

The background image shows several large, dark brown, rectangular torrefaction pellets stacked on a white surface. In the foreground, there is a pile of smaller, cylindrical torrefaction pellets. The text is overlaid on this image.

TORREFACTION – INTERNATIONAL OVERVIEW OF DEVELOPMENTS IN THIS NOVEL TECHNOLOGY

Michael Wild
Wild&Partner LLC, Vienna, Austria
IBTC, Brussels, Belgium

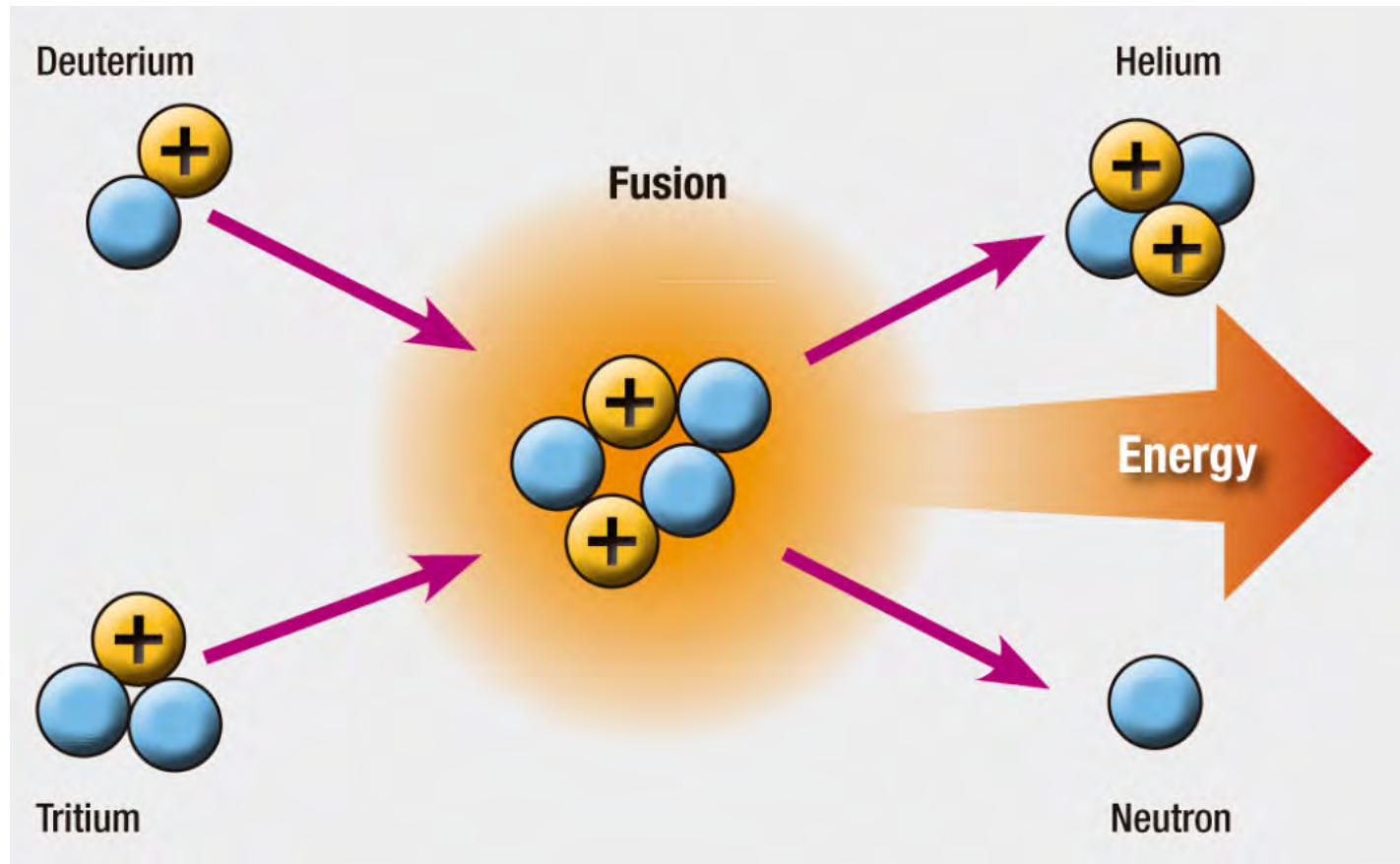
Picture: M.Englisch

Graz, January 17th 2014

1960ies

NUCLEAR FUSION

THIS IS THE ENERGY OF THE FUTURE
AND IT IS JUST AROUND THE CORNER



2014

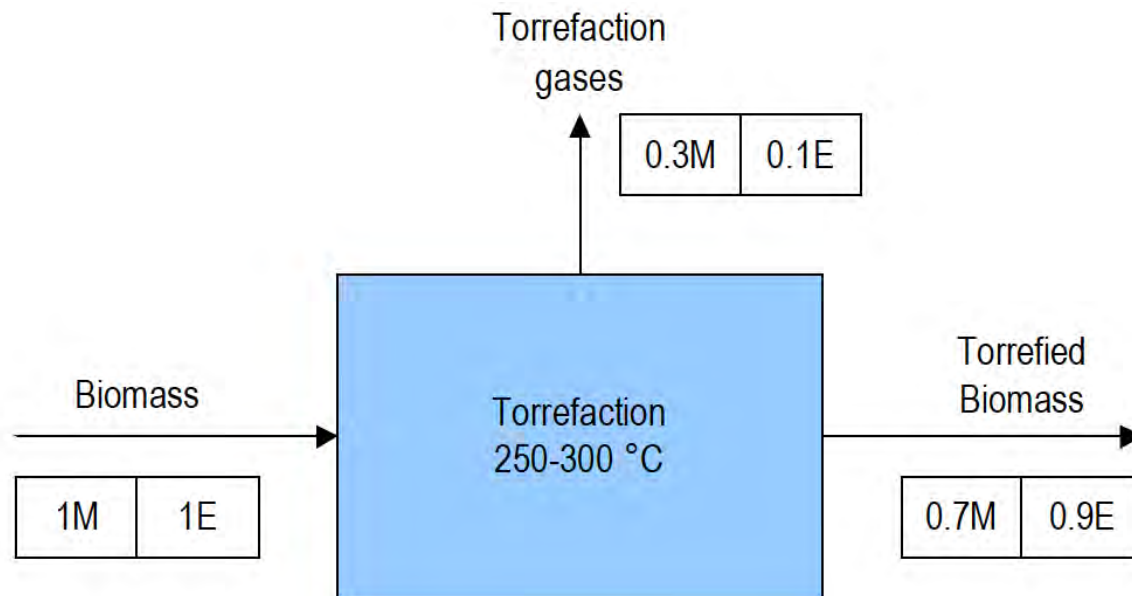


.....AND IT ALWAYS WILL BE

2007



TORREFIED BIOMASS IS THE SOLID RENEWABLE FUEL OF THE FUTURE



Source: P.C.A. Bergman

2014



...AND IT IS AVAILABLE **NOW**



Loading at Production Site

W&P



Source: ACB Entwicklungs GmbH

Loading at Production Site



Source: NewBiomassEnergy

Loading at Production Site



Very limited dusting and breakage



Source: NewBiomassEnergy

Loading at Production Site

W&P



Source: NewBiomassEnergy

Loading to the Vessel

Truck – hopper – conveyor belts



Loading to the Vessel



Truck – hopper – conveyor belts



