Potential för energieffektivisering i industriella klustrar – analys och scenarier

Simon Harvey

Professor i industriella energisystem

Värmeteknik och maskinlära, Chalmers

Ingår i projektet ***Bærkraftig bruk av energibærerne i KASK regionen***

EUROPEISKA UNIONEN
Europeiska regionala utvecklingsfonden

Interreg IVA
ÖRESUND – KATTEGAT – SKAGERRAK

KASK
SUSTAINABLE USE OF ENERGY SOURCES IN THE KASK REGION

Kort om projektet ***Bærkraftig bruk av energibærerne i KASK regionen***

Exercising Pathways towards a sustainable energy system

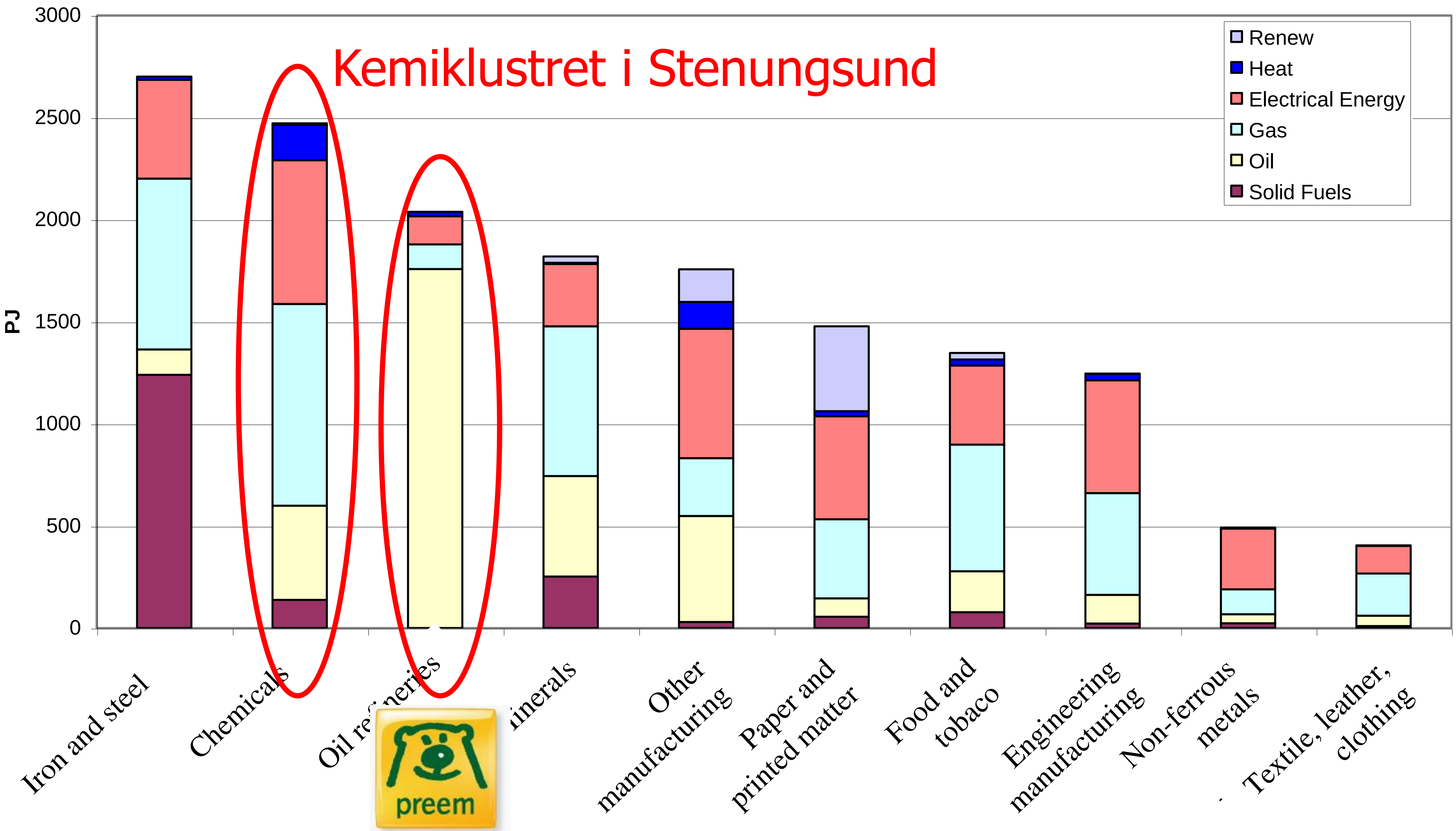
Year 2020 is not far away when it comes to transformation of the energy system!

