized for feedstock flexibility, yield, quality and further up-scaling is studied. A logistic model for feedstock supply and connection of de-central with central conversion is set up and validated allowing the determination of costs, the number and location of de-central and central sites. Techno/economic and environmental assessment of the value chain supports the optimization of products and processes. Application of energy carriers is investigated in existing and coming applications of heat and power production, synthetic fuels & chemicals and as bio-crude for refineries. Promising pathways are demonstrated over the whole chain. A market implementation scheme of ramping up energy carrier production and subsequent phase in of large-scale gasification is developed regarding optimal technical and economic performance.

Results along the complete production chain obtained to date will be presented. Substantial progress has been made towards an energy carrier concept enabling to exploit the feedstock potential of European regions into the production of fuels, chemicals and power.

Standort- und Kapazitätsplanung von strohbasierten BtL-Anlagen in Österreich

DI Tobias Moser
Institut für Agrar- und Forstökonomie, Boku Wien
Feistmantelstraße 4
1180 Wien, Österreich
tobias.moser@boku.ac.at
www.boku.ac.at

Co-Autoren: Dr. Martin Kapfer, DI Stefan Kirchweger, Univ.-Prof. Dr. Jochen Kantelhardt

Die zunehmende Nutzung landwirtschaftlicher Flächen zur Erzeugung von Bioenergie muss im Hinblick auf den weltweit steigende Nachfrage nach Nahrungsmitteln kritisch hinterfragt werden. Um dieser „Tank oder Teller“ Problematik zu begegnen werden neue Verarbeitungskonzepte, wie etwa „Biomass to Liqid (BtL)“ – eine Verwertung von organischen Reststoffen zur Biotreibstoff – diskutiert. Ziel des, am Institut für Agrar- und Forstökonomie (BOKU Wien), entwickelten Optimierungsmodells ist die Ermittlung der optimalen bzw. kostengünstigsten Verteilung der BtL-Anlagen in Österreich. Basierend auf der zur Verfügung stehenden Menge an Stroh werden innerhalb der Modellrechnungen die Standorte, Anlagengröße und Verarbeitungskapazität möglicher BtL-Anlagen bestimmt. Dabei erfolgt die Ermittlung der kostenminimalen Struktur der BtL-Produktion in Österreich unter Berücksichtigung der Möglichkeit von räumlich und zeitlich getrennten Verarbeitungsprozessen (Pyrolyse und Synthese). Die Bedeutung der Opportunitätskosten der Strohbereitstellung wird mit Hilfe der zwei Szenarien „ohne alternative Verwertungsmöglichkeit für Stroh“ und „mit alternativer Verwertungsmöglichkeit für Stroh“ untersucht.

Die Ergebnisse zeigen in beiden Angebotsszenarien einen absoluten Kostenvorteil des dezentralen Verarbeitungskonzeptes. Die Verarbeitung des Ausgangsrohstoffs Stroh erfolgt in dezentralen Pyrolyseanlagen, die vorwiegend in den Ackerbaugebieten realisiert werden. In Szenarien „ohne- und mit Konkurrenz“ werden 19 bzw. 12 Pyrolyseanlagen mit einer durchschnittlichen Gesamtverarbeitung von 91.930 bzw. 86.667 t Stroh FM ausgewiesen. Der zweite Verarbeitungsschritt, die Synthese, erfolgt in beiden Szenarien an einem zentralen Standort in Korneuburg (vgl. Abbildung 1 und 2).

Abbildung 1: Verarbeitungsstandorte und regionales Rohstoffpotenzial für das Szenario "ohne Konkurrenz“

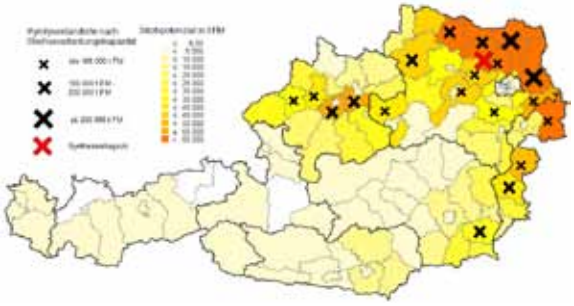
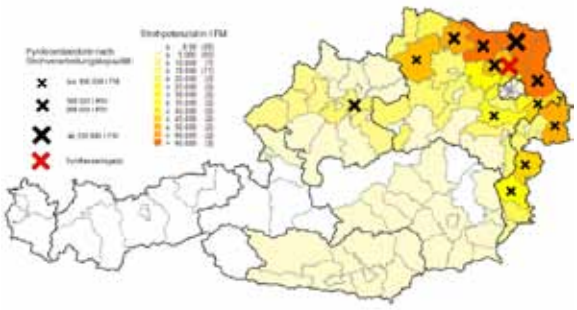


Abbildung 2: Verarbeitungsstandorte und regionales Rohstoffpotenzial für das Szenario „mit Konkurrenz“



Die fehlende Vorteilhaftigkeit einer Konzentration der Pyrolyse- und Syntheseanlagen an einen gemeinsamen Standort wird auch die zusätzlich durchgeführte Sensitivitätsanalyse bestätigt.

Die Ergebnisse unserer Arbeit zeigen also, dass dezentrale Verarbeitungskonzepte bei der Verarbeitung wenig transportwürdiger Rohstoffe wie Stroh die effizientere Lösung sind. Gemessen an einer Treibstoffausbeute von 5,3 kg/l ergeben sich in den Szenarien „mit“ und „ohne“ alternativer Verwertungsmöglichkeit für Stroh Gesamtverarbeitungskosten von 1,02 € bzw. 0,97 € je Liter BtL-Diesel.

Novel insights into the stability of petrodiesel and biodiesel fuels

Stephanie Flitsch
University of Graz
Heinrichstraße 28
8010 Graz, Austria
stephanie.flitsch@uni-graz.at
www.uni-graz.at/nawaro

Co-Authors: Philipp Neu[a], Sigurd Schober[a], Jörg Ullmann[b], Martin Mittelbach[a]
[a]University of Graz, Heinrichstraße 28, 8010 Graz, Austria
[b]Robert Bosch GmbH, Postfach 300220 70442 Stuttgart, Germany

Diesel fuels can either be derived from fossil raw materials or from renewable resources such as fats and oils. The former is referred to as petrodiesel, the latter as biodiesel. They are the predominant fuels in most types of transportation, including shipping and road transportation. Petrodiesel/biodiesel-blends with a biodiesel content of up to seven percent (B7) are used as standard diesel fuel in Europe. A continuous increase in diesel fuel demands and increased blending with biodiesel and other renewable fuels such as biomass-to-liquid (BtL) and hydrotreated vegetable oils (HVO) as well as further progress in engine development require ongoing research on fuel quality and stability. Due to increasing biodiesel blending proportions, fuel aging still can be a problem and is a subject of interest. The influence of petrodiesel as well as of biodiesel on the specific aging processes is investigated.

Diesel engines are widely used in, among others, passenger cars and transportation and agricultural vehicles. Modern diesel engines use a common rail direct fuel injection system in which all fuel injectors are supplied by one common fuel rail. Pressures of more than 2,000 bars and elevated temperatures of about 110–130 °C in the rail can lead to stressing of the fuel. The fuel is injected into the combustion chamber; a smaller portion is transferred back to the tank. Since the pressures in fuel injection systems further increase with ongoing engine development, it is important for fuels to remain stable under these increasingly harsh conditions.

Biodiesel quality parameters such as oxidation stability, acid value or iodine value are defined by European standards. Oxidation stability of a fuel is determined by its induction period (IP), the amount of time the fuel needs under accelerated aging conditions to use up its aging reserve. The addition of antioxidants increases the oxidation stability. After a fuel reaches its IP, the actual fuel aging begins and fuel properties start to change rapidly.

The aim of our research is to develop a deeper understanding of diesel fuel aging processes. In this context we present for the first time detailed investigations of these aging processes. Petrodiesel, biodiesel, B7 and an HVO were aged under elevated temperatures using a Rancimat device as well as a PetroOXY apparatus. Identification of hydroperoxides as primary oxidation products and fatty acids, aldehydes, and epoxides, among others, as secondary aging products will be presented. These compounds can have various effects on the properties of the fuel and may result in damage to fuel carrying or engine parts. Formation of the aging products was monitored during time-resolved measurements via gas chromatography-mass spectrometry and ion exchange chromatography. Additionally, the formation of oligomers was monitored using size exclusion chromatography. It will be shown that the formation of aging products is directly connected to the measured IP. After the IP of the examined fuel is reached, a strong increase in the formation of aging products can be observed.

09:00–10:30 Uhr

Parallelblock 7

Brennstofflogistik und Brennstoffaufbereitung

9:00–10:30 am

Parallel Session 7

Fuel logistics and processing

How will climate change impact on primary forest fuel supply in Austria?

Priv.- Doz. DI Dr. Peter Rauch
Institut für Produktionswirtschaft und Logistik
Universität für Bodenkultur Wien
Feistmantelstraße 4
A 1180 Wien, Österreich
peter.rauch@boku.ac.at
www.wiso.boku.ac.at/pwl_ma.html

Climate change effects will increasingly have an impact on forest ecosystems in the future and research on methods including uncertainty in forest-planning models is of increasing relevance. Primary forest fuel (PFF) supply is connected with several specific risks, which are seldom considered explicitly in PFF procurement planning. Storms and bark beetle infestations are the most significant causes of forest damage in Central Europe, and have a massive impact on security of wood supply. Additionally, in Austria security of wood supply is threatened by recent trends like restrictions on import, new raw material competitors (Wood Plastic Composites and Biomass to Liquid), or rising roundwood demand in yet exporting neighbour countries.

In order to assess risks and their mid and long-term impacts on wood supply a System Dynamics model of the Austrian wood supply was developed that includes a stochastic simulation (Monte Carlo simulation) of the main risk agents for Austrian forests, namely storms and bark beetle infestations. The model examines future annual cut of Austrian forestry and evaluates next to other wood assortments PFF supply security under different scenario assumptions. Therefore, simulation results provide insights on probabilistic future wood supply security for sawlogs, pulpwood and energy wood. The climate change scenario assumes an increase in natural disturbances due to climate change impacts leading to a higher amount of salvage wood. Nevertheless, a contra-intuitive effect was observed. Even though salvaged wood volumes were clearly increasing, supply situation worsens for all roundwood assortments and supply security decreased, since wood harvest was markedly reduced after damaged forest sites had been harvested.

Technische Hackguttrocknung – ein Verlustgeschäft?

Alois Kraußler
FH Joanneum Gesellschaft mbH
Werk-VI-Straße 46
A-8605 Kapfenberg, Österreich
alois.kraussler@fh-joanneum.at

Damit Hackgut lagerfähig wird, Gesundheitsauswirkungen durch Schimmelbildung vermieden werden und der Abbau des Materials signifikant reduziert wird (vorherrschend bei Natürlicher Trocknung), ist eine Hackguttrocknung erforderlich, wobei die Technische Hackguttrocknung als sinnvolle Alternative zur Natürlichen Trocknung gilt. Die Technische Hackguttrocknung ist nicht nur eine energetisch und ökologisch sinnvolle Möglichkeit zur Etablierung einer Alternative zu Holzpellets insbesondere für den kleineren Leistungsbereich (kleinere Feuerungsanlagen benötigen ein trockneres Material), sondern könnte auch eine Effizienzsteigerung von mittleren/größeren Biomasseanlagen (z. B. durch Abwärmenutzung) ermöglichen. Anhand einer Technischen Hackguttrocknung kann mit geringerem Primärenergieeinsatz die gleiche Wärme- bzw. Strommenge für dezentrale und zentrale Versorgungsanlagen bereitgestellt werden. Das Potenzial wird auch von heimischen Biomasseakteuren wahrgenommen, weshalb Optimierungsempfehlungen für den Betrieb und das Anlagendesign von Technischer Hackguttrocknung erarbeitet werden sollen.

Methodische Vorgangsweise
(1) Durchführung und Analyse von umfassenden Trocknungsserien im Labormassstab und an einem Biomasseheizwerk; (2) Breiter Diskurs mit Heizwerkbetreibern und Anlagenhersteller; (3) Simulation verschiedener Szenarien und Erstellung von Benchmarks; (4) Ableiten von Empfehlungen und Erkenntnissen der Technischen Hackguttrocknung; (5)Anwendungsgerechte Ergebnisaufbereitung für Heizwerkbetreiber und Anlagenhersteller;

Ergebnisse und Schlussfolgerungen
Die Technische Trocknung von Hackgut hat in den letzten Jahren stark an Bedeutung gewonnen, da dieses Verfahren durch auslaufende Ökostromabnahmeverträge, strengere Bestimmungen für die Ökostromproduktion, wachsende Hackgutabnahmemärkte (insbesondere für Haushalte), verfügbare Abwärmequellen des Niedrigtemperaturbereiches und steigende Alternativbrennstoffpreise (insbesondere von Holzpellets) mit hohem Markt- und Gewinnpotenzial für die heimische Energiewirtschaft zunehmend sinnvoll wird. Die steigende Zahl an Anlagenherstellern und Betreibern/Lieferanten („Biomassehöfe“, Heizwerke, abwärmeproduzierende Gewerbebetriebe) untermauern dies. Die Trocknung ermöglicht einen höherwertigen Brennstoff, der eine höhere Energiedichte aufweist (bessere Transporteigenschaften und kleinerer Vorratsraum), keine gesundheitlichen Auswirkungen aufweist (z. B. durch Schimmelbildung), lagerfähig ist, kein Selbstentzündungsrisiko in sich birgt und für die Verbrennung in Klein- bzw. Haushaltsanlagen geeignet ist. Diese Voraussetzungen stellen eine sinnvolle Pelletsalternative auch für Haushalte dar. Die Technische Hackguttrocknung ist ein wesentlicher Enabler für ein nachhaltiges Energiesystem. Ein optimaler Betrieb kann durch ein Online-Anlagenmonitoring in Kombination mit einer Parameterregelung unterstützt werden. Es wurde festgestellt, dass bei Erreichen eines charakteristischen Wassergehaltes des Schüttguts eine repräsentative Messung notwendig ist. Die Herausforderung der Messung im Schüttgut besteht jedoch durch das offene System und der Notwendigkeit eines Online-Monitorings. Gas- und holzbetriebene Biomasse-Anlagen haben eine unterschiedliche Lastcharakteristik, wobei sich die Möglichkeit einer sinnvollen Kombination dieser Technologien für die Trocknung ergibt. Das bestehende Temperaturniveau bei Biogasanlagen könnte für die Hackguttrocknung optimal verwertet werden, wodurch aufgrund der notwendigen Hackgutmanipulation empfohlen wird, eine Biogasanlage in Kombination mit einer Hackgutfeuerungsanlage zu betreiben. Die Effizienz des Gesamtsystems würde wesentlich steigen. Nur wenn ein effizienter Trocknungsbetrieb gewährleistet werden kann, kann eine Technische Hackguttrocknung gewinnbringend durchgeführt werden und neue Anwendungsfelder adressieren: Etablierung einer tatsächlichen Pelletsalternative, Effizienzsteigerung und Erschließung von neuen Einsatzbereichen am Heizwerk (z. B. Trocknung bei Wärmeüberschuss und Verwertung bei Wärmebedarf). Viele Trocknungsanlagen werden aktuell unwirtschaftlich und mit geringem ökologischem Nutzen betrieben. Auch wenn die Trocknungswärme (kosten)günstig zur Verfügung steht (z. B. durch Abwärme), ist ein ökologisch und wirtschaftlich sinnvoller Betrieb für das geläufige Verfahren der Rosttrocknungen nur bei OPTIMALEN Bedingungen (geringer Luftmassenstrom, hoher Isolationsgrad, optimierte Strömungsführung, mittleres Niedrigtemperaturniveau, mäßige Schüttungshöhe, geringe Hackgutmanipulation uvm.) möglich, da ein hoher Hilfsenergie- bzw. Stromeinsatz insbesondere für das Gebläse notwendig ist. Ein Qualitätsmanagementsystem sollte daher eingeführt werden.

Dieses Projekt wurde aus Mitteln des Klima- und Energiefonds gefördert und im Rahmen des Programms „NEUE ENERGIEN 2020“ durchgeführt.

Alternative biomass fuels

Andreas Kunter
Komptech GmbH
Kühau 37
A-8130 Frohnleiten, Austria
a.kunter@komptech.com
www.komptech.com

The market for renewable fuel sources is growing across Europe. Fuel producers now compete with the paper industry for supplies of trunk wood, the conventional starting material. The use of woody green cuttings to produce alternative biomass fuels can help improve the situation. This raw material must be processed in order to create standardized fuels that meet the requirements of specific systems. Numerous companies in Austria and Germany are already successfully engaged in the manufacture of defined biofuels. Many of them are composters who have expanded into biofuel production.

The manufacturing process
Upon delivery, the material is divided into batches with higher wood content for fuel production, and batches with higher fines and water content. Shredding is normally done with low-speed shredders, as these produce fewer additional fines than high-speed machines. Fresh green cuttings with high amounts of water and leaves or needles are briefly composted to reduce the water content and make the material more readily screenable. A 3-fraction screener can then separate the fines and overlengths from the usable fraction, in this case the medium grain, in one pass. Experience has shown that a lower screen cut of 15–25 mm and upper screen cut of 80–100 mm give good results. The fines are composted. No deleterious effect on composting has been observed. The woody overlengths are shredded and likewise used as fuel. The ratio of fuel to compost depends on the quality of the raw material and the amount of processing required. In most cases fuel yield is 30 to 40 percent. To reduce the ash content and improve the quality of the fuel, stones can be removed in a stone separator with a separation rate of up to 90 percent.

Classification of products to existing standards
An analysis was done of biofuels from woody green cuttings and rootstocks, processed by the means described above using composting and biomass facilities. Table 6 of the currently valid standard EN 14961 “Solid biofuels, fuel specifications and classes,” which specifies the properties of coarse shredded wood, allowed classification of all samples in classes P63 to P200. In all cases the largest amount (at least 75 percent by mass) went to classes P45 and P63, but in most cases the maximum diameter and particle length of the coarse fraction was responsible for “bumping up” the samples. The ISO 17725-1 standard “Solid biofuels, fuel specifications and classes” currently in preparation, likewise allows classification of the samples. In addition, it allows classification of samples processed by fast shredders in an initial step. In general it can be said that this standard describes the character of the samples better, since its criteria for the main fraction, coarse fraction and maximum particle length are adapted to real-world use. The position paper “Thermal use of tree and shrub cuttings” by ARGE Kompost & Biogas calls for an ash content not exceeding 10 percent and a content of fines under 8 mm likewise not exceeding 10 percent. The analysis showed that these quality criteria represent a challenge for processors. However, this quality level can be achieved given the proper choice raw materials and processing steps.

Biomass markets – the „eBay“ for regional energy resources

Josef Walch
University of Applied Sciences Wiener Neustadt für Wirtschaft und Technik GmbH – Campus Wieselburg
Zeiselgraben 4
A-3250 Wieselburg, Austria
josef.walch@amu.at
www.amu.at

Co-Authors: Dominik Haider, Rainer Watzinger

Introduction
This paper firstly investigates the current status and customer requirements of online-biomass sales platforms in Austria and secondly undertakes an assessment of the usability of those sales platforms. The initial position is the assumption that the usability significantly determines the success of online biomass sales platforms.

Scientific Methods
To determine the current status and customer needs 103 people were interviewed with an online questionnaire. All people who buy solid woody biomass or people who are at least involved in the buying process belong to the target group. For the evaluation of the usability of the online biomass exchanges a heuristic method, developed by Nielsen and Molich was used. The heuristic is based on nine criteria and the assessment was conducted by four experts.

Results
From the customer point of view 17 websites were identified as online-biomass exchanges (open question). The evaluation shows that only six platform's out of 17 provide use permit for different sellers. All other platforms are services offered by individual companies or organizations selling only their own fuels. The information sources used in fuel procurement are mainly offline: local fuel dealers, friends, and farmers. For 37 percent of the investigated platforms poses the internet as a source of information in fuel procurement - though only eight out of 103 have bought biomass fuel online. The main benefit of an online biofuel exchange stated is the better comparability of fuel properties. Since biofuels differ in many physical parameters the advantage of comparability has the potential to become beneficial for online-biofuel exchanges. The usability assessment identified potential for improvement by providing feedback and error prevention. While “eBay”, “WILLHABEN” and “amazon” – the more developed, well known platforms – fulfil this criterion, smaller platforms, dealing with biofuel still have a lack of knowledge and experience in this field. Further, experts found that five of the seven platforms provide simple and natural dialogs and speak the user's language.

Conclusion
Online biomass sales platforms have the potential to become a relevant market in biofuel trade. Smaller online-biofuel exchanges need to improve their usability and should focus on providing easily understandable information on biofuels physical properties to make them competitive.

11:00–12:30 Uhr

Parallelblock 8

Biowärme: Simulation und Effizienzoptimierung

11:00 am–12:30 pm

Parallel Session 8

Biomass heat: Simulation and efficiency optimization

Transient CFD simulation of wood log stoves with heat storage devices

Mag. Dr. Claudia Benesch
BIOS Bioenergiesysteme GmbH
Inffeldgasse 21b
8010 Graz, Austria
benesch@bios-bioenergy.at
www.bios-bioenergy.at

Co-Author: Martina Blank[(1)], Robert Scharler[(1,2,4)], Manuel Kössl[(3)], Ingwald Obernberger [(1,2,4)]

[(1)]BIOS Bioenergiesysteme GmbH, Inffeldgasse 21 b, A-8010 Graz, Austria
[(2)]Bioenergy 2020+ GmbH, Inffeldgasse 21b, A-8010 Graz, Austria
[(3)]RIKA Innovative Ofentechnik GmbH, Müllerviertel 20, A-4563 Micheldorf, Austria
[(4)]Institute for Process and Particle Engineering, Graz University of Technology, Inffeldgasse 21 b, A - 8010 Graz, Austria

Wood log fired stoves are not only an attractive eye-catcher creating a warm and comfortable atmosphere in the living room, they constitute also increasingly effective heating systems due to new innovative concepts including heat storage devices. These devices accumulate a certain fraction of the heat released in a special storage medium for a certain period of time (e.g. over night) and release it after opening discharge channels. Typical heat storage concepts either store sensible heat (via their heat capacity) or both sensible and latent heat (via a phase change). In this publication only heat storage devices of the first kind will be regarded. For this application, BIOS has developed an innovative CFD model for wood log fired stoves operated in batch mode consisting of an empirical model for wood log combustion and CFD models for the turbulent reactive flow and heat transfer in the stove.

The combustion of wood logs in small-scale stoves is a highly transient and complex process, as a wood log stove is operated in batch mode with one batch consisting of a starting, a main combustion and a burnout phase. The transient character of the operation of wood log stoves becomes even more important, when a heat storage system is included. In this case, steady-state conditions do not apply, as the operation of a heat storage device is divided into 3 phases: heat-up, heat storage (without charging) and heat discharge. Therefore, for the CFD-based characterisation of wood log stoves with heat storage devices, a transient simulation is necessary.

To this end, BIOS has developed a new methodology, which runs in several steps: As a first step, the wood log stove with integrated heat storage device is simulated with the developed basic model. This allows to asses the performance of the stove and a characterisation of the maximally charged state of the heat storage device. In the next step, a transient simulation of the system of stove and heat-storage device is performed. Thus, the energy distribution in the stove as well as the storage-device can be investigated during the whole 24-hour cycle of operation (heat-up, heat storage, discharge). In order to save computational time, a transient simulation of the heat storage device alone is performed simultaneously to serve as a basis for a case study to optimise the geometry of the storage device and the storage material. The boundary conditions used for this calculation are obtained from the stationary simulation of the complete system (mass fluxes and temperatures at the entrance of the heat storage device). In this way, it is possible to optimise the system of the stove and the heat storage device, while keeping computational time reasonable. This procedure was successfully applied to a study for a wood log fired stove with an integrated heat storage device of the company RIKA Innovative Ofentechnik GmbH.

With this innovative methodology it was possible to derive and discuss the heating rate of the storage material during heat-up, the energy release during storage and the thermal power during the discharge phase. The influence of the air-flow in the discharging channels and the flue gas flow in the charging channels as well as material properties on the charging/discharging processes have been identified. Furthermore, a considerable increase in the energy efficiency of the stove on integration of a heat storage device could be found. Besides, the CFD simulations provide information concerning the performance of the wood log stove (air supply, mixing of flue gas and air in the combustion chamber, quality of CO burnout). Concluding, the results showed that the stove including the heat storage device geometry is optimised more effectively by this new and innovative CFD method for the transient simulation of stoves than by trial-and-error test runs. It constitutes a powerful tool for the support of the development of new stove concepts and the evaluation and optimisation of heat storage devices.

Thermal simulation of a pellet boiler and a heat storage tank for future control strategies

Rosemarie Schnetzinger BSc MSc
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
rosemarie.schnetzinger@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: Ivana Musumarra BSc MSc, DI Babette Hebenstreit, DI Mag. Dr. Klaus Lichtenegger, DI Dr. Markus Schwarz, DI Dr. Ernst Höftberger

The efficiency of heating systems in buildings is generally dependent on the performance of the heat generator, like a small-scale biomass boiler, and the corresponding distribution system. For good system efficiencies not only the use of highly efficient parts but also their intelligent assembly should be ensured. This study is focussed on heating systems with small-scale biomass pellet boilers and water storage tanks.

Simulation models of a biomass pellet boiler and a storage tank have been developed. The two models have been created in the MATLAB/Simulink© environment and fulfil two main aims. First, they enable real time simulation due to fast calculation. Second, the models are detailed enough to depict the thermal behaviour of a biomass pellet boiler and a water storage tank.

Both dynamic simulation models are based on thermodynamic relationships and balance equations for mass and energy. Concerning the pellet boiler model also empirical parameters have been included to fit the model to the real boiler behaviour. Due to the widespread structure of the boiler model, it enables to calculate different pellet boilers with only one model. The validation with measurement data from different boilers confirmed its wide range of applicability.

Regarding the storage tank model, it is a one-dimensional multi-node model. Each node represents a cylinder having the same temperature level. Depending on the water mass flow, three different modes are distinguished: charging, discharging and storing.

A measured 24-hours-load-cycle of a pellet boiler with a nominal power of 25 kW and a 1,500 litres-water storage tank was simulated. The comparison of measurement and simulation data shows good accordance with only small deviations. Through further simulations of measured load cycles the empirical parameters will be adapted to minimize differences to reality.

In future these models could supplement and shorten elaborate and expensive long-term measurements for efficiency estimations of whole heating systems. Moreover, these simulation models will be used for the development of control strategies for good interaction of the heating system to enhance operation efficiency.

Identification and evaluation of optimization measures to increase the annual utilization rate of residential biomass heating systems

DI Klaus Supancic[1,], Prof. Univ.-Doz. DI Dr. Ingwald Obernberger[1,2], DI Martin Rammer[2], DI Christian Schraube[3]*
[1] BIOS Bioenergiesysteme GmbH, Inffeldgasse 21b, A-8010 Graz, Austria, www.bios-bioenergy.at
**Corresponding author: e-mail supancic@bios-bioenergy.at*
[2] Institute of Process and Particle Engineering – Graz University of Technology, Inffeldgasse 13/III, A-8010 Graz, Austria
[3] European Institute for Energy Research EDF-KIT (EIFER), Emmy-Noether-Straße 11, 76227 Karlsruhe, Germany

Purpose of the work
Modern small-scale biomass boilers (<100 kW) usually show efficiencies in nominal-/partial load above 90 %. In comparison, the annual utilization rates (heat production per year divided by fuel energy consumption per year) of these boilers only reach between 70 to 80 %. The purpose of this work was to identify the reasons for the low annual utilization rates of small-scale biomass boilers and to define possible optimization measures.

Approach
The investigation of the weak point analysis followed a two-step approach. In a first step the monitoring data of four residential biomass heating systems during a two-year monitoring phase, were analyzed, evaluated and compared to each other. In a second step the annual operation of these plants was simulated with TRNSYS. Despite the fact that the annual utilization rate determines the fuel consumption of a heating system in field operation, knowledge regarding the impact factors on the annual utilization rate is scarce. In the research project presented TRNSYS simulation software was used to identify and evaluate relevant impact factors on the annual utilization rate of residential biomass-fired heating systems by applying a comprehensive sensitivity analysis. This way, the impact of each individual parameter could be investigated and evaluated separately. By comparison with measured data over the whole heating season an evaluation and validation of this method was possible.

Results and conclusions
The results of the data analysis showed that the annual boiler utilization rates are in the range between 73 to 84.5 %, which is significantly lower compared to the boiler efficiencies typical for this type of boilers (approx. 92 %). The complete system efficiency of the different plants is, under consideration of the electricity consumption, only in the range from 58 to 72 %. These values show that current residential heating systems feature considerable weak points and significant improvements of the annual utilization rate are necessary.

After verification of the TRNSYS simulation model developed using the monitoring data available, the individual impact factors on the annual boiler utilization rate as well as on the annual utilization rate of the overall plant were identified and evaluated. The relevant impact factors can be classified into control related factors (boiler- and plant control), boiler specific factors (flue gas outlet temperature, excess O_2-content in the flue gas, heat losses to the environment) as well as design relevant factors (dimensions of boiler, buffer storage and solar plant, insulation).

These results form a relevant basis for a targeted optimization of the annual utilization rate of small-scale biomass boilers in the future. The optimization potential is considerable and an increase of the annual utilization rate of up to 16 % absolute seems possible (without consideration of the additional potential given by flue gas condensation).

Investigation of user behavior and operating conditions of residential wood combustion (RWC) appliances and their impact on emissions and efficiency

DI (FH) Gabriel Reichert
Bioenergy 2020+ GmbH
Inffeldgasse 21b
A-8010 Graz, Austria
Gabriel.Reichert@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: DI (FH) Dr. Christoph Schmidl, DI Dr. Walter Haslinger, DI Dr. Wilhelm Moser, DI (FH) Stefan Aigenbauer, Marius Wöhler M.Sc., Ing. Mag. (FH) Franz Figl

Background & Objectives
Residential wood combustion (RWC) appliances have been identified as major source of air pollution in Europe [1,2]. As the thresholds for ambient levels of harmful particulate matter (PM10 and PM2.5) are exceeded in many regions, the public authorities are forced to implement effective emission reduction measures. But it seems that especially in real life operation RWC appliances are far away from test stand results regarding emissions and efficiency. Prohibition as the most effective measure, however, is clearly in conflict with Europe's renewable energy targets. Therefore it is essential to understand the reasons for high emissions of RWC appliances in real life operation to be able to improve the situation. Beside technological reasons (e.g. long lifetime of old technologies which are not state-of-the-art) it is claimed that important reasons for high emission and low efficiency in compare to standard type testing results are the user behavior as well as specific operating conditions in real life operation. Therefore the study aimed at the following objectives:

- Investigation of user behavior of RWC appliances by a survey
- Assessment of operation conditions of RWC appliances in real life operation
- Investigation of impact of user behavior and operating conditions respecting emissions and efficiency

Approach
In order to investigate user behavior of RWC appliances a survey based on a questionnaire was performed. Furthermore field measurements were done to get basic information of real life operating conditions and to assess their impacts on emissions and efficiency.

Results
The results of the survey show that RWC appliances are predominantly operated with hardwood. For lighting RWC appliances commonly small firewood pieces are used that are placed on shavings at the bottom of combustion chamber. The shavings at the bottom or bottom third of combustion chamber are ignited with paper. Analysis of real life operation by long-term field measurements showed clear differences regarding frequency as well as duration of operation of RWC appliances. Whereas some appliances are used only occasionally other appliances were operated more than 7 hours per day. The field measurements illustrate that operating conditions differ significantly from operating conditions during standard type testing. For example draught levels up to 32 Pa were measured during real life operation. The results of the field measurements also indicate high gaseous as well as particulate emissions and low efficiencies. Further the field tests confirmed that results of standard type tests for RWC appliances are hardly realizable in real life operation even when the appliance is operated according to manufacturers manual.

Conclusion
RWC appliances still have a significant improvement potential in particular in field operation. The findings of the study confirmed the assumption of significant influence of operating conditions as well as of responsibility of user behavior respecting emissions and efficiency in real life operation. Therefore it will be necessary to develop new test methods for RWC appliances which – once implemented as standard – should be capable of leading to further technological innovation and improvement and finally to a satisfaction of future market and legal requirements.

Acknowledgements
The study was part of the project "stove testing 2020" funded by the Austrian Climate and Energy Fund in the frame of the "New Energy Projects" of the Austrian Research Promotion Agency (FFG project 834 639).

[1] Kappos et al.: Health effects of particles in ambient air. Int. J. Hyg. Environ. Health 207(4):399–407, 2004
[2] Directive on Ambient Air Quality and Cleaner Air For Europe. (http://ec.europa.eu/environment/archives/cafe/general/keydocs.htm) EU CAFÉ Program; 2005.

09:00–12:30 Uhr

Parallelblock 9

WBA Workshop:
Weltweite Märkte für Biomasse

9:00 am–12:30 pm

Parallel Session 9

WBA Workshop:
Global markets for biomass

The dynamics of global pellet markets – growth prospects, sustainability and price scenarios

Silvio Mergner
Senior Consultant
Pöyry Management Consulting
Lutzstraße 2
80687 Munich, Germany
silvio.mergner@poyry.com
www.poyry.com

Hannes Lechner, John Nowak, Elisabeth Huesing, Dan Rocca, Rickard Frithiof, Heikki Heiskanen

Introduction
Wood pellet market figures indicate growth rates of above 14 % CAGR. Now, the first signs indicate that domestic production in some countries may not be able to satisfy future demand. Stronger trade may result. Key questions:

- How will demand for wood pellets develop?
- Will suppliers be able to source enough raw material?
- Do sustainability aspects pose a serious threat to bioenergy projects?
- Can technology innovations such as torrefaction further boost the sector?

How will demand for wood pellets develop?
In 2012, more than 20 Mt of pellets were being consumed worldwide, while less than a handful players exceed a total production capacity of 1 million metric tonnes per year (Mtpa) each. The industry is rather fragmented and demand is largest in Europe, representing more than 70 % of total global consumption today. Demand is projected to grow strongly in Europe, Japan and South Korea – making the market almost triple by 2025 (54 Mtpa in Pöyry central scenario).

Pöyry projects total imports of wood pellets to Europe to exceed 19 Mtpa by 2025. Main drivers are the UK and Denmark. Developments in the Asia Pacific market are less certain due to pending policy decisions. Pöyry expects pellet trade to Japan and South Korea to increase from marginal volumes today to up to 8–18 Mtpa by 2025.

Will suppliers be able to source enough raw material?
Key supply regions for the Atlantic Basin market are the US Southeast, Canada and Russia. All these regions hold a substantial, sustainable supply potential of suitable biomass. Going forward the US is expected to be the dominant supplier of wood pellets globally. The key reasons supporting this are a good resource base, competitive wood costs and infrastructure, and an efficient forest industry.

Do sustainability aspects pose a serious threat to bioenergy projects?
At the time of writing no binding sustainability requirements for solid biomass exist in the EU and some utilities have developed their own solutions in order to demonstrate sustainable business cases. Policy considers the sustainability risk for biomass coming from forests to be manageable.

The three main phases in biomass supply chains that affect levels of greenhouse gas emissions are (1) biomass production, (2) processing and logistics and (3) combustion. In the absence of binding EU sustainability criteria for solid biomass, the UK has decided to limit the emissions of co-firing, conversion and dedicated biomass plants to 285 $kgCO_2e/MWh$. Thresholds leave headroom for supply chains of pellets.

Can technology innovations such as torrefaction boost the sector?
Black pellets have advantages compared to white pellets: transport efficiency, higher heating value, better grindability, higher bulk energy density and higher water resistance. Higher rates of co-firing may lead to capex savings downstream. Black pellets are not currently being produced commercially, but there is interest from market participants to develop this technological path.

Current biofuel market and technology trends in the Russian Federation

Tatiana Pantsyrnaya
"New Engineering Technologies" Center
Moscow State University of Mechanical Engineering
Bolshaya Semenovskaya str., 38
Moscow, 107023, Russian Federation
tatiana.v.p@hotmail.com
www.mami.ru/index.php?id=1598

Co-authors: Boris Reutov, Raif Vasilov

One of the main goals of Russian Technology Platform "Bioenergy" (TP "Bioenergy") is providing the diversification of Russian economy through the implementation of new high-tech products and innovative bioenergy technologies with high export potential. The aim of the communication is to present current achievements of TP "Bioenergy" in the field of biofuel, with particular attention paid to its current market and technology trends in the Russian Federation.

The communication contains information on the main technological activities of the TP "Bioenergy" related with the generation of heat and electric energy from biomass, obtaining biofuel and its components, utilization of organic wastes as a source of energy, bioenergy mechanical engineering, etc. In particular, Russian market of biofuel is discussed. The first step of its development was based on the production of solid biofuel (fuel pellets, briquettes, etc.) due to the presence of a considerable part of world forests in Russia and of efficient technologies of wood processing and conversion of wood biomass into fuel. This production is mainly export-oriented and tends to the rapid development. Another priority direction of Russian bioenergy sector is the development and the implementation of biomass gasification technologies based on the processing of wood, agricultural and solid housing wastes into biogas.

It is pointed out that as cellulose-containing biomass, energy crops and wastes have the highest resource potential in Russia, agriculture may become an important element of the development of Russian bioenergy market by the creation of new production chains for bioenergy raw materials. The communication also contains recent operating results of TP "Bioenergy" and data on its strategic research program.

Opportunities and challenges of Japan's bioenergy market

Hisashi Kajiyama
Economic Research Center, Fujitsu Research Institute
Kajiyama.his-01@jp.fujitsu.com, kajiyama93@ybb.ne.jp
http://jp.fujitsu.com/group/fri/

Japan's biomass potential
Japan's biomass potential is nearly infinite. Its volume of timber is more than 6 billion cubic meters, with annual growth reaching 200 million. However, just less than 20 million cubic meters of timber are felled each year, resulting in an annual increase of more than 100 million cubic meters. The reason for this gap between timber accumulation and timber production is that until now Japan's forests were too young to be used. However, its vast tracts of woodland have finally reached an age where Japan can begin producing timber and using biomass in earnest. Furthermore, interest in renewable energies is on the rise due to the lasting effects of the Fukushima nuclear disaster and the introduction of feed-in tariffs (FIT) in 2012.

Lack of knowhow, technology and engineering
Biomass energy use is still a new field, however, and Japan is severely lacking in knowhow and technology. Biomass-using facilities are all trying to do things in their own way without adhering to the basic logics and principles of biomass. Consequently, mismatches arise between boiler technology and heat demand or available biomass fuels. Japan has few manufacturers of biomass boilers, and those few do not have very advanced technologies. Most boilers installed in Japan are of European manufacture. The problem, however, is the cost of installation: construction of boiler-related facilities is at least 5 times greater in Japan than in Europe.

Following the introduction of FIT in 2012, more than 100 biomass power generators were put into the planning stages in Japan. The majority were facilities with output of more than 5 MW_{el} with no CHP. Further, all of them used chips produced from round wood and required moisture content below a certain level, some even as low as 25 %. Japan's boiler technology was undeniably immature. Japan's problem is that it does not have engineers capable of designing power plants. Most engineering firms in Japan are plant manufacturers' in-house product design and construction divisions, whose aim is their company's own products. Such firms are fundamentally different from Europe's independent and neutral engineering firms, who create a design for the customer and oversee construction.

Future efforts
In 2012, we used part of the Forest Agency's budget to perform a survey of Japan and Europe's biomass plants and summarized the problems from which Japan suffers. We then invited an expert from Switzerland to inspect Japan's boilers and give us advice, whereupon we created a handbook which systematically lays out the basic principles of biomass usage. In November 2013, with the goal of spreading biomass throughout Japan in earnest, we organized a symposium entitled "Japanese German Biomass Day", in cooperation with governments and research institutes from both countries.

In December 2013, we invited an expert from Seeger Engineering, a German engineering company, to inspect potential sites for a biomass plant and create a concept design for us. With his help, we hope to build a model plant, first taking a heat-based approach before moving on to building a CHP plant in 3–5 years' time.

Entering the Japan biomass market
Japan's biomass market is a potential goldmine for European companies. We need European knowhow and technology for a reasonable price. However, because small and medium-size companies have difficulty entering the Japanese market on their own, they will need a trustworthy and honourable partner. Japanese companies will also no doubt benefit from the technology and expertise of their European counterparts. Much deliberation and effort will be needed to successfully match business partners in the field of biomass between Japan and Europe.

Australia, New Zealand and Korea: market development in small-scale bioenergy technologies

Andrew Lang
World Bioenergy Association
141 Skipton Rd
Lismore, Victoria, Australia
andrewlang001@yahoo.com.au
www.worldbioenergy.org

Australia and New Zealand each annually generate very significant amounts of sustainably and economically-available biomass that could be utilised for industrial and domestic heating, and for production of second generation transport biofuels. The development of the bioenergy sector in each country is proceeding on very different lines.

New Zealand's main direction is in conversion of coal and gas heating of institutions, homes and sports facilities to heating with chips or pellets from timber industry residues. Australia has mainly developed cogeneration at larger scale using agricultural biomass residues including sugar cane bagasse and timber industry residues. Landfill gas, blackliquor and sewage gas to electricity make up a significant balance of bioenergy in Australia.

In both countries the developments to date make up only a tiny fraction of the potential. For Australia the potential is estimated to be over 20 % of current electricity demand, and a significant fraction – up to 30 % - of both heat and transport fuels demand. For New Zealand it is about 30 % of transport fuels, a minor amount of electricity but as much as 50 % of domestic and industrial process heat.

The obstacles to achieving the bioenergy potential of these two countries lies principally within their governments' existing policies. In both cases the overhaul of these has to be driven by more well-informed bureaucrats and politicians with a better understanding of the economics of bioenergy, and the benefits that are demonstrated to flow to rural and regional economies.

This presentation looks at current bioenergy technologies in use in both Australasian countries, and at the current industry and commercial development in a situation of little government support or subsidy. It also considers the most obvious undeveloped opportunities for applying mature bioenergy technologies. These examples may be relevant to other countries at a similar point of development of their bioenergy sectors.

Korea imports over 95 % of its energy requirement and until recently utilised only a tiny fraction of the very large amounts of available biowastes and biomass. Until 2009 its rate of rise of GHG emissions was the highest of all OECD countries at over 4.5 % per year since 1990. It has now commenced to intensively work at all levels and on all options to increase use of renewables toward providing 20 % of all energy by 2050. While for bioenergy technologies this is mostly at large-scale, R&D is also directed at developing smaller-scale systems for utilising combustible and putrescible biomass.

Korean application of small-scale bioenergy technologies includes the area of domestic use of pellets for space heating. Under a program driven by government subsidy and incentives installation of pellet-fuelled furnaces-particularly in households in rural and mountain regions-has been between 3,000–4,000 units per year since 2009. About 85 % of first-grade pellets are currently produced domestically by 20 different suppliers. South Korea's domestic pellet production is estimated to have the potential to increase to as much as 1 million tonnes a year by 2020. While Korea is 65 % forested much of this is not accessible. Pellet production is mainly from residues from sawmilling, and from thinnings arising from forestry management.

Markets for small and micro-scale bioenergy in Canada

Douglas Bradley
Climate Change Solutions
402 Third Avenue
Ottawa, Canada
douglas.bradley@rogers.com
www.climatechangesolutions.net

The presentation will show that Canada is blessed with an enormous amount of biomass, but Canada also has considerable oil and gas resources, and a natural gas pipeline provides low-cost gas for heating across the country, making bioenergy economics difficult. In regions where the only alternate fuel is expensive oil, such as Quebec and the Atlantic provinces, bioenergy is being implemented rapidly.

The presentation will show that the Canadian Bioenergy Association has lead several trade missions to Sweden, Finland, Denmark, Austria and Italy to bring bioenergy know-how back to Canada. It will show how a combination of supportive policies, local champions, and newly acquired know-how have resulted in biomass heating systems increasing from 3 in 2003 to over 70 by 2012, primarily in British Columbia, Quebec and the North West Territories.

While many of the installations are in small communities, we also have a 5 MW plant installed in the middle of Quebec, a major city. Special FIT rates in Ontario have led to a large number of on-farm combined heat and power installations, and also a demonstration plant that proved pyrolysis oil can be economically be put into a turbine to make power for the grid. Lastly the presentation will look at bioheat and biopower opportunities for remote and near remote communities in Canada's north.

Distributed CHP production with biomass

John G. Bernander, CEO
Viking Heat Engines AS
Østre Strandgate 40
NO-4661 Kristiansand, Norway
jgb@vdg.no
www.vdg.no

Biomass currently represents the source of renewable energy that contributes the most to meet the world's total energy demand. At the same time cogeneration using biomass is one of the best means of converting a renewable energy source into heat and power. Higher fuel consumption efficiencies are gained from both utilizing heat in district heating systems and producing electricity.

To reach the climate targets of 2020 the European Union has to increase the use of renewable energy. Thermal energy (heat) has a bigger potential than any other renewable energy source to reach these goals. Heat engines can be used to convert thermal energy into electricity and thereby play a critical role in increasing the efficiency of energy production and usage.

Viking Heat Engines AS has in cooperation with AVL Schrick, the world's largest privately owned motor design company, developed CraftEngine, a patented heat engine that is able to produce electricity and heat based on renewable, low-temperature heat sources. The CraftEngine can utilize any heat source such as solar thermal, waste heat, geothermal, waste combustion or biomass combustion and does this in a more cost effective way than existing Combined Heat and Power (CHP) technologies.

In partnership with Austrian boiler manufacturer ETA Heiztechnik the CraftEngine is being tested and optimized for CHP applications utilizing biomass as heat source. The CraftEngine can be installed in any type of building, ranging from common households and farms to heating centrals, hotels and office buildings in order to cover the various electricity and heating requirements.

14:00–16:00 Uhr

Parallelblock 10

Energiepflanzen

2:00–4:00 pm

Parallel Session 10

Energy plants

KUP: Hohe Erwartungen kontra Praxiserfahrungen

Johann Reicht, Obmann
Bioenergie Hitzendorf Reg.Gen.mbH
A-8151 Hitzendorf Nr. 284, Österreich
bioenergiehitzendorf@aon.at

Die Bioenergie Hitzendorf Reg.Gen.mbH. ist eine, 2004 gegründete, aus 43 Mitgliedern bestehende bäuerliche Genossenschaft. Zur Zeit werden zwei Heizzentralen (Ein Ortsnetz und eine Objektversorgung) mit einer Kesselleistung von 1.200 KW betrieben. Jährlich werden über 3.500 MWh Wärme erzeugt und mehr als 3.000 MWh an die Kunden geliefert. Für den Betrieb der Anlagen werden jährlich ca. 5.000 Schüttraummeter Hackgut benötigt. Diese Menge wird von den Mitgliedern in Form von Waldhackgut angeliefert. Ein kleiner Anteil davon stammt auch aus Kurzumtrieb (KUP).