Source: NewBiomassEnergy

Dusting less or compareable to WWP



Loading MV HENNY on order of NEW BIOMASS ENERGY



Source: NewBiomassEnergy

Metering at unloading



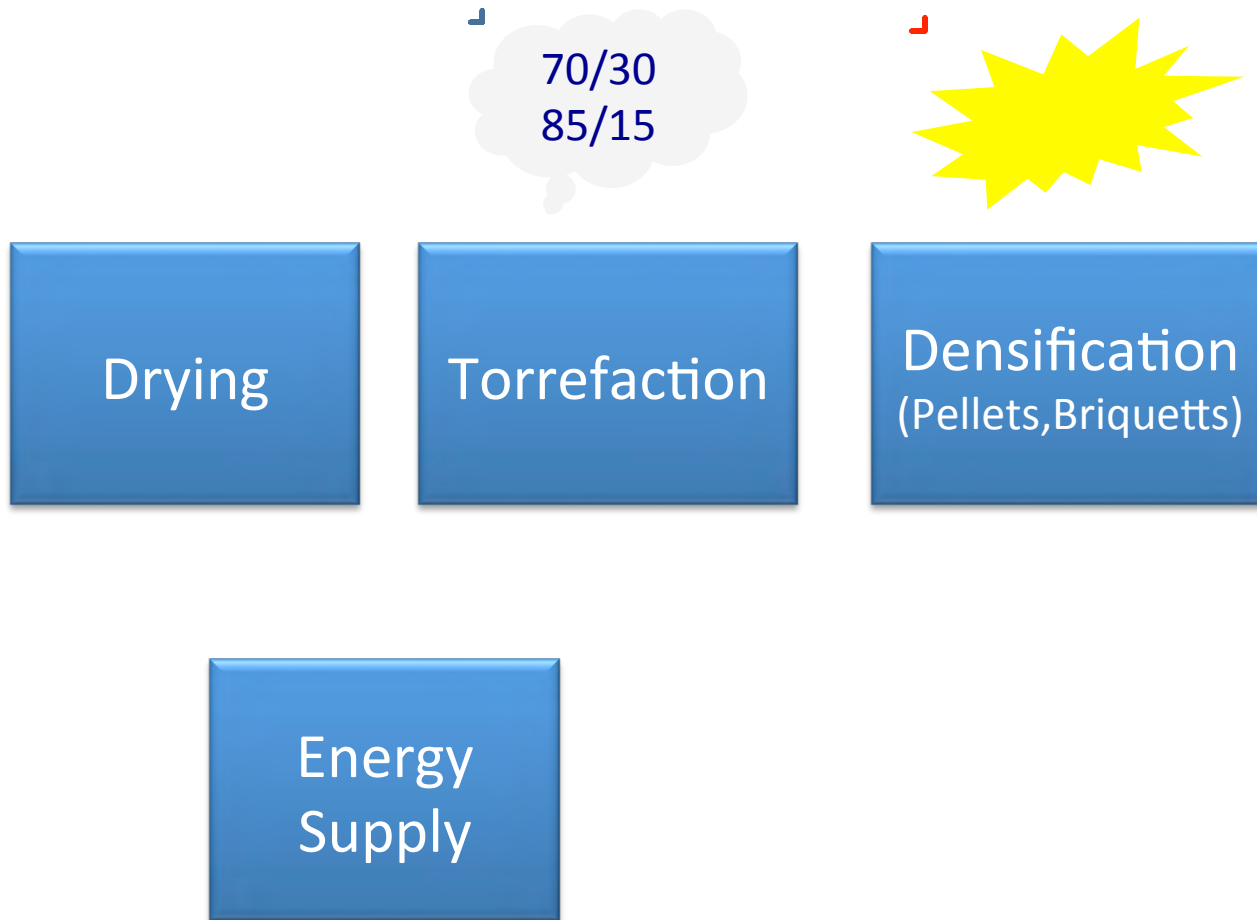
Mission of companies in Torrefaction

- Produce the best solid biomass in terms of
 - Application efficiency and variability
 - Supply chain efficiency
 - Cost effectiveness
 - Storeability
 - Carbon efficiency
 - Tradeability
- Make remote biomass accessible to the market
- Help in creating a **win - win - win** situation
for **producer - trader - consumer**

Why Torrefaction

1. Significant cost reductions in transport and handling
2. Broader feedstock basis - geographically + types of raw material
3. Almost 0 biodegradation of product when stored
4. Large variety of applications
5. Reduces CAPEX&OPEX at enduser – Immediate use in existing coal fired plants –grindability, water resistance....
6. Combusts cleaner, gasifies easier and cleaner
7. Can be made to measure to clients requirements
8. Helps developing the market towards commoditisation

More than 1 issue to be solved



Continuous Densification Today



The torrefaction process (example ACB)

