Methodology for streams definition and graphical representation in Total Site Analysis

Elfie Méchaussie
Stéphane Bungener, François Maréchal, Greet Van Eetvelde

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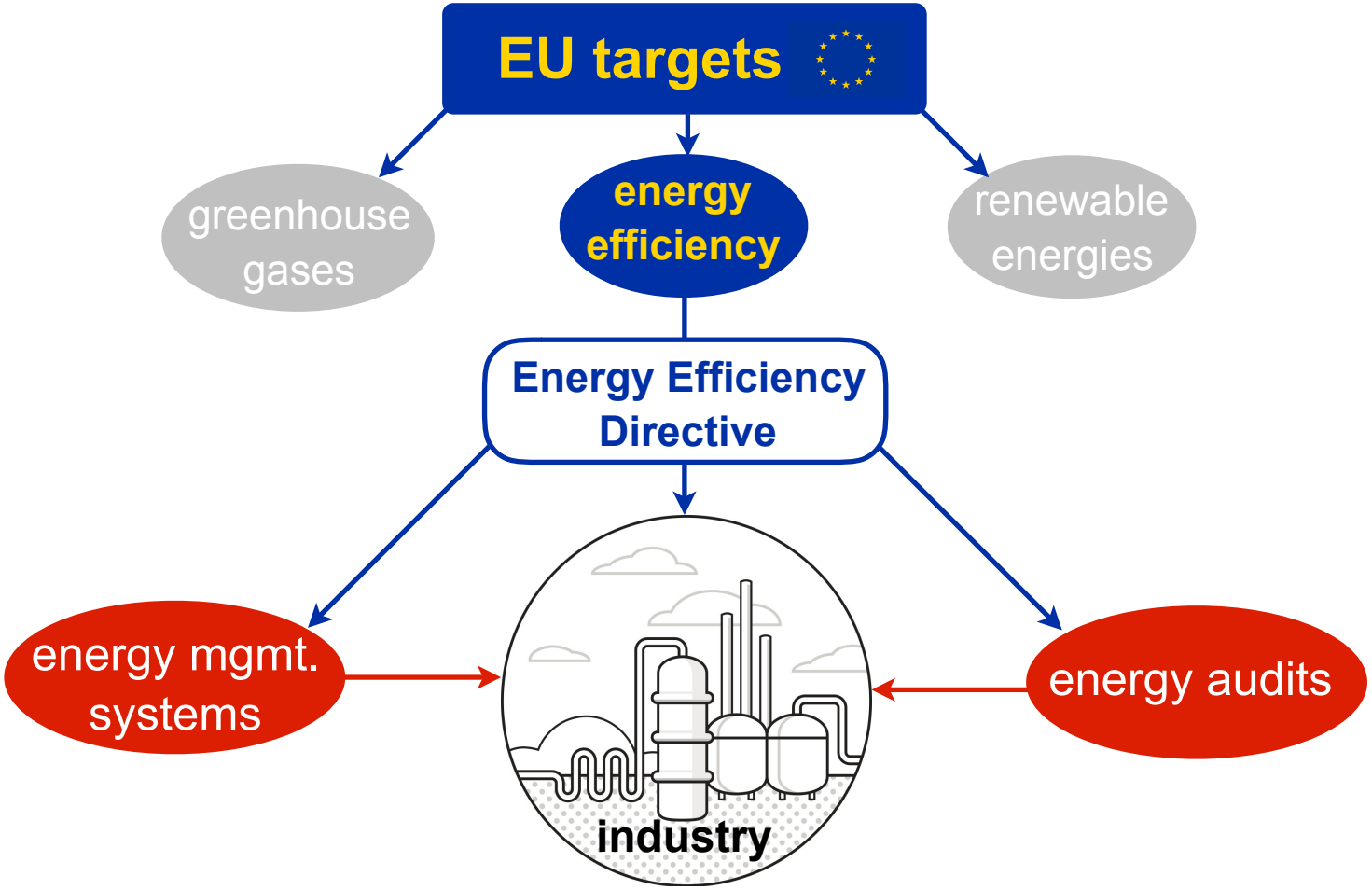
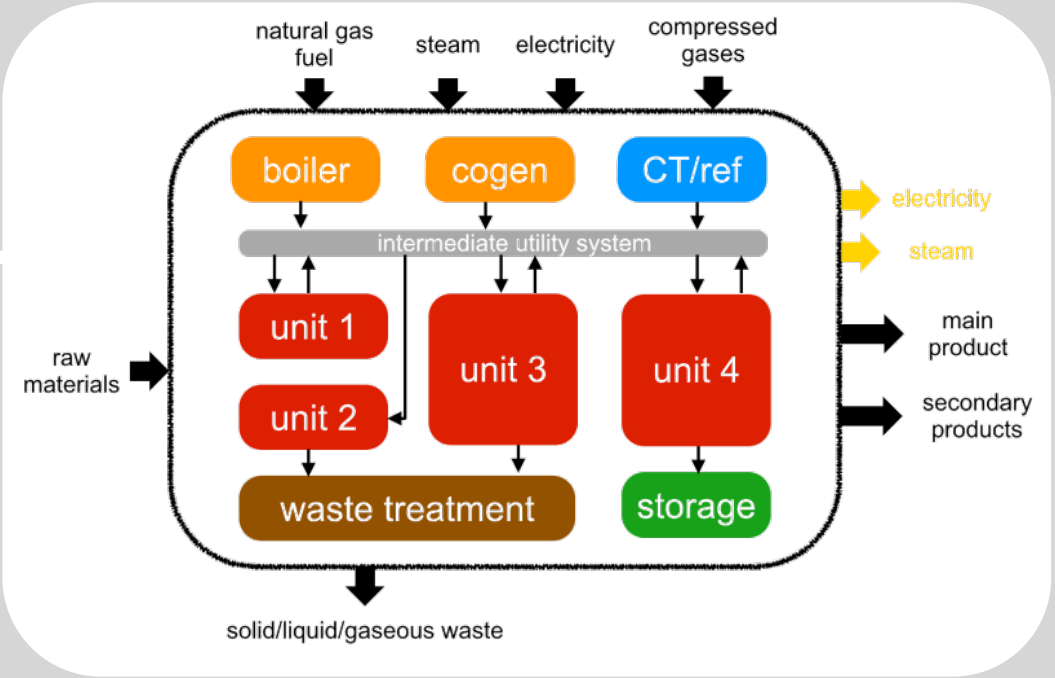
European context



