Metso Gasification
IEA Task 33 meeting
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Chief Engineer

Gasification Technology

Metso

Global supplier of sustainable technology and services

- Our customers operate in the following industries:
  - Mining
  - Construction
  - Energy
  - Oil and gas
  - Recycling
  - Pulp and paper
- About 28,500 employees in over 50 countries
- Net sales in 2010 EUR 5.6 billion
- Shares listed on NASDAQ OMX Helsinki Ltd

Metso Power

Wide scope of fuel-flexible power technology

Boiler plants

Modular power plants

Heating plants

Gasification

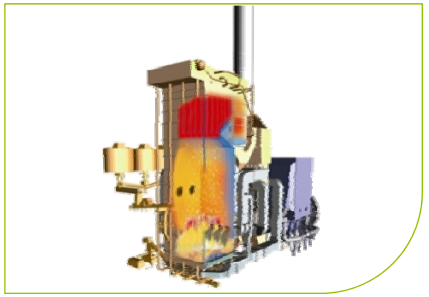
Power solutions

Recovery boilers

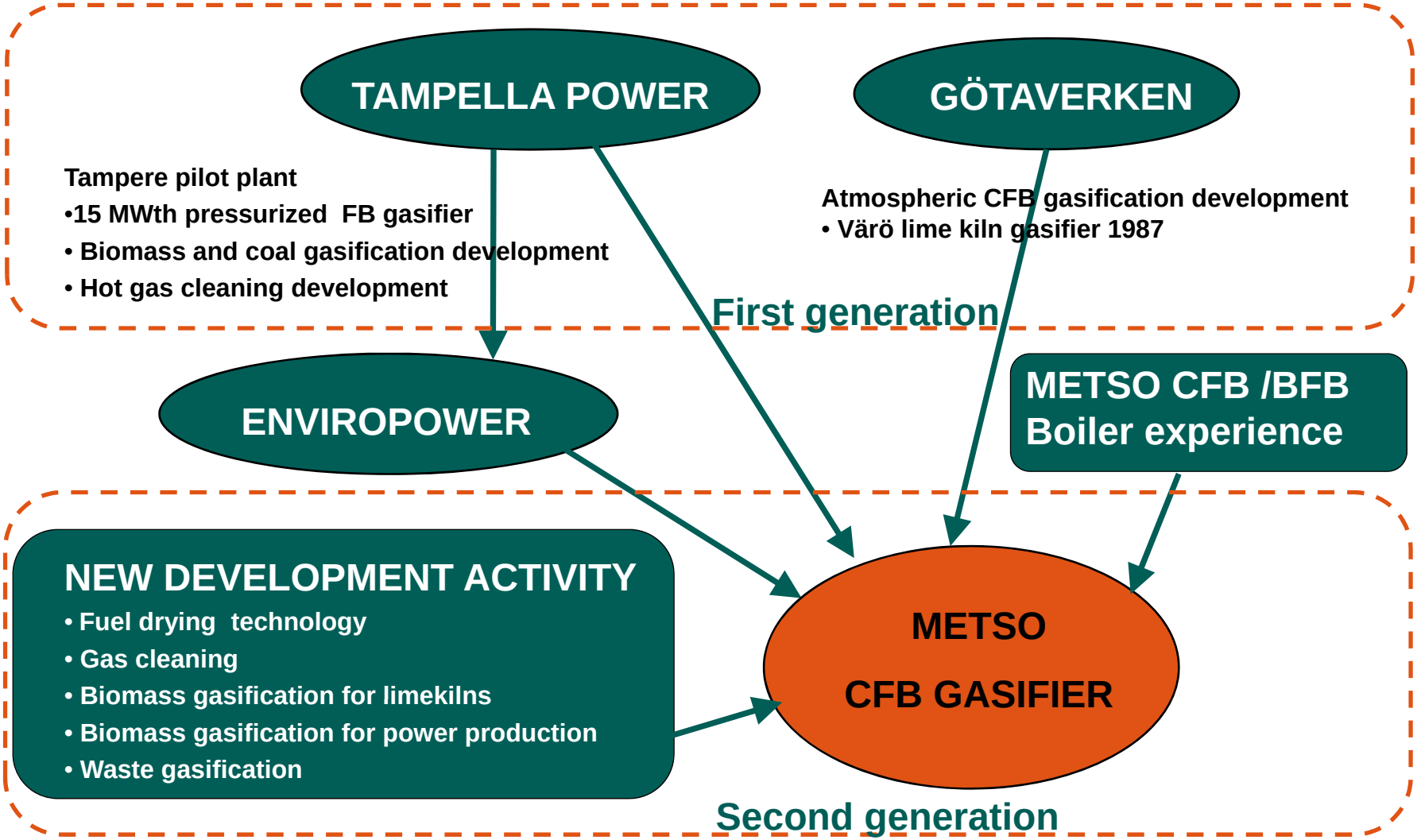
Environmental systems

Automation

Rebuilds and upgrades



Metso's evolution in gasification



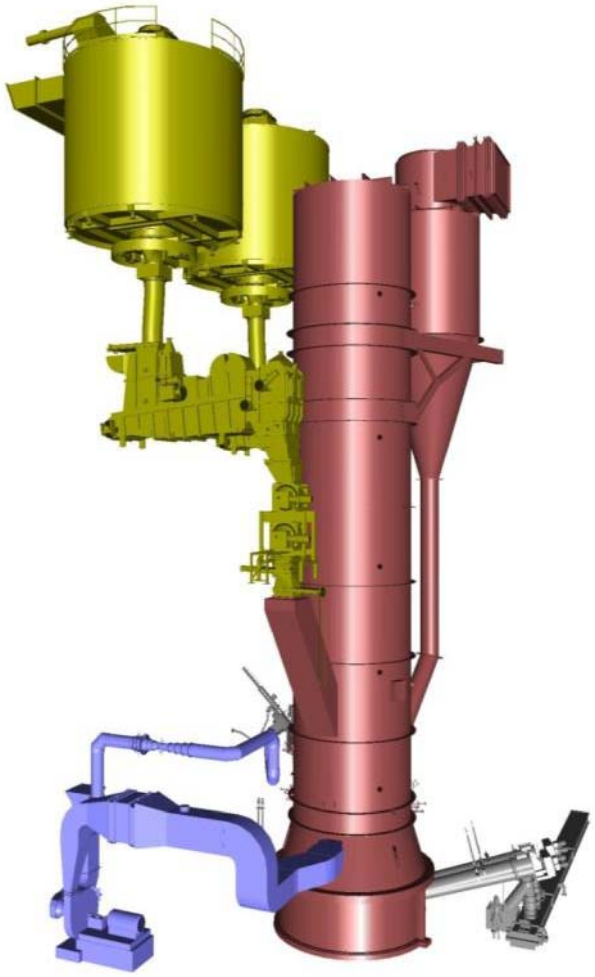
Gasification technologies

Position of Metso CFB gasification

PRESSURE	OXIDISIER	PROCESS	ASH	FUEL	SIZE	APPLICATION
Atmospheric	Air	Fixed bed	Slagging	Coal	SMALL 0 – 10 MW	Combustion engines
Pressurized	Oxygen	BFB	Non-slagging	Biofuel	MEDIUM 5-50 MW	Combustible gas for industrial furnaces
	Steam	CFB		Oil	LARGE 50 -200 MW	Fossil fuel replacement by bio/waste in power plants
		Entrained flow		Gas	HUGE 200 -2000 MW	IGCC
		Transport reactor		Waste		Transport fuels
		Flame gasification				Synthetic NG

Metso's CFB gasifier

CFB Gasifier	
Size	20 – 140 (200) MWth
Fuel	Biomass, waste
Gasification media	Air (steam)
Operating temperature	750 – 900 C
Operating pressure	5-30 kPa(g) /0,05-0,3 atm(g)
Product gas heating value	3-7 MJ/kg (LHV)

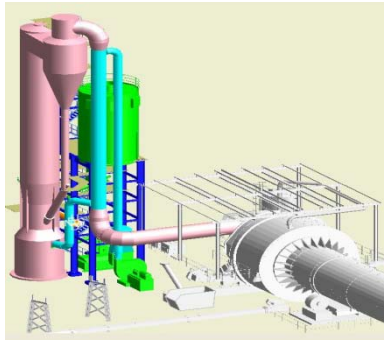


Metso's Solution for Gasification

CFB Gasifier

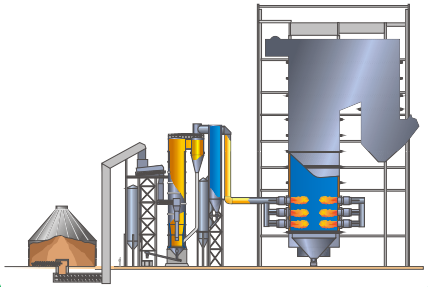
Product gas for (lime) kilns

- Sawdust, forest residues, fresh wood, bark
- 20 – 80 MW_{fuel} units
- Typically includes a dryer
- Dusty product gas
- Also other types of kilns possible



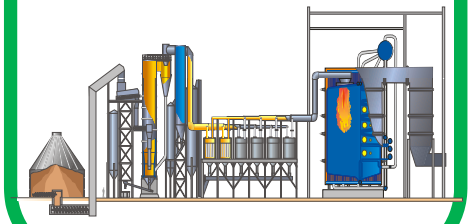
Product gas for power boilers

- Woody biomass, bark, peat, straw…
- Superior electricity efficiency
- (Existing) power boilers
- 50 – 150 MW_{fuel} units
- Typically includes a dryer
- (Gas filtering)