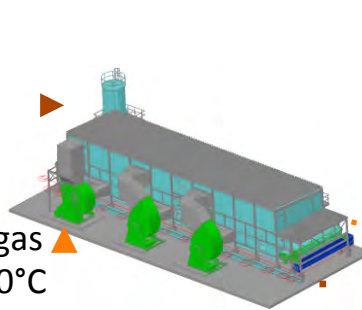
Fresh biomass



Fresh biomass fuel



Flue gas
 $T=300^{\circ}\text{C}$



Dryer offgas

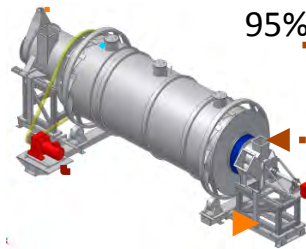


Dried biomass
95% DS



ACB gas
 $T=280^{\circ}\text{C}$

Flue gas
 $T=400^{\circ}\text{C}$



Torrefied biomass



Torrefied biomass



Fresh biomass

DRYING

TORREFACTION

PREPARATION(milling)
of torrefied material

DENSIFICATION
of torrefied material

ACB Fuel

ENERGY SUPPLY

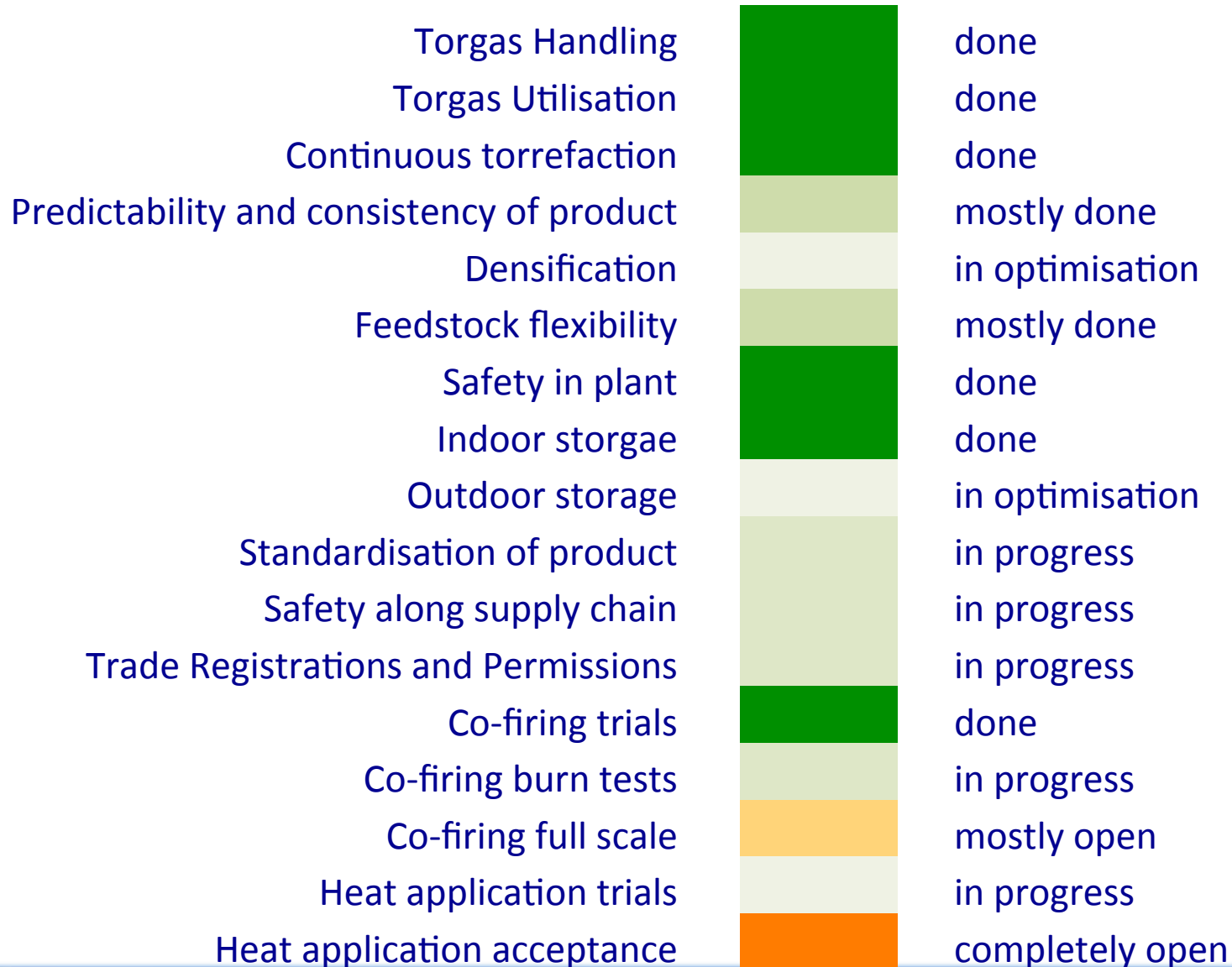
Biomass +
lean gas incineration

ACB Process
development
supported by:



Source ANDRITZ AG, Design W&P

Torrefaction Implementation Thermometer





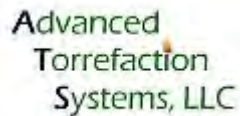
Bringing together the performing companies in Torrefaction

- Promoting the uptake of torrefied biomass for Energy
- All issues of common interest which are not under competition
- Regulatory Barriers, general permissions along supply chain
- Link to Policy
- Safety and Health
- First contact for everybody interested in Biomass Torrefaction

IBTC Full Members



IBTC Supporting Members

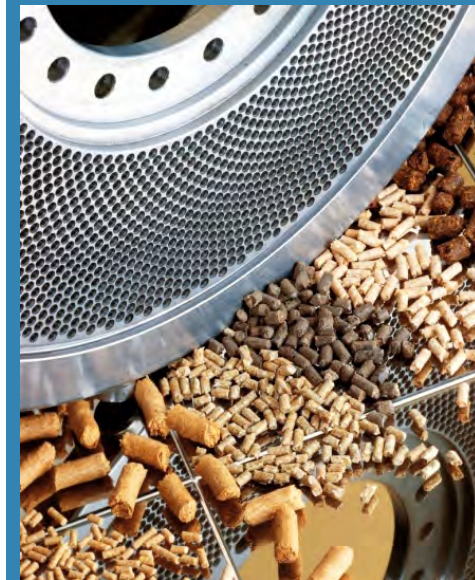


Amandus Kahl GmbH & Co. KG in Hamburg (Germany) plans, designs, and builds machines, plants, and turnkey production plants for conditioning and compaction of various materials for a range of industrial processes in the biomass, feed, food, chemical and recycling industry.

Besides AMANDUS KAHL, the companies SCHULE MÜHLENBAU, NEUHAUS NEOTEC and HEINEN FREEZING belong to the Kahl-Group (650 employees in total).

In recent years, numerous trials were carried out in our technology centre on the pelleting of torrefied wood and torrefied biomass as well as of steam explosion products in order to gain experience and data for upscaling the pelleting plant to a commercial scale (> 10 t/h) with flat die pelleting presses. Amandus Kahl installed the pelleting line for Topell (NL) and installs plants for other contractors in North America.

Together with Neuhaus Neotec, Amandus Kahl carries out research work on the torrefication of wood and biomass pellets using a modified coffee roaster.