Year 2050 is useful as a Compass for the direction of change (and is not far away when it comes to transforming the building stock, road infrastructure, power plants…)

Projektets mål och fokus

- Mål - mot ett oberoende av fossila bränslen i regionen
  - Ta fram utvecklingsvägar för energisystemet i regionen som visar hur regionen kan uppfylla EUs 20-20-20 mål samt hur utvecklingen kan fortsätta efter 2020 mot ett hållbart energisystem
  - Ge underlag för hur kortsiktiga mål kan knytas till långsiktiga visioner
  - Stärka det goda nätverk för forskning som redan etablerats inom regionen genom tidigare Interregprojekt (CCS i Skagerrak/Kattegat-regionen)
- Fokus:
  - Effektivisering hos ett antal nyckelindustrier
  - Storskalig integration av vindkraft/annan förnybar kraftproduktion
  - Effektivisering av befintlig byggnadsstock

Energy usage in industrial sector. EU 27, 2004



Källa: Eurostat

Energy efficiency in the Stenungsund chemical cluster

Rising energy prices + Threat of global warming + Policy instruments for CO_2-emissions reduction = Strong incentives to improve energy efficiency

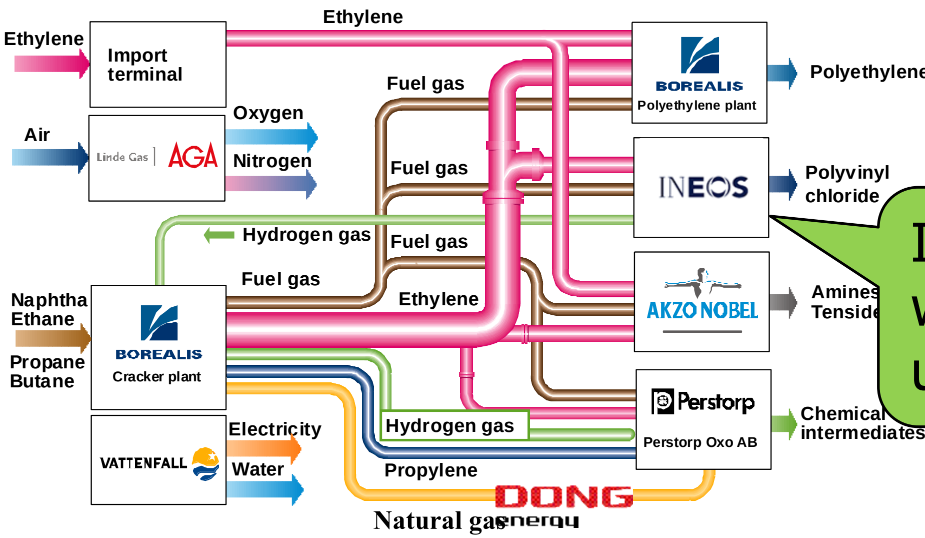
Energy intensive industrial process clusters can significantly increase energy efficiency by inter-process heat exchanging

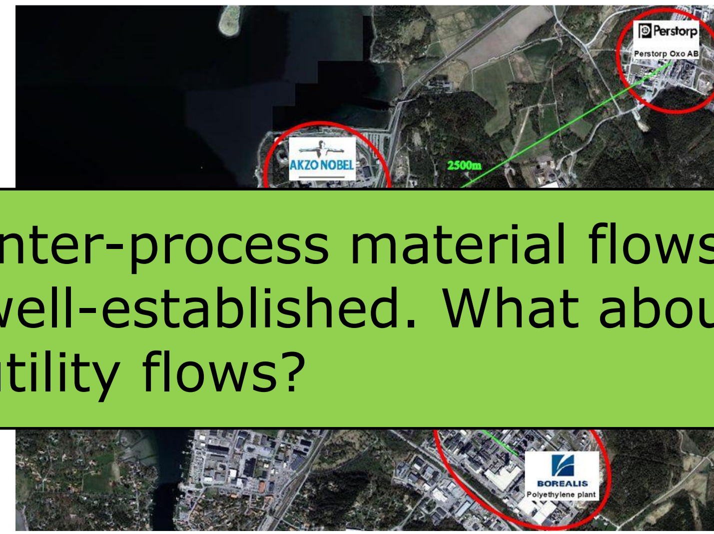
Total Site Analysis (TSA) is a useful tool to investigate opportunities for inter-process heat recovery in industrial process clusters

This presentation:

- Tools for Single process and total site analyses
- Highlights from a case study (Chemical cluster, Stenungsund)

The potential of inter-process heat integration: Opportunities for improving energy efficiency in Stenungsund – Sweden's largest chemical cluster





Inter-process material flows are well-established. What about utility flows?

Key figures for total site:

- Total CO_2 emissions: ~900 kton/yr
- Total heating demand: 442 MW – 320 MW are covered by internal heat recovery
- Current utility usage fr fired boilers: 122 MW
- Can theoretically be reduced to **0 MW** through inter-process heat integration!

