Business from technology

Experiences and solutions of biomass and waste co-firing

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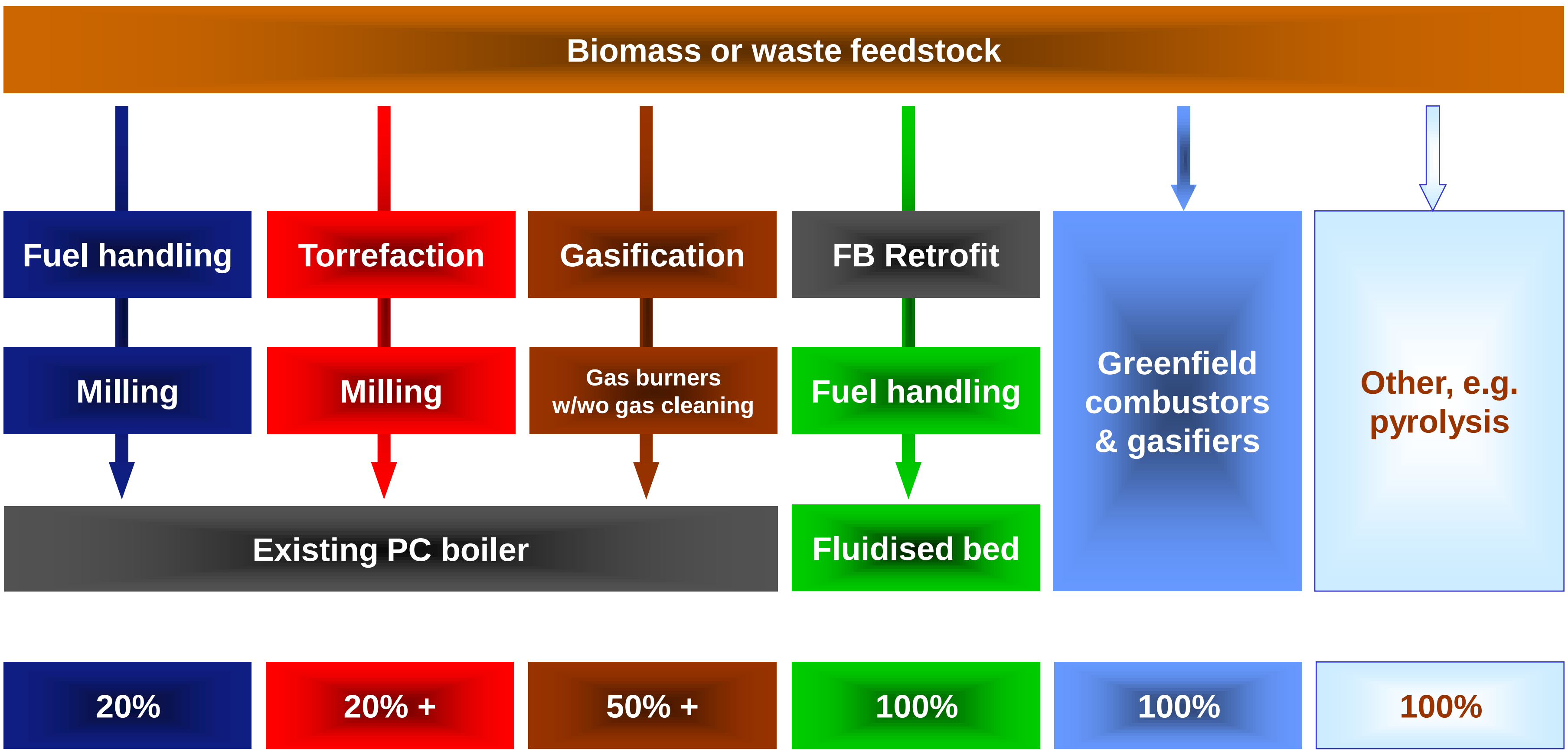
Contents

- Technical options for biomass and waste utilisation in combined heat and power generation
- Examples of
  - recent new units
  - a fuel availability pre-study
- Municipal solid waste - do not overlook it!

Supported by: Developing research and innovation environment in five European regions in the field of sustainable use of biomass resources - BIOCLUS (FP7/245438)

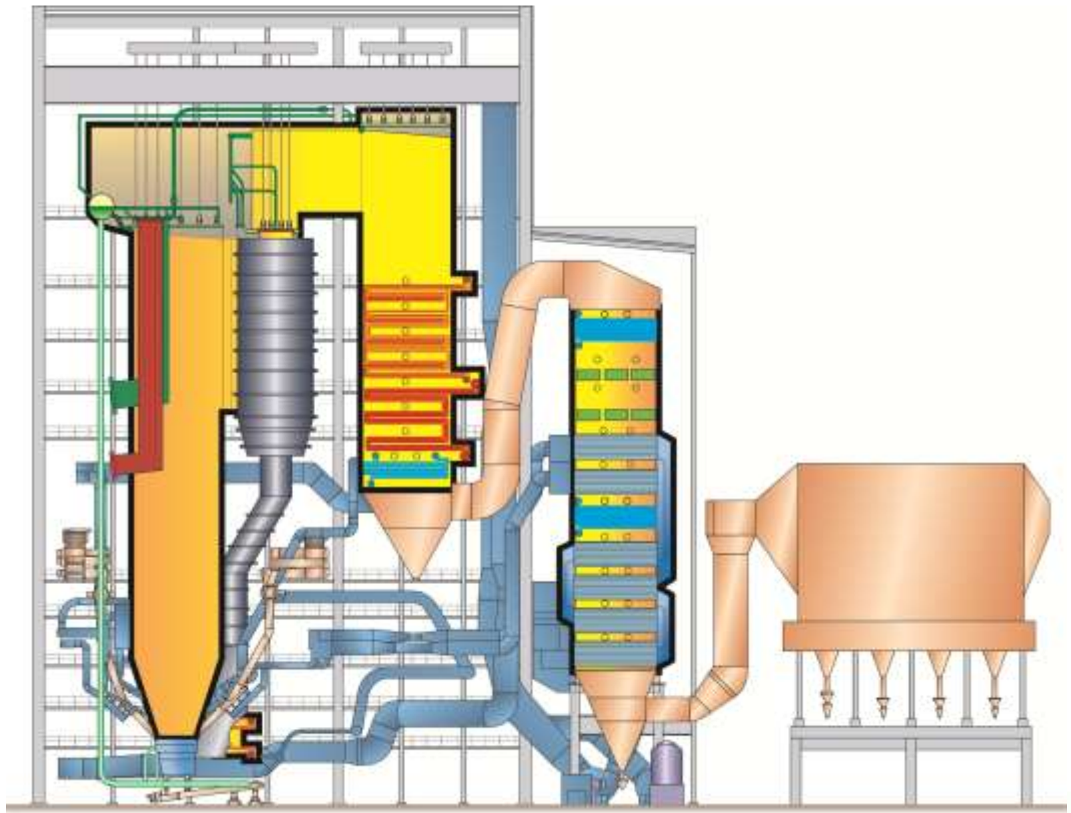
Do I go for a greenfield plant?
Do I take advantage of something existing?
Do I need fuel flexibility?