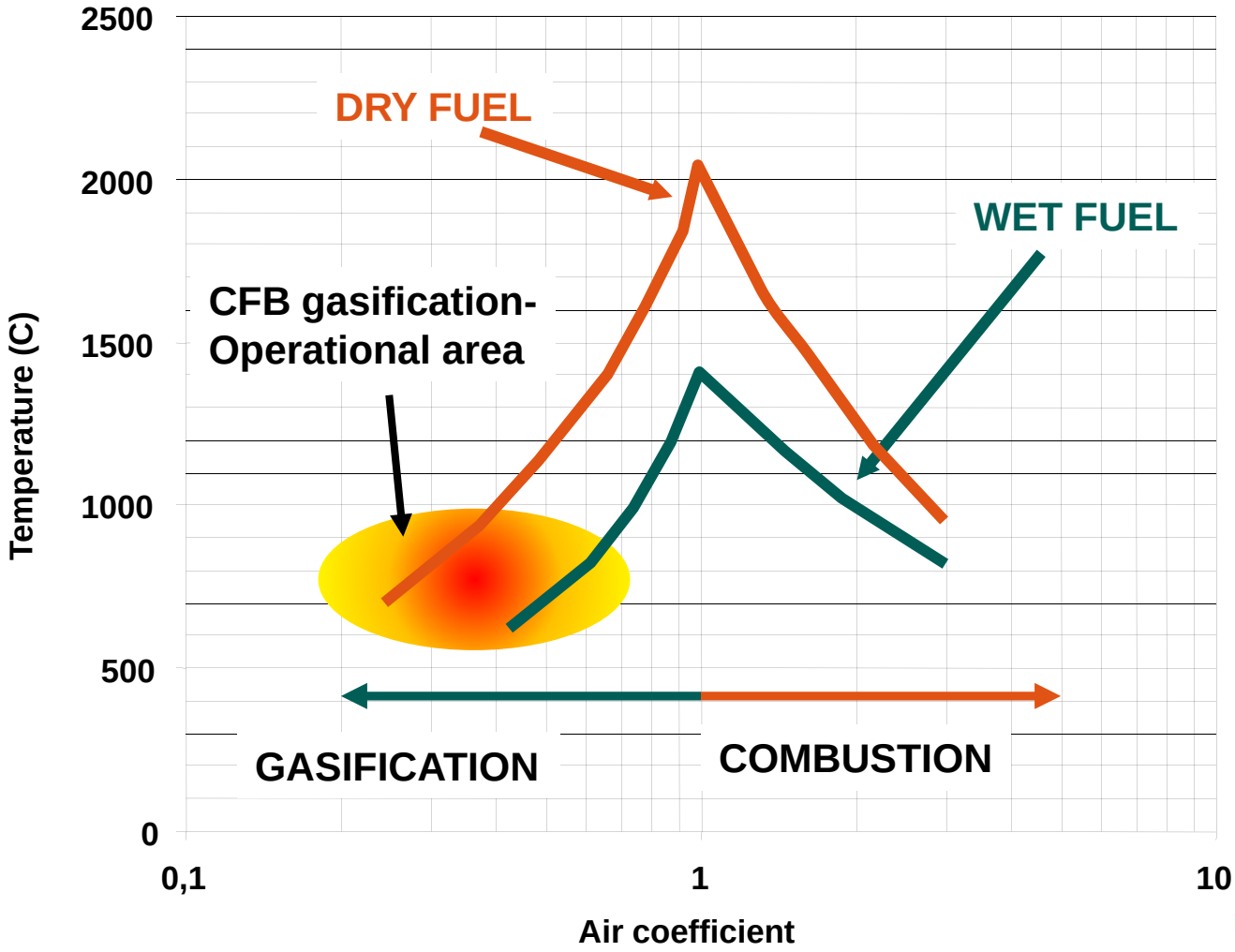
Product gas from waste for power production

- Waste-derived fuel
- High electricity efficiency
- Typically a new gas boiler
- Gas filtering -> clean product gas
- 50 – 100 MW_{fuel} units or multiple units connected to a boiler



