



Energy research Centre of the Netherlands

Biomass Pre-treatment by Torrefaction

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Torrefaction

Various definitions

Roasting

High T drying

*Wood
cooking*

?????

Pre Pyrolysis

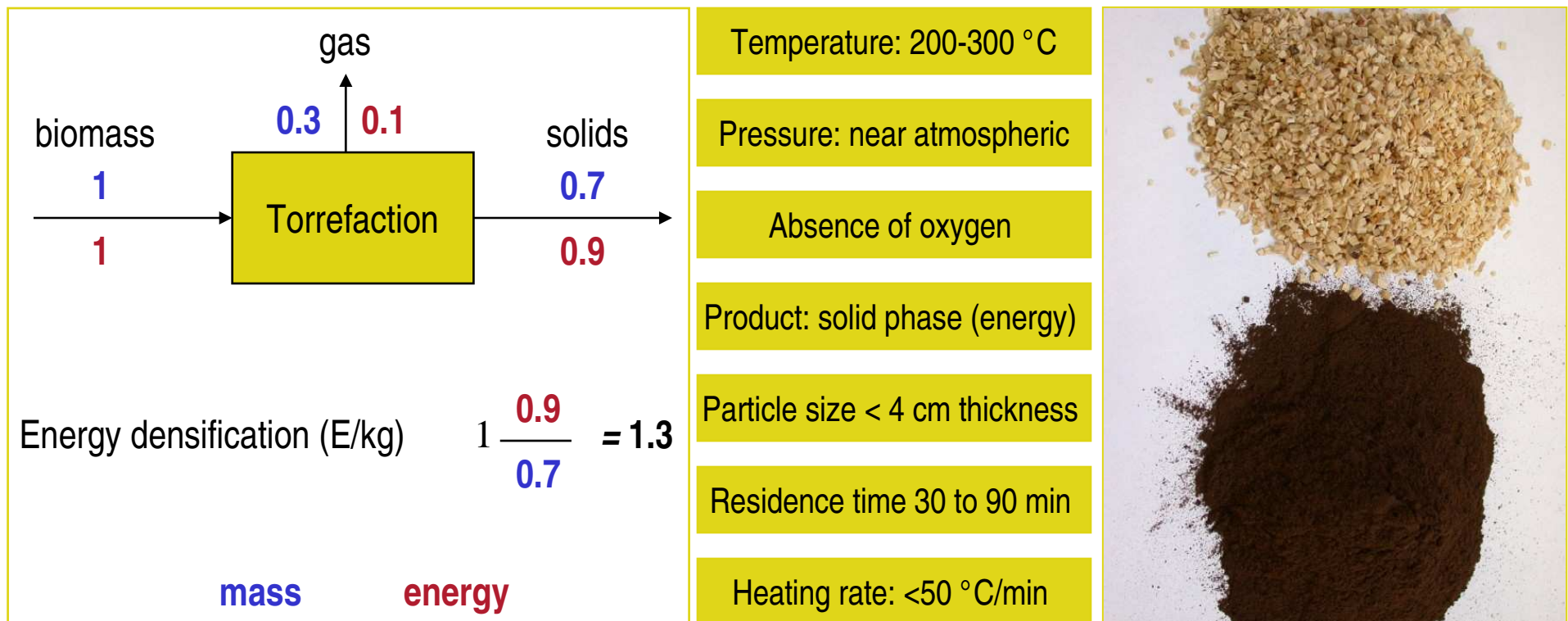
Mild Pyrolysis

mild thermal treatment

Wood browning

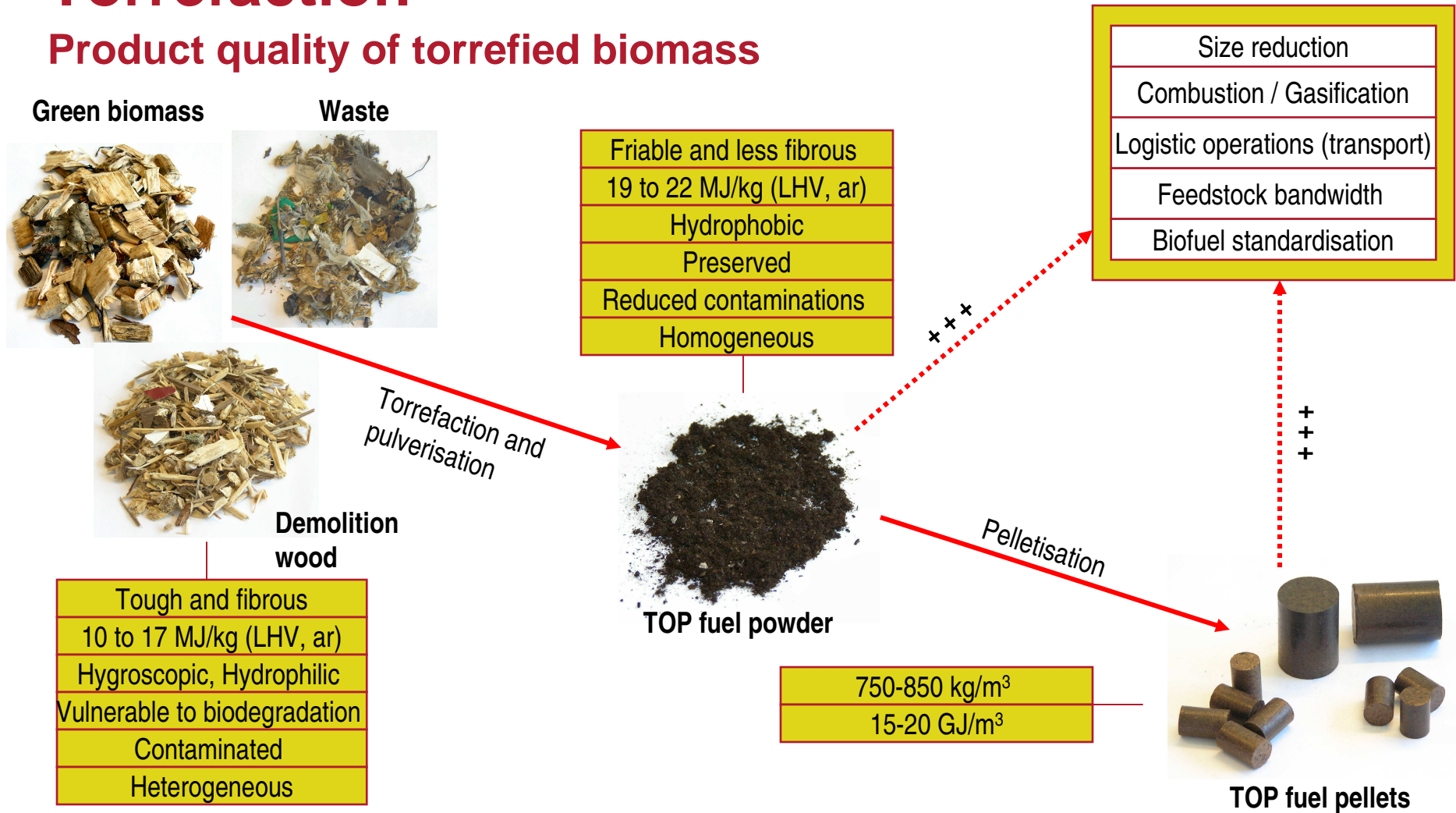
Torrefaction

General process description



Torrefaction