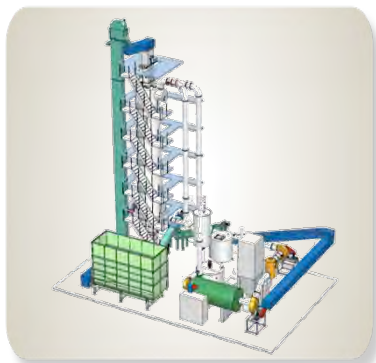
Andritz Torrefaction Technologies

▪ Two Main Technology Platforms

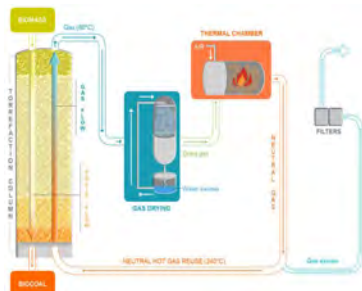


Large plants: up to 700.000 t/a per line	Small / medium plants: 50.000-250.000 t/a
Andritz/ECN Torrefaction Design	Andritz ACB® Torrefaction Design*
Industrial Demoplant (1t/h) in Denmark starting up in 3 rd quarter 2012	Industrial Demoplant (1t/h) in Austria in operation from 4 th quarter 2011.
Pressurized, moving bed reactor Andritz/DTI Pelleting plant	Rotating, indirectly heated drum reactor Briquetting plant
Key Features: Scale up to huge capacities possible (experience from Pulp & Paper) Feed material: Wood Chips/Forest Residuals	Key Features: Simple process concept specially developed for decentralized plants Flexibility in feed material

Supplying turn key plants 50.000 to 250.000mt/a
separation@andritz.com www.andritz.com



- ▶ **AREVA is the leading global provider of products and services related to nuclear power.**
- ▶ **The group is also a major player in renewables energy ; AREVA Renewables provides advanced technology solutions in offshore wind, concentrated solar power, energy storage and bioenergy.**
- ▶ AREVA Bioenergy acquired the “Thermiya” torrefaction technology in July 2012. Thermiya was a French engineering company funded in 2002, specialized in biomass conversion.
- ▶ This acquisition is in line with AREVA Renewables’ strategy to increase the technological content of its portfolio, and allows to widen the range of products addressing the biomass to energy market.
- ▶ **AREVA Bioenergy has since been engaged into a full process and product development approach to deliver industrial-scale EPC torrefaction plants, and is currently constructing a 2.5 tons per hour prototype plant.**
- ▶ **The AREVA Biomass Torrefaction Process relies on a direct heating, moving bed technology. It implements a continuous thermal treatment in a torrefaction column, where two flows move vertically in opposite directions.**



AREVA Biomass Torrefaction – Key Advantages

- ▶ **A process that can be fine-tuned to reach the desired output product specifications.**
- ▶ **A process that offers an optimized heat and mass balance**
 - ◆ Direct heating of the biomass by neutral gas ensures that no unnecessary mass or calorific potential is lost.
 - ◆ In standard operating conditions, the process produces a biocoal that still contains 95% of its energy potential.
- ▶ **A process that ensures an homogeneous production and a constant quality of product**
 - ◆ Continuous process guaranteeing that biomass particles are torrefied to the core and to the same extent.
- ▶ **A robust process that offers the lowest possible operating and maintenance costs**
 - ◆ Low temperature of torrefaction, direct temperature exchange between gas and biomass
 - ◆ Very few moving parts
- ▶ **A process that avoids the formation of tars and pyrolitic juices**

Arigna Fuels Limited

- Family owned mining business based in Arigna since late 1800's
- First briquetting plant was built in 1937 and used a pitch binder
- Smokeless Briquetting Process using starch based binder developed in Arigna and Patent granted in 1992
- Now Irelands largest manufacturer of coal based smokeless fuel , built up after the closure of the coal mines in 1990.
- Our interest in renewables to date has centred on development of wind farms on our old opencast mine sites.
- 50 employees, €20m turnover , 20% export



Biolake BIOpellets

Status overview:

- Successful trials have been conducted to torrefy herbaceous biomass such as straw and miscanthus
- Industrial pellet test were successful, durable BIOpellets can be produced without a binder
- The system operates auto thermal on the ablated torrefaction gas after the initial start-up
- Now working on process control automation of the BTS system
- Testing more biomass types



Highlights of the BTS system

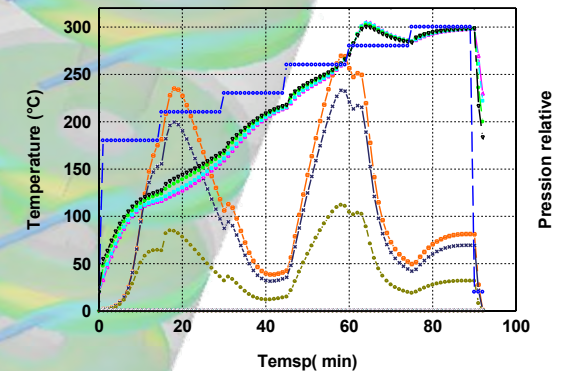
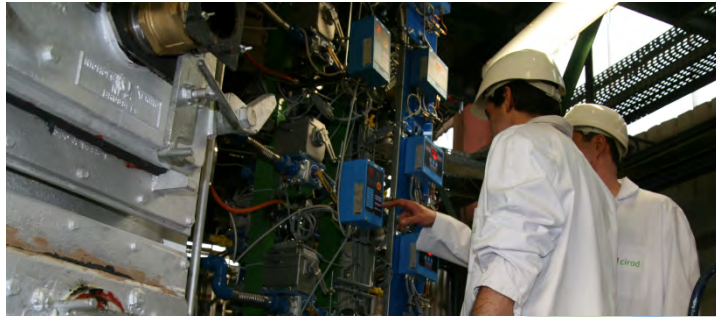
- Modular system with a capacity of 7,000 ton/year output for each line, scaling up by adding more lines
- Low transport cost of the raw biomass, torrefaction system can be placed near the biomass source
- System suitable for a wide variety of biomass sources





Nesa

(<http://www.cmigroupe.com/en/p/sustainable-development>)



Since 2009, Extensive RD program in Partnership with CEA and Cirad to industrialize the most promising technology in line with the market expectations

River Basin Energy

- Founded in 2008 to develop advanced fuels for coal power stations.
- Commercialising biomass fuel production globally to replace coal with bio-coal in thermal power stations as well as supplying high quality coal fuels upgraded from low-rank coal reserves.
- A leading supplier of enhanced fuels for existing thermal power plants in regions where asset utilisation and a low carbon footprint are of importance to utilities and generators.
- Liberates biomass fuel supply for coal power assets through application of unique and efficient upgrading technology.
- Provides the most effective solutions to decarbonize existing coal burning utilities, while keeping operational cost and generation performance at current levels without the need for significant capital spending.
- Bridges the gap between;
 - The capability of forest owners and coal miners who supply feedstock with complex sourcing and quality attributes; and
 - The need of power generators for standard, reliable and appropriate fuel sources.



