Industrial CO2 Mitigation and Energy Efficiency--A Driving Force for New Strategic Decision-Making and Cooperation in Process Industries

By

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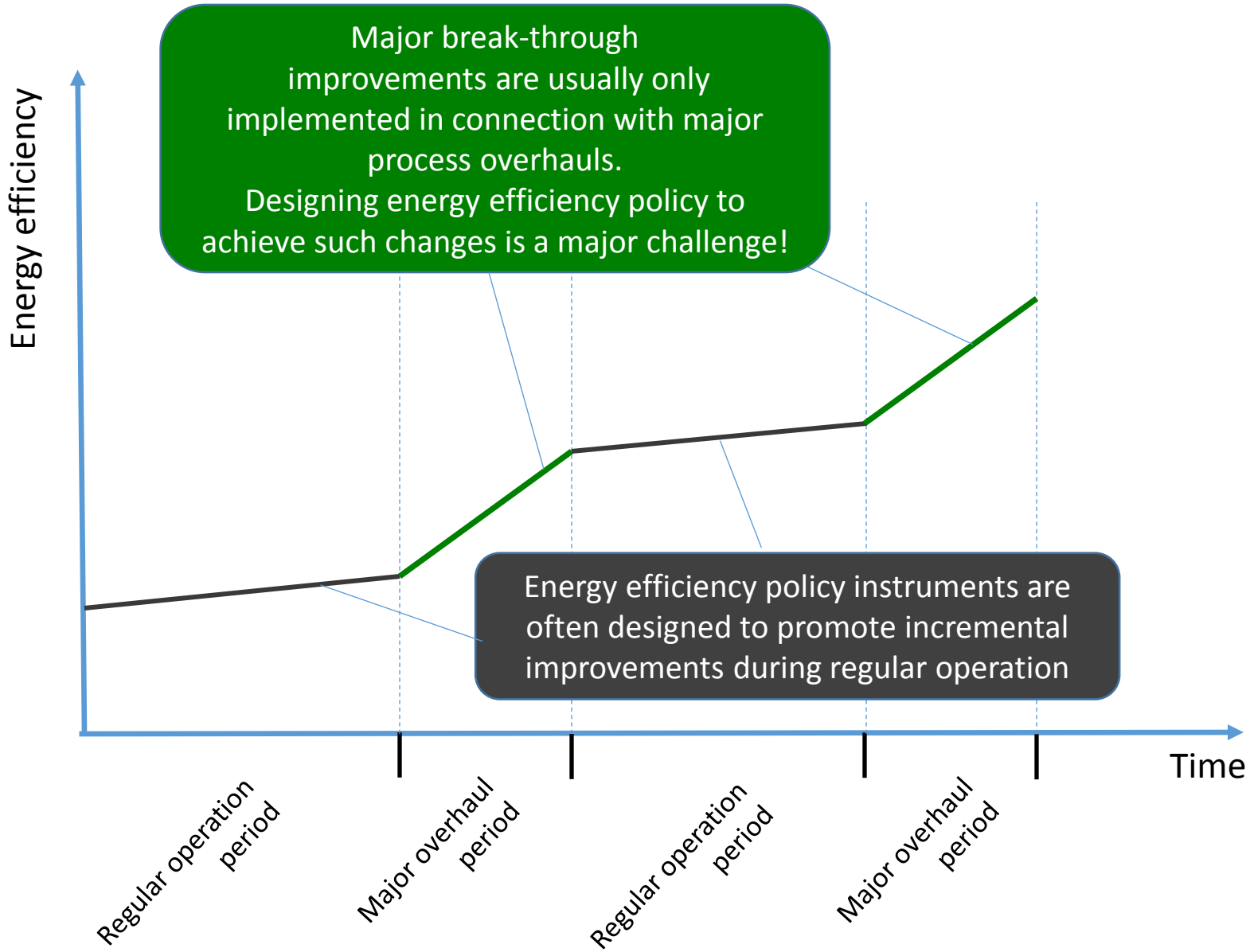

Major break-through improvements are usually only implemented in connection with major process overhauls.
Designing energy efficiency policy to achieve such changes is a major challenge!
Energy efficiency policy instruments are often designed to promote incremental improvements during regular operation
Energy efficiency
Time
Regular operation period
Major overhaul period
Regular operation period
Major overhaul period

New Strategic Decision-making in Industry

- Expected/Possible increases in future CO2-charges and energy prices call for a need/interest in new, more advanced technologies and systems
- Large uncertainties about the future
- Possible developments mean opportunities for more radical system changes
- The time perspective of changes becomes more important
- More need for cooperation and new business models

Major Developments in Process Industry

- Energy Efficiency, short term < 5 years
- Energy Efficiency/Large Process, System changes, 10-20 years
- Integrated Large Biorefineries > 10 years
- Industrial CCS (CCU) >15-20 years
- Electrification ?