continuous evaluation - improvement - monitoring

Total Site Analysis (TSA)

- **powerful method to identify energy efficiency improvements**
- **pinch analysis applied to large industrial sites**
  - 50 to > 500 MW of thermal power demand



- **"grey box" level**
  - process / utility interface
- **heat recovery through common utility system**

presented work

state of the art:

- important body of work on TSA (since the 90's)
- many aspects/limitations adressed in literature

- **in-detpth explanations for practical applications hard to find**

- **recurrent practical issues**
  - large data size, system complexity, lack of time & skills

presented methodology:

- step-by-step approach to properly define main heat flows
- temperature-enthalpy profiles

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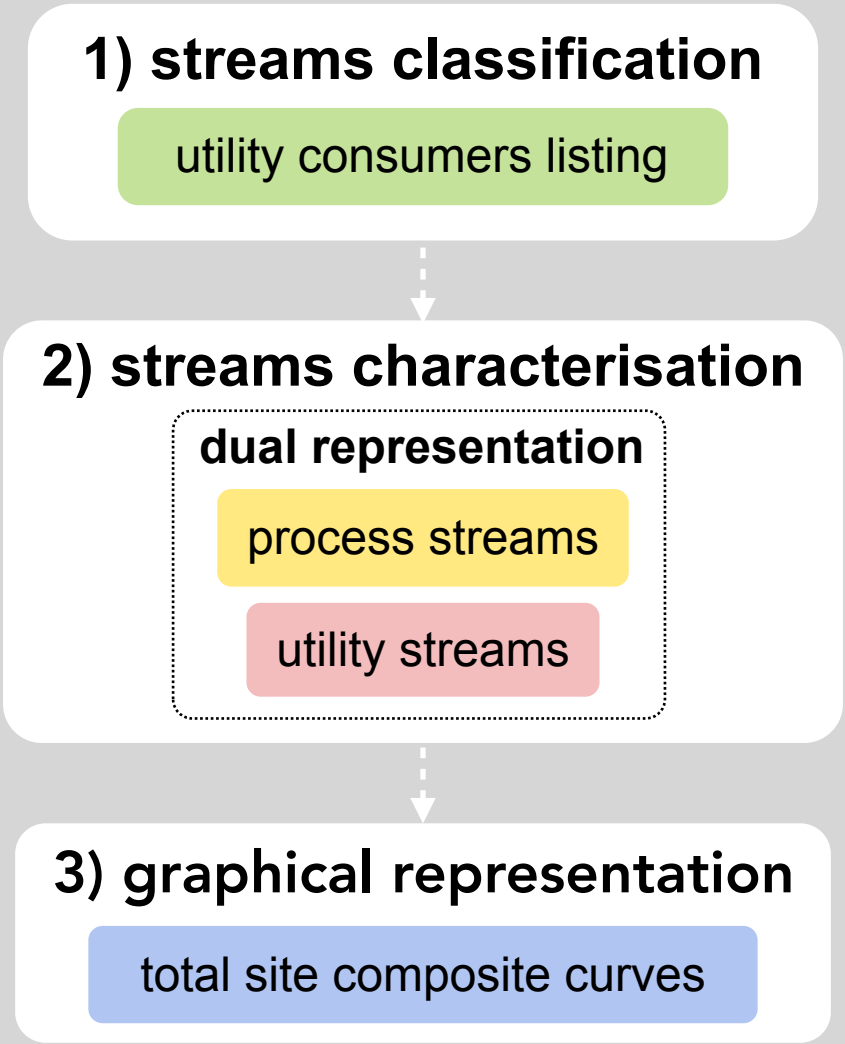
methodology for streams definition



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streams classification

- **process - utility HEX listing and classification**

cold streams:

- heaters
- reboilers
- stripping
- tracing/storage
- building heating
- losses

structuring & simplification of data collection

hot streams:

- coolers
- condensers
- reactor cooling

process streams characterisation

- **required parameters:** T_{in}, T_{out}, Q, $\Delta T_{min}/2$
- **dual representation:** easier calculations from utility side

T_{in}, T_{out}	Q	$\Delta T_{min}/2$
from process side (P, composition, phase change profile, TBP)	**from utility side** (m_u, $T_{u,in}$, $T_{u,sat}$, $T_{u,out}$, $P_{u,in}$, $P_{u,out}$)	**typical values** (5-10°C)

- **if not available, additional data need to be collected**
  - mass & energy balances, modelling… ⇨ context dependent

special cases

- **injections**
  - minimum P required (process/equipment constraints)
- **reactor cooling**
  - X_r, reaction conversion; ΔH_r, heat of reaction
  - intermediate cooling system (security constraints)
- **building heating**
  - usually a black-box
  - more detailed methods can be used (heating degree-day)

objective is to define minimum process requirements

utility streams characterisation

- **defined simultaneously to the process demand**
  - dual representation
- **no additional data collection needed!**

other important utility flows:

- letdowns & turbines
- intermediate utility systems
- deaerator venting

cogeneration potential

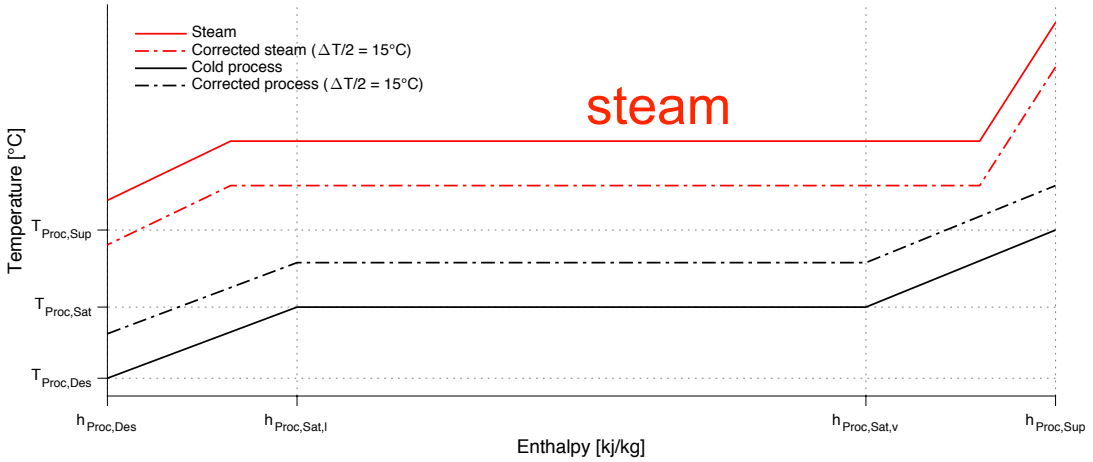
security/technical constraints

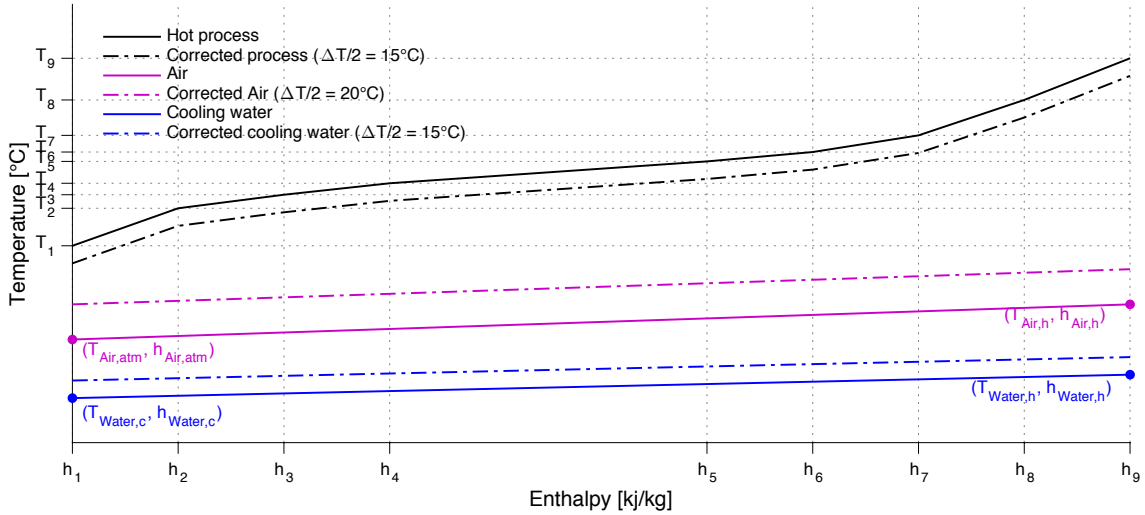
preheating & gas removal

graphical representation - phase change