Bereits 2007 wurde eine ein Hektar große Versuchsfläche mit Weide angelegt, die sich sehr gut entwickelt hat. Im Nachhinein stellt es sich heraus, dass die ausgewählten Fläche (mittelschwerer Boden, ausreichende Nährstoffversorgung) ein optimaler Standort für die gewählte schwedische Weide „Tordis“ war. Schon im Herbst 2009 wurde mittels Claas Jaguar geerntet. Die Erntemenge lag mit mehr als 13 Atrotonnen pro Jahr und Hektar in den hochgesteckten Erwartungen. (Erntevideo auf youtube.com - Suchbegriff: Weidenernte Hitzendorf) Der zweite Umtrieb hat mit knapp 20 Atrotonnen/a/ha die Erwartungen ebenfalls voll erfüllt.

2008/09 starteten in der Steiermark dank E-Steiermark und Landwirtschaftskammer Steiermark weitere KUP-Projekte mit dem Ziel die Brennstoffversorgung für Heizwerke auf eine breitere Basis zu stellen. In den folgenden Jahren wurden mehr als 100 Hektar neu angepflanzt. Dabei lag der Schwerpunkt bei der Pflanzenauswahl bei Pappel im Kurzumtrieb und die hohen Erwartungen haben etliche Landwirte motiviert KUP im größeren Stil anzubauen. Die gemachten Erfahrungen mit Pappel im Kurzumtrieb sind in der Steiermark ernüchternd. Blattrost und Rindenbrand führte zu Ausfällen und auch die Zuwachsmengen lagen auf vielen Flächen unter den Erwartungen. Zu wenig wurde in den Anfangsjahren auch auf die Bodenbeschaffenheit und entsprechenden Untersuchungen gelegt.

Die eigentliche Ernüchterung gab es dann im vergangenen Jahr bei der Ernte des zweiten Umtriebes bei Pappel. Nach drei Jahren Erträge von etwa 6 bis 8 Atrotonnen/a/ha haben die Erwartungen in keiner Weise erfüllt und nicht einmal die Anlage- und Betreuungskosten gebracht. Diese Negativbilanz führte im Endeffekt dazu dass im Winter 2012/13 in der Steiermark etwa 25 Hektar Pappelkulturen nach nur zwei Umtrieben gerodet und in die konventionelle Landwirtschaft zurückgeführt wurden. Aufgrund dieser Erfahrungen sieht man die Chancen für Pappel derzeit eher im mittleren Umtrieb (6–8 Jahre) auf geeigneten Böden bzw. Standorten.

In der Steiermark findet mittlerweile ein Umdenken in Richtung Weide statt. Auf geeigneten Böden konnten bei Weide im zweiten Umtrieb bereits mehr als 20 Atrotonnen/a/h geerntet werden. Diese Menge macht die Weide in der Wirtschaftlichkeit sehr attraktiv. Weide kann mit bestehender Erntetechnik problemlos, mit dem Nachteil des sehr feuchten Hackgutes, geerntet werden. Allerdings nur im Kurzumtrieb alle 2–3 Jahre und auf geeigneten (fast) ebenen Flächen.

Mittlerweile gibt es schon gute Ansätze für eine Erntelinie mit dem Ziel trockenes Hackgut zu erzeugen. Ein erster Prototyp einer „Rutenerntemaschine“ die auch auf steileren Flächen einsetzbar ist, hat im letzten Jahr erfolgreich geerntet und wurde weiterentwickelt. Mit der natürlichen Trocknung über den Sommer kann dann im Herbst trockenes Weidenqualitätshackgut erzeugt werden welches in der Praxis auch schon bei uns derzeit schon sehr erfolgversprechend eingesetzt wird. Mit dieser Entwicklung scheint der Anbau von KUP in der Steiermark mit ihren eher kleinräumigen Strukturen und möglichst direkter Nutzung auf einen erfolgversprechenden Weg zu sein.

The economics of SRC in agroforestry systems and small sliver surfaces in urban areas

Dr. Christian Schmidt
GeoS Consulting and Assistance &
Nordwestdeutsche Forstliche Versuchsanstalt
Prof.-Oelkers Str. 6
D-34346 Hann. Münden, Germany
christian.schmidt@nw-fva.de
www.nw-fva.de, www.geoschmidt.info.se

The aim of designing agricultural landscapes is to find a compromise between society's acceptance of ecologic and economic functions. The goal of increasing economic productivity, often conflicts with ecologic goals and vice versa.

Designing landscape elements increase the ecologic function of agricultural land, but results also in increased opportunity cost with a lower revenue for the farmer because agricultural production areas are divided into smaller field-partitions with declining yields of annual crops, less production area and higher production costs in monetary unit per hectare.

Another possibility is to produce renewable energy with short rotation coppice in agroforestry-systems and free areas in urban areas, where the customers' market might be nearby. One problem is the field-size in or nearby urban and metropolitan areas. In this publication, are analyzed ways for producing wooden chips on small sliver surfaces in urban areas and on fields with agroforestry-systems in rural areas.

In agroforestry-systems, the wind-speed on the lee-side of a wooden row is decreasing over a distance which depends on the highness and density of the wooden rows. In the area with a decreased wind-speed is an accumulation of moisture due to increased precipitation, dew and less evaporation found, which leads to an increased growth of the annual crops between the wooden rows.

To analyze and to compare the total value of agroforestry-systems with that of short-rotation tree plantations and field crops is developed the AgforS-model, with which are calculated the ground-rents of agroforestry systems and small sliver surfaces in urban areas. Additional costs due to rest journeys at all operations on the fields and transfers of machines can be denied by planting agroforestry-systems in the shelter-belts-system, one wooden-row in the west of the field and one in the north.

In an urban region, a short rotation coppice might be also rentable in the case of a big distance between farm and field or when the farmer has just small sliver surfaces in the urban area nearby a plant as a customer which leads to smaller transportation costs.

Possible to plant short rotation coppice are also at post-industrial areas which might be heavily polluted and which are not anymore used by companies. Often they are held by companies which do not want to leave the location for maybe future business in the metropolitan area. In urban regions, post-industrial quarters are usually situated beside the centers and living-quarters at which could be used the produced energy of a plant, which could be the customer of the short rotation coppice-farmer.

Pre-treatment of wet biomass for fuel production – the florafuel process

Dr. Swantje Mignon Schlederer
Faculty for Civil Engineering and Surveying
Institute of Water Management,
Professorship Domestic Water Management and Waste Technology
Werner-Heisenberg-Weg 39
D-85577 Neubiberg, Germany
swantje.schlederer@gmx.de
www.unibw.de/bauv6/swa

florafuel AG, a medium-sized company located in Munich, is about to make a breakthrough with production of biogenic fuels and exploitation of hitherto unused energy potential from land management material and bio-waste materials. Using the florafuel-procedure, high-quality biomass fuels can be produced. The processing steps include “washing, shredding, mechanical dewatering, thermal drying and compressing (briquetting/ pelleting)“. The positive effects on fuel quality are not only the reduction of water content of the biomass fractions. Mechanical dewatering alone, achieved using very little energy consumption, reduces the water content to the level of fresh wood; in addition to this, the procedure reduces critical substances typically found in stalks and grass such as chlorine and potassium, which are hazardous during combustion.

In the same way, mineral particles (such as stones, sand) and metals are washed out during the washing process. By using various biomass types, such as grass, wetland cuttings, roadside cuttings, foliage, surplus fermentation waste, silage, wood and cuttings from pruning, plants can be used throughout the whole year. High-quality fuels are produced either from one raw material (foliage, grass pellets) or as mixed fuels. Under current conditions regarding the price of landscape management waste material and biomass waste (e.g. bins for bio-waste), a florafuel system can generate adequate value-added for the operator provided that the capacity of the system is efficiently used and fuel sales revenues are included in the calculations. The fuel price should be set clearly under those of normal market prices for wood fuels.

Within the framework of a new project (FKZ-No. 03KB088A: IbeKET), a transferable concept for the procurement, processing and energetic use of biomass waste material using the florafuel-procedure is being researched. The intention is to develop an energy concept on a local level based on the needs of the community, which can in turn be adapted to other communities or municipalities. After successful results have been achieved, it is planned to implement the processing of biomass waste material using a florafuel demonstration system for the de-central generation of heat and electricity at LUTRA GmbH, near Berlin.

Useable biomass:

- Grass
- Foliage (leaves)
- Various moist biomass
- Material from landscape management

Benefits of the florafuel-Procedure:

- CO_2 neutral fuel
- Environmentally-friendly processing
- Contribution to energy independence through regional value-added
- No competition with food production
- Fuels are easily transported and storable; base load capability
- Completion of regional waste management cycle
- Potential use of lost heat by industrial and biogas plants
- Space-saving (current size of hall 24 m * 28 m)
- De-central job creation

Nutrient accumulation and distribution in woody crops of Eucalyptus nitens

Marta González-García
Sustainable Forest Management Area, Wood and Forest Research Technology Centre of Asturias (CETEMAS)
Finca Experimental La Mata s/n
33820 Grado, Asturias, Spain
mgonzalez@cetemas.es
www.cetemas.es

Co-Authors: Andrea Hevia, Juan Majada, Rosa Calvo de Anta, Marcos Barrio-Anta

Eucalyptus nitens was introduced in Northwest of Spain in the 1990's for pulpwood production. Nowadays, with the interest in renewable energies, this species began to be used as an energy crop to produce biomass. Despite short rotation woody crops are very helpful to obtain biomass in a short-term, their cycles, although longer than agricultural crops, are relatively short. In addition, *Eucalyptus* spp. are perennial species whose harvesting implies, in general, bales production which collects the whole tree including the leaves. The massive extraction of nutrients in the land can produce the decline of soil properties compromising the agricultural or forestry potential in the future. Therefore, the objective of this work is to study the nutritional state and the biomass nutrient content of *E. nitens* energy plantations.

Biomass and nutrients dataset came from 40 experimental plots located in Northwest Spain. They represent the existing range of ages, stand densities and site conditions. Plantation age ranged from 2 to 5 years and stocking density from 2,300 to 5,500 trees ha^{-1}. A total of 120 trees were selected for the destructive sampling. They were divided in five components: leaves, branches, dead branches, stemwood and bark, to study the biomass distribution and the nutrients content. Finally, a total of 50 samples, 10 samples per fraction, were dried, milled and analysed using suitable methods.

Leaves showed the highest value of N, 1.46±0.32 %, while wood and dead branches components had the lowest mean values, 0.21±0.06% and 0.26±0.06 % respectively. Similar trends were found out in P analysis, where mean values ranged from 2.38±0.58 $g \cdot kg^{-1}$ for leaves and 0.28±0.079 $g \cdot kg^{-1}$ for dead branches. Regarding K and Mg nutrients, leaves together with bark reached the highest mean values and dead branches and wood the lowest as in the above elements. Their ranges were from 0.86±0.41 to 4.95±0.50 $g \cdot kg^{-1}$ for K and from 0.27±0.15 to 1.66±0.34 $g \cdot kg^{-1}$ for Mg. The values obtained in Ca analysis showed a different trend, where bark and dead branches obtained the highest values, followed by branches, leaves and wood. These values varied from 0.62±0.30 to 10.92±3.36 $g \cdot kg^{-1}$. Finally, the average results were very similar for all the components in Na analysis, the range of values being from 0.56±0.15 to 0.84±0.31 $g \cdot kg^{-1}$.

The nutrient state of the stands was characterized by high values of P and deficiencies for the other elements which did not reach the optimal level, although the total N, K and Ca were included in typical ranges. On the other hand, Mg showed higher limitations due to none of the samples reached the minimum of the typical range and it had a positive and significant correlation with Mg foliar content.

The mean nutrient content estimated for each tree components at the age of 6 years showed that wood fraction, it is the most important component for P (21.88 $kg \cdot ha^{-1}$), K (78.04 $kg \cdot ha^{-1}$) and Na (20.42 $kg \cdot ha^{-1}$) elements due to it is the majority fraction in the tree (59%) at this age. Furthermore, leaves was the component with the highest content in N (0.12 $kg \cdot ha^{-1}$) and Mg (10.78 $kg \cdot ha^{-1}$). The bark component contained the top value of Ca (46.35 $kg \cdot ha^{-1}$), due to the high content of this element found for dry weight biomass, followed closely by leaves (42.18 $kg \cdot ha^{-1}$).

Finally, the total nutrient content per stand at the age of 6 years was estimated at 0.29±0.08 $kg \cdot ha^{-1}$ and 57.31±15.99 $kg \cdot ha^{-1}$ for N and P elements respectively, 159.74±43.46 $kg \cdot ha^{-1}$ for K, 313.61±82.33 $kg \cdot ha^{-1}$ for Ca, 45.99±12.51 $kg \cdot ha^{-1}$ for Mg and 33.67±9.16 $kg \cdot ha^{-1}$ for Na.

These estimations can be a very useful tool for the forest manager to replace the extraction of nutrients in this kind of plantations. However, the actual quantity of nutrients depends on biomass stand production which must be predicted using biomass models for a later balanced application of fertilizers in the plantations.

Development of high-density algal biomass production technology

Tatiana Pantsyrnaya
"New Engineering Technologies" Center
Moscow State University of Mechanical Engineering
Bolshaya Semenovskaya str., 38
Moscow, 107023, Russian Federation
tatiana.v.p@hotmail.com
www.mami.ru/index.php?id=1598

Co-authors: Elena Krasnoslobodtseva, Anastasia Reutova, Olga Shchelkanova

In recent years much attention was paid to the production of algal-derived biofuels. Nevertheless, its commercial production in most cases is not economically feasible due to various related limiting factors. Our study was focused on the development of a new high-density algal biomass production technology. A gel-based gas-exchange system was introduced in the photobioreactor. It was designed to provide a better CO_2 and O_2 exchange in the culture medium and to improve algal growth.

It was shown that this system permitted to obtain a considerable increase of biomass concentration of *Chlorella vulgaris* in the developed technology as compared to cultures without it and to attain a cell concentration of more than 20 g/L. Several key operating parameters (light, growth media and conditions) were further optimized. The developed technology of high-density algal biomass production was shown to be efficient and possesses a good potential for commercial production of biofuels and other algal-derived products.

16:30–18:30 Uhr

Parallelblock 11

Brennstoffcharakterisierung und Energiepflanzen

4:30–6:30 pm

Parallel Session 11

Fuel characterisation and energy crops

Neue Methoden zur Charakterisierung von Biomasse-Brennstoffen

DI Peter Sommersacher
Bioenergy 2020+ GmbH
Inffeldgasse 21b
A-8010 Graz, Österreich
peter.sommersacher@bioenergy2020.eu

Co-Autoren: DI Dr. Thomas Brunner, Prof. Univ.-Doz. DI Dr. Ingwald Obernberger

Der stetig steigende Bedarf an Energie aus Biomasse führt zum Einsatz s.g. neuer Biomasse-Brennstoffe (z.B. Energiepflanzen, Kurzumtriebshölzer, Abfälle und Rückstände der Landwirtschaft und der Lebensmittelindustrie). Diese neuen Biomasse-Brennstoffe zeichnen sich zumeist durch erhöhte Aschegehalte sowie erhöhte S-, Cl- und N-Konzentrationen aus. Daraus können während der Verbrennung vermehrt Probleme bezüglich des Ascheschmelzverhaltens, Feinstaubemissionen, Korrosion sowie gasförmiger NO_x-, SO_x- und HCl-Emissionen resultieren. Um feuerungstechnische Probleme, die mit neuen Biomasse-Brennstoffen verbunden sein können, zu prognostizieren, wurden neue Charakterisierungsmethoden entwickelt. Diese sollen eine rasche feuerungstechnische Evaluierung von Brennstoffen ermöglichen und erforderliche Verbrennungstests an Pilot- oder Großfeuerungsanlagen minimieren. Dazu werden nasschemische Brennstoff-Analysen, spezielle Brennstoffindexe für Biomasse-Brennstoffe sowie Abbrandtests in einem speziell dafür entwickelten Laborreaktor angewendet. Diese Methoden liefern außerdem Eingangsdaten für CFD-Modelle zur detaillierten NO_x- und Aerosol-Bildungsberechnung, die wiederum zur Optimierung von Feuerungen verwendet werden können.

Die Grundlage für eine umfassende Brennstoffcharakterisierung stellen nasschemische Analysen bzgl. Hauptelementen und Aschebildnern dar. Mit den Analysenergebnissen können Brennstoffindexe gebildet werden, die eine grobe feuerungstechnische Vorevaluierung zulassen. Dabei werden erste Informationen bezüglich des Ascheschmelzverhaltens über das molare Verhältnis von (Si+P+K)/(Ca+Mg) gewonnen. Dieses molare Verhältnis kann auch für eine erste Abschätzung des K-Freisetzungsverhaltens aus dem Brennstoff in die Gasphase verwendet werden. Die Summe von K, Na, Zn und Pb liefert eine grobe Indikation der zu erwartenden Feinstaubemissionen. Weiters kann auch das Risiko bezüglich Hochtemperatur-Chlor-Korrosion anhand des molaren 2S/Cl-Verhältnisses abgeschätzt werden. Der Bereich der SO_x- und HCl-Emissionen kann über das molare (K+Na)/[x*(2S/Cl)]-Verhältnis abgeschätzt werden. Abbrandtests in einem speziell konstruierten Laborreaktor geben genauere Informationen zum Abbrandverhalten und Freisetzungsverhalten von Biomasse-Brennstoffen in Rostfeuerungen. Sie liefern experimentell abgesicherte Daten bzgl. der K-, Na-, S-, Cl-, Zn-, Pb- und P-Freisetzung aus dem Brennstoff-Bett, woraus das Potential für die Bildung von Depositionen, Feinstaubemissionen sowie der gasförmigen SO_2- und HCl-Emissionen abgeleitet werden kann. Des Weiteren ist eine optische Beurteilung der Verbrennungsrückstände bezüglich Versinterungs- bzw. Verschlackungstendenzen möglich. Es wird auch die Freisetzung der NO_x-Vorläufersubstanzen (NH_3, HCN, NO, NO_2 und N_2O) vom Brennstoff in die Gasphase bestimmt, welche für CFD-Simulationen bzgl. NO_x-Bildung herangezogen werden kann. Anhand dieser relativ einfach durchzuführenden Verbrennungstests im Laborreaktor können somit wertvolle Informationen für eine umfassende Brennstoffcharakterisierung gewonnen werden.

In diesem Beitrag werden die theoretischen Hintergründe zu den genannten Charakterisierungsmethoden erläutert. Ergebnisse zu Untersuchungen für eine Bandbreite von verschiedenen Biomasse-Brennstoffen werden präsentiert. Die Methoden sollen dabei helfen zu entscheiden, ob ein neuer Biomasse-Brennstoff für die Verbrennung in einer herkömmlichen Biomassefeuerung geeignet ist bzw. welche Maßnahmen getroffen werden müssen, um einen vernünftigen Betrieb unter Einhaltung der Emissionsgrenzwerte sicherzustellen. Diese Methoden können auch als Entscheidungshilfen bei der Vorauslegung von Anlagen sowie für die Wahl einer speziellen Feuerungstechnologie für einen bestimmten Brennstoff oder ein Brennstoff-Spektrum verwendet werden.

Ash slagging in woody and herbaceous biomass fuels: results of new laboratory methods for the prediction and quantification of slagging

*Daniel J. Vega-Nieva [a *], Christian Alvarez [a], Luis Ortiz [a]*
[a]Forest Engineering Faculty. U. Vigo. Campus A Xunqueira
36005 Pontevedra, Spain.
Corresponding author: Daniel J. Vega-Nieva
DanielJVN@gmail.com

Ash sintering and fusion in the boiler – ash slagging – is one of the main concerns for a successful pellet quality standardization. The method included in *ENplus*® as a descriptor of ash slagging – standard ash fusion temperature – has often been criticized not to be a reliable ash slagging indicator. In addition, new feedstocks such as agro/forest residues and herbaceous pellets, require reliable methods for predicting and quantifying potential ash slagging and for establishing the most appropriate boilers for their combustion. New methods are required for a sound pellet quality certification system.

The presentation will focus on two key topics:

1) The results from Domoheat VI Framework European project on ash slagging quantification and classification from the combustion of forest and agricultural pellets and biomass residues mixtures in domestic pellet boilers.

2) The performance of new laboratory methods for quantifying ash slagging of forest and agricultural pellets and woody and herbaceous biomass feedstocks.

Maize cobs for energetic use – properties and challenges

Josef Rathbauer
BLT Wieselburg, HBLFA Francisco Josephinum
Rottenhauserstraße 1
AT 3250 Wieselburg, Austria
josef.rathbauer@josephinum.at
www.josephinum.at/blt.html

Co-Author: Lukas Sulzbacher
Josephinum Research, Rottenhauserstraße 1, AT 3250 Wieselburg, Austria

Maize cobs are more and more under consideration as competitive agricultural solid biofuel. Especially in regions which are dominated by arable land, with a low forest percentage, this biomass source might be used for the production of heat in biomass boilers. In Austria approximately 200,000 ha of maize for corn production are cultivated. As rough estimation 1 t of maize cobs per ha can be harvested. This makes an overall potential of 200,000 t per year of maize cobs for the use as raw material and for energy purposes.

Four different types of harvesting systems are used in Austria. In the case of maize seeds production the maize ear is harvested with a maize-picker-husker. After drying of the maize ear and separation of the kernels very pure and dry (water content approx. 12–14 %) maize cobs are available. Further two systems have been analyzed where the maize cobs are separated in the combined harvester. In the first case the maize cobs are stored in a maize-cob-bin and overloaded to a trailer. The quality of these maize cobs is good, the portion of husks rather low. In the second case the maize cobs are thrown permanently to an accompanying trailer which is towed by a tractor. The separation of husks of this technology needs still some improvement. The last version is the harvest as corn-cob-mix (CCM) with a combined harvester. This mixture of kernels and cob (-parts) is separated subsequently.

Based on the master table of the European standard 14961-1:2010 Solid Biofuels – Fuel Specifications and Classes – Part 1: General Requirements an Austrian standard has been developed. The specific Austrian standard is titled: ÖNORM C 4003: Maize cob – Requirements and test methods. This document comprises as many as necessary but as few as possible normative and informative parameters and limits.

Within a national funded research project in total nearly some 50 different maize cob samples have been analyzed. In general the set limits for the respective parameter in the Austrian Standard ÖNORM C 4003 are suitable for the characterisation of this agricultural solid biofuel.

In contrast to the situation in Styria in the maize production regions of western Lower Austria and Upper Austria the biggest challenge is to get the maize cobs dry enough for avoiding storage losses. In most cases an artificial drying is necessary.

Concerning the energetic use – especially in small-scale biomass boilers – further research and development is needed. In the case that the portion of husks is over 5 % a suitable feeding system from the storage to the biomass boiler is an absolute must. The ash melting behaviour is varying heavily. The chlorine content is mostly over the set limit stated in the Austrian standard. This specific limit is based on legal national documents. These two parameters are challenging the boiler manufacturers.

Optimizing wood chip production in the field – fuel quality and energy consumption

Dr. Daniel Kuptz
Technologie- und Förderzentrum (TFZ), Solid Biofuels
Schulgasse 18
D-94315 Straubing, Germany
daniel.kuptz@tfz.bayern.de
www.tfz.bayern.de

Co-authors: Peter Turowski, Dr. Hans Hartmann

Introduction
Fuel qualities of wood chips vary depending on raw materials and machine settings. Especially for small combustion units, high fuel qualities are recommended, e.g. low amounts of fines, low fuel moisture and low ash content. Secondary measures are often applied after the chipping process to increase wood chip quality, e.g. sieving or artificial drying. These measures consume time, labor and energy and might be avoided by efficient chipping practice, i.e. by producing high fuel qualities directly in the forest. Moreover, energy consumption during chipping may be minimized by easy measures, leading to higher production efficiency. To identify optimization potential within the production process, a broad survey on various raw materials and wood chip production chains was conducted between 2011 and 2013.

Materials & Methods
Numerous wood chip samples were collected from different production sites in Bavaria (n = 55). Raw materials derived from forest wood (i.e. forest residues, whole trees and stem wood of different tree species), from short rotation coppice and from cuttings in urban areas. Chipper settings varied in machine type, knife sharpness, screen size and discharge systems. All samples were analyzed according to European standards (moisture content, bulk density, ash content, net calorific value, particle size distribution by horizontal screening and elemental composition). In addition, particle size distribution and particle form were analyzed using a continuously measuring image analysis device allowing for highly detailed information on the size and shape of the bulk material. Classification of wood chips followed the draft ISO standard (ISO 17225-1, ISO 17225-4). In addition to wood chip quality, fuel consumption during chipping was recorded and related to volume and weight of the bulk material.

Results & Discussion
Mean moisture content of fresh wood chips was 49.1 ± 6.8 m.-% and constantly exceeded the optimal MC for small combustion units (i.e. ≤ 35 m.-%). Drying of unchipped raw material for one year resulted in significant lower MC values of 31.0 ± 5.8 m.-%. Net calorific value mainly depended on tree species while ash content of wood chips mainly depended on tree compartments ranging from 0.4 to 1.8 m.-% for stem wood and from 1.0 to 5.4 m.-% for forest residues. Highest values for ash content (> 10 m.-%) were observed for samples with high amounts of silicon (> 35,000 mg/kg), indicating contamination of the sample with mineral soil. Bulk density was highest for stem wood of beech (297.4 kg/m³ at 15 m.-%) and lowest for poplar from short rotation forestry (170.6 kg/m³). Particle size distribution of each wood chip sample could be classified according to ISO 17225-1 but only 30 % of all samples could be classified as “graded wood chips”, i.e. as wood chips for small combustion units (P31S or P45S, ISO 17225-4). In all other cases, classification was not possible due to high amounts of fines or due to high maximal particle length. Particle size and particle form were affected by raw material, screen size and knife sharpness. Throughput rate during chipping strongly related to chipper size while energy consumption related to chipper type. Specific fuel consumption during chipping ranged from 0.17 to 0.76 l/m³ of bulk material and from 1.13 to 4.10 l/t (dry matter), respectively. Thereby, large chippers > 200 kW proofed to be more energy efficient during wood chip production compared to chippers < 200 kW when the machine is driven at full capacity. Overall, energy consumed during the chipping process ranged from 0.22 – 0.81 % (0.50 ± 0.15 %) when related to the energy stored within one ton of wood chips (dry matter), highlighting the energy efficiency of the chipping process.

Development of novel concepts for microalgae in the Austrian energy system

DI (FH) Andrea Sonnleitner
Bioenergy 2020+ GmbH
Standort Wieselburg
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
andrea.sonnleitner@bioenergy2020.eu
www.bioenergy2020.eu

Co-Author: DI Dina Bacovsky

Microalgae are seen worldwide as a new and promising feedstock for the energy supply chain. Because of their high productivity and their ability to convert CO_2 into biomass, microalgae are a potential raw material for biorefineries, avoiding the food versus fuel conflict, and contributing to an increased share of renewable energy. According to the current state of the art the utilization of algal biomass for the production of fuel, energy and heat seems to be economically not competitive and the life cycle assessment shows improvement possibilities in energy consumption (project Algae&Energy:Austria). There are different options for utilization concepts which are technologically and economically feasible. New concepts need to be developed and synergies with already existing technologies need to be used.

Challenges along the value chain:

- Supply of water for cultivation
- Supply of nutrients for cultivation
- Energy consumption during cultivation
- Harvesting and processing of biomass
- Investment and operating costs

One possibility to cover the need of water and nutrients in a cost-effective way is the combination of microalgae cultivation and waste water treatment. The cultivation of algae using different waste water types common in Austria is technologically possible. In particular municipal waste water and effluents from breweries and dairies are suitable as substrate. Due to the usage of this synergy the need for fresh water and artificial fertilizer for algae cultivation decreases substantially and therefore operating costs are reduced. Promising production concepts were developed and further research and development needs were pointed out (project SAM).

After producing algal biomass the harvesting and processing steps for further utilization seem to be difficult. In particular the high amount of water increases the energy expenditure in most of the conversion pathways. Hydrothermal liquefaction seems to be promising to reduce the energy intensity through two major factors: First, the conversion takes place in the liquid phase, and no energy intensive drying of the algal biomass is needed. Second, the entire carbon which is fixed in the algae can be used for energy production. The main product of hydrothermal liquefaction is a bio-oil, which can be further processed in existing refinery processes into biogenic motor fuels, plastics and basic chemicals (project microHTL).

In Austria many scientific research groups and companies are dealing with microalgae in the energy system. These research and development efforts comprise different topics and approaches, like different cultivation system designs (open pond, photobioreactor), biotechnological optimization of microalgae species, the utilization of algal biomass in energetic and material pathways or the combination of microalgae cultivation with existing technologies. It is of growing importance to establish a network of Austrian experts and research groups for enhancement of cooperation and research within the field of algae (project network biobased industry).

Through the optimization along the entire value chain with special regard to novel concepts of cultivation, harvesting, processing, conversion and utilization, as well as an enhanced network of Austrian experts and research groups, microalgae can serve as biogenic feedstock for the energy system of the future and can contribute to the sustainable development of a low-carbon society.

14:00–16:00 Uhr

Parallelblock 12

Biomassepotenziale

2:00–4:00 pm

Parallel Session 12

Biomass potentials

Nutzung regional anfallender Biomasse zur Wärme- und Stromversorgung im innerstädtischen Bereich

DI Carsten Keichel
Fraunhofer-Institut für Fabrikbetrieb und -automatisierung IFF
Geschäftsfeld Prozess- und Anlagentechnik (PAT)
Sandtorstr. 22
39106 Magdeburg, Deutschland
Carsten.Keichel@iff.fraunhofer.de

Motivation
Zur Deckung des steigenden Energiebedarfs bei gleichzeitiger Reduzierung der CO_2-Emissionen aus fossilen Energieträgern ist zukünftig die Nutzung regenerativer Ressourcen für die Energiebereitstellung unumgänglich. Ein nicht unerheblicher Teil der benötigten Primärenergie kann durch die Nutzung von Biomasse nachhaltig substituiert werden. Da die Potentiale für holzartige Biomassen durch die stoffliche als auch die energetische Nutzung nahezu erschöpft sind, wird in diesem Projekt die Nutzung neuer Energiepfade sowie der die Schaffung regionaler Wertschöpfungsketten in effizienten Energiewandlungsanlagen unter Verwendung von KWK-Konzepten untersucht. Obwohl große Mengen an Grünabfällen als Brennstoff nutzbar wären, kommt die Verwertung technisch nur zögerlich voran. Grund dafür sind die Inhomogenität des Brennstoffs hinsichtlich Stückigkeit und Wassergehalt. Derzeit sind in Deutschland keine mit Grünabfällen betriebenen KWK-Anlagen im mittleren Leistungsbereich (1 bis 10 MW) bekannt. Die dezentrale Nutzung von Grünabfällen zur gekoppelten Wärme- und Stromerzeugung durch die hier betrachtete Technologie stellt nicht nur in mittleren Anlagenleistungsbereichen eine Neuigkeit dar.

Inhalt
Im Rahmen des Projektes wird exemplarisch für die Stadt Magdeburg das Potential der regional zu Verfügung stehenden und nicht stofflich nutzbaren Biomasse (Grünschnitt, Frisch- & Wurzelholz, Laub, Astholz, etc.) erhoben, der Bedarf für die Wärmeversorgung eines Magdeburger Stadtteils ermittelt sowie die Möglichkeit der energetischen Nutzung des vorhandenen Brennstoffes zur Energieversorgung dieses Stadtteils untersucht. Ziel dieses Projektes ist die Vorplanung eines Biomasse-Heizkraftwerkes mit gekoppeltem Organic Rankine Cycle -Prozess (ORC-Prozess) zur Strom- und Wärmeversorgung mit einer Feuerungswärmeleistung (FWL) von ca. 4 MW. Die geplante Feuerungsanlage soll ein innovatives Verbrennungskonzept, basierend auf der Wirbelschichttechnologie, nutzen. Im Gegensatz zur konventionellen Rostfeuerung können in einer Wirbelschicht auch Brennstoffe unterhalb der Stückigkeitsgrenze von Rostfeuerungen, wie z. B. Holzspäne und Grünschnitt, energetisch genutzt werden. Durch den Einsatz eines gestuften Feuerungskonzeptes mit Sekundär- und Tertiärluft wird ein hoher Ausbrand bei gleichzeitiger Minderung von NOx-Emissionen erreicht. Der innovative Kern des Projektes besteht in der Entwicklung und dem Test einer kompakten Wirbelschichtfeuerungsanlage für die thermische Nutzung von biogenen Reststoffen zur Realisierung eines quasi geschlossenen CO_2-Kreislaufs.

Ergebnisse
Die in Magdeburg regional zur Verfügung stehende und bisher energetisch ungenutzte naturbelassene Biomassebildet ein Potential von jährlich ca. 88 EJ. Darüber hinaus fallen in der Region jährlich ca. 265 EJ biogene Reststoffe an, welche bereits einer energetischen oder stofflichen Weiterverarbeitung zugeführt werden.

Anhand der durchgeführten Verbrennungsuntersuchungen an einer Wirbelschichtfeuerungsanlage im technischen Maßstab konnten das sehr gute Ausbrandverhalten sowie der Einfluss der Luftstufung auf die erzeugten Emissionen, zur Einhaltung der gesetzlich vorgeschriebenen Grenzwerte, nachgewiesen werden.

Weiteres Vorgehen
Im weiteren Verlauf des Projektes wird sowohl ein Anlagenkonzept für ein Biomasseheizkraftwerk im urbanen Raum entwickelt sowie die für die Realisierung notwendige Projektierung erarbeitet. Anhand der des verfahrenstechnischen Anlagenschemas wird ein Mess-Steuerungs- und regelungs-technisches Konzept ausgearbeitet. Darüber hinaus werden auf Basis der spezifischen bau- und umweltrechtlichen Anforderungen sowie der Nachweis zur Einhaltung der Emissionskriterien aus der Versuchsdurchführung Vorarbeiten zur Erarbeitung der Genehmigungsunterlagen ausgearbeitet.

Development trends of woody energy plantations in Hungary

Andrea Vágvölgyi
University of West-Hungary, Institute of Forest and Environmental Techniques
Bajcsy-Zs. u. 4
H-9400 Sopron, Hungary
avagvolgyi@emk.nyme.hu
www.nyme.hu

Co-Authors: Bálint Heil, Gábor Kovács

Hungary's Renewable Energy Plan has set out the achievement of the target of 14.65 % minimum share of renewable energy in gross final energy consumption by 2020, with 62 % (60,72 PJ) originating from biomass. Our biomass potential – products and wastes of vegetable origin excluding treated or contaminated products – is approx. 70 % wood-based, i.e. dendromass. In Hungary short rotation coppice energy plantations are the most widespread, where the rotation time doesn't exceed 5 years. The high costs of harvest and the often great distances from the consumer market induces nowadays a growing interest to cylindrical timber plantations with wider spacings and larger piece size.

Hungary currently has three laws disposing of the establishment of woody energy plantations. In our opinion, the elimination of over-regulation and the introduction of a simple registration system would significantly increase the installation enterprise. A similar stimulus could result of a non-refundable subsidy for the establishment of a new plantation, complementary to the area based subsidy. The Greening of the Common Agricultural Policy includes the possibility of short rotation coppicing, which could increase the area of wood energy plantation in Hungary by around 80.000–100.000 ha.

First wood energy plantations were mostly established in Hungary on sites with low agricultural productivity. Several plantations in the South-Western Region of Hungary can be found on slightly acidic fluvial, loamy parent materials, with a rooting depth of 150–200 cm, with a soil water level between 150–220 cm, on Gleysols with a medium nutrient supply. The other large-scale area for plantations in South-West Transdanubia is the sand region of Somogy county, where Arenosols, sandy Luvisols and Gleysols are most widespread, with groundwater influence. Plantations in Northern Transdanubia and Western Transdanubia are also to be found mostly in low-lying areas on Gleysols and Fluvisols, where groundwater influence is present for poplars. In the East-Hungarian region plantations can mostly be found along the river Tisza, on clayey, loamy clayey or loamy textured Fluvisols, Gleysols, with good nutrient and water supply. More and more frequently new plantations also appear in the hilly regions (altitude 200–300 m above sea level) of Hungary. In this elevations most common soil types are Cambisols (brown forest soils), Luvisols and sandy Luvisols.

In 2012 woody energy plantations in Hungary had a total area of 2,141 ha. Around 103 localities, a total of 420 plantations can be found, with 5.1 ha average plot size. In Hungarian plantations mainly poplar clones (AF-2, Monviso) play a prominent role, with a territorial ration of 64.67 %, which continues to grow. Most of the plantation of different willow clones did not meet expectations. Territorial growth of black locust plantations can be expected in the future primarily in the plainland, as well as in heavily eroded hilly and mountainous areas with non favourable water regime.

Own yield measurements were carried out for a range of 8–112 mm diameter at soil surface and 2–90 mm breast height diameter, and they resulted in high correlation yield estimation functions. In case of the plantations of this measurement, with an age ranging from 1–7 years (later already after 3 harvesting), yield estimation functions predict 2 t/ha to 50 lutro-t/ha yearly biomass production (6,600 shoots/ha, 90 % planting success).

We examined the location of power plants and plantations creating a matrix, from which the different input-output of them can be determined. Today in Hungary, ca. 35 biomass power generation units (generating electrical power / for direct heating / combined power plants) work with an approx. 1,500,000 atro-t / year of biomass demand. This demand can only be covered to a slight part (1.3%) by the Hungarian woody energy plantations located around 103 settlements, producing a sum of 20,900 atro-t dendromass / year. Based on the experiences in Hungary, the economical efficiency of woody energy plantations largely depends on the attitude of the farmers.

Analysis and development of supply chains of forest biomass focusing on firewood in the area of Western Macedonia, Greece

Chrysovalantis Ketikidis, MSc Chemical Engineer
Centre for Research and Technology Hellas, Chemical Process & Energy Resources Institute
4th km Ptolemaida Mpodosakio Hospital, P.O. Box 95
502 00 Ptolemaida, Greece
ketikidis@lignite.gr
www.lignite.gr

Co-Authors: Maria Christidou, Dr. Panagiotis Grammelis, Dr. Antonios Gypakis

A very important source of biomass is wood and especially firewood. Woody biomass can constitute a potentially important tool in the national strategy to reduce greenhouse gas emissions and resist global climate change. In Greek forest practice, the main utilization of wood apart from products of primary manufacture is as a source of thermal energy, especially in the form of firelogs. There are some factors that kept the Greek forest sector underdeveloped. The factors and the development constraints include the indigenous characteristics of the Greek forests, the inhibitory policy for timber production investments, the lack of market research, the high cost of production and the drawbacks of a global economic recession.

This paper explores and applies the traditional supply chain principles of the forest biomass in order to organize its best exploitation either for power or for heat generation. To that end, descriptive statistics and logistic analysis were used in order to define supply chain performance measures and to identify constraints for the supply chain optimization problem, since a large fraction of cost in woody biomass exploitation originates from the logistics operations. Additionally, a SWOT analysis was applied aiming to create a qualitative diagnosis which can be used to identify the strengths, weaknesses, opportunities and threats – both in the present as in the future – for a firewood supply chain in Greece and especially in the area of Western Macedonia.

Impacts of renewable energy on European farmers – potential and perspectives for 2020

J.W.A. Langeveld
Biomass Research
P.O. Box 247
6700 AE Wageningen, The Netherlands
hans@biomassresearch.eu
www.biomassresearch.eu

Co-Authors: G.B.M. Pedroli, K. Umpfenbach , B. Elbersen, J.P. Lesschen, T. Bole-Rentel, K. Umpfenbach, E.Maletta, and W. Steeneveld

The project Impacts of Renewable Energy on European Farmers analysed on-farm generation of renewable energy in the EU-27 as a way to achieve environmental targets and to (re)vitalize agriculture and rural economies. Renewable Energy (RE) includes energy generated by wind, photovoltaics (PV), solar thermal, hydro, geothermal or biomass resources. Environmental and economic impacts were assessed for 2008 while National Renewable Energy Action Plans (NREAPs) were used to identify future (2020) RE development under two scenarios, one following projections in the NREAPs, and another assuming higher on-farm RE production due to additional policy measures (NREAP+). Main results of the project were presented in a report for the European Commission [1]. The project included assessment of national and EU RE balances for 2008 and projections for 2020, an analysis of implications of RE development (GHG emission reduction, farm income), and a questionnaire survey held among 800 farmers in 8 European case regions.

On-farm final RE production in 2008 amounted to 11.8 Mtoe, 8.0 Mtoe of electricity (mostly generated by wind) and 3.8 Mtoe of heat. Under the NREAP scenario, on-farm 2020 RE production reaches 35.9 Mtoe of electricity, a four to five-fold increase compared to 2008. Increase of heat production (6.1 Mtoe in 2020) is modest. Energy crop production is doubling, mainly due to woody crop cultivation. Energy crops could however fall behind agricultural waste, which is projected to reach 21 Mtoe. Under the NREAP+ scenario, electricity production reaches 62.5 Mtoe (eight times the 2008 levels) while final production of heat (7.9 Mtoe) and primary energy production are considerably smaller. GHG reduction by on-farm RE production in 2008 amounted to 86 Mton CO_2-eq in 2008, while GHG emission reductions in 2020 rising to 315 Mton CO_2-eq under the NREAP and 512 Mton CO_2-eq under the NREAP+ scenario. Most savings are realized by wind energy (about 73 %). Germany remains the largest contributor, but it is caught up by France under the NREAP+ scenario.

RE development was studied in eight representative regions: North East Brandenburg and Saarland (Germany), Valencia and Soria (Spain), Mazowiecki and Warminsko-Mazurskie (Poland) and Upper Austria and Carinthia (Austria). Farmers in these regions reported RE investments valued at 125 million Euro (average of 350,000 Euro per farmer). Average investments were lowest in Warminsko-Mazurski and highest in Brandenburg and Valencia. Some 37 % of the investments relate to biomass (not including biogas), mostly solid (woody) biomass use for heating and electricity production. The income effect of RE production on farms is generally positive, with the largest effect in Polish regions. This may be indicative for the Central European situation. Although investments required in biogas and biomass installations are high, there is a general positive labour effect of RE, more labour being required on the farm when the share of RE increases, especially on Polish farms.

It is concluded that on-farm RE production can provide a meaningful contribution to RE production and GHG reduction, while offering perspectives for employment and farm incomes.

References

[1] B. Pedroli and H. Langeveld (eds.), Impacts of renewable energy on European farmers. Creating benefits for farmers and society. Wageningen, Alterra Wageningen UR (2011)

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16:30–18:30 Uhr

Parallelblock 13

Biogas

4:30–6:30 pm

Parallel Session 13

Biogas

Exploring integrated concepts for energy production from green waste

Ir. Luc Pelkmans
VITO NV
Boeretang 200
BE-2400 Mol, Belgium
luc.pelkmans@vito.be
www.vito.be

Co-Authors: Nathalie Devriendt[1], Ruben Guisson[1], Erwin Cornelis[1], Liesbet Goovaerts[1], Miet Van Dael[2], Steven Van Passel[2], Jonathan De Witte[3]

Within the project 'Energy Conversion Parks' a consortium of Belgian and Dutch research institutes has analysed whether an economically viable concept can be achieved to valorize locally available biomass waste and residue streams, through the use of synergies and clusters between different biomass streams and conversion technologies. The project developed a technological concept and a business plan for five pilot Energy Conversion Parks in the border region Flanders (Belgium) - Netherlands. The five cases have different starting points, like the types and availability of biomass streams, the presence of other industrial activities that can be linked to, and potential energy exchange with nearby companies.

In this paper we discuss the concept developed for Beerse-Merksplas in the North of Belgium, where the starting point was a waste collection company (IOK Afvalbeheer) which already has an existing composting plant and a gas engine running on landfill gas on the targeted site. IOK Afvalbeheer collects around 60,000 tonnes of VFG (vegetable, fruit and garden waste) and other green waste in a region with 500,000 inhabitants. Quite soon in the process there was agreement with IOK Afvalbeheer to focus on a VFG digester to produce biogas, coupled with composting of the digestate. The existing landfill gas engine will also remain operational in the next years. The main uncertainties were what to do with the biogas, what to do with the woody fraction of the biomass input, and how to deal with the balance of plant and the way heat is provided within the site. The on-site heat demand is limited (some could be used in the digester and for gas cleaning). There are no nearby neighbour companies who could use heat.

Considered options/scenarios for biogas were (1) on-site electricity production and limited use of heat, (2) on-site electricity production and export of the heat through pipes, (3) export of biogas through pipes to a CHP site, (4) upgrading of biogas to bio-methane and injection to the natural gas grid, and potentially use it as transport fuel for waste collection lorries. These options are actually valid for whatever biogas production site. The optimal choice will depend on local conditions and the legislative framework. Woody fractions will partly be used as structure material in the composting (with digestate), partly to produce heat for the digester and for gas cleaning, part will be chipped to be sold to electricity and/or heating installations. The exact configurations will be discussed in the paper.

Techno-economic assessments have been performed for the main scenarios. The current legislative framework and renewable electricity support system in Flanders drives the case to invest in an on-site CHP, but energetically other options could be more interesting. At the moment the investment decision seems to tend to a stepwise approach, where the biogas will first be valorized in an on-site CHP, while in the longer term there will be an investment in gas grid injection and use of the green gas in CNG refuse collection trucks.

The ECP project is supported by the European Interreg IVa programme Flanders-Netherlands, and co-funded by Dutch and Flemish authorities (national and provinces). The project was active for a period of three years from April 2010 until June 2013.

[1] *VITO NV*
[2] *Hasselt University*
[3] *IOK Afvalbeheer*

Nitrogen removal with membrane contactors for improved anaerobic digestion under hydrogen sulfide and ammonia inhibition

Benjamin Lauterböck
University of Natural Resources and Applied Life Sciences-Vienna, Department of IFA-Tulln, Institute for Environmental Biotechnology
Konrad Lorenz Straße 20
3430 Tulln, Austria
benjamin.lauterboeck@boku.ac.at
www.ifa-tulln.ac.at

Co-Authors: G. Liebhard, M. Baumgartner, W. Fuchs

The aim of this study was to investigate the performance of a digestion process under various organic loading rates (3.1 and 4.2 kg COD/m³ * d), ammonium nitrogen (3.0–7.3 g/l NH_4-N) and hydrogen sulfide levels (0.4, 1.3 and 3.3 mg/l H_2S). Therefore a membrane contactor, consisting of polypropylene hollow fibers, was used to continuously reduce ammonia from a digestion process treating slaughterhouse waste.

Membrane contactors are a new technology to degas liquids. They consist of hydrophobic hollow fibers with gas filled pores. Thus, gaseous substances are able to diffuse from a liquid phase through the membrane pores into an absorbent liquid. Hydrogen sulfide and free ammonia are occurring in inhibiting concentrations in many industrial waste waters such as slaughterhouse wastes or swine manure. Applying membrane contactors in anaerobic digestion to remove nitrogen was already reported to counteract ammonia inhibition or to treat digester effluent having high ammonium nitrogen content.

The reactor having lower ammonium nitrogen levels performed better under increasing hydrogen sulfide levels. The process of the reactor with membrane contactor was more stable and the digester had better substrate conversion, higher methane yield (**Fehler! Verweisquelle konnte nicht gefunden werden.**) and lower volatile fatty acid concentration. The large difference between the two reactors occurred especially under the high organic loading rate, were the reference reactor showed major inhibition effects.

