SUCCESSFUL BIOENERGY INSTALLATIONS

The tradeoff between capital and operating expenditure

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WOOD FUELS

Wood / Biomass Classification

- Type / traded form
- Size
- Moisture
- Ash
- Bulk density
- Energy density
- Additional data EN 14961:1-2010

Wood fuels

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COMMON POLYTECHNIK FUELS


WOOD PELLETS


WOOD BRIQUETS


WOOD SHAVINGS


SAWDUST


WOOD CHIPS


PEELINGS


SHREDDED TIMBER


HOG FUEL


FOREST RESIDUES


BARK


PEAT

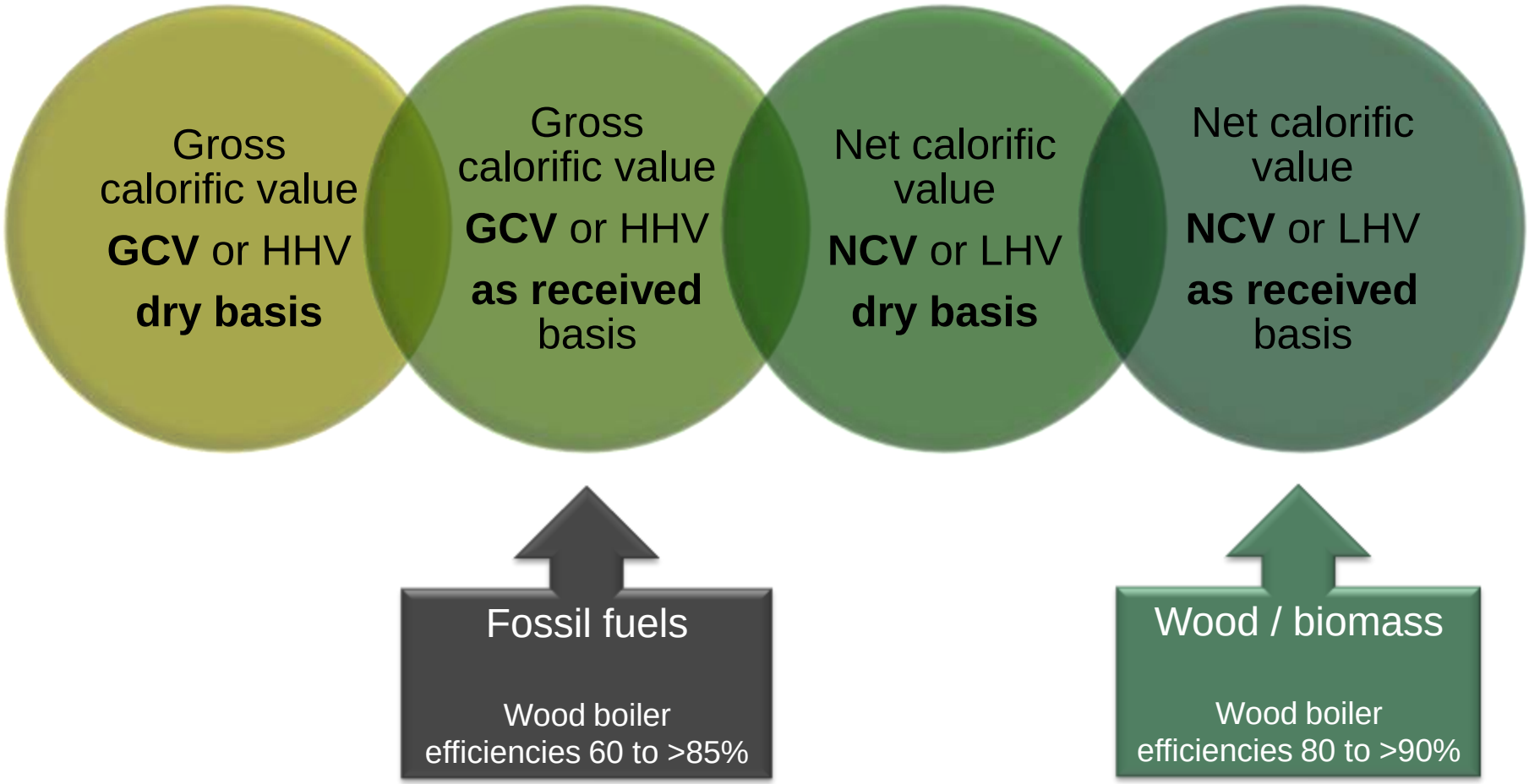

CONSTRUCTION & DEMOLITION WOOD


MISCANTHUS


NUT SHELLS


CHICKEN LITTER

Energy content of wood



NCV_{ar} of high moisture content fuels

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$4 to $8 / GJ wood boiler fuel