single compound evaporation

utility = steam

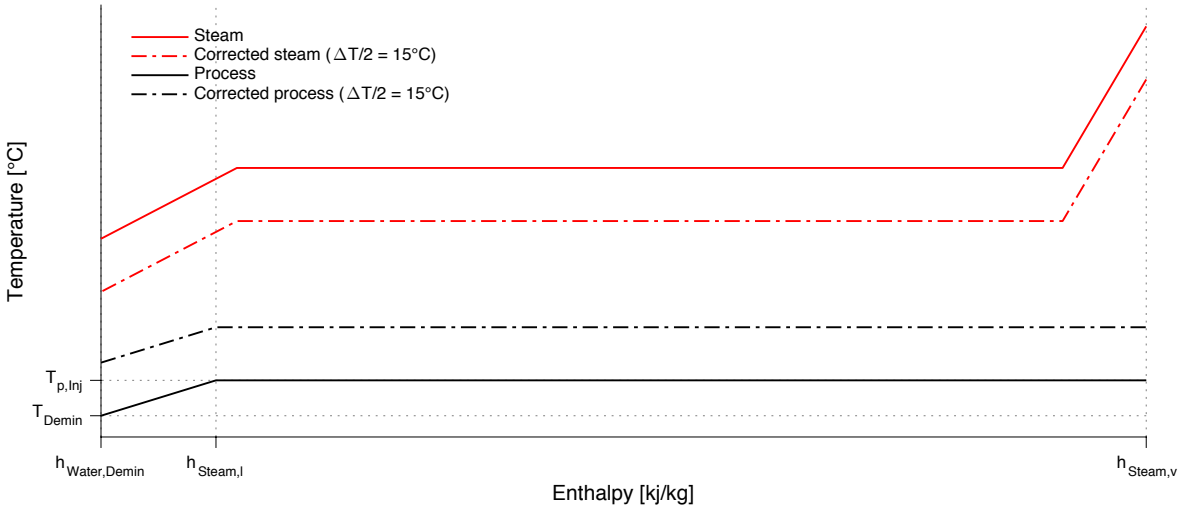




multi compounds condensation (True Boiling Point)

utility = air/water

graphical representation - special cases

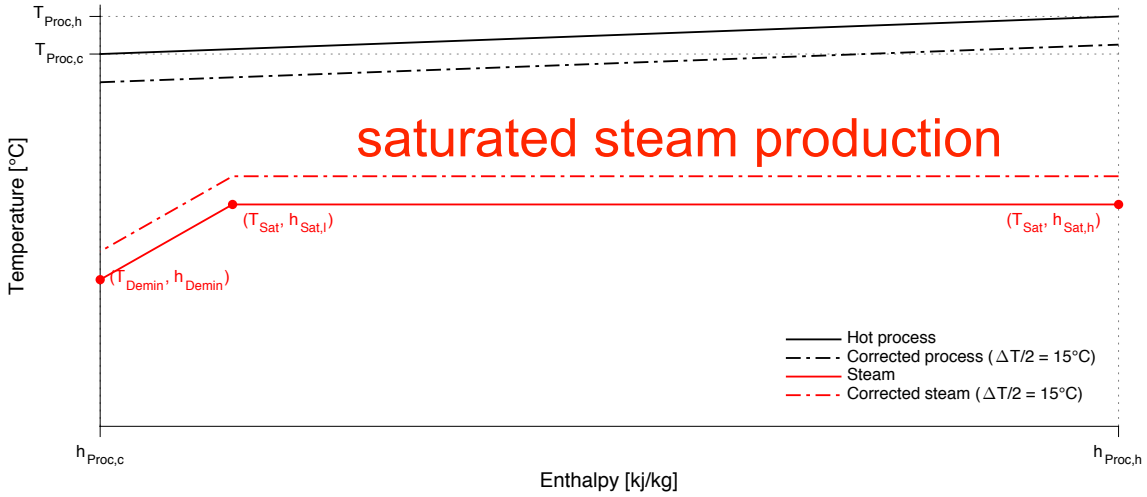


steam injection

(= steam requirement at Pmin)