Product quality of torrefied biomass



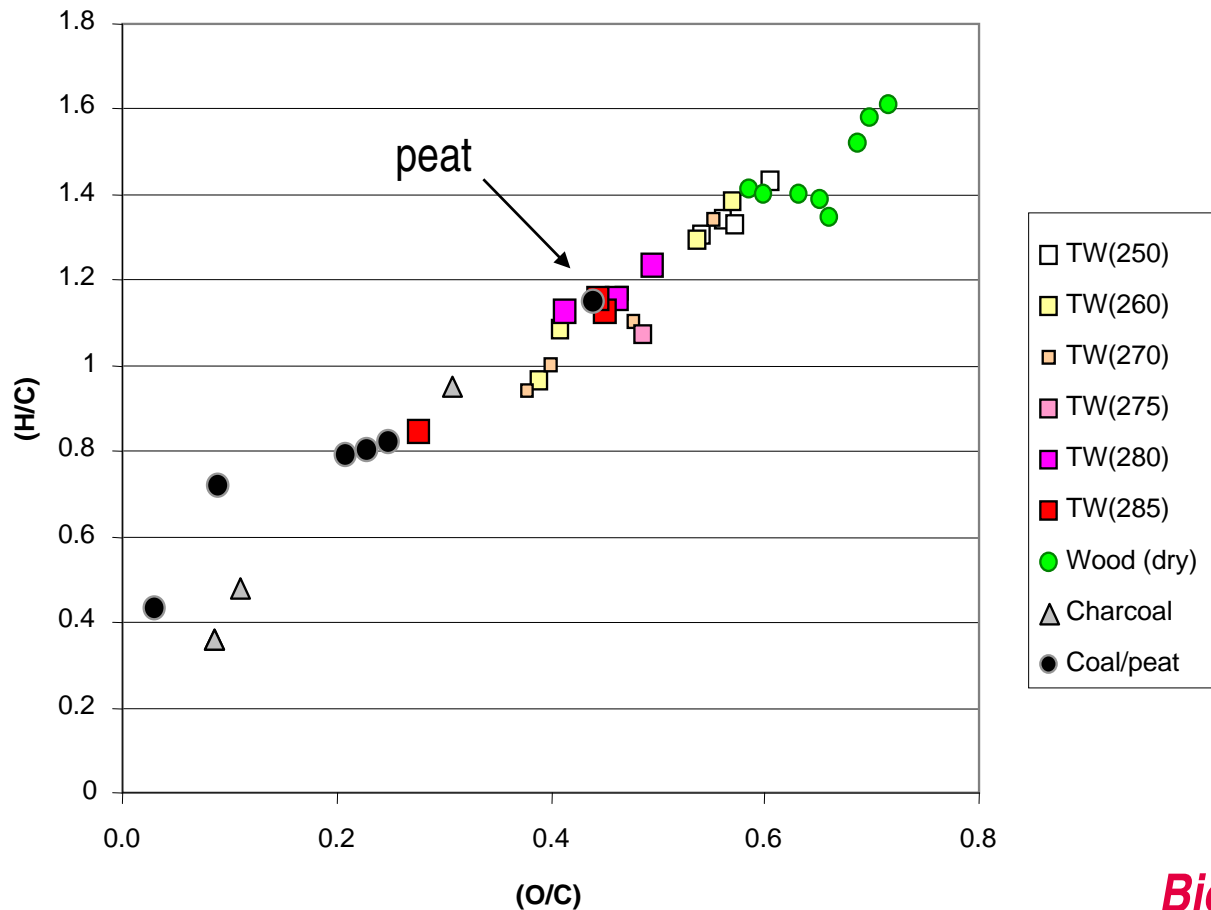
Torrefaction

Comparison of (torrefied) biomass and (TOP) pellets

Properties	unit	Wood	Torrefied biomass	Wood pellets		TOP pellets	
				low	high	low	high
Moisture content	% w.t.	35%	3%	10%	7%	5%	1%
Calorific value (LHV)							
dry	MJ/kg	17.7	20.4	17.7	17.7	20.4	22.7
as received	MJ/kg	10.5	19.9	15.6	16.2	19.9	21.6
mass density (bulk)	kg/m ³	550	230	500	650	750	850
energy density (bulk)	GJ/m ³	5.8	4.6	7.8	10.5	14.9	18.4
Pellet strength		-	-	good		very good	
Dust formation		moderate	high		limited		limited
Hygroscopic nature		water uptake	hydrophobic	swelling / water uptake		poor swelling / hydrophobic	
Biological degradation		Possible	Impossible	Possible		Impossible	
Seasonal influences (noticeable for end-user)		High	Poor	Moderate		Poor	
Handling properties		normal	normal	good		good	