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Fuel yard

Fuel yard

Fuel yard

Fuel yard

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WOOD COMBUSTION

Wood / biomass combustion

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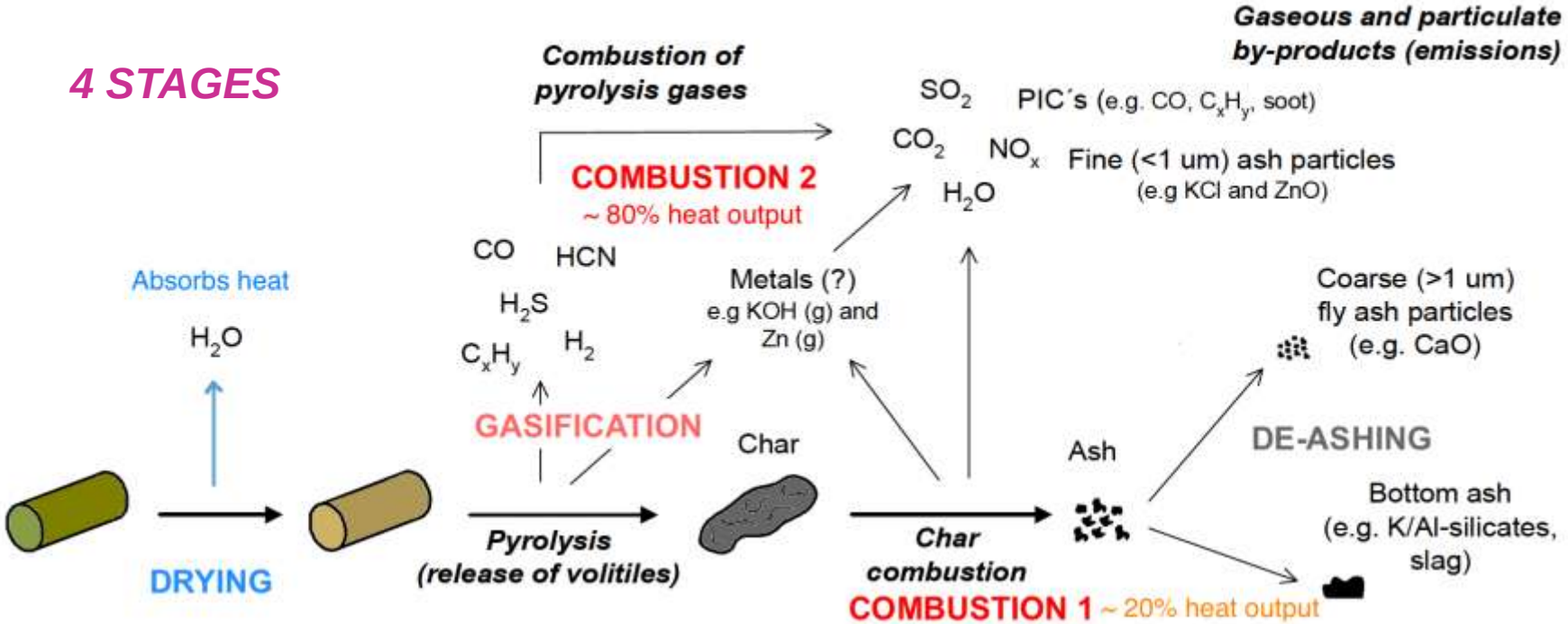
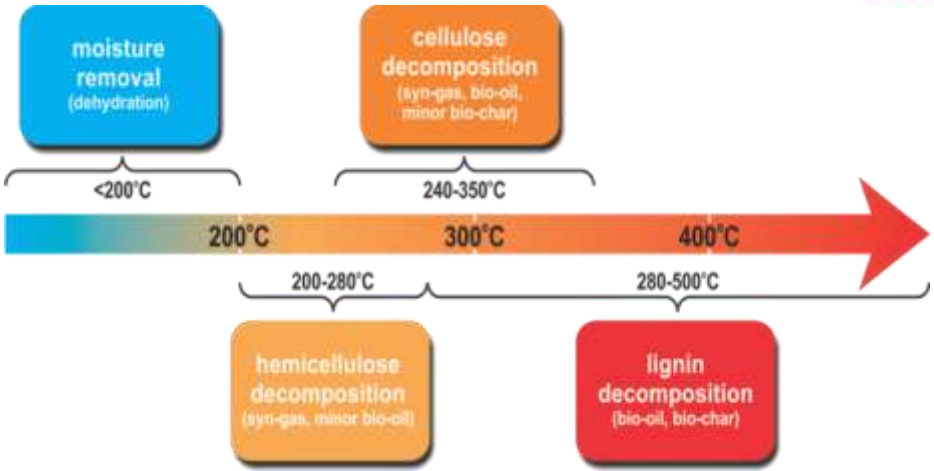
4 STAGES

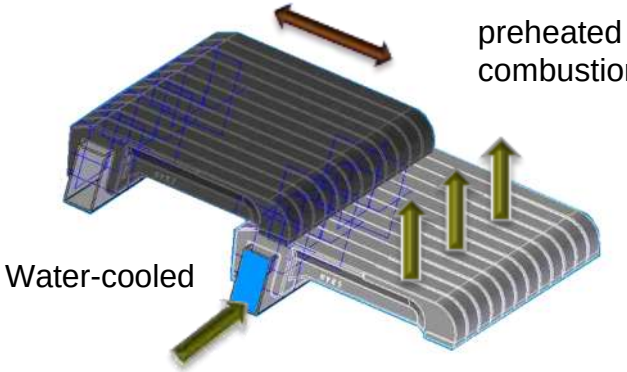


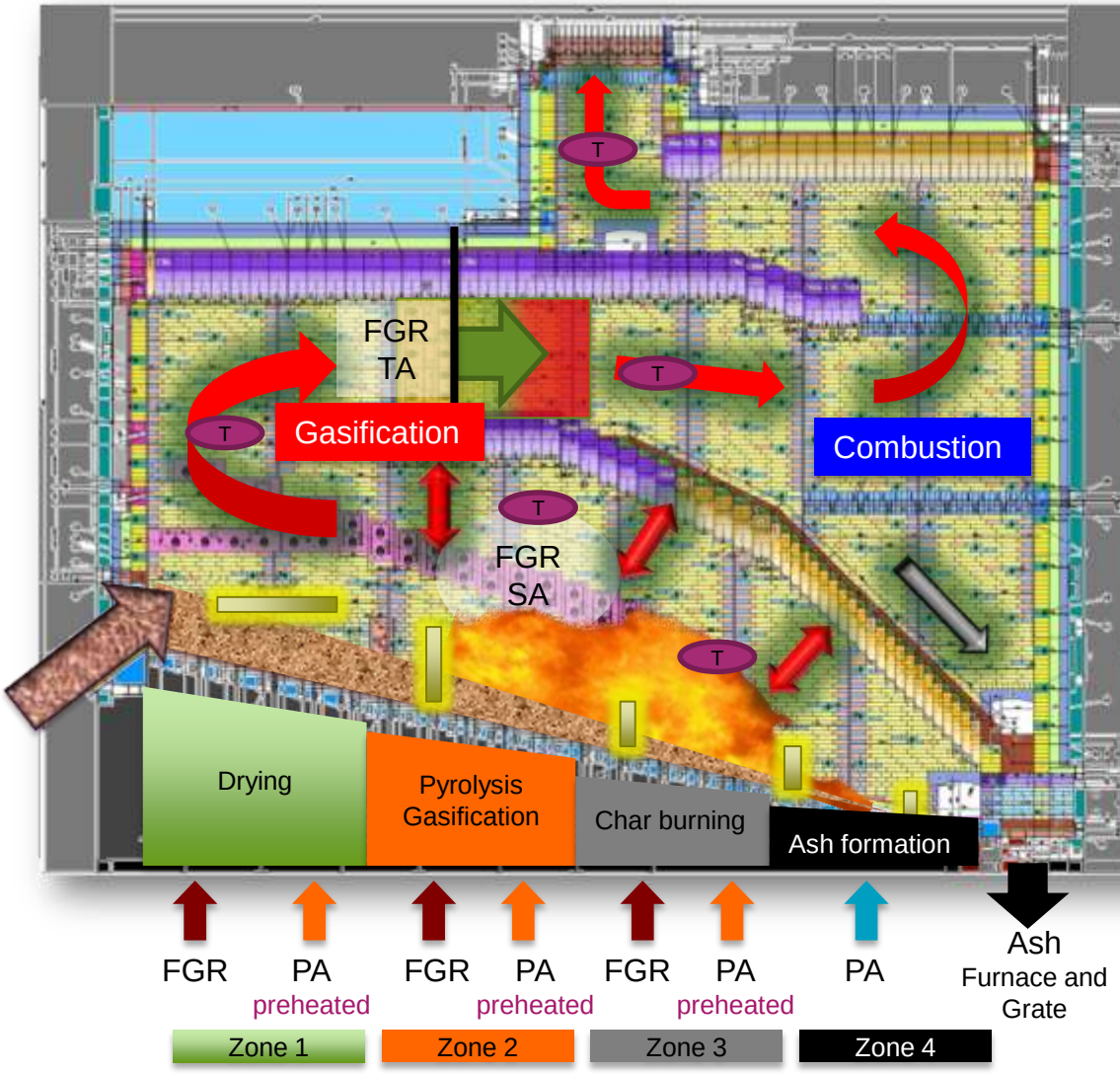


Wood
Carbon: ~ 50%
Volatile: >85%
CV: 4 to 17 GJ/t

Coal
Carbon: 80 to 90%
Volatile: 10 to 40%
CV: 18 to >30 GJ/t

Wood / biomass combustion system





Furnace types for wood firing

- fixed bed & pile burners
- stoker-firing system (firing on grate)
- fluidized beds (bubble, circulating)

