
By

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Energy efficiency policy instruments are often designed to promote incremental improvements during regular operation.

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!
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 commitments at this stage)
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**

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

HOT UTILITY SAVINGS TARGET ADOPTING TOTAL SITE APPROACH = approx 122 MW!!
(3 * target that can be achieved by measures at individual plant level)
Forest Chemistry
Sustainable drop-in chemicals from the Swedish forest
Project partners

- ADITYA BIRLA Domsjö
- SCA
- SEKAB
- processum
- HOLMEN
- INEOS ChlorVinyls
- BOREALIS
- SVEASKOG
- metso
- BioEndev
- CHALMERS INDUSTRIETEKNIK
- MoRe Research
- CHALMERS
- BIO4ENERGY
- SP
Forest Chemistry

Gasification

Sugar platform

Market analysis

Innovation systems

System analysis and LCA

Process integration:
Energy products/biproducts
LCA
Policy instrument
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