Metso's Solution for Gasification

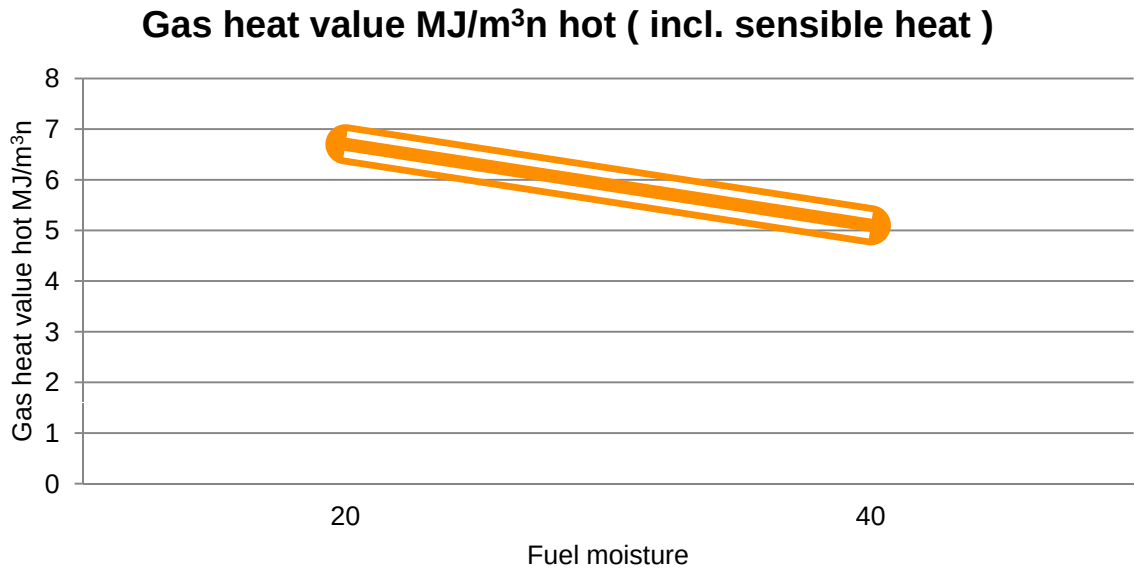
CFB gasification: Reaction temperature



Fuel moisture vs. gasifier output

Fuel moisture	20% (Design point)	30%	40%
Gasifier max output %	100	89	77

Example case:Waste fuel, HHV dry 22,5 MJ/kg, Ash 7,6%



Biomass gasifier for a lime kiln

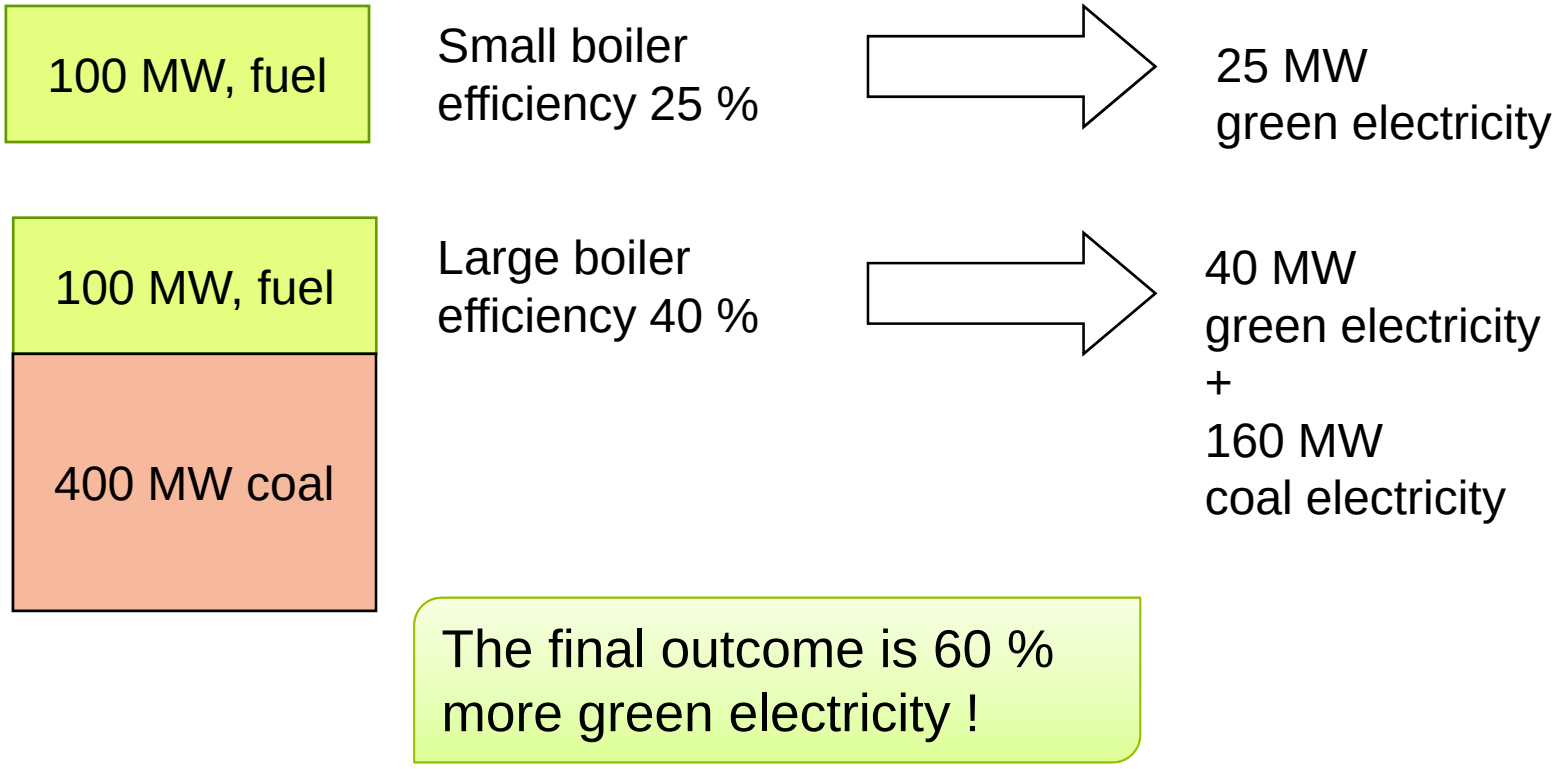
- A lime kiln can easily be switched over to use gasified biomass