Efficient wood / biomass combustion

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4 Stages	• Drying | Gasification | Combustion | De-ashing
Temperature	• < 800°C in gasification zone, and > 850°C in combustion zone
Air and gas staging	• PA, SA, TA & FGR zones = low NOx
Turbulence	• when mixing gas with oxygen - secondary and tertiary air, …not primary air!
Gas residence time	• > 2 seconds in high temperature zone > 850°C …but <1,000°C
Sufficient air	• Oxygen / Lambda < 1 in gasification zone, and 1.2 to 1.6 after combustion (low CO)
Adiabatic conditions	• No cold surfaces in the gasification and combustion zone = refractory
Heat load	• Low thermal load on furnace and grate

Wood / biomass combustion

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Wood / biomass combustion

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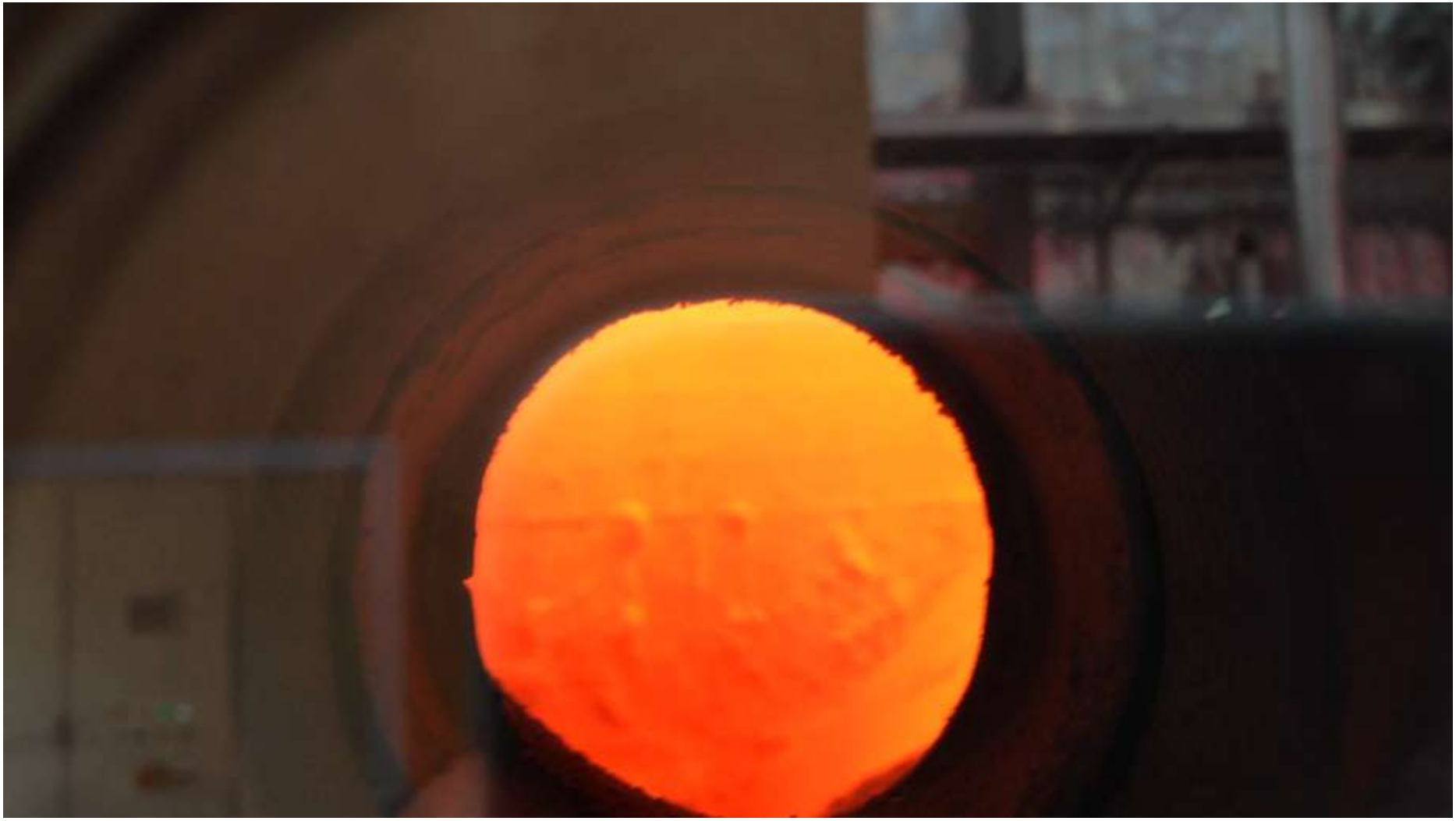