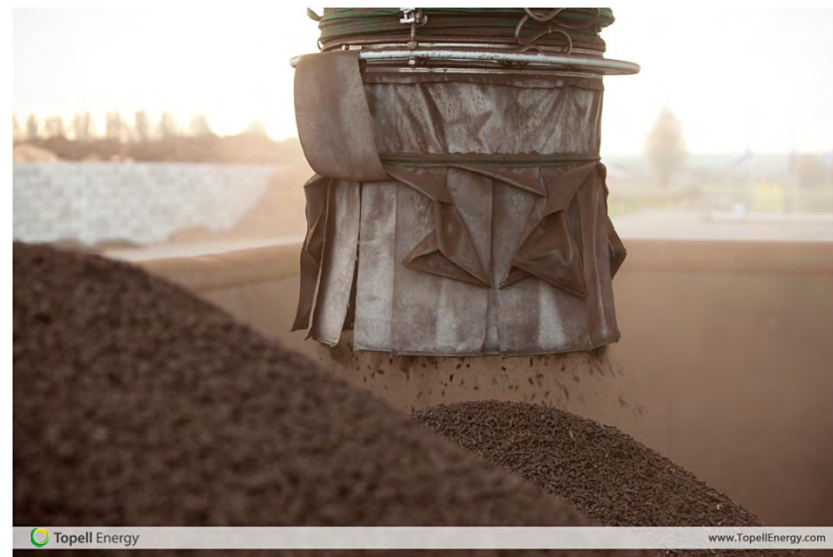
Rotawave Biocoal

- Rotawave Biocoal has developed and patented an innovative microwave assisted torrefaction process to convert biomass into biocoal.
- This Targeted Intelligent Energy System (TIES) ensures consistent product from a wide range of feedstocks.
- Industrial scale pelletisation trials have been successfully completed
- Full scale co-firing trials of our biocoal have shown that coal substitution is possible with out major modification to the coal power station.
- A 100,000 MT/annum TIES is under construction in the USA. A total of 1.7m tonne per annum capacity is planned by 2017.
- The system has a small footprint, and can be easily retrofitted to white pellet plants
- Biocoal has a high energy density and can be stored outside, this means transport and handling costs are significantly reduced.



Topell Energy

- Topell Energy develops and sells torrefaction technology
- Proof of technology with test reactor(2009)
- Built full scale demo plant in Duiven, The Netherlands (2010)
- Start-up Duiven plant and failure to ramp up (2011-2012)
- Re-design Duiven plant (H1 2013)
- Proof of concept at industrial scale, including large scale co-firing test (H2 2013)
- International roll-out of Topell Torrefaction System (2014)



■ Company information.

The Torr-Coal Group was founded in 2005 to develop a torrefaction technology for pure and impure biomass.

In 2010 our own demonstration plant, capacity 30.000 t/y, started the deliveries of Torr@Coal powder and Torr@Coal pellets based on pure biomass.

We are now ready to introduce this technology in the market.

Presently the Group is one of the leading providers of torrefaction technology solutions in the world.



■ Torr-Coal technology.

Torr-Coal Group has developed a partly patented, continuous torrefaction process, from different types of raw material till the end product. The process centres around a rotary drum reactor with a state of the art process control system.

The technology allows us to produce a highly consistent, stable product with excellent fuel properties.

The own demonstration plant has been intensively in use, since 2.5 years, to produce quantities for large scale co-firing and for gasification. Also the production of test quantities of different raw materials, as well as providing the necessary data to optimize both product quality and the design of our industrial scale production plant.

■ Environment.

Replacing fossil coal by torrefied wood pellets decreases the total CO₂ emissions, decreases the demand of imported energy sources and enhances local economy.

■ Applications.

Torr@Coal bio-fuels are suitable for use:

- in conventional coal fired energy plants
- in gasification units.

Mission

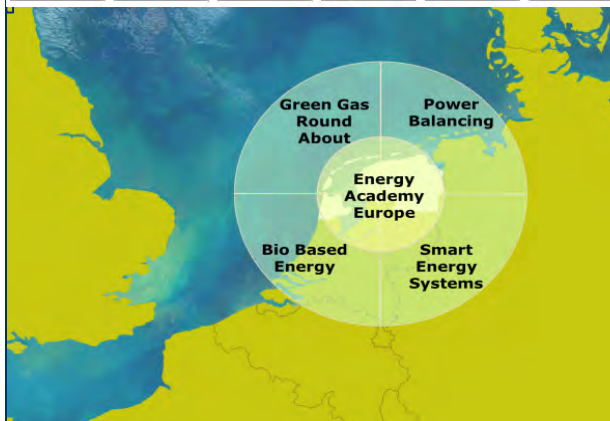
Energy Valley's mission is to encourage, incite, facilitate and connect companies, knowledge institutes and government bodies to develop projects together and make real progress in clean, reliable and innovative energy.

Energy Valley Foundation

The Energy Valley Foundation is a network organisation working together with public and private partners to explore regional growth opportunities in the energy sector. The institute acts as an intermediary to accelerate projects, promote knowledge sharing and strengthen the northern energy region.

The institute is made up of a team of energy professionals who, in consultation with the Supervisory Board and relevant government bodies, support initiative-takers in implementing energy projects. The focus lies on energy innovations which link up directly with national and international energy ambitions and regional strengths.

Strategic Partners



Torrefaction

Torrefaction is one of the key technologies in our future sustainable energy system. Energy Valley supports initiatives that develop and market torrefaction technologies, a.o.:

- Biolake
- Wood Spirit
- Dutch Torrefaction Association

Bio Based Energy

- Innovative conversion technology
 - Energy: Thermo- and biochemical conversion (digestion, torrefaction, pyrolysis, gasification)
 - Green chemistry and bio refinery
 - Feedstock
 - Biomass and waste streams
 - Innovative biomass: aquatic biomass