The World's largest 100% biomass CFB

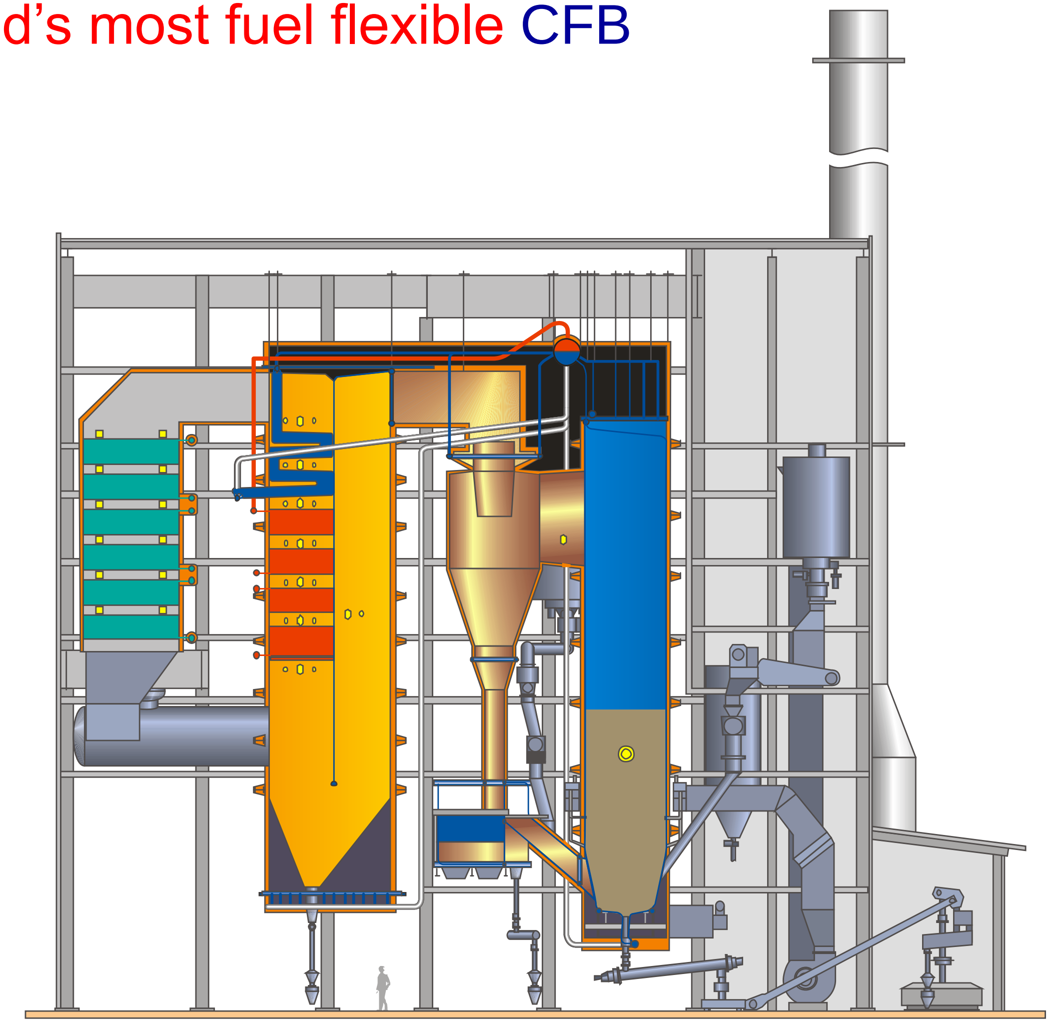
GDF Suez Energia Polska S.A.
Połaniec
Poland

Steam	447 MW_{th} 153/135 kg/s 128/20 bar 535/535 °C
Fuels	
Wood	0 – 100 %
Agro	0 – 20 % straw, sunflower pellets, dried fruit (marc), and palm kernel
Start-up	2012
Cost	240 M€



The World's most fuel flexible CFB

Stora Enso Langerbrugge nv
Gent
Belgium



Steam	125 MW_{th}
	45 kg/s
	60 bar
	475 °C
Fuels	
SRF	0 – 100%
Woody	0 – 100%
	- treated and untreated
Coal	0 – 100%
Sludge	0 – 20%
Start-up	2010
Cost	140 M€

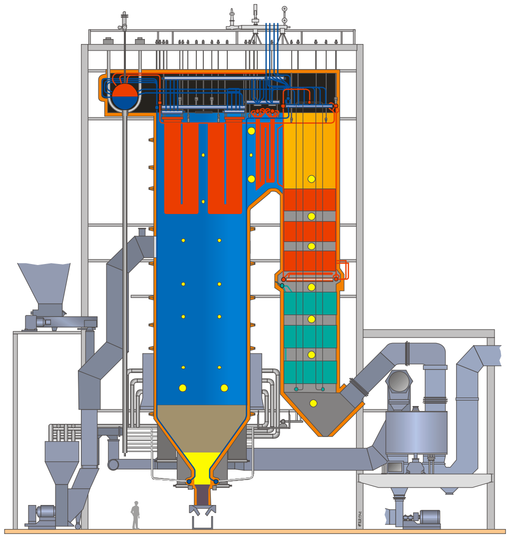
metso power

Retrofit to Bubbling Fluidized Bed (BFB)

Elektrociepłownia Białystok S.A
Białystok
Poland

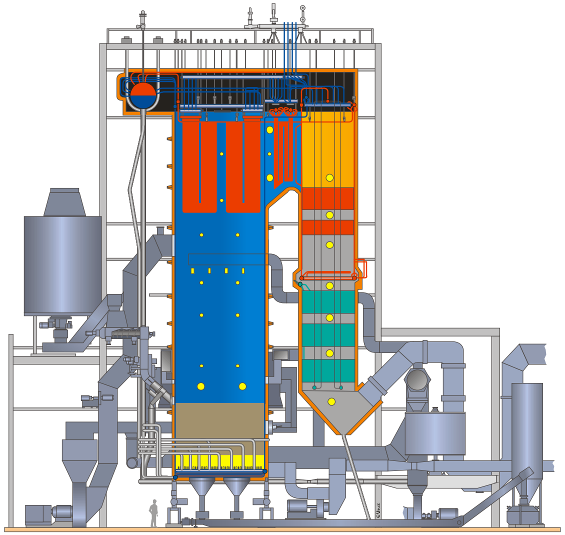
Original

Steam	100 MWth
	39 kg/s
	138 bar
	540 °C
Fuels	Coal
Start-up	1978



Converted

Steam	75 MWth
	29 kg/s
	138 bar
	540 °C
Fuels	Wood chips, forest residue, willow, grain waste, coal
Start-up	2008
Total cost	30M€