Wood / biomass combustion

Wood / biomass combustion

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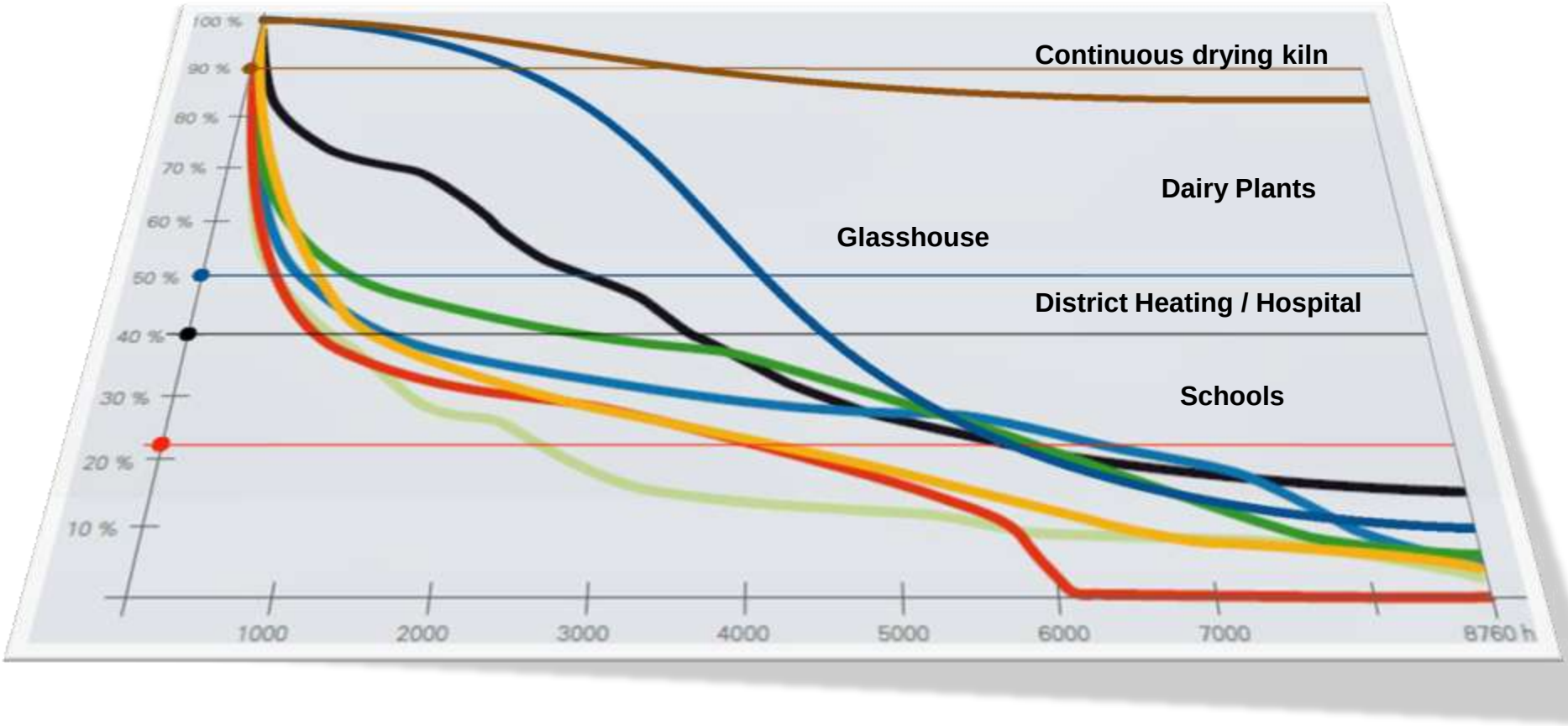
HEAT PLANT UTILISATION INVESTMENT COST AND EFFICIENCY

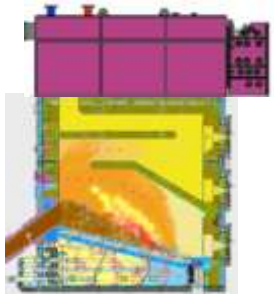
Heat plant utilisation



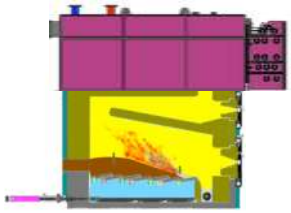
40 % heat plant utilisation – 1 MW

Utilisation of 50%, output 80%
= 800 kWh for 4,300 hrs. or 400 kWh for 8,600 hrs.)

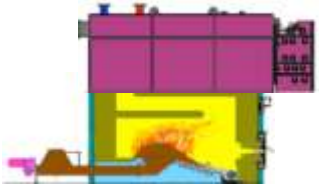
1.) Water-cooled grate, 2 pass, ram stoker feed, automatic furnace and grate de-ashing

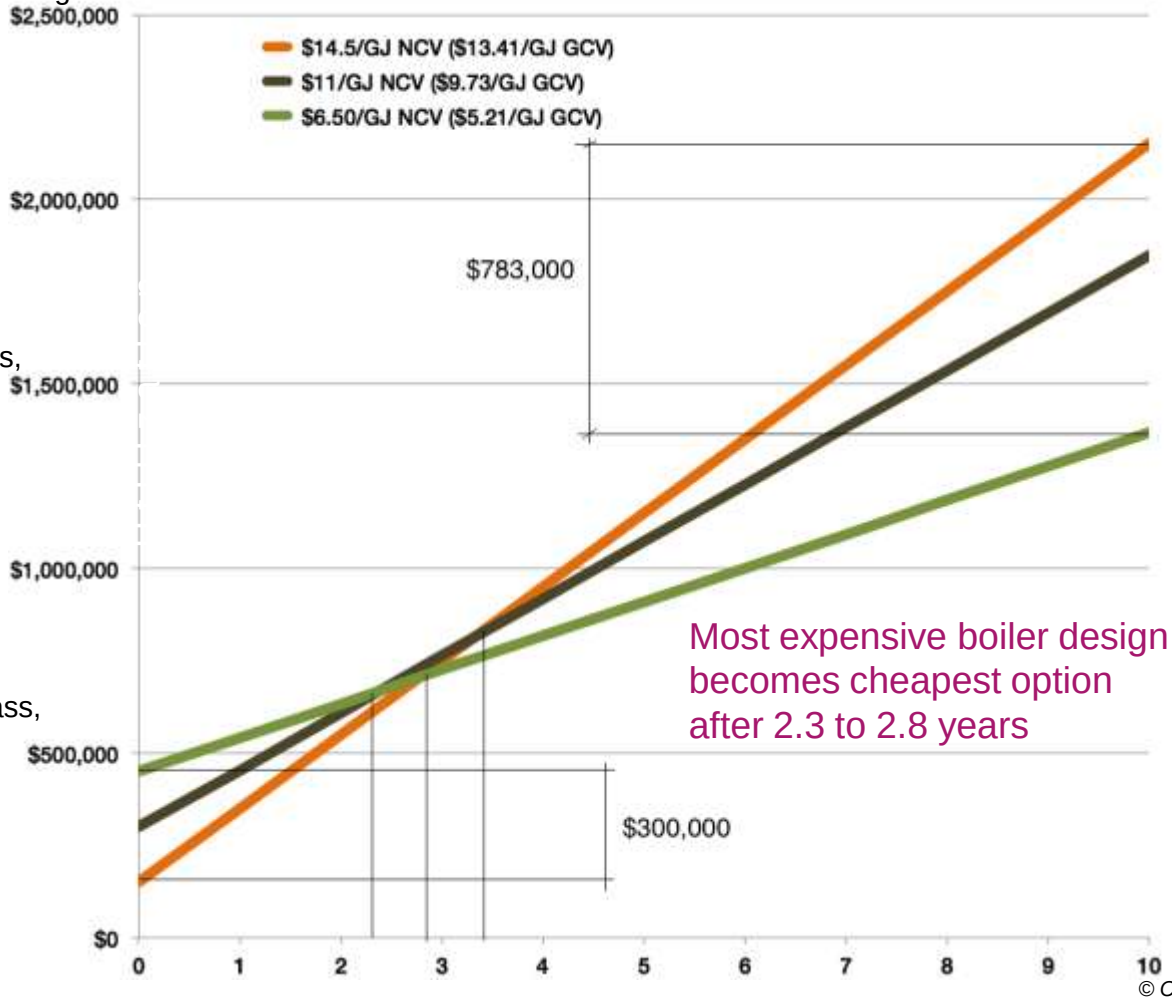


2.) Air cooled grate, 1 pass, auger feed, automatic grate de-ashing



3.) Underfeed stoker, 1 pass, auger feed, automatic de-ashing



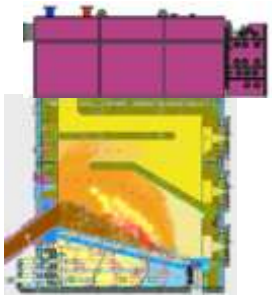


Most expensive boiler design becomes cheapest option after 2.3 to 2.8 years

64 % heat plant utilisation – 1 MW

Utilisation of 80%, output 80%
= 800 kWh for 6,880 hrs. or 640 kWh for 8,600 hrs.)