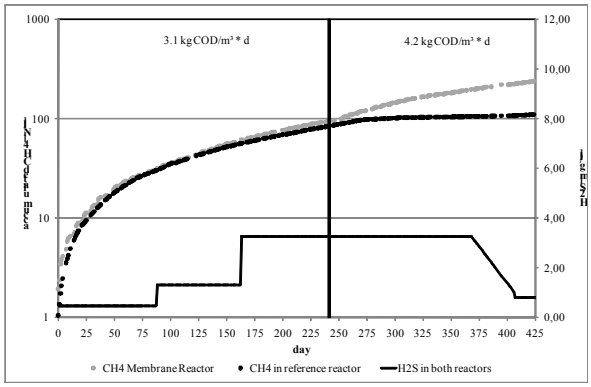

Figure 1: *accumulated methane yield under various H_2S concentrations and organic loading rates*

Generally, the use of membrane contactors provides highly promising results. Ammonium nitrogen can be directly removed out of the process without the need of excessive energy or chemical input as for example gas stripping units do. It was demonstrated that such a system can be employed to limit free ammonia and sulfide inhibition enabling a more stable process under high organic loading rates and short hydraulic retention times. Anaerobic treatment of protein rich substrates like slaughterhouse wastes, swine manure or chicken manure can be improved. First results in a technical scale with a manufactured membrane contactor module show the high potential of the investigated technology for industrial applications.

Combination of dry anaerobic digestion, composting and energy exploitation of biogas for innovative utilization in a pilot plant

Silvia Silvestri
Biomass and renewable energy Unit
Fondazione Edmund Mach (FEM)
Via E. Mach 1, 38010 San Michele a/A (TN), Italy
silvia.silvestri@fmach.it
www.fmach.it

Co-Authors: Daniela Bona, Andrea Cristoforetti, Lorenzo Forlin, Davide Papurello

The source selected organic fraction of municipal solid waste (OFMSW) can be advantageously sent to a first anaerobic process for a partial degradation followed by a second aerobic phase (composting) to reach a high stabilization and complete maturation of the organic matter. As concerns the biogas exploitation to produce electricity, the innovating possibility to use it for feeding solid oxide fuel cells (SOFCs) was investigated. SOFCs represent a good option due to their high biogas-to-electricity conversion efficiency, the possibility to recover high-grade waste heat in cogeneration mode, and the tolerance of the SOFC to operate under carbon dioxide and diluted fuels in general.

This paper presents the results of different tests on the OFMSW using a combination of dry anaerobic digestion and composting in a pilot plant at FEM. Dry digestion of solid waste (dry matter content around 25 %) is well known even if not widely applied. It is characterized by the use of wood (to give structure and porosity), the recirculation of digestate as inoculum and the use of leachate for the irrigation of the mixture. It minimizes the required reactor volume, the water and thermal demands as well as the losses of organic matter during pre-processing operations; it also requires a lower number of biomass pre-treatment steps.

Aim of this project was the study of the process management in a real scale reactor. At the same time it gives important data about the production of biogas from OFMSW collected in a specific area, in order to understand the considerable variability depending on the eating habits, type and frequency of waste collection.

The main results achieved in relation to the process management are the pH correction, the identification of efficient and repeatable pretreatments of the waste and finally the control of the biological anaerobic transformation. Also the influence of leachate on the process and the recirculation amounts have been analysed. The double pre-treatment on fresh waste consists in a preliminary aerobic step for 5 days and subsequently an addition of calcium hydroxide 0,3–0,5 % w/w. This allows the improvement of the biomass degradability, the increase of temperature (45–56°C) and the reduction of lag-phase before methane production (about 3 days instead 10 days). The production of biogas was included in the range 0,48–1,02 m^3 kg^{-1} of TVS loaded. The concentration of methane in the biogas is good: the average value is 58,8 %; only 10 % of the total biogas is less than 40 %.

The composting of digestate requires specific conditions: 10 days bio-oxidation (closed aerated system) and 40 days maturation. The biological stability of the composted digestate was very good (about 300 mg O_2 kg^{-1} TVS) and the odour impact (odour units) decreased up 90 % after 10 days of process.

The composition of biogas produced was monitored daily for impurities detection, through a rapid direct injection mass spectrometric technique known as Proton Transfer Reaction – Time of Flight – Mass Spectrometry (PTR-Tof-MS). VOCs detected (mostly sulfur compounds and terpenes) showed that a gas cleaning section is certainly required in order to feed the biogas into a SOFC stack, even during the central weeks of higher production amounts.

Buckwheat and quinoa as late catch crops for biogas production – results of 2012

MSc. Falko Stockmann
Technologie- und Förderzentrum im Kompetenzzentrum für Nachwachsende Rohstoffe
Schulgasse 18
94315 Straubing, Germany
falko.stockmann@tfz.bayern.de
www.tfz.bayern.de

Co-Author: Dr. Maendy Fritz

Implementation of new species for the production of bioenergy in alternative cropping systems can improve biodiversity of the agricultural landscape and raise field productivity. Especially as narrow crop rotations are linked to negative effects like pest infestation extending the crop rotation can lower these effects. Therefore integration of species having a short vegetation time offers the possibility to create flexible crop rotations.

Buckwheat and quinoa require both a very short vegetation time (90 to 100 days). Thus, their integration into crop rotations is very variable. Buckwheat has a good weed suppression potential due to its fast development and high growing density. Catch crops can improve soil structure and minimize soil erosion as well as reduce the needed fertilizer amount. Finally, buckwheat and quinoa have a high ecological value due to their long flowering period and colourful appearance.

The aim of a current research project, starting 2011, is to investigate buckwheat and quinoa as second crops for biogas production following cereals as main crop. The second year (2012) of the trials was completed and biomass yield potential, dry matter content and substrate quality of eight buckwheat and nine quinoa cultivars, including two sowing times and two sites, are available.

During summer cultivation drought stress can be the limiting growth factor. Thus, cultivation of species with high water use efficiency is necessary. Buckwheat and quinoa are both known for their potential to resist periods with low water supply. To get knowledge of differences between cultivars concerning their water use efficiency, an additional greenhouse trial was carried out including four cultivars and four different water supplies. To detect differences between the two species concerning their drought stress resistance the method of ^{13}C-isotopic-discrimination was used.

Dry matter yield of buckwheat cultivars ranged from 4.3 to 7.5 t ha^{-1}. Dry matter content was close to the desired level of 28 % (ranging from 23 to 27 %). For location Straubing and sowing date 1, dry matter content was mostly within the range (26 to 31.5 %). Dry matter yields of quinoa cultivars showed a range of 4.3 to 7.0 t ha^{-1}. This represents analogue to buckwheat a very high amount of biomass production within a very short vegetation time of only 98 days. Dry matter contents exceeded mostly the level of 28 %. Four cultivars even topped the amount of 35 % (max: 42 %). This could allow even shorter vegetation times and thus ease the integration into crop rotations. Results of substrate quality and the water use efficiency showed an impact of species, cultivar and sowing date. Quinoa in detail showed higher amounts of crude fat, crude protein and a lower content of crude fiber and acid detergent lignin, which indicate a better fermentability than buckwheat cultivars.

For the parameter water use efficiency, buckwheat cultivars were higher affected if water supply was reduced than the quinoa cultivars which showed only a little effect if deficits in water supply were present. Same was analysed if the ^{13}C-isotopic-discrimination of both species was compared. Quinoa cultivars showed a better strategy to resist drought stress than buckwheat cultivars.

In summary, due to their short vegetation time buckwheat and quinoa could be gainful species to enrich crop rotations. Both crops provide a high ecological value and a good biomass yield. Quinoa seams better adopted if water supply is reduced. Some quinoa varieties reached the desired range of dry matter contents (28–35 %) very early. This can shorten the required vegetation time even more.

The project is funded by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV), supervised by the Agency for Renewable Resources e.V. (FNR e.V.).

Environmental evaluation of biogas production from intercropping

Mag. Stephan Maier
University of Technology Graz
Institute for Process and Particle Engineering
Inffeldgasse 13/3
A-8010 Graz, Austria
stephan.maier@tugraz.at
http://ippt.tugraz.at

Co-Authors: MSc. Khurram Shahzad, Dr. Manfred Szerencsits, Prof. Michael Narodoslawsky

Project Syn-Energy II determines the potentials for a synergetic expansion of agricultural biogas production. Field experiments during this project have shown that the cultivation of intercrops between common main crops increases the crop rotation yield and reduces ground water pollution, erosion and emissions of greenhouse gases. Simultaneously the food security is not limited. Furthermore an examination of synergies can be made for biological crop rotation systems and measurements of conservational soil cultivation. Additional research takes a profound contemplation on impacts on soil water content and energy efficiency of agricultural production (Anspach et al. 2013).

Energy- and materials flows in a variety of arable-farming and biogas production systems within the research test areas of the project should be examined and then be integrated in Life Cycle Analysis (LCA) methodologies. On behalf of the Process evaluation group of the Institute for Process and Particle Engineering (TU Graz) an ecological evaluation was carried out. In this respect comprehensive energy- and material balances have been examined and provided robust indicators for the determination of the ecological footprint executed by the Sustainable Process Index (SPI, http://spionweb.tugraz.at/en/welcome) (Krotscheck and Narodoslawsky 1996; Narodoslawsky and Krotscheck 1995; Niederl and Narodoslawsky 2005).

Besides common types of biogas use (electricity, heat) additionally biogas cleaning and fuel use is ecologically evaluated. Goal of the project is the evaluation of biogas use in agriculture (e.g. gas-tractors) in sense of a closed energy-cycle or a cradle-to-cradle biogas production cycle (cropping, biogas production/-cleaning, biogas in tractor).

Evaluations of considered crop rotation systems and the energetic use of intercrops (use machinery, fertilisers, pesticides, area needed) are shown together with the respective emissions (nitrous oxide, nitrate, methane, carbon dioxide, etc.). Hence a comparison can be carried out directly as well as the determination of ecological hot-spots and conclusions on their reduction and optimisation potential (SUSTAIN 1994).

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Freitag
17
Jänner

14:00–18:30 Uhr

Parallelblock 14

Workshop Torrefikation von Biomasse

Friday
17
January

2:00–6:30 pm

Parallel Session 14

Workshop Torrefaction of biomass

Überblick über internationale Entwicklungen im Bereich Torrefikation

Michael Wild
International Biomass Torrefaction Council
Renewable Energy House, Rue d'Arlon
63-65,Brussels 1040, Belgium
michael@wild.or.at
www.aebiom.org/blog/category/networks/ibtc/

Torrefikations-Demonstrationsanlagen werden kontinuierlich betrieben und Anlagenerrichter sind bereit kommerzielle Anlagen in industriellem Maßstab zu liefern. Aus dem Wunsch und den Ankündigungen ist Realität geworden. Das Up-scaling ist in vollem Gange. Sowohl Pellets als auch Briketts werden produziert und stehen dem Markt zur Verfügung.

Torrefikation, die Wundertechnologie um aus Biomasse den idealen Kohleersatz zu machen, so oder ähnlich war die Einschätzung vor einigen Jahren. Eine große Anzahl von Entwicklern hat sich aufgemacht, diese „Wundertier" zu erschaffen. Viele haben wiederholt Ihren Erfolg hinausgerufen und Ankündigungen gemacht. Tatsächlich aber waren viel mehr Misserfolge als klare Erfolge zu verzeichnen, gerade unter den lautesten Initiativen. Das hat das Image der Torrefikation beschädigt. Heute, die Nebel des Marktschreiens lichteten sich, stehen mehrere Unternehmen mit fertigen technischen Lösungen für die Torrefikation, teilweise auch Systemlösungen samt Verdichtung, bereit industriell kommerzielle Anlagen zu liefern bzw. zu betreiben. Belege der technischen Machbarkeit sind erbracht, Anlagen werden kontinuierlich betrieben, handelbare Produkte erzeugt.

Die unterschiedlichen technischen Ansätze und Lösungen für Torrefikationsreaktoren sind bekannt. Wesentlich ist, dass heute die Systemintegration der Torrefikationsanlagen von vielen Unternehmen vollzogen ist. Dennoch ist die Entwicklung nicht abgeschlossen. Zwar sind Torrefikation selbst und das Handling der Gasströme nahezu komplett beherrscht. kontinuierliche Prozesse, die homogen torrefizierte Biomasse erzeugen sind heute Realität. Die Entwicklungen wurden Großteils auf Basis Holz durchgeführt. Die Umsetzung der Erkenntnisse auf andere feste Biomassen ist im Gange und wird dank der Vielzahl an zur Verfügung stehenden Pflanzen und Reststoffe wohl nie komplett abgeschlossen sein. Als Verdichtungstechnologien kommen Brikettierungen oder Pelletierungen zum Einsatz. Auch hier sind kontinuierlicher Betrieb und stabile Produktqualität erreicht. Dichte, Mahlbarkeit sind gänzlich sichergestellt, hinsichtlich Abriebfestigkeit und Wasserbeständigkeit besteht noch Potential zur Verbesserung und wird heute viel Augenmerk auf diese Bereiche gelegt.

Im Rahmen des Vortrages werden Unternehmen die heute Anlagen und Komponenten anbieten und ihre Lösungen präsentiert sowie in Folge auch auf den Stand der Entwicklung in den Rahmenbedingungen eingegangen. Der größere Teil dieser Unternehmen hat das International Biomass Torrefaction Council IBTC im Jahr 2012 ins Leben gerufen. Dieses ist eine gemeinsame Plattform zur Förderung des Aufbaues eines Marktes für torrefizierte Biomasse.

Das IBTC unterstützt dabei Marktzutrittsbarrieren zu überwinden, günstige Marktbedingungen für torrefizierte Biomasse zu schaffen, und den Bereich torrefizierte Biomasse von Ihrem heutigen Niveau der Demonstrationsanlagen zu einem Commodity Sektor zu entwickeln.

Unter die zahlreichen Aktivitäten des IBTC fallen zum Beispiel die Abklärung der anzuwendenden Tarifnummern, nötige Zulassungen für den Transport der torrefizierten Produkte, alle Angelegenheiten rings um Health and Safety, wie auch die genauere Festlegung der Produktbeschreibung als solche. Hier dem Markt Klarheit über die Spezifikationen und Eigenschaften des Produktes zu geben ist eines der wichtigsten Anliegen des IBTC. Zu diesem Zweck wurde die im Rahmen der ISO Biomasse Standardisierung eingeleitete Dynamik genutzt und gemeinsam mit dem Österreichischen Normungsinstitut und Dr. Englisch sowie dem SECTOR Project ein Vorschlag für eine Norm Torrefizierter Biomasse entwickelt welcher in Folge vom ISO Committee als Proposal new work item ISO 238 WG 2; ISO 17225: Solid biofuels – Fuel specifications and classes – Part XX: Graded torrefied pellets aufgenommen und nun weiter bearbeitet wird. Es ist zu erwarten, dass nach Durchlaufen des üblichen ISO Prozesses in etwa 2 Jahren torrefizierte Biomasse einen eigenen Standard haben wird. Dies wird sicherlich wesentlich zur weiteren Ausbildung der Märkte beitragen.

Densification of torrefied materials – the SECTOR project

Wolfgang Stelte
Danish Technological Institute
Gregersensvej
2630 Taastrup, Denmark
wst@dti.dk
www.dti.dk

The SECTOR project (Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction) is a large-scale European project with a strong consortium of 21 partners from industry and science. The project is focused on the further development of torrefaction-based technologies for the production of solid bioenergy carriers up to pilot-plant scale and beyond, and on supporting the market introduction of torrefaction-based bioenergy carriers as a commodity renewable solid fuel.

In parallel to the development of torrefaction and densification technologies the consortium will work on the assessment of selected logistics aspects and the use of torrefied products in existing conversion options as well as fuel specification and testing methods. This is complemented by a full sustainability assessment of torrefaction-based biomass-to-end-use value chains. The partners CENER (Spain), DTI (Denmark), ECN (Netherlands), Topell (Netherlands) and Umeå University (Sweden) provide the knowhow and equipment for the core technologies of torrefaction and densification. Industry partners such as EON (UK) and Vattenfall (Sweden), amongst others, will concentrate on logistics and end use applications. The scientific organizations, like ofi (Austria), TFZ (Germany) and VTT (Finland), bring in their expertise in terms of analysis and testing methodologies as well as standardization.

Densification of torrefied materials
Densification of torrefied biomass is a crucial step to improve its handling and storage properties. Torrefied biomass is a challenging raw material for pelletization and briquetting processes, and therefore an important aspect to be addressed in the SECTOR project. The partners in the project have the equipment and the know-how to study pelletizing properties of torrefied biomass from laboratory to production scale size. Laboratory trials based on single pellet press units have been used for screening different raw materials and for optimizing process parameters. Pilot plants across Europe have successfully produced several thousand kilos of torrefied pellets and briquettes from various biomass residues.

Results from the project show that the densification properties of torrefied biomass depend to large extend on the torrefaction conditions (temperature, retention time) and biomass feedstock. Densification processes of torrefied biomass can be improved by fine-tuning the processing parameters i.e. water content of the material, die temperature, press channel dimensions and/or additive addition. The product quality of the produced pellets and briquettes varies according to the used raw material and process conditions. It is possible to produce high quality pellets and briquettes of torrefied biomass that match the end user requirements. The main challenge at the present time is to produce constantly high quality, independent of the used biomass feedstock and at a cost competitive level.

Characteristics of torrefied products and their dependence on process conditions

Ute Wolfesberger-Schwabl
OFI Österreichisches Forschungsinstitut für Chemie und Technik
Franz-Grill-Straße 5
1030 Wien, Österreich
Ute.wolfesberger@ofi.at
www.ofi.at

Co-Authors: Kay Schaubach[1], Kathrin Bienert[1], Jaap Kiel[2], Michiel Carbo[2]
[1] DBFZ Deutsches Biomasseforschungszentrum gGmbH, D-04347 Leipzig, Germany
[2] ECN Energy Research Centre of the Netherlands. 1755 ZG Petten, The Netherlands

Torrefaction is considered worldwide as a promising key technology for bioenergy applications. It involves heating biomass in the absence of oxygen to a temperature of 200 to 320° C. This results in the loss of moisture and volatile matter of the biomass leading to a higher energy density and to improvements of other material characteristics, e.g. a better grindability. The torrefied material shows a lower water absorption rate as well as a change in fuel composition. The analyzed and evaluated biomass includes different wood species and agricultural fuels in the form of chips as well as densified pellets or briquettes.

The torrefaction parameters like process temperature, residence time and input fuel characteristics have an influence on the characteristics of the “end product”. These properties will be highlighted in this work and considered in detail. Especially the water absorption behavior and the fuel characterization such as carbon content, net calorific value and further fuel parameters will be focused on. The fuel characterization methods are similar to those applied for untreated biomass but also further methods are required for the description of the new fuel “torrefied biomass” e.g. water absorption behavior. Therefore new methods are under development and will be presented within this work.

All research is part of the EU-project SECTOR (Production of Solid Sustainable Energy Carriers by Means of Torrefaction) with a duration of 42 months (start: 01.01.2012) which includes 21 partners of 9 EU countries and is funded within the 7th Framework Program.

Further information can be found on the website www.sector-project.eu.

Advantages and drawbacks for international trade of torrefied products

Dr. Mark Beekes
DNV GL Energy
Utrechtseweg 310
6812 AR, Arnhem, The Netherlands
mark.beekes@dnvkema.com
www.dnvkema.com

Co-Authors: Ir. Henk Koetzier, Dr.Ir. Marcel Cremers, Ir. J. Middelkamp

DNV KEMA has witnessed an increase in torrefied biomass pellets quality, mainly resulting from technology improvements and lessons learned about the fundamental process of torrefaction, ensuring torrefied wood pellets to be an attractive add-on to the biomass portfolio.

The last few years, we have improved our BioCase® biomass supply chain software to determine the cost and CO_2 emissions over the biomass supply chain. Depending on the layout of the supply chain we are capable to compare the specific cost of wood pellets with torrefied pellets. We will present for a number of typical layouts the BioCase® calculated cost of torrefied pellets and wood pellets, as injected in the power plant boiler.

These layouts include:

- Cost of wood pellets and torrefied pellets originating from the Canada/US and transported to a European pulverized coal-fired power unit
- Impact of distance
- What is the upper limit of torrefaction plant cost in order to have lower or equal cost of electricity (originating from firing wood dust in a pulverized fuel fired boiler) with and without investment in wood pellet handling facilities at the power plant site?
- And how does this influence the CO_2 intensity levels over the whole supply chain?

Experiences from large-scale test with torrefied biomass fuel at the IGCC plant Willem Alexander Centrale

Dr. Nader Padban
Vattenfall Research & Development AB
R&D Projects
Sustainable Energy Projects
SE-, 169 92 Stockholm, Sweden
nader.padban@vattenfall.com
www.vattenfall.se

Co-Authors: Raziyeh Khodayari, Anna Hinderson and Rutger Quak

Abstract
Large-scale co-gasification of torrefied biomass pellets and coal was performed at the Willem Alexander Centrale (WAC) in the spring 2012. In total approximately 1,200 tonnes of biomass were used during the tests at a biomass share of 70 % on energy basis. Prior to the tests an extensive laboratory and small-scale tests had been performed to be able to minimize the failure risk during large-scale tests. Unloading, storage, reclaiming, blending with coal and conveying of the torrefied pellets with the existing mechanical installation was basically possible.

To reduce the dust emissions it was necessary to install new dust suppression equipment such as water dispersion systems. The milling was not an important issue at WAC power plant however the small-scale tests had indicated the grindability of the tested fuel was sufficient enough. The sluicing and feeding system worked stable, no problems were reported. It is estimated that with a torrefied material with higher heating value (~ 22 MJ/kg) and good quality it will be possible to reach the power output of ~230 MWe (96 % of full load at only coal) at the 70 % (e/e) co-gasification with small hardware modifications, adjustments and fine-tuning. The impact of co-gasification on the composition of the syngas was in the line with what one could expect in co-gasification of biomass fuels: The CO_2-content of the syngas increased and the CH_4-content decreased for instance. Fouling was not an issue during the test because of low capacity of the gasifier.

Acknowledgment
The research leading to these results has received funding from the European Union Seventh Framework Programme FP7/2007-2013 under grant agreement n° 282826, within SECTOR project (“Production of Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction”). For more information please visit: www.sector-project.eu.

Andritz torrefaction technologies and summary of pilot plant operation in Austria and Denmark

DI Klaus Trattner
Separation / Thermal Systems
Andritz AG
Stattegger Str. 18
8045 Graz, Austria
klaus.trattner@andritz.com
www.andritz.com/ep-thermal-main

The globally operating technology company Andritz has invested a lot of know-how and effort into torrefaction during the past few years. Two different process routes have been developed, which are optimized for different approaches towards this new and promising technology to upgrade biomass. Two pilot plants (one in Austria, the other in Denmark) - each showing the entire process, including drying, torrefaction, energy supply and densification - were built and successfully commissioned. Many test runs with different kinds of biomass feedstock and different process settings have been accomplished and offer now a broad and solid know-how base for further commercialization of torrefaction.

In the beginning, the creation of pilot plants was necessary to proof the concept and to optimize all processes under genuine conditions. By now, the pilot plants are increasingly used to demonstrate use cases for customer-specific raw materials and to provide significant quantities of test material.
A – strongly condensed – summary of these activities will be presented at the 4th CEBC.

Denmark, Andritz/ECN vertical reactor design
The Torrefaction Demo Plant in Sdr. Stenderup, Denmark, was a cross divisional project under Andritz Pulp & Paper Division management. The Demo Plant was commissioned in October 2012, running 5 x 24 hours per week. The Energy research Centre of the Netherlands (ECN) has provided design inputs for the reactor and taken active part in the daily operation, while the Danish Technological Institute (DTI) has provided expert knowledge regarding pelletizing.

The process consists of a rotary dryer, a vertical, pressurized torrefaction reactor and a pelletizing plant. Through 2012 and 2013 various wood species (spruce, cedar, eucalyptus, beech, poplar) were tested successfully. Special focus has been set on optimizing the pelletizing process, which indeed was the most challenging part of the whole project. 100 tons of torrefied pellets were manufactured in November 2012. The material was successfully co-fired at a potential customer. Further 200 tons of pellets were manufactured for a combustion test to be conducted in Q1-2014, also at a potential customer.

Austria: The ACB® process
The ACB® process (ACB® – Accelerated Carbonized Biomass) has been developed by a consortium based in Austria, consisting of Andritz Separation Division, Polytechnik and Wild&Partner.

After preliminary studies, the consortium started the erection of a pilot plant in Frohnleiten, Austria in 2010. The Pilot plant erection and operation were executed by ACB Entwicklungsgesellschaft, a joint venture of Andritz and Polytechnik. During the project execution widespread types of activities were accomplished ranging from staffing, utilities and maintenance issues to scientific project execution.

The pilot installation in Austria was successfully commissioned in September 2011 (Phase I:Drying, Torrefaction and Energy supply) and September 2012 (Phase II: Briquetting). Until October 2013 in total more than 6000 m^3 of different raw materials were processed. Focus was on low cost forest and agricultural waste fractions, so besides doing tests with locally sourced softwood and hardwood (spruce, pine, beech, aspen, alder, birch, poplar) logging residues, municipal “green-waste” and sugar cane leaves from Brazil were tested. Briquettes were used for different test purposes and were also delivered to small or medium-scale heating plants.

The ACB torrefaction plant was taken over by the municipality of Frohnleiten in October 2013. Future utilization will be based on both: pilot testing and commercial production of briquettes.

14:00–16:30 Uhr

Parallelblock 15

Workshop Pellets

2:00–4:30 pm

Parallel Session 15

Workshop Pellets

Classification of slagging tendencies of biomass fuels

Marcus Öhman
Energy Engineering, Division of Energy Science, Luleå University of Technology
971 87 Luleå, Sweden
Marcus.ohman@ltu.se
www.ltu.se/org/tvm/Avdelningar/Energivetenskap?l=en

Co-Authors: Ida-linn Näzelius, Luleå University of Technology; Anders Rebbling, Umeå University; Christoffer Boman, Umeå University

Slag and ash deposition problems have more than occasionally been observed in biomass fired plants. These problems can lead to reduced accessibility as well as performance of the combustion appliances. In addition to the more fundamental research in the area, initiative has been undertaken to evaluate the usefulness of fuel indices and different classification systems to help assess and predict these kinds of slagging problems.

The objective of the present work was to formulate a classification system that is able to determine the slagging behaviour of a certain fuel in a specific combustion appliance. 15 different wooden and non-wooden pelletized biomass fuels were selected covering a broad range of fuel ash composition and slagging behavior. These pellets fuels were further subjected to controlled combustion experiments in 9 different combustion appliances. Based on the combustion results a fuel classification system relating raw material composition, ash content, concentrations of ash forming elements/matter and the type of combustion appliance to slagging tendency and potential operational problems of a fuel were formulated.

The classification system is presented both as a matrix from which the recommendations can be deduced and in multivariate projection models/methods (i.e. PLS). The present work is part of the EU FP7-SME project AshMelT in progress 2012-2014, coordinated by the Austrian competence centre Bioenergy2020+.

Ash melting behaviour of solid biofuels in residential pellet boilers

Manuel Schwabl
Bioenergy2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg, Austria
manuel.schwabl@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: Sabine Feldmeier, Klaus Nagelhofer, Jonas Dahl, Claudia Schön, Ida-Linn Näzelius, Christoffer Boman, Elisabeth Wopienka, Walter Haslinger

To overcome the 2020 goals of the EU, solid biofuels will have to take over a big role in the energy provision. Since the resources for wooden biofuels are limited and are in competition with other industry, new solid biofuels will be introduced to the markets. However, to be applicable in residential pellet boilers, certain quality criteria have to be met. The ash melting behaviour is one of these criteria.

This work investigated the ash melting behaviour of solid biofuels and their impact on residential pellet boilers. Overall 14 different solid biofuels, ranging from different wood species to agricultural waste, were tested in overall 9 different combustion technologies, ranging in a power output from 5 to 200 kW. An assessment method to determine the severity of ash melting and the applicability of a fuel to a combustion system was developed. The results show, that the fuels have a slight variation of the ash melting behaviour in the different combustion systems and particularly have a distinctly different impact on the combustion system. The impact on the combustion system was made measurable by the applicability method and thus a ranking on how the combustion technologies cope with the ash melting was elaborated.

Comparison of laboratory methods to characterise ash melting behaviour

Jonas Dahl
Danish Technology Institute
Gregersensvej
2630 Taastrup, Denmark
joda@teknologisk.dk
www.teknologisk.dk

Co-Author: Torben Nørregard

The use of the AFT method for predicting slagging in pellet boilers is commonly failing and users of the results have troubled with understanding its relevance. It is thus the aim of the AshMelt project to develop and test a method more accurate and adequate for this purpose. For this purpose three potential laboratory characterization methods has been tested, using 14 different pelletfuels which also been tested in ordinary pellet boiler test runs in the AshMelt project. The methods tested were 1) the simple slag test, 2) The CIEMAT slag test and 3) the Slag Analyser. The presentation will reveal the comparison of results from these laboratory tests as well as comparison with the results obtained from the boilers test runs and there compatibility.

Off-gassing – safety issues related with emissions from wood pellets along the pellet supply chain

Waltraud Emhofer
Bioenergy2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg, Austria
Waltraud.emhofer@bioenergy2020.eu
www.bioenergy2020.eu
www.safepellets.eu

Co-Authors: Mehrdad Arshadi, Per Blomqvist, Jonas Dahl, Hari Arti Khalsa, Ida Larsson, Anders Lönnermark, Niels Peter Nielsen, Henry Persson, Annett Pollex, Irene Schmutzer-Roseneder, Wolfgang Stelte, Elizabeth Valencia-Reyes

Safety issues along the pellet supply chain are currently in the focus of international standardization processes. Off-gassing is one of the main topics especially with respect to safe transportation and storage of biomass pellets. An introduction to the phenomenon of off-gassing is given and the risks and implications arising from this challenge for the pellet industry are presented.

The SafePellets project – studies of self-heating in biopellets storages

Niels Peter K. Nielsen
Danish Technological Institute
Gregersensvej
2630 Taastrup, Denmark
npkn@teknologisk.dk
www.dti.dk

Co-Authors: Mehrdad Arshadi, Per Blomqvist, Jonas Dahl, Waltraud Emhofer, Hari Arti Khalsa, Ida Larsson, Anders Lönnermark, Henry Persson, Irene Schmutzer-Roseneder, Wolfgang Stelte, Elizabeth Valencia-Reyes

The presentation will provide an introduction to the methodologies and aims of the self-heating studies in the SafePellets project. A number of laboratory methods are used to measure self-heating potentials of various pellet types, and these results are verified in several scales of applied storages ranging from $1m^3$ to full-scale silos and warehouses.

The importance of standardization and certification for small-scale pellet producers

Andreas Schneider
Pusch AG
Auf der Weid 1-15
56242 Marienrachdorf, Germany
andreas.schneider@pusch.ag
www.pusch.ag

Co-Authors: Annett Pollex, Martin Hoeft, Jan Khalsa

With the increasing use of alternative biomasses for the production of high quality pellets, even small pellet producers have to deal with the methods of standardization and certification. Are the associated costs justified? A brief overview from the perspective of a pellet manufacturer.

Safety issues – impact on pellet industry

Hans Martin Behr
German Pellet Association (Deutscher Energieholz- und Pellet-Verband e.V.)
Neustädtische Kirchstraße 8
10117 Berlin, Germany
martin.behr@holzpellet.com
www.depv.de

CO off-gassing in pellet storages became a widely discussed subject in the pellet industry. Approaches have to be found not only to minimize the danger of off-gassing in pellet storages. Appropriate measures to avoid the formation of CO have to be defined for the production of pellets. Aim of the European research project SafePellets is to discuss the issue with experts from the pellet industry and to develop approaches to solve the problem.

Postersession

Poster Session

Bio-refinery of lignocellulosic rice straw to produce valuable by-products

Abdallah. S. Ali[1,2],
[1] Chair of Chemistry of Biogenic Resources, Technische Universität München, Schulgasse 16, 94315 Straubing, Germany.
[2] Microbiology Department, Faculty of Agriculture, Cairo University, 12613 Giza, Egypt.
a.abdraboh@wz-straubing.de
http://www.rohstoffwandel.de

Co-Authors: D. Schieder[1], V. Huber[3], H. M. Riepl[3], V. Sieber [1]
[3] Chair of Organic and Analytical Chemistry, HS Weihenstephan -Triesdorf, Schulgasse 16, 94315 Straubing, Germany.

Introduction
Our research aims at recovery of high valuable substance such as wax, silica, lignin and cellulose by using biorefinery systems. Rice straw is readily available, cheap and renewable lignocellulosic source for producing bio-valuable substances without interfering with the food cycle. The utilization of rice straw could reduce the global greenhouse gas emission resulting from annual on-site burn of 63 million tons of rice straw. Additionally, sources for fuel production will increase and dependency on fossil fuel will decrease as a result. However, structure complexity and inhomogeneity of straw hinder the microbial digestion.

Method
Rice (*Oryza glaberrima*) straw samples were collected from Al-Sharkia City in Egypt. They were washed, dried and milled to 1-2 mm. Physico/chemical properties were evaluated to create a full overview on the straw structure. The biorefinery was fractionated the main components in the straw by sequential refinery system, depending on their polarity and solubility, organic valuable compounds were extracted by organic solvents for removal of wax. $NaOH/H_2O_2$ is used to destroy the complex structure of straw, and to dissolve hemicellulose, lignin and silica. The insoluble residue contained of cellulose and the rest of hemicellulose was recovered by filtration and washing with water to be ready for subsequent fermentation processes. The final products were evaluated with physical/chemical tests and microscopic observation to identify their quality and quantity.

Results
The sequential refinery system started by organic solvents followed by the $NaOH/H_2O_2$ treatment almost completely destroyed the complex structure of straw. This process allows recovering the organic valuable compounds, silica, lignin and hemicellulose up to 30, 131, 54 and 235 g/kg dry weight rice straw respectively. Conversely, hemicellulose and cellulose were not well separated from each other. However, after saccharification with commercial cellulase and hemicellulase mixtures, xylose and glucose were recovered between 90 % and 97 %, respectively, without any inhibitory compounds. Furthermore, hemicellulose/cellulose mixture is helpful to enhance the productivity of SSF in fermentation products by increasing of the carbohydrate content (pentose and hexose sugars).

Conclusions
Bio-refinery is a promising technique to providing an alternative sustainable renewable resource for fuels, other valuable products, alongside with the air pollution decrement.

Analysis of efficiency losses and solar heating ratio of a storage integrated pellet boiler in combination with a solar heating system under real life conditions

DI (FH) Stefan Aigenbauer
Bioenergy2020+ GmbH
Gewerbepark Haag 3
A-3250 Wieselburg-Land, Austria
stefan.aigenbauer@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: Dr. Michael Hartl, DI Andreas Simetzberger, Dr. Ir. Vijay Verma, DI Dr. Christoph Schmidl

Modern state-of-the-art pellet boilers reach at the type testing according to ÖNORM EN 303-5 a high efficiency of above 90 %. In contrast to type test results different studies and monitoring data (KUNDE 2009[i]; SCHWARZ 2011[ii]) of such systems under real life operation conditions show annual efficiencies of around 75 %. This demonstrates the optimisation potential and therefore the feasibility of fuel saving in real life operation. A further possibility to decrease the heating cost is to install solar collectors as an auxiliary heating system for warm water supply and depending on the system configuration sometimes also for room heating. Today products that combine both technologies in one system are commercially available. The objective is to investigate the laboratory- and field performance of a pellet burner which is directly integrated into the solar storage combined with a solar heating system. Reasons of efficiency losses and low solar heating ratio were identified and the optimisation potential was derived.
The background of this abstract is the project KOMBINE. This project is focused on laboratory tests on a solar thermal-biomass system, a detailed monitoring of four different sites to collect measurement data and a computer simulation model for this combined system. This simulation model and the acquired data are used for developing a new control concept for such device. Field and laboratory measurement data of the project KOMBINE are the basis for the current investigation. The approach of the work is to analyse this data and evaluate the optimisation potential.

First Results & Outlook
The collected monitoring data of the first year shows an annual system efficiency [SE] in field conditions between 70.7 % to 81.7 %. Furthermore the solar heating ratio [SHR] of the investigated systems was measured in the range between 19.7 % to 21.2 %.

$$SE = \frac{\int (\boldsymbol{Q}_{\mathbf{room\ heat}} + \boldsymbol{Q}_{\mathbf{warm\ water}})\boldsymbol{dt}}{\int (\boldsymbol{Q}_{\mathbf{Pellets}} + \boldsymbol{Q}_{\mathbf{Solar}})\boldsymbol{dt}} \qquad SHR = \frac{\int \boldsymbol{Q}_{\mathbf{Solar}}\boldsymbol{dt}}{\int (\boldsymbol{Q}_{\mathbf{room\ heat}} + \boldsymbol{Q}_{\mathbf{warm\ water}})\boldsymbol{dt}}$$

Following main efficiency losses of the system could be identified: exhaust gas losses, missing thermal insulations of hydraulic, natural circulation effects, inefficient operating stages (start up and shut off) and storage losses. Detailed investigations of the monitoring data to evaluate the losses during the start up and shut off phase are currently done. These results will show the potential of a new, well modulating power control concept. It is currently estimated that the proposed new control concept and additional technical measures will result in an increase of around 10 percentage points of annual efficiency compared with existing systems.

Acknowledgement
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Recent developments of advanced biofuels demoplants

Dina Bacovsky, Nikolaus Ludwiczek
Bioenergy 2020+ GmbH Standort Wieselburg
Gewerbepark Haag 3
3250 Wieselburg-Land, Österreich
dina.bacovsky@bioenergy2020.eu
www.bioenergy2020.eu

Co-Author: Mag Nikolaus Ludwiczek

Around the world a number of companies pursue projects to develop and deploy advanced technologies for the production of biofuels. A broad variety of raw materials is suitable, multiple conversion technologies are being developed and a range of different fuel products can be marketed. With so many different options, it is hard to keep track of the development of the sector.

One of those that give a good overview but also provide some level of technology detail is IEA Bioenergy Task 39 “Commercializing Liquid Biofuels”. Task 39 has gathered data on more than 100 projects from the technology developers, and provides this data through an online interactive map (http://demoplants.bioenergy2020.eu) and a summary report.

Between 2010 and 2012, biofuels technologies have developed significantly. Hydrotreatment as pursued by e.g. Neste Oil has been commercialized and accounted for app. 2.4 % of biofuel production worldwide in 2012. Fermentation of lignocellulosic raw material to ethanol has also seen a strong development, and several large-scale facilities have come online in Europe and North America in 2012 and 2013. As for thermochemical processes, the development has turned to the production of mixed alcohols rather than BtL-Diesel. Economic reasons drove this development and concepts like the integration into existing industries and the production of several products instead of biofuel only (biorefinery concept) receive increased attention. The production capacity for biofuels from lignocellulosic feedstock (i.e. advanced biofuels technologies excluding hydrotreatment) accounted for some 140,000 tons per year in 2012, while hydrotreatment capacity reached 2,190,000 tons per year.
But, this development has also seen some drawbacks, and some of the projects for advanced biofuel production have failed. Choren, Range Fuels and Terrabon closed their companies; others have stopped their planned activities relating to specific advanced biofuels technologies. Several large-scale projects have been postponed, some even though public funding would have been granted. It is important to learn the lessons from these drawbacks.

The advanced biofuels sector is expected to further increase dynamically, especially for the production of biofuels from lignocellulosic raw material. Based on the announcements for further demonstration plants and commercial facilities, the production capacity for biofuels from lignocellulosic feedstock is expected to triple between 2012 and 2015. Yet the contribution made to the total production of biofuels is small and a much faster development is required until significant amounts of lignocellulosic biofuels can be produced.

The timing of emissions from forest based bioenergy – potential strategies in Austria to meet bioenergy needs and commitments and minimize short-term emissions

MSc David Neil Bird, DI Lorenza Canella, Dr. Gudrun Lettmayer, Dr. Hannes Schwaiger – Joanneum Research Forschungsgesellschaft mbH
Dr. M. Lexer, DI S. Perez, DI W. Rammer – University of Natural Resources and Life Sciences (BOKU)

Contact person:
Neil Bird
neil.bird@joanneum.at
www.smartforests.at

Bioenergy is often considered CO_2 neutral because the biomass used for energy regrows after it has been used if the biomass is harvested sustainably or would have oxidized if it had not been used. However, this view, though correct, is somewhat simplistic. There is a time component to the CO_2 fluxes. There are also CO_2 and non-CO_2 emissions from the bioenergy supply-chain: the collection, transportation storage, conversion and distribution of the energy service. As a result, bioenergy causes greenhouse gas emissions. In addition, since combustion of biomass has a higher carbon intensity and lower energy efficiency than fossil fuels, the bioenergy emissions for a period of time may be more than the emissions from the equivalent fossil fuel energy that the bioenergy displaces. With time, bioenergy may result in less emissions than the reference energy system.

SMART FORESTS (**S**electing **M**anagement **A**lternatives **R**esponding to **T**argets. **F**orest **O**ptimization for **R**enewable **E**nergy and **S**equestration using **T**ime-dependent **S**trategies) is a project sponsored by the Austrian Climate Research Programme (Klimafonds Antragsnummer: B068656). SMART FORESTS investigates the time aspect of greenhouse gas emissions from Austrian forestry operations. The project has produced a tool that combines state-of-the-art forest carbon stock modelling (BOKU) with complicated, cascading product chains (JOANNEUM RESEARCH) to produce a time-series of emissions from a range of bioenergy system. This tool can be used by policy makers to analyze which forest management options and biomass uses produce bioenergy while minimizing the short-term increase in greenhouse gas emissions over the fossil fuel counterpart.

Four forest management options, business-as-usual and three types of intensified management, with and without impacts of climate change, and three energy policy scenarios; business-as-usual, wood-for-energy, and modified wood-for-energy, were evaluated using the aforementioned tool. Impacts of increased residential energy efficiency and increased combustion of waste paper for energy were also analysed.

Results:

1) Increasing the intensity of forest management causes a short term increase in greenhouse gas emissions as compared to business-as-usual management. This occurs for approximately 40 years after which this strategy causes less greenhouse gas emissions. In addition, Austria's renewable energy targets will be met if only 15 % of the forest is subjected to intensive management.
2) Austria's renewable energy targets can be also met by increasing energy from wood by only diverting wood to energy from other wood product streams (i.e. without changing forest management) However, this strategy increases greenhouse gas emissions because of the necessity to make material substitutes from fossil energy materials.
3) Using more discarded paper for energy instead of recycling also causes an increase in greenhouse gas emissions and will not allow Austria to reach its renewable energy targets.
4) Improving residential combustion efficiency does reduce greenhouse gas emissions, but does not allow Austria to meet its renewable energy targets.

Energy recovery from agricultural waste by means of thermochemical conversion in fluidized bed reactors

Torsten Birth
Fraunhofer Institute for Factory Operation and Automation IFF
Sandtorstraße 22
39106 Magdeburg, Germany
torsten.birth@iff.fraunhofer.de

Co-Authors: Ling He, Patric Heidecke

The current commercial supply of renewable energy from biomass and the legislative focus on cutting-edge cogeneration is predominantly based on the renewable resource wood. This is generating an exponentially increasing demand for wood as reserves are steadily being reduced by competition for material. Wood prices are therefore rising and the cost effectiveness of existing methods of use is diminishing. By 2030, Europe will face a deficit between supply and demand of 150 million tons of wood. This makes the development of unutilized biowaste with great potential for energy recovery imperative and particularly pertains to agricultural waste, which is largely precluded from direct use as material. Germany alone has a theoretically available supply of 20 million tons of culmiferous waste per year. Other agricultural waste includes rice husks (China alone produces 197 million tons of rice annually, olive pits and citrus fruit waste (from Italy and Spain), and sugar cane (Brazil produces 514 million tons annually).

The objectives of the project are to ascertain both the hyperstoichiometric and hypostoichiometric thermochemical conversion characteristics of representative agricultural fuels with high relevance for Central European agriculture sector separately and in blends using laboratory and pilot-scale fluidized bed combustors, to identify the options for conditioning process products, and to assess the potential for optimization. Furthermore, potential uses of process products as material will be identified for the purpose of creating closed material cycles and measures will be taken to influence the quality of the process products positively. Combustion, gasification, pyrolysis and combinations of individual conversion paths will be the processes studied.

The conversion characteristics of agricultural waste will be studied to underpin the process engineering of thermochemical conversion plants, specifically innovative concepts for distributed recovery of power and heat or cooling in the range of 1-10 MW of thermal output. This will contribute to the development of hitherto unutilized potentials of agricultural waste for energy recovery.

Project deliverables will be reliable bases of data on conversion characteristics of agricultural wastes, thus facilitating the implementation of a system and/or concept in the agricultural sector in particular. Among others, potential users will be farms and farming collectives requiring heat, cooling and power and possibly requiring material from process products, which essentially produce the respective waste. Plant engineering will pursue the implementation of the conversion concepts developed.

Decentralized modular thermo-chemically conversion facilities for utilizing biogenic energy sources in fuel cells

Torsten Birth
Fraunhofer Institute for Factory Operation and Automation IFF
Sandtorstrasse 22
39106 Magdeburg, Germany
torsten.birth@iff.fraunhofer.de

Co-Authors: Wolfram Heineken, Ling He

The supply of the annually 2 % increasing energy demand through fossil fuels is not sustainable. Alternatively energy from biogas can be used. State of the art is the conversion of biogas into heat and electricity or its upgrading to bio-methane. More innovative is the conversion of biogas into H_2. About 60 % of the world's annual demand (500 Mio.m³) of H_2 is provided by the reforming of fossil fuels, while 40 % are by-products of industrial processes. Substitution with H_2 from biogas is an important part of the H_2 infrastructure development and the establishment of multi-purpose H_2 utilization technologies.

Within the scope of the project Green-FC a modular prototype was developed for the conversion of biogas into H_2, which includes five modules: I gas supply, II gas purification, III gas reforming, IV gas utilization and V post-combustion. The modules were designed using CAD software and simulated with CFD software. For the simulation of gas reforming, the eddy dissipation model and reaction kinetics from De Smet et al., Numaguchi & Kikuchi and Hla et al. were used. The simulation results indicated a full conversion of methane, a maximum H_2 yield and a low carbon monoxide concentration in the gas, which is suitable for HT-PEMFC. The instrumentation and heat utilization concept will be described in detail. The replacement of modules is possible so that alternative reactors for biogas conversion and the further use of this concept can be studied.

The project aimed to develop a prototype, as a process chain and modular connected components, to study the conversion of biogas into hydrogen for HT-PEMFCs.

Based on the overview of the state of the art in process steps, a flow diagram was identified, a built-up plan for the subsequent realization of the components was designed, and the components were dimensioned and simulated for implementation.