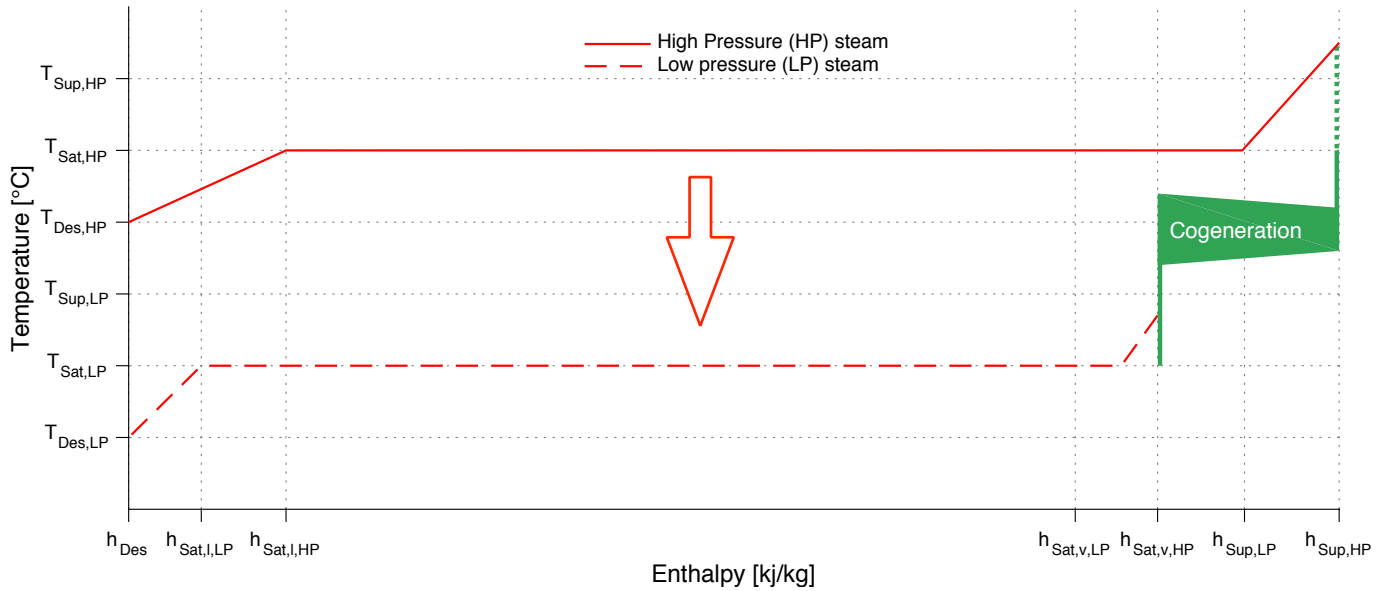
steam production through process cooling

(from hot stream or reaction heat)