1.) Water-cooled grate, 2 pass, ram stoker feed, automatic furnace and grate de-ashing



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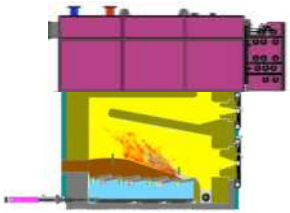

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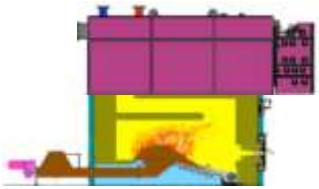
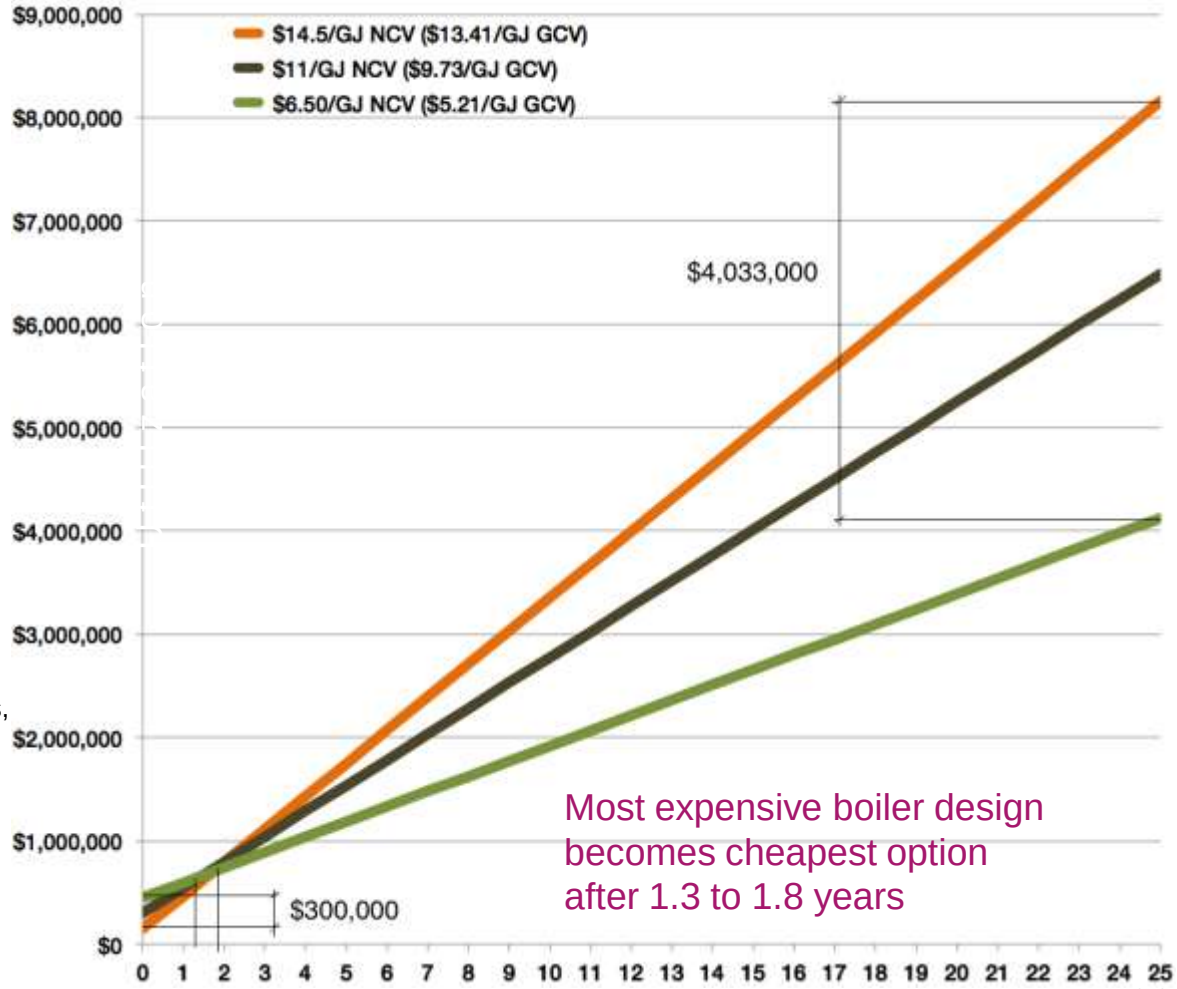