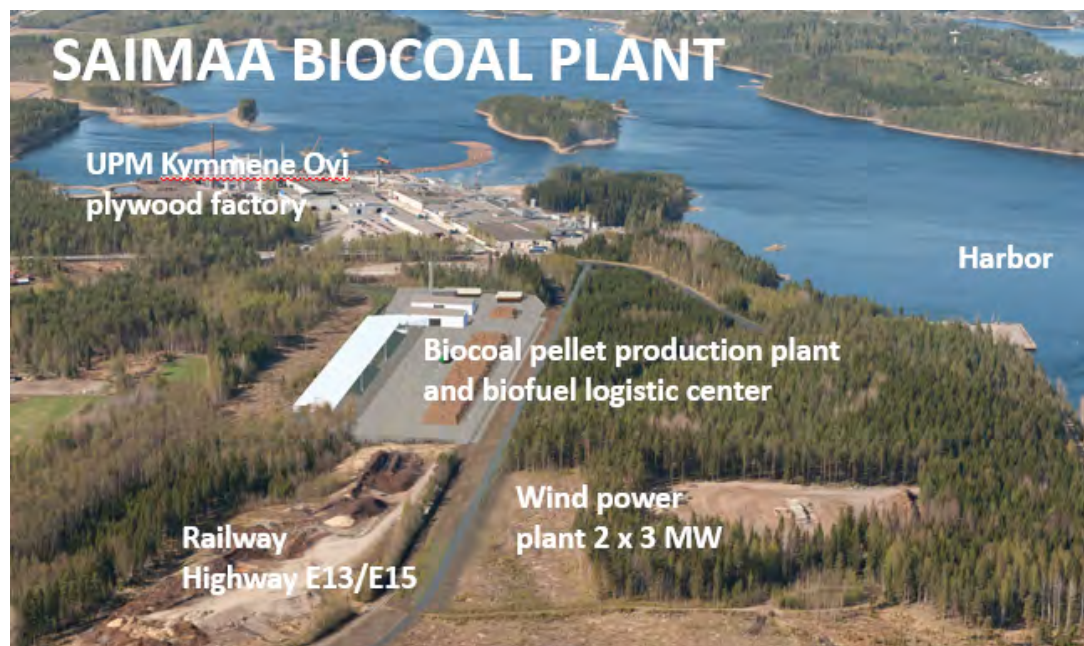
Energy Valley Region

- **Feedstock** is available
 - Biomass: agri and related industries
 - Logistical advantages
- **Technology** is available
 - Knowledge: Universities of Applied Science, University Groningen, Carbo Hydrate Competence Centre
 - Projects in entire innovation chain
- **Application**
 - Chemical industry is present
 - Ambition toward sustainability
- Favourable **Conditions**
 - Stimulation of economic development
 - Sustainability policy
 - Space

DNV GL Energy and upgraded biomass

- We consider ourselves as an independent party to supply investors, suppliers, and end-users with dedicated upgraded biomass technical and business support to integrate upgraded biomass processing technologies (primarily torrefaction and steam explosion) in the biomass supply chain while ensuring the availability, reliability, sustainability and profitability of the generation of electricity and heat
- DNV GL Energy continuously tracks and evaluates the development of torrefaction and steam explosion technologies and commercial parties that bring torrefaction and steam explosion to the next level.
- Our biomass upgrading services include technology verification, technical due diligences, tendering assistance, process and design reviews, co-firing feasibility studies / operational impact studies, guarantee measurements, measurement campaign support, risk assessments

Miktech Ltd.



- Miktech is an innovation and technology center in Mikkeli, eastern Finland. It provides various business development services for technology companies and coordinates diverse projects. Miktech coordinates Biosaimaa cluster that aims at the establishment of a commercial scale (200 000 t/a) biocoal production plant to Ristiina as one of its key projects.
- The construction of a torrefaction technology pilot plant capacity of 10 000 t/a started in Mikkeli in October 2013. It is expected to be in operation in early 2014. The implementation of the pilot plant is carried out by Torrec Ltd., which aims to develop and commercialize torrefied wood pellet production technology.

CPL Industries

CPL has been making coal since the 1940s, with the production of their first Phurnacite plant. But since then, the company has grown to encompass a range of industries, from charcoal and activated carbon, to gardening and renewable energy. Their wealth of industry knowledge, combined with enormous manufacturing capabilities and a team of expert staff has helped to position CPL at the forefront of the European solid fuel industry. They also maintain a successful and growing European export business, exporting over 60,000 tonnes every year into major markets in France, Germany and Ireland.

CPL is focused on the future, with emphasis on developing technologies, notably in the field of torrefaction. Our development of innovation technologies happens through our own research and through partnerships:

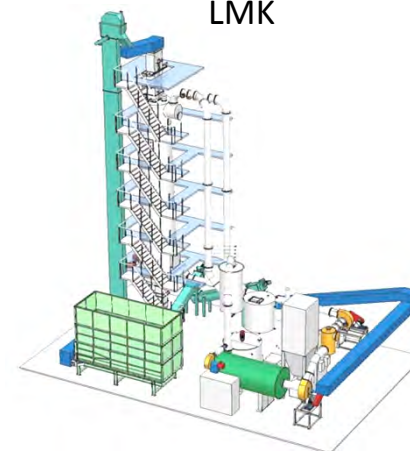
CPL Immingham



Ingelia



LMK



For further information on our plans to develop a pyrolysis plant in Ireland modifying biomass (c 100kt pa) to provide 100% biomass fuels and biomass for blended products see: www.cplindustries.co.uk

Energy Research Centre of the Netherlands

- 20 years experience in biomass co-firing R&D, identified the potential of torrefaction and played a pioneering role in adapting torrefaction to bioenergy applications since 2002
- ECN's torrefaction technology proven on pilot-scale and together with industrial partners now taken to demonstration and commercial market introduction
- Contract R&D for industry to assess the torrefaction potential of specific feedstocks, produce test batches and optimise product quality



BioEndev AB

- BioEndev is an engineering spin-off company originating from R&D at Umeå University, Sweden
- Torrefaction has been the focus area since 2004 and BioEndev was started in 2007
- Since then and utilizing the flexible first pilot plant, BioEndev developed its own proprietary torrefaction technology, subsequently demonstrated in the 2nd generation pilot plant during 2013. The technology is now to be demonstrated in a (24h/7d) industrial demonstration unit (IDU) located in Holmsund, 15 minutes east of Umeå. The plant will be inaugurated this year and brought up to a full capacity of 16 000 t/yr during the autumn 2014



- The innovative (patented) process solutions governs:
 - high product quality (more hydrophobic and durable pellets/briquettes)
 - a cost efficient production
 - low investment costs
 - high product yield
- The BioEndev initiative is carried out in close collaboration with a number of highly qualified and experienced partners, benefitting from the long tradition of biomass handling and conversion experiences in Sweden



Biocoal from straw - supply chains from Ukraine

Unused straw Ukraine > 16 million tons

#bio working with large Agricultural holdings

Our own technological solutions developed in-house

Mobile installations to bring processing onto farms.

We aim to sell finished product in bulk not torrefaction machinery

Completing proof of concept/ first commercial plant for 2014

5 year plan to build in partnership large capacity in Ukraine of ½ million tonnes a year

Good logistical links to

Poland (via rail)

Klaipeda

Black Sea

Danube

All Ukraine (via rail)



Pilot Group Clean Coal

- Torrefaction is meant for producing bio-coal able to substitute fossil coal
 - for biofuel production
 - for power generation in pulverised coal power plant
- Torrefaction is being developed for two key purposes:
 - 1) Get rid of the difficulties of milling fibrous biomass such that coal mills can be used
 - 2) Increasing the energy density of biomass for efficient and economic transport
- But problems !!!
 - 1) Torrefaction increases energy to mass density **but not necessarily** volumetric density
 - 2) So, pelletisation (6x denser) is needed and must be organised in a **continuous process**
 - the torrefied material must be cooled down before pelleting to avoid fire
 - pelletisation do not necessarily deliver high durability pellets because the binder=lignine is eliminated within the torrefaction process
 - Difficult to optimize the production process with a high capacity on a continuous way
 - 3) Torrefied product generate much fine dust that is more explosive than wood dust and the product can also produce self heating that makes transport risky in containers/trains
 - 4) Torrefaction consumes part of the carbon and concentrates the minerals and alkali
- Consequences
 - 1) Most of the process owners are unable to produce adequate product
 - 2) There is a tendency to decrease torrefaction T to keep lignine but then fibrous character is not suppressed and the product is not black but green
 - 3) Ash content increases and alkali concentration can go above technical limits for boilers



