bioenergy2020+

Bioenergy R&D – Key to Success

Manfred Wörgetter,
Bioenergy 2020+ GmbH., Austria
National Representative in IEA Bioenergy
Manfred.Woergetter@bioenergy2020.eu

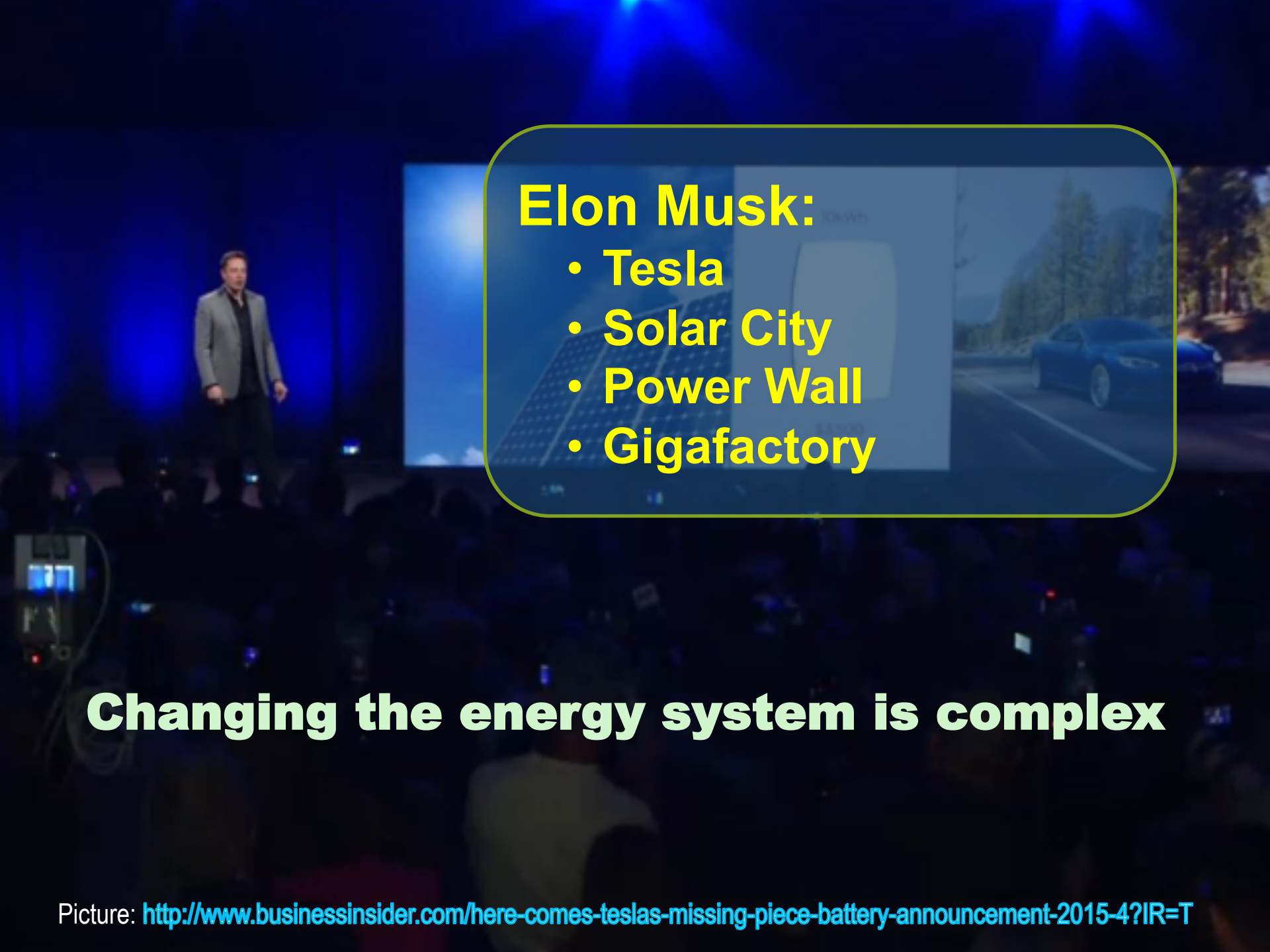
innovations kompetenz

Introduction

- Introducing myself: since 1975 bioenergy RDD&D
  - Bioheat & biofuel,
  - Resources & sustainability,
  - Government consultancy
  - Executive Committee of IEA Bioenergy
- What I will talk about:
  - Worldwide growing interest in Renewable Energy (RE)
  - Introducing IEA Bioenergy
  - Bioenergy success stories in Austria
  - R&D in bioenergy2020+
  - Austrian´s technology provider

My credo: Bioenergy = RE Number ONE worldwide on the way to a zero carbon society and a biobased economy

https://techcrunch.com/2016/12/11/bill-gates-jeff-bezos-and-18-others-commit-1-billion-to-new-cleantech-fund-breakthrough-energy-ventures/



Changing the energy system is complex

Picture: http://www.businessinsider.com/here-comes-teslas-missing-piece-battery-announcement-2015-4?IR=T

Budget von 50 Milliarden Dollar
Saudis bauen Ökostrom massiv aus

www.xing-news.com/reader/news/articles/562479?link_position=digest&newsletter_id=18866&xng_share_origin=email

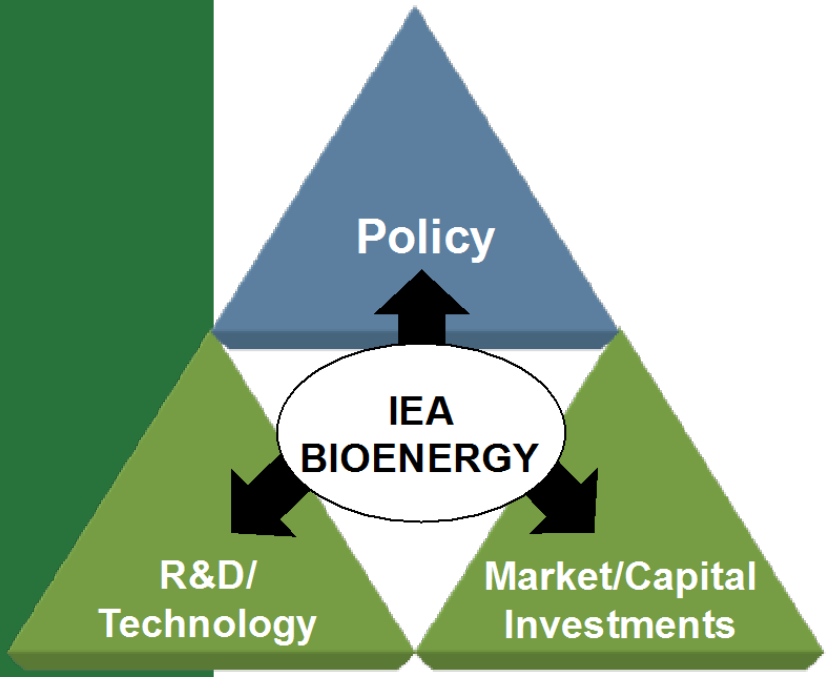
https://www.youtube.com/watch?v=TUYdK4cNsBY&feature=youtu.be

President Obama : U.S. hosted 7th Clean Energy Ministerial 2016

Introducing IEA Bioenergy

IEA Bioenergy

An **independent body** to give clear and verified information on Bioenergy; **founded 1978**



KEY DRIVERS

- ***Energy security***
- ***GHG Emissions reduction***
- ***Transition to a low carbon society***
- ***Need for robust policy analysis***
- ***Optimisation of the economic, environmental and social value of sustainable bioenergy***

One of the numerous Technology Collaboration Programmes of the IEA

IEA Bioenergy: 23 Contracting Parties

- Bioenergy Australia
- The Republic of Austria
- The Government of Belgium
- Ministry of Mines and Energy (Brazil)
- Natural Resources Canada
- The Croatian Energy Institute
- The Danish Ministry of Transport and Energy
- Commission of the European Union
- The Finnish Technology & Innovation Agency
- L'Agence de l'Environnement et de la Maîtrise de l'Énergie, France
- German Federal Ministry of Food and Agriculture
- The Irish Sustainable Energy Authority
- Gestore dei Servizi Energetici, Italy
- New Energy and Industrial Technology Development Organization, Japan
- Ministry of Knowledge Economy, Republic of Korea
- NL Enterprise Agency, The Netherlands
- The New Zealand Forest Research Institute
- The Research Council of Norway
- South African National Energy Research Institute
- Swedish Energy Agency
- The Swiss Federal Office of Energy
- Department of Energy and Climate Change (United Kingdom)
- The United States Department of Energy

Collaboration with FAO, GBEP, IRENA, S4All, IPCC, World Bank, ….