Most expensive boiler design becomes cheapest option after 1.3 to 1.8 years

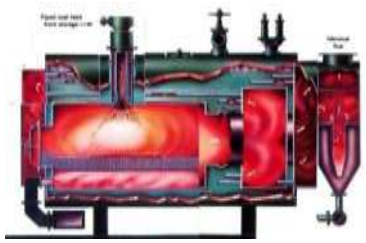
64 % heat plant utilisation – 5 MW

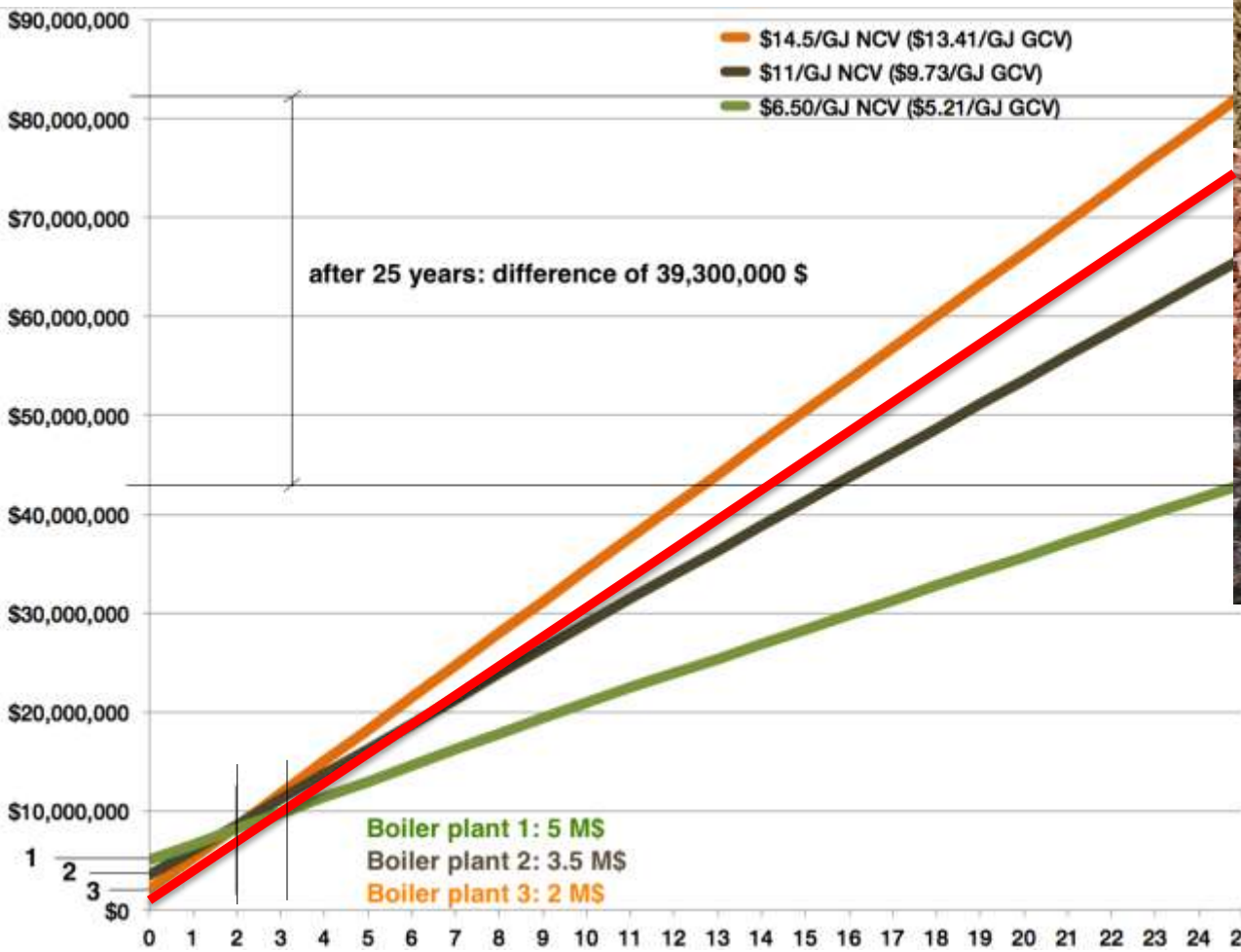
utilisation of 80% running at 80% load
= 8 MWh for 6,680hrs or 6.4 MWh for 8,600h)
10 year financing of 80%

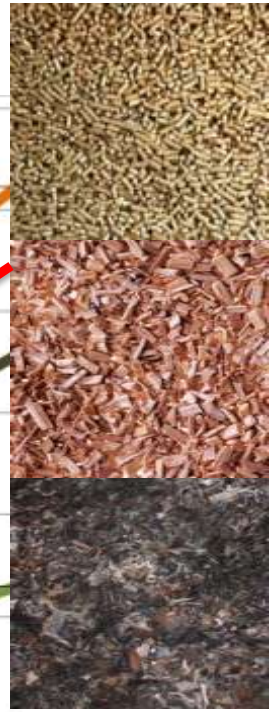
NEW
and advanced

vs.

2ND HAND







Investment cost of heat plants

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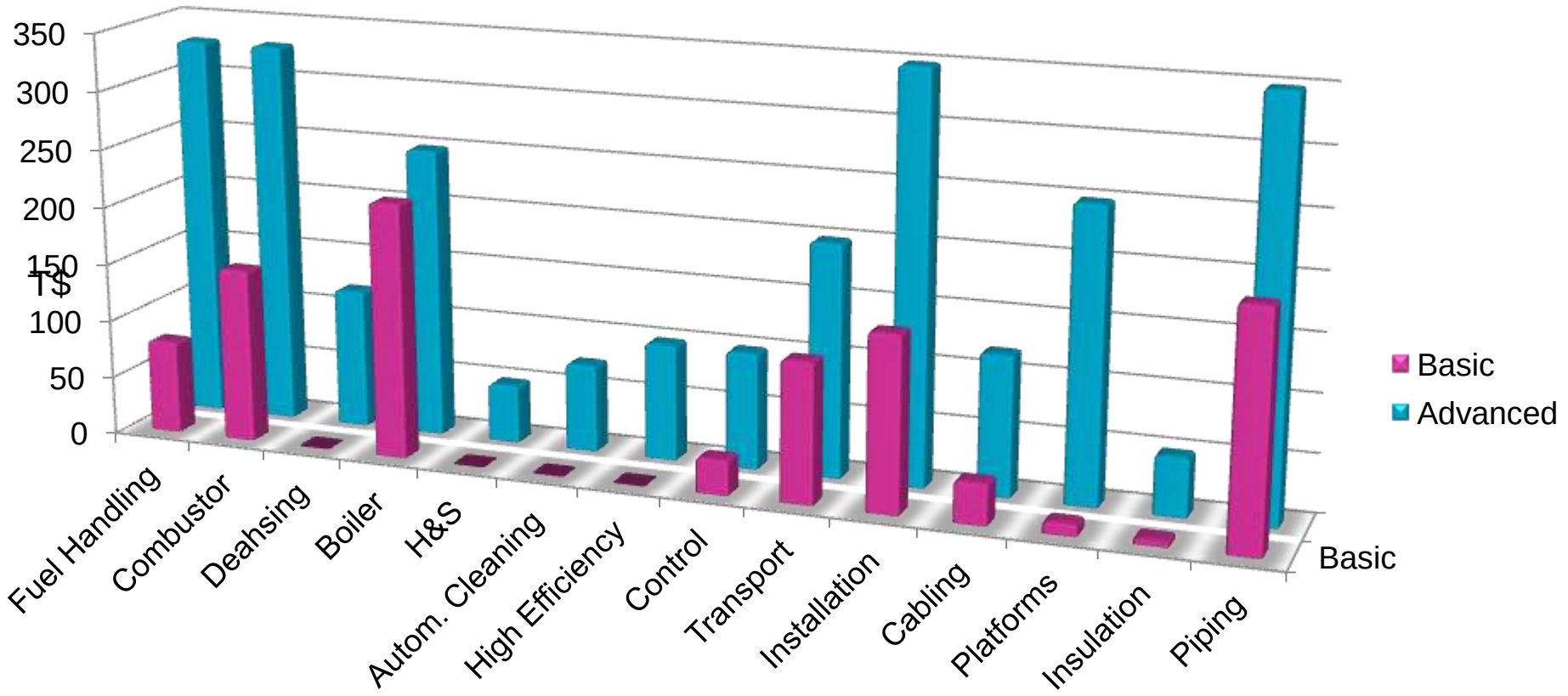
Investment cost of a 4 MW boiler plant



Main “savings”:

- Fuel flexibility and storage
- Service and maintenance: de-ashing, automatic cleaning, access, control system, etc.
- Efficiency / emissions: furnace size, combustion and control system
- Health and safety: fire protection, accessibility, insulation, de-ashing, etc.