Torrefaction

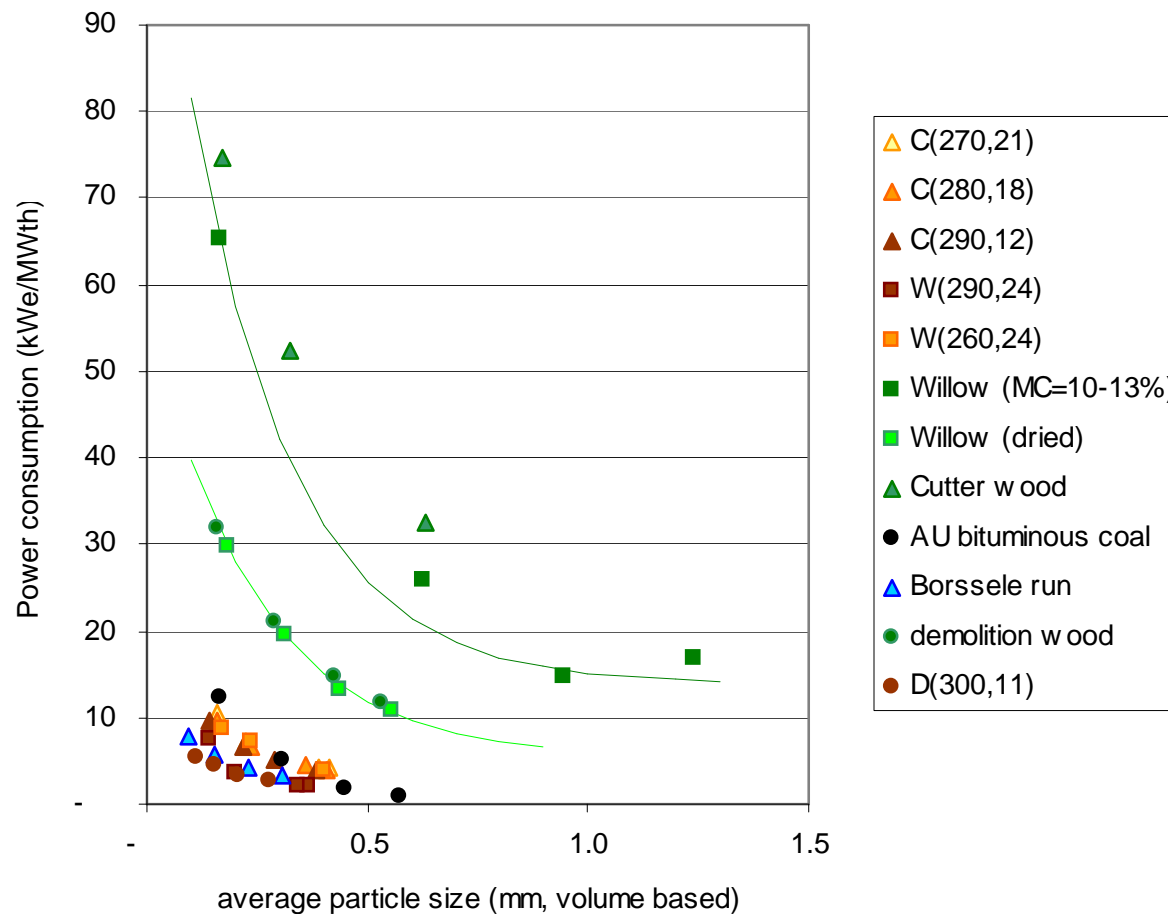
Van Krevelen Diagram



Biomass becomes like peat !