Analyses of fuel supply chain – ForPower™ - References
Case Bialystok, POLAND

- The target of the study was a 100 MW CHP plant in North-East Poland aiming to retrofit old coal-fired boiler to biomass boiler applying bubbling FB technology.
- The aim of the study was to evaluate:
  - Availability of forest fuel
  - Possibilities and economy of modern forest fuel harvesting in polish conditions
  - Economy of retrofit for energy production using biomass forest fuels
- Co-operation with Polish forest authorities
- The studied forest fuel materials were:
  - logging residue from final fellings
  - small tree from thinnings

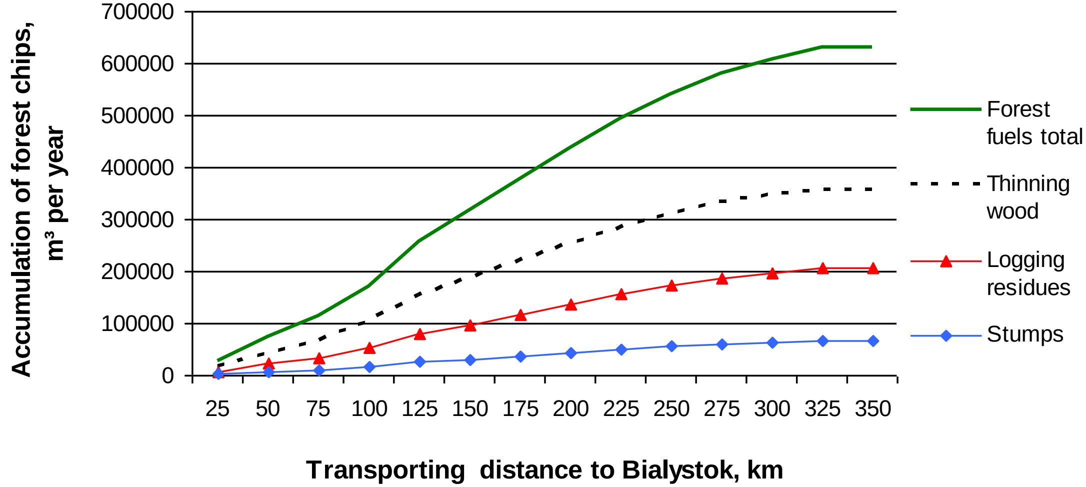
Pictures: VTT

ForPower™ - References
RESULTS: forest fuel availability vs. transportation distance

Accumulation of forest fuel is sufficient

- Total accumulation 631 000 m^3 of forest fuels/year
  - 360 000 m^3 small wood, 200 000 m^3 of logging residues
  - Thinning wood is the most important raw material source

- Long transport distances
  - Realistic maximum transport distance 175 km, --> accumulation total 320 000 m^3 --> sufficient

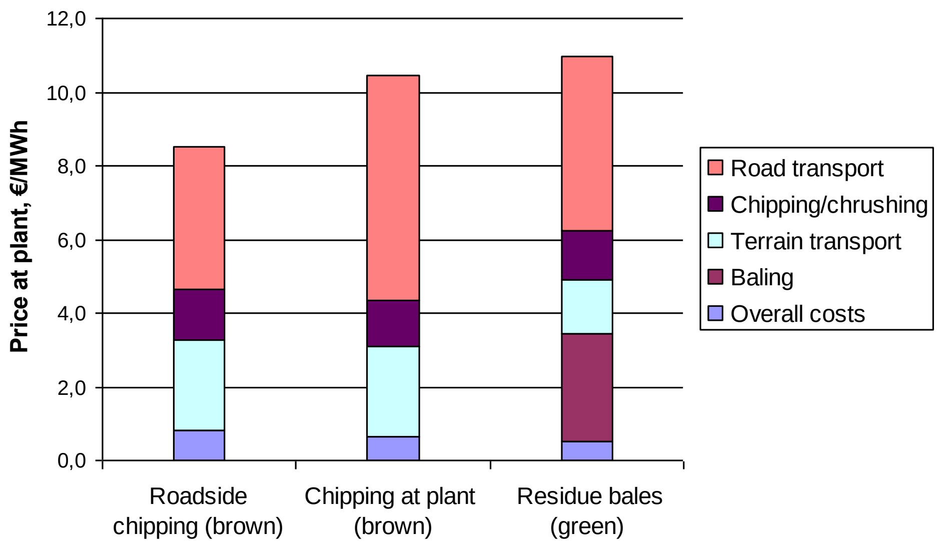


Source: Metla: Asikainen &Laitila 2006

ForPower™ - References
RESULTS: Harvesting costs, logging residues

- Main cost differences built up in road transport, roadside chipping -method most economic
  - Cost at plant 8.8 €/MWh
- With long transport distances (140-200 km) baled residue is more cost efficient than loose
  - Cost 14 -15 €/MWh