Example – Fuel Storage and Handling

Basic vs. state-of-the-art

Example – Furnace & Automatic Cleaning

Basic vs. state-of-the-art

Example – De-ashing

Basic vs. state-of-the-art

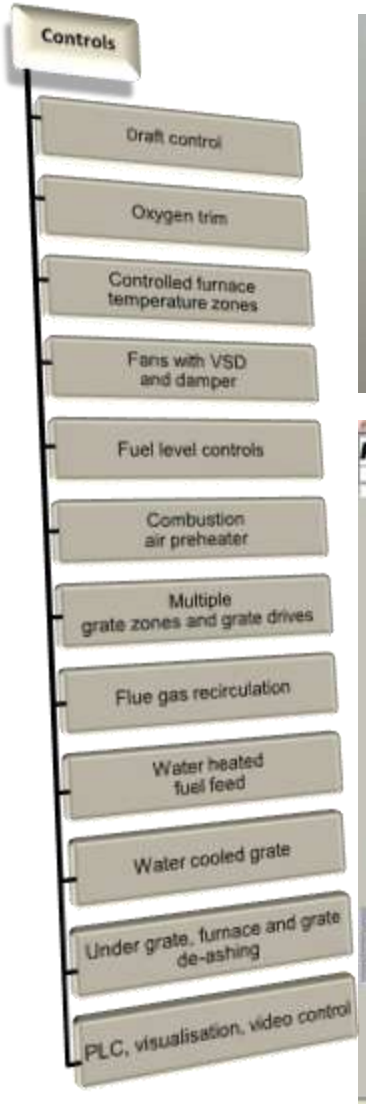
Example – Plant Access

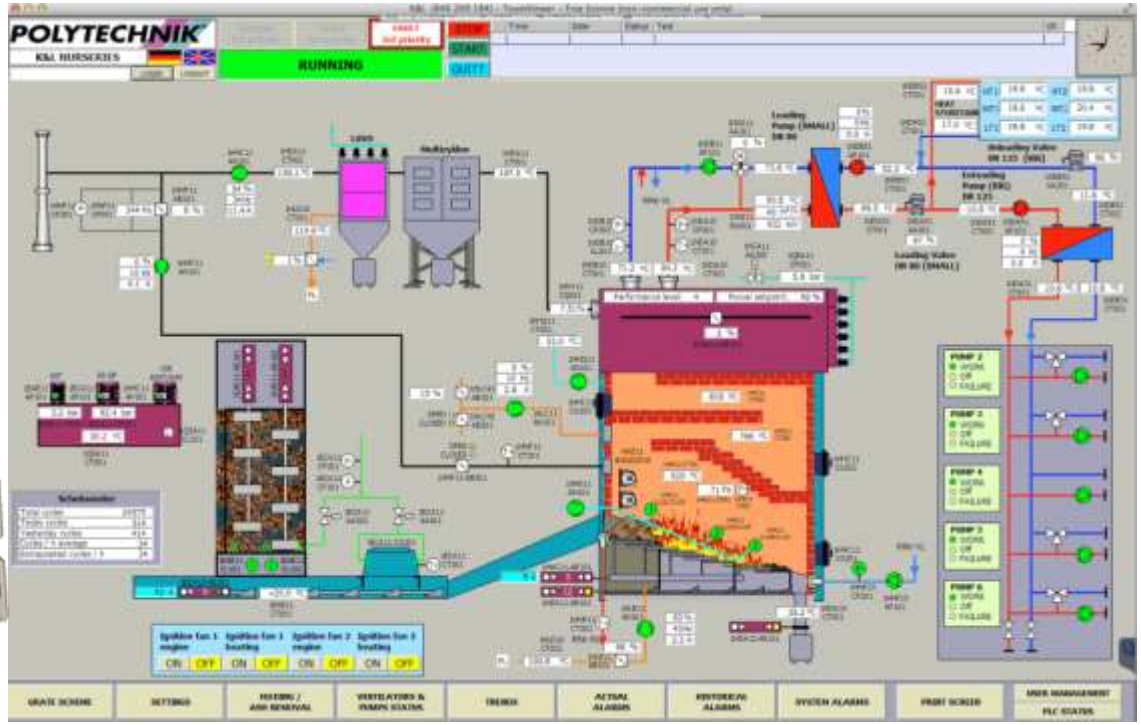
Basic vs. state-of-the-art

Example – Insulation & Heat Losses

Basic vs. state-of-the-art

Example – Automation & Control





Basic vs. state-of-the-art

Air pollution due to inefficient heat plants

New Zealand 2012

Air pollution from fires, vehicles and industry

kills 1,170 people