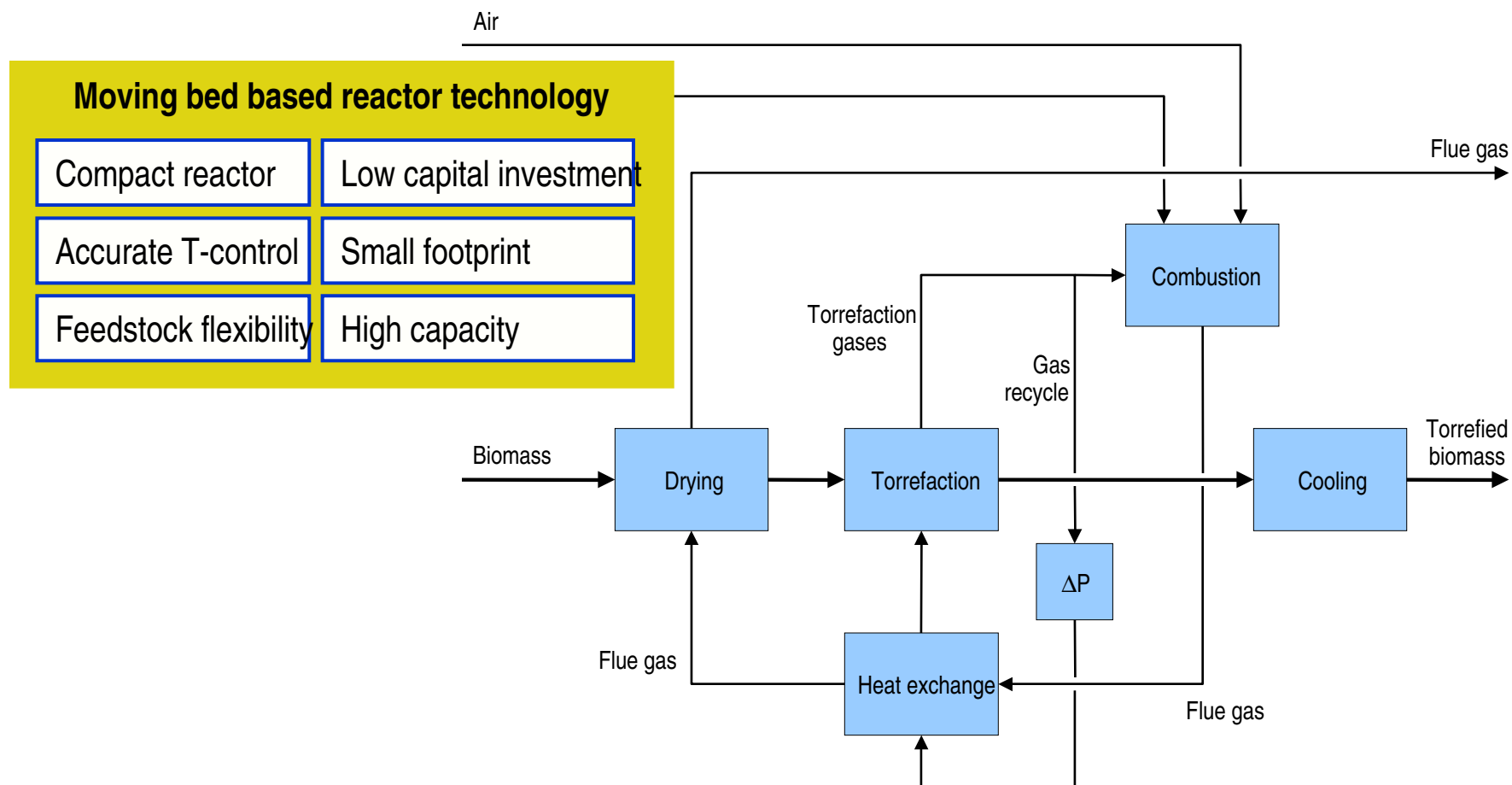
Torrefaction

Grindability improvement (experimental results)