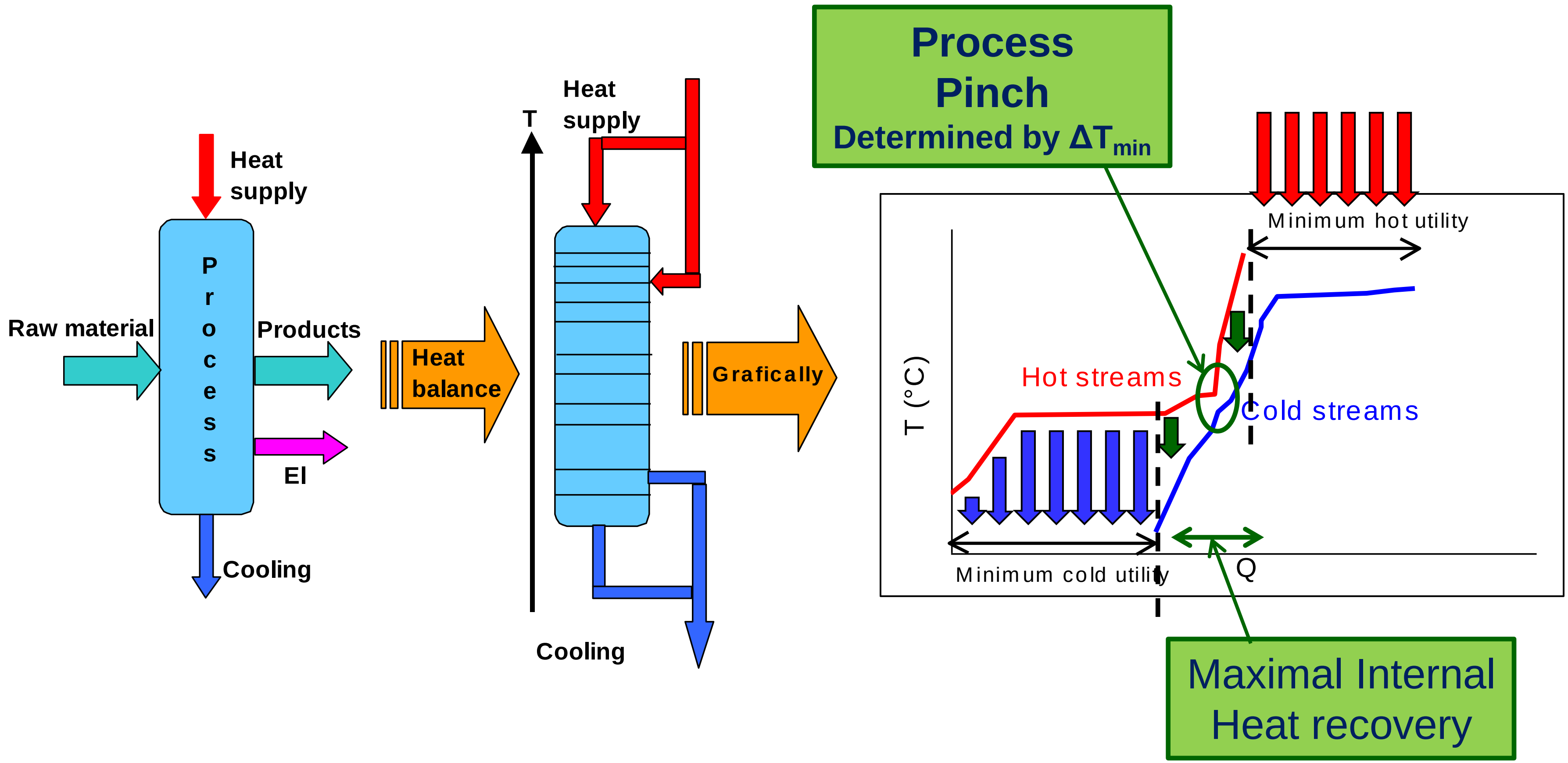
How this can be accomplished:

- New circulating hot water systems 50-100°C
- Harmonization of utility pressure levels to enable heat exchange between process plant utility systems
- Rebuild steam heaters for 2 bar(g) operation
- Fire process off-gases in different boilers

Pinch Analysis for Heat Integration studies

- Process integration (PI) refers to the analysis and optimization of large and complex industrial processes
- Pinch analysis is a widely-used PI tool in many industry sectors, including Chemical sector
- Pinch analysis enables investigation of energy flows within a process, and identification of the most economical way to maximize heat recovery and minimize the demand for external utilities (e.g. steam and cooling water)