Making the product tradeable

Quality – Standardisation



New Work Item ISO 238 WG 2
ISO 17225: Solid biofuels – Fuel
specifications and classes – Part XX:
Graded torrefied pellets

Comments will be collected by
national standardisation
committees

Please address also IBTC with
comments and requirements

Grindability
Water resistance
Energy balance

Property class, Analysis method	Unit	TW1	TW2	TW3
Origin and source, ISO 17225-1		1.1.1 Whole trees without roots 1.1.3 <u>Stemwood</u> 1.1.4 Logging residues 1.2.1 Chemically untreated wood residues *	1.1 Forest, plantation and other virgin wood 1.2 By-products and residues from wood processing industry	1.1 Forest, plantation and other virgin wood 1.2 By-products and residues from wood processing industry
Diameter, D ^a and Length L ^c ISO 17829 According Figure 1	mm	D06, 6 ± 1; 3,15 < L < 40 D08, 8 ± 1; 3,15 < L < 40	D06, 6 ± 1; 3,15 < L < 40 D08, 8 ± 1; 3,15 < L < 40	D06 6 ± 1; 3,15 < L < 40 D08 8 ± 1; 3,15 < L < 40
Moisture, M, EN 14774-1, EN 14774-2	as received, w-% wet basis	M10 ≤ 10	M10 ≤ 10	M10 ≤ 10
Ash, A, ISO 18122	w-% dry	A2.0 ≤ 2,0	A5.0 ≤ 5,0	A10.0 ≤ 10,0
Mechanical durability, DU, ISO 17831-1	as received, w-%	DU97.5 ≥ 97,5	DU96.5 ≥ 96,5	DU96.5 ≥ 96,5
Fines, F ^a , ISOWD XXXXX (hand sieving)	w-% as received	F1.0 ≤ 1,0	F1.0 ≤ 1,0	F1.0 ≤ 1,0
Additives *	w-% dry	Type and amount to be stated	Type and amount to be stated	Type and amount to be stated
Net calorific value, Q, ISO 18125	dry, MJ/kg or kWh/kg	Q20, Q ≥ 20 Q5.6, Q ≥ 5,6 Value to be stated	Q20, Q ≥ 20 Q5.6, Q ≥ 5,6 Value to be stated	Q19, Q ≥ 19 Q5.3, Q ≥ 5,3 Value to be stated
Bulk density, BD, ISO 17828	kg/m ³	BD650 ≥ 650 Value to be stated	BD650 ≥ 650 Value to be stated	BD650 ≥ 650 Value to be stated
Nitrogen, N, ISO 16948	w-% dry	N0.5 ≤ 0,5	N0.5 ≤ 0,5	N1.0 ≤ 1,0
Sulphur, S, ISO 16994	w-% dry	S0.3 ≤ 0,3	S0.3 ≤ 0,3	S0.5 ≤ 0,5
Chlorine, Cl, ISO 16994	w-% dry	Cl0.03 ≤ 0,03	Cl0.05 ≤ 0,05	Cl0.1 ≤ 0,1
Arsenic, As, ISO 16968	mg/kg dry	≤ 2	≤ 2	≤ 2
Cadmium, Cd, ISO 16968	mg/kg dry	≤ 1	≤ 1	≤ 1
Chromium, Cr, ISO 16968	mg/kg dry	≤ 15	≤ 15	≤ 15
Copper, Cu, ISO 16968	mg/kg dry	≤ 20	≤ 20	≤ 20
Lead, <u>Pb</u> , ISO 16968	mg/kg dry	≤ 10	≤ 10	≤ 10
Nickel, Ni, ISO 16968	mg/kg dry	≤ 10	≤ 10	≤ 10
Zinc, Zn, ISO 16968	mg/kg dry	≤ 200	≤ 200	≤ 200
Volatile matter, VN	w-% dry, ash free	VN ≤ 75 Value to be stated	VN ≤ 75 Value to be stated	VN ≤ 75 Value to be stated
Ash melting behaviour ^f , CEN/TS 15370-1 ^[4]	°C	To be stated	To be stated	To be stated

Documentation, Permissions and Registrations

W&P

MSDS

REACH

Customs CODE EU

IMO, IMSBC code

Department of Homeland Security/US Coast Guard 3 years permit

To develop/receive this extensive tests have been carried out:
Results all equal or superior to wood pellets

MATERIAL SAFETY DATA SHEET

Presented to U.S. OSHA, OMA, AMS, Canada (RMR) Standards, Australian WorkSafe, Japanese Industrial Standard JIS Z 7202:2000, and European Directives

1. PRODUCT IDENTIFICATION

TRADE NAME (AS LABELED): Torrefied Wood (BioCoal)
PRODUCT USE: Torrefied wood is wood that has been roasted. The torrefaction process causes the wood to (1) have increased energy density; (2) have characteristics that make it easy to handle and transport; and (3) be practical to cofire in existing coal plants. These characteristics make it a practical renewable coal substitute.
CHEMICAL SHIPPING NAME/CLASS: Non Regulated
U.N. NUMBER: NA
MANUFACTURER'S NAME: New Biomass Energy LLC
ADDRESS: 252 Hickory Street, PO Box 29, Gultman, MS 39355
EMERGENCY PHONE: (601) 776-3444
BUSINESS PHONE: (601) 776-3444
DATE OF PREPARATION: January 2, 2011
DATE OF REVISION: New

2. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Caution!
Product Description: This product is a black all natural wood chip (solid) with no odor.
Health Hazards: This product does not meet the definition of a hazardous substance or preparation according to EU Regulations. Wood products can produce wood dust which can cause eye, skin and respiratory tract irritation.
Flammability Hazards: Wood is combustible when exposed to heat and flame.
Reactivity Hazards: This product is not reactive.
Environmental Hazards: Release of the product is not expected to cause adverse effects to the aquatic environment.
Emergency Recommendations: Emergency responders must have personal protective equipment and the protection appropriate for the situation to which they are responding.

EU LABELING AND CLASSIFICATION: This product does not meet the definition of a hazardous substance or preparation according to EU Regulations. According to Reach (annex IV) substances which occur in nature, if they are not chemically modified are exempted wood, iron ore, coal etc.