- Future energy efficiency opportunities heavily dependent on possible Biorefinery and CCS developments

Energy Efficiency

--Clustering of Industries

--Industrial Excess Heat

--New Separation Processes

--New, Lighter, Products

--New Business Models, Cooperation

Time Perspective on Biorefinery Developments

Short term:

- Improved competitive position of core business

Medium term (5-10 years):

Focus on market development for added-value bioproducts over the longer-term, eg

- Sugar extraction for xylose production
- Lignin extraction for PF resins
- Mechanical pulping adaptation for cellulose filaments
- CNC production from kraft pulp
- Fermentation Ethanol
- Dissolving Pulp E g ethanol from hemicellulose

Long term (>10 years):

Bulk-type biorefinery concepts, coupled with added-value strategy e. g.:

- Black Liquor Gasification Green Power, DME
- Biomass Gasification Green Power, Methanol, FT-diesel, SNG
- Fermentation Ethanol, advanced end products
- Dissolving Pulp E g advanced products from hemicellulose
- Lignin Precipitation Carbon fibre, etc

Industrial CCS

Continuation of a national ”agenda” project.

Participants were from research, branch organisations and:

--Iron and steel industry

--Cement industry

--Chemical industry

--Oil refinery industry

--Utility industry (large CHP plants)

--Pulp and paper industry (having a special view)

Industrial CCS

Suggestions from the Agenda work:

National Strategy

National Research Program

Demo project:

3 phases, totally 10 years

A full-scale demo plant for the whole chain

Assumed cost 500 Meuro

Practically all process industries have a high interest as a part of strategic thinking (in planning stage, no committments at this stage)

Time Perspective

The time perspective is important for several reasons, e. g. :

- policy instrument and energy price development (sensitivity analysis important)
- Sustainability in terms of system GHG mitigation of a measure can be considerably different in 10-20 years than today
- Industry road maps important

