



Application of torrefaction technology for coal power plants

Workshop “Bioeconomy in the Netherlands”
Tokyo, 4 September 2018

Blackwood
TECHNOLOGY



Koninkrijk der Nederlanden

Blackwood Technology company background

- Blackwood Technology acquired leading torrefaction technology from Topell Energy
- Award winning technology
- Backed by major EU utility companies
- Built and operated commercial demonstration plant in the Netherlands (2010–14). Proved its torrefaction technology at industrial scale
- Successful co-firing tests with utilities in coal fired power plants (2012–17)
- Signed strategic licensing agreement with Eskom for roll-out of torrefaction plants in SADC region



Blackwood's *FlashTor*[®] torrefaction technology

- *FlashTor*[®] is proprietary torrefaction technology turning biomass into a high-grade solid bio-fuel (“bio-coal”)
- *FlashTor*[®] enables large scale replacement of fossil coal by renewable biomass in power generation and steel production
- *FlashTor*[®] is proven and demonstrated at industrial scale
- *Blackwood pellets*[®] have been successfully tested and co-fired by utilities in Europe and South Africa
- *FlashTor*[®] technology is protected by patents



Blackwood's technology was proven in Topell's industrial scale demo plant in Duiven (Netherlands, 2010–14)

Demonstration plant in Duiven (NL)



Key Information

Background

- Built full scale demo plant Duiven (2010)
- Start-up plant, first adjustments and first product shipped (2011–12)
- Re-design of torrefaction system (H1 2013)
- Successful commissioning and ramp-up (H2 2013)
- Proof of concept: industrial scale production and large scale co-firing (2013–14)
- Plant shutdown and mothballed due to ending of Dutch co-firing support (H2 2014)

Key facts

- First commercial scale torrefaction plant
- Input feedstock: forest residues
- 7 t/hr, 24x7, 50,000 ton production capacity

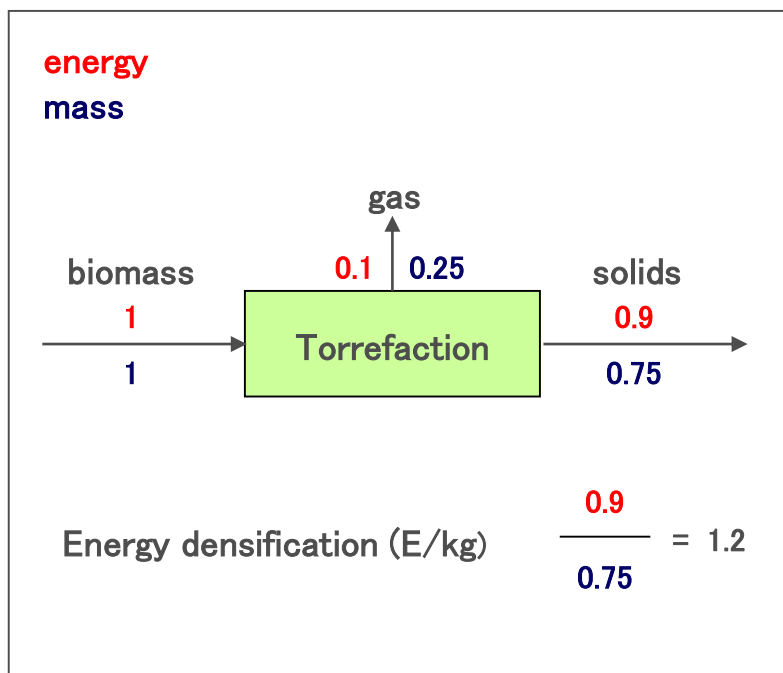
Blackwood pellets[®] have been successfully co-fired in European power stations



- Co-milling and co-firing biomass using existing coal infrastructure
- No adverse effect on handling, milling and combustion
- Benefits from biomass (lower ash, reduced emissions)

Torrefaction transforms biomass into bio-coal

Torrefaction of biomass ...



... makes coal-like, high grade fuel

- High caloric value
- Excellent grindability
- High bulk density
- Hydrophobic nature
- No biological activity



Biomass is heated to between 250 and 300°C in an inert atmosphere

Torrefaction has a positive impact on cost of supply chain



Feedstock/production

- Lower cost biomass from forestry operations
- Alternative feedstocks (agricultural residues)

Transport

- High caloric value results in lower transport cost
- Hydrophobic nature
- No biological activity

Power plant

- Handling, co-milling and co-firing by existing coal infrastructure
- High caloric value – lower de-rating