- The size is usually large enough to make solution economically viable
- Fuel is normally available in a mill
- During the second oil crisis in the 1980s, several gasifiers were built to replace oil with biomass
- At Värö, Södra Cell, Sweden, a Metso (Götaverken) gasifier has been used since 1987

=> Over 20 years of industrial experience

Typical gasification applications

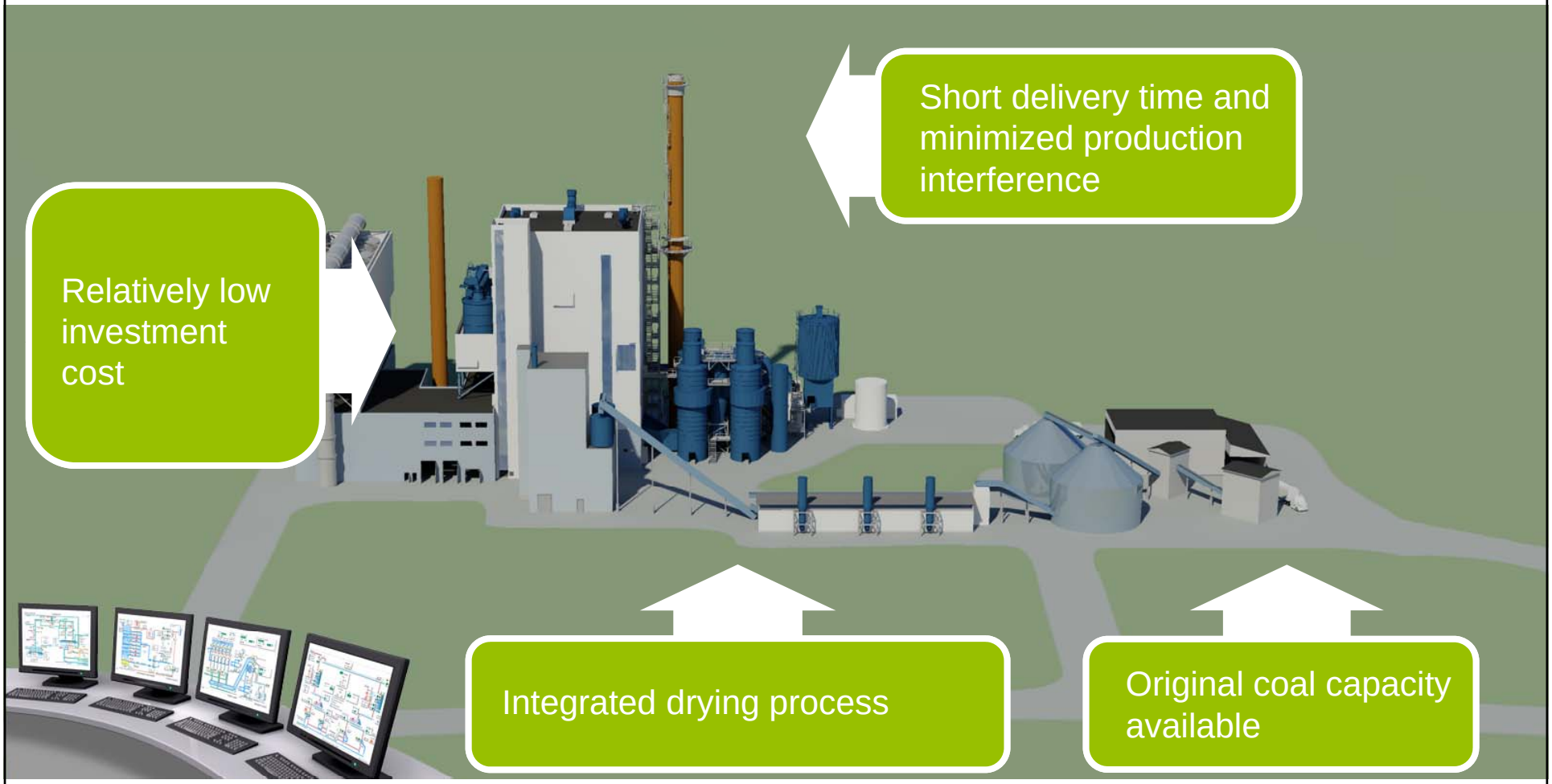
Example:100 MW of biofuel available at the district