Membership expansion planned, particularly in IEA non-member countries

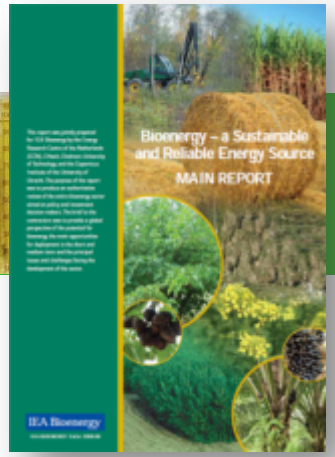
Working on 10 different Technologies

IEA Bioenergy

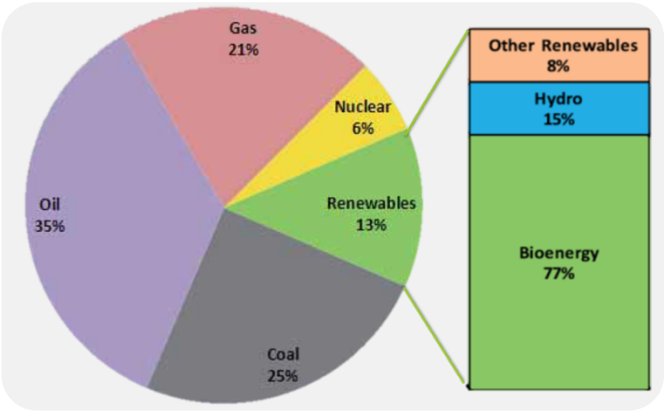
- 32 Biomass Combustion and Co-firing
- 33 Gasification of Biomass and Waste
- 34 Direct Thermochemical Liquefaction
- 36 Integrating Energy Recovery into Solid Waste Management Systems
- 37 Energy from Biogas
- 38 Climate Change Effects of Biomass and Bioenergy Systems
- 39 Commercialising Conventional and Advanced Liquid Biofuels from Biomass
- 40 Sustainable biomass markets and international bioenergy trade to support the biobased economy
- 42 Biorefining in a future BioEconomy
- 43 Biomass Feedstocks for Energy Markets

Experts from Austria

- Ch. Schmidl, Bioenergy2020+
- Hermann Hofbauer, TU Wien
- Berhard Drosg, Bioenergy2020+
- Dina Bacovsky, Bioenergy2020+
- Lukas Kranz, TU Wien
- Michael Mandl, tbw research



IEA Bioenergy Main Report 2009



Bioenergy – number one renewable energy worldwide, can be expanded significantly

- Bioenergy could contribute ¼ to $^1/_3$ of global primary energy supply in 2050
- The only RE that can replace fossil fuels in all energy markets - heat, power and transport fuels

Concerns has been raised in the past years:

- **Endangering food supply**
- **CO_2 emission through land use change from bioenergy expansion**
- **Economic competitiveness**

IEA Bioenergy Workshop Rome 17 May 2016

"Mobilizing bioenergy supply chains: opportunities for agriculture"

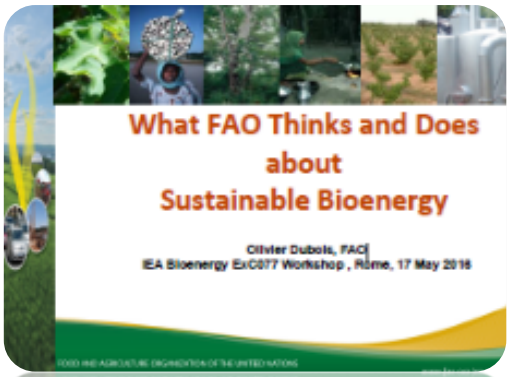
www.ieabioenergy.com/publications/ws20-mobilising-sustainable-bioenergy-supply-chains-opportunities-for-agriculture/

With speakers from FAO, IRENA, World Agroforestry Centre, GIZ, CIEMAT, …, Thailand, Indonesia, …

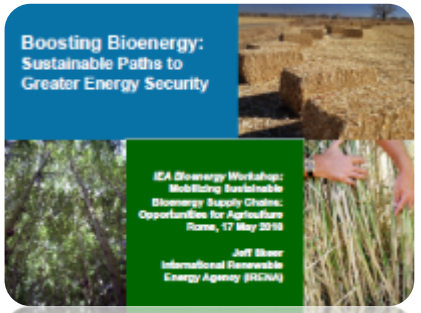
O. Dubois, FAO: What FAO thinks about Sustainable Bioenergy

FAO key messages on Bioenergy

- Biofuels: **not good or bad** – the way how they are used decides!
- **Assessments must be based on reality, not on models and global studies**
- Bioenergy – an other opportunity for responsible investment in agriculture and rural development
- FAO tools are available to help governments



J. Skeer, IRENA: Sustainable Paths to Greater Energy Security



Policies to boost biomass production:

- Improve crop yield
- Improve harvesting and logistics
- Collect data on land for production
- Provide better governance for land management
- Provide incentives

Modern Biomass may more than triple
- **26 EJ in 2010**
- **94 EJ in 2030**

Potential Land for Solid Biomass	
Closing the Yield Gap	550 M ha
Better Use of Pasture Land	950 M ha
Reduced Food Chain Losses	270 M ha
Reafforestation	350 M ha
Total	2000 M ha

IEA Bioenergy Workshop Rotorua November 2016

"Drop-in biofuels for international marine and aviation markets"

www.ieabioenergy.com/publications/ws21-drop-in-biofuels-for-international-marine-and-aviation-markets/

Aviation Industry Committed to Actions

www.ieabioenergy.com/wp-content/uploads/2016/11/P10-Aviation-and-Environment-Lakeman.pdf

BOEING

- Aviation: 2 % of global CO_2 emissions, 5.4 %/a growth of traffic
  - after 2020 **carbon neutral growth**, **½ 2005 CO_2 emissions in 2050**
- CO_2 policies in place: COP 21, ICAO CO_2 Emission Standard, ICAO Carbon Offsetting Scheme
- Four aviation biofuel pathways approved since 2011
- Barriers: costs and availability (feedstock, fuel)

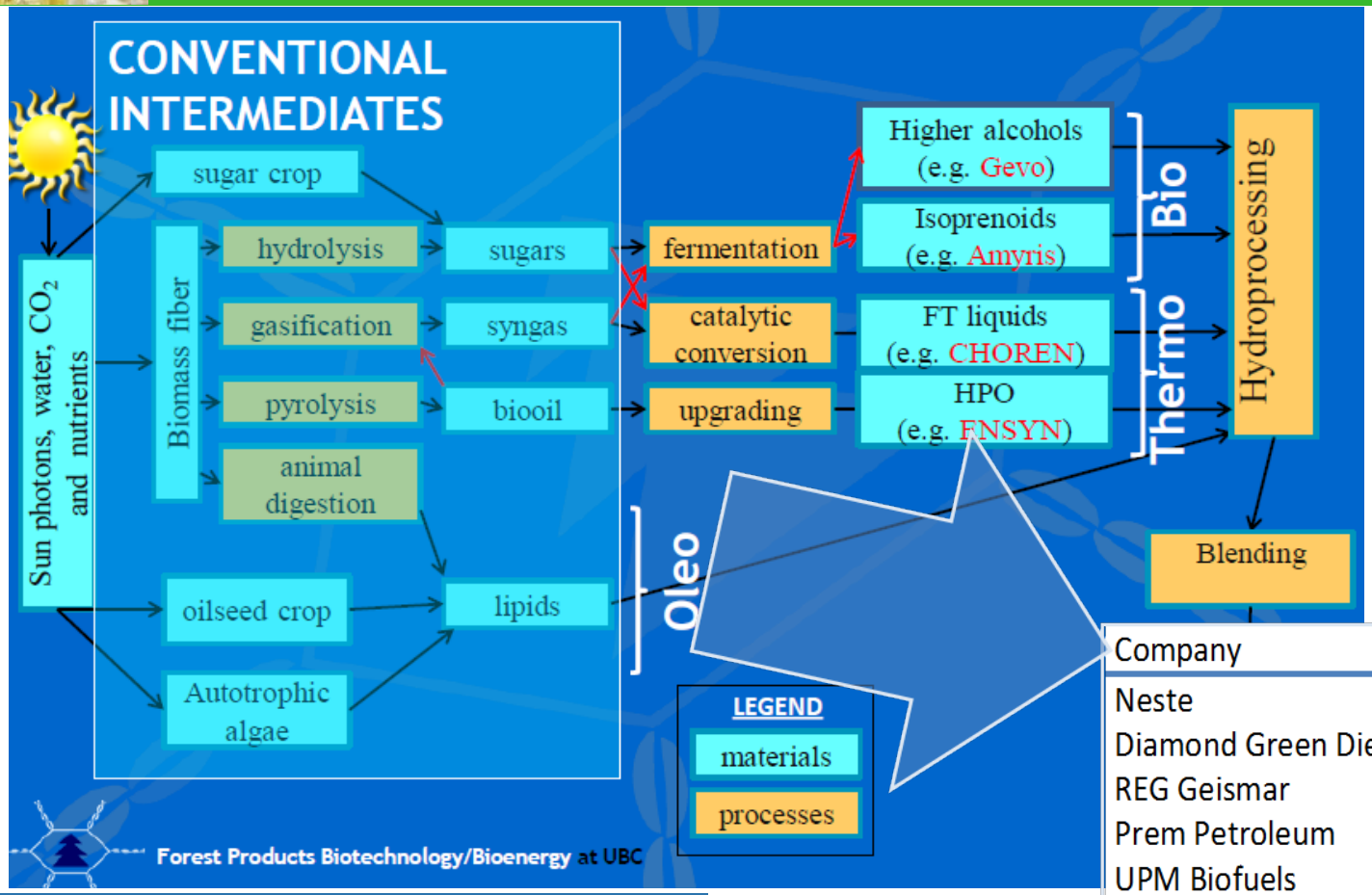
CORSIA
CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION

Reliable policy needed:

- Long term oriented, taking the unique role of aviation in account
- First steps: Regional multi-stakeholder initiatives
- Pay for the external benefits (eg CO_2 tax)

ICAO: International Civil Aviation Organization (UN Agency)
CORSIA - Carbon Offsetting and Reduction Scheme for International Aviation

BioJetFuel Technologies



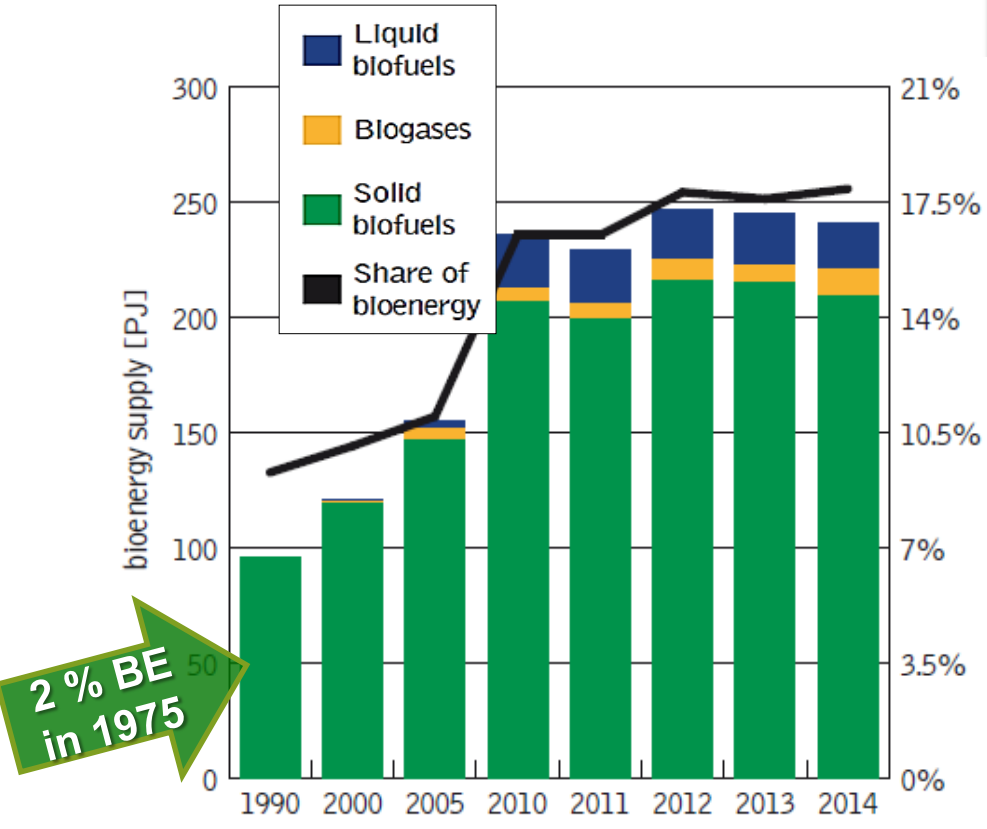
OleoJetFuels on the market

Company	Feedstock	Mio. m^3/y
Neste	Fats and oils	2.37
Diamond Green Diesel	Tallow	0.49
REG Geismar	Tallow	0.27
Prem Petroleum	Tall oill	0.02
UPM Biofuels	Tall oil	0.12
ENI	Vegetable oils	0.59
Capsa (Spain	Unknown	0.12
AltAir Fuels	Mixed	0.14
World, total		**4.12**

J. Saddler, J. McMillan, S. van Dyk
IEA Bioenergy Liquid Biofuels Task
www.ieabioenergy.com/publications/ws21-drop-in-biofuels-for-international-marine-and-aviation-markets/

Bioenergy success stories in Austria

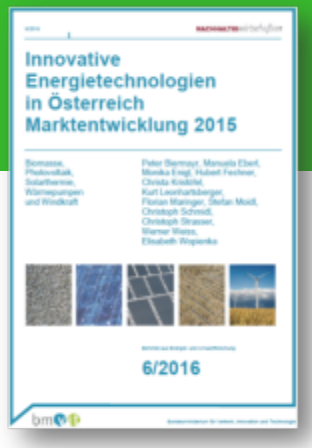
Austria: a look back on successful bioenergy development

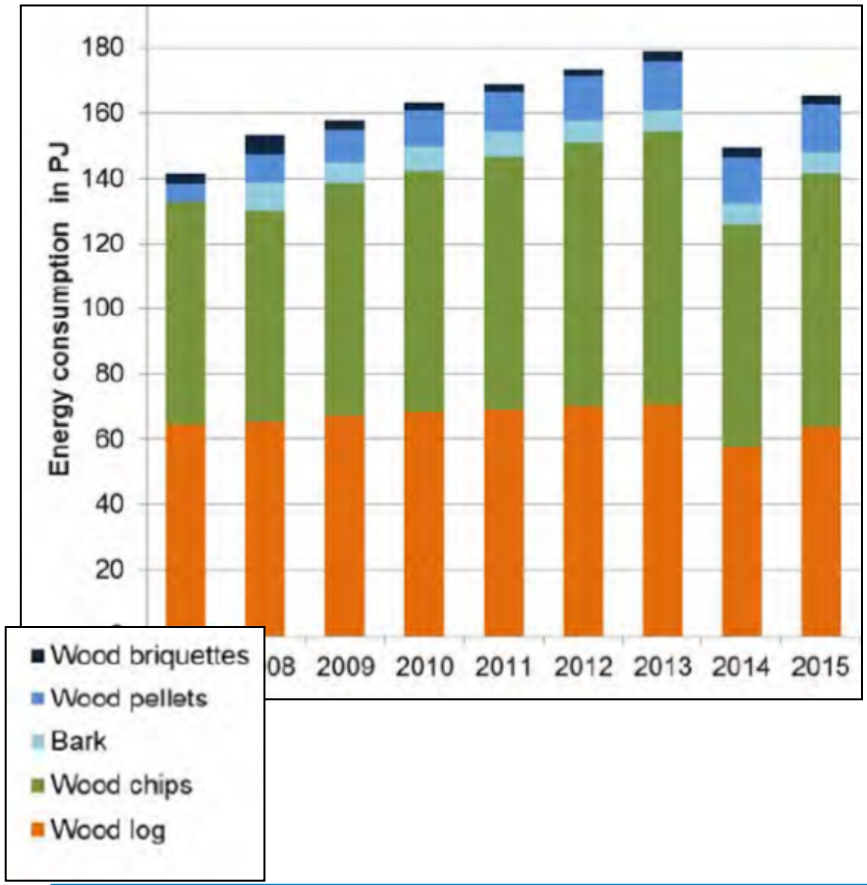


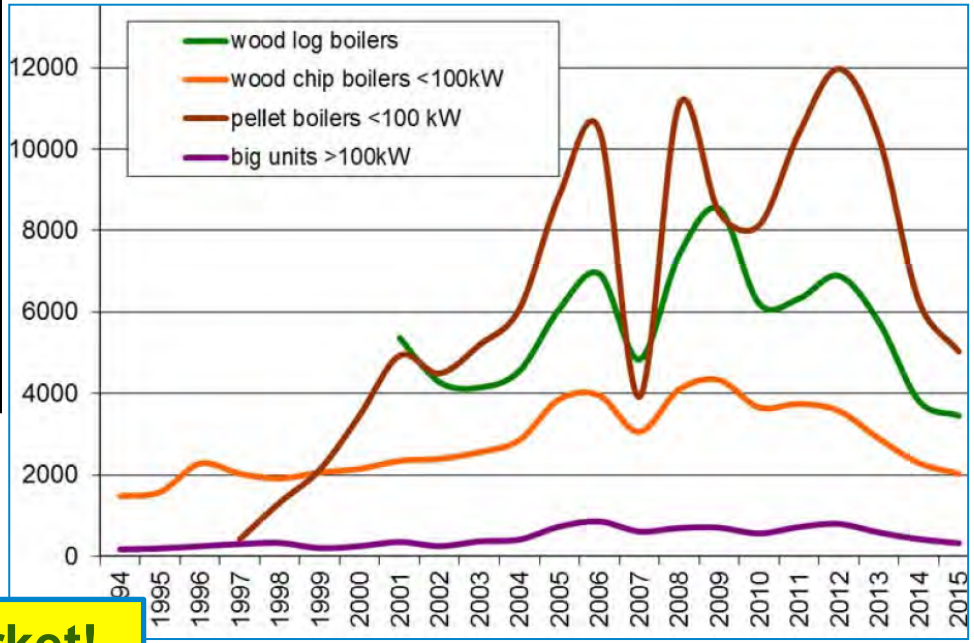
Success factors

- Oil price shock 1973
- Tradition in “bioheat”
- The attitude of the Austrians
- Strong lobbying, eg at the Austrian Biomass Association
- Policy framework
  - Eg an early “oilseeds for food, feed and fuel programme”
- **Top class innovations, competitiveness**
- **R&D in bioheat and biofuels, successful market launch**