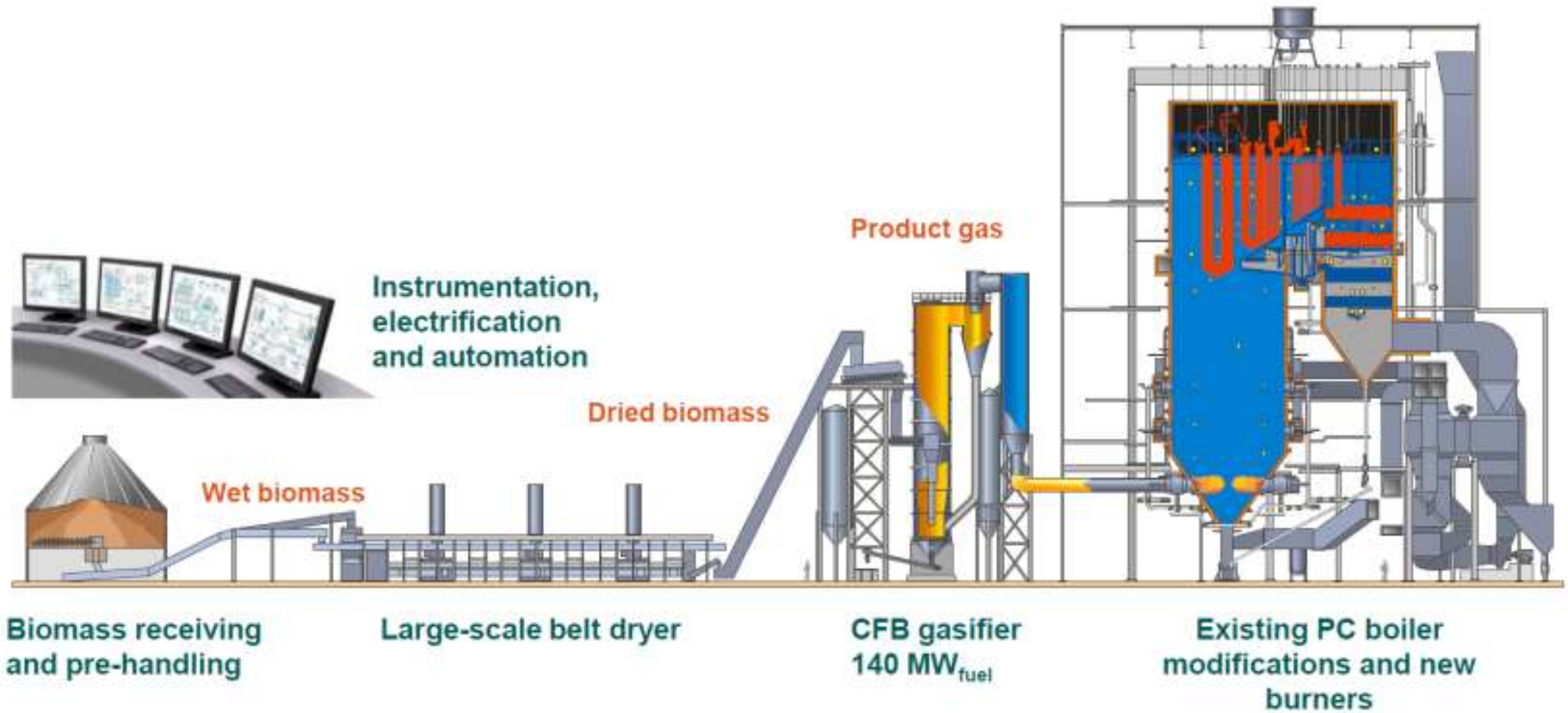
Storage options: No storage (green), 4 month terrain storage (brown). Logging residue accumulation 30 m3/ha (VAT excluded).



Logging residue harvesting costs with 80 km transport distance

Source: VTT: Virkkunen & Leinonen 2006

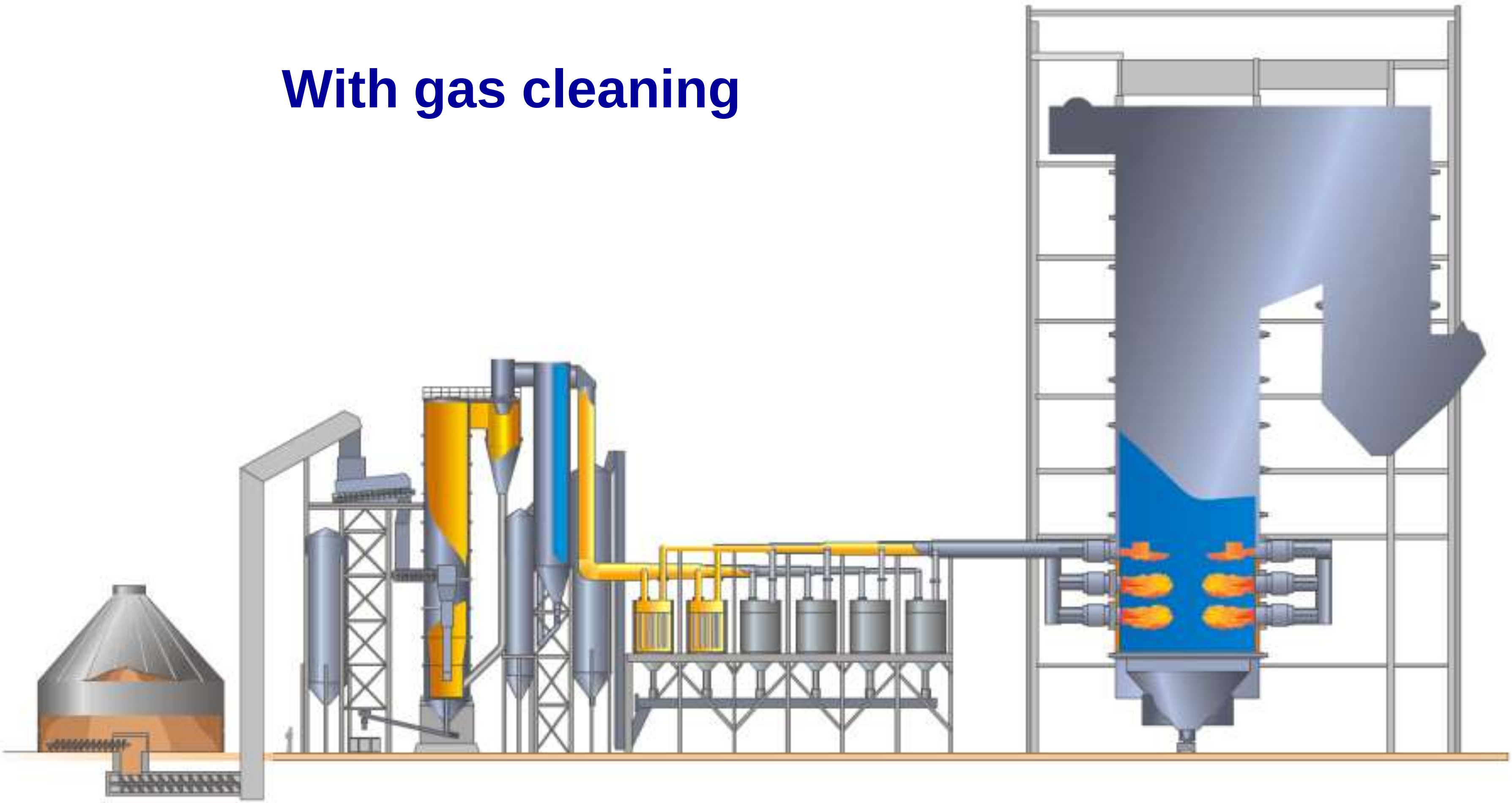
Gasification gas co-combustion in a pulverised coal boiler