- Cofiring is an efficient way to use biomass



The final outcome is 60 % more green electricity !

Biomass gasification into the existing coal-fired plant



Vaskiluoto coal-fired power plant in Vaasa

- In operation since 1982
- Production
  - electricity 230 MW
  - district heating 170 MW
- Coal consumption
  400,000 – 500,000 t/a
- Produces approximately 90% of the district heat needs in Vaasa region

Vaskiluodon Voima Oy gasification project

Enables to replace a large share of coal with biomass

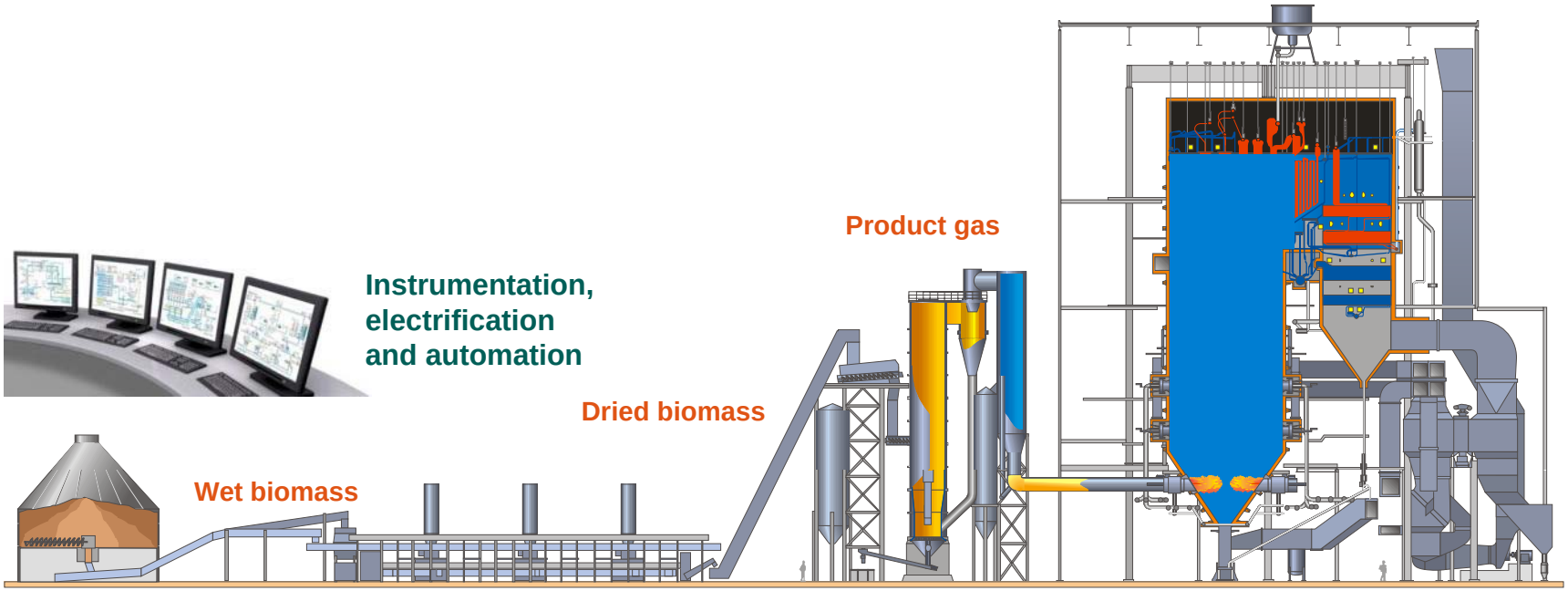
- 140 MW biomass gasifier and dryer
- Adjoined to the existing
  560 MW coal-fired power plant
- Up to 40 percent replacement of coal