prematurely each year

and causes

$4.28 billion

in social costs,

researchers have estimated

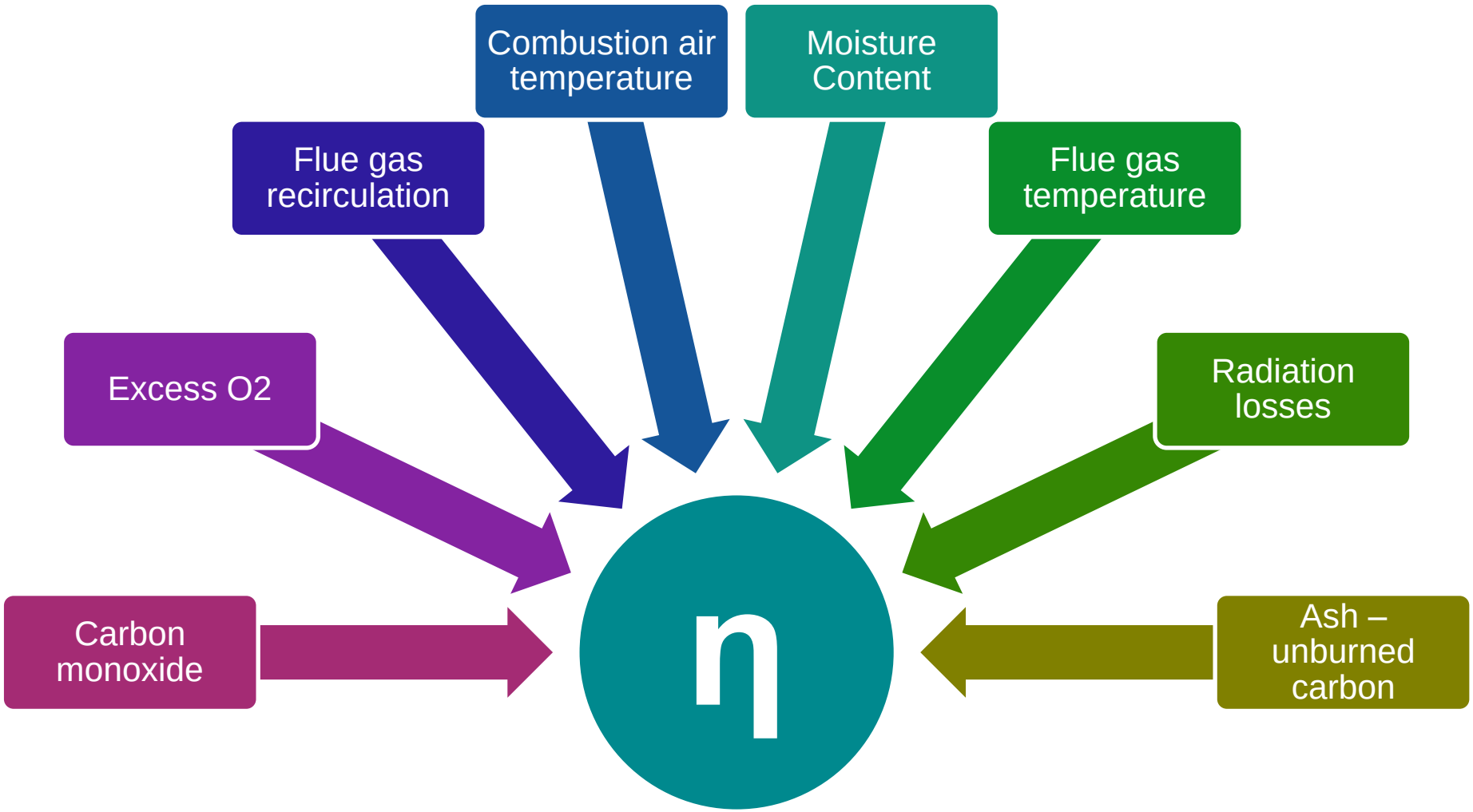
Problem

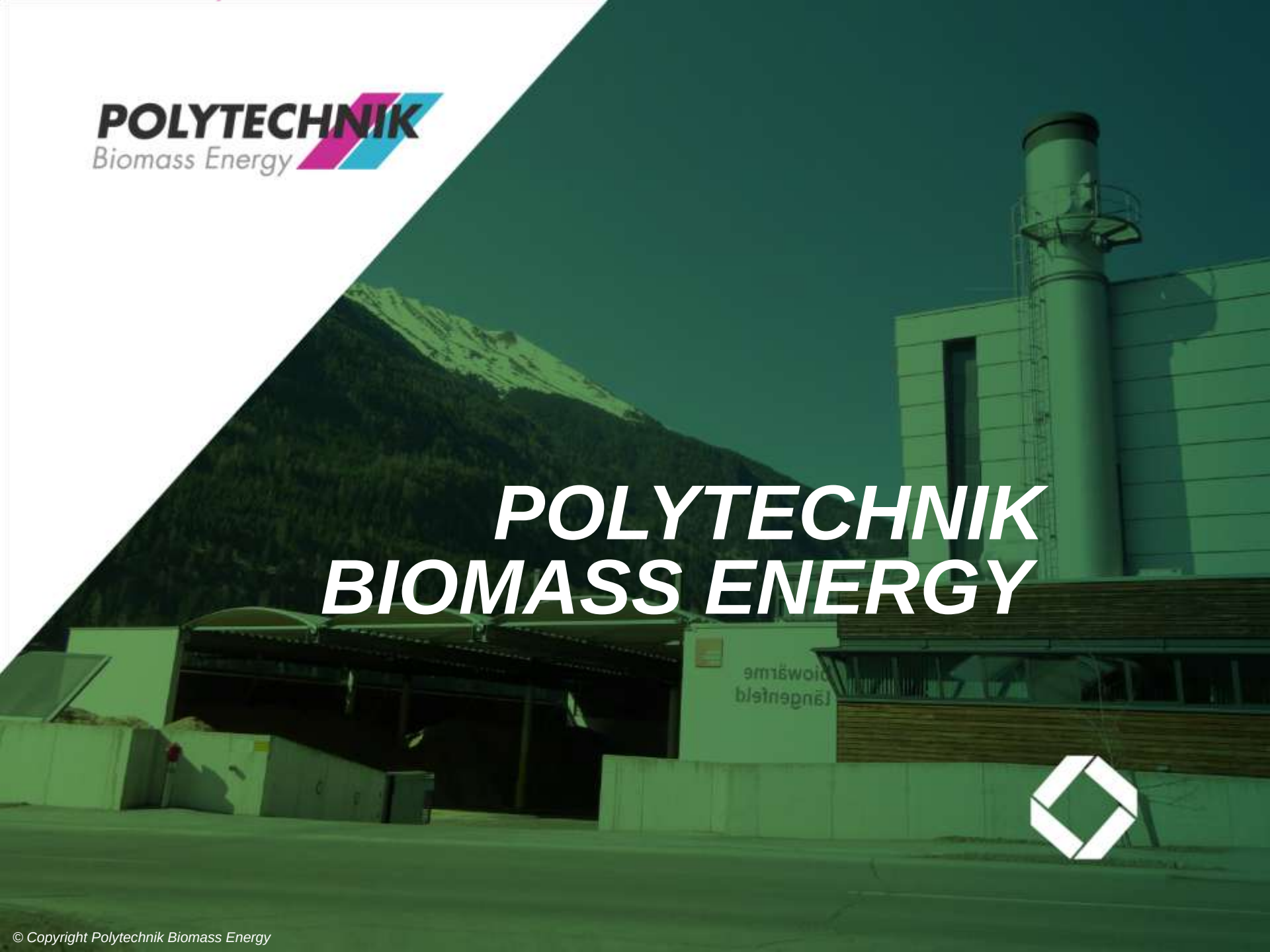
Inefficient boiler plants

Lack of air emission standards for

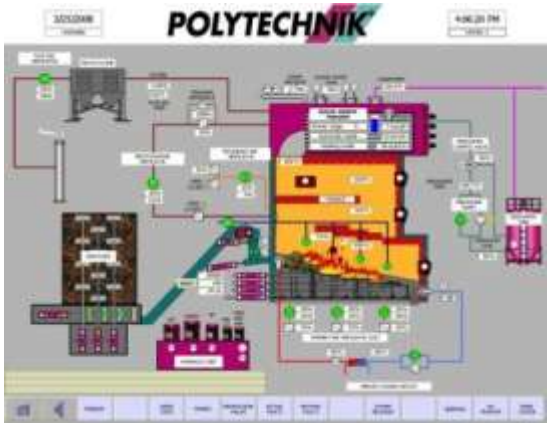
PM10, PM2.5, CO, NOx, HC

Efficient Combustion





Small hot water heating plants



Hot water and steam boilers

Thermal oil boiler / ORC CHP plants

Thermal oil boiler / ORC CHP plants

Steam boiler / Cogeneration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THANK YOU
FOR YOUR
ATTENTION