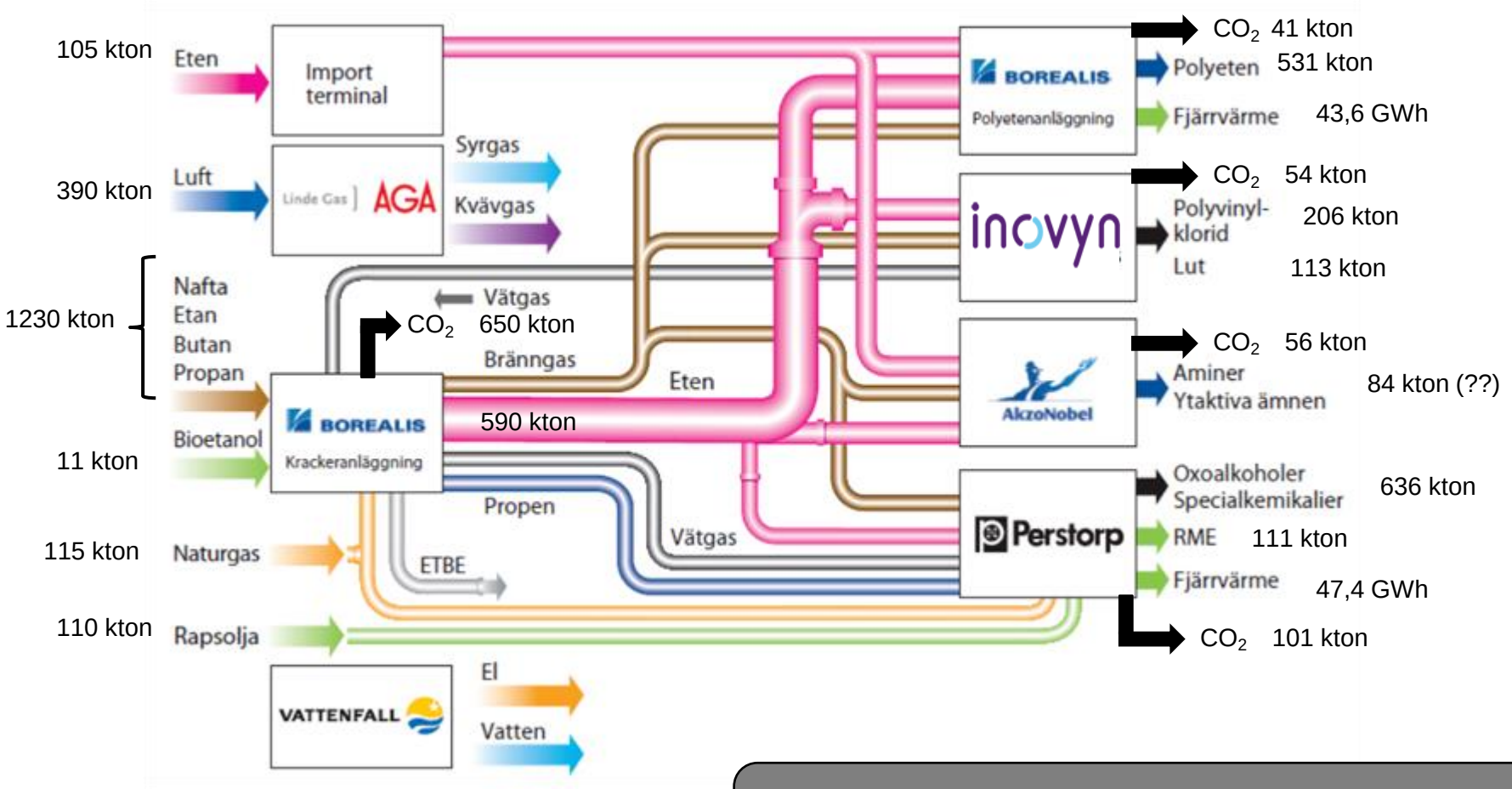
Ex-Ante Evaluation

- Increased need/interest for ex-ante evaluation of new concepts for energy efficiency and CO2 mitigation
- Future scenarios for CO2 charge, energy prices etc
- For example, CO2 charge 35 or 117 Euro/ton 2040? Coal price 25 or 51 Euro/MWh?
- Ex-ante evaluation for identifying ”robust” energy efficient concepts
- This strategic development is being successively implemented

Five companies with a common future vision

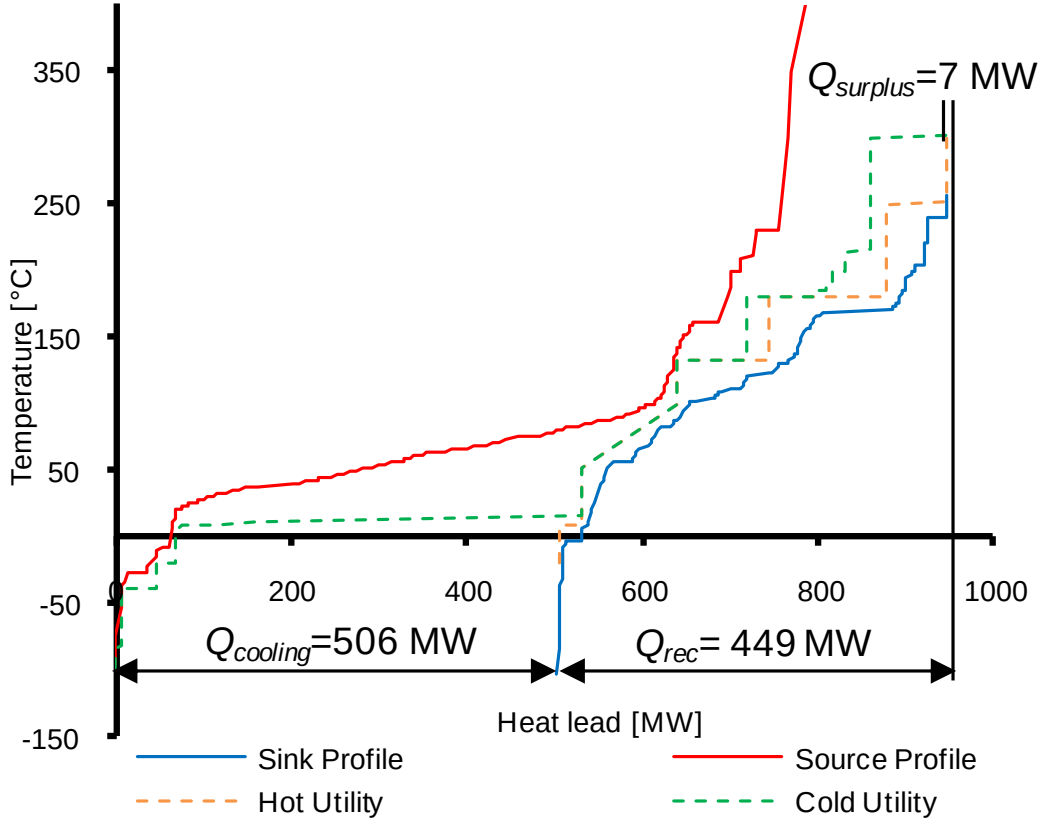
"By 2030 Stenungsund will have been transformed into a chemical process cluster for production of sustainable products. All activities will be based on renewable feedstock and fuels and will contribute to a sustainable society"