The innovations are the continuous operation of dual cartridge filters for the removal of hydrogen sulfide and siloxanes, and the compact reformer employing catalysts for ideal gas conversion through optimum heat and mass flow utilization.

The simulation of the individual apparatus (e.g. reformer, water-gas-shift-reactor and afterburner) indicates optimal methane utilization, maximum hydrogen yield, minimal carbon monoxide content and proper after-treatment of the exhaust fulfilling emission limits.

The result is the concept of a prototype to study the biogas conversion, provided with all design and construction documents, process control concept and simulation results for the system operation.

From manure to biofuels in rural areas: bioethanol and biomethane

Daniela Bona
Fondazione Edmund Mach
Via E. Mach, 1, San Michele a/A (TN), Italy
daniela.bona@fmach.it
www.fmach.it

Co-Authors: Silvia Silvestri, Lorenzo Forlin, Marco Tassan

The creation of short and sustainable chains in agriculture for the production of biofuels from biomass is the aim addressed in different works and projects from our working group. Between agriculture biomass, the manure is of particular relevance as by-product of animal breeding and as renewable energy source. Traditionally manure is the most important biomass used for the maintenance of soil fertility, but sometimes the problems due to an excess of nutrients back into the soil forces the looking for solutions. Actually one of the widely adopted techniques applied to manure is anaerobic digestion to produce power and heat from biogas, but the study of its use for biofuels generation is very interesting.

The first research project ZOOTANOLO (*The production of bioethanol as alternative energy exploitation of animal manure)* supported by Italian Ministry of Agriculture*,* analysed at lab level the possibility to extract and ferment to alcohol the indigested fiber and litter. The characterization of different samples of dairy cattle manure and slurry show the good presence of cellulose and hemicellulose (about 27 % on dm of cellulose and 20 % on dm of hemicellulose). The results obtained demonstrate that the production of bioethanol from this biomass is possible, even if some aspects have to be improved. The steps of the process studied are: pre-treatment, hydrolysis and fermentation[1]. The hydrolysis yields are good, about 40 % of fiber were split in fermentable sugars (hexose and pentose); however the fermentation yield are lower (about 30 %), because the production of ethanol from pentose (xylose and arabinose) is not efficient[2]. The hydrolysis of recalcitrant fiber and the fermentation of pentose are the most difficult issues. The work had the dual purpose: optimize the extraction of ethanol and at the same time identify the pretreatments and extraction systems simple and inexpensive. At the moment about 10 kg of ethanol/ton from dairy cattle manure and 12 kg/ton from solid fraction of dairy slurry have been obtained.

The second project BIOMASTER - *biomethane for transport* supported by Intelligent Energy Europe Programme deals with the promotion of biomethane for transport use and grid injection as innovative use of biogas. The technologies for the upgrading of biogas to biomethane are already developed and applied in many European countries. In Italy the problems limiting the diffusion of this option are mainly related to overcoming the so-called non-technological barriers (laws and incentives) and, in our region (Trentino), to the downscaling of the plants in alpine rural areas. One aim of the BIOMASTER project (www.biomaster-project.eu) is related to define the minimum size of the biogas plants for farms making convenient and interesting the upgrading to biomethane. Strictly connected to this aspect is the survey carried out at local level in all the four regions partner to assess the availability of other feedstocks. Due to the low specific biogas production of manure (0.30 m^3/kg of organic fraction of dry matter)[3] the energy and economical sustainability of small-size biogas plants is dependent on the co-digestion of manure and other by-products. Two Italian companies are implementing the membrane upgrading technology as the most suited to small amounts of input biogas (up to 50 Nm^3/h). Demonstration plants complete of fueling station have been realized./

Both, bioethanol and biomethane, can contribute to reach the European target (replacement of 10 % of fuels with biofuels) and to overcome the competition of food and no-food destination of land use in line with the recent indications from EU Commission.

Finally, an environmental aspect related to the production of biofuels from manure is the management of excess nutrients. So far have been conducted preliminary tests to verify the possibility of growth of microalgae on samples of distillation stillage obtained by alcoholic fermentation of manure. The results show that with a proper dilution (1:50) a removal of 90 % of the ammonia can be obtained.

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PEMURES _ Penetrating the **E**nergy **M**arket by **U**nused **R**enewable **E**nergy **S**ources

DI (FH) DI Christian Doczekal
Güssing Energy Technologies GmbH
Wiener Straße 49
7540 Güssing, Austria
c.doczekal@get.ac.at
http://get.ac.at
www.pemures.com

Co-Author: DI Dr. Richard Zweiler, Blaz Sunko, Rok Sunko

PEMURES is aiming to increasing the utilization of renewable energy sources in the cross-border region Slovenia-southern Burgenland with strong focus on making up to now unused renewable feedstocks accessible. The three-years project is carried out within the OP SI-AT 2007-2013 programme, which is co-financed by the European Union Regional Development Fund and the Ministry for Economic Development and Technology of the Republic of Slovenia. The lead partner Güssing Energy Technologies and the other Austrian partner European Centre of Renewable Energy is forwarding their knowledge to the Slovenian partners. The Slovenian partner skupina FABRIKA is very experienced at the Slovenian energy market and is identifying these border conditions for Renewables, which are better than on the Austrian energy market. The municipality of Ljutomer is willing to implement the newly developed models in Slovenia, scientific input is introduced by the University of Maribor and the Slovenian Forestry institute. The goal is to initiate projects between these two countries, support one of these projects by preparing a business plan and to summarize urgent needed policy changes.

Details and preliminary results
In the first phase additional required information has been gathered in order to prepare a trend-setting opening conference. Several municipalities from the cross-boarder region and high level stakeholders, resp. experts participated and initiated cooperations. Final outcomes were presented to increase the impact. Six best practise examples from the cross-boarder region were discussed to prepare the ground for new ideas, whereas the conference participants introduced valuable input to PEMURES. New models have been presented at the PEMURES – start conference, like Agroforst. The main focus concerning promoted renewable energy sources is now on unused biomass potentials, waste, geothermal energy and short rotation croppices. The project related publication from the Forestry institute of Slovenia states for instance, that the main weaknesses for the further development of SRC plantations in Slovenia is the country's topography (more than a third of its territory lies above an elevation of 600 m), the availability of technologies for planting, maintaining and cutting, and a lack of experience with new developed poplar and willow clones.

As part of the knowledge transfer a network office similar to the European Centre of Renewable Energy has been already established in Ljutomer, which name is COVE. The basis for the potential on renewable energy sources in this region is the energy concept, which will be established detailed within PEMURES. First results from the organic waste study in Slovenia are already available, which is the basis for the further development of prospective demonstration projects.

Another approach is the development of a rough business model for farmers. The idea is, that the farmers could advance to "energy farmers", which are providing services, like supply of wood chips in the simplest way. The final business model could be, that a farmer is providing the entire chain as turnkey solutions for multi-family houses.

In the final stage of the project several demonstration projects will be scheduled. The most promising will be identified and a business plan will be provided to the responsible stakeholders.
Finally, the findings from the legislative and policy survey will be summarized in a white book, which could be the basis for political stakeholders to improve the border conditions for renewable energy.

BIOMASTER – a European project on biomethane for transport

Fred Dotter, Senior Project Manager
Forschungsgesellschaft Mobilität – Austrian Mobility Research
FGM-AMOR gemeinnützige GmbH
Schönaugasse 8a
8010 Graz, Austria
dotter@fgm.at
www.fgm.at

There are significant barriers to the use of biomethane for transport that have prevented uptake almost everywhere across the European Union. While in some EU-countries financial incentive schemes for the use of biogas in power generation exist, the wide use of biomethane for transport is significantly hindered by the lack not only of funding schemes but also by inexisting EU-standards. Therefore the take-up of biomethane for transport is limited to isolated activities not following an overall approach.

Creating a project that links several members of the European Union should make possible to address a wide variety of different framework conditions for the use of biomethane for transport, and to tackle the barriers in a way that would not be possible within one country alone.

BIOMASTER - www.biomaster-project.eu - is such a project, which runs from May 2011 to April 2014. Co-funded by the Intelligent Energy Europe-Programme, and composed of 17 partners from Austria, Italy, Poland, Sweden and the United Kingdom, the project aims to prove that the use biomethane for transport can work and be a viable option.

To achieve that, knowledge and operational gaps fragmenting the biomethane chain are bridged and local alliances of stakeholders are established, to foster an open dialogue and to create a mutual understanding which will facilitate an increase in actions along this biomethane chain.

BIOMASTER is committed to a „waste-to-wheel“ partnership. This works, among other things, by addressing all stages of biogas production and upgrading – from feedstock, through production to upgrading to the appropriate quality for distribution; it also considers use of byproducts and residuals resulting from the production process. A core part of BIOMASTER is dealing with grid injection of biomethane and other distribution options. Biomethane can be distributed by injection into the natural gas grid or transported in either compressed or liquefied form. Finally, BIOMASTER strives to expand the use of biomethane as a renewable fuel in vehicles with a view to sharing this information more broadly in Europe.

The four participating regions Małopolska Region (Poland), Norfolk County (United Kingdom), Skåne Region (Sweden) and Trentino Province (Italy) are ready to show that the potential of biomethane production and use for transport can overcome current barriers by bringing together the key components of the biomethane chain into a joint initiative and furthermore stimulating investments, removing non-technological barriers and driving action plans for biomethane uptake.

Promoting the biomethane economy at European level, through BIOMASTER, has a remarkable advantage as it widens the potential of the market beyond national borders and can be much more effective in achieving critical mass in contrast to what can be achieved in scattered national or regional projects. The results of BIOMASTER can be used to work with decision makers and investors both at national and at European level to help in overcoming those barriers.

Economic and ecological comparison of torrefaction-based biomass supply chains in Central Europe

Rita Ehrig
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
rita.ehrig@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: Christa Kristöfel, Peter Rauch, Matthias Kolck, Helmut Gugler, Christian Pointner, Irene Schmutzer-Roseneder, Christoph Strasser, Manfred Wörgetter

Torrefied biomass is one of the most promising pre-treatment technologies in bioenergy research. It is expected to relevantly reduce costs and energy consumption in the supply chain. The present study compares the economic and ecological performance of torrefied pellets with standard wood pellets during production, transport and end-use. Different supply cases serve as basis to prove the eligibility of torrefied biomass for small- to large-scale utilisation options in Central Europe. This allows a step-by-step comparison of cost advantages or additional expenses as well as the eco-balance from biomass resource to end-user.

Investment costs and energy requirements for the biomass pre-treatment and end-use have been derived from plant engineering expertise, literature data and technology component costs. Based on laboratory pelletising tests the energy demand during grinding and pelletisation of torrefied biomass are assessed. A standardised fuel characterisation of torrefied biomass samples allows conclusions on the increased calorific value compared to input material. Expert and market based data lead to transport and logistic costs and energy demand. Finally, three different real case supply chains are compared: Regional and intra-continental supply of quality pellets and use in domestic appliances and as well as intra-continental trade within Europe for use in small- to large-scale combustion units.

The supply costs of torrefied biomass are expected to be in a range of 223 – 238 €/t for regional delivery free domestic end-user and in the range of 218 – 232 €/t for large-scale end-users, under assumed torrefaction costs of 30 €/t. Supply costs for torrefied pellets per ton are higher than for conventional pellets, but due to higher energy density, transport costs per MWh are lower for torrefied pellets. Torrefied biomass is expected to be a cost-competitive alternative to conventional pellets when additional costs for torrefaction are under 37 €/t. In ecological terms, the production of torrefied pellets results in slightly higher energy demand and emissions compared to conventional pellets. These can be compensated by reduced transport costs through higher energy density. Torrefied pellets are even more advantageous compared to wood pellets when energy and emission intensive transportation means are required.

As a conclusion, torrefied pellets turn out to be a certain alternative for industrial as well as quality wood pellets, especially for long-distance and large-scale biomass trade. Key for an economically and ecologically reasonable supply chain will be to use synergies of a combined torrefaction and pelletisation plant and having access to existing large-scale volume production and logistical infrastructure. Costs and ecological balance can be more advantageous when using dry and cheap raw material, when assuming favourably interest rates and high capacities.

Still, there is need to gain further evidence on the higher energy density of the torrefied biomass product, connected with a favourable energy balance and reduced costs along production and the whole supply chain.

Decentralized energy by cogeneration up to 1 MW_e

DI Dr. techn. Peter Eisenkolb, MBA
Recuperation e.U.
Steinbrunngasse 37
3400 Kierling, Austria
p.eisenkolb@recuperation.at
www.recuperation.at

Co-authors: Ing. Ernesto Granelli, Stefania Granelli, Adriana Dancus; Energy Recuperator Spa, Via Colombo 27, 25013 Carpenedolo, Brescia, Italien; www.energyrecuperator.it

All ask for it. It deems necessary to produce electric power decentralized at a maximum local added value. Plants using solid biomass shall provide a significant contribution to the renewable energy mix.

We look at the markets in four different European countries and present results of our investigation for Austria, Italy, Romania and Croatia. The following will be presented:

- Plants for solid biomass for a power range up to 1 MW_e, comparison of the plants regarding their fuel requirements
- Legal, economical and technical boundary conditions
- Specific investment cost of the different plants, advantages and disadvantages
- Regional fuels: quality, price, supply area, cost of supply
- Regional added value, comparing different types of plants

The different legal and economical boundary conditions, in the markets looked at, led to different results concerning the market development. Although the declared target is quite similar, different reasons and restrictions exist and slow down the development towards decentralized plants. One condition seems true for all markets: If there is an implementation of a decentralized strategy, most likely this is based on private initiatives or initiatives of the industry. In some cases legal boundary conditions may even play a minor role for an investment decision. Wrong pulses can interfere with the desired development and even lead to a dismantling of existing cogeneration plants towards heat generation after the funding period.

Based on a realized cogeneration plant for 1 MW_e, we present the profitability and the necessary conditions. In conclusion, we show that the expansion of decentralized heat and power generation in the small power range makes sense, is profitable and feasible short notice.

Next generation crude production

DI Dr. Markus Ellersdorfer
Chair of Process Engineering and Industrial Environmental Protection, University of Leoben
Franz-Josef-Straße 18
8700 Leoben, Austria
markus.ellersdorfer@unileoben.ac.at

One of the major challenges in fuel and hydrocarbon industry will be to provide biogenic energy sources with a low carbon footprint and relieved indirect land use change consequences. Microalgae can close the gap between the amount of used oil and animal fats available for recycling in Austria and the demand of fossil fuels (around 6 Mio t/a) due to their approximately 50-fold higher oil and biomass production capacity compared to land plants. Nevertheless, the production of algal biomass as well as the extraction of biomolecules from microalgae is actually limited to certain applications like pharmaceutical products and dietary supplements due to economical reasons.

The project “Next Generation Crude Production” investigates engineering requirements for the economically feasible implementation of a large-scale production of biomass via microalgae in the basic materials industry. The proposed process consists of a decentralised production of oil-rich biomass at energy-intensive plant locations like steel works, building materials industry and power stations utilising existing CO_2-sources (off-gas), waste water (nutrients) as well as infrastructural synergies (material and energy flows, waste heat, shift operation). Biomass as well as extracted oil components are processed in a centralised plant located at a conventional oil refinery as an alternative to fossil crude oil. Integration into existing infrastructure and utilisation of synergy effects to existing processes are leading aspects for the economic efficiency of an industrial biomass production process.

Based on estimations of the off-gas and waste water potential of the primary industry in Austria, the whole process chain of an industrial biomass production is investigated. Focused on engineering aspects of up- and down-stream-processing steps, biomass separation and oil extraction an integrated study supported by specific laboratory experiments is prepared to evaluate the room for improvement of the involved unit operations. Furthermore, scenarios of an optimal utilisation of residual biomass after oil extraction are investigated to close mass and energy flows in plant internal loops for optimised biomass utilisation coupled with processes of the primary industry. Concurrently, legal requirements and orders for the practical realisation of the process are examined.

In direct contact and cooperation with potential industrial users the capability of an industrial biomass production is identified by means of case examples. Thereby the integrated, industrial-scaled biomass and oil production from microalgae in the primary industry should be developed to be implemented in the medium term.

30 years renewable energy for Heiligenkreuz – a success story

Mag. Christian Engel
Thermaflex International
Veerweg 1
5145 NS Waalwijk, The Netherlands
c.engel@thermaflex.com
www.thermaflex.com

One of the pioneers in the Austrian Biomass District Heating scene, the Abbey of Heiligenkreuz, was celebrating its 30 years anniversary in October 2013. In 1983 the decision was taken to establish a 3.8 MW central heating plant at the sawmill in Heiligenkreuz. Gradually extensions were developed, so that today the abbey does not only supply heat to their wood dryers and own building, but also to all communes' public buildings as well as 50 single-family houses with district heating.

Novelty and main contribution
In this heating network the engineering has been carried out based on a complete new flexible pipe material for district heating. The new pipe material, developed and tested in co-operation between the Styrian Energy company STEWEAG, the University of Leoben and the Austrian plastic pipes producer Pipelife, was just launched under the brand Flexalen when the abbey of Heiligenkreuz started the project.

The poster demonstrates the practical experiences and the advantages with flexible plastic pipes in a growing network one side and improving boiler and control technology on the other side.

- Smart solutions for district heating by using state-of-the-art flexible pre-insulated Flexalen pipe systems
- Products are recyclable and environmental friendly
- Flexalen is up to five times faster to install
- Lifetime is estimated at 50 years for warm, and over 100 years for cooling applications
- Network optimization of biomass driven district heating, in order to reach the highest efficiency and the lowest carbon footprint
- Improvement of air quality
- Use of bark and sawmill waste in a sawmill
- Replacement of the oil boiler in the diocese

Efficient heating distribution from biogas CHP – an innovative and sustainable approach in network design

Mag. Christian Engel
Thermaflex International
Veerweg 1
5145 NS Waalwijk, The Netherlands
c.engel@thermaflex.com
www.thermaflex.com

The market for Combined Heat & Power generation (CHP) from biogas has developed rapidly in Germany over the past years especially in making use of the rest heat from the CHP process for district heating. Electricity generation from biogas has been in many cases the premier focus and starting point. The utilisation of the rest heat for district heating was considered at a later stage and can significantly increase the overall efficiency of the biogas plant.

As not only the generation of heat, but also the distribution should be green, an innovative and sustainable approach in network design has been applied. The impact on the use of steel and Flexalen district heating networks has been researched to come to the most efficient way of thermal energy transport.

Novelty and main contribution
In most heating networks the engineering is carried out in the same way as it has been done for ages. With the coming of new pipe materials this way of engineering has hardly changed leading to networks that leave a lot of room for improvement. This counts most for plastic networks wherein the routing as well as the pressure drops differs heavily from the traditional steel based designs.
Making full use of the advantages can lower the carbon footprint substantially.

- Flexible, pre-insulated Flexalen piping systems – environmental friendly and recyclable
- Optimized network design for efficient heating distribution
- Minimize the waste of energy – maximize the use of renewable
- Smart solutions for efficient heating & cooling applications
- Short installation time
- Corrosion free
- Safe connections

Effects of two years' fertilization with liquid digestate on chemical and physical soil characteristics

Dr. Eva Erhart
Bio Forschung Austria
Esslinger Hauptstraße 132
1220 Vienna, Austria
e.erhart@bioforschung.at

Co-Authors: T. Siegl, M. Bonell, H. Unterfrauner, R. Peticzka, C. Ableidinger, D. Haas, W. Hartl

Using biomass from intercrops as feedstock for biogas production makes it possible to produce renewable energy without compromising food production. With liquid digestate, crops can be fertilized in a targeted way. For long-term sustainability, however, this practice must not have adverse effects on soil fertility.

In order to assess the effects of fertilization with liquid digestate on soil fertility, two randomised field experiments were conducted for two years on different soil types near Bruck/Leitha (Lower Austria). One experiment was set up on a calcareous chernozem with 4 % humus content, the other on a parachernozem with pH 5.9 and 2.1 % humus. Soils were analysed for acidity, the proportions of exchangeable cations, water-soluble, exchangeable and reserve macro- and micronutrients, aggregate stability and infiltration rate.

On chernozem soil, soil pH was only minimally influenced by liquid digestate. Also on the parachernozem with pH 5.9, short-term effects of liquid digestate on soil acidity were small due to the low salt content and high C/N ratio of the digestate. Soil potassium content, both in the water-soluble fraction and in the exchangeable fraction, increased significantly at both sites. As fertilization with liquid digestate exceeded the potassium requirements of the crops by far, the proportion of potassium of the exchangeable cations increased rapidly.

Soil physical properties were not influenced by digestate fertilization on the chernozem site. On the parachernozem, aggregate stability was increased by the organic matter applied via digestate. On this acidic site low in humus content, the supply of 4 t/ha organic matter, which featured a lignin content of 37 % and was relatively resistant to decomposition, had a clearly positive impact on soil physical properties.

Humus balances were computed both with the "Humuseinheiten"-method and with the site-adapted method STAND. They were calculated on the basis of equal amounts of intercrop biomass either left on the field as green manure or used for biogas production and the resulting amount of liquid digestate brought back to the field. The humus balances showed that the humus-efficacy of the liquid digestate was equal to slightly higher than that of the intercrop biomass left on the field. But as there are no sound humus reproduction values for liquid digestate, which is derived from plant material only, this estimation still has to be ascertained.

The long-term sustainable use of intercrops for biogas and the recycling of liquid digestate as a fertilizer have two prerequisites: the rate of digestate fertilization should correspond to the amount of intercrop biomass harvested, and the digestate fertilization should be adjusted to the potassium requirements and potassium uptake of the crops.

This research is currently continued in the project ‚Syn-Energy II' funded by Klima- and Energiefonds.

The energy transition in rural areas – examinations of the Bavarian energy transition discourse

Dr. Beate Formowitz
Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ)
Schulgasse 18
94315 Straubing, Germany
beate.formowitz@tfz.bayern.de
www.tfz.bayern.de

Co-Authors: Mag Christian Duernberger (TTN), Fabian Karsch MA (TTN), Carolin Riepl MSc MA (TFZ)

The energy transition from fossil and nuclear energy towards regenerative energies will change the country. Thereby the expansion of wind-, solar- and bioenergy (biomass from arable land and forest) predominantly takes place in rural areas. Changes in the landscape are already visible in many places, will increase in the future and may create conflicts of interest. In those conflicts cultural and ethical aspects of the energy transition play an important role for the realization of this historical project. Therefore this interdisciplinary project, conducted by the Technology and Support Centre (TFZ) and the Institute Technology - Theology - Natural Sciences (TTN), aims at a scientifically founded and practice oriented development of a guideline for farmers, citizens, politicians, "energy counsellors" or other stakeholders leading towards a value-centred communication. This guideline should include the most relevant ethical and socio-cultural aspects and propose a dialogical handling for future communication strategies.

To determine the main arguments and aspects concerning the energy transition, the medial discourse in Bavaria was evaluated by examination of newspaper articles and various subject-related info materials or websites. The generated database was expanded with experts opinions gained in interviews. Furthermore, farmers, being the centre of many emotional debates about renewable energies, were interviewed to gather their views and opinions on the energy transition and policy. To complement the data collection, several moderated group discussions about the energy transition induced changes in their rural surrounding have been carried out.

As an outcome of the evaluation three major fields of conflicts were identified: a) Conflicts that refer to the location, such as energy transition induced changes in the landscape, regional coherence of energy construction projects or other regional aspects, e.g. perspectives to enhance regional wealth. b) Conflicts that refer to technological aspects of renewable energies, such as the efficiency of specific techniques, the CO_2 balance or general uncertainties about safety or risks of new technologies. c) Conflicts with reference to aspects of governance, conceptual procedures and the specific realization of projects. Political regulations like subsidy policies are critically discussed. Also questions of how the specific local organization works in terms of transparency, information and participation are subjects of controversy.

Many different stakeholder, individuals or groups following various opinions or interests take part in the energy transition. Individual sets of values and ideals can contain conflicting values (e.g. climate protection vs. immediate well-being). The analytical tool of constructing typical "interpretive patterns" can help to structure the diffuse and complex preferences and values. In the Bavarian energy discourse several interpretive patterns can be differentiated, e.g. "energy transition from the bottom up", "energy transition as civic duty", "the risk of energy transition", "energy creates identity" and others. For instance, the argumentation of "energy transition from the bottom up" reflects the decentralization of the energy transition with implemented hopes of citizens to participate. "Energy transition as civic duty" includes disciplinary appeals to citizens' behaviours, e.g. the appeal towards an energy-conscious lifestyle. On basis of such interpretive patterns different dimensions or ambivalences can be described, which vary according to the interests of each stakeholder and the "motives" that regulate personal perceptions of conflicts or values. Our analysis showed three main ambivalences: a) Control problems – or: Who should implement the energy transition?; b) Identity – or: The energy transition as questions concerning "lifestyle"; c) Origin and future – or: Which culture or tradition do we want to maintain?

To conclude, a value-centred communication is not meant to or is not going to restrain conflicts. But it could help to open up the minds and raise awareness for the different cultural, social and economical values of each involved stakeholder. Thus, the "sensitivity for ambivalences" could lead to a communication process that accepts opposing opinions and is open for compromises, and not only aiming at reducing oppositions.

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BIOGAS production from organic waste in the European Food and Beverage industry (FABbiogas)

Mag. (FH) Wolfgang Gabauer
University of Natural Resources and Life Sciences, Vienna, Austria
Dept. for Agrobiotechnology, IFA-Tulln
Wolfgang.gabauer@boku.ac.at
www.ifa-tulln.ac.at

Co-Authors: DI Lydia Rachbauer, DI Günther Bochmann.

The on-going debate related to the Europe 2020 strategy about the availability of sustainable bio-energy resources and the food-or-fuel discussion have revealed the urgency of using untapped waste streams to produce energy. Anaerobic digestion of industrial waste provides a promising alternative to standard waste treatment. The motivation behind the project is to further expand supplies and trigger increases in the demand for biogas/bio-methane (CHP units, transport, grid injection) from the organic fraction of Food and Beverage (FAB) industry wastes. The FABbiogas project aspires to change the mind-sets of all stakeholders in the waste-to-energy chain by promoting residues from FAB industry as a new and renewable energy source for biogas production. Project outputs will support the diversification of energy sources within FAB companies, leading to wide-spread valorisation and efficient integration of FAB residues into energy systems and boosting the realization of a growing number of biogas projects in Austria, Czech Republic, France, Germany, Italy and Poland.

Biogas from FAB Industry waste
The FAB industry represents a crucial sector of the European economy. Organic residues from production processes harbour a widely untapped potential for energy generation. A promising option for exploiting these residues is their use for biogas production. FAB industry branches with the biggest benefit comprise meat processing, breweries, sugar/starch production, dairy industry, and fruit/vegetable production.

The use of slaughterhouse residues as renewable energy source can avoid waste treatment costs and, at the same time, contribute to the reduction of production costs. The generated electricity has been shown to cover about 40 % of an abattoir's electricity demand and up to 90 % of demanded heat. The energy potential of an average brewery (100,000 hl/a) derived from brewery waste amounts to 1.79 GWh (spent grains, brewer's yeast etc.). Upon biogas implementation 75 % of a brewery's electricity demand and 35 % of its heat demand have been generated.

Expected project results
- Awareness raising events targeting all involved stakeholders will illustrate the high energy potential of FAB waste resulting in increased renewable energy production of 35,000 t/a and hence, 183,000 t CO_2/a saved.
- Maps depicting existing waste biogas plants and FAB waste streams, including 12–18 best practice examples and recommendations how to overcome barriers leading to an expected impact of comprehensive waste stream mobilization from FAB branches.
- 12–18 preliminary feasibility studies will prepare the ground for future projects on implementing the use of FAB waste for sustainable bio-energy production and trigger investments of 7.5 million euros.
- The establishment of national advisory services on using FAB waste for biogas production will implement extensive biogas expertise in FAB associations becoming sustainable contact points for industry requests about integrating the renewable bio-energy resource FAB waste.
- Information compendium (handbook, DVD, IT-tool) for a future standard on efficient use of FAB waste. FABbiogas results comprise the set of tools and guidelines needed for creating a European reference standard on industrial FAB waste usage for bio-energy generation.

For more information: www.fabbiogas.eu

Optimisation of the pre-treatment of brewer spent grains to improve biogas yields

Sije Gorter
University of Natural Resources and Life Sciences, Vienna
Department for Agrobiotechnology, IFA-Tulln
Konrad Lorenz Straße 20
A-3430 Tulln, Austria
sije.gorter@boku.ac.at
www.boku.ac.at / www.ifa-tulln.ac.at

Co-Authors: Lydia Rachbauer, Stefanie Scheidl, Markus Ortner, Günther Bochmann

The EU climate and energy strategy for 2020 is summarized in the 20-20-20 targets. By the year 2020, greenhouse gas emission should be cut by at least 20 % in comparison to the level of 1990; the use of renewable resources has to be increased to 20 % of total energy production and the energy consumption cut by 20< % of projected 2020 level.

Like many other industries, the brewing industry is suitable to decrease its ecological footprint. One way to do this is by converting waste streams into renewable energy in the form of biogas. The production of biogas results in two major advantages: waste streams, which have to be discharged, are reduced and energy expenses are cut. The greatest biogas potential lies within the brewer spent grains (BSG) with a biogas potential of about 600 L kg^{-1} FM (60 % methane). However, due to the biochemical composition of brewer spent grains, a pre-treatment is necessary to optimise the amount of biogas produced as well as the production rate, leading to a smaller biogas plant.

The pre-treatment on which this project is based on is a thermochemical pre-treatment. The feedstock (BSG) will be thermo-chemically pre-treated to accelerate the AD process with higher gas yields. The pre-treatment was optimised to find the best suitable parameters (e.g. additive concentration, temperature, duration of the exposure) at which the conditions were harsh enough to cause the release of oligomeric-sugars but mild enough to prevent the formation of thermal by-products via Maillard reactions. To avoid the production of high amounts of thermal by-products pre-treatment temperature should not exceed a certain temperature level. Currently, more experiments are done to assess which other substrates (and their optimal treatment parameters) are interesting as a substrate for the TherChem-process.

The AD step was optimised to handle the modified feedstock. During single stage (semi-)continuous fermentation, pre-treated brewer spent grain proved to be a suitable substrate for anaerobic digestion. However, using suitable pre-treatment conditions increased the gas yield of up to 30 %.

Will Poland step back from using biomass for power generation – what instead?

M.Sc. Eng. Wojciech Goryl
1) AGH University of Science and Technology, Faculty of Energy and Fuels
30 Mickiewicza Av.
30-059 Krakow, Poland
www.agh.edu.pl
wgoryl@agh.edu.pl
2) The Krakow Institute for Sustainable Energy
Kierzkowskiego 23
30-433 Krakow, Poland
www.kise.pl
kise@kise.pl

Co-Author: Prof. Dr. hab. Adam Gula

Presently a hot debate is taking place in Poland about the use of biomass for power generation. Many experts and most environmental NGOs strongly oppose this way of meeting the environmental goals of reduction of CO_2 emissions. The arguments are of technological, logistic and foremost of economic nature. Moreover, some representatives of the industry of co-firing biomass with coal in the existing power plants are siding with the critics. Most importantly, the Polish government has taken the first steps towards reducing and – in the long term – eliminating subsidies to electricity derived from biomass. The Polish government plans to reduce the subsidies by the factor of 0.30 and 0.95 to co-firing and dedicated biomass power generation, respectively.

In this contribution to the conference the arguments behind the Polish governments plans are summarized and the current status of the debate and the decision making are described. Poland has committed itself to reduce CO_2 emissions which largely originate from the power sector based in over 90 % on combustion of hard coal and lignite. The question is whether there is another way of using biomass for energy purposes that would better serve achieving the CO_2 emissions reduction goal. It is argued that in Polish conditions, typical also for many countries in Europe, the best use of the existing potential is to secure heating of buildings. This could be largely satisfied by biomass, primarily in rural areas, where biomass is locally available, in particular as agricultural residues.

In Poland the main agricultural residue is straw, which is often burnt uselessly in the fields. At the same time, it could become an environment friendly fuel for heating the rural holdings, if burnt in dedicated biomass boilers. However, most farmers in Poland heat their holdings by coal, while good and efficient biomass boilers, produced in Poland, are available on the Polish market. The estimates of the total market for individual biomass boilers range between 400,000–700,000 units. In this situation the cost of heating becomes relatively low, especially when biomass is a self-produced fuel. In this contribution an analysis is presented of economic and environmental impacts of substituting coal with biomass in agricultural holdings in Poland based on a concrete case study, where three different heat supply options in the farm are presented: (1) (erstwhile) coal boiler for space heating plus electric water heater, (2) biomass boiler plus electric water heater, (3) biomass boiler for both space heating and domestic hot water preparation. The results show that reduction of CO2 emissions could be achieved at much lower cost: up to about 8% of public subsidies paid for using the equivalent amount of biomass for power generation.

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Das BiomasseVergasungsProjekt Allgäu2013

DII Dr. Erwin Greiler, MSc
öCompany – Renewable Energy Consulting
Attemsgasse 23
A-8010 Graz, Österreich
e.greiler@oecompany.at

Die Erzeugung von hochwertiger Elektro- und umweltschonender Wärmeenergie durch Vergasung von Holzbiomasse und biogener Reststoffe, gewinnt zunehmend an Bedeutung. Einer derartigen verbreiteten Nutzung von Biomasse(n) steht jedoch bis heute hauptsächlich die bislang nicht erreichte Wirtschaftlichkeit der bereits verfügbaren Technologien und Prozesse gegenüber. Die heute um den Markteintritt ringenden Verfahren können oftmals ihre Herkunft von der althergebrachten Kohle- oder Holzvergasung nicht leugnen, sie sind in Wahrheit sehr kompliziert und arbeiten mit schwer handhabbaren physikalischen Parametern - oder aber, sie orientieren sich in ihren Standards an aufwendiger Großkraftwerkstechnik. Daher sieht die ökonomische Bilanz derartiger Projekte - *Energie aus Biomasse mittels Vergasungstechnologie* - meist nicht sehr rosig aus und solche Anlagen sind und bleiben leider sehr oft Subventions- oder gar Insolvenzfälle. Die Firma Schnell Motoren AG geht deswegen bewusst andere Wege.

Das Projekt
Das Biomassevergasungskraftwerk *Allgäu2013* verwertet regionale Holzhackschnitzel zur hocheffizienten Strom- und Wärmeerzeugung. Bei der Vergasung der Hackschnitzel entsteht ein relativ sauberes und Klima schonendes Gas. Verfahrenstechnisch kommt der weltweit patentierte Doppelfeuervergaser eines Netzwerkpartners zum Einsatz. Die hocheffiziente Verbrennung des Gases erfolgt in einem Blockheizkraftwerk des Netzwerkpartners Schnell Motoren AG. Durch die zeitgleiche Vergasung sowohl im Gleichstrom- als auch nach dem Gegenstromprinzip (doppelfeuerungsverfahren) werden die jeweiligen Nachteile der beiden Verfahren weitgehend kompensiert und die anteiligen Vorteile überwiegen dadurch.

Eckdaten des Projektes *Allgäu2013*

Investitionsvolumen (Demonstrationsanlage!)	ca. 800.000 €
Inputmaterial - Spezifikationen	~ 170 kg/h Holzhackschnitzel Materialgröße 40 bis 100 mm Dicke <= 20 mm Feuchte 15 bis 20% Feinanteil <= 10%
Kapazität	ca. 200 $kW_{elektrisch}$ ca. 185 $kW_{thermisch}$
Stromerzeugung Anlagenwirkungsgrade	ca. 1.500 MWh/a Ökostrom laut EEG 2012 η_{el} = 29% / η_{th} = 58%
Wärmeerzeugung	ca. 1.390 MWh/a
Volllaststunden	7.500 / a
Abmessungen – ohne Peripherie	2.150 mm x 1.320 mmm x 3.200 mm
Gewicht (befüllt) – ohne Peripherie	3.300 kg
Zündölverbrauch	2,5 kg/h
Biomasseverbrauch	~170 kg/h
Nachrüstung einer innovativen Nachverstromungseinheit > 25 kW_{el}	voraussichtlich in 2014

Perspectives of decentralized heat generation using local biomass from the border region of Poland and Germany

Cinthya L. Guerrero, PhD.
Brandenburgische Technische Universität Cottbus
Universitätsstraße 22 (MZG)
03046 Cottbus, Germany
guerrcin@tu-cottbus.de
http://kwt-cottbus.de/de/

Co-Author: DI (FH) Robert Guder, Dr. rer. oec. Iwona Napierala

The use of bioenergy for heat production opens up excellent perspectives but also represents major challenges such as: market and price development, secure quality fuel supply, technical adaptation and particulate emissions. The project “Heat from local biomass” aims the research, development and implementation of innovative technologies for heat supply using local biomass from the border region of Poland and Germany disseminating best practice models. The central aspect of this project is the development of appropriate and modern small-scale incinerators for solid biofuels which could enable taking advantage of the full range of domestic feedstock available. Some of the feedstock studied within this project are: pasture, poplar, birch, robinia, osier, alder, among others. This study considers as well the utilization of all the sub-products along the supply chain which currently falls under the category of waste (from the plantation residues to the ashes).

The results of these studies had shown that high values of ash, nitrogen and chlorine are still important challenges to be assessed, also in relation to the compliance with the standards of the future 1 BImSchV. The physico-chemical characteristics of biomass make necessary the development of appropriate technologies to minimize the technological challenges associated to its combustion. Slagging, corrosion, erosion, abrasion and thermal fatigue lead to reduced operating times and negatively affect the efficiency of the systems. Also, the CO, NOx, SO_2, HCl, heavy metals, particulate matter emissions and ash melting behaviour must be taken into consideration. In order to avoid combustion problems and systems’ damage it becomes relevant to homogenize the fuel in terms of quality. The practical tests of combustion technology for mixed biomass pellets are carried out in small-scale boilers in the range of 40 kW to 80 kW which are assessed in long-term under realistic conditions. Technologies are to be reviewed, adapted and further developed. The main objective of such tests is to perform an optimum CO burnout both in the primary combustion-and to the secondary combustion zone. In this way, an effective air gradation and the avoidance of temperature peaks at the small-scale combustion chambers are sought. By suitable combustion chamber geometry, optimal residence time of the combustion gases could be ensured. It would be necessary to take care of having uniform stress on all the zones of the furnace. The core aspects of these tests are to carry out modifications to reduce the emissions’ levels as much as possible.

This project also investigates whether the ash produced from the combustion of local biomass (and in which extent) could be re-integrated into the nutrient cycle. The most important justification for this study is the high natural CrVI content. The University Sulechów in Poland carries out this assessment from an ecological and economic point of view. During the investigations, various types of biomass ash are being evaluated as fertilizer and characterized in practical field tests. The expected outcome of this project is the development of a concept for the exploitation of resulting biomass ashes optimizing long-term nutrient availability. After assessing various scenarios for drying, storage, transport, fuel preparation (homogenization) and recycling of the ashes, it is possible to optimize the economic and environmental performance of the system. The results of this part of the project had lead to focus more attention to the continuous technological improvement including the production of pellets with higher quality, boilers and filters.

New engine operated by virtually unprocessed biogas for electricity and heat generation

Erich Hager
RJT GmbH (in the course of incorporation)
Willersdorferstaße 64
8061 St. Radegund, Austria
office@staustrahlturbine.at

Co-Author: Peter Breinlinger

Due to its plain construction characteristics the new combustion engine **R**am **J**et **T**urbine is suitable for the combustion of liquid and gaseous fuels having undergone only minor purification. In addition, the high process temperatures which can be achieved with the turbine result in a uniquely high mechanical efficiency.

The energy-intensive dehydration process becomes unnecessary for RJT given that the flue gas dewpoint is very low as a consequence of the huge air surplus. The latter evades corrosion and condensation and the overall efficiency of biogas increases considerably.

In spite of the lower proportion of pure methane the combustion air ratio leads to an inflammable mixture. This makes the segregation of gas dispensable from a technical point of view. Hydrogen sulfides and ammoniac only have to comply with emission standards and will be segregated primarily due smell nuisance.

The first field of application of the turbine will be the energetic utilization of accruing biomass in small municipal biological clarification plants. The potential looks as follows: Each municipality can cover the demand for electricity up to a degree of 25 % by accruing biomass, avoiding a significant proportion of emissions as well as fossil primary energy carriers.

Lower requirements with respect to biogas purity in combination with the advantageous composition of accruing biomass in biological clarification plants (as opposed to substrates from common agricultural biomass) increase the efficiency of RJT technology. Adapting existing plants of the mentioned size to use them for energy generation becomes reasonable thereby. For new plants it could become standard to deploy the turbine and biogas technology. The refitting potential only for small biological clarification plants in Austria lies at ca. 25 GWh/a, which equals the total demand for electric energy of about 5,500 households.

Parallel to developing the engine and building the prototypes, biogas plant engineering for the adaptation of existing biological clarification plants will be advanced.

The main focus of the RJT design was the efficient production of mechanical energy from biogas and its subsequent transformation to electricity. This requirement was met on a constructional basis as well as a material engineering basis, ensuring highest efficiency by most reduced gas processing and positively influencing overall efficiency. The thermodynamic process control of RJT is structured in such a way that waste heat due to recuperation largely remains in the process. Remaining waste heat can be used to support gas production (via increase of bacterial activity) but also for other forms of waste heat utilization. Efficiency in energy generation is of vital importance because demand for heat, to which the enormous amounts of waste heat produced by other combustion engines have to be routed to, occurs discontinuously. This conflicts with the continuous operation on the energy generation side. Annual efficiency of other biogas plants is thereby influenced negatively.

The patent for RJT is granted and prototypes are currently being built. Confirming test results are expected by mid-2014. After concluding the tests with the second prototype generation, test runs with pilot plants are planned for the third prototype generation.

Logistics and costs of harvesting corn cobs

Franz Handler
BLT Wieselburg, lfz Francisco Josephinum
Rottenhauser Straße 1
3250 Wieselburg, Austria
franz.handler@josephinum.at
http://www.josephinum.at/

Co-Authors: Lukas Sulzbacher, Emil Blumauer

The poster analyzes working time requirement, logistics and costs of three procedures for harvesting corn cobs.

Procedure 1 bases on an adapted combine harvester, which collects the corn cobs in a separate tank. The cob tank is unloaded into a trailer. Procedure 2 separates the cobs by means of sieves and fan. A blower conveys the cobs into a parallel driving trailer. The separation device is mounted on the combine harvester instead of the chopper. The combine harvester of procedure 3 is equipped with special sieves that let pass kernels as well as cobs. Both are collected in the grain tank. Kernels and cobs are separate by means of a drum screen before storage.

The determined bulk density of the corn cobs ranges from 87 to 138 kg DM/m³ depending on particle size and ears content. The proportion of ears mainly depends on the corn variety and harvesting machines. Normally a high proportion of ears in the harvested cobs is related with high cobs losses during harvest.

Table 1 shows the costs for harvesting corn cobs. The costs contain the fixed and variable machinery costs and the labor costs for the separation of the cobs and their transport to the storage. Depending on the capability, the investment costs and the annual utilization of the separation system the costs vary within a wide range. The cheapest separation system is used in procedure 2. However, the transport costs of procedure 2 are relatively high because a tractor with trailer must follow the combine harvester during the complete harvest. In procedure 3 two different drum sieves are calculated. The cheaper version is a self-built prototype by farmers. The more expensive version is a commercially available drum screen for compost. Widely the total costs for harvesting corn cobs are in the same range for all procedures except the cheap version of procedure 3 is cheaper for short haul distances.

	Procedure 1	Procedure 2	Procedure 3	
			Investment in equipment for separation of kernels and cobs	
			10.000 €	45.000 €
Separation of the cobs[1] [€/t DM]	62 - 74	21 - 44	27 - 41	55 - 98
Transport 10 km haul distance [€/t DM] (1 km haul distance)	37 - 45 (19 - 24)	48 - 63 (35 - 46)	50 - 63 (6 - 8)	50 - 63 (6 - 8)
Total for separation and transport - 10 km haul distance [€/t DM] (1 km haul distance)	99 - 119 (81 - 98)	69 - 107 (56 - 91)	77 - 104 (33 - 49)	105 - 151 (61 - 106)

Table 1: Total costs for harvesting corn cobs (excl. VAT)

[1] Annual utilization of the separation 150 - 300 h, average plot size 5 ha, yield kernel 10 t DM/ha, useful life 10 years, harvested corn cobs: procedure 1 1.0 t DM/ha, procedure 2 0.9 t DM/ha, procedure 3 0.36 t DM/ha; DM … dry matter

Sorghum used for biogas production – sowing date and choice of variety

Dr. Anja Hartmann
Technology and Support Centre
Schulgasse 18
94315 Straubing, Germany
anja.hartmann@tfz.bayern.de
www.tfz.bayern.de

In Germany growing sorghum for biogas use is not common yet, though restriction of maize cultivation due to legal obligation (EEG 2012, Cross Compliance), phytosanitary reasons (*Diabrotica virgifera virgifera*) or the increasing risk of summer droughts have led to a growing interest in sorghum. Sorghum can be cultivated in May (mid-May = optimal sowing date) as main crop or in June as second crop following cereal harvested at milk ripeness for biogas use. The sowing date and a well matching choice of variety are important for high yields and dry matter contents at harvest above 28 %, which are crucial for loss-free ensiling. The focus of this project is to determine the yield potential when growing sorghum as main or second crop at different sites in Germany (with varying valuation indexes of field = VI) and to investigate which maturity group (MG, according to Zeise 2012) is adequate for sowing dates between May and June.

The five experimental sites for this three year project (2011 – 2014) are spread all over Germany, covering different soil-climatic conditions: Aholfing (VI 45), Güterfelde (VI 28 - 35), Straubing (VI 75), Gülzow (VI 35 - 45), Dasselsbruch (VI 25). Sowing schedule was early-May and mid-May (main crop cultivation) as well as early-June and mid-June (second crop cultivation). The following varieties, representing early to mid-late maturing sorghum, were used in the trial: Lussi (MG 1 = early), KWS Freya (MG 3 = mid-early), KWS Zerberus (MG 4 = mid-early – mid-late), Herkules (MG 5 = mid-late). Harvest was performed between beginning of September and mid of October.

The results (table 1) show that under optimal conditions a biomass production of more than 200 decitons dry matter per ha is possible with mid-early to mid-late varieties (MG 4) sown in mid-May. For most regions, varieties of MG 4 will be a good choice assuring high yields and dry matter contents > 28 %. Sowing in early-May can result in higher yields but low temperatures might possibly delay plant development and cause severe problems with weeds or even risk necrosis of plants. It is therefore advisable only in warm regions without late frosts. Sowing in June or especially in mid-June distinctively decreases yields. Besides, dry matter contents will be lower, even when harvest is postponed to October. Consequently, for growing sorghum as a second crop early maturing varieties (MG 3 or 1) are required. In cool regions (e.g. Gülzow) sorghum should be sown in May. Growing it as second crop is probably not profitable due to low yields and high moisture of harvested material.