graphical representation - mechanical power

- representation of electricity produced in steam turbines



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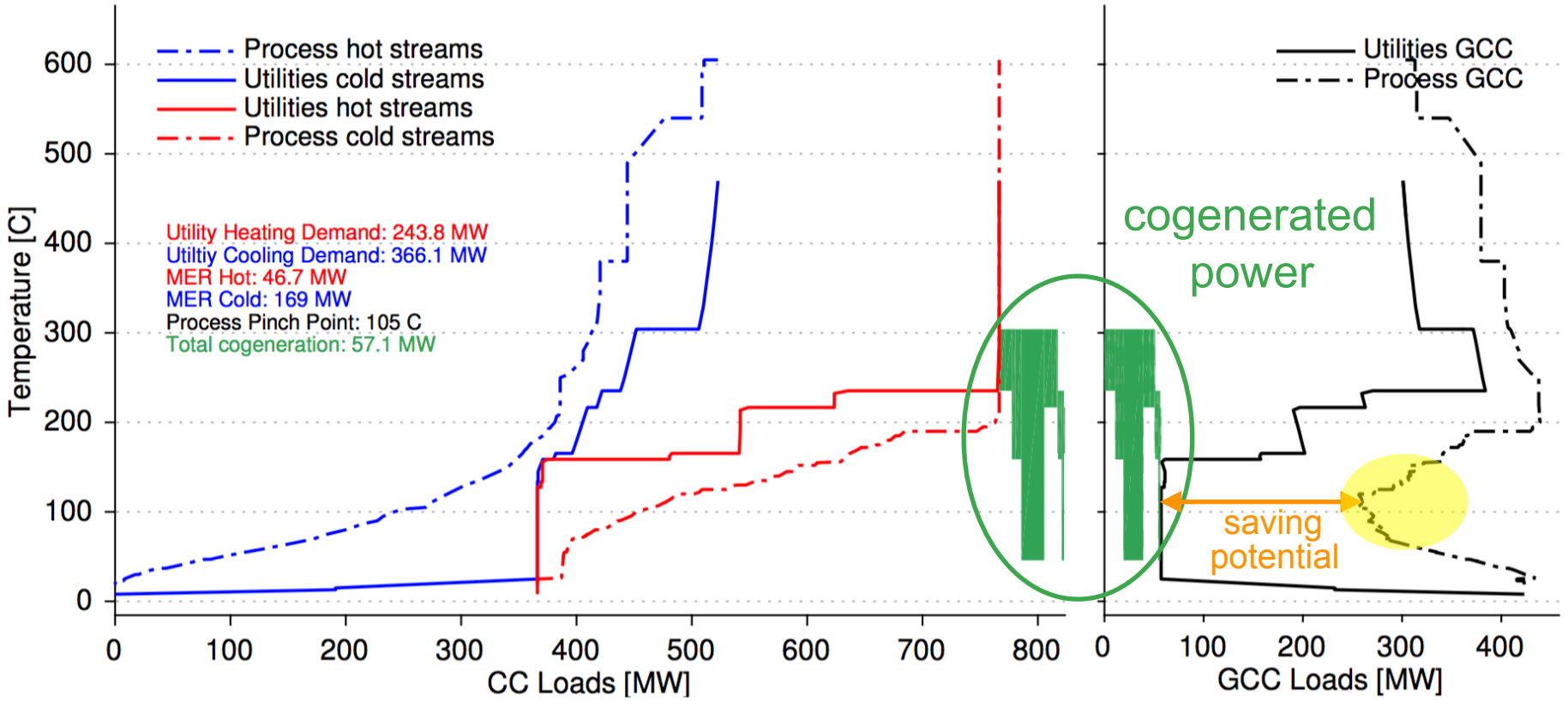
- **total site composite curves of an industrial cluster**

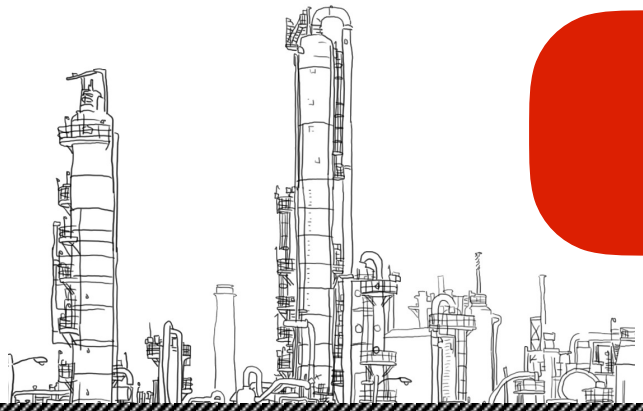


key points - outlook

- **methodology for streams definition in TSA**
  - support for practical application
  - systematic approach (3 steps)
  - reduce time and complexity

- **outlook:**
  - input to high level energy review
    - **in the framework of energy audit and EnMS**
  - development of the full methodology and output required
    - **performance evaluation**
    - **energy saving opportunities**
    - **monitoring**

Thank you for your attention…



…time for questions !