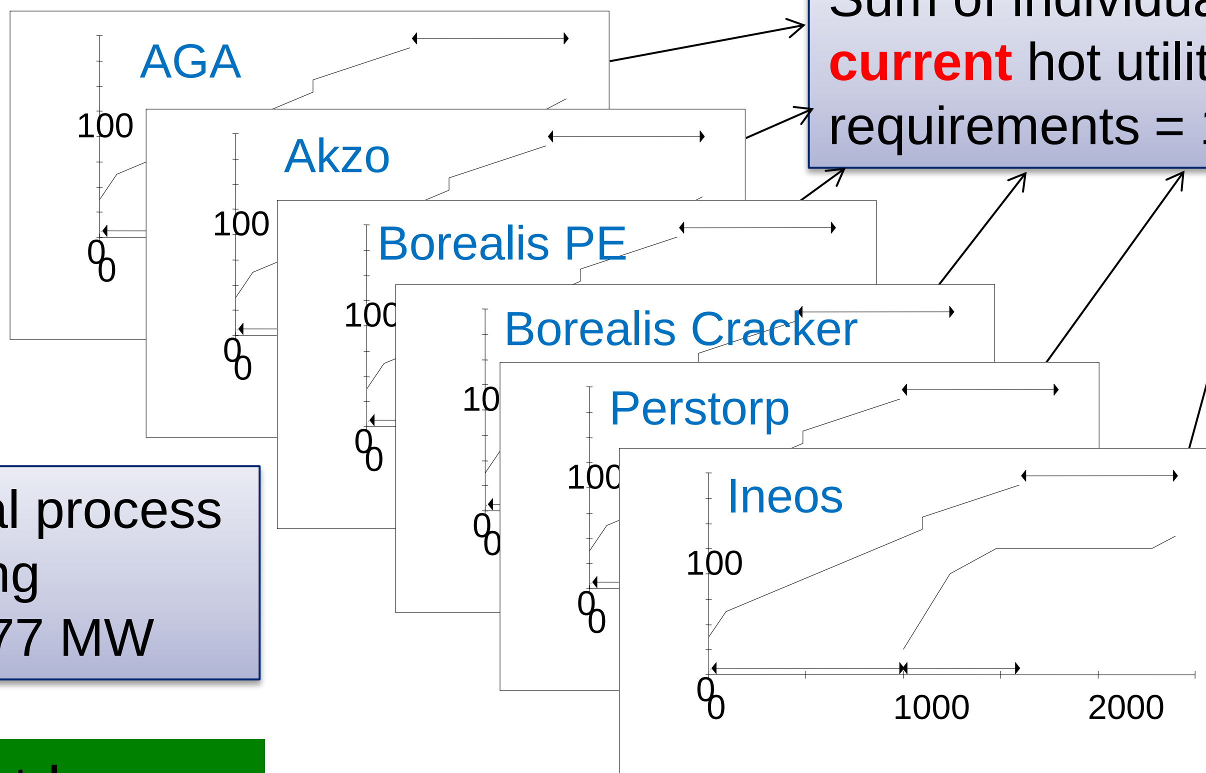
Basics of Pinch Analysis



Process streams → **Energy analysis**

Can the same approach be used for investigating inter-process heat exchange in multi-plant industrial clusters?