Schedule

- Contract signed June 2011
- Plant operational 12/2012

Total project cost < 40 M€

Vaskiluodon Voima biomass gasification plant



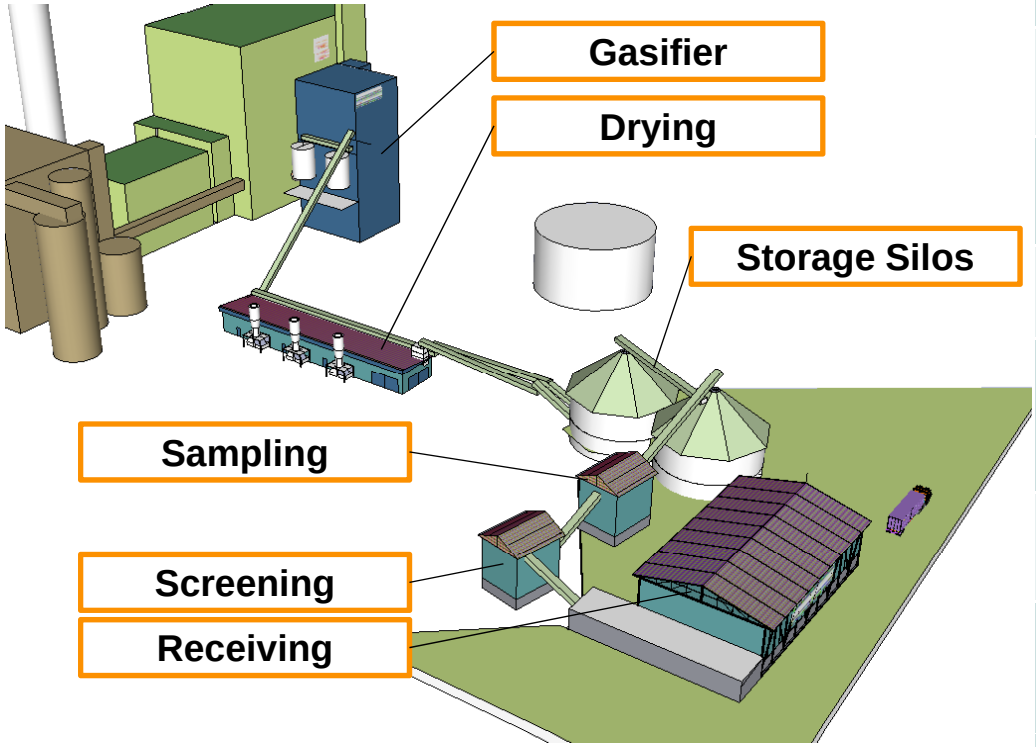
Biomass receiving and pre-handling

Large-scale belt dryer

CFB gasifier 140 MW_{fuel}

Existing PC boiler modifications and new burners

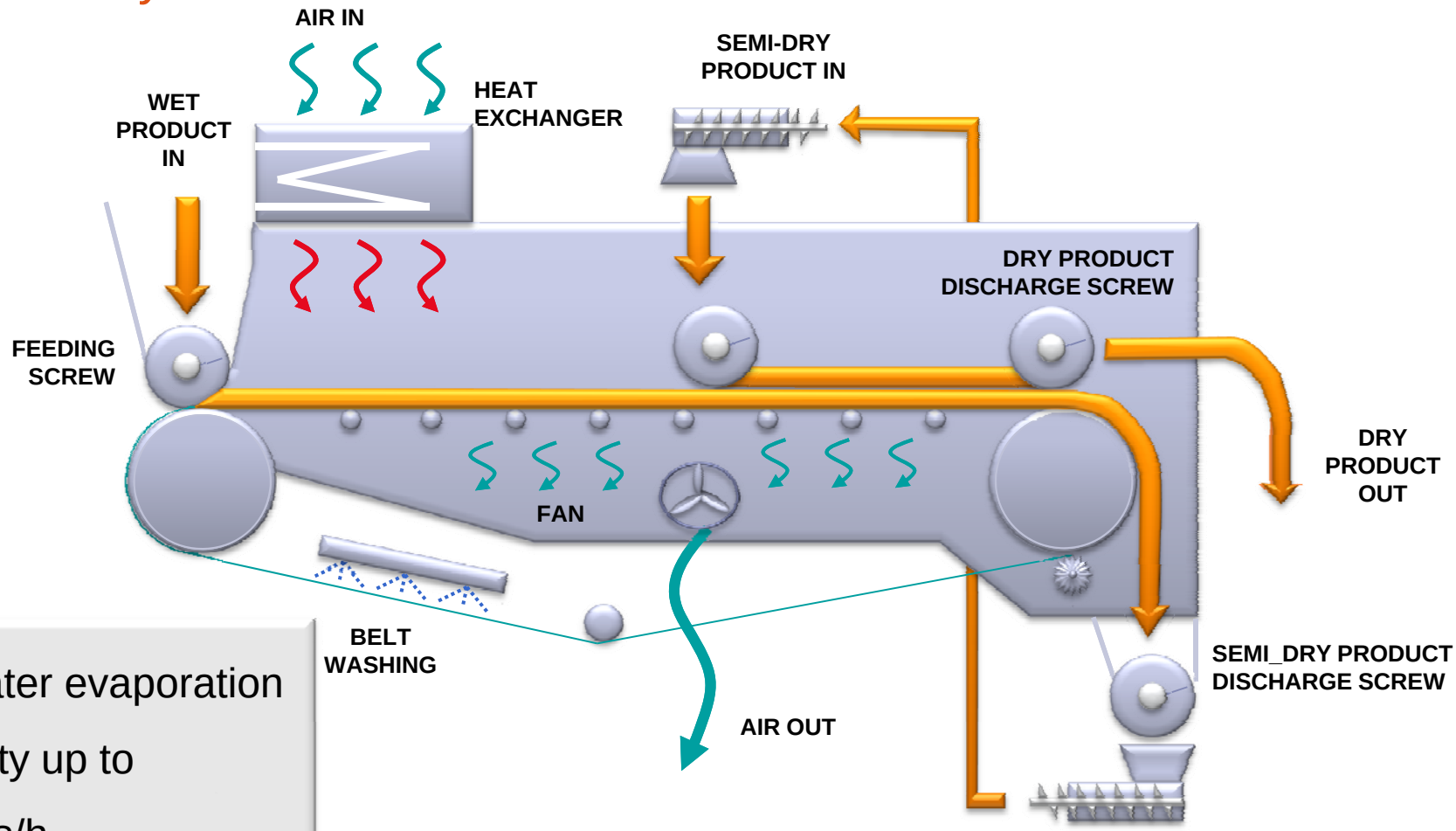
Vaskiluodon Voima, Finland
External Fuel Handling