Table 1: Dry matter yield and dry matter content of the most "adequate" variety/maturity group regarding yield and a dry matter content ≥ 28 % at different experimental sites in Germany (mean 2011/2012)

Sowing date	Aholfing	Dasselsbruch	Güterfelde	Gülzow	Straubing
	Dry matter yield in decitons per ha / Dry matter content in %				
Early-May	266 / 28 **Herkules (5)**	169 / 28 **Zerberus (4)**	196 / 29 **Herkules (5)**	152 / 29 **Freya (3)**	209 / 28 **Zerberus (4)**
Mid-Mai	213 / 32 **Zerberus (4)**	146 / 28 **Zerberus (4)**	171 / 29 **Zerberus (4)**	127 / 27 **Freya (3)**	214 / 29 **Zerberus (4)**
Early-June	200/ 28 **Zerberus (4)**	140 / 30 **Freya (3)**	145 / 30 **Freya (3)**	122 / 29 **Freya (3)**	191 / 29 **Zerberus (4)**
Mid-June	156 / 28 **Freya (3)**	92 / 27 **Lussi (1)**	118 / 28 **Freya (3)**	76 / 28 **Lussi (1)**	162 / 28 **Freya (3)**

Literature: Zeise, K. (2012): Wann muss die Hirse vom Feld? Auch für Sorghum helfen Schätzmethoden, um die Siloreife zu erkennen. BLW, Jg. 2012, Nr. 41, S. 32–33

Cooperation: Saxon State Office for Environment, Agriculture and Geology (LfULG), State Office for Rural Development, Agriculture and Land Consolidation (LELF), Chamber of Agriculture Lower Saxony (LWKNS)

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Active condensation in a 10 MW heating plant – measurement results from the first heating season

Babette Hebenstreit
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
A-3250 Wieselburg-Land, Austria
Luleå University of Technology
SE-971 87 Luleå, Sweden
babette.hebenstreit@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: Ernst Höftberger (Bioenergy 2020+ GmbH), Manuel Schwabl (Bioenergy 2020+ GmbH), Joakim Lundgren (Luleå University of Technology), Andrea Toffolo (Luleå University of Technology)

Biomass based district heating plants are common in Austria. In 2011, biomass accounted for 46 % of the heat produced in Austrian district heating systems. This corresponds to 36 PJ of biomass based heat fed to district heating systems. The biomass source is mostly wood chips and the heat is mostly used for space heating and hot tap water. The water content of the wood chips varies in the range of 30–60 % depending on the time of harvesting, the storage duration, and weather conditions. This leads to lower heating values compared to dried wood, because of the evaporation of the water. To recover the latent heat of the water vapour in the flue gas, a condensing heat exchanger operated at temperatures below the water dew point of the flue gas is necessary. This heat is often unused because of a missing low temperature heat sink. One possibility to overcome this challenge is to use a heat pump which provides the low temperature heat sink and transfers the heat energy to higher temperatures, i.e. active condensation.

The main objective of this study has been to technically analyse an active condensation system in a typical Austrian district heating plant fed with wood chips. The paper presents the results of the first measurement campaigns. The heating plant consists of two biomass boilers (5 MW + 3 MW). The flue gas of both boilers is mixed and directed to a condensing heat exchanger for heat recovery. A compression heat pump was integrated during heating season 2012/13 to enhance the heat recovery. In the paper, the hydraulic connection between the heat pump and the condensing heat exchanger is addressed. The measurement results are presented and compared to conventional operation without a heat pump. A detailed technical analysis regarding the increase of the heat recovery is given, where the corresponding temperatures, heat fluxes, and electricity used for the heat pump are presented. Furthermore, the dependence on the flue gas water content and the heat load is discussed.

Keywords:
Biomass, Flue gas condensation, Heating plant, Heat pump.

Development of a distributed cogeneration combustor for the fuel straw

Patric Heidecke
Fraunhofer Institute for Factory Operation and Automation IFF
Sandtorstrasse 22
39106 Magdeburg, Germany
patric.heidecke@iff.fraunhofer.de

Supplying energy from renewable resources is becoming an increasingly important means to avert climate change. According to estimates, the energy recovered from biomass alone could sustainably cover 8 to 10 % of Germany's primary energy consumption. While approximately 55 % of woody fuels' potential is being exploited throughout Germany, the total available quantity of straw of 100 to 130 PJ/year remains virtually unused for heat recovery. In addition to its substantial, unutilized potential, grassy biomass has an additional advantage of rapid growth rates. Typically, an annual yield of 0.8 t/ha can be expected from forest wood waste. Fast growing woody plants (12 t/ha), cereal straw (5 t/ha) and miscanthus (18 t/ha) deliver higher annual yields. Although the recovery of energy from straw will grow in importance in the future, technical advances are tentative at present because of the significant differences between the properties of straw (low energy density and high alkali and chlorine content) and of woody fuels.

A fluidized bed combustor with a power range of a distributed plant (1-10 MW) was the technology used the joint project to recover heat from straw. The Fraunhofer IFF was in charge of researching the optimal operating conditions for straw combustors and identifying process parameters. Based on the findings, a fluidized bed combustor for cogeneration in the thermal power range of 1-4 MW was planned and engineered in detail. The Deutsches Biomasseforschungszentrum researched the basic logistical and economic conditions and environmental impacts of the planned model plant. The foci of the research project were the characterization of the fuel for combustion and the development of an appropriate plant design, which served as the basis for planning a model plant for a model site and assessing its economic and environmental impacts.

The issue of emissions was researched amply in extensive experimental studies. The carbon monoxide and nitrogen oxide emission standards (Technical Instructions on Air Quality Control) were met by applying primary measures to reduce pollutant gases. The addition of fuel additives containing calcium or the use of calcium-based bed materials allowed trouble-free continuous trial operation without restrictive ash fusion. Computational flow simulations were employed to validate the results of the engineering and to verify the working principle of the combustor designed. With straw's special requirements on a fuel metering unit in mind, a continuously delivering and reliably functioning feeding system was designed, which allows for the specific conditions of combustion while feeding equally at two points in the combustion chamber. The problem of ash fusion identified beforehand was counteracted by developing a robust ash removal system.

As a follow-up to this joint project, a pilot plant will be constructed based on the concept and the base of fuels for such combustors will be expanded to include other culmiferous biomass (rape straw, miscanthus etc.).

New harvesting technologies for rapid-growing trees – application report from harvest season 2012/13

Dipl. Oec. Uwe Hempen-Hermeier
Managing Partner
Jenz GmbH
Maschinen- und Fahrzeugbau
Wegholmer Strasse 14
D-32469 Petershagen, Germany
info@jenz.de
www.jenz.de

The energetic utilisation of ligneous biomasses is becoming increasingly established for reasons of ecological and economic benefits, and has led to a constantly increasing demand for energy wood. The central European forests will be incapable of meeting the resulting demand within a very short time if utilisation is to remain sustainable. The resulting gap in coverage will lead to higher prices and therefore also to an increased demand for energy wood from rapid-growing trees.

However the lack of suitable economic harvesting technologies for smaller areas continues to present an obstacle for rapid-growing trees (RGT). In 2010, the Leibniz-Institut für Agrartechnik Potsdam-Bornim e.V. and Jenz GmbH from Petershagen signed a technology transfer agreement in order to introduce a machine based on the prototype developed and registered as a patent by the Institute onto the market. The result of this agreement is the Jenz GMHS 100 RGT harvester.

The particular special feature of the machine is its low weight of only around 1.5 t. This low weight is possible because the three process stages of "cutting, chipping and ejecting wood" is able to be carried out for the first time by one tool, a horizontal disc. This low weight now also enables new harvesting logistics, because the towing tractor can now also transport a bunker for collecting the woodchippings in a similar manner to a combine harvester.

Two prototypes with different carrier vehicles were used in different rapid-growing tree plantations, which were in parts extremely difficult in terms of topography, during the harvest season 2012/13. This also included the RGT areas belonging to heating manufacturer Viessmann in Allendorf. The results were systematically recorded, assessed and compiled in a presentation by both contracting parties. Particular attention was paid to the woodchipping sizes recorded in connection with the shelflife, the measured machine characteristic values and performance parameters and, in the end, the economic efficiency.

The machine development has been concluded with the harvest deployment in 2012/2013, the market launch is in the harvest season 2013/2014.

GIS-based method to estimate the potential biomass yield of cities and regions

Dipl.-Vw Jörg Hennersdorf
Leibniz Institute of Ecological Urban and Regional Development (IOER)
Weberplatz 1
D-01217 Dresden, Germany
J.Hennersdorf@ioer.de

Co-Author: DI Iris Lehmann

Biomass is a renewable organic resource, which can be used as an alternative energy source to traditional fossil fuels. The presented investigation deals with the annual yield of landscape management biomass from public and private green spaces in cities. Such areas include private gardens, parks, landscaped open spaces as well as nature reserves and woods. This raises the question of what potential exists in the cities.

Determination of potential biomass yield of cities and regions
The theoretical biomass yield is directly linked to the different land-use structures and the provision of green spaces of the cities. For a citywide assessment an approach was adopted, which is based on an urban vegetation structure type (UVST) approach developed in the IOER. Amongst others, each UVST is homogeneous with regard to vegetation and ground cover structure. It contains data on the average proportion of sealed surfaces and vegetated areas with low (lawns, meadows), medium (hedges, bushes, shrubs), and high (trees) biomass cover. These UVST has been enhanced by characteristic values of potential biomass yield per year. Area-specific characteristic values of biomass yielded by urban landscape management was collected and systematised from different sources of literature. These values were assigned to any UVST as additional attributes, differentiated by herbaceous (low) and woody (medium and high) vegetation. In a case study, the potential biomass yield of the city of Dresden was quantified. For the transferability of this approach, it is necessary to delineate the UVST in the cities. However, this can only be done easily, if urban-biotope-type maps in the city exist, from which UVST can be developed. Otherwise terrestrial surveys are required previously.

An intersection of the UVST with ATKIS®-Basic-DLM-feature-types and so called SEMENTA®-block-types allows the assignment of characteristic attributes of green equipment and potential biomass yield per type and thus an (semi-)automated determination. SEMENTA® (SettlementAnalyzer) developed at the IOER can be used to analyse the morphology of building stock as well as to calculate various indicators describing the built environment at urban block level. By the intersection, the feature-types and block-types consists of different ratios of diverse UVST with characteristic values of average proportions of sealed surfaces and vegetated areas with low, medium and high biomass cover. Results of the intersection are characteristic values of biomass yield of ATKIS®-Basic-DLM-feature-types and SEMENTA®-block-types. These values were systematised in table form and documented in factsheets. Dependent on ATKIS®-Basic-DLM-feature-type or SEMENTA®-block-type the biomass yield is in range from 0.08 t/(ha a) to 14.09 t/(ha a) in vegetation layer “low”, vary from 0.01 t/(ha a) to 5.73 t/(ha a) in vegetation layer “medium” as well as go from 0.01 t/(ha a) to 5.77 t/(ha a) in vegetation layer “high”. The generally wide range of characteristic values with minimum and maximum biomass yields is to be attributed to the multitude of framework conditions for actual plant growth. Particularly strong influences are the vegetation cover density of the site, the age structure of plants, climate, as well as soil characteristics and the associated nutrient availability. Since the methodology is intended for application to any city in Germany, the range of values is retained.

At medium-scale level the approach provides a (semi-)automated rough estimate of potential biomass yield of cities and regions exclusively by use of grass clippings, leaves and woody prunings in the form of branches and twigs from urban landscape management as well as by use of wood residues from forestry.

Solutions with integrated automation for sustainability in biofuels/biomass plants

Volker Hirsch
Manager Technology & Concepts
I IA AS PA CHEM 3
Siemensallee 84
76889 Karlsruhe, Germany
volker.hirsch@siemens.com
www.siemens.com/biofuels

Whether climate change, air pollution or another oil crisis – the reasons for biofuels are obvious. They actually have the potential to displace oil for fuels or for chemical products.

Modern automation concepts create a solid basis for greater efficiency in biofuel/biomass installations.

For both plant engineering companies and plant operators, the economic aspects of biofuel/biomass plants have top priority. By implementing modern control technology, plants can operate more efficiently and reliably. One key criterion in this context is the ability of the automation solution to be optimally adapted to different plant sizes and production techniques. It must also be scalable and flexible to allow for future expansion and modernization. It must enable rapid, straightforward engineering because biofuel/biomass plants are often built under extreme cost and time pressure. Finally, it must provide all the required functions, including instrumentation and drive technology, safety technology, and energy management, in an integrated solution to minimize space, cost, training and operator time.

The poster gives an overview about scalable and flexible automation solutions and shows the highlights of a modern automation platform.

Erschließung neuer Biomassepotentiale durch zwei neue Verfahren der Biomassenutzung für Heizwerke und zur Stromerzeugung

Mag. Christian Hochstöger
ecomotive
Bruno Gallee Weg 26
4060 Leonding, Österreich
office@ecomotive.at
www.ecomotive.at

Biowärme hat in Österreich mit 80 % den größten Anteil des gesamten Biomassemarktes. Und Holz ist wiederum mit 80% der wichtigste Rohstoff des Bioenergiesektors. Beim weiteren Bioenergie-Ausbau dürfte Energieholz aus der Forst- und Holzwirtschaft in den nächsten Jahren seine dominante Rolle verlieren, weil die Holznutzung nicht unbegrenzt gesteigert werden kann. Daher muss in den nächsten Jahren die agrarische Biomasse für den Biowärmemarkt verstärkt mobilisiert werden. Neben Energiepflanzen wie Kurzumtriebsholz oder Miscanthus werden auch agrarische Reststoffe wie Maisspindeln oder Landschaftspflegeheu an Bedeutung gewinnen. (Jauschnegg, Webseite der Landwirtschaftskammer OÖ, Kapitel Wärme und Energie).

Das Aufkommen an Stroh in Österreich beträgt 1,9 Millionen Tonnen pro Jahr, davon mehr als die Hälfte in Niederösterreich. Davon wird ein Teil als Dünger, als Einstreu etc. verwendet. Die nutzbare Restmenge – z. B. Für die Energetische Nutzung beträgt ca. 1 Million Tonnen pro Jahr (Staribacher, AGRAR PLUS GmbH, Vortragsunterlagen).

Maisspindeln sind ebenfalls ein in großen Mengen anfallender Rohstoff: „Niederösterreichs Landwirte ernten jährlich auf rund 51.000 Hektar Körnermais mit durchschnittlich 20 t Trockenmasse pro Hektar. Davon sind 10 t Körnermais, 9 t zu häckselndes Maisstroh und 1 t Maisspindeln. Erntefrisch entspricht dies durchschnittlich 2.500 Kilogramm Spindeln mit einem Wassergehalt von 55 bis 60 %.

Die ecomotive arbeitet seit mehr als zwei Jahren an der Markteinführung eines Biomasse-Systems mit, das seit 4 Heizperioden problemlos mit gemischten trockenen Rohstoffen wie Miscanthus, Hackschnitzel, Holzstaub etc. betrieben wird. Wir verwenden modernste Silotechnik und senken so die Investitionen, können gemischte Rohstoffe verwenden und einen vollautomatischen Betrieb gewährleisten.

Die ecomotive arbeitet seit zwei Jahren ebenfalls an der Markteinführung eines völlig neuartigen Systems zur gleichzeitigen Trocknung und Zerkleinerung von feuchten Biomassen ohne zusätzlichen externen Wärmeaufwand. Unter feuchten Biomassen verstehen wir biogene Materialien, die normalerweise ohne zusätzliche Bearbeitungs- bzw. Trocknungsschritte nicht verbrannt werden können, wie z. B. Trebern-Reste aus Brauereien, Biomüll etc.

Bei dieser Anlage handelt es sich jedoch um einen Prozess, der durch die Kombination verschiedener physikalischer Vorgänge die Trocknung des in den Biomassen enthaltenen Wassers über gewöhnliche thermodynamische Effekte ersetzt und gleichzeitig das Material auf Staubgröße bringt. Trotz des für den Betrieb nötigen elektrischen Antriebs arbeitet die Anlage so effizient, dass eine derartige Behandlung auch für bisher nicht angedachte Rohstoffe Sinn macht.

Der Industriegaspreis liegt derzeit bei 33,10 Euro/MWh (E-Control, S.2, Unternehmen mit Jahresbedarf unter 10GWh). Der Energieinhalt von Biomasse beträgt 5 – 5,2 MWh/Tonne (LWF-Merkblatt 12). Rechnet man einen Preis von 70,00 – 96,00 Euro/Atro-Tonne mit 0 % Wasseranteil (WV NÖ, LWK NÖ, Informationsblatt zur Abrechnung von Biomasse, S.2) so erhält man einen Preis je MWh Wärme von 13,46 Euro bis 19,20 Euro.

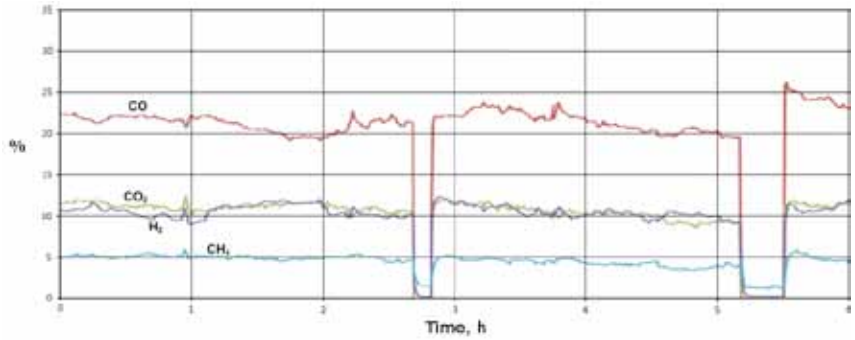
Verwendet man ein System, das durch geringe Investitionen den Preisvorteil je MWh erzeugter Wärme voll zur Geltung kommen lässt, so kann man wirtschaftlicher als mit Erdgas, dem billigsten fossilen Energieträger nach Kohle, Wärme erzeugen.

Analysis of effectiveness of biomass gasification installation generating electricity and heat

Phd. Tomasz Iluk
Institute for Chemical Processing of Coal
Zamkowa 1
41-803 Zabrze, Poland
tiluk@ichpw.zabrze.pl
www.ichpw.zabrze.pl/

Co-Author: Phd. Aleksander Sobolewski

The authors present issue related to power production from gas received during biomass gasification process and advantages of biomass gasification technology usage in cogeneration systems. They characterize research installation for power production from biomass (~ 60 kW_t), developed at the Institute for Chemical Processing of Coal in Zabrze. It consists of a fuel supply system, gas generator with fixed-bed, dry gas cleaning system and the system used to produce electricity. The article describes installation development process which was divided in three staged. The influence of four different biomass available on polish market, on quality of received process gas is presented as well as received reduction efficiencies of dust and organic contaminations in proposed new conception of dry purification of gas system. Power generation system supplied by process gas, equipped with dual fuel combustion engine with rated power of 25 kW is presented. The article presents results of work of power generation system for production of 8 and 15 kW of electricity, by engine supplied with diesel oil and process gas. Picture beneath shows exemplary gas composition change during 6 h period of wood chips gasification



In second part demonstration installation for biomass gasification of 1.5 MW_t power is shown. Its development was based on research done on pilot installation. Currently installation undergoes start-up tests. This is the last stretch for installation located on the ground of wood processing company so that it can fulfil its purpose, which is to generate electricity and heat to satisfy local demand of the company for both medias. Pictures below present demonstration installation during start-up tests.

Above-ground biomass at maize, sunflower and sorghum under specific conditions from South Romania

Viorel Ion
University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Agriculture
59 Mărăşti Blvd, District 1
011464, Bucharest, Romania
vioreliona@gmail.com
www.agro-bucuresti.ro

Co-Authors: Adrian Gheorghe BĂŞA, Georgeta DICU, Daniel STATE

Maize (*Zea mays* L.) is one of the most important crop for biomass production, this being the most important crop in Romania as harvested area. In the last decade, the annual harvested area of maize was between 2 and 3.2 million hectares. Sunflower (*Heliathus annuus* L.) ranks in the present the third place among the field crops as harvested area in Romania, after maize and wheat. In the last decade, the annual harvested area of sunflower was between 0.75 and 1.15 million hectares. Sorghum (*Sorghum bicolor* (L.) Moench) is an important alternative to maize in regions with limited water and heat stress conditions (as those from South Romania), this been better adapted. From this perspective, sorghum could be of interest from some zones in Europe, including Romania which has a real potential for developing the sorghum crop by increasing the cultivated area. In the last decade, in Romania the annual harvested area of sorghum was between 0.75 and 11.5 thousand hectares, with an increasing trend in the last years.

Researches were performed in South Romania, a very favourable area for growing maize, sunflower and sorghum both from a climatic and soil point of view. The crop technology was the usual one for growing maize, sunflower and sorghum in the farms from South Romania. In the drought year 2012, there were studied ten maize hybrids (CERA 270, CERA 290, CERA 370, CERA 390, CERA 6, CERA 420, CERA 2504, CERA 4505, Bărăgan 48, and CERA 10), ten sunflower hybrids (PRO 112, PRO 111, PF 100, PRO 229, PRO 121, PRO 122, PRO 131, PRO 132, PRO 141, PRO 142) and nine grain sorghum hybrids (ES Mistral, Solarius, Quebec, Armida, Arlys, Arkanciel, Arakan, ES Alize, Queyras). The maize and sunflower hybrids were studied in four different locations from South Romania (Fundulea – Călăraşi County; Vâlcelele – Călăraşi County; Vişani – Brăila County; Poşta Câlnău – Buzău County), while the sorghum hybrids were studied in one location from South Romania (Tunari – Ilfov County). The biomass determinations were performed at the physiological maturity of the plant. Five of the ten studied maize hybrids registered values of the above-ground dry biomass production higher than 9 tons per hectare. Although the water stress affects significantly the maize biomass production, there is a wide response of maize plant to drought according to the hybrid. Dry biomass production of maize stem and leaves that could present importance for different uses after harvesting the kernels ranged between 3.2 and 4.6 tons per hectare. Dry sunflower stem biomass production that could present importance for different uses after harvesting the grains ranged between 2.0 and 3.5 tons per hectare, which is less than the dry biomass production of maize stem and leaves. Apart the grain yield, grain sorghum can produce at the physiological maturity of plants a high green biomass production (26.0 tons per hectare of fresh biomass, respectively 14.5 tons per hectare of dry biomass), with a high content in water (the plants do not dry at their physiological maturity). This important production of fresh biomass could be of interest to be used as raw material for biogas production.

In 2013, a normal year from a climatic point of view, there were studied 6 maize hybrids (CERA 440, Flanker, ES Feria, Janett, PR35T36, CERA 540), 4 sunflower hybrids (Pro 111, LG56.62, P64LE19, Pro 953) and one sorghum hybrid (Biomass 150) specialised for biomass production. The maize and sorghum hybrids were studied in Fundulea location (Călăraşi County), and the sorghum hybrid in Moara Domnească location (Ilfov County). The biomass determinations were performed in the milk-early dough growing stage for maize and sorghum, and early ripening growing stage for sunflower, these growing stages been of importance for using the above-ground biomass as raw material for biogas production, as well as for fodder in the case of maize. In average for all the studied hybrids in 2013, and at different plant populations, the fresh above-ground biomass of maize was 79.3 tons per hectare, with limits of variation between 65.5 and 98.1 tons per hectare, while dry above-ground biomass was in average of 23.75 tons per hectare, with limits of variation between 17.6 and 31.0 tons per hectare. The fresh above-ground biomass of sunflower was 81.3 tons per hectare, with limits of variation between 59.5 and 111.2 tons per hectare, while dry above-ground biomass was in average of 16.26 tons per hectare, with limits of variation between 12.8 and 22.5 tons per hectare. The sorghum hybrid Biomass 150 produced in average 60.8 tons of fresh biomass per hectare (limits between 47.0 and 72.0 tons), respectively 23.85 tons of dry biomass per hectare (limits between 15.6 and 34.2 tons).

Methods for drying corn with corn cobs as fuel

Dr. Alfred Kindler
Landwirtschaftskammer Steiermark, Energie und Biomasse
Hamerlinggasse 3
8020 Graz, Österreich
alfred.kindler@lk-stmk.at

Initial.situation:
Corn is one of the world's most important crops with multi-purpose use. The drying of the dry corn production is carried out mainly from fossil fuels such as oil and gas. This represents both in economic (price level of fossil fuels) and in ecological terms (CO_2, sustainability, etc.) a massive problem. For this reason, a project was initiated to solve the existing problems in the economic and environmental field through substitution of fossil fuels with biomass. The use of biomass for drying purposes does not compete with another form of biomass and renewable forms of energy. Three methods will be presented.

Method.1:
The corn for the “dry maize production” is harvested with a certain proportion of cobs (500 to 600 kg / ha - depending on humidity - CCM corn for dry harvest). In the normal maize harvesting chain the corn cob is left on the field. In the special procedures for pig feeding corn is harvested at 35 % moisture content with a certain proportion on cobs. For this method, a certain proportion of the cobs must be harvested at full maturity of the corn kernel. The setting of the combined harvester on the common harvest of grain and stem is possible without problems and at harvest of CCM for pig feeding a common practice. In the drier the corn is separated from the cobs with a screening plant. Therefore the boiler can be charged with the resulting cobs. With the resulting cobs from a hectare of corn in average years a hectare of corn can be dried.

Method.2:
In this method, the harvesting of the entire cob material is made by a patented process from the company “Lohndrusch Tschiggerl”. In this harvesting process the entire cobs proportion is harvested without significant additional effort and impurities right on the field. Through a special separation module in the harvester the corn is separated from the cobs. These cobs are transported in a separate container and emptied simultaneously with the container of the corn harvest. This means, that in average years three to four acres of corn can be dried with the resulting cobs from an acre of corn.

Method.3:
In this method, the harvesting of the entire cob material is carried out by a "corn picker", who is harvesting the entire corn. Afterwards the corn will be separated from the cobs in the drying plant. With the resulting cobs the boiler for drying can be loaded. Thus, three or four acres of corn can be dried.

In all three processes virtually cost-free corn cob harvesting is practically possible with the additional advantage of the corn cob as oven-ready fuel and the saving of extensive storage capacity in the drying plant.

Combustion of reed biomass in small and medium scale plants – results of laboratory and field tests

DI (FH) DI Jürgen Krail
Forschung Burgenland GmbH
Steinamangerstraße 21
7423 Pinkafeld, Austria
juergen.krail@fh-burgenland.at
www.fh-burgenland.at

Co-Authors: DI Hannes Kitzler[1], DI Helmut Plank[2], Univ.-Prof. DI Dr. Christoph Pfeifer[3]
[1] University of Technology, Institute of Chemical Engineering, Vienna, Austria
[2] University of Applied Science Burgenland, Energy and Environmental Management, Pinkafeld, Austria
[3] University of Natural Resources and Life Sciences, Institute for Chemical and Energy Engineering, Vienna, Austria

The aim of the Project ENEREED (Sustainable Energy Conversion from Reed Biomass) is to analyse the supply-chain of reed biomass from harvesting to thermal utilization in different conversion paths. The focus of the project is on the specific circumstances of the reed-belt at Lake Neusiedl (Austria) which offers the largest connected reed potential in Central Europe (total area about 18,000 ha and 84,000 t total biomass potential on Austrian territory).

The results of the technical evaluation of reed used in combustion processes, both in small and medium scale plants are compared. The combustion experiments were done in a domestic wood chip boiler (capacity 80 kW) and in a district heating pant (capacity 3 MW). In both types of boilers, different mixtures of reed with wood were tested. In the case of the domestic boiler, pellets were used. In the case of the district heating pant, chopped reed and wood-chips were used. To evaluate the fuel properties, proximate as well as ultimate analyses are carried out.

A qualitative comparison of the ultimate-, proximate and ash melting analysis of reed to other types of biomass show, that the critical elements (N, S, Cl), which lead to air pollution are mostly in a lower level in comparison to other agricultural biomass, like straw, grain – whole crops, grain or grasses, but in a higher level in comparison to woody biomass. On the other hand, the ash- content of the compared biomass is in a lower level than the ash content of reed with a mean value of 7.5 %. The sintering (SIT = 1409°C) and softening temperature (SOT > 1500°C) of the ash from reed biomass is rather in a high level in comparison to woody as well as agricultural biomass. The lower heating value of the dry biomass ($H_{u,p,dry}$ = 16,4 MJ/kg) is lower than wood, but higher in comparison to most other herbaceous biomass.

The best results in the domestic wood-chip boiler could be achieved with 100 % wood pellets. A heat power output of 95 kW, with an efficiency factor of 92 %, was reached by using only wood pellets. The generated heat power decreases proportionally as the mass fraction of the reed pellets increases. With 100 % reed pellets, an average heat power of 40 kW was achieved. By the use of wood chips as reference fuel, a heat power output of 77 kW was measured. The experiments with wood chips and with a 50/50 % wood pellets/reed pellets mixture showed nearly similar results (87 % and 88 % boiler efficiency). By the use of 100 % reed pellets, a boiler efficiency of 78 % was detected.

In the district heat plant the experiments show, that reed can be used as additive fuel up to 50 % energy portion to wood chips without negative influence to the combustion behaviour. The power output slightly decreases because of the lower energy density of chopped reed. There are positive effects to the NO_x, CO and dust emissions, whereas HCl and SO_2 emissions increase.

The results of the combustion experiments show, that the emissions in both type of plants meet the targets of the federal law Combustion Plant Regulation (2011) whereas the high ash content of reed may lead to problems in the ash discharging system, especially in the domestic wood chip plant.

Promotion of bioenergy initiatives in Centru region, Romania

Christa Kristöfel
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
christa.kristoefel@bioenergy2020.eu

Co-Authors: Rita Ehrig, Christoph Strasser

Introductive summary
According to the Romanian National Renewable Energy Action Plan (NREAP), at 2020 level, the potential of biomass from forestry for energy is estimated to amount to 1.8 M toe in comparison with the 2006 level of 1.2 M toe, from which about 21 % are distributed in Centru Region. Centru Region is one of the eight NUTS2 –level regions of Romania (34,100 km^2, 2.5 million inhabitants). Located in the middle of the country. Centru Region is also one of the most forested regions of Romania: the forest vegetation covers 36.5 % of the region's area. 2011 4.4 million cubic meters of wood were harvested. However, the biomass market, especially the biomass supply side, is still underdeveloped. In particular, economic expert knowledge and consistent quality standards are needed for the future development of a bioenergy market in this region.

Strategy & Objective
Objective of the project is to provide support to the regional bioenergy initiatives and to facilitate new bioenergy business projects in Eastern European countries, especially in Centru Region in Romania, where potentials in particular of forest and agricultural biomass, have been utilised insufficiently as renewable energy sources.
To build up successful bioenergy supply chains in the target region, successful business models from other regions are analysed and their transferability to the target region are studied. Constraints and drivers of developing bioenergy projects in Romania are identified. Austrian experts are offering tailored training and consultancy services to selected pilot project companies on establishing new bioenergy business projects. In addition, feasibility studies elaborating the economic efficiency of these pilot projects are conducted.

Results
As a part of the project activity, the 2 Romanian project partners (ARD Centru and ISPE Bucharest) decided to provide support for 3 small and medium scaled pilot projects and for 2 large scaled projects, initiated by the municipality of Miercurea Ciuc and by the municipality of Odorheiu Secuiesc from Centru Region and help them to fulfil their investment plans in biomass heating plants. During the first year of the project period several local initiatives and projects in the field of bioenergy were identified. One of these initiatives is the Green Energy – Biomass Cluster whose activities are focused on supporting local small scaled biomass projects.
Following constraints and drives of the bioenergy market in Centru Region could be identified:

- The biomass potential in Romania is considerable, mainly from agricultural residues (60%) and forestry or wood waste (20 %).
- There are already some initiatives involving modern technologies e.g. in combination with sawdust used for heat production and gasification of wood for co-generation.
- There is a huge potential to use corn, straw and saw dust for bioenergy production. The adaption of renewable energy solutions could play an important role for the revitalization of disadvantaged and declining areas, for the improvement of life quality level, and for the creation of new jobs in Centru Region.
- The main obstacles include the small farm size (on average around 2 ha), little cooperation, and a lack of collection systems for agro-waste.
- There is a need for an overall strategy for bioenergy in Romania, which clarifies the markets, target groups, and technologies that the country should focus on, sets clear targets, and coordinates individual actions, so that national and EU target values can be met.

The PromoBio project is financed by the Intelligent Energy Europe Programme.
Project homepage: www.promobio.eu.

Sorption properties of torrefied wood and charcoal

Maija Kymäläinen
University of Helsinki, Department of Forest Sciences
P.O. Box 27 (Latokartanonkaari 7)
00014 University of Helsinki, Finland
maija.kymalainen@helsinki.fi

Mikko Havimo, Jarmo Louhelainen

The pre-treatment of biomass intended as fuel through the process of torrefaction has provoked much interest during the last few years because the resulting material has improved features compared to those of untreated biomass. During torrefaction, thermochemical degradation occurs in relatively mild conditions of 200–300°C, in absence of oxygen. Torrefied material is assumed to have good storage properties because the composition of the feedstock changes during heat treatment, resulting in a hydrophobic nature that reduces the amount of wetting and the resulting risk of biological degradation. A fuel that stays dry will promote ease, efficiency and cleanliness in combustion and might allow for outside storage which in turn would result in increased cost-efficiency throughout the entire supply chain.

The material used in this study was birch and spruce wood, pyrolysed in 220, 260, 300 and 450°C. In order to assess the effect of sorption on storage properties, the adsorption and absorption were investigated. The adsorption – internal take-up of one or more molecular layers of water in the cell wall – of water vapour into torrefied wood and charcoal was studied by measuring the influence of different pyrolysis temperatures on the equilibrium moisture contents (EMC) of the samples in constant temperature of 20°C and relative humidities ranging from 30 to 95 %. The capillary absorption was studied by exposing the longitudinal surface of differently treated samples to liquid water and determining the weight of absorbed water. Maximum capillary absorption was estimated by boiling the samples, thus replacing all air inside the pieces with water. To obtain a more thorough picture of the chemical changes that occurred in the samples, an analysis using FT-IR spectroscopy was implemented.

After the pyrolysis, a decrease in the adsorption of water vapour was evident and the EMC was reduced by approximately 50–70 % for both species in 95 %RH. The EMC decreased along with higher treatment temperatures as the ability to bind water became smaller due to less available hydroxyl groups, a result of degradation of the wood constituents, namely hemicellulose and amorphous cellulose. The capillary absorption was slower with treated samples than with untreated references. However, determining the maximum capillary absorption showed an increase in the capacity for water uptake with increasing severity of treatment, as the constituents of cell walls volatilize, thinning them out and thus enlarging the lumina and creating more available space to be occupied by water. The maximum capillary absorption increased from around 130 %MC up to a maximum of 440 %MC when considering the spruce samples. Birch was not affected as much and showed an initial decrease in absorption capacity up to 260°C, with a subsequent increase. The results from the FT-IR coincided with previous studies, showing a reduction in OH-groups and increase in aromatic structures that have a role in forming crystalline structures, possibly leading to increased porosity in temperatures above 300°C.

As a conclusion, torrefied and charred material should not be stored outside, as it needs to be protected from liquid water that absorbs readily into the material, reducing its heating value and turning it into a suitable substrate for fungi. But, when only subjected to water vapour, the stability of the material seems to be quite good, promoting storage in covered areas.

Renewable energy monitoring, control and simulation for small community heating networks (REM/REC/RES)

Evelyn Lang, BSc
4ward Energy Research GmbH
Tannengasse 18/6
A-1150 Vienna, Austria
evelyn.lang@4wardenergy.at
www.4wardenergy.at

Co-Authors: Herbert Wernig (ASTRA BioEnergie GmbH), Stefan Spann, BSc (4ward Energy Research GmbH), Ing. DI Dr. Manfred Tragner (4ward Energy Research GmbH)

Heating networks have sophisticated electronics which allow remote monitoring, control and extra-services of the systems. There are various software and hardware applications on different levels with different formats and interfaces that work without any communication between each other. Due to this a potential for optimisation can be assumed.
The main objective within the project REM/REC/RES was therefore to investigate the feasibility of an overall energy management system for small and medium scale heating networks. In order to make a statement on the feasibility of such a tool the following steps were carried out:

- Identification and analysis of available data and components.
- Inquiry of essential parameters for modelling the thermal system and additional renewable energy and heat sources that can be integrated in the existing network.
- Development of a simulation model for a reference system in MATLAB/Simulink.
- Evaluation of the energy efficiency potential and estimation of integration possibilities for renewable and other heat sources by using the simulation model.
- Technological and economical assessment for the development of an overall energy management system.

The elicitation of data was done for two selected heating plants in Carinthia. Firstly data on the components and the control and regulation within the heating network was collected. Within the next step the components were documented, the interfaces were analyzed and data was read out. In addition the main parameters of the heating plant (generation facilities), the data of the network structure and the load profiles (production and consumption) were collected.
With regard to the data volume it can be said about 285 sensors (heating plant, grid, consumers) are used within a small heating network. If the sensors record data every minute this means approximately 400,000 values per day. Extrapolated to one year in total about 150 Mio values are recorded. To handle this, a database was programmed within the project which allows to merge the existing data. As a result the data is available for further processing and can be used for the simulation and optimization. Furthermore the database is also adapted to provide the necessary information for the milestones of QM-Heizwerke. The analysis of the available data shows that errors in the measurement of the data collection and registration occur that must be corrected for the simulation.
Based on the available data and information a model in MATLAB/Simulink was created for one district heating network. After validating the model by comparing results of the simulation and selected parameters the actual simulation process was started. Therefore different scenarios have been calculated. The idea was to firstly optimize the system by changing or adapting parameters which should lead to an improvement in the overall efficiency of the heating system. Within a second step solar collectors have been integrated into the existing system in order to find the sustainable optimum for the corresponding heating network. Based on the results of the different scenarios the expected system costs and potential savings were determined. For the optimisation scenario total savings of about 6.000 €/a (fuel costs and electricity) can be realized by optimizing the supply temperature of the network. By integrating a solar system fuel costs of about 5.100 €/a can be saved.

Considering the implementation of a real-time optimization tool the measurement errors have to be identifiable and manageable. Based on the results of the simulations a significant potential for optimising heating networks can be assumed. The development of an overall energy management system for small and medium heating networks could be a future possibility for heating network operators to accomplish the entire operation (generation, grid, consumers) in an easy and more efficient way.

Danubenergy – Prograss-Alliance

Wolfgang Lehner
Ikervári u. 23
Sárvári HUKE Kft, Hungary
w.lehner@sarvarihuke.hu
www.huke.hu

Danubenergy Lead Partner: Energieagentur der Regionen, H.-Kudlich-Str.2,
A-3830 Waidhofen/Thaya, Austria, office@danugenergy.eu, www.danubenergy.eu

Danubenergy –"Improving eco-efficiency of bio-energy production and supply in riparian areas of the Danube river basin and other floodplains in Central Europe"
is a 30 months project funded by the Interreg Central Europe from 2012 to 2014.

At present the energy production from biomass is often economically inefficient. The conventional production of biomass for biogas plants is often eco-inefficient, e.g. due to the dominance of maize and the increased risk of soil erosion and nutrient losses, as well as through the low use of thermal energy during generation of electricity in the combined heat and power plant. Furthermore, the competition with food-production on fertile land and the resulting increase of prices for land and agricultural products causes ethical and socio-economic problems. Thus, the eco-friendly improvement of bioenergy production processes as well as the opening-up of abandoned natural and agricultural areas for the energy production is necessary.

Danubenergy offers introduction of an high efficient Production processes by introducing a new technology (IFBB: Integrated generation of Solid Fuel and Biogas from Biomass), either as standalone or add-on technology.
With that - Danubenergy contributes both to exploration and utilisation of new bio-energy inputs and to a diversity oriented management of abandoned sites.
With the concrete implementation of a model example in nine countries in parallel, the project will clarify, which technical possibilities and methodological approaches are applicable to improve the production, the efficiency, the supply and the transnational cooperation in the field of production of renewable energy in Central Europe - focused to "small regional level".

Danubenergy – project vision:
- Production of a storable solid fuel with a highly energy-efficient process
- Utilisation of extensively produced biomass from riparian grassland and landscape management areas, which can neither be used in animal feeding nor in conventional energy conversion technologies
- Increasing the efficiency of distributed biogas or waste water treatment plants through the addition of a year-round heat sink
- Securing livelihood for small farmers in retreated areas through the creation of new income sources and regional added values with renewable energy production.
- European wide creation of awareness for environmentally-friendly renewable energy production

Danubenergy - next steps:
On one side Danubenergy will have the main purpose to introduce a more efficient way of biomass utilization in line with European climate policy objectives and special "Renewable Energy Action Plans" on national level.
Parallel to that Danubenergy will promote development of a "Prograss product" as solid fuel with special admissions for use.
Hungarian project part of Danubenergy will be introduced as an "investment project approach"

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Bi-directional networks in district heating systems

DI Mag. Dr. Klaus Lichtenegger
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
A-3250 Wieselburg-Land, Austria
klaus.lichtenegger@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: DI David Wöss; DI Christian Halmdienst; Rosemarie Schnetzinger, MSc; DI Dr. Ernst Höftberger; Univ.-Prof. DI Dr. Tobias Pröll

Typical district heating systems contain many consumers but only one or a few producers. In summer, network main boilers usually operate in partial load mode. In this mode the efficiency is typically lower and the emissions are significantly higher than for full load. In winter, additional peak load boilers are in use. These boilers are often fired with fossil fuels like natural gas or light fuel oil, or (when using old equipment) they have worse emission characteristics than the basic load boilers. Apart from these aspects, having to acquire and maintain equipment which is in use only for a few days or weeks per year is also economically unfavorable.

On the other hand, one has an increasing number of buildings which have the capacity to (partially) cover their heat demand in a cheap and sustainable way, using biomass boilers or solar heat. Most of these buildings are not connected to a heat grid. But if they were, in way similar to the envisioned *smart grids* of electrical power, new solutions could become possible. It could be feasible to cover the low summer heat demand of a heating network completely with excess solar heat and thus be able to shut down the main boiler for an extended period. In winter, the peak loads could be covered by distributed biomass boilers of residential or commercial buildings. The capacity to cover short-term peaks with heat from decentralized sources could further be increased by proper use of the storage tanks usually present in such energy-plus buildings.

The other way round, even an energy-plus building can profit from the possibility to obtain heat from the network – in particular if the local boiler would run only in partial load or for a rather short period of time. Thus the connection of energy-plus buildings to a heat grid in a bi-directional way can turn out to be beneficial for both sides. For buildings which can both supply heat to and draw heat from the network, the term *prosumer* (as a composition of *pro*ducer and con*sumer*) has been coined. On a technical level, such a connection is expected not to pose serious problems, even though several details of the connection are still topics of current investigation. Even for suboptimal conditions (e.g. close to the main heating plant, where flow temperature and pressure difference are high), the electric energy required for pumps is typically less than one percent of the heat transferred to the system. The main challenge in this approach is to establish a reliable financial and control system for such a smart heat grid.

In a fully dynamical computer simulation model, a combined technical and economic control model for inclusion of prosumers in a district heating system has been studied. This way, interactions between the technical and the economic system are directly included. Even a simple control strategy contains several parameters to be optimized, depending also on the time of the year (summer, winter, transition time). The optimal parameters depend on the definition of the cost function, i.e. on the decision how to define the relative weights of economic savings, reduced emissions, CO_2 reduction and increased stability of the network.

The economic model most closely investigated is based on a heat price communicated by the heating plant. The calculation of this price is based on the estimated cost for producing additional heat and thus is high when prosumer contributions can avoid the use of a peak load boiler. Depending on the price, each prosumer can individually decide whether to providing heat to the network or not. A small transmission delay and response hysteresis are introduced in order to avoid unwanted oscillations.

The results demonstrate that in many situations the inclusion of prosumers can indeed improve the characteristics of a district heating system and significantly reduce fuel costs. (Emissions are rarely reduced, since small boilers tend to have worse emission characteristics than large ones.) The economic model, however, has to be quite elaborate in order to avoid unbalanced cash flows (like payments for excess heat actually not needed).

Harmonising greenhouse gas calculations for electricity, heating and cooling from biomass

Mag. Nikolaus Ludwiczek
Bioenergy 2020+ GmbH
Standort Wieselburg
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
nikolaus.ludwiczek@bioenergy2020.eu
www.bioenergy2020.eu

Co-Author: DI Dina Bacovsky

In 2009 the EU set clear greenhouse gas (GHG) reduction targets: minus 20 per cent of the Community's emissions and a 20-per-cent-share of renewables in the total energy consumption. Whereas the Renewable Energy Directive consequently mandates to calculate the life cycle greenhouse gas emissions of biofuels and defines a minimum reduction requirement compared to fossil fuels, it does not so for all other kinds of bioenergy, i.e. electricity, heating and cooling from biomass. Yet this could change soon: In its report of 2010 (COM(2010)11) the Commission recommended that member states should follow a harmonised approach when introducing sustainability schemes on national level. As harmonisation failed and trade with solid biomass is becoming increasingly important, the Commission might suggest binding criteria in a directive proposal. If this happens, member states, economic operators, and verifiers will face an administrative workload which the BioGrace-II project offers to facilitate considerably.

Equal to the biofuel regulation the Commission would probably publish default values for GHG emission savings of common solid and gaseous biomass production pathways and state a basic formula as well as fossil fuel comparators. Yet the directive is not expected to provide detailed rules that allow producers to perform own calculations. Based on data from the European Joint Research Centre the BioGrace-II consortium would retrace how the default values were calculated and elaborate a comprehensive GHG calculation tool featuring:

- a list of standard values
- an Excel tool that will:
    - show how the default values were calculated
    - allow stakeholders to make calculations themselves
- a user manual
- detailed calculation rules
- a methodological background document.

Version 1 of the Excel tool has been developed using preliminary data and has already been tested by a group of stakeholders. In addition to that BioGrace-II runs a campaign to inform policy makers and stakeholders and discuss steps of harmonisation. Core element of that is meant to be the list of standard values that unambiguously defines emission factors and other background data. The campaign also includes feedback sessions in order to achieve the most user-friendly tool possible. Thus BioGrace-II takes an intermediary role between legislation (EU, EC, and member states), producers and verifiers.

The project is financed by the Intelligent Energy Europe programme (IEE) and builds upon the earlier (2010-2012) IEE-project, equally named BioGrace, which harmonised GHG calculations for biofuels. As a late outcome the calculation tool of BioGrace (I) was recognised as a voluntary scheme by the European Commission in June 2013. BioGrace (I) attracted 500 stakeholders to public workshops and informed more than 12,000 via its website. BioGrace-II is expected to have the same reach.

Exploiting the potentialities of solid biomasses in EU parks

DI Volkhard Maier
Sölktäler Nature Park
8961 Stein/Enns 107, Austria
v.maier@soelktaeler.at
www.soelktaeler.at

Co-Autor: Mag. Ferdinand Prenner (Sölktäler Nature Park), Mag. Thomas Guggenberger (AREC Raumberg-Gumpenstein)

The project "Exploiting the potentialities of solid organic dimension in EU parks", short "BIOEUPARKS", was under the programme "intelligent energy - Europe (IEE) programme deemed worthy of funding and is equipped for period of 36 months with a budget of EUR 1.3 million over one. The project is coordinated by the Italian partner of Legambiente ONLUS and consists of a total of ten partners from seven EU countries. Five partners (Italy, Hungary, Greece, Austria and Slovenia) provide a nature park for project activities each, all of which are part of Natura 2000. The other five partners (Italy, Germany, Greece, Slovenia and the Netherlands) represent the environmental combinations as well as administrative and research institutions in the area of biomass, bioenergy, and forestry.