Sum of individual process **current** hot utility requirements = 122 MW

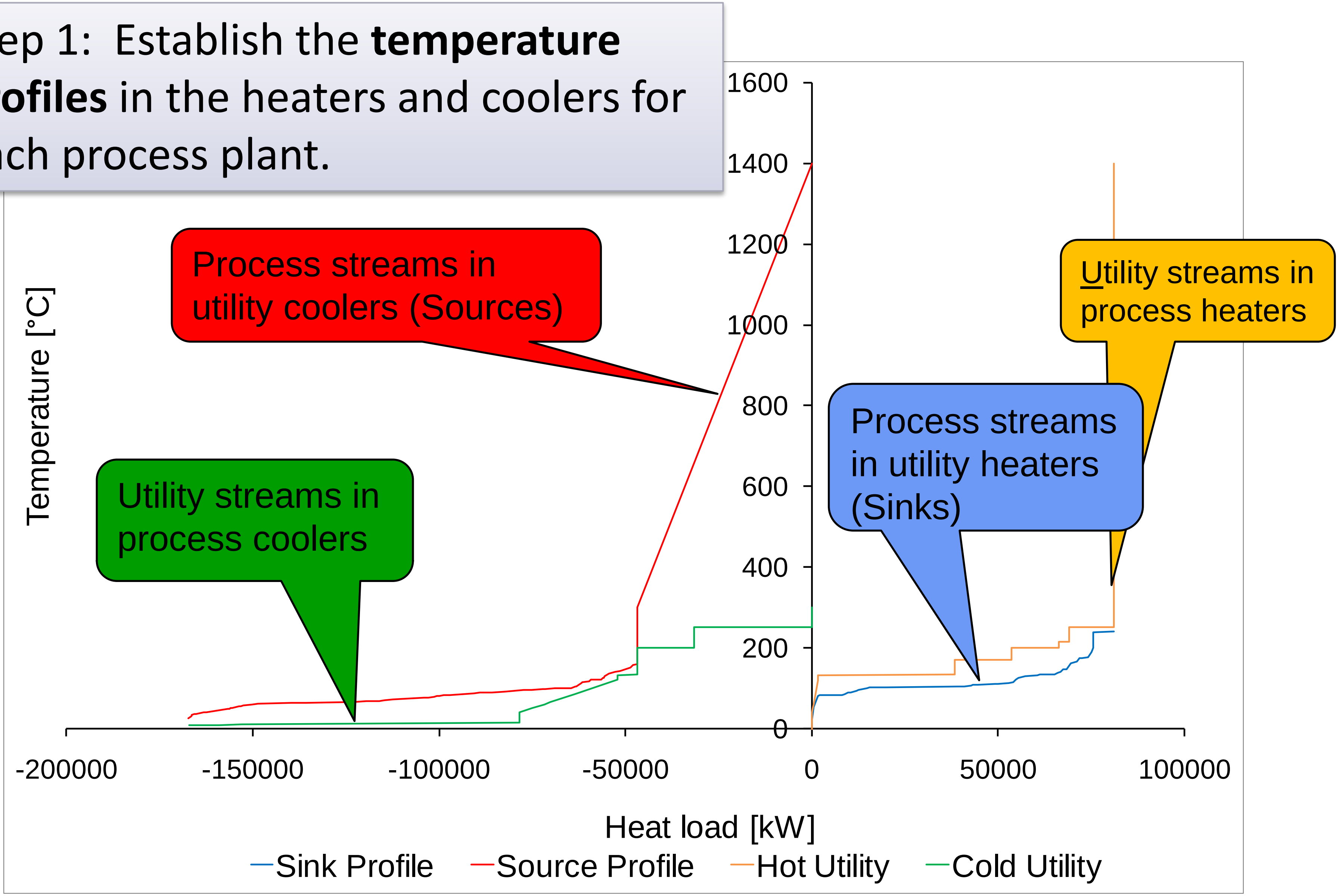


Sum of individual process **minimum** heating requirements = 77 MW

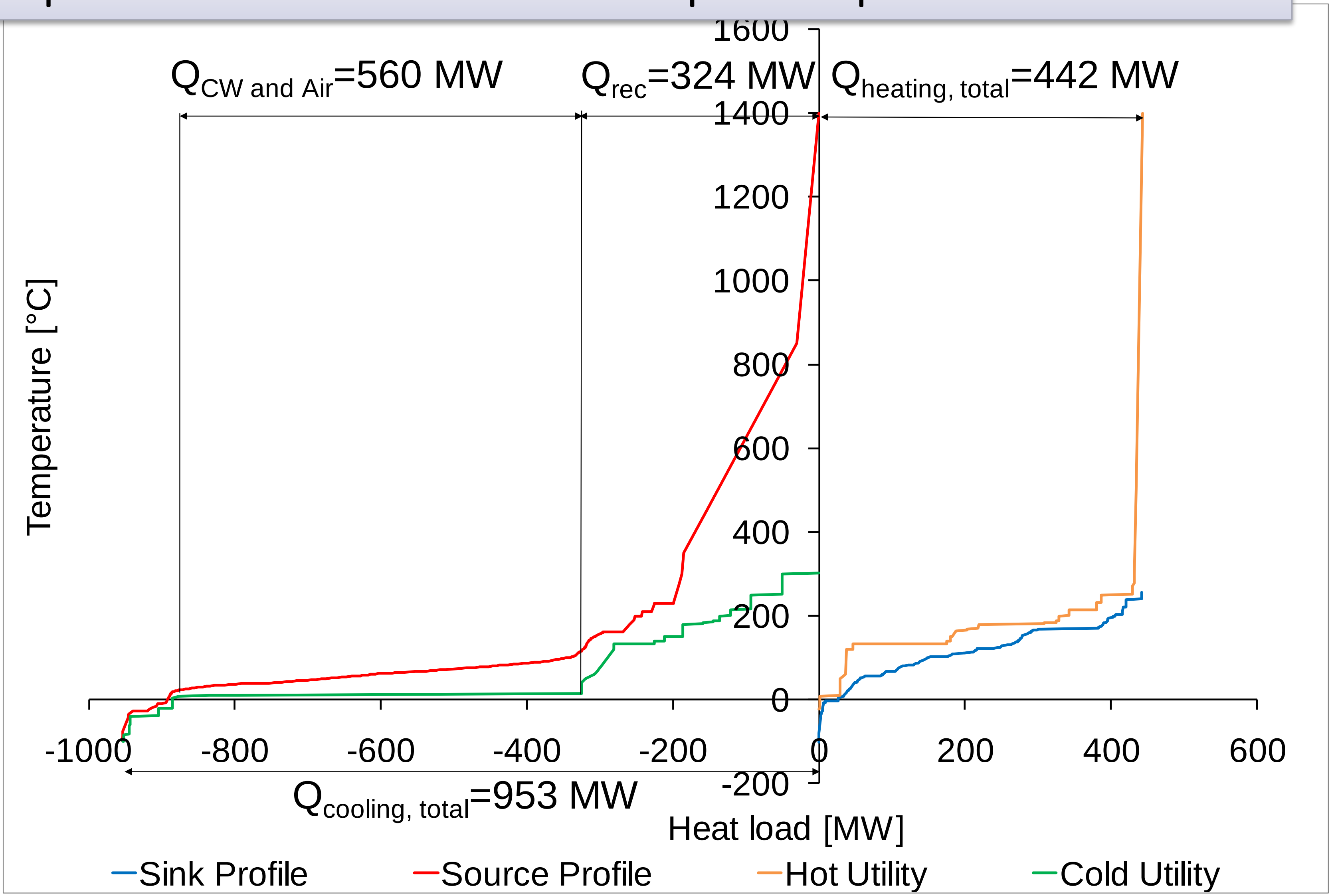
Can this target be decreased further?

Use **Total Site Analysis (TSA)**

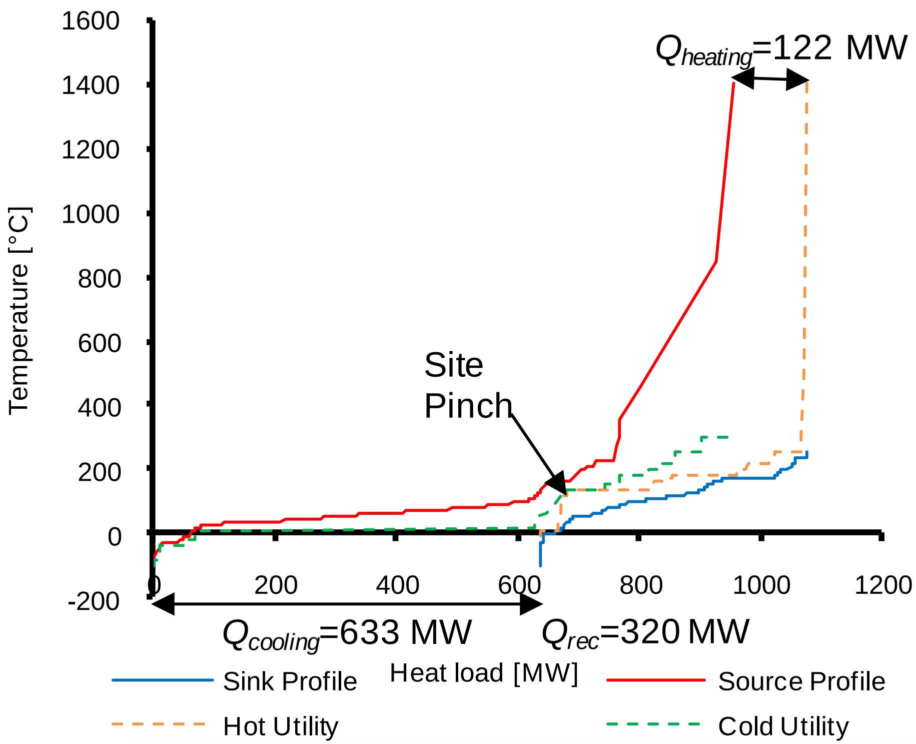
Step 1: Establish the **temperature profiles** in the heaters and coolers for each process plant.