Vaskiluodon Voima, Vaasa, Finland

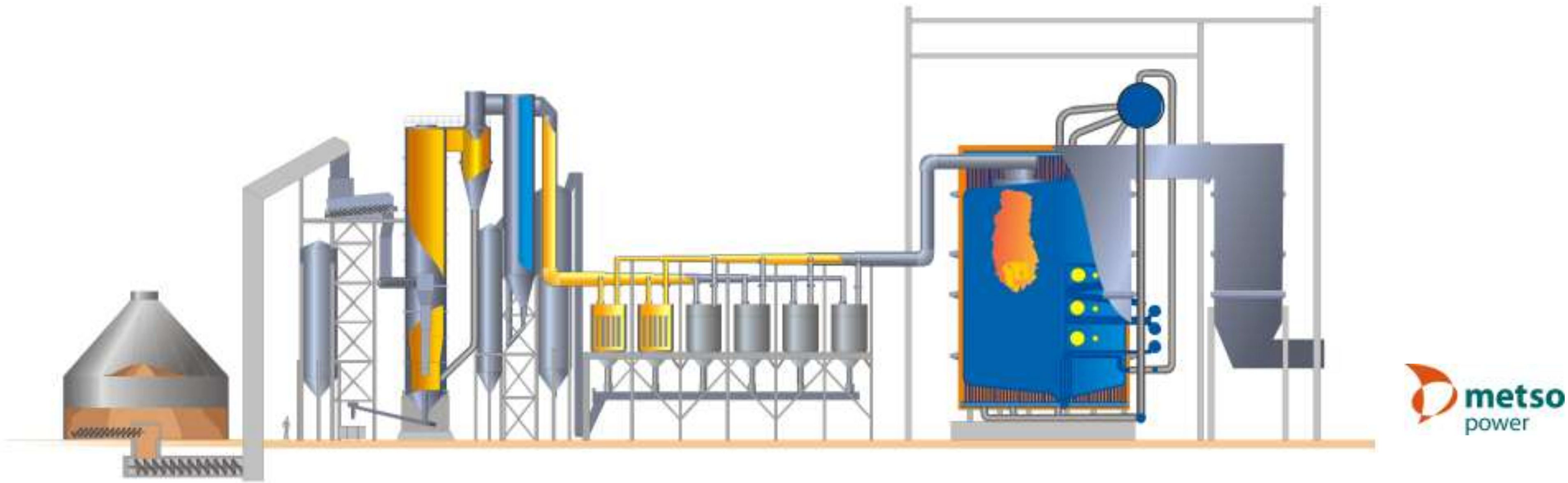
- 565MW Vaskiluoto 2 coal-fired plant generates electricity and provides district heating to the local community.
- The 140MW gasifier will produce gas from wood as the primary fuel, which will largely comprise of forest residue. It can also use agro-biomass, peat and other fossil fuels.
- A €40m project, operational in December 2012
- Replacement of 25-40% from the coal.
- The project involves construction of a fuel handling area, a drying plant and a circulating fluidised bed gasifier. Also modification of the existing coal boiler and automation.
- Feedstock drying process
- Fuel flexible

With gas cleaning



Waste gasification

- Waste gasification, Lahti II



- 200 000 t/a
- 80 MW_{fuel}
- 540°C, 140 bar

- 24 m€ LahtiStreams EU project http://www.lahtistreams.com/
- 157 M€

ADVANCED WtE TECHNOLOGIES

Seminar on 8-9 May 2012 in Lahti, Finland

Registration (until 30.4.2012) and more information at *www.lahtistreams.com*

The seminar will focus on new and advanced industrial scale technologies designed particularly for efficient energy utilisation of waste. Special attention will be paid to the new gasification based WtE plant of Lahti Energia Oy.

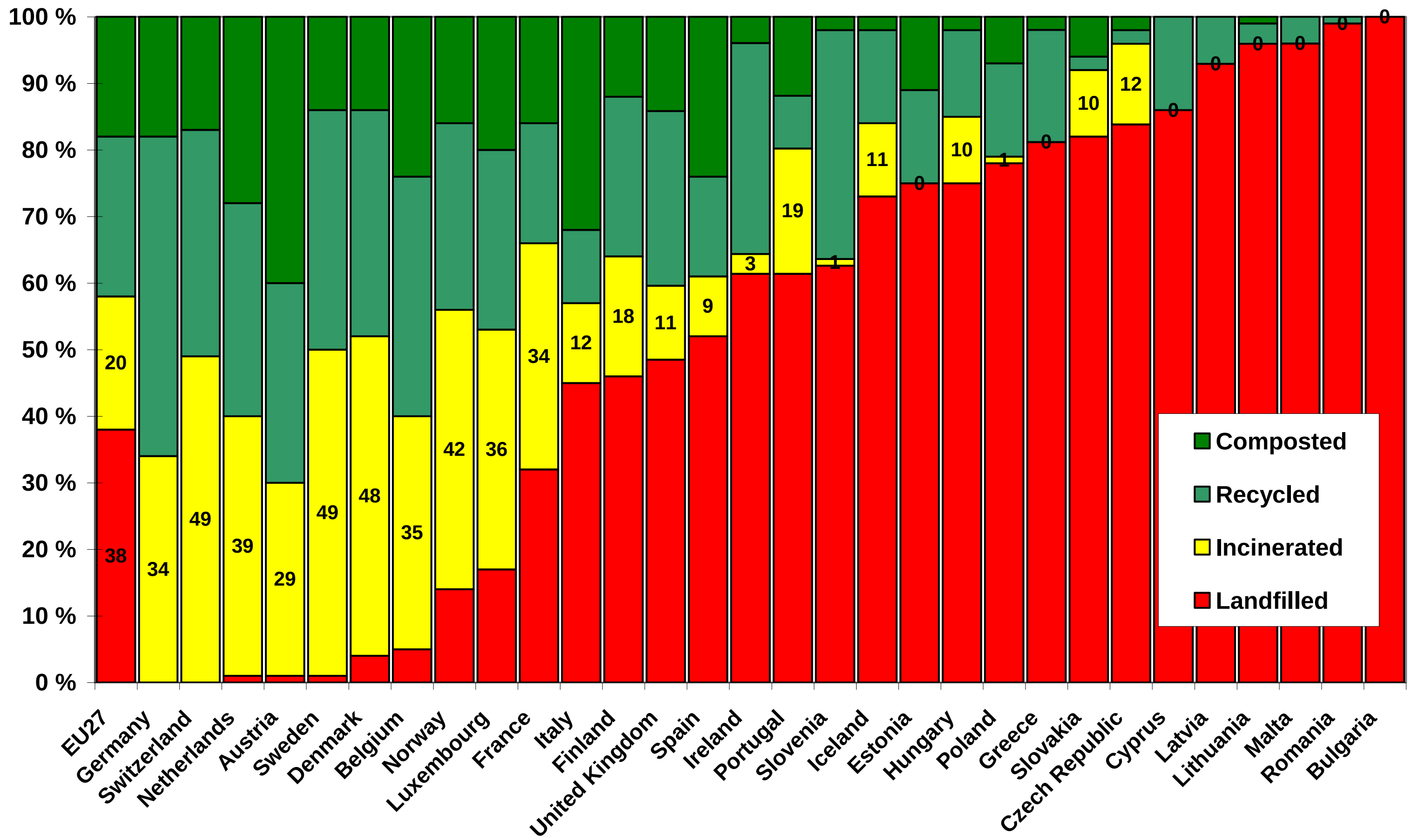
The seminar will be held in the Sibelius Hall in Lahti, Finland. The seminar will be opened at 14.00 on 8 May 2012 and it will continue on 9 May. After the seminar there will be a visit to the new gasification based WtE plant (160 MW_{th}) of Lahti Energia Oy.