The main goal of BIOEUPARKS is to develop a method for the design, control and dissemination of short supply chains for biomass (< 50 km) and small heating and power-heat cogeneration plants (< 1 MW) in European nature parks. This emphasis on solid biomass from sustainably managed forest and agricultural areas.
The planned project activities are divided into four main phases:

- Provision of information and awareness creation, taking into account direct and indirect local communities
- Introduction a sustainable supply chain for solid biomass in participating nature park
- Sharing experience and training with the involvement of the actors directly involved
- Spread of part / results within the public

Biomass potential in Sölktäler Nature Park
The forest in the Sölktäler Nature Park covers around 13,800 hectares with mainly spruce dominated coniferous forests. 55 % of these forests are by legal or factual restrictions. 460 km of logging roads open up the forest mainly in the lower altitudes. The total growing stock in the study area is approximately 3.3 million cubic meters of standing wood. Effected by various restrictions on use only 1.6 million cubic meters can be used. The terrain relief of the forests in the Nature Park leads quickly to high altitudes. In this areas protected forest can be used only slightly. Due to the altitude the forests only have small growth of up to 2 vfm / ha per year . In favorable areas growth up to 7.6 vfm / ha can be achieved. The currently available annual timber volume decreases over three assessment levels (legal aspects, probability of harvesting and logging) from 65,000 to around 34,000 vfm. The annual harvest is currently around 26,000 vfm. This corresponds to a harvesting degree of 78 %. For the energy use around 9,000 vfm per year can be expected. In the project BIOEUPARKS the calculated data is compared with real data from selected farms in the next step. Subsequently, the biomass quantities are revised with the real data.

First results of the research project “Increasing biomass production by Silphium perfoliatum L. for energy recovery in Austria"

Dr. Josef Mayr
AGES – Austrian Agency for Health and Food Saftey
Spargelfeldstraße 191
1221 Vienna, Austria
josef.mayr@ages.at
www.ages.at

Co-Authors: Dr. Peter Liebhard, DDipl.-Ing. Markus Gansberger

The increasing impoverishment of the agricultural landscape of flowering plants in late summer and autumn, especially in areas with a high proportion of maize for biomass production, led to the search for alternative crops. In more than one view *Silphium perfoliatum* L. (*Silphium*) is an alternative, such as ongoing trials in other European countries show. In Austria, the yield potential of this plant is for the first time in the project "Increasing biomass production by Silphium perfoliatum L. for energy recovery in Austria" (acronym: "Bioenergy-*Silphium*") determined which is supported by the Climate and Energy Fund and carried out in the context of the program "Neue Energien 2020 ".

Materials and Methods
In spring of 2012 at three different in regard to soil and climate favored locations (Strem - Illyrian climate area, Vienna - Temperate continental / Pannonian climate area and Grabenegg - Semihumide climate area) and a marginal position (Schönfeld - Central European transitional climate) experimental stations for *Silphium* were constructed. The planting was done with a vegetable-planting machine. When the root balls were not enough embedding in the ground, they were reworked by hand. Immediately after planting the partially weak *Silphium* seedlings, the inventory was irrigated with a low water transfer (about three to eight millimeter). Two to five mechanical weed control measures were necessary in the planting year. In the following year, no vegetation weed control was necessary. The experimental plots in Grabenegg, Schönfeld and Vienna were fertilized like the maize plots. In practice, at the experimental area in Strem no fertilization was required due to the high nutrient supply of the soil. Selected soil chemical and physical indicators will be collected to compare them with these of corn silage and their impact on environmental criteria is assessed.

Results and Discussion
The establishment of sampling area (planting) and weed control in the planting year was very working intensively and costly, as the results of *Silphium* tests in other countries also show. After the successful establishment of the experimental area in 2012 (without harvesting) the yield of the complete plant was determined in the second growing season (2013) at two dates. Due to the extremely abnormal weather running from early July to mid-August (very high temperatures without precipitation) the highest biomass yields were already achieved in early July on three sites with *Silphium*. The highest dry matter yields were harvested at the sites Grabenegg 17.9 t ha $^{-1}$ and Schönfeld 14.8 t ha $^{-1}$. In Vienna 13.8 t ha $^{-1}$ and in Strem 10.0 t ha $^{-1}$ dry matter were harvested. Despite the very different dry matter yield in the year 2013 in all four test sites, the dry matter yields of *Silphium* were bigger than the maize yields (Grabenegg 14.6 t ha $^{-1}$, Schönfeld 10.5 t ha $^{-1}$, Vienna 12.6 t ha $^{-1}$ and Strem 6.6 t ha $^{-1}$). The achieved maize yields in 2013 were significantly lower than on the long-term average.

Conclusion
To reduce the cost of establishing *Silphium* field, currently made with potted plants, extensive experiments are performed and field trials with treated seed are planned consecutively. In optimizing the energy yield from the *Silphium* biomass, the date of harvest must be adjusted to the location, in relation to the weather-related development of growth and extending. In further experiments, the utilization of biomass as well as potential environmental benefits is examined and an economic assessment of biomass production of *Silphium* will be undertaken.

Energy conservation during the ensiling process for improving methane production from sugar beet

M. Sc. Amany Metwally
Department of Physical and Biological Processes, Clauthaler Umwelttechnik-Institut GmbH (Cutec)
Leibnizstraße 21+ 23
38678 Clausthal-Zellerfeld, Germany
amany.metwally@cutec.de
www.cutec.de

Co-Authors: Prof. Dr.-Ing. Michael Sievers, Dr.-Ing. Ottmar Schläfer

Abstract
Sugar beet is a promising substrate for biogas production but short storage capability and seasonal availability lead to apply the "ensiling" as a conservation process. As the ensiling is a biological fermentation process, a loss of carbon and energy occur. In this study procedures are investigated to minimize energy loss in the ensiling for enhanced methane production.

Keywords
Sugar beet; ensiling; additives; energy; methane

Introduction
The main objectives of this study are to: Ensure high storage stability and silage quality for possible use in biogas plant throughout the whole year. Reduce the loss of carbon and energy of the sugar beet in the silage process in order to improve output biogas production. Optimize process parameters in order to improve biodegradability and decrease the cost of producing energy from sugar beet. Increasing the overall economical efficiency of the sugar beet as feedstock for methane production.

Under laboratory conditions fresh sugar beet ensiled with different inoculation for screening. Five strains of lactic acid bacteria (homo and hetero fermentative LAB) and in addition the yeast *Saccharomyces cerevisiae* and non-inoculated as a control. After the ensilage process anaerobic biogas digestion was done for methane production. Gross energy, carbon component and organic acids were measured to balance the energy from fresh sugar beet to silage until methane production.

Results
During the different ensiling processes a turnover from sucrose to ethanol, lactic acid, acetic acid, other organic compounds and CO_2 takes place. With the CO_2 production a carbon source is leaving the system but in different quantities. The ensiling process pathway affected in the energy balance from fresh sugar beet to methane as a final energy output. While the methane production from fresh sugar beet (without silage) was about 420 l/kg carbohydrate, it came to an energy loss up to 30 % using the standard ethanol ensiling before methane production (297.76 l/kg carbohydrate). With our new fermentative bacterial ensiling setup, the energy loss was reduced to only 18,5 % (342.2 l/kg carbohydrate) compared to fresh sugar beet, which means a reduction of energy loss in the silage process of approximately 40 %. Latest results and parameters of optimized ensiling processes with minimum energy loss will be presented together with economical calculations of the entire fermentation chain from fresh sugar beet to silage and then to methane.

Wärmeversorgungskonzepte für Siedlungen bzw. Ein- und Mehrfamilienhäuser

Manuel Mitterndorfer
Austrian Energy Agency
Mariahilferstraße 136
1150 Vienna, Austria
manuel.mitterndorfer@energyagency.at
www.energygagency.at

Co-Author: Günter Simader

Durch die Implementierung der EU-Gebäuderichtlinie in Österreich ist zukünftig mit erhöhten Anforderungen an die Gesamtenergieeffizienz von Gebäuden zu rechnen. Neben den Anforderungen wie Heizwärmebedarf kommen zusätzliche Anforderungen hinsichtlich Kohlendioxid Emissionen, Primärenergiebedarf sowie Anforderungen an die Effizienz des Heizsystems mit dem das jeweilige Gebäude versorgt wird. Schließlich sollen bis 2020 alle neuen Gebäude sogenannte „Nearly-Zero-Energy-buildings“ sein.

Aufbauend auf den zukünftigen Anforderungen hinsichtlich Gesamtenergieeffizienz wurden in einer Untersuchung der Österreichischen Energieagentur unterschiedliche Wärmeversorgungskonzepte für Siedlungsgebiete bzw. Ein- u. Mehrfamilienhäuser gegenübergestellt. Schwerpunkt der Untersuchung war die Gegenüberstellung von unterschiedlichen Einzelhausversorgungskonzepten mit unterschiedlichen Nahwärmeversorgungskonzepten. Wobei hier wiederum der Fokus auf Hybridversorgungskonzepten lag. Hierzu wurden spezifische Referenzgebäude sowie eine fiktive Bebauungsstruktur einer Siedlung definiert. Ziel der Untersuchung war es auf Basis von ökonomischen (jährliche Kosten) sowie ökologischen Parametern, (Primärenergiebedarf und Kohlendioxid Emissionen) eine Entscheidungsmatrix sowohl für einen Eigenheimbesitzer als auch für einen Nahwärmenetzbetreiber zu schaffen.

Aus Sicht des Eigenheimbesitzers stellte sich das System eines Gasbrennwertkessels zwar am ökonomisch günstigsten heraus jedoch gleichzeitig am ökologisch ungünstigsten. Wobei sich im Allgemeinen der Kostenvorsprung des Gasbrennwertkessels zu den Biomassekesseln als nur sehr gering herausstellte. Eine Sensitivitätsanalyse hinsichtlich Energiepreissteigerungsrate ergab in einem Referenzgebäude sogar einen Kostenvorsprung des Biomassekessels gegenüber dem Gasbrennwertkessel. Am ökologisch günstigsten konnten die Wärmepumpensysteme in Kombination mit einer Photovoltaik Anlage bzw. ein Pelletskessel in Kombination mit einer thermischen Solaranlage bewertet werden.

Aus Sicht eines Nahwärmenetzbetreibers stellte sich ein innovatives Systemkonzept bestehend aus einem Hackschnitzelkessel, einer Luft/Wasser Wärmepumpe und einer Photovoltaik Anlage am ökologisch günstigsten heraus. Geht man davon aus, dass die kapitalgebundenen Kosten des Nahwärmekonzepts durch die Anschlusskosten der Abnehmer getilgt werden ist dies gleichzeitig die ökonomisch rentabelste Ausführung.

Allgemein wurde festgestellt, dass ein Nahwärmekonzept bestehend aus einem zentralen Pelletskessel und einer Solaranlage ökologisch der dezentralen Ausführung von Pelletskesseln und Solaranlagen zu bevorzugen ist.

Energy consumption of the grinding process of selected types of biomass for the purpose of the compaction process

Dr. Eng Krzysztof Mudryk
University of Agriculture in Krakow, Faculty of Production and Power Engineering
120 Balicka street
30-149 Krakow, Poland
Krzysztof.Mudryk@ur.krakow.pl
www.wipie.ur.krakow.pl

Economic considerations, qualitative and technological point to need for a systemic approach to the process of solid biofuels production. This process, despite appearances, is complex and involves a sequence of several technological operations (transport and reloading processes, grinding, drying up, compaction and cooling).

Shredding of the material is the one of the most important stages which deciding about the energy consumption in the production of solid biofuels. In the technological process can be distinguished two types of fragmentation, i.e. the initial and final. Pre-shredding is carried out usually at grinders or forage harvesters, and the obtained mass are wood chips or chopped straw with a length of 0.5 to 10 cm. The final grinding - a milling conducted on devices equipped with sieves capable to producing a material of uniform geometry. The most commonly used are rotor beater mills and knife mills.

In order to indicate the optimal parameters of grinding technology, it is essential, that the scope of research, in addition to the analysis of energy inputs, also included a qualitative analysis of the resulting products (inter alia the geometry of the particle and the bulk density). Only a comprehensive approach in on-going study, will allow for a full assessment of the process and identify optimal solutions.

The main aim of conducted researches was to determine the energy consumption of the grinding chips of willow *Salix viminalis* L. and poplar *Populus* L. and chopped straw of *Miscanthus x giganteus* Greef et Deu. and wheat straw. The researches were performed on half-industrial flail shredders (installed capacity 11 kW) with the option of changing the working sieves and shredding blades. Due to the fact that the process of solid biofuel production (pellets and briquettes) require the raw material of different particle size, in the studies were used four sieves of sizes 4, 8, 12 and 15 mm, and two variants of the working blades, i.e. from a blunt and sharp edges working. The test stand was equipped with an electronic system for measuring energy expenditure to enable the determination of net energy [Wh/kg] (energy for grinding the material) and gross (energy for grinding the material and to overcome the resistance of the machine).

The research material, before grinding process, was analyzed relating to grain size composition and the level of humidity. The obtained mass, after grinding, was analyzed relating to the particle size and bulk density. Due to the need to express the analysis of particle size by using one parameter for example in modelling of energy inputs, for the purpose of these tests, the indicator of mass fineness Sg was developed.

Conducted researches enable to characterize parametrically energy inputs in the grinding process and the quality of the resulting raw material for production of solid biofuels.

Production and storage of the bioliq®-Syncrude as feedstock for the bioliq®-gasification

DI Thomas Nicoleit
Karlsruhe Institute of Technology (KIT)
Institute of Catalysis Research and Technology (IKFT)
Herrmann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen, Germany
thomas.nicoleit@kit.edu
www.ikft.kit.edu

Co-Authors: M.Sc. Andreas Niebel, Prof. Dr.-Ing. Jörg Sauer

The purpose of Karlsruhe's bioliq®-project is the conversion of dry biomass into synthetic chemicals and fuels (also referred to as BTL, biomass to liquids) by producing process energy in two steps to achieve a desirable high carbon dioxide reduction. The lignocellulosic biomass is first liquefied by fast pyrolysis in distributed regional plants to produce an energy-dense intermediate composed of a viscous biooil and a high-energy char powder. Both products are mixed to a suspension (the so called bio-slurry or bioliq- SynCrude®) to be suitable for long storage periods and economic transport over long distances. Afterwards, the biosyncrude is converted into syngas through entrained flow gasifier and then by catalysis to synfuels or platform chemicals.

This work focuses on the production and storage of the bio-slurry out of the pyrolysis products. This includes:

1) Determining the energy consumption during mixing
The char and the condensates are mixed by several laboratory mixers (~ 5 liters) to determine the energy consumption during mixing. The investigations are being carried out by the model slurry (suspension of ethylene glycol and char powder) due to be adequate with the start-up conditions of the Karlsruhe pilot gasifier test in January 2013. The results are compared with experiments on "the original biosyncrude", which consist of pyrolysis condensates and char. Besides the power consumption investigation, the mixing efficiency regarding to the speed of rotation of the mixer and the homogeneity of the slurry after specific length of mixing times are being examined.

2) Storage in stirred tanks
The slurry is stored in several large tanks (4–20 m³) after mixing until gasification step. Due to the settling of the char particles, the slurry is slowly stirred. The required stirring energy is being measured to slow down the stirring speed nearly to a critical minimum speed, over which the sedimentation is avoided.

3) Sedimentation within the bioliq®-SynCrude
The char particles tend to settle and build solid sediments. Therefore this settling is investigated by variation of several parameters like settling time, particle size, settling height, initial solid concentration.

4) Stirring out of settled suspensions
The energy for re-stirring out of a bioslurry with a solid char sediment is investigated as function of initial solid concentration, particle size distribution and settling time. The results show, that solid sediments are to avoid, as the energy peak for re-agitating the suspension is very high, compared to the energy consumption for continuously slowly stirred slurries.

Development and optimization of a wood-based biorefinery concept for the production of platform chemicals on the basis of economic and environmental aspects

DI Roy Nitzsche
DBFZ - Deutsches Biomasseforschungszentrum gGmbH
Torgauer Straße 116
04347 Leipzig, Germany
roy.nitzsche@dbfz.de
www.dbfz.de

Co-Authors: Dipl.-Kfm. Maik Budzinski, DI Arne Gröngröft, DI Stefan Majer

The scarcity of fossil resources increases the need to develop and detect new sustainable processes, materials and products. The utilization of lignocellulosic biomass as raw material is a promising alternative to fossil resources. The production of platform chemicals in a biorefinery is seen as one way of reducing environmental effects and ensuring resource availability. In order to meet the requirements of competitiveness and low environmental impact of products it is necessary to use appropriate methods assessing and optimizing biorefinery concepts already during process design.

The presented study is part of a subproject of the “Spitzencluster BioEconomy” and is promoted by the German Federal Ministry of Education and Research. The aim is to develop a methodology for the economic and environmental assessment and optimization of biorefinery concepts. For that purpose an exemplary biorefinery concept is designed, which contains the following reaction steps: beech wood is separated in its main constituents cellulose, hemicellulose and lignin via the ethanol-organosolv-pretreatment; cellulose is converted via saccharification and fermentation to ethanol which is further processed to olefins over dehydration; hemicellulose and stillage from ethanol purification are converted to methane in a biogas plant; lignin is precipitated from the organosolv solution and dried; solid residues (hydrolysis lignin) are burned in a boiler. This concept is modeled and simulated with the process-simulation-software Aspen Plus® V 8.0 to determine all mass and energy flows in the system and the dimensions and properties of the reactors and utilities. Based on these results an economic (cash-flow model) and an environmental (life-cycle assessment) analysis is carried out with the aim to identify bottlenecks within the biorefinery concept. Economic weak points are these processes which cause the highest costs and ecological weak points are these processes which cause the highest environmental impacts (e.g. greenhouse gas emissions, eutrophication). With this knowledge, optimization of the biorefinery concept can be conducted. Thereby established process optimization methods like sensitivity- and pinch-analysis are used to eliminate the weak points and thus reduce costs, energy consumption and waste- and effluent-streams.

The presented results show a first example (simulation) of a wood-based biorefinery concept with mass and energy balances and the resulting economic (e.g. net present value) and ecological indicators (e.g. global warming potential). The next steps in this study are to identify improvement potentials and to generate deign alternatives. Finally, the economic and environmental performances of the biorefinery alternatives are evaluated by using eco-efficiency analysis.

Eco-energy aspects of the production and utilization of agripellets

Viktória Papp
PhD student
University of West-Hungary
Faculty of Forestry
Bajcsy-Zs. street 4.
9400 Sopron, Hungary
pappviktoria@emk.nyme.hu

In addition to the environmental reasons, growing energy demand, running out of fossil fuel supplies, and the expected increase in gas prices, all indicate that we must change in our power supply. The opportunities among the renewable energies available in Hungary largely lies in the utilization of biomass. This compressed energy has come into the purview of Europe and our country too. The EU market is ideal for wood-pellet production. In Hungary, due to the characteristics of its agricultural industry large amounts of herbaceous biomass is available.

Straw and various agricultural by-products can be used as the raw materials for agripellets. Common complications of the various by-products used in pellet production are the the ability to store and manage them, in addition to their combustion. Therefore it is important to create pellets that will reduce the energy put into transportation and improve the combustion parameters. Despite the fact that we have the herbaceous raw material base, the agripellet production is only slowly developing in our country. One reason for this is that while we have various agripellet combustion furnaces and boilers, these systems are relatively expensive. In addition, due to the high ash content of herbaceous plants it can not be burned in wood pellet boilers. Furthermore furnaces in the market are relatively few. However, a number of EU countries are helping with subsidies for the initial investment to make the changeover to pellet heating.

In our studies we dealt with the biodiesel production generated from the by-product of rapeseed stalk. After the grinding process we produced rapeseed stalk pellets with a small pellet making machine. Studies show that we can obtain a lot of energy from the rapeseed stalk. The location of the examination took place in T&T Technik Ltd. in Szentes. They are producing agripellets from different agricultural by-products. In the future I would like to expand on energy balance research in the area of agripellet production. Conclusions were made from the obtained results how much carbon dioxide is emitted by the production technology.

Keywords:
agripellets, energy balance, renewable energy

Anaerobic digestion modelling for mono-fermentation of different substrates

M. Sc. Hirenkumar Pastagiya
Department of Physical and Biological Processes, CUTEC Institut GmbH
Leibnizstraße 21+ 23
38678 Clausthal-Zellerfeld, Germany
hirenkumar.pastagiya@cutec.de
www.cutec.de

Co-Authors: DI Hinnerk Bormann, Dr.-Ing. Ottmar Schläfer, Prof. Dr.-Ing. Michael Sievers,

Abstract
Interest in biogas production as renewable energy has draw great attention to anaerobic digestion modelling for mono-substrates. This study has been carried out to characterise and provide information for operation and limitation of biogas plant and to validate Anaerobic Digestion Model No. 1 (ADM1) for different mono-substrate digestions.

Keywords
ADM1; mono-substrates; maize silage; sugar beet; biogas

Objectives of this study
Main objectives of this study are

- To provide information for characterisation method for mono-substrates
- To ensure a quick start-up and operational control for stable biogas production at maximum loading rates
- To provide modified kinetic constant values and sensitive parameters for modified ADM model.
- To validate the model for lab-scale and pilot-scale biogas plant
- To verify IWA published Anaerobic digestion model 1 (ADM1) and prepare in MATLAB - Simulink and Microsoft excel – visual basic for further usage and modification

Methods and results
In this study batch and long-term continuous anaerobic digestion experiments have been considered. For this work a new measurement method (Schlaefer, 2005, CUTEC-Schriftenreihe No. 62) has been considered to validate the kinetic parameters for the different groups of microorganisms to calibrate the model. The simulation results obtained from calibrated model have been compared to the experimental results. Results show that the calibration should be renewed after a period. Additionally, new insights in the development of the concentration of different microorganisms groups were given thus enabling a more stable biogas production at high loading rates.

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Anthropogenic methane utilization via co-production of green hydrogen and crystalline carbon as intermediates for bio-refineries

Ing. Stefan Petters,
guo – Business Development Consult e.U.,
Weidlichgasse 12
1130 Vienna, Austria
st.petters@guo4.biz

Co-Authors: Dr. DI Michael Fuchs, Dr. DI Stefan Koppatz, Dr. DI Klaus Mauthner,

Global Anthropogenic Methane from agriculture-, foresting-, mining- as well as wastewater- and municipal solid household waste disposal (landfills) is number two Green House Gas [GHG] contributor after the energy sector[i]. But state of art usage paths usually lack financial self-sufficiency and are often not afforded. Only as already demonstrated in a Polygeneration's part-use of the available Hydrogen-/Carbon monoxide fractions from a producer gas off Steam Driven Indirect Fluidized Bed [SDIFB] Gasification, chemical synthesis output could unlock higher level planes in the value-adding pyramid[ii]. Unlike CHP only, you wouldn't loose it if you don't use it.

Bio-Refineries for downstream Chemical Synthesis production

Integrating dissociation of gaseous hydrocarbons via our materials Technology developed in the last 10 years, co-producing Hydrogen and highly surface active, crystalline Carbon[iii] (we call it the Carbon Capture for Use [CCU] approach) as refining intermediaries into the "energy cell" application developed in Guessing, the entire decomposition-gas stream could be transformed into a chemical synthesis adequate H_2:CO mixture. A simulation model in IPSE-Pro was developed and validated within the team of authors, promising economical mass- and energy- balances.[iv] Dry thermo-catalytic splitting [CCU] was applied to the Methane fractions of thermo- and bio-chemically decomposed organic residues in the ratio typically co-existing in MSW, typically requiring 50 – 150GJ installations. Its renewable synthesis product outputs do not conflict with land use or food. The available high temperature waste heat of the gasification allows CCU to be performed without auxiliary energy supply. The process's endothermic requirement is only ~55 % of Steam Methane Reforming [SMR].[v] Left over high temperature waste heat can further support a Boudouard reactor to transform thermal waste energy and CO_2 into chemical energy in the aggregate of carbon monoxide [CO] [vi] by consuming the produced carbon. Delinquent net process- heat requirement can be covered by the Hydrogen in excess of an achievable 1:1 synthesis gas ratio. The simulated decomposition gas usage for Fischer Tropsch fuel synthesis shows output products producible at arms length's unsubsidized market price covering cost at raw oil ~U$ 110/Barrel.

Implementation of Bio-Refinery Innovation

Large-scale gasification exists since 180 years. At first for the production of „town gas" from coal and since 90 years for the production of synthetic chemicals. SDIFB Gasification originally was developed as an environmentally clean and efficient method for flexible energy recovery from poor carbonaceous fuels (above and beyond FB sewage sludge incineration).[vii] While coal gasification typically ranges in the order of 500 – 1,800 GJ feed stock, SDIFB gasification has so far addressed a range from 50 – 300 GJ feed stock. Due to lower operating temperatures its product gas' equilibrium contains about 30 % energy content in the form of Methane. The more plastic residues a feedstock contains, the higher.[viii] But most applications looking towards SNG production from logistically awkward feed stock (such as ligneous biomass or MSW), for which SDIFB gasification deems to be best suited, yet fail to meet NG market prices. On the other hand, a Roll-Out of $\geq$10 installations for chemical synthesis products over a 10 years term shows a net present value based on DCF method, at a multiple of the initial investment required and could create a multi billion capital equipment market segment employing a few 10,000 people and reduce 3 times the CO_2 emission per ton of organic MSW, current state of the art Waste to Energy concepts can, with fossil fuel substitution as a leverage.

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Wood chips and hog fuel: standards in practice

DI Wilfried Pichler
Holzforschung Austria, Bioenergy
Franz Grill Straße 7
1030 Vienna, Austria
w.pichler@holzforschung.at
www.holzforschung.at

Co-Authors: DI Monika Steiner, DI Andreas Haider

The growing demand of wood chips and hog fuel for the use in heat- and CHP-plants created the need to mobilise many different kinds of woody biomass. This results in huge differences in fuel quality. Short supply chains and low processing increase the influence of the raw material on the final quality of the fuel for the trade of 'forest chips'.

Projects on national level in Austria generated a fairly strong database on the different qualities on the market. Especially the ash content, the content of fine particles but also the levels of chlorine and nitrogen differ widely. The ash content for example varies in a wide range between 0.5 % and up to 40 (!) %. Although it is very difficult to predict the correct quality, some patterns are evident. The 'origin and source' of the material has a causal influence on ash content and the content of fine particles in a sample. These patterns have been used to develop a supplementing national standard to ÖNORM EN 14961-1. ÖNORM C 4005 'Wood chips and hog fuel for energetic use in heating appliances with a thermal output over 500 kW', which was published in 2013, forms raw material groups based on specific typical properties of the materials. For example class C1 consists mainly of stemwood/roundwood, and is characterised by fairly low ash contents.

The use of ÖNORM C 4005 in practice
The uptake of standards by the industry usually takes some time. Therefore 10 months after its publication the effects of ÖNORM C 4005 still remain to be seen. Fact is, that the still widely used ÖNORM M 7133 was withdrawn in February 2013 and will disappear from the market. Because ÖNORM C 4005 was developed especially for 'forest chips' it better serves the needs of this specific market than the former ÖNORM M 7133. With some training and experience and with the help of typical values of the standard a material can be specified visually. Several dissemination activities are still ongoing and different market actors show high interest in the use of the standard.

In a follow-up project additional data will be generated to improve this specification system of raw material groups and typical values.

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Optimized production of torrefied pellets from alternative biomasses

Andreas Pilz
Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Straße 116
D-04347 Leipzig, Germany
andreas.pilz@dbfz.de
www.dbfz.de

Co-Authors: Jan Hari Arti Khalsa, Thomas Zeng

Because of the worldwide rising energy demand and the national and international climate targets, the use of biomass for combustion is of great importance and will even increase in the near future. Especially small scale combustion units are fired almost exclusively with high quality wood fuels resulting in a reduced availability of these wood assortments. Solid biofuels from alternative biomasses are experiencing growing interest as the demand for material and energetic use of wood is growing.

Among other possible fuel types, pellets are particularly promising due to their advantageous characteristics like high energy density, homogeneous physical characteristics and easy handling. However, for the utilization of alternative biomasses such as straw residues, wood residues from forest or landscape preservation material as solid fuels certain pre-treatment steps might be required.

In principal, the pelletizing of alternative raw materials is very similar to the production of wood pellets, which can be considered state of the art. However, homogeneity of the raw material declines comparing common wood residues with forest residues with herbaceous biomasses. The pelletizing behaviour and pellet quality can vary significantly even amongst different batches of the same material when homogeneity of the raw material is low. Therefore, the fuel processing of these biomasses requires additional modification of technical details and process parameters to produce a homogenous fuel. The torrefaction as an added process step can be an efficient step toward a more homogeneous raw material and consequently a more homogeneous solid fuel.

In the present work, fuel conditioning experiments were carried out using a rotary batch reactor for the torrefaction, a hammer mill and a ring die press in pilot scale to investigate the influence of different process parameters on the properties of the pellets and the process stability. The focus of these studies was to investigate (i) suitable torrefaction temperatures and resting times, (ii) the effect of different process steps on the fuel quality and energy requirement and (iii) potential improvements of raw material and process parameters during pelletizing.

It was shown that choosing the right order of milling, pelletizing and torrefaction can reduce the energy requirements for upgrading the heterogeneous raw material to a higher quality solid fuel. Furthermore, optimizing the individual process steps can reduce the overall energy requirements.

Torrefied pellets – influence of torrefaction on pellet characteristics and combustion behaviour

Christian Pointner,
Bioenergy 2020+ GmbH
Gewerbepark Haag 3
3250 Wieselburg-Land, Austria
christian.pointner@bioenergy2020.eu

Co-Authors: Irene Schmutzer-Roseneder, Sabine Feldmeier, Christa Kristöfel, Rita Ehrig, Manuel Schwabl, Christoph Strasser, Manfred Wörgetter

Introductive summary
In the last decade tremendous efforts have been made to develop a process for the production of torrefied pellets. These efforts were carried out based on the assumption that various biogenic raw materials can be used and simultaneously the homogeneity as well as the characteristics of the fuels will be improved. An increased application of so far challenging biofuels like straw or residues of landscape maintenance is possible and may affect the market of sawmill residues positively. This study reflects the applicability of different torrefied pellets in a 15 kW pellet boiler.

Approach
Pellets quality of two different samples of torrefied pellets were analysed according to EN 14961-2 and the results were compared with A1 EN plus certified wood pellets. The first charge of torrefied pellets was produced by a laboratory pelletizing press. The used torrefied material was prepared from spruce sawdust. The second sample of torrefied pellets consisted of residues from landscape maintenance and were directly bought from the producer. The combustion behaviour, released gaseous emissions and particulate matter, respectively were determined according to standardized combustion experiments based on EN 303-5. Fuel analyses provide essential results for a first characterisation of fuels regarding transport properties, combustion behaviour and gaseous emissions. The influence of torrefaction on chemical fuel characteristics is investigated by comparing the results from untreated raw materials and the torrefied pellets made of them. The production of torrefied pellets in a laboratory pelletizing press allows an evaluation of the impact of torrefaction on the physical properties like bulk density, water content or mechanical durability. Due to the combustion experiments conclusions regarding the applicability of torrefied pellets in small-scale pellet boiler can be drawn.

Results
The fuel analyses show that physical fuel properties strongly depend on the torrefaction process. The higher the degree of torrefaction the more difficult is the production of high quality pellets referring to the parameters bulk density, fines and mechanical durability. Further fuel properties like calorific value, water content or hydrophobicity are influenced positively. The elemental composition of the fuel is not influenced by the torrefaction. Elements like nitrogen and chlorine or heavy metals are obviously not reduced by the torrefaction process. The two torrefied pellet charges were combusted in the pellet boiler. The lambda controlled pellet boiler is equipped with a sliding grate and the fuel feed from side is operated by a horizontally moving auger. Slagging and fouling were not observed neither inside the combustion chamber nor on the grate. During the experiment, the heat output of the certified wood pellets was higher compared to the combusted torrefied pellets. However, the efficiency was less. The utilization of the second sample of torrefied pellets generated higher emissions of CO and NO_x which was due to the raw material.

Conclusion
Torrefied pellets turn out to be a certain alternative for industrial as well as quality wood pellets. However, there are no quality standards for torrefied pellets for the application in small scale pellet boilers available yet. The elemental composition of biofuels is not changed by torrefaction. That is the reason why the content of critical elements, concerning the combustion behaviour, in energy grain or straw will not be reduced by torrefaction. Therefore the application of torrefied energy crops and straw, respectively in small scale combustion units must be investigated. The utilisation of high quality torrefied pellets in small scale pellet boilers is possible according to the present state of knowledge. Due to different fuel properties (e.g.: calorific value) of torrefied pellets compared to wood pellets, adjustments and optimisation of commercial pellet boilers are inevitable to guarantee optimal and secure combustion. The reduction of combustion emissions of the torrefied pellets may be achieved by adjustments of the control system.

Biomasse-Potentialstudien als Entscheidungs-grundlage für Investments und Projektentwicklungen

Manfred Prosenbauer
NÖ Landes-Landwirtschaftskammer
Wiener Straße 64
3100 St. Pölten, Österreich
manfred.prosenbauer@lk-noe.at
www.lk-noe.at

Co-Autoren: Werner Löffler, Herbert Haneder, Gregor Hoffmann

Die Idee des Einsetzens von Biomasse und erneuerbaren Energien ist – vor allem vor dem Hintergrund neuester technischer Entwicklungen, Errungenschaften und Möglichkeiten – bestechend. Ob im großtechnischen oder regionalen Bereich – der Einsatz erneuerbarer Rohstoffe wird favorisiert und entspricht dem aktuellen Zeitgeist energetischen Kreislaufdenkens.

Für Investoren stellt sich allerdings vor Investment-Entscheidungen die Frage der tatsächlich regionalen Verfügbarkeit von Rohstoffen, die vornehmlich aus der Land- und Forstwirtschaft stammen. Das stehende Holz beispielsweise ist die eine Sache, die Verfügbarkeit desselben sprich die Bereitschaft der Eigentümer und die Umstände unter welchen sie zu einer Holzbringung bereit sind die gänzlich andere. Statistiken über z. B. Holzbestände sagen daher nur bedingt etwas über deren regionaler Verfügbarkeit aus.

Dieser Tatsache wird durch die Erstellung von Biomasse-Ressourcenpotentialstudien im Wege der lk-projekt praxisnah Rechnung getragen: Durch die Einbindung regionaler Beraterinnen und Berater, die die regionalen und örtlichen Verhältnisse kennen, können allgemeine statistische Daten auf realistische und praxisnahe Annahmen korrigiert werden.

Das Ergebnis sind Potentialstudien die hinsichtlich ihrer praktischen Anwendbarkeit einen hohen Anspruch auf die tatsächliche Umsetzbarkeit in der Realität innehaben.

Praktische Umsetzbarkeit im Vordergrund
Bei der Erarbeitung von regionalen Energiekonzepten steht bei uns die praktische Umsetzbarkeit ganz klar im Vordergrund. Dies ist mit gut vernetzten Strukturen und schlagkräftigen Organisationen mit nationalem und internationalem Wissen im Agrar- und Energiebereich erreichbar. Rohstoffkompetenz in Verbindung mit technischer Kompetenz ist hier ebenso von zentraler Bedeutung wie lösungsorientierte, projektbezogene Fachkompetenz verbunden mit Praxisbezug und praktischer Erfahrung. Auf www.lk-projekt.at finden Sie unter „Referenzen“ ein Beispiel einer Biomassenressourcenpotentialstudie, welche diese geforderten Kriterien erfüllt*).

Die lk-projekt niederösterreich│wien GmbH ist gemeinsam mit den Mutterorganisationen, den Landwirtschaftskammern Niederösterreich und Wien sowie dem sich über sämtliche Landwirtschaftskammern Österreichs erstreckenden ihr nahestehendem Netzwerk im Bereich der Erstellung von regionalen Energiekonzepten erfolgreich aktiv und steht für nachhaltige und in der Praxis umsetzbare Ergebnisse.

Structure analysis of the wood pellet industry in Austria

Daniel Raab B.A.
University of Applied Sciences Wiener Neustadt campus Wieselburg
Zeiselgraben 4
3250 Wieselburg, Austria
daniel.raab@amu.at
www.amu.at

Co-Author: Mag. (FH) Josef Walch

Rising gross national consumption of wood pellets (+42 % in the period from 2008 to 2011), annual growth of the installed wood pellet heating systems (+28 % in the period from 2010 to 2011) and a rising production capacity (+23 % in the period from 2008 to 2012) has attracted increased interest in the Austrian wood pellet market. The aim of this project was to find out the current attractiveness of the wood pellet industry for established and new wood pellet producers in Austria. The Porter´s Five Forces model was used as the methodology. This model analyzes five competitive forces (threat of substitutes, threat of new entrants, bargaining power of buyers, competitive rivalry within an industry and bargaining power of suppliers) to determine the attractiveness of an industry. The industry is considered to be attractive, if all five competitive forces have a low threat potential.

The forces “threat of substitute products” and “danger of new entrants” have a low threat potential. New entrants are confronted with high entry barriers. Moreover new wood pellet producers are also facing retaliatory measures by existing producers. Substitute products show a low threat potential in the short term, because wood pellets have a low price elasticity of demand short. The bargaining power of buyers (retailers) can be classified in low until medium, as the present (2013) business conditions (market growth, no free wood pellet reserves) reduce the high danger potential of the retailers. The high threat potential of the retailers consists of the high market concentration and the standardization of the industry product (normed solid biofuel). Competitive rivalry within an industry can be categorized as medium, because the present market growth reduces the high rivalry within the pellets industry. Intense competition within the pellet industry has its origin in similar production facilities and the absence of differentiation regarding the product. Suppliers, especially raw material suppliers (saw mill industry) represent the highest threat potential for the wood pellet producers, because the commodity market is characterized as a bull market. Moreover, the absence of a substitute raised the threat potential of the raw material suppliers. Furthermore, wood pellets producers are not the only consumers of these raw materials.

The analysis of the five forces has shown that the attractiveness of the industry of wood pellet producers in Austria is predominantly influenced by raw material suppliers. Although business conditions are good (market growth, no free wood pellet reserves), the industry is not very attractive. Due to the high entry barriers and retaliatory measures by existing wood pellet producers, new entrants have difficulties to enter the pellets industry.

H_2S and NH_3 tolerance of acidophilic sulfur-oxidizing bacteria

DI Lydia Rachbauer
Bioenergy 2020+ GmbH
Konrad-Lorenz Straße 20
3430 Tulln / Donau, Austria
lydia.rachbauer@bioenergy2020.eu
www.bioenergy2020.eu

Co-Authors: BSc Georg Lorber, DDI Markus Ortner, DI Dr. Günther Bochmann

H_2S and NH_3 are toxic, corrosive and odorous gases that are released as byproducts during anaerobic digestion. Although biological techniques for the treatment of the resulting biogas are available, high H_2S and NH_3 contents have been reported to inhibit the microbial activity of sulfur-oxidizing bacteria that are involved in the removal process [1].

In biological methods H_2S is oxidized to either elemental sulfur or, at elevated O_2 concentrations, to sulfuric acid. This work investigated the tolerance of acidophilic sulfur-oxidizing bacteria towards increasing ammonia and sulfide concentrations during microbial conversion of H_2S to sulfuric acid. The study consisted of two sets of bacteria incubations with either increasing ammonia or sodium-thiosulfate concentrations of 1.5, 3.0, 5.0, 7.5 and 10.0 g/L. Sodium-thiosulfate was used as model substrate mimicking H_2S.

Results show that even 10.0 g/L ammonia or sodium-thiosulfate did not completely inhibit H_2S oxidation. Nevertheless, a prolonged adaptation phase was observed for both compounds at concentrations above 5.0 g/L. At ammonium concentrations of 1.5, 3.0 and 5.0 g/L the pH dropped from initially 4.5 to 1.1 on day 5 indicating the production of sulfuric acid, whereas with 7.0 g/L ammonium the same pH was reached only after 12 days. With 10.0 g/L pH dropped to a final minimum of 1.3 on day 16. The same trend was observed with increasing sodium-thiosulfate concentration. When incubated with 7.5 and 10.0 g/L sodium-thiosulfate pH slightly increased during the first 9 days of incubation and was followed by a sharp drop until a final value of ~1.7 on day 13. At 1.5 and 3.0 g/L no such adaptation phase occurred.

Using the example of sodium-thiosulfate it was proven that although an inhibitory effect does occur at higher ammonium and sulfide concentrations, the sulfur-oxidizing bacteria efficiently convert toxic H_2S to sulfuric acid after a short adaptation phase.

[1] Lee, EY, Cho, K-S, Ryu, HW (2005): Simultaneous Removal of H_2S and NH_3 in Biofilter Inoculated with *Acidithiobacillus thiooxidans* TAS. Journal of Bioscience and Bioengineering 99/6: 611-615.

Strategy development for regional forest fuel supply chains in Southeast Europe

U. J. Wolfsmayr & P. Rauch
University of Natural Resources and Life Science Vienna, Institute of Production and Logistics
Feistmantelstraße 4
1180 Vienna, Austria
ulrich.wolfsmayr@boku.ac.at
www.boku.ac.at

Based on the analysis of regional forest fuel supply chains in 10 European Countries[1], a strategy development method was applied to investigate future strategies for supporting the biomass sector in Southeast Europe. The SWOT (Strengths, Weaknesses, Opportunities and Threats) approach was used to evaluate regional supply chains. Based on that a supraregional Joint-SWOT analysis was compiled and strategies maximising strengths and opportunities resp. minimising threats and weaknesses were formulated. Table 1 shows the Joint-SWOT for forest fuel supply chains in Southeast Europe. National experts indicated the relevance of each developed strategy for the individual countries; Table 2 shows the summary for all countries, the ranking reflects the average importance in the countries.

Table 1: Joint-SWOT for forest fuel supply chains in Southeast Europe

Internal strengths	**Internal weaknesses**
Sufficient wood quantity Utilisation of otherwise not marketable timber qualities Short distribution distances European biofuel standards Short raw material transport distances	Low profitability due to high procurement resp. investment costs Lack of all year round available forest roads and low forest road accessibility Weather dependency of harvesting & logging operations Information deficits and lack of coordination resp. transparency in the supply chain Excessive bureaucracy High variation of quality and moisture in wood fuels Lack of qualified work force
External threats	**External opportunities**
Raw material competition with forest based industry (leading to increasing feedstock price) Unpredectable periodical undersupply Natural conservation (e.g. Natura 2000) restricting harvesting Competition with fossil fuels Restrictive capital market	Fast growing market Increasing wood land area resp. growing stock and high regional biomass resource potential Innovation due to R&D in advanced processes for biomass procurement (including ICT), pre-processing and conversion Governmental/EU support: CO2-taxes, subsidies, feed in tariffs, research projects Instability of fossil fuel supply and volatile fossil fuel prices

Table 2: Strategies for developing forest fuel supply chains

SO-Strategies	1. Promotion of local producers, e.g. match-making events, demo events (S1/S2/S3/S5–O1/O5) 2. Promoting available biomass fuel standards (S4–O1)
ST-Strategies	1. Increase harvested wood quantities, e.g. utilise more forest area, shorten rotation period, utilise new assortments (S1/S2–T1)
WO-Strategies	1. Disseminate specific inventory management strategies to overcome common biomass market disturbances like fluctuation in supply/production and demand, periodical undersupply due to fast increasing market, weather conditions, or short-term orders (W2/W3–O1/O2) 2. Dissemination of actual research results in advanced processes for pre-processing (e.g. natural drying, technical drying), harvest and transportation of wood biomass (W1–O3) 3. Re-engineer processes in the biomass supply chain (W1/W4–O3) 4. Design organizational structures or new business models to improve the economic performance of biomass supply, especially under preconditions of small scale forests (W1/W4–O1/O2) 5. System of permanent education for high qualified work force, e.g. periodical trainings (W7–O3) 6. Establishment and promotion of smart quality systems, also for smaller companies (W6–O1) 7. Public presentation and education on ICT opportunities applicable also for smaller companies (W4–03) 8. Establishment of private forest owner networks to improve supply chain integration (W1/W4–O3) 9. Reduce interaction costs by minimizing bureaucracy and intra-organisational transactions (W5–O3)
WT-Strategies	1. Sharing investment cost between companies / introducing forest owner cooperatives (W1/T5) 2. Establish a monitoring system for wood fuel prices (W1/W4–T1/T4) 3. Establish public available cost calculation models for SCORPs (W1/W4–T1/T4) 4. Develop innovative transshipment points, biomass terminals, biomass trade centres (W1/W2/W3–T2)

[1] *The EU-Project FOROPA is a cooperation of organisations from Austria, Bosnia-Herzegovina, Greece, Italy, Romania, Serbia, Slovakia, Slovenia, Switzerland and Ukraine.*

Mus-Max WOOD-TERMINATOR 12 Z: The largest tractor wood chopping machine of the world has arrived!

Nina Reiterer
MUS-MAX Landtechnik Urch GmbH
Oberer Markt 8
A-8522 Groß St. Florian, Austria
urch@mus-max.at
www.mus-max.at

And it comes from Styria – the home province of Arnold Schwarzenegger. It was developed and built by the chopper manufacturer “Mus-Max”, one of the leading producers of drum-type wood chippers for wood chip production. With an incredible infeed width of 1.35 m and an infeed height of 0.9 m, this machine trumps everything you have seen before.

With the new WT 12 Z, Mus-Max sets new standards in the field of drum-type wood chippers. As a result of the high degree of in-house production at the company (the parts to be produced are made almost 100 % in-house), it was possible to adapt the machine ideally to the requirements of the customer Mandl from Liezen. The result is this absolutely premium-class machine with the following highlights:

1. The amply dimensioned infeed roller has aggressive feed tools and pulls in the wood like a “crocodile”.
2. An extremely wide, horizontal feed belt with ripping tools welded on it ensures the trouble-free feeding of shrubbery, residual processor waste wood and treetops.
3. The hydraulically pivotable roller as tray extension provides for a feed belt length of 3 m, which is a huge advantage for long timber.
4. The amply dimensioned chopping rotor with a diameter of approx. 1.2 m can be equipped with fixed chopping knives or blades. The best chopped material is produced thanks to the extremely large travel of the chopping knives and the special design of the rotor.
5. The blower has a novel blade that runs with the same speed with special, replaceable, gentle ejection tools. This internally dynamic structure ensures a nice ejector jet with little air. Tanks can be filled accurately with chopped material, of which little gets re-shredded.
6. The range of the new ejector can be adjusted hydraulically and steplessly with a radius of 4.5 – 5.3 m. The ejector flap consists of 3 parts, is designed for blowing up as standard, and covers a range of 145 degrees. All wear parts can be replaced.