Start-up	2012
Process	Gasification (140 MW) for Power Generation
Fuels	Forest resudues (chips), Peat
Fuel Receiving	4 x 120 m^3
Receiving and Screening Capacity	600 m^3/h
Fuel Sampling	Automatic 5 samples / truck
Fuel Silos and Reclaiming Capacity	2 x 2 500 m^3 2 x 50 - 200 m^3/h
Drying Capacity	10 t/h of evaporated water

Metso belt dryer for biomass

Double layer



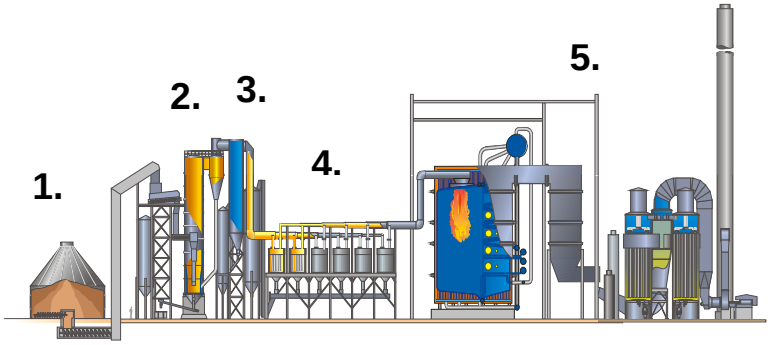
For water evaporation capacity up to 20 tons/h

metso

Lahti Energia - solid waste gasification

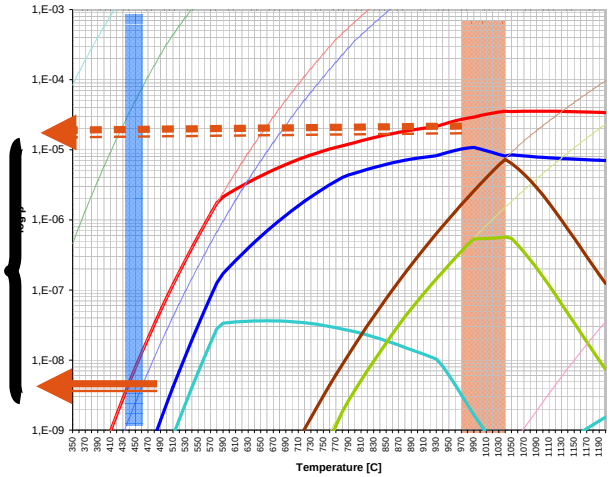
- 160 (2x80) MW, 250 000 tn/a
- Total Investment 157 M€
- Start up April 2012

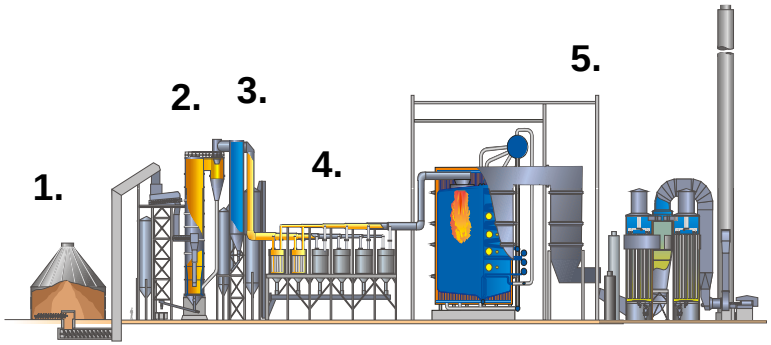
1. Fuel handling
2. Gasifier
3. Gas cooling
4. Gas filter
5. Gas boiler and flue gas cleaning



Technical concept

- Gasify waste at 850-900 C
- Cool it down to about 400 C
  - all corrosive components, alkalichlorides, Pb, Zn will be in solid form
- Filter all dust out so the resulting gas is clean
- Burn clean gas in gas fired boiler