Bioheat Market Austria





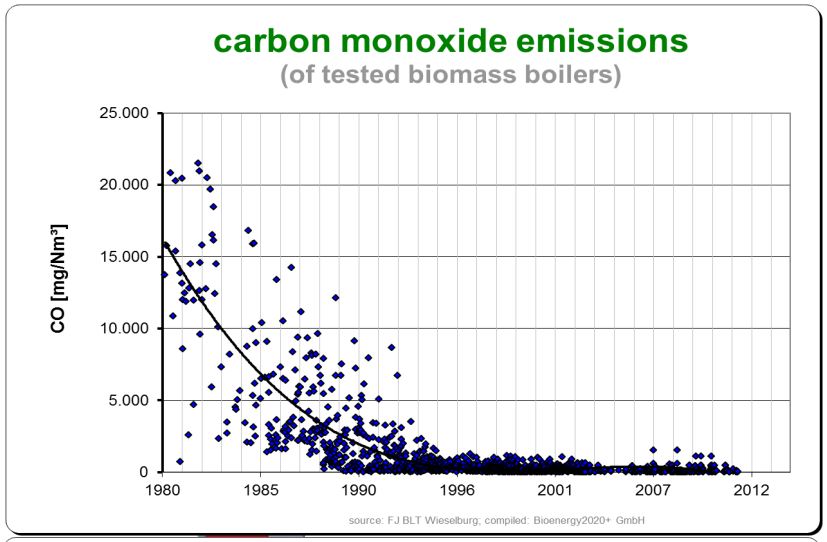


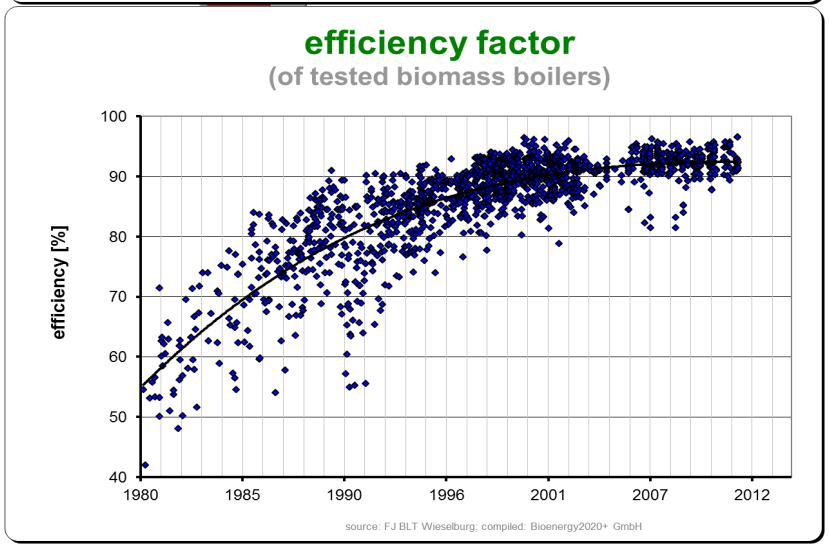
… going for the European market!

https://nachhaltigwirtschaften.at/de/iea/publikationen/innovative-energietechnologien-in-oesterreich-marktentwicklung-2015.php

Small scale biomass fired boilers, improvements since 1980

Full load test results





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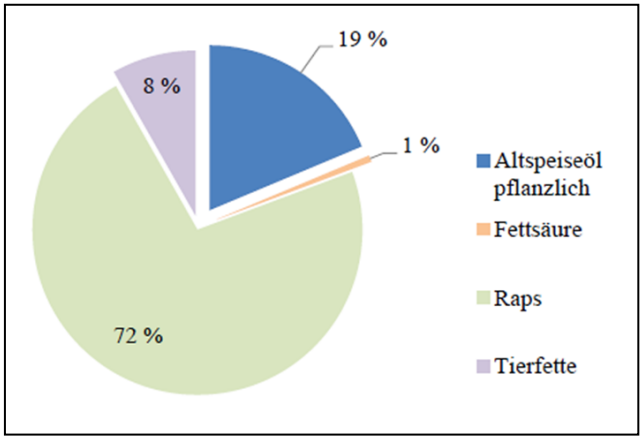
Biofuels use, biodiesel feedstock

Biodiesel, added	433547 t
HVO, added	4633 t
Biodiesel direct use	142986 t
HVO, direct use	36507 t
Pure vegetable oil in agriculture	769 t
Pure vegetable oil in road transport	15259 t
Vegetable oil based fuel, total	**633701 t**

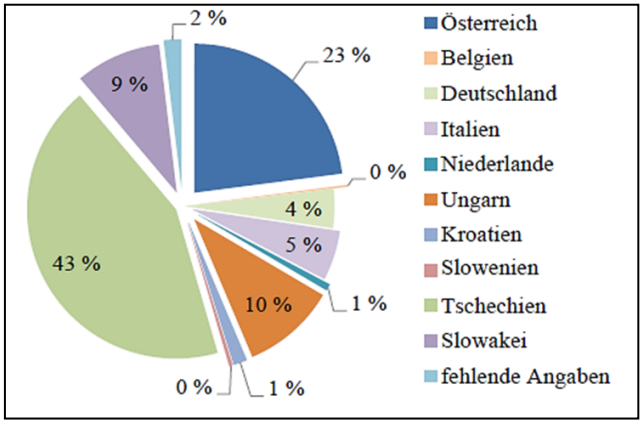
Ethanol, added	**87872 t**
thereof ETBE	29226 t

Fossil diesel, total	***5694520 t***
Gasoline, fossil	***1536217 t***
Substitution goal	***5.75 %***
Fossil fuel, substituted	***7.7 %***

Biodiesel feedstock



Feedstock origin



Biokraftstoffbericht 2015
https://www.bmlfuw.gv.at/umwelt/luft-laerm-verkehr/verkehr-laermschutz/alternatkraftstoffe/biokraftstoffbericht.html

Success factor R&D: based on strong strategies

Efforts since 1979

Energy Research Strategy 2010:

Consistent, energy-related R&D portfolio from basic research toward mar
transition

Forward looking

- Dialog process “Energy Future 2050” – just finished
- Smart technologies, systems and innovations
- Socio-economic aspects of a climate-friendly energy future
- Dialogue for a technology policy as basis of a sound energy strategy

www.dialog-energiezukunft2050.at/strategieprozess-dialog-energiezukunft-2050/

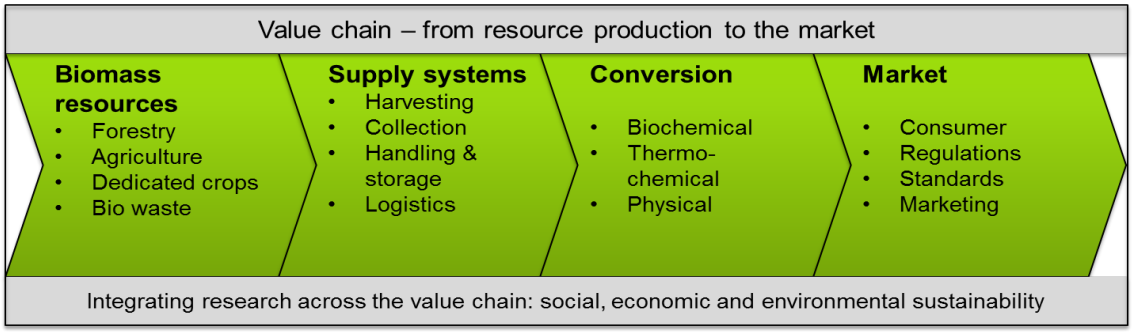
www.bmvit.gv.at/innovation/downloads/energieforschungsstrategie.pdf

Introducing bioenergy2020+,

Some results of successful R&D

bioenergy2020+
ONE in Bioenergy R&D in Austria

- Competence centre mainly financed in the COMET II program
- Ownership: public + industry Partners, turnover: ~ 8 mio €/a
- ~85 employees on 3 locations a 2 research sites
- More than a decade experience in bioenergy with the vision to become a world leader in bioenergy R&D and a member of the biobased economy community, R&D backbone of our industry
- National and international R&D network node aimed at contributing to **national and EU RE targets and to the formation of a biobased economy** by technology transfer along the value chain

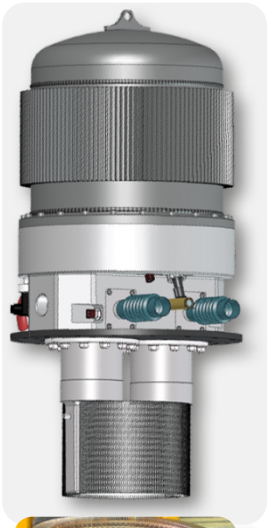


COMET
Competence Centers for Excellent Technologies

„StirBio“ Stirling engine, biomass fired

Technical data:

- 35 kW pellet boiler, preheated air, adiabatic combustion, air staged
- 15 kW heat exchanger at 1150°C gas temperature
- 5 kW 600 cm^3 Frauscher Thermal Motor
  700°C process gas temperature
  www.frauscher-motors.com



Results

- Electric efficiency up to 15%
- Successful operation (200 h)
- Heat exchanger can be cleaned automatically

Innovative products and patents

Wood briquette “Candle Burner”