Organised by *Lahti Energia Oy* and *VTT Technical Research Centre of Finland* together with the European Commission funded *LahtiStreams* Integrated Project.

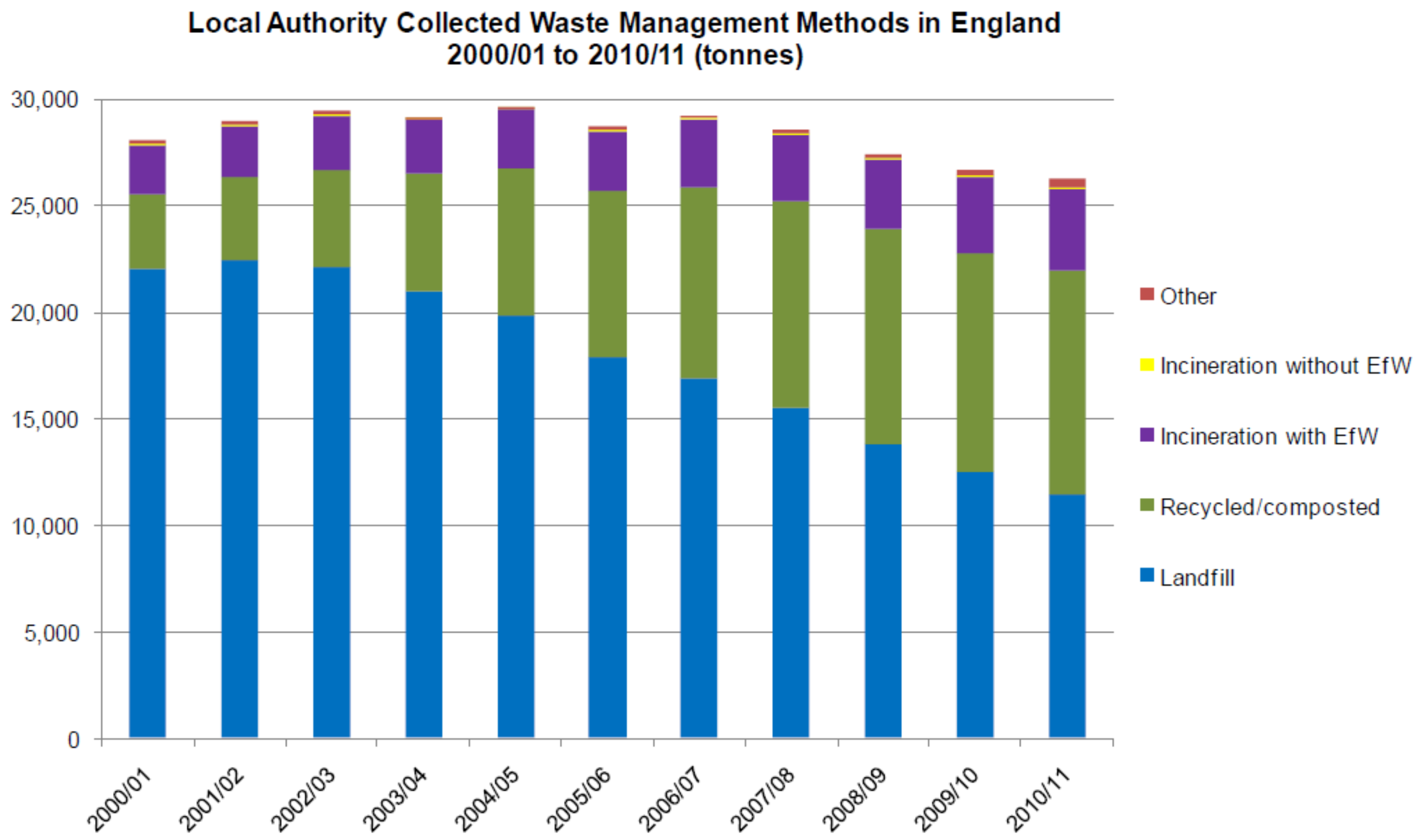
LAHTI ENERGIA VTT

Municipal solid waste treatment, 2009

- 270 Mt, half of its energy is renewable (more than half is biomass by weight)



Implementation – case England = Vision for the rest?



MSW LHV & fraction of biogenic energy

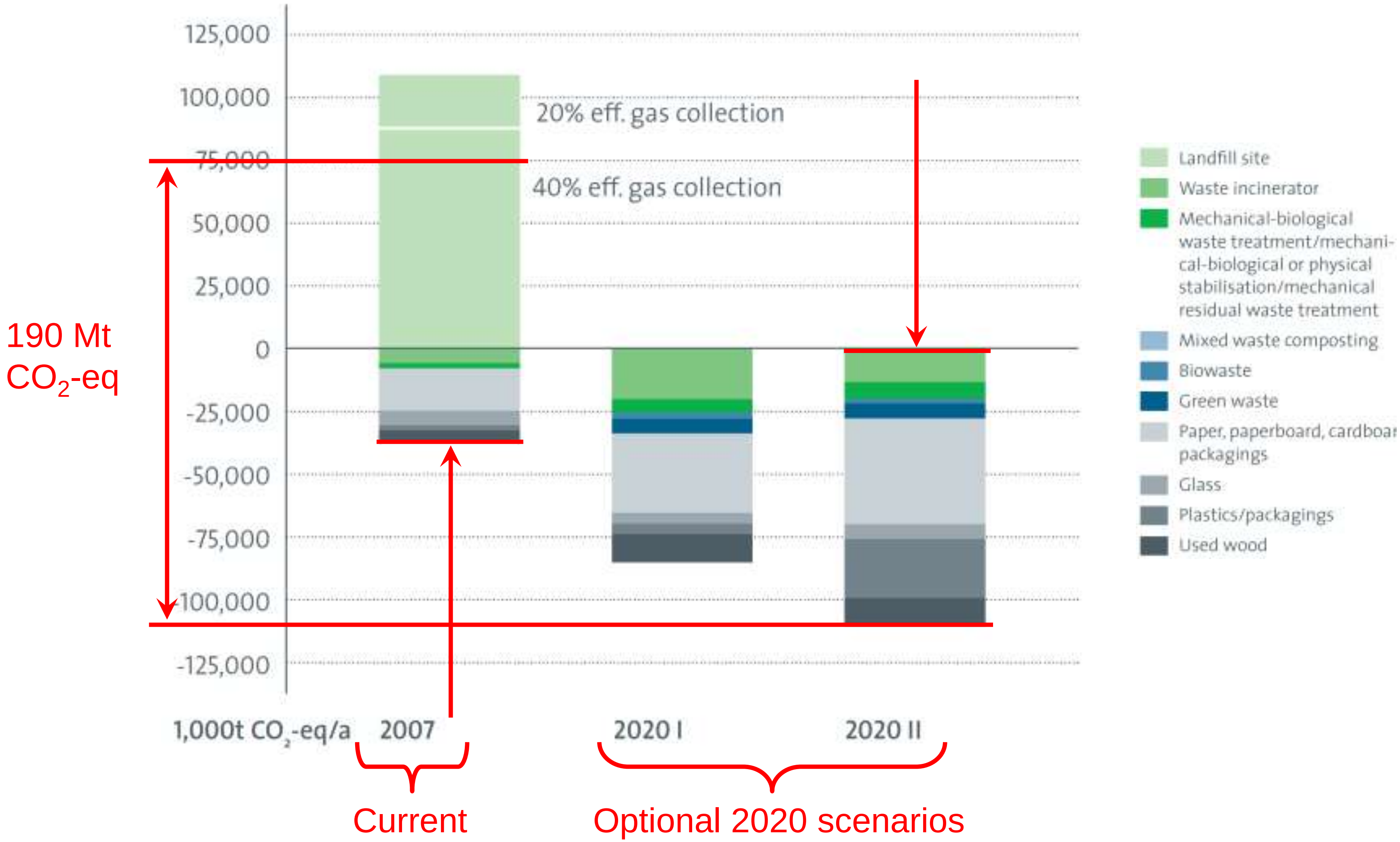
Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