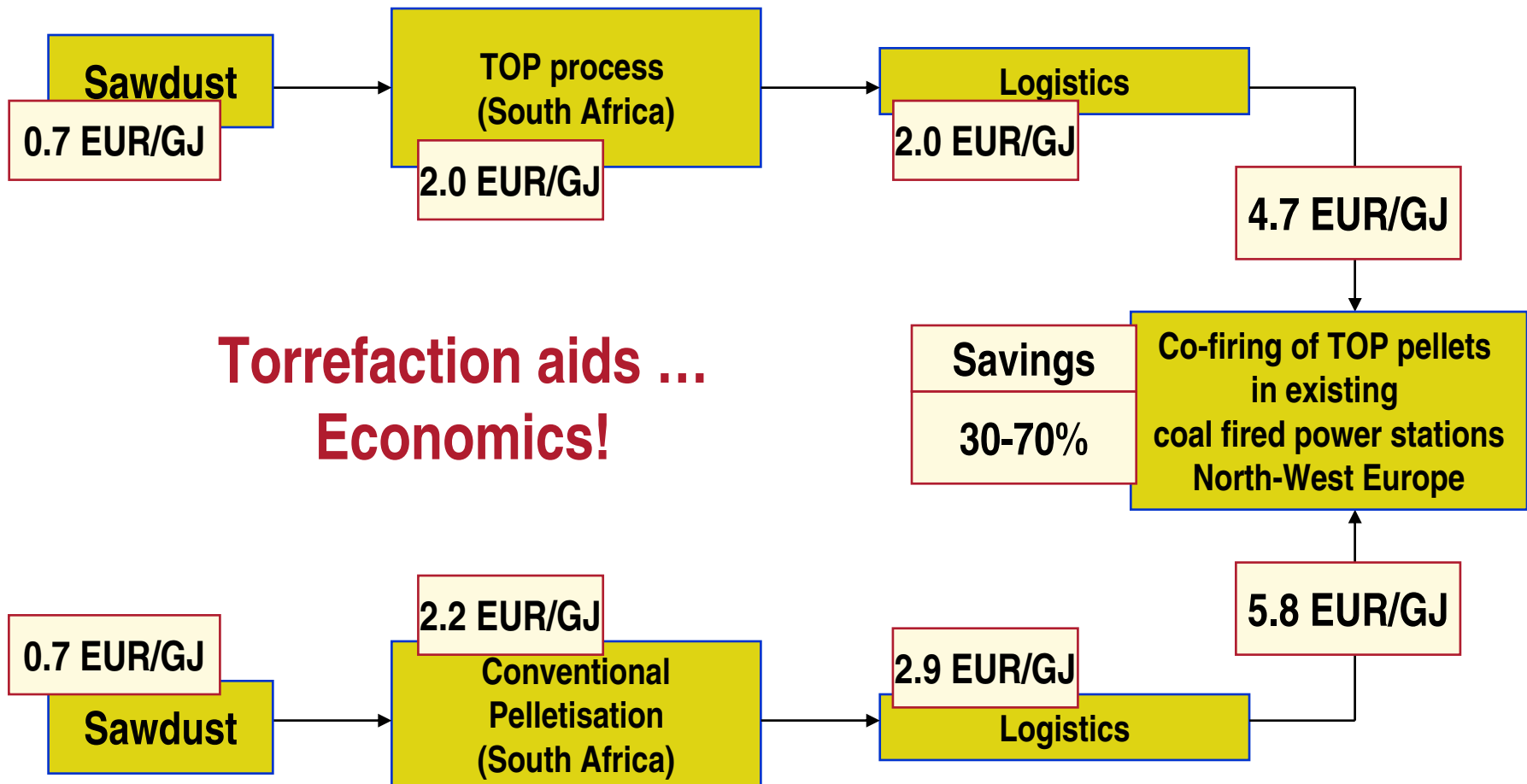
Torrefaction Technology

ECN directly heated torrefaction process



Torrefaction Economics

Change study: TOP pellets vs. conventional pellets



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