1.8-4 kW heat output, automatically operated,

4-8 h burning time, low emissions

Invented by Josef Lumper & Jens-Michael Kirchhof

Tradition meets High-tech: tiled stove plus heat pump

Dissipation of tiled stove heat to house heating system

Variable operation of heat pump (outdoor air or heat from stove

Maximising energy efficiency

Inventor: Lazlo Golicza

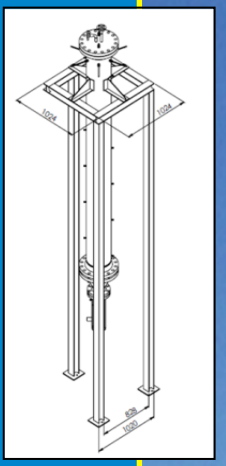
Syngas platform Güssing

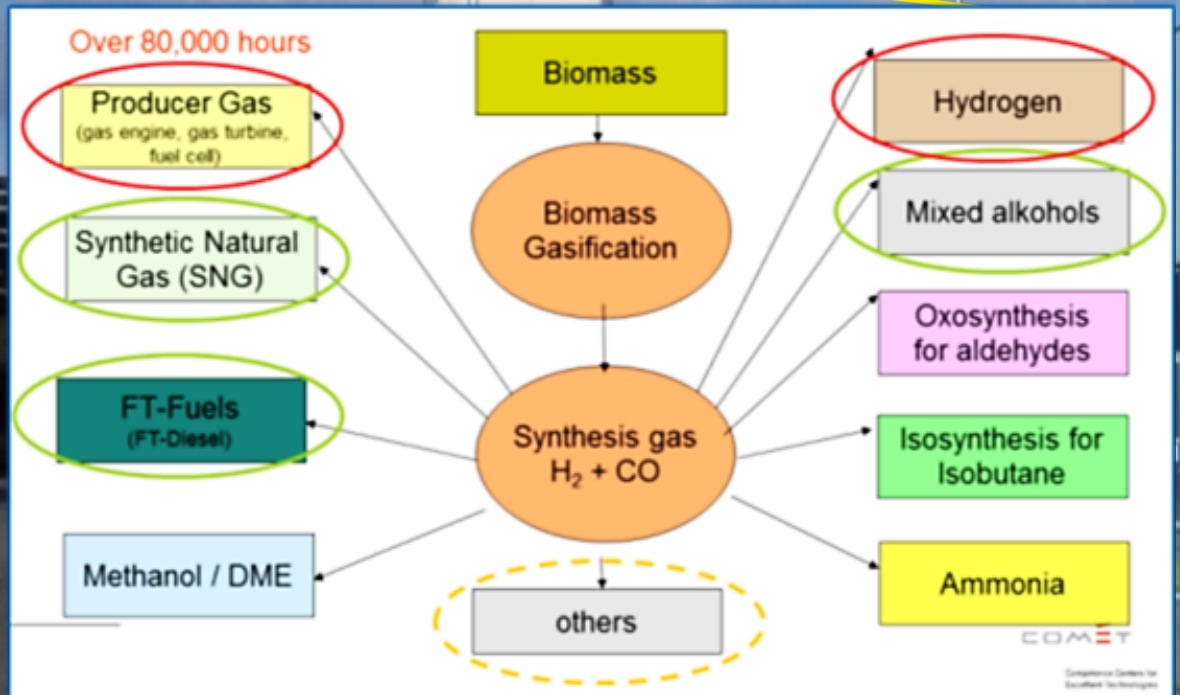
8 MW gasifier,
80 000 h successful operation

1 MW SNG PDU

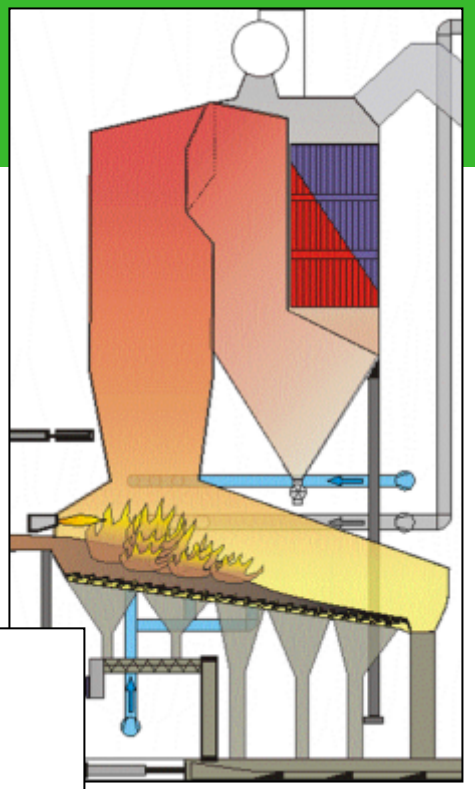
Pilot plants inside, eg
1 barrel/day
FT synthesis plant

- Gas treatment
- Scaling up of a slurry reactor
- Long term tests with synthesis gas
- Upgrading of the raw FT products

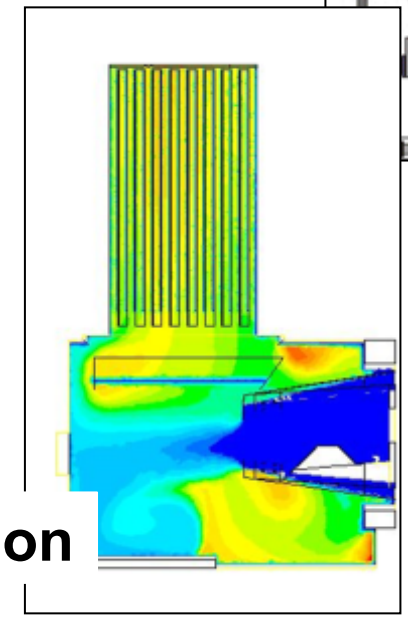




CFD Simulation of biomass thermal conversion; “virtual boiler”



- **Ash:**
  - particle and deposit formation,
  - corrosion,
  - deposit layer on heat transfer
- **Gas phase combustion:**
  - turbulent reactive flows,
  - gas phase emissions,
  - streaks from the fuel bed
- **Packed bed conversion:**
  - conversion of particles,
  - heat and mass transfer,
  - granular flow
- **Fine particle formation and deposition**

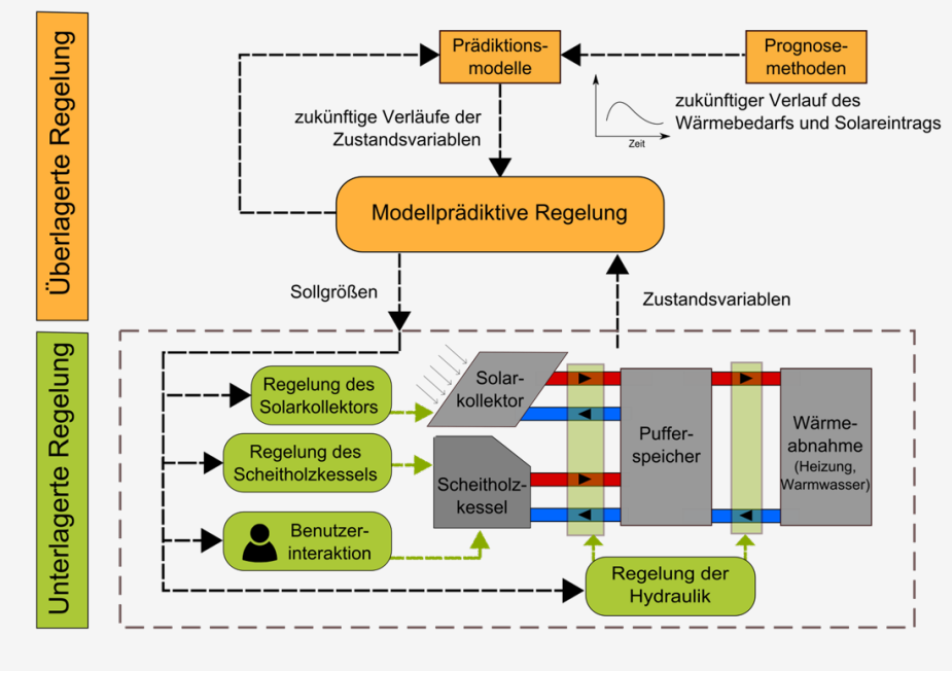


Model-based predictive control for central heating systems

- Improvement potential through predictive control
  - Overall annual efficiency: **from 75 to 80-85 %**
  - CO reduction: **minus 40-50 %** (from 345 down to 170-200 mg/MJ)
  - Particle emission : **minus 15-30 %** (from 14 down to 10-12 mg/MJ)

(Baseline: log wood boiler, cutting edge technology, state of the art installation)

Model based predictive control can be used for solid, liquid and gaseous fuels, solar systems and district heat



Preventing (deadly) accidents in pellet stores

Bioenergy2020+´s approach since 2007:

- Cause studies and basic research,
- Technical solutions including training materials for professionals
- Cooperation with standardization organizations, agencies, professionals in the pellet supply chain*
  - E.g. ISO TC 238 WG 7 – 5 Suggestions for new standards
- Ongoing work on characterisation of pellet store emissions

* www.safepellets.eu/wp-content/uploads/2014/10/relation_between_offgassing_and_selfheating_from_biomass_pellets+will_it_impact_the_work_of_the_pellet_industry.pdf

Market Surveys, Networking and Information Dissemination

- Market surveys
- Price and market models
- Support of initiatives, trainings
- Roadmaps and Strategies
- IEA Bioenergy: Task 32, 33, 37, 39; Executive Committee
- IEA AMF Secretariat
- National:
  - “Biobased Future”
  - Network Biofuels
  - Algae R&D network
  - …

https://nachhaltigwirtschaften.at/resources/nw_pdf/201606_marktentwicklung_2015.pdf?m=1469659717
https://nachhaltigwirtschaften.at/resources/nw_pdf/1254_fti_roadmap_bioheating_and_cooling.pdf?m=1469660261
https://nachhaltigwirtschaften.at/resources/iea_pdf/mitteilungsblatt-biobased-future-6_juli-2016.pdf
www.network-biofuels.at/menus/home/abonnieren


Many thanks to the bioenergy 2020+ team!!!