Courtesy of Juegen Vehlow

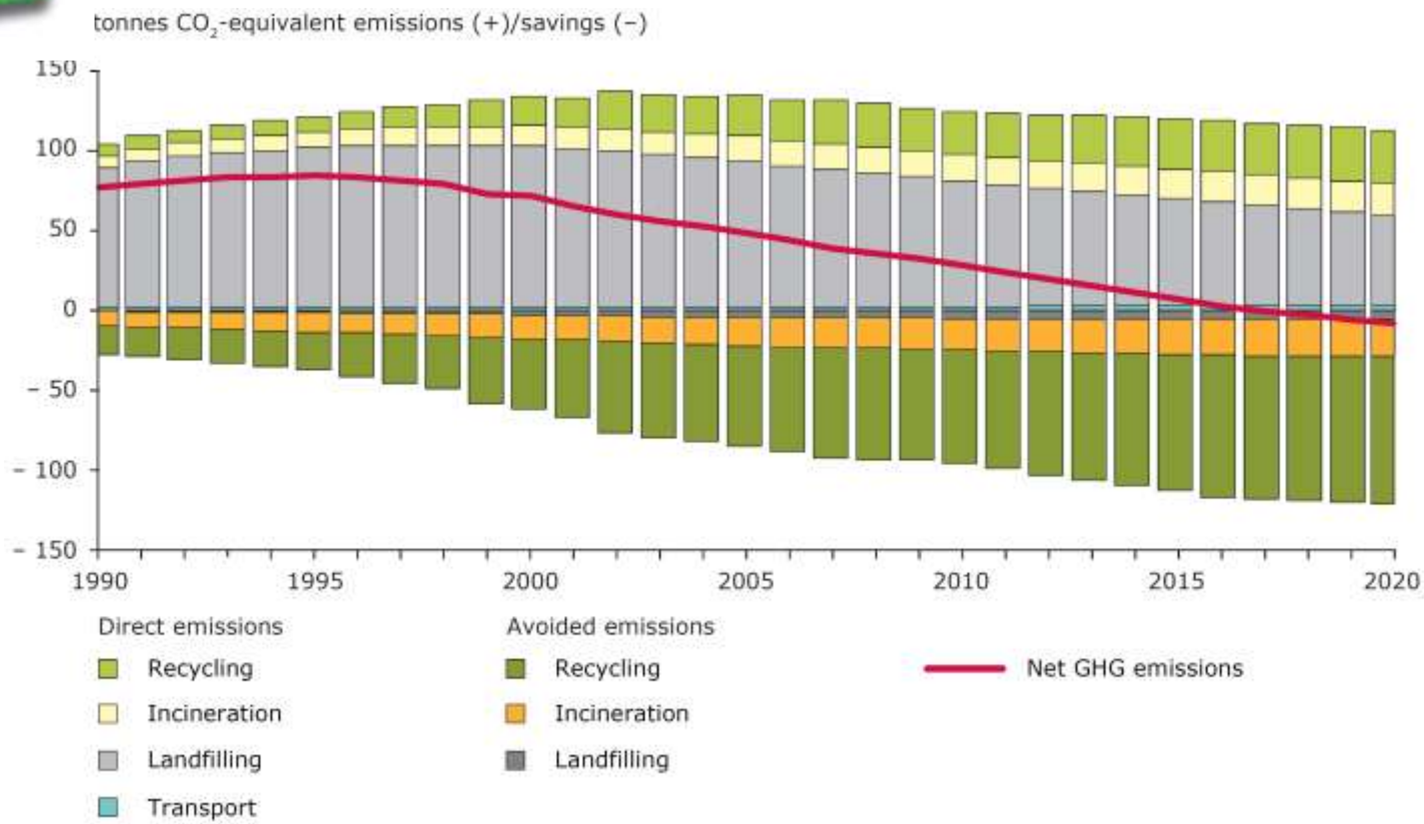
country	LHV	FBE		country	LHV	FBE
Austria	9.7	0.49		Luxembourg	8.7	0.58
Belgium	9.4	0.53		Netherlands	9.2	0.70
Bulgaria	7.2	0.48		Norway	11.0	0.64
Czech Republic	5.1	0.68		Poland	7.2	0.54
Denmark	8.5	0.65		Portugal	10.4	0.50
Finland	10.1	0.55		Romania	7.1	0.52
France	9.5	0.59		Russia	8.0	0.78
Germany	9.8	0.67		Spain	8.7	0.62
Greece	8.6	0.62		Sweden	10.7	0.75
Hungary	7.8	0.45		Switzerland	11.6	0.58
Ireland	10.9	0.58		Turkey	5.5	0.68
Italy	10.0	0.59		United Kingdom	10.5	0.63
Slovakia	6.6	0.51				

Umwelt Bundes Amt
Für Mensch und Umwelt

GHG -balance for the EU 27, Municipal solid waste (MSW)