GHS CLASSIFICATIONS: None

SIGNAL WORD: Caution

HAZARD STATEMENT: H315 Causes mild skin irritation
PREVENTION STATEMENT: P303+P361 If skin irritation occurs - Get medical advice/attention
RESPONSE STATEMENT: P303 Wash contaminated clothing before reuse.
P302+P352 IF ON SKIN: Wash with plenty of soap and water.
HEALTH EFFECTS OR RISKS FROM EXPOSURE: ACUTE: INHALATION: High concentrations of wood dust are irritating to the respiratory tract.
SKIN: Contact may cause slight irritation.
EYES: Contact or dust may cause irritation and/or discomfort.
New Biomass Energy LLC Page 1 of 6

MATERIAL SAFETY DATA SHEET

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA) DANGEROUS GOODS REGULATIONS

MATERIAL SAFETY DATA SHEET

INTERNATIONAL MARITIME ORGANIZATION (IMO) DANGEROUS GOODS REGULATIONS

MATERIAL SAFETY DATA SHEET

U.S. COAST GUARD DANGEROUS GOODS REGULATIONS

Water Uptake

ACB - Weather test prelim. results briquettes

Briquette Quality
before and after:

Method:

Briquettes (D=70mm, spruce,
production 10.04)
filled in a box of 1,4 m height
and been stored outside

After 43 days of storage box
has been dismantled and
briquette quality evaluated

Rainfall during storage time:

21 rainfalls have been
documented

3 rainfalls with > 20 mm/m2



Sample 1



Sample 2



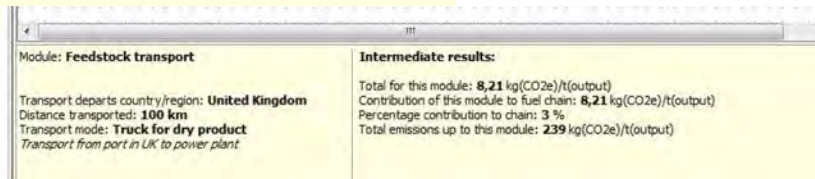
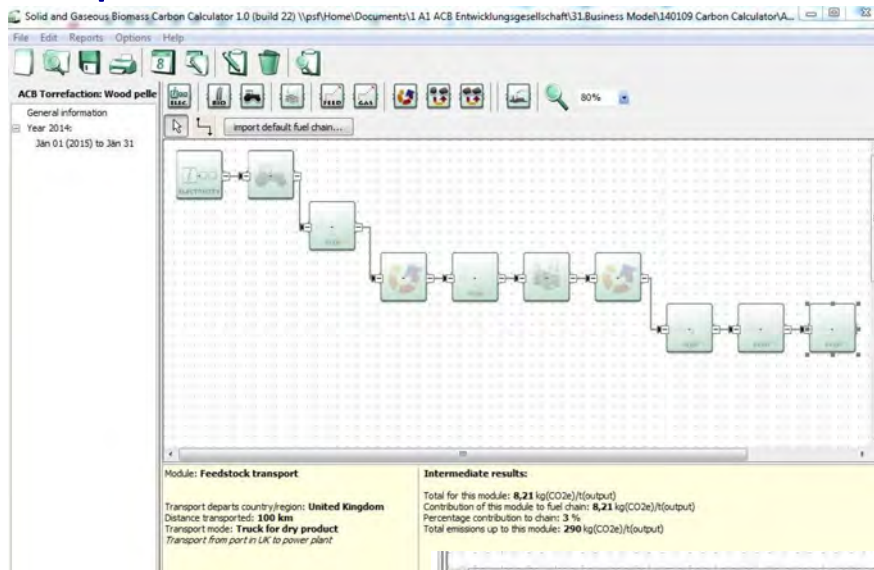
Sample	Diameter [mm]	TG [%]	DS [%]	Water uptake [%]	Durability [%]	Density [kg/dm ³]
Original Sample	71	25	97%	2	96	1,14
Sample 1	71	25	92%	1	84	1,14
Sample 2	71	25	93%	1	91	1,16

CO2 Value Comparison

Comparison of White Wood Pellets with Torrefied Wood Pellets supplied from South East USA to UK

CO2 Emissions along supply chain calculated with OFGEM Solid and Gaseous Carbon Calculator are in the same range and directly comparable on CPT basis

Torrefied vs Wood pellets
 290kgCO₂/t vs 239kgCO₂/t @
 17 vs 21GJ/t
 13,8kg/GJ vs 14,05kg/GJ

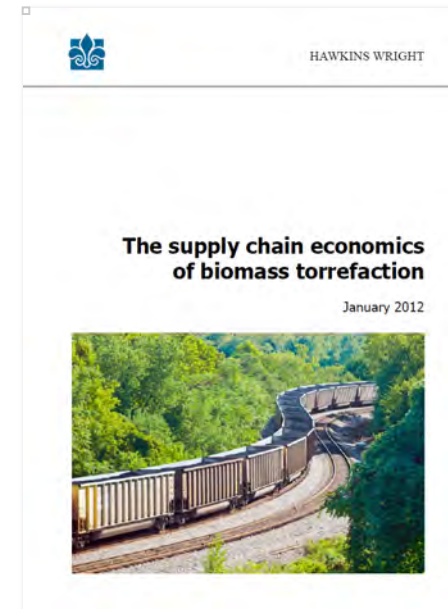
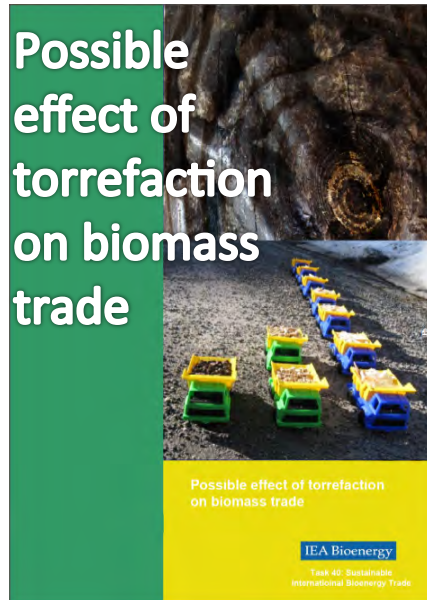


Conclusion

- torrefied biomasses are available to the market and do offer best cost benefit ratio of solid biomasses
- Product quality well defined by ISO standard soon
- Test burns in both power and heat applications will be done extensively in the next 12 month
- 2014 will see first torrefaction lines sold to customers
- ISO standard covering torrefied product will clearly define quality
- „Performers“ in Torrefaction are willing and able to provide technology and product of consistant quality
- Further cost reductions by upgrading of very low cost biomasses

International Biomass Torrefaction Council

<http://www.aebiom.org/blog/ibtc/>



Download from:

<http://www.bioenergytrade.org/>

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Thank you for paying attention

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