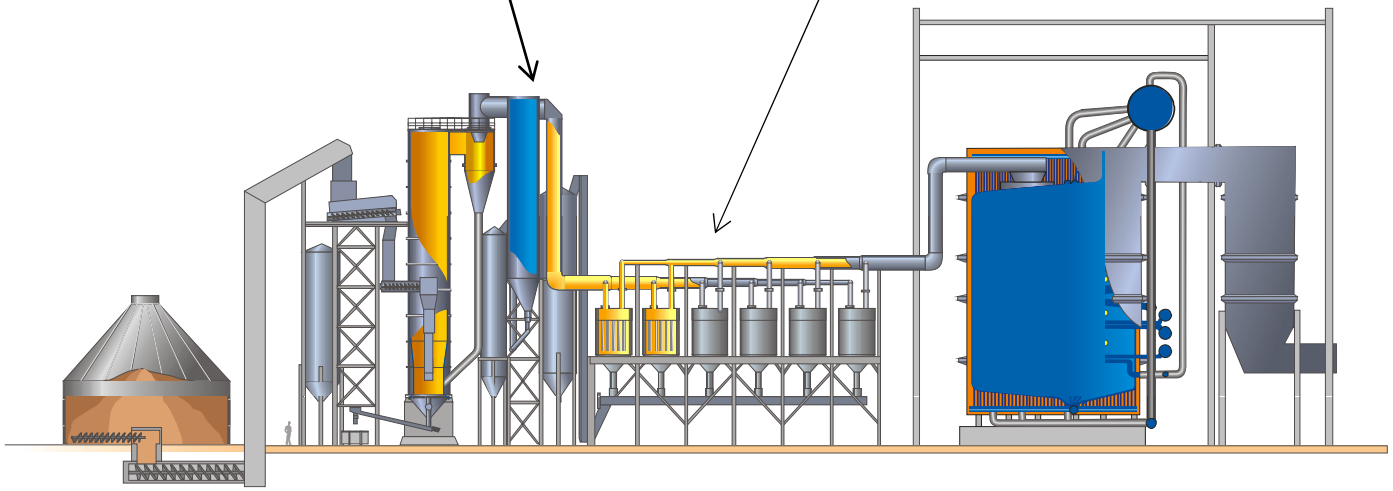


1. Fuel handling
2. Gasifier
3. Gas cooling
4. Gas filter
5. Gas boiler and flue gas cleaning

Operational window to clean out corrosive compounds

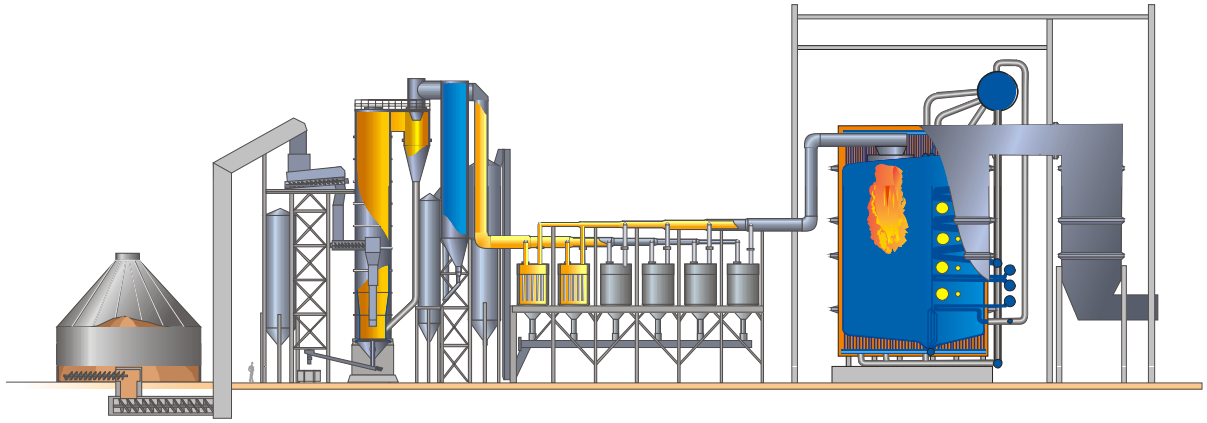
- All water walls cooled with boiler feed water
  - Avoid risk of corrosion in cooler
  - Condensate corrosive components on particles
  - Avoid tar condensation in cooler

- High temperature ceramic filter
  - Filter can tolerate high temperatures
  - Tar condensation can be avoided



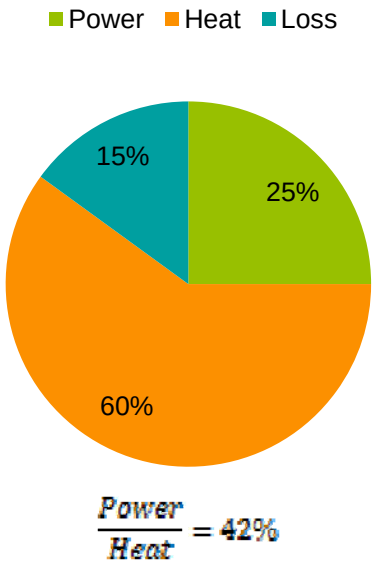
Benefits of waste gasification

- High steam parameters → higher efficiency
  - Lahti 160 MW fuel => 50 MWe + 90 MW district heat
  - Lahti 120 bar, 540 C live steam
  - Technology can offer even higher electricity efficiency
- Lower grade waste as a fuel → lower fuel cost
  - Lahti fuel : Household waste (origin sorted), Industrial waste, demolition wood, waste wood from industry
  - LHV 14 -24 MJ/kg, dry ; Moisture< 30 %, Cl < 0,4 %
- Tolerance for fuel quality → multiple fuel sources
- Less corrosion → less expensive materials in the boiler



“Modern” technology vs. Metso technology

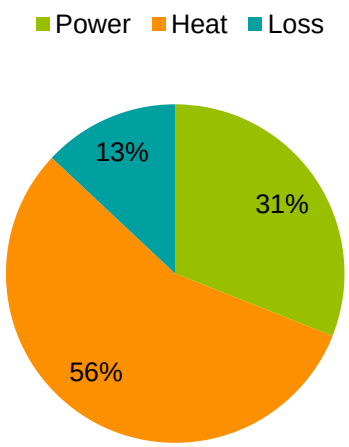
Modern grate firing waste power plant (www.jly.fi)



$$\frac{Power}{Heat} = 42\%$$

Metso technology

Lahti Case (www.roskatenergiaksi.fi)



$$\frac{Power}{Heat} = 56\%$$

Metso technology is not limiting steam parameters, it is possible to built a plant with even higher power efficiency than Lahti

- Metso technology: Worlds highest power production efficiency in waste firing

The pilot phase is over

Lahti Energia, installation

Thank You!