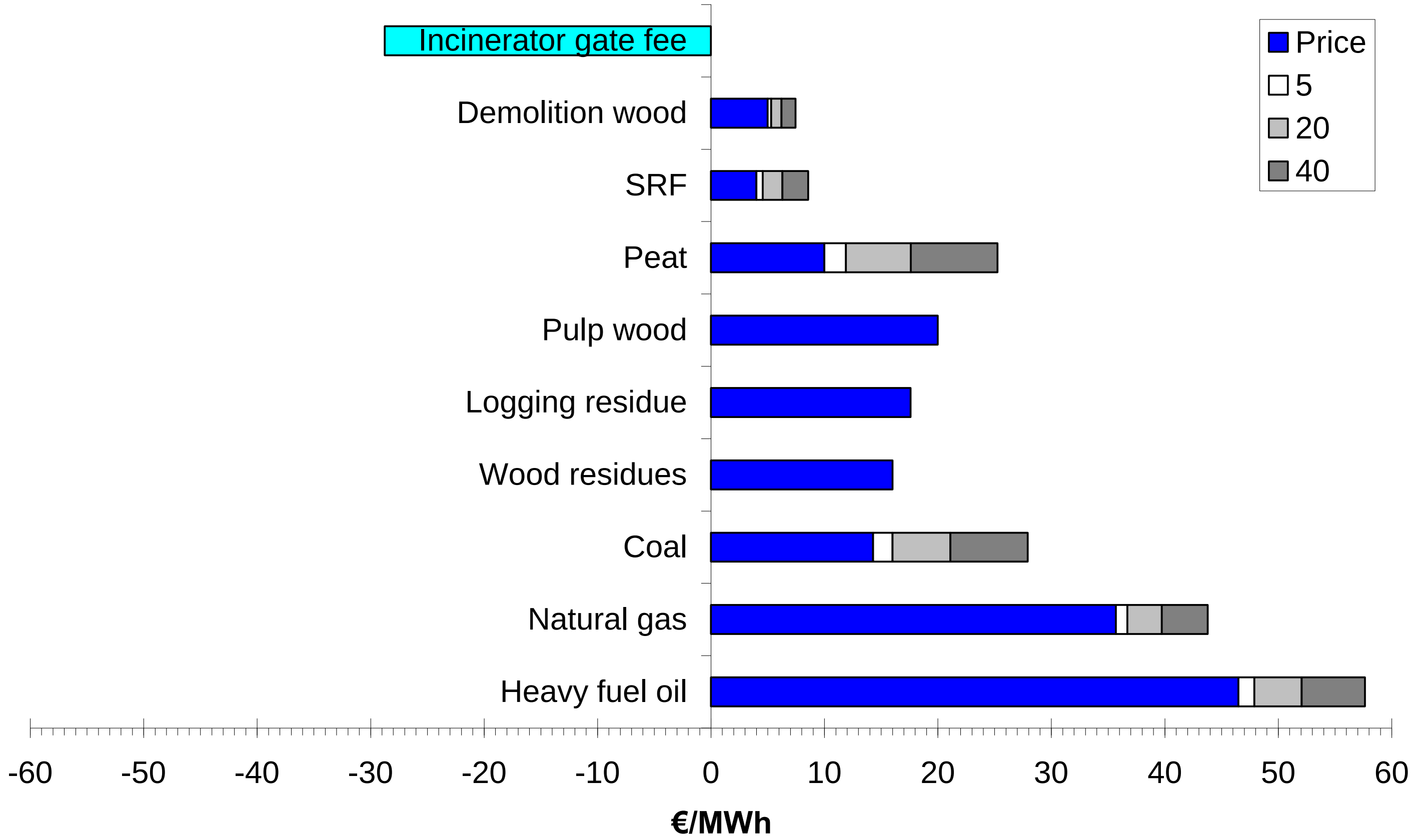
Modelled GHG emissions from MSW management in the EU



EEA Report No 3/2011

About fuel 'prices'

Modified from Martti Flyktman et al



Conclusions

- For high efficiency biomass utilisation - namely CHP in this presentation - cost efficient technologies are available
- The supply (chain) is the bottleneck
  - fuel flexibility is of increasing importance
  - security of supply, global trading
- Municipal solid wastes have a significant bioenergy potential in the EU
  - The sector will be in rapid shift towards waste-to-energy in the coming decade
  - Particularly in WtE CHP is crucial to achieve high efficiency
  - The supply is there, it is on wheels every day anyway
  - The operational framework, economics are funny

www.bioclus.eu

Supported by: Developing research and innovation environment in five European regions in the field of sustainable use of biomass resources - BIOCLUS (FP7/245438)

VTT creates business from technology

Whole system analysis

Christensen et al. Waste Manag Res 2009; 27; 871

Table 8: Disaggregated GHG emissions (kg CO_2-equivalents per 1000 kg of waste) for MBT-based scenarios. Bottom ash disposal (< 1 kg), iron recovery from bottom ash (–1 to –2), MBT landfilling (2–3) and methane emissions from MBT –landfill (4–5) were only included in the total.

Scenario	Total	Collection	Transport	Recycling of paper	Recycling of glass	Recycling of plastic	MBT plant (total)	MBT plant: iron scrap recovery	Power plant: emissions from RDF	Power plant: coal substitution	Incinerator consumption	Incinerator: emissions	Incinerator: electricity recovery	Incinerator: heat recovery	Landfilling: C-binding
MBT1-0	–684	9	34	–	–	–	51	–60	270	–892	–	–	–	–	–101
MBT2-0	–234	9	20	–	–	–	51	–60	–	–	39	261	–460	–	–101
MBT3-0	–523	9	20	–	–	–	51	–60	–	–	39	261	–460	–289	–101
MBT4-0	–190	9	19	–	–	–	125	–118	–	–	43	268	–534	–	–
MBT5-0	–525	9	19	–	–	–	125	–118	–	–	43	268	–534	–335	–
MBT1-1	–757	10	33	–255	–8	–	42	–60	267	–715	–	–	–	–	–74
MBT2-1	–397	10	23	–255	–8	–	42	–60	–	–	30	260	–369	–	–74
MBT3-1	–628	10	23	–255	–8	–	42	–60	–	–	30	260	–369	–231	–74
MBT4-1	–372	10	21	–255	–8	–	103	–118	–	–	31	267	–421		–
MBT5-1	–636	10	21	–255	–8	–	103	–118	–	–	31	267	–421	–264	–
MBT1-2	–752	10	33	–255	–8	–10	41	–60	237	–671	–	–	–	–	–74
MBT2-2	–414	10	23	–255	–8	–10	41	–60	–	–	29	231	–346	–	–74
MBT3-2	–631	10	23	–255	–8	–10	41	–60	–	–	29	231	–346	–217	–74
MBT4-2	–388	10	21	–255	–8	–10	101	–118	–	–	31	238	–399	–	–
MBT5-2	–638	10	21	–255	–8	–10	101	–118	–	–	31	238	–399	–250	–