Austrian´s technology provider

Bioheat – a very long list of manufacturers

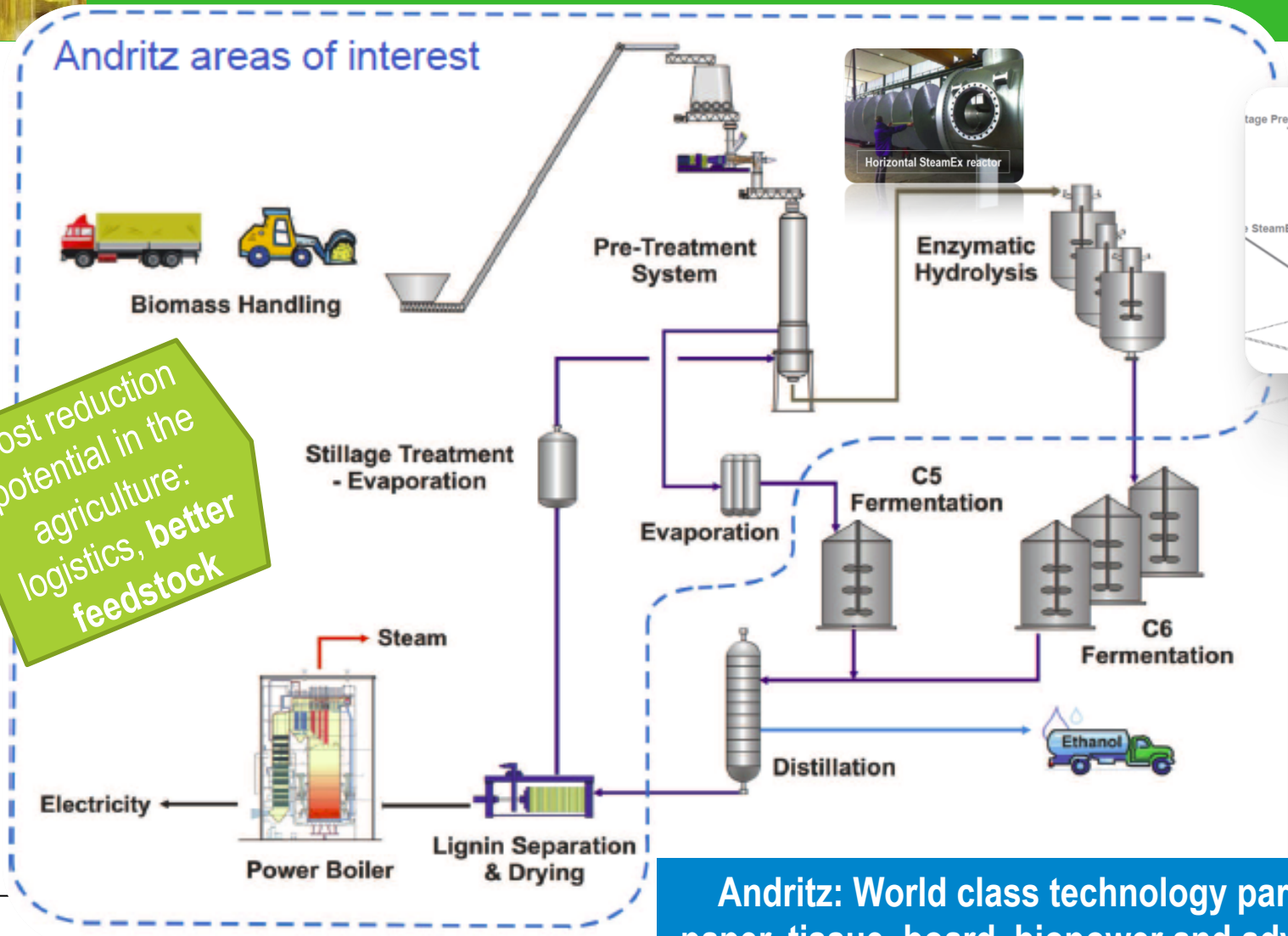
Agro Forst & Energietechnik GmbH
ATG AgrarTechnikGeräte e U
Becoflamm Bach KEG
BINDER Maschinenbau- u. Handel
BIOKAMPAKT Heiztechnik GmbH
Biotech Energietechnik GmbH
Eder Anton GmbH
ETA Heiztechnik Gmbh
Fröling Heizkessel- und Behälterba
Gilles Energie und Umwelttechnik
Guntamatic Heiztechnik GmbH
HARGASSNER GmbH
Heizbär Heiztechnik GmbH
LB HeizCenter Handels GmbH
HZA GmbH
HERZ-Energietechnik GmbH
HM Gebäudetechnik
HOVAL Gesellschaft m.b.H.
Inocal Wärmetechnik GmbH
ILS.AT Solarcenter Mag. Karl Linne
KCO Cogeneration und Bioenergie
KWB Kraft u. Wärme aus Biomasse

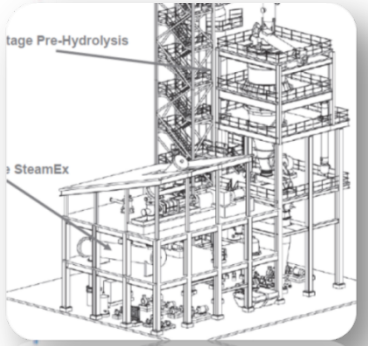
Prima heat GmbH
HDG Bavaria GmbH
Lindner & Sommerauer Heizanlagenbau
Lohberger Heiztechnik GmbH
Neuhofer Heiztechnik GmbH
ÖKOFEN Forschungs- u. Entwicklungs GmbH
Olymp Werk GmbH
PERHOFER Gesellschaft m.b.H.
PÖLLINGER Heizungstechnik GmbH
POLYTECHNIK Luft- und Feuerungstechnik GmbH
Santer Solarprofi GesmbH
Schmid AG - energy solutions
Solarbayer GmbH
Solarfocus Ges.m.b.H.
Thermostrom Energietechnik G
Tropenglut GmbH Hackschnitze
TM-Feuerungsanlagen GmbH
Urbas Maschinenfabrik Ges.m.b.H
Viessmann Ges.m.b.H
WINDHAGER Zentralheizung GmbH
Wodtke GmbH

Austroflamm GmbH
Haas & Sohn Ofentechnik GmbH
Lohberger Heiz- und Kochgeräte Technologie
Rika Innovative Ofentechnik GmbH
Wamsler Haus- und Küchentechnik GmbH

https://nachhaltigwirtschaften.at/de/iea/publikationen/innovative-energietechnologien-in-oesterreich-marktentwicklung-2015.php

