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MSW incineration: from waste processing to combined heat and power production

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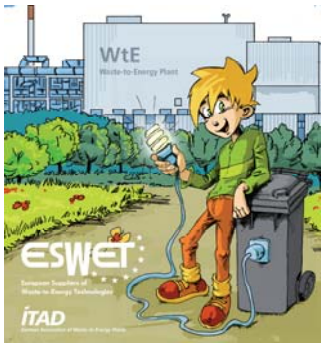
Evolution of MSW treatment

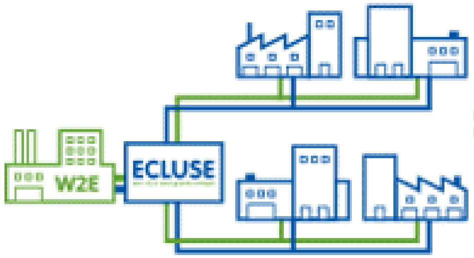
Landfill

Waste incineration

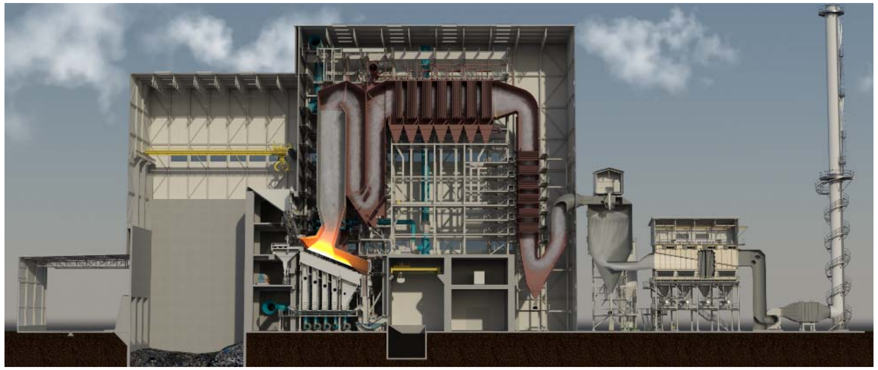
Waste-to-Energy



WtE as CHP



Energy from waste



- Energy from waste
  - Electricity
  - Heat, e.g. district heating
  - Steam

- Energy efficiency dependent on:
  - Calorific value of the waste
  - Heterogeneity of the waste
  - Chemical complexity of the combustion gases
  - Legal requirements

WtE as CHP

- Not straightforward

- Challenges:
  - General energetic optimization of the process
  - Design and operational challenges for WtE as CHP
    - Annual waste throughput
    - Plant availability
    - Plant operation: flexibility vs. continuity
    - Stability of energy supply

General energetic optimization

- <u>Optimization of process control</u>
  - Automated waste feeding, air management, grate movement

  →Energetic content of the waste released in most stable way possible

  → Stable flue gas conditions

- <u>Lowering of excess oxygen</u>
  - To avoid excessive cooling
  - > 5v% at boiler outlet!

General energetic optimization

- Internal recycling of process heat
  - Primary/secondary combustion air preheating

- Recovery of low-temperature heat
  - Flue gas T > dewpoint acids

- Increase of boiler steam parameters
  - Need for costly extra protective measures

→ Up to 10% improvement of electrical efficiency

→ Increase of R1 value above limit value of 0.60

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Design and operational challenges for WtE as CHP

- <u>Annual waste throughput</u>
  - o Needs to be ensured continuously
  - o Also when no steam required by customer
    - Send additional steam to a turbine
    - Send excess heat to buffering heat network
  - o Needs to be incorporated in design waste-fuelled CHP plant

Design and operational challenges for WtE as CHP

- Plant availability

- Customers:
  - Chemical industry, paper mills, large greenhouses, district heating, 24/7 operation
  - Require steam 100% of the time, typical WtE availability 90-95%