Step 2: Combine the curves for all process plants in the cluster



Step 3: investigate the potential to reuse heat from coolers as hot utility elsewhere. Total Site Approach (TSA)

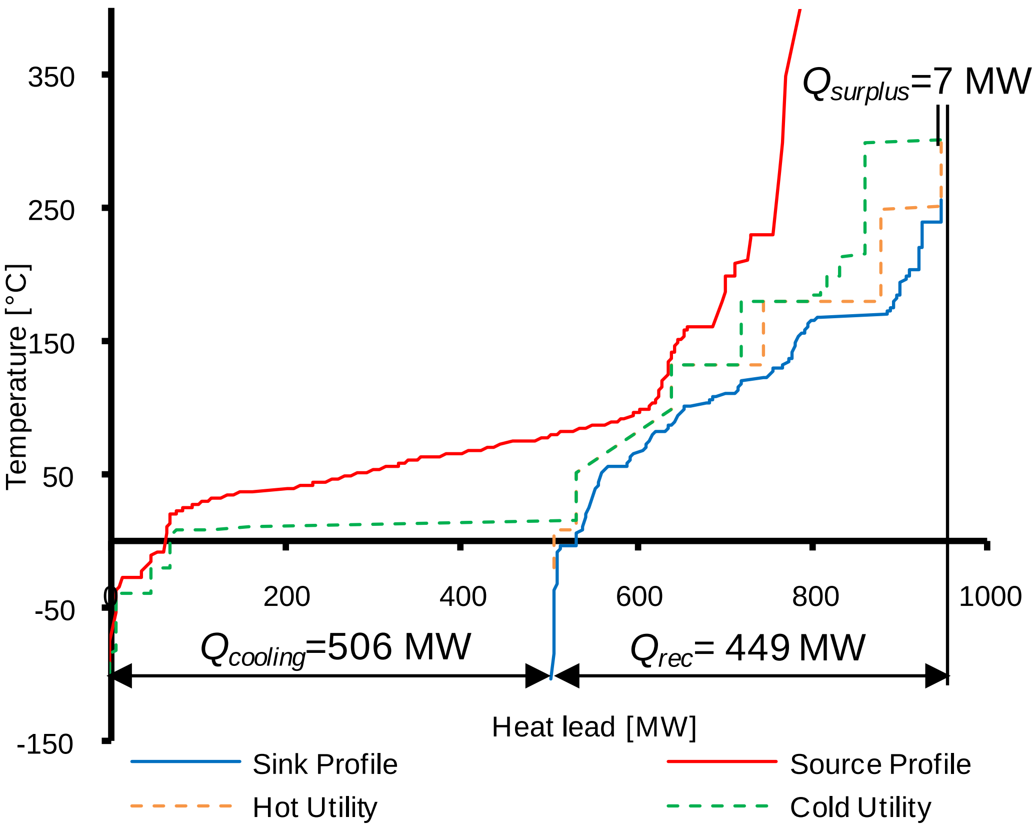


TSA results:

- Hot utility load is $Q_{heating}$ = 122 MW from fired boilers, i.e. no improvement over analysis of separate processes
- Site pinch at 120 °C
- Cooling provided by CW, air and refrigerant

→ In order to improve energy efficiency we must make changes to utility systems (in order to shift site pinch)

Step 4: Investigate ways to improve the site utility system so as to reduce the total site heat demand



Technical measures:

- Hot water system 50-100°C
- Increased recovery of 2 bar(g) steam
- Harmonize utility levels (only 3 levels)

