WORLD ECONOMIC FORUM

Technology Pioneers

Topell Energy

Graz, January 28th 2011

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TURBULENCE DRIVES HEAT TRANSFER AS REQUIRED FOR TORREFACTION

Highly efficient in realizing fast homogenuous torrefaction at mild temperatures with 10-11 mt/hr systems(further upscaling ongoing)

TopellTorrefactionSystem	How it operates	Advantages
	• High turbulence inside reactor causes intense contact between material and process air • Small bed volumes • No moving parts inside reactor	• Very fast reaction kinetics, very efficient heat/mass transfer, and therefore short throughput times for specific processes • Low pressure drops drive high energy efficiency • Ability to retain wide particle size ranges, no need for precise grading • Technology has been scaled up in a wide variety of applications

From biomass to coal: in 90 million years by nature, in 90 seconds by torrefaction

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TOPELL ENERGY FINALIZING COMMISIONING OF FIRST COMMERCIAL SCALE TORREFACTION PLANT IN DUIVEN

First production per Q1 2011

Key (approximate) figures: 135.000 ton biomass in . 60.000 ton torrefied biomass out . ‘Powers’ 40,000 families

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DUIVEN PLANT IS IN FINAL STAGES OF COMMISSIONING

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PRODUCT QUALITY: KEY PROPERTIES IMPROVE

- **Combustiblity of torrefied product in coal blends improves on:**
  - Ignition temperature
  - Ignitability
  - Flame stability
  - Grinding behaviour

Torrefied products improve the coal blend: better combustion characteristics without performance loss of the coal mill

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- **Densification – some typical characteristics**
  - Fines : < 2%
  - Density : 700 to 750 kg/m3 (optimised per business case)
  - NVC : 20 – 24 MJ/kg (ar)
  - Auto-ignition temperature: > 400 C

Main challenge: large scale open storage and transportation

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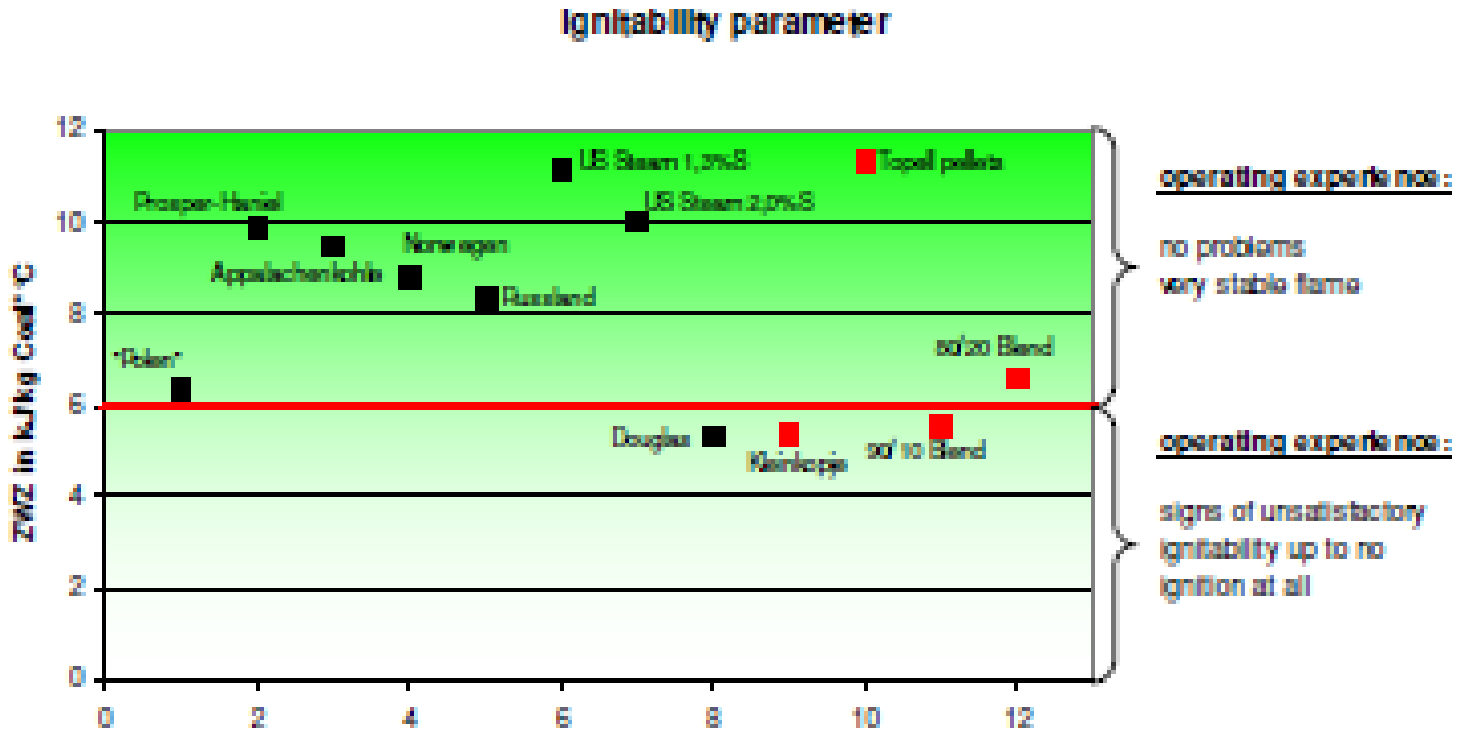
EON TEST TRIALS WITH TOPELL PELLETS ENCOURAGING