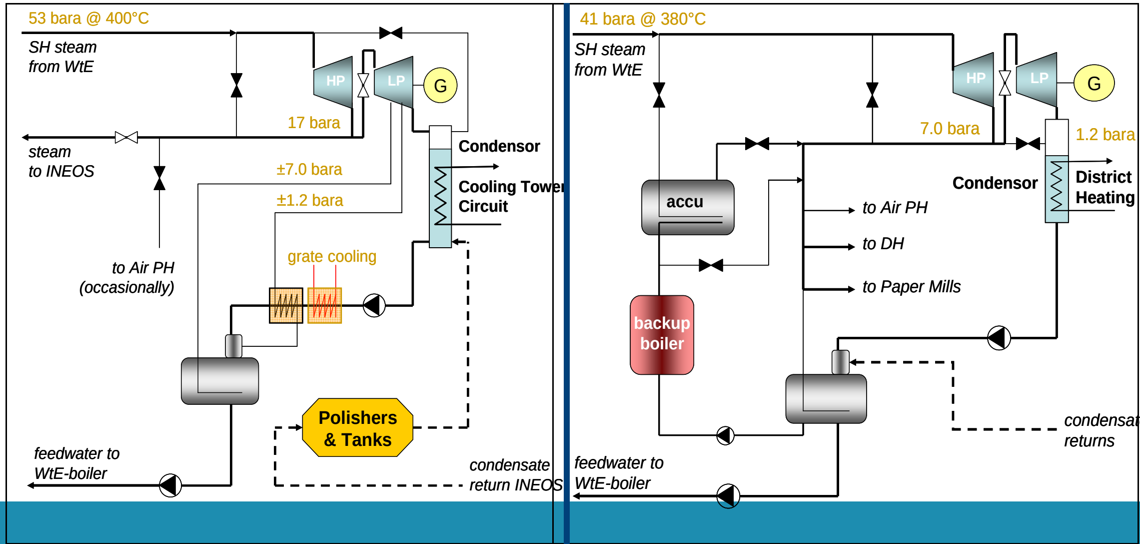
- Extend operation period between shutdowns
  - Redundant equipment, additional on-line boiler cleaning, more frequent technical inspections and small reparations
- Anticipate alternate downtimes of the WtE process lines

Design and operational challenges for WtE as CHP

- Plant operation: flexibility versus continuity

- Different customers have different steam demands
  - Chemical industry vs. small paper mill vs. district heating

- Complex design of Rankine cycles



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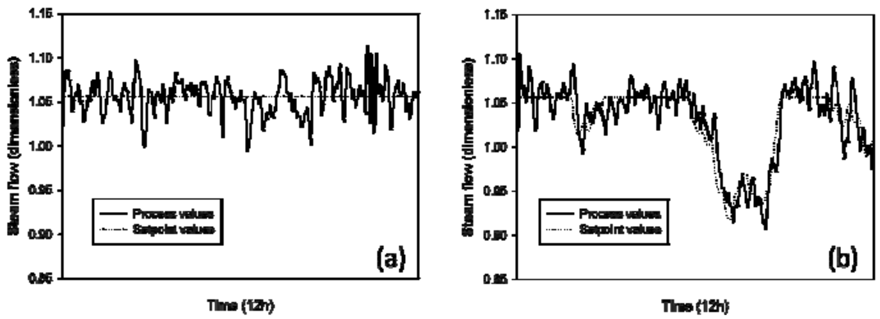
Design and operational challenges for WtE as CHP

- Stability of energy supply

- Steam stability dependent on definition
    - Standard deviation from process value
    - Average of deviation of the process value from setpoint



WtE as CHP

- Examples
  - Great Manchester Waste Disposal, Runcorn, UK
    - 17 bar steam to INOVYN + electricity, total plant efficiency 48%
  - Indaver site, Beveren, Belgium, Ecluse project
    - Steam network + electricity, total plant efficiency ± 50%
  - Attero site, Moerdijk, The Netherlands
    - 100 bar, 400°C steam to Essent→Shell, total plant efficiency 85%

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Conclusions

- Electrical energy efficiency of WtE plants is low due to properties inherent to waste
- Nowadays integration in CHP schemes
- 3x increase of energy efficiency compared to stand-alone
- Tailored design to integrate WtE in CHP schemes, to meet criteria:
  - High yearly availability
  - A stable steam supply
  - Cope with variable/seasonal demand
  - Different types of energy to multiple energy consumers

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Thank you for your attention!

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