Chemical Cluster Stenungsund: Production & CO_2 emissions 2011



TOTAL emissions of CO_2 approx 900 kton/yr

Total Site Heat Integration Target



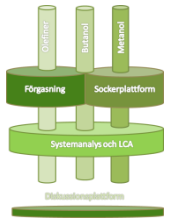
HOT UTILITY SAVINGS TARGET ADOPTING TOTAL SITE APPROACH = approx 122 MW!!
(3 * target that can be achieved by measures at individual plant level)

Technical measures:

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

Results:

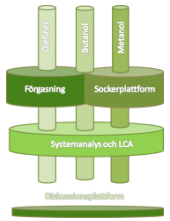
- New heating demand:
  $Q_{heating}$ = 0 MW
- Potential savings: 122 MW
- Steam surplus: $Q_{surplus}$ = 7 MW
- Compare with sum of individual process minimum heating demands (77 MW)



Forest Chemistry

Sustainable drop-in chemicals from the Swedish forest

Project partners



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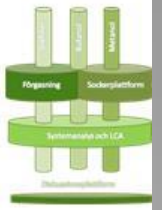

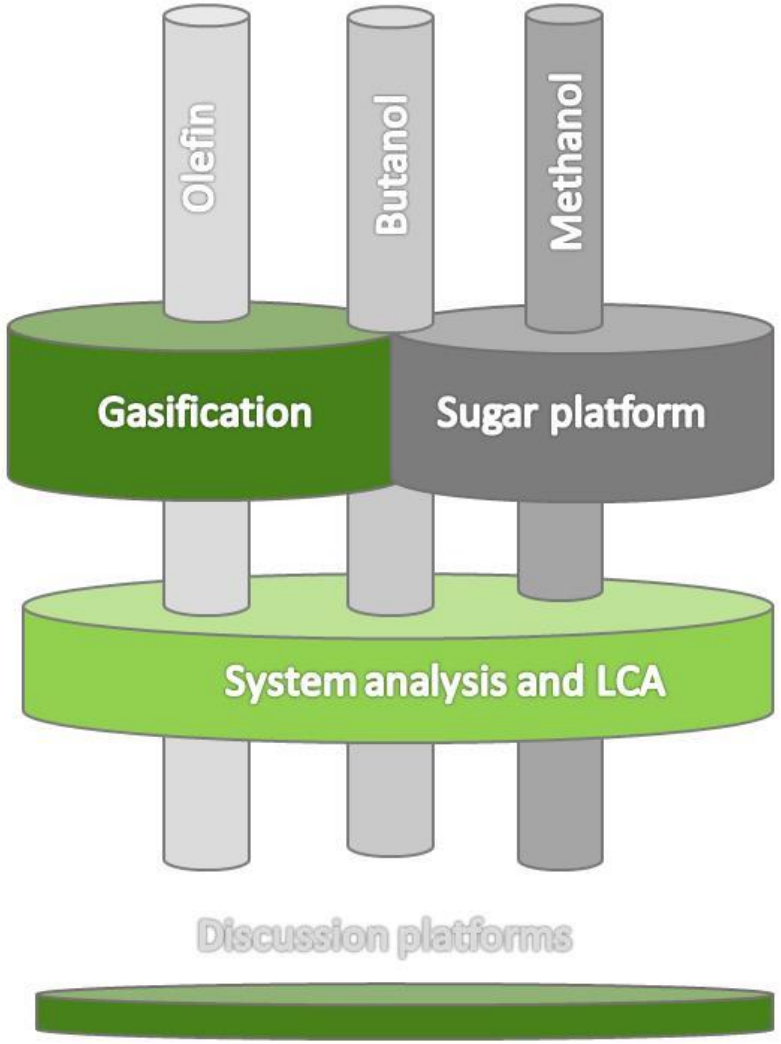

Market analysis

Innovation systems

Process integration: Energy products/biproducts

LCA

Policy instrument

processum

Conclusions

- Future expected/possible changes in CO2 charges and energy prices has developed a more strategic decision-making in process industry
- The time frame for important new technologies/systems is longer than earlier
- The step-wise energy efficiency improvements will be even more important
- There is a need for more clustering, new business models and new tools and methods for quantification
- New long-term strategic energy efficiency and CO2 mitigation solutions are being investigated in industry
- Strategic thinking opens up for new energy efficiency solutions