Topell pellets outperform coal benchmarks in both combustion and milling



Picture 5 Ignitability parameters (ZWZ) of the coal samples and examples of some other coal types

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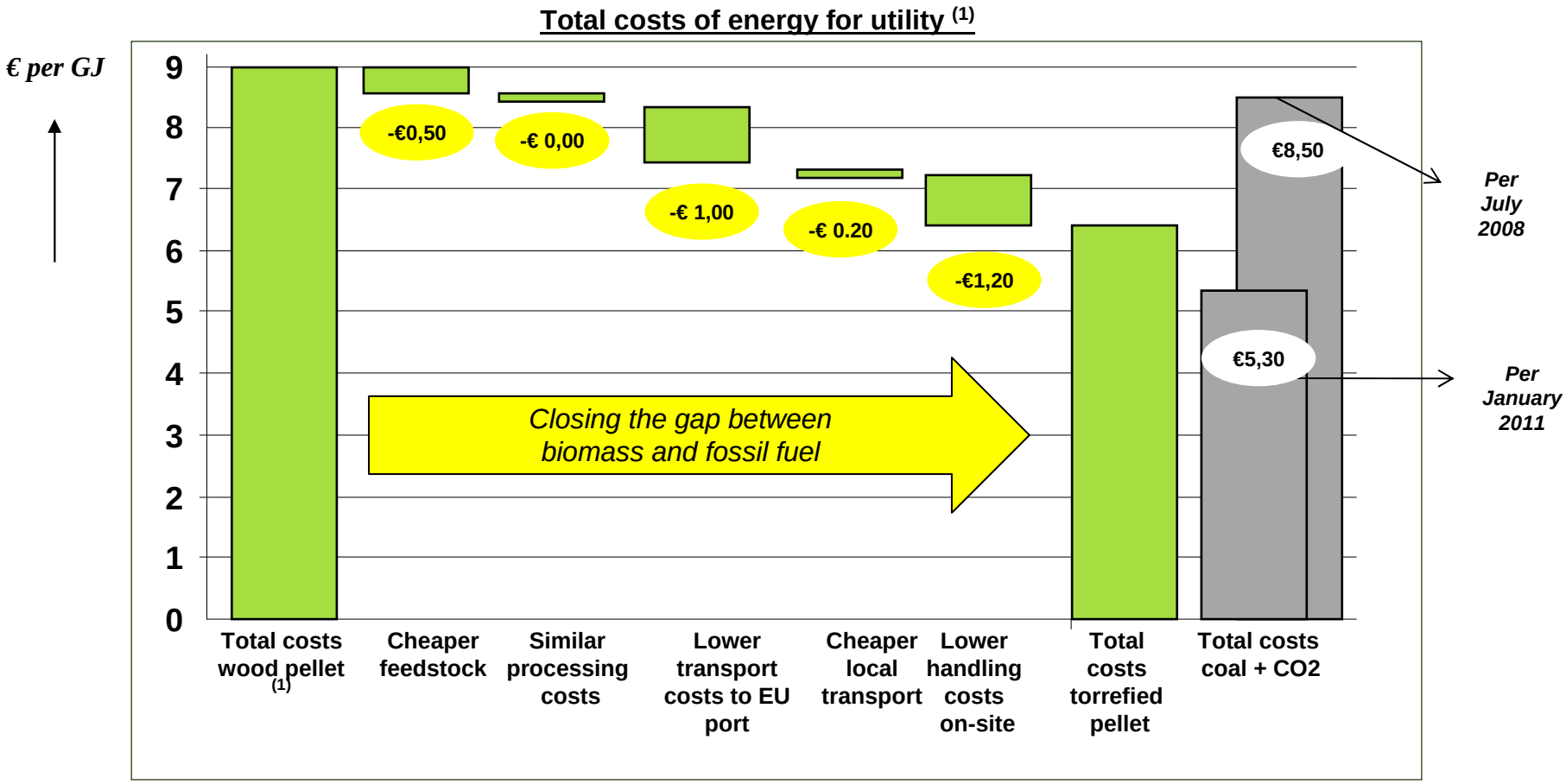
TORREFACTION HAS MAJOR IMPACT ON PRICE COMPETITIVENESS OF BIOMASS VS. FOSSIL FUELS