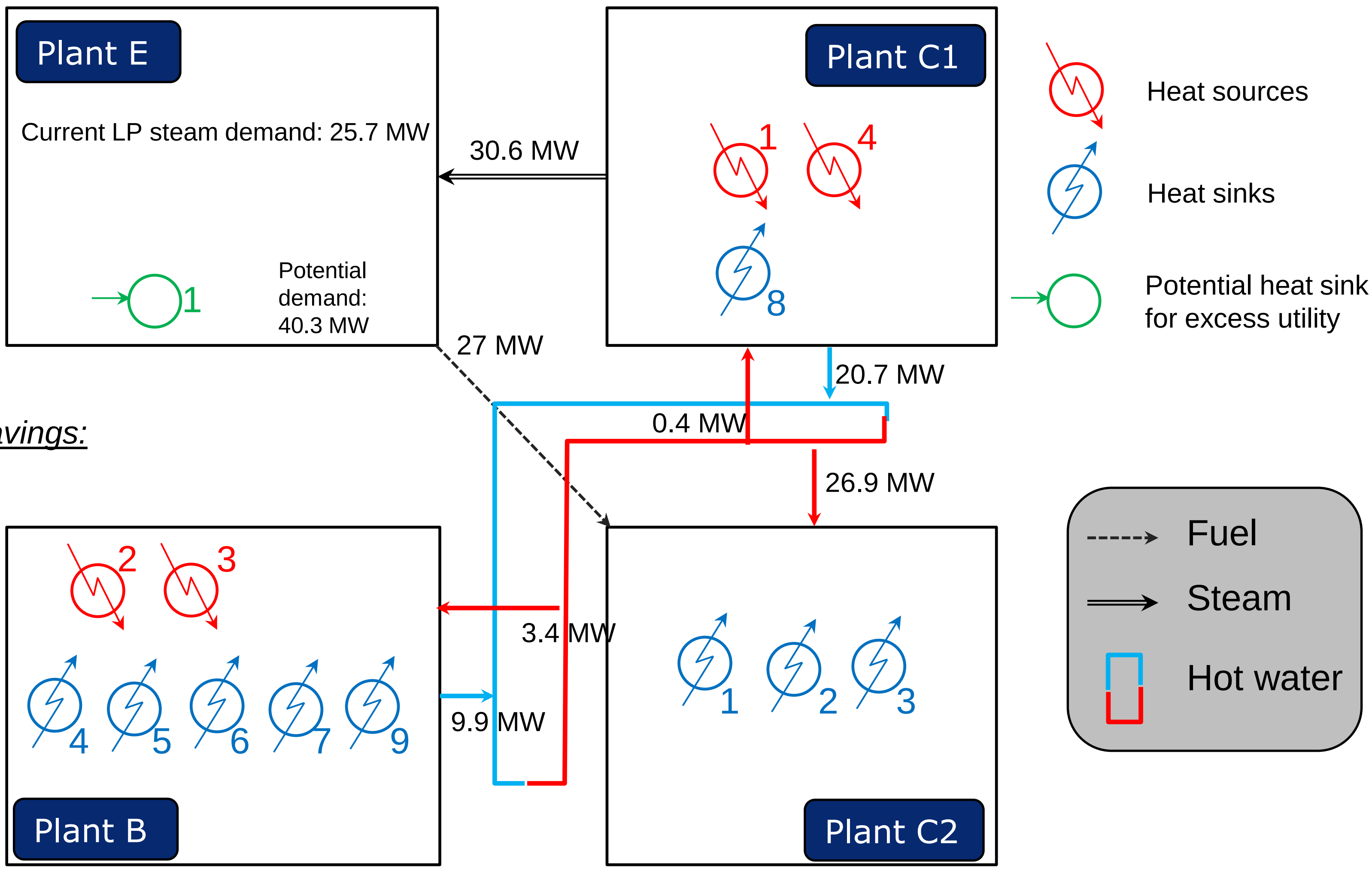
Results:

- New heating demand:
  $Q_{heating}$ = 0 MW
- Potential savings: 122 MW
- Steam surplus: $Q_{surplus}$ = 7 MW
- Compare with sum of individual process minimum heating demands (77 MW)

Design options

- Availability of different heat sources and sinks at different companies provides many degrees of freedom in the design of the heat recovery system
- Delivering heat from one plant to another requires **new HXs** and **piping construction**
- Recovered excess heat mainly replaces LP steam, which can cause excess of LP steam at certain sites
- Excess LP steam has to be redistributed to sites with LP steam demand
- Combustible by-products (off-gases) that can't be used otherwise have to be redistributed to sites with demand

Hot water circuit – max heat recovery (4 plants involved)