Drive shafts or Hydro Drive Poclain wheel drives are installed on request. This drive technology and the amply dimensioned wheels make sure that the chopping device with a weight of 19 tons does not get stuck anywhere on rough terrain.

Many advantages:

- You can use it around the clock on farmland – no tachograph.
- You never get stuck with the tractor on rough terrain any more because it has wheels of the same size, for example Claas-Xerion – Furthermore there is a “pivotable high-visibility cab“ and motors with a greater displacement that are suited for continuous operation. The chopper can also be equipped with a special tread pattern so that the driven wheels pull through without spinning.
- The flexibility, the efficiency, the life cycle, the maintenance-friendliness, the ergonomic handling and the comfort it offers the driver – only the tractor chopper WT 12 Z can do that.

A generously dimensioned tractor with up to 600 HP and this WT 12 chopper are currently the best on the chopper market! For more information: www.mus-max.at

Economic and ecological evaluation of different supply chains for energy conversion from reed

DI (FH) DI Doris Rixrath
Forschung Burgenland GmbH
Steinamangerstraße 21
7423 Pinkafeld, Austria
doris.rixrath@forschung-burgenland.at
http://www.fh-burgenland.at/

Co-Authors: Prof. (FH) DI Dr. Christian Wartha, University of Applied Science Burgenland, Energy and Environmental Management, Pinkafeld, Austria and DI (FH) DI Jürgen Krail, Forschung Burgenland GmbH, Pinkafeld, Austria

Introduction
Within the project ENEREED, reed from the Lake Neusiedl in Austria is examined as energy source for thermal utilization. The aim of the project is to investigate methods for using reed as a renewable fuel for combustion processes in industry (cement production), biomass power plants and biomass boilers. To evaluate thermal utilization methods an economic and environmental assessment were done.

Material and Methods
In order to investigate the environmental impact a Life Cycle Assessment (LCA) of the total supply chain (harvesting technology, fuel logistics, fuel processing and thermal supply) was done. Calculations use primary data from field tests along the total supply chain and different combustion processes experiments and secondary data for the component materials (database ecoinvent 2.1).

For the economic evaluation the different parts of the supply chain were calculated separately as cost objects. Costing was done for fixed and variable costs. For calculation, data from producers, field tests, literature or own estimations were used.

This study analyses and compares two types of harvesting equipment. The first type of harvester was an ordinary harvester with mow and hand-loading. The second technology was a harvester with mow and baler. Several transport and storage possibilities were investigated. Reed can be used for energy generation in different forms. Therefore another objective in this work was to examine reed chopped short and reed as pellets where combustion experiments were done.

In order to quantify the environmental impact the CML2001 and ReCiPe methods were used. The CML 2001 is a collection of impact assessment methods which restrict quantitative modeling to relatively early stages in the cause-effect chain to limit uncertainties. To give a good estimation of the environmental impacts of the thermal utilization and harvesting alternatives different impact categories were examined (e.g. climate change, depletion of resources).

Results and Conclusion
The results of energy conversion from reed were compared with results of other fuels which are typical used in the observed fields. Harvesting reed, as well as pelletizing, has a significant influence on the results for the ecological and the economic investigation. The environmental and economic findings could enhance considerably, when inventing a more efficient harvesting technology. The results of the environmental analyses indicate that using reed as chopped material has the lowest overall specific global warming potential compared to reed pellets and natural gas and light fuel oil. On the other hand using reed shows a high ratio of sulphur which results in higher values for acidification and particulate matter (secondary PM10 emissions are formed).

Designing Trans-European logistics networks for biogenic residues-based energy carrier production

Stefan Rotter, MSc
Fachhochschule OÖ, Forschungs & Entwicklungs GmbH
Wehrgrabengasse 1-3
4400 Steyr, Austria
stefan.rotter@fh-steyr.at
www.fh-ooe.at/forschung-kooperation/forschung

Co-Authors: Stefan Brunner, Stephan Hutterer, Erik Pitzer, Christian Rohrhofer

Facing a cascading use of biomass, several types of biogenic residues as well as different conversion technologies for energy carrier production are under recent investigation. A further prominent issue in this context is given by the way of supplying biogenic residues and energy carriers as derived fuels, respectively. Here, logistics is supposed to have a decisive impact on total costs of such energy supply networks. In order to verify this argument, logistics networks which consider both operational as well as strategic modeling aspects need to be designed and evaluated holistically. This specific scientific examination has emerged from the BioBoost project (FP7 project, http://www.bioboost.eu/).

In this project a holistic logistics model is set up in order to determine an optimal, that is, a cost and/or emission efficient supply network topology for second-generation bioenergy production in Europe. A major input for the logistics model constitutes the operational logistics processes, i.e. transport, handling and storage for biogenic residues as well as energy carriers. Initially, a main emphasize is put on defining and evaluating proper equipment and infrastructure required for efficient and secure logistics operations. Thereby, most of these data are defined through consulting practitioners and reviewing existing literature. Based on this dataset, logistics costs for logistics equipment, i.e. transport mean, handling device and type of storage are calculated. By means of all evaluated cost rates (EUR/t & EUR/t*km), a reference logistics process chain is defined for each individual product type.

Among others, these cost data serve as a major input for the holistic logistics model, which aims at strategically locating facilities and allocating product sources in Europe in an optimal manner (MIP model). Since this endeavor is highly complex, a simulation-based optimization approach using meta-heuristics is applied in order to derive an optimal logistics network design. In addition to the optimization model, also a (geo) graphical user interface is created in order to visualize the optimization process.

Moreover, a risk analysis is conducted for the before-mentioned reference logistics process chains. Within this task, a qualitative as well as quantitative assessment of different risk types (e.g. biomass loss, HazMat, quality, environmental, etc.) along the supply chain is conducted through, again, consulting literature and practitioners. As a result, actions for risk mitigation are identified and evaluated in order to be integrated in the holistic logistics model.

This research work provides concrete insights into the field of biomass as well as energy carrier logistics by combining both operational and strategic designing and planning elements. Most important, the outlined logistics network for biogenic residues-based energy carrier production in Europe serves as a fundament for another main task within the BioBoost project, namely a life cycle assessment (LCA), which aims at integrating the economic and environmental impacts of the reference supply chains in order to benchmark the biofuels against its fossil equivalents.

The energy³ saving stove

Dr. Thomas Schiffert
Austrian Kachelofen Association
Dassanoskyweg 8
1220 Vienna, Austria
office@kachelofenverband.at
www.kachelofenverband.com

Richard Jussel
Ofenbau und Feuerstellen
Klein Wetzles 35
3920 Groß Gerungs, Austria
feuermacher@gmx.at
www.feuermacher.com

Why the energy³savingstove?

- it provides a smoke free kitchen
- fuel saving
- high efficiency – up to 84 %
- 100 % appropriate technology
- safety against burns
- heat tolerance
- time saving on cooking as three or more pots can be used at a time
- labour saving on fuel collection
- stoves of any size, shape and function can be made to suit any size and type pot and any cooking habits
- the stove can burn almost any fuel
- material cost very little and is locally available
- it can be built wherever there is sand and clay available in the soil
- the method of construction requires simple skills
- the approach requires only construction skills that are found in even the poorest household
- long standing heat for baking and for space heating enabled by unburned clay bricks storing the heat and radiating it cosily to the surrounding and a damper that completely closes the draft
- such stoves heat water with waste heat when big pots with covering are placed on the cooking surface
- water stays warm over night and is ready for the women for the morning's washing ritual
- without starting a new fire
- the stoves are used for cooking, baking, warming water, space heating, ironing, brewing beer etc.…..
- stoves can be broken apart and the material can be reused to build a new stove
- built of a mud mixture comprised of clay, sand, straw, etc. all materials are locally available, the technology is an open source technology that has been implemented in different kind of stove in countries like Africa, Asia and South America.

Target groups:

- all institutes for development aid
- all associations for sustainable energy
- all groups of appropriate technology
- all technical advisers
- people all over the world living in sparsely wood areas with sensitive ecosystems

In cooperation with Austrian Kachelofen Association, www.kachelofenverband.com, Interdisciplinary institute for development cooperation, www.iez.jku.at, Federal Ministry for Transport, Innovation and Technology, www.bmvit.gv.at, the energy agency of Upper Austria, www.esv.or.at

Torrefaction: Scenarios for biomass-to-end-use chains for the investigation of the diffusion into European energy markets

Fabian Schipfer
Energy Economics Group,
Institute of Energy Systems and Electrical Drives,
Gusshausstraße 25-29
A-1040 Vienna, Austria
schipfer@eeg.tuwien.ac.at,

Co-Authors: Kathrin Bienert, Rita Ehrig, Lukas Kranzl, Stefan Majer, Julian Matzenberger, Martin Svanberg

A biomass-to-end-use chain simulation tool (BioChainS) was developed which is capable of assessing the high number of production and utilisation pathways based on torrefaction that could become relevant in the near future. The statistical programming environment of R (RStudio, 2012) was used to connect the different parts of the model. The first part mainly consists of the cost summation of biomass supply including the purchase of the feedstock, its preparation to a high-energy dense solid biofuel, its consumption (e.g. combustion) at the end user and every single transportation step that occurs within this biomass-to-end-use chain. The chain links are allowed to form all possible combinations as long as no linkage restriction is violated. Technological and economic data of the solid biofuel preparation steps, the consumption and handling properties and physical properties of the feedstock were obtained from the experimental research of the European research project SECTOR (Solid Sustainable Energy Carriers from Biomass by Means of Torrefaction), funded under the 7th framework programme. Regional costs of feedstocks, labour, fossil fuel, electricity, interest rates and taxes were gathered in extensive literature researches and from internal sources.

For the deployment scenario simulation exogenous scenario data is defined following four main storylines. Based on a discussion during an expert workshop held within the project, we identified the following main aspects to be modified for different deployment scenarios: Biomass availability, demand for (torrefied) biomass and technological development. All these dimensions may be strongly affected by policies, which therefore form a higher-level aspect to be discussed separately. Using these dimensions, four storylines were drawn to facilitate the quantification of the model input data as well as the discussion. These storylines will form the main paths of the different deployment scenarios of torrefied biomass and the torrefaction technology in this work.

The main outputs of BioChainS are comparative chain assessments and deployment scenarios for torrefied biomass in the time range between 2020 and 2030. A large range of production and utilisation pathways based on torrefaction, that could become relevant in the near future are addressed and their biomass-to-end-use chains are evaluated in terms of socio-economics and GHG-emissions. Cost-efficient and environmental sound deployment strategies for torrefied biomass under different framework conditions are outlined in this paper. Further work within the SECTOR project will extend selected examples of the comparative biomass-to-end-use chain assessment with a full environmental assessment and overall conclusions and recommendations for stakeholders, policy makers and international sustainability forums will be derived.

New evaluation strategies regarding slag prediction in pellet boilers

Claudia Schön[a]
Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ)
Schulgasse 18
D-94315 Straubing, Germany
Claudia.Schoen@tfz.bayern.de
www.tfz.bayern.de

Co-Authors: Hans Hartmann[a]*, Manuel Schwabl*[b]*, Sabine Feldmeier*[b]*, Jonas Dahl*[c]*, Josef Rathbauer*[d]*, Daniel Vega*[e]*, Christoffer Boman*[f]*, Marcus Öhman*[g]

[b] Bioenergy 2020+/Austria, [c] Danish Technological Institute – DTI/Denmark, [d] BLT - Biomass, Logistics, Technology - Francisco Josephinum/Austria, [e] Escola de Enxeñería Forestal da Universidade de Vigo/Spain, [f] Umeå University/Sweden, [g] Luleå University of Technology/Sweden

Purpose
Pellet boilers are widely used for heat production. In most cases only wooden pellets with low ash content are suitable for these appliances due to the increased risk of slagging. The ash fusion test (AFT) is the only standardized method currently available for the prediction of slagging but it frequently failed when solid biofuels were investigated. Therefore different methods for the prediction of slagging tendencies were applied in order to identify the most suitable method for reliable prediction of slagging tendencies.

Approach
After a literature study on available methods for the prediction of slagging for solid biofuels three laboratory methods were selected. 14 different fuels ranging from different wooden fuels to rape seed extraction pellets were used. The following methods were chosen after an objective assessment of all methods: rapid slag test, CIEMAT method as well as the slag analyser. The first two methods were conducted at three laboratories while the slag analyser was only available at one laboratory. The obtained results were compared to the results from the standardized ash fusion test as well as to combustion tests at nine different pellet boilers with varying technologies.

Results
The rapid slag test is an easy method directly performed on the pelletized fuel itself but it only results in a “Yes” or “No” judgment having a high prediction capacity but without further differentiation of different wooden fuels. The CIEMAT method is extremely time consuming but the tests were done at different temperature level between 800 and 1100 °C. Therefore some differentiation between temperature levels as well as fuel types was detected. The last method was the slag analyser which used the pelletized fuels directly. This third method showed feasible results and also different slagging behaviour of different fuels was visible. All three laboratory methods were compared to the AFT leading to an improved slagging prediction for the CIEMAT method as well as the slag analyser. The results were compared with the combustion test performed on nine different pellet boilers. It could be concluded that the slag analyser has the highest potential for a reliable slagging prediction.

Conclusions
Three different laboratory tests for the description of the ash melting behaviour were tested on 14 different solid biofuels. The rapid slag test was the most simple test in this evaluation. The CIEMAT method as well as the tests with the slag analyser showed the potential for the identification of different qualities of wooden pellets in contrast to the standardized AFT. The suitability of the obtained results was validated by practical combustion tests on nine different pellet boilers. An objective final evaluation of the laboratory tests in comparison to the combustion tests proved that the slag analyser showed the best agreement between laboratory test and combustion test. Therefore, this method will be further developed for possible standardization within the ongoing AshMelT project.

The Research leading to these results has received funding from the European Union's Seventh Framework Programme managed by REA - Research Executive Agency (Grant No. 287062).

Particle precipitation in electrostatic precipitators for non-woody biomass – dust resistivity and ash melting behaviour

Dominik Steiner, DI (FH) Dr. techn. MSc
Scheuch GmbH
Weierfing 68
4971 Aurolzmünster, Austria
d.steiner@scheuch.com
www.scheuch.com

Co-Author: Michael Adlmannseder

Particulate emissions of biomass combustion processes are a topical subject for all plant sizes. For industrial sized units secondary control techniques are used to address the increasingly more stringent legal limits. Electrostatic precipitators (ESPs) have been used in this sector for decades due to their high reliability and low energy consumption.
Industrial sized plants are more and more fuelled by non-woody biomass due to their local availability and tendency to reduce greenhouse gas emissions. Examples are coffee grounds, cacao shells, sunflower shells, acai palm or Empty Fruit Bunch (EFB) as a residue of the palm oil production process. Those fuels necessitate different requirements for ESPs than clean Middle-European wood chips from spruce and fir. On one hand side ashes can have low ash fusion temperatures e.g. <950 °C; on the other hand their specific dust resistivity can vary significantly.
Low ash fusion behaviour can lead to ash melting on the discharge electrode tips (Fig. 2) where the corona discharge process takes place and thus inhibit the process. The specific dust resistivity is determined by the combustion process as well as by the ash composition (Fig. 1). Dust resistivity is crucial for the ESP design and thus important to predict in advance as accurate as possible.

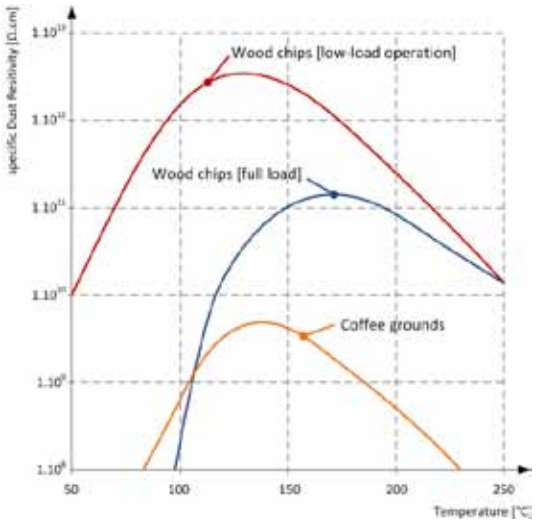

Fig. 1 Dust resistivity for biomass ashes for different combustion regimes

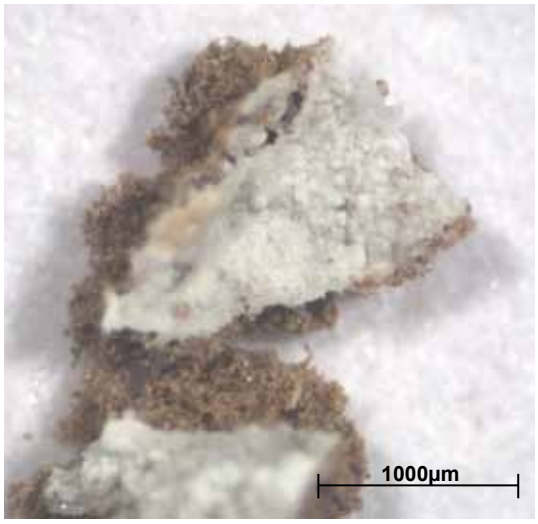

Fig. 2 Melted ash – deposit from discharge electrode tip

The presented work explains the influence of the above mentioned parameters on ESP efficiency und addresses the aspects relevant to daily operation. Non-contact temperature measurement was used to verify the presence of a hot-spot during corona discharge on the electrodes' tip.
To investigate the impact of fly ash composition on dust resistivity, 32 ash samples from various biomass fuels out of industrial applications where taken. Essential ions were determined by ion chromatography (IC). Relevant semi-metals and metals were quantitated by inductively coupled plasma optical emission spectrometry (ICP-OES). The determination of the carbon content was accomplished using a high-temperature-TOC/TNb-analyzer. Ash resistivity was determined between 80 – 250°C with constant current density of 0.5 mA/m² and air-environment with water dewpoint 50°C.
Based on the results, an attempt was made to develop a model to predict biomass fly ash resistivity based on fuel analyses and identify major elements impacting fly ash resistivity.

Process optimization of biomass district heating systems by operating data analysis

DI Hubert Steiner
Universität Innsbruck, Arbeitsbereich für Konstruktions- und Materialwissenschaften,
AB Energieeffizientes Bauen
Technikerstraße 13
6020 Innsbruck, Austria
hubert.steiner@uibk.ac.at
www.uibk.ac.at/bauphysik

Co-Author: Univ.-Prof. Dr. Wolfgang Streicher

In Austria are more than 1,400 biomass district heating plants under operation. Public buildings, industry, businesses and private households in one and multi family houses are heated with biomass as a fuel. Biomass district heating networks show very high technical standards of equipment. Several measures to increase the quality and the know-how responsible for the design engineering process have been used to increase plant design quality. Biomass district heating plants are an established way to supply whole villages with heat generated by biomass use and help to increase the added value in Austria. Additionally biomass use helps the agricultural sector because the wood is provided by local forest owners. The public authorities invest a lot of money in the form of grants to keep plant quality high and to provide low energy prices for heat customers.

The design engineering process delivers plants equipped with high quality plant components. Plant operators face the challenge to conduct business with these high investments and more and more businesses face problems to pay back their loans. Many operators come from a rural background and don't possess the know-how and resources to fulfil all needs of conducting a heat plant business. Therefore some plants have the difficulty to fulfil their trading results. The investors, mostly banks, are more sensitive since the economic downturn and excuse no lack of professionalism.

The intention of this project is to alleviate operators the plant management of biomass district heating plants. Processes of the biomass plant company are analysed and described. The analysis starts with the allocation of wood until the billing of the heat sold to the customers. After the processes have been laid out, all operation processes will be analysed and checked for possible optimization. Additional a software-tool ("heidi" / www.nw-heidi.at) will be updated which allows executing all optimized processes assisted by information technology.

In a second step 3-4 district heating plants will be fitted with the tool and the operation will be carried out aided by the updated tool. The aim is to fulfil a defined, measurable increase in plant operation and administration efficiency. 10 percent of the administration cost shall be reduced and controlling tools for the plant owner will be established.

The processes of wood chip delivery (from a nahwaerme.at logistics centre), heat plant optimization and operating reports have been analysed and optimized. In the case of wood chip delivery, the necessary process steps have been reduced from eight to five and a couple of difficult communication interfaces have been removed resulting in an efficient, repeatable process.

The process operation report is carried out by means of direct communication using information technology. Necessary reports to the federal government are composed by the web-tool "heidi" and can be exported in a required XML-format. The file resulting can be directly imported into the database of the authorities after a check if all the data is accurate. Soft facts can be added in the form of text fields. A couple of fault-prone process steps have been reduced, and a function for reminding the user of his responsibility will be added. Graphic charts have been created allowing the plant operator to quick check all data submitted and compare to previous periods.

This project is subsidised by the "Klima- und Energiefonds" via the programme "Neue Energien 2020".

Richtiger Einsatz des Energieträgers Holz – mit innovativer Technologie das Maximum erreichen

Erwin Stubenschrott
KWB – Kraft und Wärme aus Biomasse GmbH
Industriestraße 235,
A-8321 St. Margarethen an der Raab, Österreich
erwin.stubenschrott@kwb.at
www.kwb.at

Warum Holz sparen? Biomasse, im speziellen Holz aus dem Forst in Form von Hackschnitzel oder Stückholz sowie Pellets aus Sägenebenprodukten, ist mit einem Anteil von rund 75 % der zurzeit wichtigste erneuerbare Energieträger für die Wärmebereitstellung. Diese wiederum hat mit annähernd 50 % den größten Anteil am Energieverbrauch in Europa. Nichts liegt somit näher, als mit Holz zu heizen. Obwohl derzeit mehr Holz in Europa nachwächst als verbraucht wird, ist es ein Gebot der Stunde, sorgfältig und effizient mit diesem wertvollen Rohstoff umzugehen. Zwei Wege, die zum sparsamen und gleichzeitig sorgfältigen Umgang mit Wärme aus Biomasse führen:

- Deckung des Wärmebedarfes mit höchsten Systemwirkungsgraden
- Sinnvolle Dämmung der Gebäude beginnend mit der Geschoßdecke, und somit Reduktion des Wärmebedarfes

Wie funktioniert Holz-Sparen aus technischer Sicht? KWB als Systemanbieter liefert für eine Heizanlage neben der Fördertechnik, der Regelung und dem Speichersystem den Kessel, einen bestimmenden Teil des Gesamtsystems. Der „beste Kessel“ allein ist aber nicht ausreichend, wenn das Gesamtsystem der Heizungsanlage nicht auf das Gebäude abgestimmt und optimiert ist.

1. Gesamtsystem: Damit der Kessel wirtschaftlich betrieben werden kann und höchste Wirkungsgrade erreicht, muss das Wärmeverteilungssystem an Kessel und Gebäude angepasst werden. Eine sorgfältige Planung ist Voraussetzung für einen hohen Jahresnutzungsgrad. Bei komplexeren Anpassungen sind Planungsbüros, bei kleineren Standardlösungen ist der Heizungsbauer gefordert, das Heizsystem entsprechend auszulegen. Eine höhere Systemeffizienz durch optimale Planung und Ausführung verringert bei einer 300 kW Anlage die Brennstoffkosten um bis zu EUR 4.800/Jahr. Bei einer Nutzungsdauer von 20 Jahren ergibt dies eine Einsparung von insgesamt EUR 120.000. KWB bietet Schulungsprogramme an, bei denen Planenden und Ausführenden vermittelt wird, wie unsere Biomasseheizungen hydraulisch optimal eingebunden werden – ein Grund, warum es unsere Kessel nur bei qualifizierten Heizungsbauern zu kaufen gibt.
2. Kessel

2.1. Wirkungsgrad in der Verbrennung*:* Viele Kaminöfen aus dem Baumarkt und alte Kessel haben Wirkungsgrade um die 50 %. Die Hälfte der im Holz gespeicherten Wärmeenergie entweicht mit höchsten Emissionen ungenutzt durch den Kamin. Ein moderner Biomassekessel mit elektronischer Verbrennungsregelung erreicht einen Kesselwirkungsgrad von bis zu 95 %. Auf 2 Parameter legen wir bei den KWB-Konzepten besonders Wert:

- Sauberste Verbrennung des Holzes durch innovative Verbrennungstechnik und Regelung
- Hocheffizienter Wärmeabtausch in jedem Leistungsbereich, von der Teillast bis zur Volllast

2.2. Sauberkeit der Verbrennung (Feinstaub): Die Feinstaubgrenzwerte werden in den nächsten Jahren nicht nur am Prüfstand, sondern auch am Feld streng kontrolliert und durch die Gesetzgebung weiter verschärft. Die BImSchV sieht vor, dass alle ab 2015 installierten Holzzentralheizungen nicht mehr als 20 mg Feinstaub pro Normkubikmeter bezogen auf 13 % O_2 im trockenen Abgas emittieren dürfen. Eine optimale Verbrennungsregelung sowie entsprechende Maßnahmen zur primären Verhinderung einer Feinstaubentstehung bilden dafür die Basis. Brennertechnologien mit besonders ruhigem Glutbett haben hier erhebliche Vorteile, es ist wichtig, das Brennstoffbett ruhig zu führen um so wenig Asche und Glut wie möglich aufzuwirbeln. Eine Abscheidung von Staub im Rauchgas ist eine weitere Maßnahme, um Staubemissionen zu minimieren. KWB arbeitet seit Jahren mit modernster Computer-simulation (CFD) an der optimalen Modellierung unserer Technologien. Damit sind wir in der Lage die Effizienz, die Sauberkeit der Verbrennung, Temperaturverläufe, Spannungen und vieles mehr in aufwendigen Computermodellen zu simulieren. Bevor der erste Prototyp am Prüfstand steht, wissen wir bereits welche Effizienz und Abgaswerte wir zu erwarten haben.

2.3. Komfort: Höchste Zuverlässigkeit und minimaler Betreuungsaufwand des Heizkessels führen zu einer Komfortmaximierung. Das ist für uns eine Basisanforderung, an welcher wir kontinuierlich arbeiten um unsere Partnern und Kunden zu begeistern.

Hydrochar – is it fuel or soil?

DI Dr. mont. Walter Tesch[1]
[1]*Blue Innovations OG*
Gusindegasse 9
2361 Laxenburg, Austria
office@blue-innovations.org

Co-Author: DI Dr. Petra Tesch[1]*, Univ.-Prof. Dr.Christoph Pfeifer*[2]
[2]*University of Natural Resources and Life Sciences, Vienna*
Muthgasse 107, 1190 Vienna, Austria

In 1932 Friedrich Bergius received the Nobel Prize in Chemistry for the discovery of a new biomass conversion process, called Hydrothermal Carbonization (HTC). HTC is a thermochemical process for the conversion of organic substances to a hydrophobic solid of reduced mass and increased fuel value named hydrochar. The possibility to gain coal from organic substances by reproducing the gradual transition of organic matter into bituminous coal within hours instead of millions of years showed great promise. Although this approach has been one of the main economic drivers of that age, it got buried on oblivion with the emerging of the oil age. However, during the first decade of this century the hydrothermal carbonization process has been rediscovered and further analyzed scientifically by different research Groups (e.g. Markus Antonietti at the Max Planck Institute of Colloids and Interfaces in Golm,
Titirici et al., 2007). However, most researchers focus on the application of hydrochar as solid bio-fuel.

Erosion of fertile soil is a severe problem arising right after peak oil (Myers, 1996). The application of manmade bio-char produced by hydrothermal carbonization for the remediation, revegetation and restoration of depleted soils started to gain momentum recently (Rillig et al., 2010, Lehmann et al., 2011, Kloss et al., 2012). As hydrochar is considered to be rich in functional groups and can be derived from the HTC process under “wet” conditions, it is expected that it shall allow soil bacteria to settle more easily compared to the bio-char derived by torrefaction or pyrolysis.

The presentation compares the general advantages and disadvantages for the application of hydrochar as solid bio-fuel and for soil amelioration. In addition, results of own hydrothermal carbonization experiments are presented.

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Competences for tomorrow's energies: a qualification scheme for biomass consultancy

Ms Katalin Varga
Energiaklub Climate Policy Institute and Applied Communication Association
Szerb u. 17-19
1056 Budapest, Hungary
varga@energiaklub.hu
www.energiaklub.hu

Fostering the utilization of bioenergy is a key to an energy turnaround and the reduction of climate-damaging CO_2 emissions. Biomass is today the most important renewable energy source in Europe. Nevertheless, the comparison between countries shows wide differences with regard to the utilization of bioenergy. These differences can also be linked to the respective issue-specific state of knowledge. There can be witnessed a lack of specific bioenergy expertise at the levels of multipliers and decision-makers in economy and administration. Especially in Central and Eastern Europe exists a lack of suitable trainings that go beyond the scope of general knowledge on renewable energies and facilitate deep and specific competences in the field of bioenergy.

Q-BICON
The international project Q-BICON (Competences for tomorrows energies: A qualification scheme for biomass consultancy) is funded by the European Commission in its Leonardo da Vinci programme for two years, beginning in 2012. In the course of the project consortium partners from Austria, Germany, Hungary and Poland design a new type of advanced training for consultants and multipliers whose planning and investment decisions are crucial for the future utilization of bioenergy. The advanced vocational training addresses the following topics:

- Understanding energy systems
- Sustainable utilization of biomass for energy purposes
- Project management, legal framework and funding programmes
- Communication and participation (regarding stakeholders)

Addressed by the Q-BICON training course are especially skilled employees and decision makers from public and private sector, as well as NGOs. Potential participants work in the following fields in particular:

- Waste disposal, technical and building services
- Agricultural and forestry
- Spatial planning and architecture
- Energy providers and municipal utilities
- Organizations and associations related to (bio)energy

Interested persons have the chance to participate at no charge in the practical phase of Q-BICON and to avail of the new vocational training. The pilot course will take place mid-2014 in Berlin (D), Budapest (H), Minikowo (PL) and Wels (A). The courses will combine the advantages of e-learning and classroom training.

Project consortium

- Fraunhofer Centre for Central and Eastern Europe (MOEZ), Leipzig (D)
- C & Q Bildungszentrum Haberhauffe GmbH, Berlin (D)
- Kujawsko-Pomorski Agricultural Advisory Centre, Minikowo (PL)
- Energiaklub Climate Policy Insitute and Applied Communications, Budapest (H)
- Berufsförderungsinstitut Steiermark, Graz (A)
- Europäisches Zentrum für Erneuerbare Energien, Güssing (A)

Project information: www.q-bicon.eu

Increasing productivity of regional forest fuel supply chains using process management tools

Matthias Kolck [$], *Peter Rauch* [¥], *Ulrich Wolfsmayr* [¥, #]
[$] *Holzcluster Steiermark GmbH*
[¥] *University of Natural Resources and Life Sciences Vienna, Institute of Production and Logistics*
[#] *Correspondence:*
Feistmantelstraße 4
1180 Vienna, Austria
ulrich.wolfsmayr@boku.ac.at
www.boku.ac.at

The transnational project FOROPA aims at strengthening the competitiveness of forest fuel in the energy market in Southeast Europe and beyond. The project includes partner organisations from 10 countries – Austria, Bosnia-Herzegovina, Greece, Italy, Romania, Serbia, Slovakia, Slovenia, Switzerland and Ukraine. FOROPA is funded within the ETC SEE programme and runs from Dec 2012 until Nov 2014.

Existing regional forest fuel supply chains were analyzed and evaluated in detail. Firstly, the current state of specific supply chains in each country was documented by guided interviews. Based on that, supply chains were analysed and mapped using business process modelling notation 2.0 (BPMN 2.0). The standardised method can be used for improving the productivity of supply chains. Moreover, reference processes have been identified and should be used for knowhow transfer within Southeast Europe.

As example for the analysed supply chains in Austria the supply chain for high quality wood chips in Styria is shown (Fig. 1).

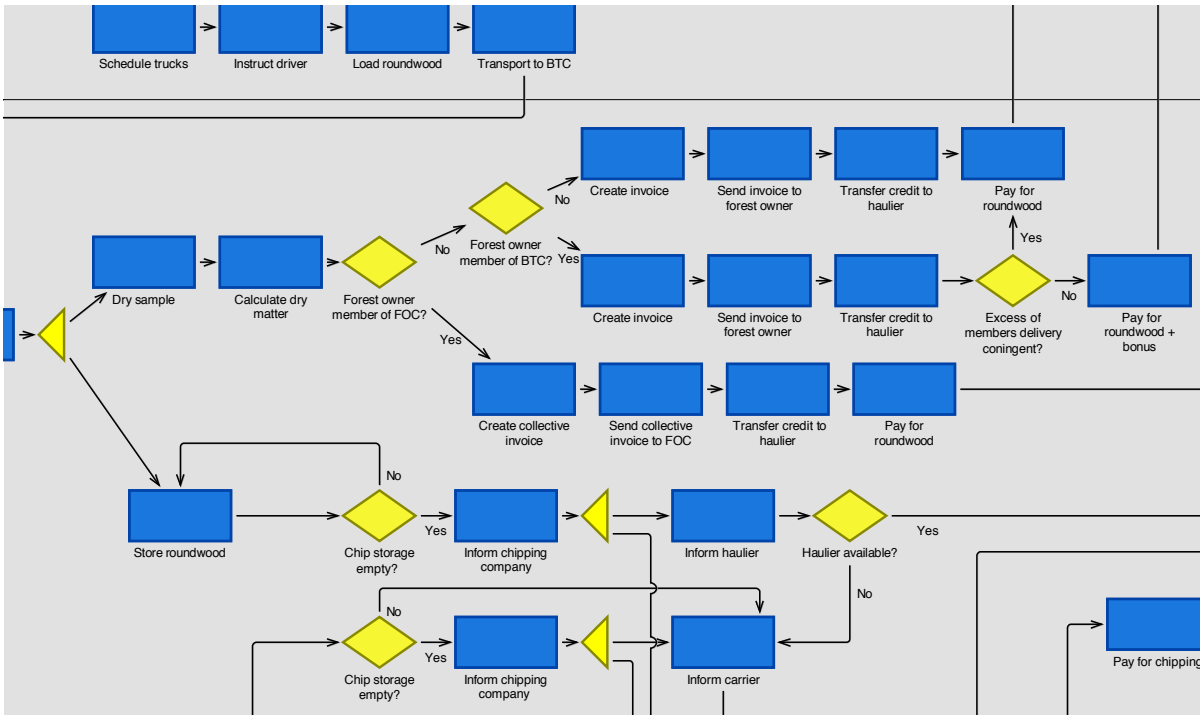

Fig. 1: Detail of the business process model of a regional supply chain for high quality wood chips in Styria. The BPMN 2.0 scheme was used for all supply chains. The whole supply chain is illustrated on the poster.

Influence of time and temperature of torrefaction on the selected parameters of torrefied black locust and poplar

Dr. Eng Marek Wróbel
University of Agriculture in Krakow, Faculty of Production and Power Engineering
120 Balicka street
30-149 Krakow, Poland
Marek.Wrobel@ur.krakow.pl
www.wipie.ur.krakow.pl

One of the technology that allows to obtain solid biofuels with high performance is torrefaction, which is a process of converting biomass into solid fuel with properties similar to coal. It relies on thermal treatment of biomass in the temperature range 200–300 ° C under atmospheric pressure, in anaerobic condition.

The results obtain is a completely dry fuel (humidity: 1–6 %), with a higher calorific value relative to the raw material. In addition, the hydrophobicity of the resulting products of biomass torrefaction completely protects it against biological degradation. The density of torrefaction biomass is in the range 180–300 kg/m^3 and is about 10–20 % lower than the density of the raw material. The products of biomass torrefaction is more brittle compared to untreated biomass which is transferred into a reduction of energy inputs for shredding.

Increasing of the energy density of biomass is mainly caused by the decomposition of the most reactive component which is hemicellulose, which amount is dependent on the species of biomass. Thus, the type of biomass varied in composition and parameters of the process (temperature, reactor residence time) have a crucial impact on the quantity and characteristics of the resulting products of biomass torrefaction.

The aim of this study was to determine the effect of time and temperature of torrefaction on selected parameters of torrefied wood biomass. The research material was poplar biomass, representing the tree of soft wood and biomass of black locust which is representative of hardwood trees. The selected species belong to a group of trees cultivated on energy purposes in so-called short rotation.

The samples were dried to a humidity of 12 % and then was specified the calorific value, heat of combustion, specific density, ash content, and mass. Such characterized samples were subjected to torrefaction process in a muffle furnace. In the study was planned the torrefaction temperature range 150–300 ° C and the duration of the process in the range of 0.5–3 h which resulted in products of biomass torrefaction about the different degree of the carbonization, which were characterized by the same parameters as before biomass torrefaction.

The analysis of obtained results allowed, for a given species of biomass, to determine the optimal process parameters for torrefaction (minimum duration and temperature), to obtain a product with the highest energetic parameters. The results provide a basis for the development of biomass torrefaction technology, taking into account the properties of the feedstock.

Winter rye/hairy vetch in biogas crop rotations

Daniela Zander
Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ)
Schulgasse 18
94315 Straubing, Germany
daniela.zander@tfz.bayern.de
www.tfz.bayern.de

Mixed cultivation of cereals and legumes combines many agronomic and agro-ecological advantages such as optimal utilization of acreage, income stabilization, flexibility of harvest time, good weed suppression and thus reduction of pesticide expenses, saving of mineral fertilizers and supply of blooms for insects. These benefits of the two mixture partners (winter rye and hairy vetch) were crucial for their integration in selected energy crop rotations within the EVA project. The aim was to examine the mixed cultivation of winter rye and hairy vetch regarding their yield performance, integration in energy crop rotations and weed suppression potential.

The multi-year field trial was established in the Bavarian Forest at Ascha (7.5 °C; 807 mm; valuation index of field: 47). The cultivation of the mixture matched the requirements of rye. Seeding was done in September at optimal sowing time (sowing depth: 2 cm; row distance: 14.5 cm). N-fertilization was applied at early spring and at BBCH 31 (rye). Due to the N-fixation capacity of vetch the optimal fertilizer amount of single crop rye was reduced about 20 % for the mixed crop. Winter rye/hairy vetch were harvested in early May as a catch crop (BBCH of rye: 51) in 2009 and 2010 and in mid/late June (BBCH of rye: 71) as main crop in 2011 and 2012. Methane yields of silage samples were determined in batch experiments done by the Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB). An ecological evaluation was carried out by the Leibniz-Centre for Agricultural Landscape Research (ZALF), and an economic assessment was done at the Institute for Management of Agricultural and Food Economics at the Justus Liebig University in Giessen.

The dry matter yield was significantly influenced by its position within the crop rotation. In 2009 and 2010, the mixed crop achieved 4.4 and 3.9 t DM/ha when harvested as catch crop. The yield level was similar to green rye (3.7 t DM/ha, 2010). With dry matter contents of only 16 and 17 %, ensiling was critical. In contrast, in 2011 and 2012 very good yields of 11.8 and 11.6 t DM/ha were achieved in main crop position. Thus, yields were comparable to winter wheat (10.6 t DM/ha) and winter triticale (11.2 t DM/ha), both harvested as whole plant. Besides, a dry matter content of 35 % guaranteed low-loss ensiling. With 291 l_N/kg oDM methane, the mixed crop reached a low methane yield compared to classic winter cereal silages. In combination with a high dry matter yield, a maximum of 3400 m^3 CH_4 per hectare is possible, which is at the level of winter wheat whole plant silage (3435 m^3 CH_4/ha) and winter triticale whole plant silage (3730 m^3 CH_4/ha). The economic evaluations show, that a positive contribution margin of winter rye/hairy vetch of 172 and 203 €/ha is only possible in main crop position, while contribution margins of -305 and -322 €/ha are uneconomical in catch crop position. However, positive humus balances both with and without returning biogas digestates can be expected in catch crop position only. At main crop position a positive humus balance is possible only at full repatriation of the digestates.

The results show that a mixed cultivation of winter rye/hairy vetch for biogas usage in the low and middle mountain region can only be recommended in main crop position in terms of biomass and methane hectare yield and profitability. As a following crop are only very early maize or sorghum varieties (early to medium early) advisable. Possible savings of fertilizers and pesticides contribute to the improvement of groundwater and to climate protection as well as economic efficiency. A full repatriation of the digestates is needed to get a positive humus balance.

Cooperation: Bavarian State Institute for Agriculture (LfL); State Research Centre for Agriculture and Fishery Mecklenburg-Western Pomerania (LFA); Saxon State Office for Environment, Agriculture and Geology (LfULG); Center for Agricultural Technology Augustenberg - Rheinstetten-Forchheim (LTZ); Chamber of Agriculture Lower Saxony (LWKNS); State Office for Rural Development, Agriculture and Land Consolidation (LELF); Saxony-Anhalt State Research Centre for Agriculture, Forestry and Horticulture (LLFG); Leibniz Centre for Agricultural Landscape Research (ZALF); Institute of Agricultural and Food Systems Management of Justus Liebig University of Gießen; Leibniz Institute for Agricultural Engineering Potsdam-Bornim (ATB); Agricultural Center Haus Düsse – Chamber of Agriculture North Rhine Westphalia (LWKNRW); Service Center Rural Areas Eifel, Rhineland-Palatinate.
Funding: The joint project "Development and comparison of optimized production systems for the agricultural production of energy crops under different site conditions in Germany" is sponsored by Association funds of the Federal Ministry of Food, Agriculture and Consumer Protection of the Agency of Renewable Resources.

Quality determining ingredients and methane potential of sorghum

Karen Zeise
Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ)
Schulgasse 18
94315 Straubing, Germany
karen.zeise@tfz.bayern.de
www.tfz.bayern.de

Up to now, reliable in situ generated data on the methane potential of sorghum are hardly available. The most common approach implies its evaluation by theoretical models. One of those models derives from the analysis of forage for ruminants and is based on the percentages of crude fat, crude protein, crude fibre and nitrogen free extractives within the organic dry matter (Weender analysis), and their digestibility along with the tables “DLG Futterwerttabellen Wiederkäuer”. Together with the biogas and methane potentials of these substance groups published by Baserga it is possible to calculate the theoretical methane potential of any biogas substrate. The weak point of this procedure is the small number of digestibility data for the genus sorghum at all and the lack of distinctive data for different sorghum species and development stages. With a range (min to max) of only 12 Nl/kg DM methane potential there was nearly no differentiation between the numerous sorghum cultivars tested.

Compared to sorghum the methane potential of maize was about 10 % higher according to the “Baserga”-model. A much greater range of about 80 Nl/kg DM between Sorghum cultivars appeared with the “Weißbach“-model which is based on the crude fibre content (XF). The difference between the arithmetic mean of Sorghum and the maize cultivar “AgroGas” added up to 30 %. The best differentiation within Sorghum was achieved with the “Weißbach“-model using the enzyme resistant organic matter (EROM) as parameter. The counterpart to EROM, the enzyme degradable organic matter (EDOM), averaged in maize 70 % with a negligible variation. In contrast, the variation in Sorghum was huge ranging between 31 and 60 %. The highly significant negative correlations between the contents in EDOM and the structural substances (crude fibre, NDF, ADF, ADL) could be approved. The six in 2011 tested bmr-cultivars (brown midrip as phenotypical characteristic for low lignin content) did not only have a significantly lower content in lignin but also in the other structural substances resulting in a higher digestibility. Their DM yields however were about 30 % lower than those of non-bmr cultivars which was mainly a result of lodging. With regard to the digestibility the short corn type cultivars of S. bicolor came just behind the bmr-cultivars. Nonetheless, their higher digestibility could not counterbalance the much lower DM yield compared to the large fodder type cultivars of S. bicolor and thus their methane yield per hectare remained significantly lower.

Finally, the methane potential of 90 sorghum cultivars was determined by in-vitro fermentation at a laboratory scale (Hohenheimer biogas test, HBT). The detected range within Sorghum was only 45 Nl/kg DM and with that surprisingly low. There was no correlation between the results of the “Baserga”-model and the HBT data. Whereas in maize the “Weißbach”-XF model gave a good accordance with the HBT data, in sorghum both “Weißbach”-models underestimated the methane potential compared to HBT. Using the assortment of Sorghum cultivars as a whole, there were only weak correlations between the “Weißbach”-models and HBT data. Much stronger correlations of HBT to both models occurred by dividing Sorghum into S. bicolor and S. bicolor x S. sudanense prior to statistical examination. The correlation coefficients between HBT and “Weißbach”-EROM for example grew to significant 0.47 and 0.53 with S. bicolor x S. sudanense and S. bicolor respectively. Until now it was not possible to deduce the HBT measured methane potential to a certain ingredient of Sorghum or to a combination of them.

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Die Preisfrage: Nachhaltige Bioenergie durch Co-Vergasung von Biomasse?

Dipl.-Wi.-Ing. (FH) Martin Zeymer
DBFZ - Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Str. 116
04347 Leipzig, Deutschland
Martin.Zeymer@dbfz.de
www.dbfz.de

Co-Autor: Dr.-Ing. Stefan Rönsch (DBFZ)

Ein Vorteil von Energierohstoffen wie Methan und Methanol aus Biomasse ist die problemlose Integration in die bestehende Energieinfrastruktur. Um die Weichen für eine kosteneffiziente und nachhaltige Nutzung der limitierten biogenen Ressourcen stellen zu können, ist eine ökonomische und ökologische Bewertung der Nutzungspfade erforderlich. Ausgangspunkt dafür sind die Gestehungskosten sowie die THG-Minderung, um daraus die THG-Vermeidungskosten zu berechnen. Der Einsatz von Biomasse hat dabei den Vorteil, THG-Emissionen und zugleich Kosten, die durch den europäischen Emissionshandel (EU ETS) entstehen, zu senken.
Ohne THG-Emissionen monetär zu berücksichtigen (Szenario 1), liegen die Methanolgestehungskosten (s. Abb. 1) je nach Biomasseanteil zwischen 6,6 und 12,4 €ct$_{2012}$/kWh. Damit sind auch die Gestehungskosten beim Einsatz von 100 % Kohle höher als der europäische Methanolhandelspreis (5,3 €ct$_{2012}$/kWh). Nur geringe Änderungen sind zu erkennen, sofern die Kosten der THG-Emissionen entsprechend des EU ETS und Preise in Höhe von 30 €/t$_{CO2-Äq.}$ berücksichtigt sind (Szenario 2). Durch die monetäre Einbeziehung aller bei der Produktion (Szenario 3) und Nutzung (Szenario 4) freiwerdenden THG-Emissionen treten deutliche Kostensteigerungen besonders bei einer hohen Kohlebeimischung auf.