(1) Total costs woodpellets are €7,8/GJ CIF + €1.2/GJ cash&capital costs for additional infrastructure include landed costs on site and handling costs for power plant

(2) Study Copernicus Institute-Topell; for older coal plants avoided capital and cash cost raise From 1,2 €/GJ to €1,5/GJ

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4. **Torrefaction plant – scope of supply Topell Energy**

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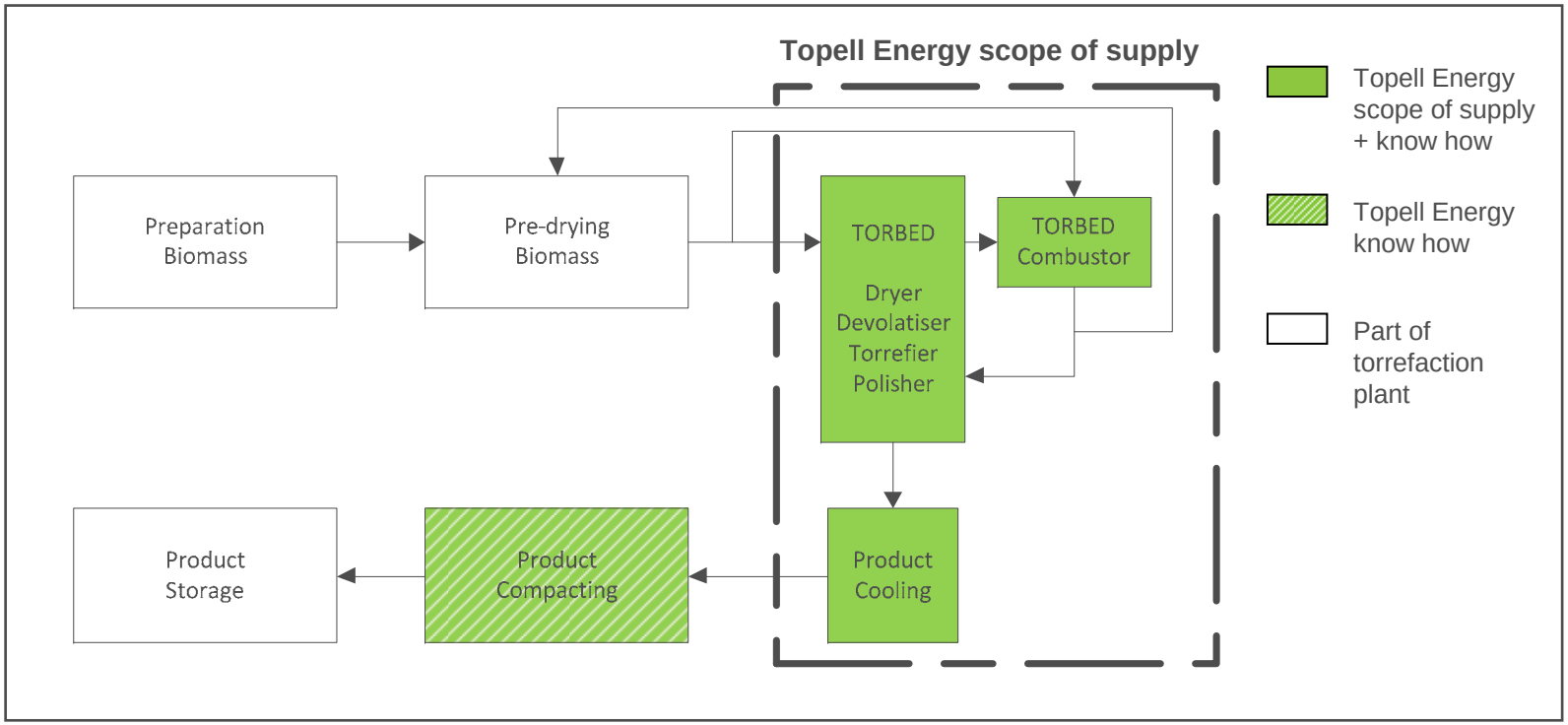
Within torrefaction plant, Topell Energy focus is on torrefaction system and product compacting

Torrefaction plant



Torrefaction system is either part of greenfield (new) plant, or integrated in existing wood pellet plant

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