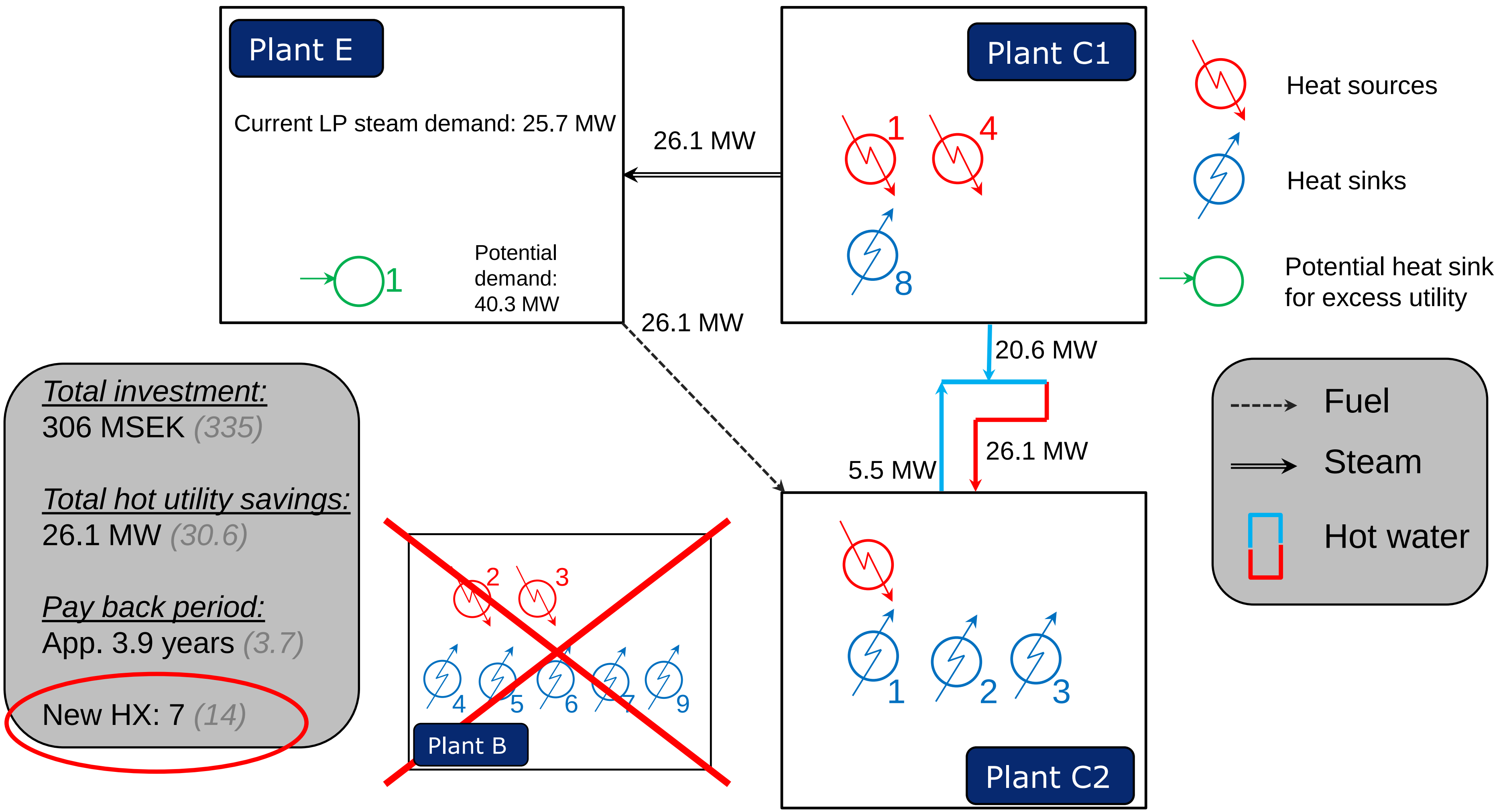
Total investment:
335 MSEK

Total hot utility savings:
30.6 MW

Payback period:
App. 3.7 years

New HX: 14

Can we reduce complexity without severe energy savings penalty?



Summary

- Pinch analysis tools can be extended and used for Total Site studies of industrial process clusters
- TSA applied to the chemical cluster in Stenungsund indicates major opportunities for increased energy efficiency through inter-process heat exchange
- BUT this is not Business-as-usual
- New business models are required to realize the potential (or part thereof)

Combining Energy Efficiency in Industrial Clusters with integrated biorefinery options

Overview of ongoing activities within the SKOGSKEMI project

Simon Harvey and Matteo Morandin

OBJECTIVE, Partners, time-frame

To support strategic, renewable, competitive productions from two of the basic Swedish industrial sectors: forest and chemical

(co-)financed by dish Governmental Agency for Innovation Systems

Budget: 20 MSEK for 2 years project (sep 2012 – sep 2014)

10 MSEK from VINNOVA, 10 MSEK "in-kind" from research partners

Scope

Feedstock is any forest product

(mainly lignocellulosic biomass)

3 final products ("pathways"):

. Methanol

. Olefins (Ethylene, Propylene)

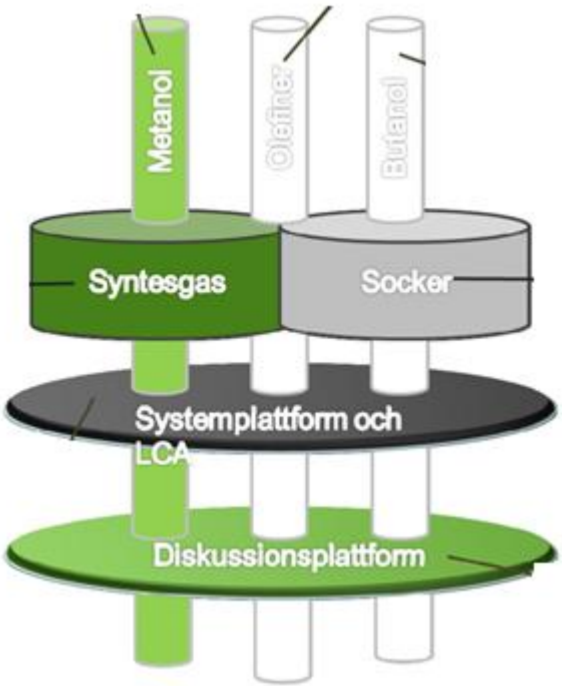
. Butanol

2 technology "platforms"

. Gasification (syngas)

. Fermentation (sugar)

2 analysis "platforms": system analysis, discussion



Possible Pathways

Cluster heat integration →

Feedstock Sustainability ↓

Current situation
- little or no green Feedstock;
- 122 MW heat from fired boilers

Improved heat efficiency
- Little or no green Feedstock;
- Reduced heat from fired boilers (25…50% of current demand)

Green Feedstock
- large part of the feedstock is green MeOH or EtOH;
- 122 MW heat from fired boilers

Green Feedstock and Increased heat integration
- large part of the feedstock is green MeOH or EtOH;
- Reduced heat from fired boilers (25…50% of current demand)

Tack!
Frågor?

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