Torrefaction also reduces CO₂-footprint of supply chain

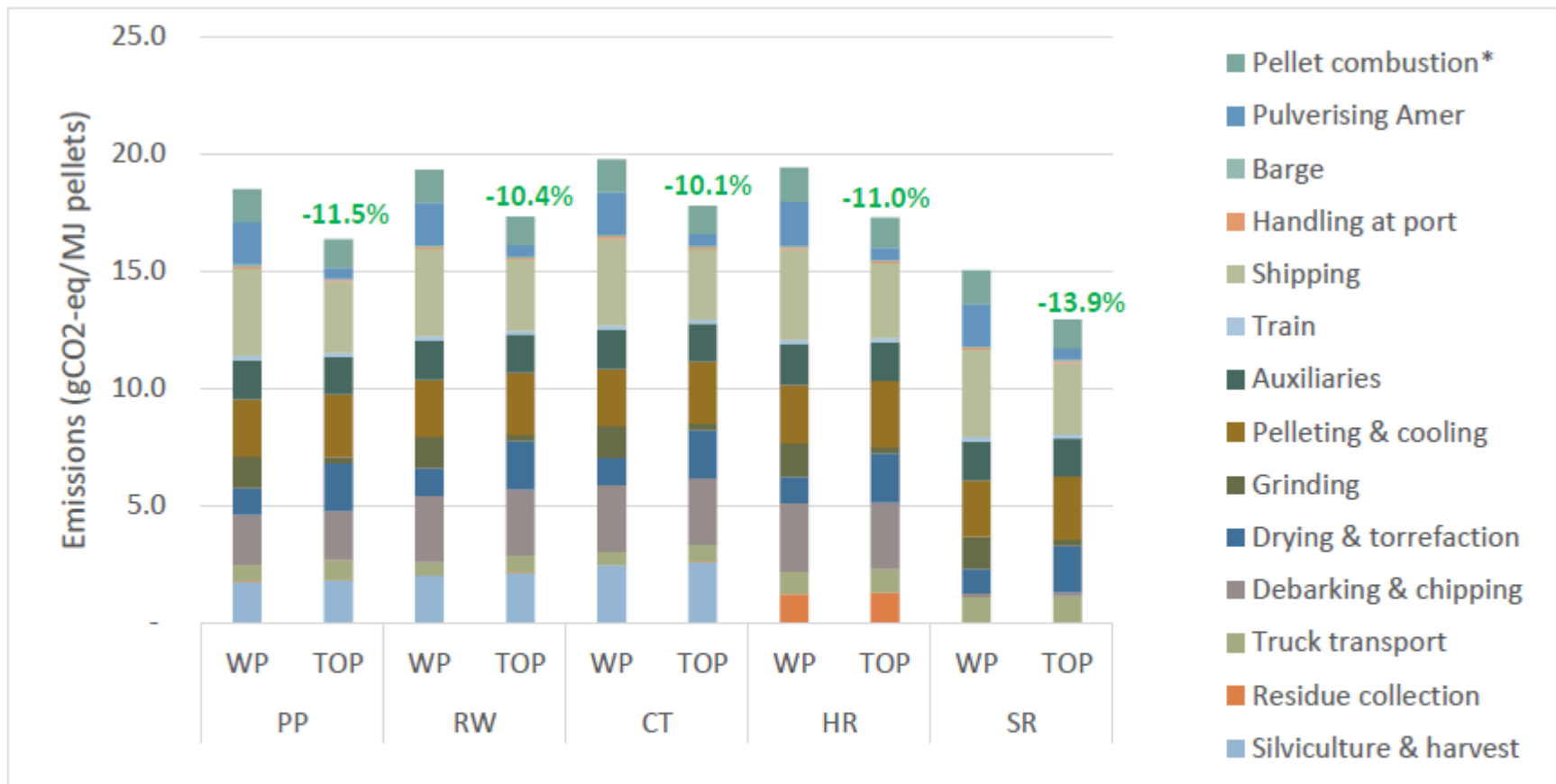


Figure E1. GHG emissions of white- (WP) and torrefied pellet (TOP) scenarios on a pellet energy basis. US Pellet Producer (PP), roundwood (RW), commercial thinnings (CT), harvest residues (HR), sawmill residues (SR). *CO₂ emissions from combustion excluded to account for forest carbon sequestration. Numbers above data columns are percental changes from switching from WP to TOP.

Comparison with wood and steam explosion pellets

	Wood pellets	SE pellets	<i>Blackwood pellets®</i>
Calorific value (NCV a.r.)	17 – 18 MJ/kg	19 – 19.5 MJ/kg	20 – 22 MJ/kg
Grindability	--	+/-	++
Biological activity	Yes	Yes	No
Bulk density (kg/m ³)	600–650	675–725	700–750
Issues	Self-heating	Smell, leachate and no-supply	No-supply
Economics (CIF cost price)	+	-	++

Note: values will depend on feedstock used

Torrefaction unlocks a wide array of feedstocks

Feedstock alternatives: from woody biomass to agro residues



Forest residues



Wood chips

Woody – biomass



Rice hulls



Coconut shells



Straw



Miscanthus

Agro residues



Bagasse



EFB

Can Japanese offtakers benefit from torrefaction?



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Observations

- Limited amount of domestic biomass available
- Dedicated biomass stations (CFB) and PC power plants
- Other countries (will) start biomass co-firing (Korea, India, China)



Japan

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Implications

- Import of biomass using overseas supply chains
- PC power stations need retrofitting or use bio-coal
- Incentive to start using agro-residues which need upgrading

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Torrefaction can play a pivotal role in securing a low cost biomass supply chain while using existing PC power plant infrastructure



THANK YOU

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