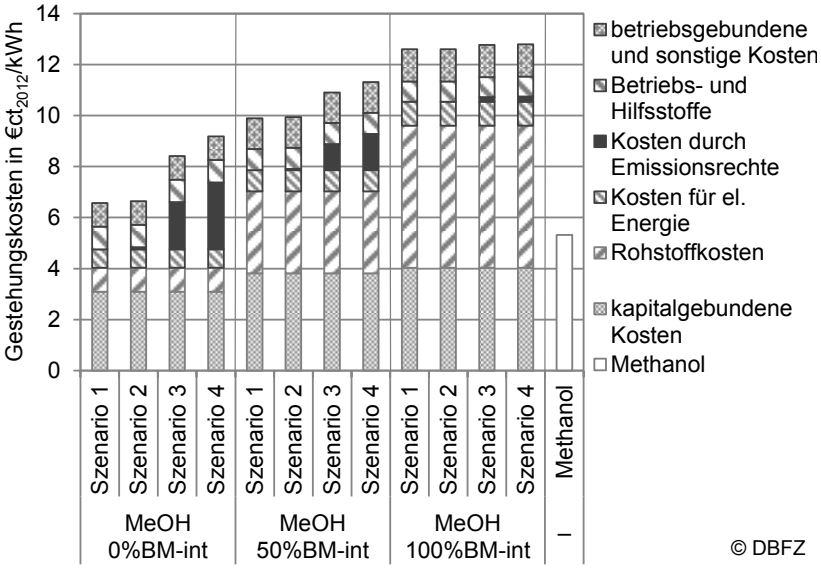

Abb. 1 Brennwertbezogene MeOH-Gestehungskosten (eigene Darstellung)

Die THG-Vermeidungskosten beim Einsatz von 100 % Biomasse liegen für SNG bei 370 €/t$_{CO2-Äq.}$ bzw. für Methanol bei 210 €/t$_{CO2-Äq.}$. Alle anderen Konzepte mit höheren Kohleanteilen weisen keine THG-Vermeidungskosten auf, da keine THG-Minderung im Vergleich zur fossilen Referenz (erdgasbasiert) vorliegt. Erst ab Beimischung von mindestens 60 % Biomasse entsteht ein ökologischer Vorteil. Die Co-Vergasung von Kohle und Biomasse kann eine Option zur Bereitstellung von SNG oder Grundchemikalien wie z. B. Methanol sein. Unter rein betriebswirtschaftlichen Gesichtspunkten ist die preiswerteste Variante die Monokohlevergasung. Dabei liegen die Methanolgestehungskosten 15 % über dem derzeitigen europäischen Methanolhandelspreis. Die Co-Vergasung von Kohle und Biomasse weist betriebswirtschaftlich unter den derzeitigen Rahmenbedingungen keinen Vorteil auf. Der Einsatz unterschiedlicher Rohstoffe erhöht nicht nur Komplexität und Anfälligkeit des Verfahrens, sondern auch die Kosten. Der positive Effekt des Biomasseeinsatzes, der zur Einsparung von THG-Emissionen führt, fällt unter dem europäischen Emissionshandel betriebswirtschaftlich kaum ins Gewicht und kann höhere Rohstoffpreise der Biomassen nicht kompensieren. Dies liegt vor allem an der geringen Menge CO_2, die unter den kostenpflichtigen Handel fällt, und am sehr niedrigen Preis. Letztlich bleibt fraglich, ob EU ETS das richtige Instrument ist, um den Einsatz fossiler Energieträger zu steuern. Einerseits sind ausschließlich THG-Emissionen und keine anderen Umweltwirkungen erfasst, andererseits müssen aufgrund sehr niedriger Zertifikatpreise Effizienz und Wirksamkeit infrage gestellt werden.
Alle Ergebnisse stammen aus dem Teilprojekt „Analyse und Bewertung von Prozessketten basierend auf der Co-Vergasung von Biomasse“ des Vorhabens Spitzenforschung und Innovation in den Neuen Ländern - Technologien für das Nach-Erdölzeitalter. Mehr Informationen dazu sind verfügbar unter: http://energierohstoffzentrum.com/partner/forschung/deutsches-biomasseforschungszentrum-leipzig

Qualification schemes for installers of small-scale biomass boilers and stoves – implementation of the EU-directive 2009/28/EC

DDipl.-Ing. Ulrich J. Wolfsmayr & Hermann Pummer
Austrian Biomass Association
Franz Josefs-Kai 13, A-1010 Vienna
wolfsmayr@biomasseverband.at
www.biomasseverband.at

All EU member states must ensure that certification schemes or equivalent qualification schemes for installers in the field of renewable energy[1] are available as from 2013 [1]. However, in Austria such qualification schemes have been in existence since 2000 for installers and since 2001 for chimney sweepers. Additionally, installers and chimney sweepers who have completed the training are allowed to use the registered trademarks and logos "Biowärme-Installateur®" or "Biowärme-Rauchfangkehrer®", respectively [2].

In 2012 the course content for installers was expanded firstly in order to meet the directive's requirements and secondly due to a fast-growing market for small scale biomass heating systems and the innovation this generated. The courses are aimed at experienced experts who intend to deepen their skills. The courses include both theory and practice. Participants must have attended a four-year apprenticeship[2] and have already installed a minimum number of biomass heating.

We note that both installers and chimney sweepers are important opinion leaders for changing the energy system towards renewable energies.

References

[1] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

[2] www.biowaermepartner.at

[1] i.e. "small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps" [1].
[2] System of dual vocational education and training in Austria.

Programm Teil 2

Programme Part 2

Parallelblock 3

Workshop Verwertung von Pflanzenaschen

Donnerstag 16 Jänner

Moderator:
Ingwald Obernberger, *BIOS Bioenergiesysteme GmbH, Graz, & TU Graz*

13:30 **Eröffnung**

13:40 **Überblick über die Pflanzenascheverwertung in Österreich und rechtliche Rahmenbedingungen**
Rainer Handl, *Kooperationsplattform Forst Holz Papier (FHP), Wien*

14:00 **Holzasche als Bindemittel im Straßenbau**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz*

14:20 **Verwertung von Holzasche im Forststraßenbau**
Gerald Bohrn, *Universität für Bodenkultur (BOKU), Wien*

14:40 **Ökologische Bewertung von Boden-/Aschegemischen im Straßenbau**
Eva Oburger, *Universität für Bodenkultur (BOKU), Tulln*

15:00 **Verwertung von Pflanzenaschen im Straßenbau in Schweden**
Josef Mácsik, *Ecoloop AB, Stockholm, Schweden*

15:20 **Verwertung von Pflanzenaschen im Straßenbau in Finnland**
Pentti Lahtinen, *Ramboll, Luopioinen, Finnland*

15:40 **Holzasche-Recycling – eine sinnvolle Maßnahme zur Schließung des Nährstoffkreislaufs in Wäldern**
Klaus v. Wilpert, *Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Freiburg, Deutschland*

16:00 **Kaffeepause**

16:20 **Verwertung von Pflanzenaschen im Deponiebau und der Revitalisierung von Deponieflächen**
Lotta Sartz, *Bergskraft Bergslagen, Kopparberg, Schweden*

16:40 **Pflanzenasche als Rohmaterial für die Zementproduktion**
Bjarte Oye, *SINTEF Materials and Chemistry, Trondheim, Norwegen*

17:00 **Auswirkungen der Lagerung im Freien auf die physikalischen und chemischen Eigenschaften von Holzaschen**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz*

17:20 **Pflanzenaschenverwertung zur Düngung von Kurzumtriebsflächen**
Heinrich Holzner, *Landwirtschaftskammer Steiermark, Graz*

17:40 **Rollpelletierung von Pflanzenaschen**
Linnéa Lövgren, *Pöyry Sweden AB, Falun, Schweden*

18:00 **Podiumsdiskussion**

18:30 **Abschluss Moderator**

FHP FORST HOLZ PAPIER

Parallel Session 3

Workshop Biomass ash utilization

Thursday 16 January

Chairman:
Ingwald Obernberger, *BIOS Bioenergiesysteme GmbH, Graz, & TU Graz, Austria*

1:30 pm **Opening**

1:40 pm **Overview of biomass ash utilization in Austria and legal constraints**
Rainer Handl, *Kooperationsplattform Forst Holz Papier (FHP), Vienna, Austria*

2:00 pm **Biomass ash utilization as a binder in road construction**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

2:20 pm **Biomass ash utilization in forest road construction**
Gerald Bohrn, *Vienna University of Natural Resources and Applied Life Sciences, Vienna, Austria*

2:40 pm **Ecological evaluation of ash/soil mixtures in road construction**
Eva Oburger, *Vienna University of Natural Resources and Applied Life Sciences, Tulln, Austria*

3:00 pm **Biomass ash utilization in low level roads in Sweden**
Josef Mácsik, *Ecoloop AB, Stockholm, Sweden*

3:20 pm **Biomass ash utilization in high level roads in Finland**
Pentti Lahtinen, *Ramboll, Luopioinen, Finland*

3:40 pm **Wood ash recycling – an appropriate measure to close nutrient cycles in forests**
Klaus von Wilpert, *Forstliche Versuchs- und Forschungsanstalt Baden-Württemberg, Freiburg, Germany*

4:00 pm **Coffee break**

4:20 pm **Landfill construction and revitalization**
Lotta Sartz, *Bergskraft Bergslagen, Kopparberg, Sweden*

4:40 pm **Biomass ash as raw material for cement manufacturing**
Bjarte Oye, *SINTEF Materials and Chemistry, Trondheim, Norway*

5:00 pm **Conversion and leaching characteristics of biomass ashes during outdoor storage**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

5:20 pm **Biomass ash utilization as a fertilizer for short rotation coppice**
Heinrich Holzner, *Styrian Chamber for Agriculture and Forestry, Graz, Austria*

5:40 pm **Roll pelletizing of ash**
Linnéa Lövgren, *Pöyry Sweden AB, Falun, Sweden*

6:00 pm **Panel discussion**

6:30 pm **Closing remarks by the chairman**

FHP FORST HOLZ PAPIER

Industrieforum
Biomasse, Biogas und Biotreibstoffe

Donnerstag 16 Jänner

Moderator:
Gerold Thek, *BIOS Bioenergiesysteme GmbH, Graz*

Im Industrieforum werden österreichische und internationale Unternehmen aus den Bereichen Biomasse, Biogas und Biotreibstoffe ihre Aktivitäten, Kernkompetenzen und Referenzen mittels einer kurzen Präsentation vorstellen. Im anschließenden „Get-together"-Diskussionsforum haben Teilnehmer die Möglichkeit, Vertreter der präsentierten Unternehmen zu treffen und mögliche zukünftige Kooperationen und Projekte auf einer individuellen Basis zu diskutieren. Das Industrieforum ist für alle Konferenzteilnehmer offen.

14:00 **Einleitung Moderator**
14:05 **Andritz AG,** Doris Thamer
14:10 **Komptech GmbH,** Andreas Kunter
14:15 **Neuson Ecotec GmbH,** Christian Richter
14:20 **Josef Bertsch Gesellschaft m.b.H. & Co KG,** Thomas Strasser
14:25 **Schmid energy solutions GmbH,**
Bernd Hörzer & Josef Strohmeier
14:30 **Polytechnik Luft- und Feuerungstechnik GmbH,** N. N.
14:35 **Viessmann Deutschland Industrie GmbH,** Thomas Krause
14:40 **ReGaWatt GmbH,** Klaus Röhrmoser
14:45 **Spanner Re² (Renewable Energy Experts) GmbH,** Thomas Bleul
14:50 **Scheuch GmbH,** Franz Söllhinger
14:55 **K. Schräder Nachf.,** Christoph Schade
15:00 **OekoSolve AG,** Daniel Jud
15:05 **Ochsner Wärmepumpen GmbH,** Karl Ochsner
15:10 **EnergieComfort Energie- und Gebäudemanagement GmbH,** Thomas Hartner & Christian Call
15:15 **Bioenergy 2020+ GmbH,** Walter Haslinger
15:20 **BIOS Bioenergiesysteme GmbH,**
Peter Thonhofer
15:25 **SW-Energietechnik-GmbH,** Walter Sailer
15:30 **Siemens AG Österreich,** Volker Hirsch
15:35 **Valmet GesmbH,** Markus Bolhàr-Nordenkampf
15:40 **Thermaflex - Flexalen Rohr- und Isoliersysteme GmbH,** Artur Klos
15:45 **Flowtec Industrietechnik GmbH,** Peter Pauritsch

Diskussionsforum: Get-together
Für die Konferenzteilnehmer wird hier die Möglichkeit geschaffen, mit Unternehmen direkt in Kontakt zu treten. Dazu stehen den Unternehmen unmittelbar neben dem Vortragssaal Stände zur Verfügung, an denen sie sich entsprechend präsentieren können. In entspannter Atmosphäre bei Kaffee und Kuchen können dort persönliche Kontakte geknüpft und Projekte besprochen werden. Die Stände sind mit Tisch und Stühlen ausgestattet und stehen den Unternehmen während der beiden Hauptkonferenztage (16. und 17. Jänner) ganztägig zur Verfügung.

Industry Forum
Biomass, biogas and biofuels

Thursday 16 January

Chairman:
Gerold Thek, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

In the Industry Forum national and international companies active in the fields of biomass, biogas and biofuels will present their core competencies, activities and relevances in a short presentation. In the subsequent „Get together"–discussion forum the participants have the chance to meet members of the presented companies and can initiate possible
future projects and cooperations on an individual basis. The Industry Forum is open to all conference participants.

2:00 pm **Opening chairman**
2:05 pm **Andritz AG,** Doris Thamer
2:10 pm **Komptech GmbH,** Andreas Kunter
2:15 pm **Neuson Ecotec GmbH,** Christian Richter
2:20 pm **Josef Bertsch Gesellschaft m.b.H. & Co KG,** Thomas Strasser
2:25 pm **Schmid energy solutions GmbH,**
Bernd Hörzer & Josef Strohmeier
2:30 pm **Polytechnik Luft- und Feuerungstechnik GmbH,** N. N.
2:35 pm **Viessmann Deutschland Industrie GmbH,** Thomas Krause
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2:45 pm **Spanner Re² (Renewable Energy Experts) GmbH,** Thomas Bleul
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3:00 pm **OekoSolve AG,** Daniel Jud
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3:15 pm **Bioenergy 2020+ GmbH,** Walter Haslinger
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3:35 pm **Valmet GesmbH,** Markus Bolhàr-Nordenkampf
3:40 pm **Thermaflex - Flexalen Rohr- und Isoliersysteme GmbH,** Artur Klos
3:45 pm **Flowtec Industrietechnik GmbH,** Peter Pauritsch
3:50 pm **Clariant Produkte (Deutschland) GmbH,** Beate Arendt
3:55 pm **GE-Provi Global Energy Provision,** Johannes Wittkowsky
4:00 pm **Beta Renewables S.p.A.,** Raffaella Serra
4:05 pm **Closing remarks by the chairman**
4:10 pm **Discussion forum: Get together (including coffee break)**
6:30 pm **End of the event**

Discussion forum: get together
This discussion forum will offer the opportunity for participants to contact representatives of the presented companies and to discuss possible future projects and cooperations. For individual discussions in relaxed atmosphere each company will have its own stand next to the hall, where the company presentations take place, equipped with chairs and tables, where coffee and refreshments will be served. These information stands will be available on both main days of the conference (16th and 17th of January).

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Parallelblock 4
Strom aus fester Biomasse

Freitag 17 Jänner

Moderator:
Ingwald Obernberger, *BIOS Bioenergiesysteme GmbH, Graz, & TU Graz*

09:00 **Sunstore 4: KWK-Anlage auf Basis eines Hybridsystems Biomasse und Solarthermie - Monitoringergebnisse**
Alfred Hammerschmid, *BIOS Bioenergiesysteme GmbH, Graz*

09:20 **Theoretische Potenzialanalyse für KWK-Hybridanlagen auf Basis Biomasse und Solarthermie**
Roland Sterrer, *Fachhochschule Technikum Wien, Wien*

09:40 **Cleanstgas - Markteintritt und Demonstration der gestuften Biomassevergasung**
Stephan Jantscher, *Cleanstgas GmbH, St. Margarethen/Raab*

10:00 **Kraft-Wärme-Kopplung mit Holzgas - Erfahrungen aus dem Praxisbetrieb und künftige Perspektiven**
Thomas Bleul, *Spanner Re² GmbH, Neufahrn i. NB., Deutschland*

10:20 **Kaffeepause**

10:40 **Vergleichbarkeit von Feldmessdaten zur technischen Bewertung von Biomassevergasungsanlagen**
André Herrmann, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Deutschland*

11:00 **Leistungsmessung von kleinen Biomasse-Vergasungsanlagen mit Massen- und Energiebilanzen – Erfahrungen aus dem GAST-Projekt**
Marco Baratieri, *Freie Universität Bozen, Fakultät für Naturwissenschaften und Technik, Bozen, Italien*

11:20 **Technische, ökonomische und ökologische Bewertung von kleinen Biomassevergasern**
Martin Zeymer, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Deutschland*

11:40 **Wirtschaftlichkeit und Potenziale von Holzgas-KWK-Anlagen in der österreichischen Sägeindustrie**
Gerald Kalt, *Österreichische Energieagentur, Wien*

12:00 **Abschluss Moderator**

12:10–14:00 **Mittagspause und Postersession**

Parallel Session 4
Electricity from solid biomass

Friday 17 January

Chairman:
Ingwald Obernberger, *BIOS Bioenergiesysteme GmbH, Graz, & TU Graz, Austria*

9:00 am **SUNSTORE 4: CHP plant based on a hybrid biomass and large-scale solar system – monitoring results**
Alfred Hammerschmid, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

9:20 am **Theoretical analysis of the potential of hybrid biomass-solar CHP plants in Austria**
Roland Sterrer, *University of Applied Sciences Technikum Wien, Vienna, Austria*

9:40 am **Cleanstgas – Market entry and demonstration of a staged biomass gasification technology**
Stephan Jantscher, *Cleanstgas GmbH, St. Margarethen/Raab, Austria*

10:00 am **Combined heat and power using wood gas - experience from practical operation and future prospects**
Thomas Bleul, *Spanner Re² GmbH, Neufahrn i. NB., Germany*

10:20 am **Coffee break**

10:40 am **Comparability of field measurement data for the technical assessment of biomass gasification plants**
André Herrmann, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Germany*

11:00 am **Measuring the performance of biomass small-scale gasification plants by implementing mass and energy balances**
Marco Baratieri, *Free University of Bolzano, Faculty of Science and Technology, Bolzano, Italy*

11:20 am **Technological, economic and ecological evaluation of small-scale biomass gasifier**
Martin Zeymer, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Germany*

11:40 am **Economics and potentials of wood gasification CHP plants in the Austrian sawmill industry**
Gerald Kalt, *Austrian Energy Agency, Vienna, Austria*

12:00 pm **Closing remarks by the chairman**

12:10–2:00 pm **Lunch break and poster session**

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Parallelblock 5
Bioraffinerie

Moderator:
Arthur Wellinger, *IEA Bioenergy, Aadorf, Schweiz*

09:00 **Die mögliche Rolle von Bioraffinerien in der BioÖkonomie – Aktivitäten von IEA Bioenergy Task 42 „Bioraffinerie"**
Gerfried Jungmeier, *Joanneum Research Forschungsgesellschaft mbH, Graz*

09:20 **Green Chemistry Belt: integratives Gesamtkonzept für die Nutzung nachwachsender Rohstoffe im Donauraum und den Rohstoffwandel in der chemischen Industrie Europas**
Thomas Schleker, *BioCampus Straubing GmbH, Straubing, Deutschland*

09:40 **Biomassevergasung Oberwart – Produktion von Strom, Wärme und Produktgas**
Reinhard Rauch, *Bioenergy 2020+ GmbH, Güssing*

10:00 **KACELLE: Ökonomische und ökologische Bewertung einer lignozellulosebasierten Ethanolanlage mit Inbicon-Technologie**
Konstantin Zech, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Deutschland*

10:20 **Abschluss Moderator**

10:30 **Kaffeepause**

English only
Alle Vorträge werden auf Englisch gehalten ohne Simultanübersetzung.

Parallelblock 6
Biotreibstoffe

Freitag 17 Jänner

Moderator:
Reinhard Rauch, *Technische Universität Wien, Wien*

11:00 **BTG Biomasse-Kraftstoffe**
Gerhard Muggen, *BTG BioLiquids BV, AV Enschede, Niederlande*

11:20 **BioBoost: Steigerung der Biokraftstoffproduktion durch Energie-Zwischenprodukte**
Andreas Niebel, *Karlsruher Institut für Technologie, Karlsruhe, Deutschland*

11:40 **Standort- und Kapazitätsplanung von strohbasierten BtL- Anlagen in Österreich**
Tobias Moser, *Universität für Bodenkultur Wien (BOKU), Wien*

12:00 **Neue Erkenntnisse zur Stabilität von Diesel und Biodiesel**
Stephanie Flitsch, *Universität Graz, Graz*

12:20 **Abschluss Moderator**

12:30–14:00 **Mittagspause und Postersession**

English only
Alle Vorträge werden auf Englisch gehalten ohne Simultanübersetzung.

Parallel Session 5
Biorefineries

Chairman:
Arthur Wellinger, *IEA Bioenergy, Aadorf, Switzerland*

9:00 am **The possible role of biorefineries in a BioEconomy – activities of IEA Bioenergy Task 42 „Biorefining"**
Gerfried Jungmeier, *Joanneum Research Forschungsgesellschaft mbH, Graz, Austria*

9:20 am **Green Chemistry Belt: an integrative concept for the use of bio-based raw materials in the Danube region and their increasing importance for Europe´s chemical industry**
Thomas Schleker, *BioCampus Straubing GmbH, Straubing, Germany*

9:40 am **Biomass gasification Oberwart – production of heat, electricity and valuable gases**
Reinhard Rauch, *Bioenergy 2020+ GmbH, Güssing, Austria*

10:00 am **KACELLE: Economic and ecological evaluation of a lignocellulose-based ethanol plant with Inbicon technology**
Konstantin Zech, *Deutsches Biomasse Forschungszentrum (DBFZ) gemeinnützige GmbH, Leipzig, Germany*

10:20 am **Closing remarks by the chairman**

10:30 am **Coffee break**

Parallel Session 6
Biofuels

Friday 17 January

Chairman:
Reinhard Rauch, *Technical University of Vienna, Vienna, Austria*

11:00 am **BTG BioLiquids**
Gerhard Muggen, *BTG BioLiquids BV, AV Enschede, Netherlands*

11:20 am **BioBoost: Biomass based energy intermediates boosting biofuel production**
Andreas Niebel, *Karlsruhe Institute of Technology, Karlsruhe, Germany*

11:40 am **Location and capacity planning of straw-based BtL plants in Austria**
Tobias Moser, *Vienna University of Natural Resources and Applied Life Sciences, Vienna, Austria*

12:00 pm **Novel insights into the stability of petrodiesel and biodiesel fuels**
Stephanie Flitsch, *University of Graz, Graz, Austria*

12:20 pm **Closing remarks by the chairman**

12:30–2:00 pm **Lunch break and poster session**

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Parallelblock 7
Brennstofflogistik und Brennstoffaufbereitung

Moderator:
Nikolaus Nemestothy, *Forstliche Ausbildungsstätte Ort, Ort/Gmunden*

09:00 **Auswirkungen des Klimawandels auf die Energieholzversorgung in Österreich**
Peter Rauch, *Universität für Bodenkultur Wien (BOKU), Institut für Produktionswirtschaft und Logistik, Wien*

09:20 **Technische Hackguttrocknung – ein Verlustgeschäft?**
Alois Kraußler, *FH Joanneum Gesellschaft mbH, Kapfenberg*

09:40 **Alternative Biomassebrennstoffe**
Andreas Kunter, *Komptech GmbH, Frohnleiten*

10:00 **Biomassebörsen – Das „eBay" für regionale Energierohstoffe**
Josef Walch, *FHS für Wirtschaft und Technik GmbH, Wieselburg*

10:20 **Abschluss Moderator**

10:30 **Kaffeepause**

Parallelblock 8
Biowärme: Simulation und Effizienzoptimierung

Freitag 17 Jänner

Moderator:
Anders Evald, *HOFOR, Kopenhagen, Dänemark*

11:00 **Instationäre CFD-Simulation von Scheitholzkaminöfen mit Wärmespeicher**
Claudia Benesch, *BIOS Bioenergiesysteme GmbH, Graz*

11:20 **Thermische Simulation eines Pellet-Kessels und eines Wärmespeichers für künftige Steuerungsstrategien**
Rosemarie Schnetzinger, *Bioenergy 2020+ GmbH, Wieselburg-Land*

11:40 **Identifikation und Bewertung von Optimierungsmaßnahmen zur Steigerung des Jahresnutzungsgrades von Biomasse-Kleinfeuerungsanlagen**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz*

12:00 **Untersuchung von Nutzerverhalten und Betriebsbedingungen von Biomassefeuerungen zur Raumwärmeversorgung und deren Auswirkungen auf Emissionen und Effizienz basierend auf Umfragen und Feldmessungen**
Gabriel Reichert, *Bioenergy 2020+ GmbH, Wieselburg-Land*

12:20 **Abschluss Moderator**

12:30–14:00 **Mittagspause und Postersession**

Parallel Session 7
Fuel logistics and processing

Chairman:
Nikolaus Nemestothy, *Forstliche Ausbildungsstätte Ort, Ort/Gmunden, Austria*

9:00 am **How will climate change impact on forest fuel supply in Austria?**
Peter Rauch, *Vienna University of Natural Resources and Applied Life Sciences, Institute of Production and Logistics, Vienna, Austria*

9:20 am **Technical drying of wood chips – unprofitable?**
Alois Kraußler, *FH Joanneum Gesellschaft mbH, Kapfenberg, Austria*

9:40 am **Alternative biomass fuels**
Andreas Kunter, *Komptech GmbH, Frohnleiten, Austria*

10:00 am **Biomass markets - the „eBay" for regional energy resources**
Josef Walch, *FHS für Wirtschaft und Technik GmbH, Wieselburg, Austria*

10:20 am **Closing remarks by the chairman**

10:30 am **Coffee break**

Parallel Session 8
Biomass heat: Simulation and efficiency optimization

Friday 17 January

Chairman:
Anders Evald, *HOFOR, Copenhagen, Denmark*

11:00 am **Transient CFD simulation of wood log stoves with heat storage devices**
Claudia Benesch, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

11:20 am **Thermal simulation of a pellet boiler and a heat storage tank for future control strategies**
Rosemarie Schnetzinger, *Bioenergy 2020+ GmbH, Wieselburg-Land, Austria*

11:40 am **Identification and evaluation of optimization measures to increase the annual utilization rate of residential biomass heating systems**
Klaus Supancic, *BIOS Bioenergiesysteme GmbH, Graz, Austria*

12:00 pm **Investigation of user behaviour and operating conditions of residential wood combustion (RWC) appliances and their impact on emissions and efficiency**
Gabriel Reichert, *Bioenergy 2020+ GmbH, Wieselburg-Land, Austria*

12:20 pm **Closing remarks by the chairman**

12:30–2:00 pm **Lunch break and poster session**

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Parallelblock 9
WBA-Workshop: Weltweite Märkte für Biomasse

Freitag 17 Jänner

„Für die Wärme- und Stromgewinnung aus Biomasse ist in vielen Teilen der Welt ein starker Wachstumsmarkt im kleinen Leistungsbereich zu erkennen. Dazu berichten im WBA-Workshop Experten aus fünf Kontinenten."

Heinz Kopetz, Präsident des Weltbiomasseverbands

Moderator:
Heinz Kopetz, *Weltbiomasseverband, Stockholm, Schweden*

09:00 **Eröffnung**
Günter Liebel, *Leiter der Sektion V – Allgemeine Umweltpolitik, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien*

09:10 **Neue globale Pelletsmärkte**
Silvio Mergner, *Pöyry Management Consulting (Deutschland) GmbH, München, Deutschland*

09:30 **Der Biomasse-Markt und Technologie-Trends in Russland**
Tatiana Pantsyrnaya, *Moscow State University of Mechanical Engineering, Moskau, Russland*

09:50 **Japan: Energiepolitik nach Fukushima: Chancen für Biomassetechnologien im kleinen und mittleren Leistungsbereich**
Hisashi Kajiyama, *Fujitsu research institute, Tokio, Japan*

10:10 **Südkorea, Australien, Neuseeland: Marktentwicklung von Bioenergie-Technologien im kleinen Leistungsbereich**
Andrew Lang, *Vizepräsident Weltbiomasseverband, Smart timbers Cooperative, Australien*

10:30 **Diskussion**

10:40 **Kaffeepause**

11:10 **Nordamerikanische Märkte für Bioenergie im kleinen und mittleren Leistungsbereich**
Douglas Bradley, *Vizepräsident Weltbiomasseverband, Präsident Climate Change Solutions, Kanada*

11:30 **Künftige KWK-Lösungen im kleinen Leistungsbereich**
John Bernander, *Viking Heat Engines AS, Kristiansand, Norwegen**

11:50 **Märkte für Biowärme und Biomasse-KWK in Lateinamerika**
Laércio Couto, *Vorstand Weltbiomasseverband, Präsident RENABIO, Brasilien*

12:10 **Europäische Märkte für Biowärme und Biomasse-KWK im kleinen Leistungsbereich**
Alexander Weissinger, KWB, St. Margarethen/Raab

12:30 **Diskussion**

12:40–14:00 **Mittagessen und Postersession**

Parallel Session 9
WBA Workshop: Global markets for biomass

Friday 17 January

„In many parts of the world a strong growing market in small-scale biomass heat and power can be noticed. In the WBA Workshop experts from five continents refer to this topic."

Heinz Kopetz, President of the World Bioenergy Association

Chairman:
Heinz Kopetz, *World Bioenergy Association, Stockholm, Sweden*

9:00 am **Opening**
Günter Liebel, *Director General, Head of Department General Environmental Policy/Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna, Austria*

9:10 am **New global pellet markets**
Silvio Mergner, *Pöyry Management Consulting (Deutschland) GmbH, Munich, Germany*

9:30 am **Current biofuel market and technology trends in the Russian Federation**
Tatiana Pantsyrnaya, *Moscow State University of Mechanical Engineering, Moscow, Russia*

9:50 am **Japan – energy policy after Fukushima: opportunities for micro-scale and small-scale biomass technologies**
Hisashi Kajiyama, *Fujitsu research institute, Tokyo, Japan*

10:10 am **Korea, Australia, New Zealand: Market developments in small-scale bioenergy technologies**
Andrew Lang, *Vice President World Bioenergy Association & Smart Timbers Cooperative, Australia*

10:30 am **General discussion**

10:40 am **Coffee break**

11:10 am **Markets for small-scale and micro-scale bioenergy in North America**
Douglas Bradley, *Vice President World Bioenergy Association & President of Climate Change Solutions, Canada*

11:30 am **Future developments in the field of small-scale and micro-scale CHP**
John Bernander, *Viking Heat Engines AS, Kristiansand, Norway*

11:50 am **Possible market for micro-scale and small-scale biomass to heat and CHP in Latin America**
Laércio Couto, *Board Member World Bioenergy Association & President of RENABIO, Brazil*

12:10 pm **Markets for micro-scale and small-scale biomass heat and CHP in Europe**
Alexander Weissinger, *KWB, St. Margarethen/Raab, Austria*

12:30 pm **General discussion**

12:40–2:00 pm **Lunch break and poster session**

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Parallelblock 10
Energiepflanzen

Moderator:
Manfred Wörgetter, *Bioenergy 2020+ GmbH, Wieselburg-Land*

14:00 **Kurzumtrieb: Hohe Erwartungen kontra Praxiserfahrungen**
Johann Reicht, *Bioenergie Hitzendorf regGenmbH, Hitzendorf*

14:25 **Die Ökonomie von KUP in Agroforstsystemen und kleinen Splitterflächen in urbanen Räumen**
Christian Schmidt, *Nordwestdeutsche Forstliche Versuchsanstalt, Hann. Münden, Deutschland*

14:50 **Aufbereitung von feuchter Biomasse zu Brennstoff – das Florafuel-Verfahren**
Swantje Mignon Schlederer, *Universität der Bundeswehr München, Neubiberg, Deutschland*

15:15 **Nährstoffanreicherung und -verteilung in Eukalyptus-nitens-Flächen in Nordwestspanien**
Andrea Hevia Cabal, *Forest Management Area, Wood and Forest Research Technology Centre of Asturias (CETEMAS), Grado, Spanien*

15:40 **Technologieentwicklung zur Produktion hochdichter Algenbiomasse**
Tatiana Pantsyrnaya, *Moscow State University of Mechanical Engineering, Moskau, Russland*

Parallelblock 11
Brennstoffcharakterisierung und Energiepflanzen

Freitag 17 Jänner

Moderator:
Thomas Brunner, *Bioenergy2020+ GmbH, Graz*

16:30 **Neue Methoden zur Charakterisierung von Biomasse-Brennstoffen**
Peter Sommersacher, *Bioenergy 2020+ GmbH, Graz*

16:50 **Ergebnisse neuer Labortests und Indizes zur Vorhersage der Verschlackungsneigung von Biomasseaschen**
Daniel J. Vega-Nieva, *Universidad de Vigo, Pontevedra, Spanien*

17:10 **Maisspindeln für die energetische Nutzung – Eigenschaften und Herausforderungen**
Josef Rathbauer, *BLT Biomass - Logistics – Technology, Wieselburg*

17:30 **Optimale Hackschnitzelproduktion – Brennstoffqualität und Energieverbrauch im Feldtest**
Daniel Kuptz, *Technologie- und Förderzentrum (TFZ) im Kompetenzzentrum für Nachwachsende Rohstoffe, Straubing, Deutschland*

17:50 **Entwicklung neuer Konzepte zur Nutzung von Mikroalgen in Österreich**
Andrea Sonnleitner, *Bioenergie 2020+ GmbH, Wieselburg*

Parallel Session 10
Energy plants

Chairman:
Manfred Wörgetter, *Bioenergy 2020+ GmbH, Wieselburg-Land, Austria*

2:00 pm **Short rotation: high expectations versus practical experience**
Johann Reicht, *Bioenergie Hitzendorf regGenmbH, Hitzendorf, Austria*

2:25 pm **The economics of SRC in agroforestry systems and small sliver surfaces in urban areas**
Christian Schmidt, *Nordwestdeutsche Forstliche Versuchsanstalt, Hann. Münden, Germany*

2:50 pm **Pre-treatment of wet biomass for fuel production – the florafuel-process**
Swantje Mignon Schlederer, *Universität der Bundeswehr München, Neubiberg, Germany*

3:15 pm **Nutrient accumulation and distribution in woody crops of eucalyptus nitens**
Andrea Hevia Cabal, *Forest Management Area, Wood and Forest Research Technology Centre of Asturias (CETEMAS), Grado, Spain*

3:40 pm **Development of high-density algal biomass production technology**
Tatiana Pantsyrnaya, *Moscow State University of Mechanical Engineering, Moscow, Russia*

Parallel Session 11
Fuel characterization and energy crops

Friday 17 January

Chairman:
Thomas Brunner, *Bioenergy2020+ GmbH, Graz, Austria*

4:30 pm **New characterization methods for solid biomass fuels**
Peter Sommersacher, *Bioenergy 2020+ GmbH, Graz, Austria*

4:50 pm **Results of new laboratory methods and slagging indices for the prediction and quantification of ash slagging**
Daniel J. Vega-Nieva, *University of Vigo, Pontevedra, Spain*

5:10 pm **Corn cobs for energy use - properties and challenges**
Josef Rathbauer, *BLT Biomass - Logistics – Technology, Wieselburg, Austria*

5:30 pm **Optimizing wood chip production in the field – fuel quality and energy consumption**
Daniel Kuptz, *Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ), Straubing, Germany*

5:50 pm **Development of new concepts for the use of micro algae in Austria**
Andrea Sonnleitner, *Bioenergie 2020+ GmbH, Wieselburg, Austria*

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Parallelblock 12
Biomassepotenziale

Moderator:
André P. C. Faaij, *Utrecht University, Utrecht, Niederlande*

14:00 **Regionale Biomasse zur künftigen Wärme- und Stromversorgung im innerstädtischen Bereich**
Carsten Keichel, *Fraunhofer-Institut für Fabrikbetrieb und -Automatisierung IFF, Magdeburg, Deutschland*

14:30 **Entwicklungstendenzen der Kurzumtriebsplantagen in Ungarn**
Bálint Heil, *West-Ungarische Universität, Sopron, Ungarn*

15:00 **Analyse und Entwicklung der Bereitstellungsketten für Brennholz in West-Mazedonien, Griechenland**
Chrysovalantis Ketikidis, *Chemical Process and Energy Resources Institute (CERTH/CPERI), Ptolemais, Griechenland*

15:30 **Auswirkungen der erneuerbaren Energien auf die europäischen Landwirte – Potenziale und Perspektiven für 2020**
J.W.A. Hans Langeveld, *Biomass Research, Wageningen, Niederlande*

Parallelblock 13
Biogas

Freitag 17 Jänner

Moderator:
Werner Fuchs, *Universität für Bodenkultur Wien (BOKU), IFA-Tulln, Tulln*

16:30 **Erforschung integrierter Konzepte zur Energiegewinnung aus Grünschnitt**
Luc Pelkmans, *VITO NV, Unit Separation and Conversion Processes, Mol, Belgien*

16:50 **Stickstoffabtrennung mit Membrankontaktoren für verbesserte anaerobe Vergärung unter Schwefelwasserstoff- und Ammoniakhemmung**
Benjamin Lauterböck, *Universität für Bodenkultur (BOKU), Institut für Umweltbiotechnologie, IFA-Tulln, Tulln*

17:10 **Kombination von Trockenvergärung, Kompostierung und energetischer Nutzung von Biogas für innovative Anwendungen in einer Pilotanlage**
Silvia Silvestri, *Fondazione Edmund Mach (FEM), San Michele all'Adige (TN), Italien*

17:30 **Buchweizen und Quinoa als Sommerzwischenfrüchte für die Biogasproduktion**
Falco Stockmann, *Technologie- und Förderzentrum (TFZ) im Kompetenzzentrum für Nachwachsende Rohstoffe, Straubing, Deutschland*

17:50 **Ökologische Bewertung der Biogaserzeugung aus Zwischenfrüchten**
Stephan Maier, *Technische Universität Graz, Graz*

Parallel Session 12
Biomass potentials

Chairman:
André P. C. Faaij, *Utrecht University, Utrecht, Netherlands*

2:00 pm **Regional biomass for heat and electricity supply in urban areas**
Carsten Keichel, *Fraunhofer Institute for Factory Operation and Automation IFF, Magdeburg, Germany*

2:30 pm **Trends in short-rotation plantations in Hungary**
Bálint Heil, *West-Hungarian University, Sopron, Hungary*

3:00 pm **Analysis and development of supply chains of firewood in Western Macedonia, Greece**
Chrysovalantis Ketikidis, *Centre for Research & Technology Hellas, Chemical Process and Energy Resources Institute (CERTH/CPERI), Ptolemais, Greece*

3:30 pm **Impacts of renewable energy on European farmers – potentials and perspectives for 2020**
J.W.A. Hans Langeveld, *Biomass Research, Wageningen, Netherlands*

Parallel Session 13
Biogas

Friday 17 January

Chairman:
Werner Fuchs, *Vienna University of Natural Resources and Applied Life Sciences, IFA-Tulln, Tulln, Austria*

4:30 pm **Exploring integrated concepts for energy production from green waste**
Luc Pelkmans, *VITO NV, Unit Separation and Conversion Processes, Mol, Belgium*

4:50 pm **Nitrogen removal with membrane contactors for improved anaerobic digestion under hydrogen sulphide and ammonia inhibition**
Benjamin Lauterböck, *Vienna University of Natural Resources and Applied Life Sciences, Institute of Environmental Biotechnology, IFA-Tulln, Tulln, Austria*

5:10 pm **Combination of dry anaerobic digestion, composting and energy exploitation of biogas for innovative utilization in a pilot plant**
Silvia Silvestri, *Fondazione Edmund Mach (FEM), San Michele all'Adige (TN), Italy*

5:30 pm **Buckwheat and quinoa as summer intercrops for biogas production**
Falco Stockmann, *Technology and Support Centre in the Centre of Excellence for Renewable Resources (TFZ), Straubing, Germany*

5:50 pm **Environmental evaluation of biogas production from intercropping**
Stephan Maier, *Technical University of Graz, Graz, Austria*

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Parallelblock 14
Workshop Torrefikation von Biomasse

Freitag 17 Jänner

Moderatoren:
Jaap Koppejan, *IEA Bioenergy Task 32, Enschede, Niederlande*
Martin Junginger, *IEA Bioenergy Task 40, Utrecht, Niederlande*

14:00 **Eröffnung**

14:10 **Überblick über internationale Entwicklungen im Bereich Torrefikation**
Michael Wild, *International Biomass Torrefaction Council, Brüssel, Belgien*

14:30 **Verdichtung torrefizierter Biomasse**
Wolfgang Stelte, *Danish Technological Institute, Taastrup, Dänemark*

14:50 **Charakterisierung torrefizierter Produkte in Abhängigkeit der Betriebsparameter**
Ute Wolfesberger-Schwabl, *OFI Technologie & Innovation GmbH, Wien*

15:10 **Vor- und Nachteile für den internationalen Handel mit torrefizierter Biomasse**
Mark Beekes, *KEMA Nederland BV, Arnheim, Niederlande*

15:30 **Erste Erfahrungen mit Verbrennung und Mitverbrennung veredelter Biomassebrennstoffe in Großanlagen**
Nader Padban, *Vattenfall, Stockholm, Schweden*

15:50 **Kaffeepause**

16:20 **Torrefikationstechnologien von Andritz – Pilotanlagenbetriebserfahrungen in Österreich und Dänemark**
Klaus Trattner, *Andritz AG, Graz*

16:40 **Beschleunigung der Einführung von festen Biomasse-Brennstoffen der zweiten Generation**
Andy Piers, *River Basin Energy, Highlands Ranch, Colorado, USA*

17:00 **Areva's Weg zu einem industriell erprobten Torrefikationsprozess**
Hervé Chauvin, *Areva, Paris, Frankreich*

17:20 **Runder Tisch: Das weitere Vorgehen für Technologielieferanten, Projektentwickler und Verbraucher**

18:15 **Abschluss Moderator**

IEA Bioenergy SECTOR

Parallel Session 14
Workshop Torrefaction of biomass

Friday 17 January

Chairmen:
Jaap Koppejan, *IEA Bioenergy Task 32, Enschede, Netherlands*
Martin Junginger, *IEA Bioenergy Task 40, Utrecht, Netherlands*

2:00 pm **Opening**

2:10 pm **International overall view of developments in the torrefaction sector**
Michael Wild, *International Biomass Torrefaction Council, Brussels, Belgium*

2:30 pm **Densification of torrefied materials**
Wolfgang Stelte, *Danish Technological Institute, Taastrup, Denmark*

2:50 pm **Characteristics of torrefied products and their dependence on process conditions**
Ute Wolfesberger-Schwabl, *OFI Technologie & Innovation GmbH, Vienna, Austria*

3:10 pm **Advantages and drawbacks for international trade of torrefied products**
Mark Beekes, *KEMA Nederland BV, Arnheim, Netherlands*

3:30 pm **First experiences from large-scale combustion and co-firing tests with refined biomass fuels**
Nader Padban, *Vattenfall, Stockholm, Sweden*

3:50 pm **Coffee break**

4:20 pm **Andritz torrefaction technologies and summary of pilot plant operation in Austria and Denmark**
Klaus Trattner, *Andritz AG, Graz, Austria*

4:40 pm **Accelerating the adoption of second generation solid biomass**
Andy Piers, *River Basin Energy, Highlands Ranch, Colorado, USA*

5:00 pm **Areva's pathway to an industrially-proven torrefaction process**
Hervé Chauvin, *Areva, Paris, France*

5:20 pm **Round table: The way forward for technology suppliers, developers and consumers**

6:15 pm **Closing remarks by the chairman**

IEA Bioenergy SECTOR

Parallelblock 15
Workshop Pellets

Freitag 17 Jänner

Moderator:
Gilles Gauthier, *Geschäftsführer European Pellet Council & Bioenergie-Experte AEBIOM, Brüssel*

Teil 1: AshMelt
14:00 **Klassifizierung von Verschlackungstendenzen von Biomasse-Brennstoffen**
Marcus Öhman, *Energy Engineering - Division of Energy Science, Luleå University of Technology, Luleå, Schweden*

14:15 **Ascheschmelzverhalten fester Biobrennstoffe in Pelletskesseln von privaten Haushalten**
Manuel Schwabl, *Bioenergy 2020+ GmbH, Wieselburg*

14:30 **Vergleich von Labormethoden zur Charakterisierung des Ascheschmelzverhaltens**
Jonas Dahl, *Danish Technological Institute, Taastrup, Dänemark*

14:45 **Fragen**

Teil 2: SafePellets
15:00 **Gasaustritt – Sicherheitsprobleme mit Emissionen aus Holzpellets entlang der Logistikkette**
Waltraud Emhofer, *Bioenergy 2020+ GmbH, Wieselburg*

15:15 **Aktueller Status von „SafePellets" aufgrund von Studien der Eigenerwärmung in Biopellets-Speichern**
Niels Peter Nielsen, *Danish Technological Institute, Taastrup, Dänemark*

15:30 **Die Bedeutung der Normung und Zertifizierung für kleine Pelletsproduzenten**
Andreas Schneider, *Pusch AG, Marienrachdorf, Deutschland*

15:40 **Sicherheitsaspekte – Auswirkung auf die Pelletsindustrie**
Martin Behr, *Deutscher Energieholz- und Pellet-Verband (DEPV), Berlin, Deutschland*

15:50 **Fragerunde**

16:00 **Diskussion**

16:25 **Schlussworte Moderator**

English only
Alle Vorträge werden auf Englisch gehalten ohne Simultanübersetzung.

Parallel Session 15
Workshop Pellets

Friday 17 January

Chairman:
Gilles Gauthier, *Secretary General European Pellet Council & bioenergy expert AEBIOM, Brussels, Belgium*

AshMelt
2:00 pm **Classification of slagging tendencies of biomass fuels**
Marcus Öhman, *Energy Engineering - Division of Energy Science, Luleå University of Technology, Luleå, Sweden*

2:15 pm **Ash melting behaviour of solid biofuels in residential pellet boilers**
Manuel Schwabl, *Bioenergy 2020+ GmbH, Wieselburg, Austria*

2:30 pm **Comparison of laboratory methods to characterise ash melting behaviour**
Jonas Dahl, *Danish Technological Institute, Taastrup, Denmark*

2:45 pm **Questions**

SafePellets
3:00 pm **Off-gassing – Safety issues related with emissions from wood pellets along the pellet supply chain**
Waltraud Emhofer, *Bioenergy 2020+ GmbH, Wieselburg, Austria*

3:15 pm **Current status from SafePellets on studies of self heating in biopellets storages**
Niels Peter Nielsen, *Danish Technological Institute, Taastrup, Denmark*

3:30 pm **The importance of standardization and certification for small-scale pellet producers**
Andreas Schneider, *Pusch AG, Marienrachdorf, Germany*

3:40 pm **Safety issues – impact on pellet industry**
Martin Behr, *German energy wood and wood pellet association (DEPV), Berlin, Germany*

3:50 pm **Questions**

4:00 pm **Discussion**

4:25 pm **Closing remarks by the chairman**

Den Fortschritt erleben.









Spezialmaschinen für den Holzumschlag

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Liebherr-Werk Bischofshofen GmbH
Dr.-Hans-Liebherr-Straße 4
A-5500 Bischofshofen
Tel.: +43 50809 1-0
E-Mail: info.lbh@liebherr.com
www.facebook.com/LiebherrConstruction
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