ANDRITZ: 2nd gen EtOH and Buthanol Production

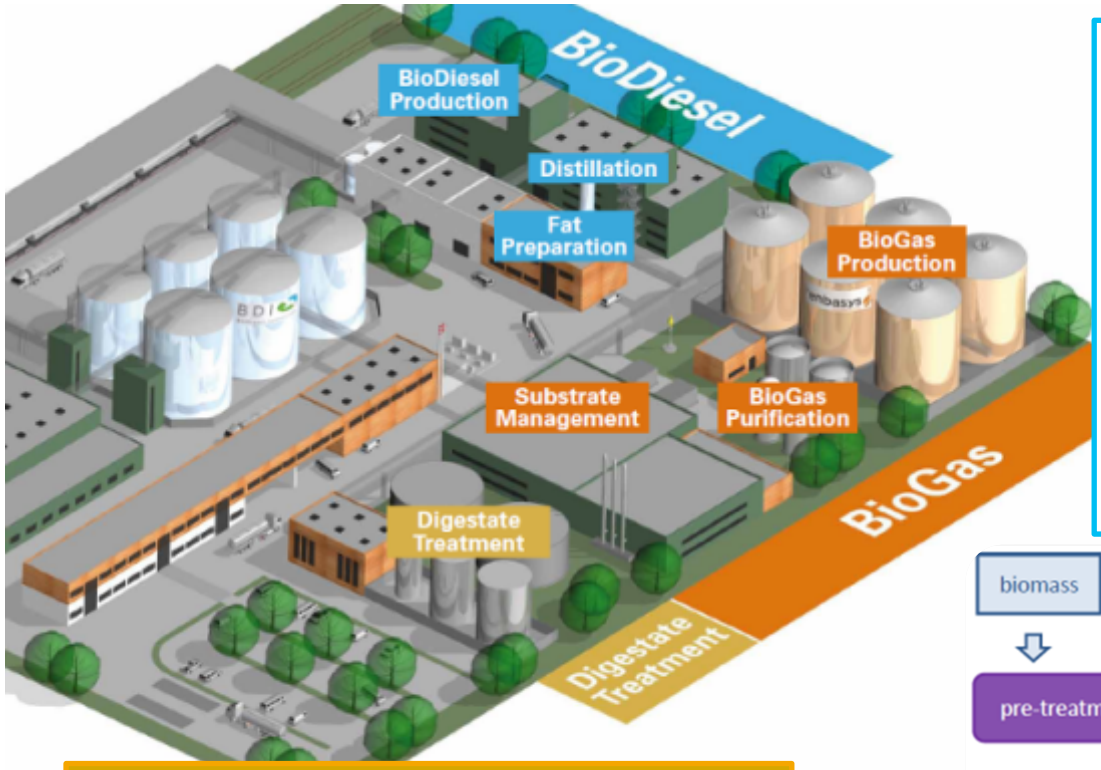




Cost reduction potential in the agriculture: logistics, **better feedstock**

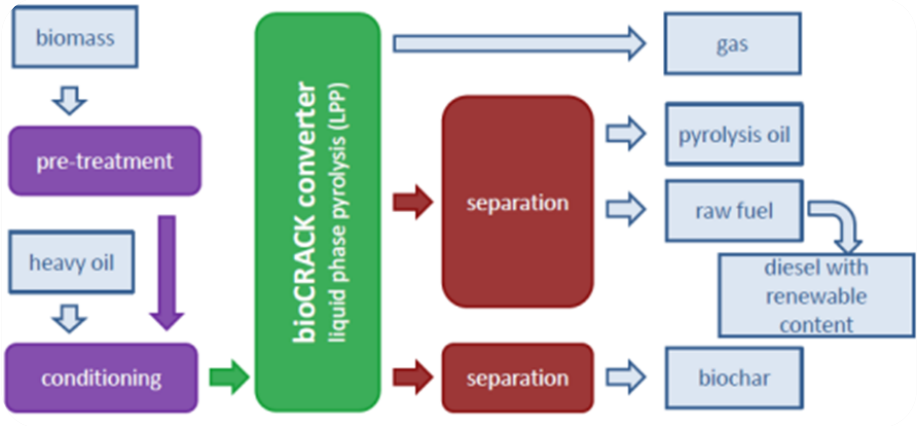
Andritz: World class technology partner for pulp, paper, tissue, board, biopower and advanced biofuels

BDI – Biodiesel International



- BDIs integrated BioCrack pilot plant at the OMV refinery
- Project : April 2010 - 2013
- Feed : 100 kg biomass + 250 kg heavy oil
- Atmospheric pressure, up to 400°C

Integrated waste-to-biofuels concept - turnkey solutions worldwide



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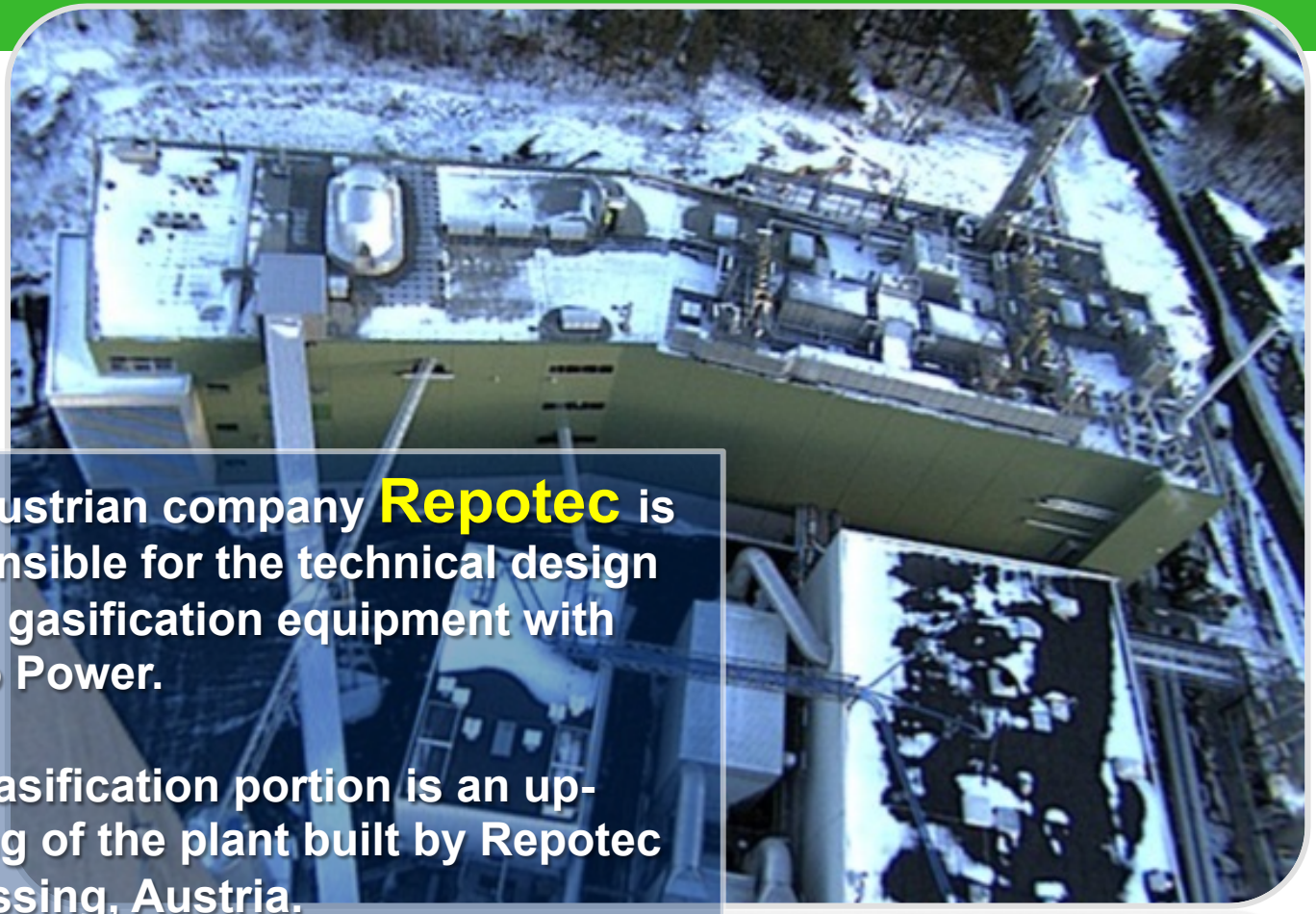
20 MW synthesis gas plant in Gothenburg;



The Austrian company **Repotec** is responsible for the technical design of the gasification equipment with Metso Power.

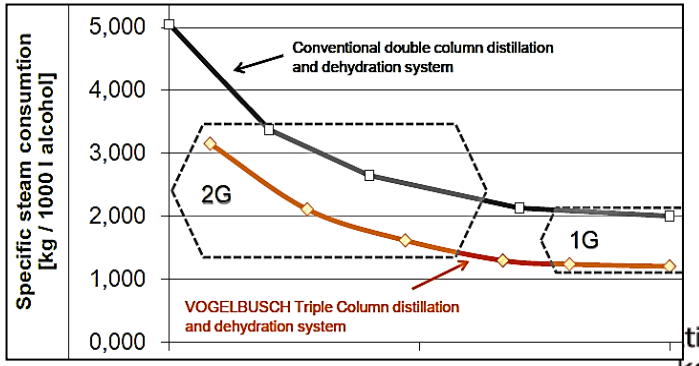
The gasification portion is an up-scaling of the plant built by Repotec in Güssing, Austria.

http://gobigas.goteborgenergi.se/En/The_plant/Follow_the_construction?Image=2014-01-20

VOGELBUSCH- experienced in 2nd gen ethanol: complementing client´s 2ndg process with proven EtOH technology

- Process design for pilot and demo plants
- Assist in developing fermentation and separation strategies
- Equipment supply for separation, distillation and dehydration
- Showcase projects:
  - IOGEN, Canada: 6 m3/d ethanol from straw
  - INBICON, DK: 53 m3/d bioethanol from wheat straw
  - INEOS BIO, USA: 90 m3 ethanol from green biomass
  - MITSUI, Malaysia: 1m3/d alcohol from fruit bunches
  - ABENGOA, USA: 270m3/d ethanol from corn cobs
  - ….
- Strong in advanced distillation

www.vogelbusch-biocommodities.com/en/technologies/alcohol.php



ecoduna©

3 ecoduna **h**anging gardens algae production sites in operation:

1. ecoduna-plant in Bruck/Leitha, Austria
2. Vattenfall Corp. in Senftenberg, Germany
3. Kalundborg Symbiosis Cluster, Denmark: www.symbiosis.dk

http://www.ecoduna.com/

Take Home Messages

- **Bioenergy - number ONE RE** in the next decades
- The way to a Zero Carbon Society is challenging
  - **Society must be convinced**
- Biomass availability is crucial for a biobased economy
- **Global approach is a must,** but framework conditions differ around the world
- Strong policy needed
- **Technologies are the key for a broad commercial success**

Read more:

- http://www.ieabioenergy.com/

IEA Bioenergy Countries' Report

- www.ieabioenergy.com/wp-content/uploads/2016/09/IEA-Bioenergy-Countries-Report-23.09.2016-1.pdf

Stay informed:

- https://twitter.com/MWoergetter
- www.nachhaltigwirtschaften.at/iea/results.html/id1970
- www.network-biofuels.at/
- www.nachhaltigwirtschaften.at/results.html/id6874

More about IEA Bioenergy in the Conference

Highlights of Bioenergy Research 2017: National and international results achieved by IEA Bioenergy Tasks and ERA-NET Bioenery, Room 12, 09:00 am – 03:00 pm

09:00 am **Welcome and Introduction IEA Bioenergy TCP**
Theodor Zillner, *Austrian Federal Ministry for Transport, Innovation and Technologies, Austria*
Luc Pelkmans, *Technical Coordinator IEA Bioenergy, Belgium*

Session 1: Highlights from the IEA Bioenergy TCP

09:30 am **Gasification of Biomass and Waste – recent activities and results from IEA Bioenergy Task 33**
Kevin J. Whitty, *University of Utah, United States of America*

09:45 **Status of Biomass Gasification – Database developed by Austria for IEA Bioenergy Task 33**
Reinhard Rauch, *TU Vienna, Austria*

10:00 am **Energy from Biogas – international and national activities „Bioenergy Task 37"**
Bernhard Drosg, *University of Natural Resources and Life Sciences, Austria*

10:30 am **Coffee break**

11:00 am **Commercializing Conventional & Advanced Liquid Biofuels „IEA Bioenergy Task 39"**
Dina Bacovsky, *Bioenergy 2020+ GmbH, Austria*

11:15 am **Global wood pellet industry – market and trade study – IEA Bioenergy Task 40 results**
Fabian Schipfer, *TU Wien, Energy Economics Group (EEG), Austria*

11:35 am **The European Wood Pellet Market for small-scale heating – data availability, price developments and drivers for trade – IEA Bioenergy Task 40 results**
Kay Schaubach, *DBFZ, Germany*

Friday 20 January

11:50 am **Biorefining – recent activities and results from IEA Bioenergy Task 42"**
Michael Mandl, *Tbw research GmbH, Austria*

12:05 pm **Highlights from Bioenergy Task 32: Combustion and Cofiring"**
Jaap Koppejan, *Procede Biomass BV, Netherlands*

12:30 pm Lunch

01:30 **Austrian contributions to Task 32: Combustion and Cofiring"**
Christoph Schmidl, *Bioenergy 2020+ GmbH, Austria*

01:45 pm **Task 41 – special project: The role of Bioenergy RES hybrids in a low-emission energy system**
Ilkka Hannula, *VTT - Technical Research Centre of Finland Ltd, Finland*

Session 2: ERA-NET Bioenergy – overview and current projects

02:00 pm **Presentation of the ERA-NET Bioenergy**
Carina Lemke, *Agency for Renewable Resources (FNR), ERA-NET Bioenergy Secretariat, Germany*

02:15 pm **MetHarmo – European harmonisation of methods to quantify methane emissions from biogas plants**
Marlies Hrad, *University of Natural Resources and Life Sciences, Austria*

02:30 pm **GrateAdvance – Advanced adjustable grate solutions for future fuel flexible biomass combustion technologies**
Sabine Feldmeier, *Bioenergy 2020+ GmbH, Austria*

02:45 pm **REFAWOOD – Resource-efficient fuel additives for reducing ash related operational problems in waste wood combustion**
Peter Sommersacher, *Bioenergy 2020+ GmbH, Austria*

03:00 pm **End**

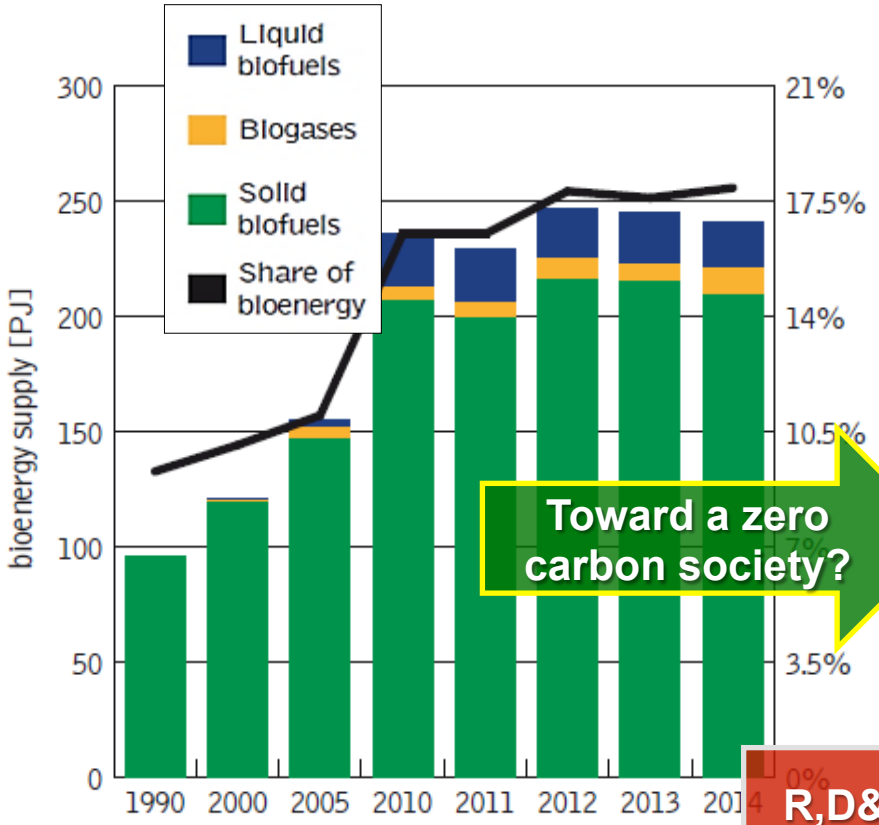
bmvrfi

Language English

Simple questions – difficult answers

- How much does it cost?
- Who is paying?
- Who benefits?
- Who arranges?
- Who is responsible?

The way forward



Toward a zero carbon society?

R,D&D is a must

- "Green book" on an integrated energy and climate policy under preparation

  https://konsultation-energie-klima.at/assets/Uploads/Grunbuch-integrierte-Energiestrategie.pdf

Aimed at sustainability, security of supply, competitiveness and affordability

IEA Bioenergy Global Bioenergy Data Set

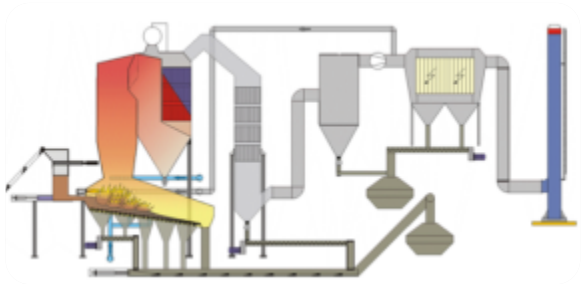
Prepared from IEA statistical data, information from IRENA, and IEA Bioenergy, combined with data provided by the IEA Bioenergy Executive Committee

www.ieabioenergy.com/wp-content/uploads/2016/09/IEA-Bioenergy-Countries-Report-23.09.2016-1.pdf

Bioenergy 2020+ working areas

1 – Combustion

- Advanced fuel characterisation
- Biomass for residential heating, medium & large scale CHP, and other applications
- Micro- und small-scale CHP plants



2 - Thermal gasification

- Increase of resource basis including biogenous residues
- Biomass for industrial applications, e.g. substitution of natural gas
- Syngas-platform for bio-refineries
- Plants with poly-generation (heat, electricity, fuel)
- Hybrid systems with other RE

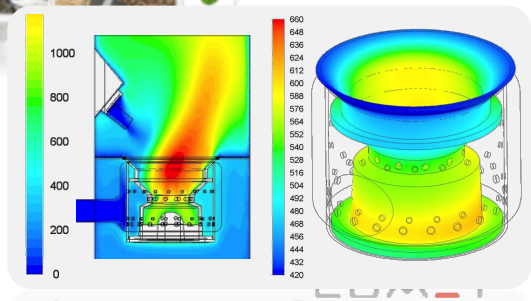
Bioenergy 2020+ working areas

3 – Bioconversion

- … to gaseous and liquid biofuels
- Pre-treatment technologies
- Nutrient recovery
- H2 production & utilisation, biogas up-grading
- Cascadic use of biomass
- Innovative biomass

4 – Cross cuttings

- Sustainable supply and value chains
- Model based control for conversion technologies,
- Software development, adaptive CFD



Bioenergy 2020 + working on Sustainable Supply and Value Chains

Supply Chains

- Availability of Biomass
  - Assessment of the potential
  - Development of logistics and supply chain concepts
- Biomass pre-treatment & upgrading technologies: Mechanical: Sorting, pelletizing; Thermal: Drying, torrefying, pyrolysis; Testing and optimization

Value Chains

- Sustainability assessment of whole value chains
- Technical and economic assessment of value chains (e.g. for algae, innovative biofuels, eg from torrefied biomass, biowaste for biogas and compost, demolition wood,…)