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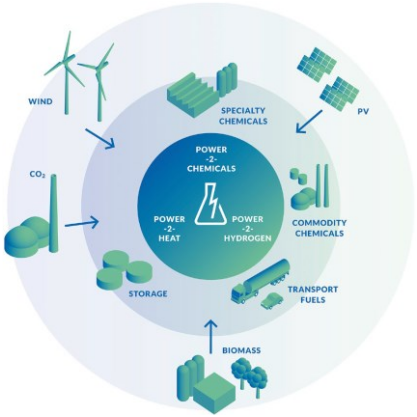

P42221 Opportunities for decarbonisation of industrial processes through increased electrification (PROCEL)

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Bakgrund: det finns många studier där man tar fram *Explorativa scenarier* om hur framtidens energisystem kan komma att se ut, beroende på vad samhället tycker är viktigt när det gäller energi
Exempel: Energimyndighetens arbete **Fyra framtider**

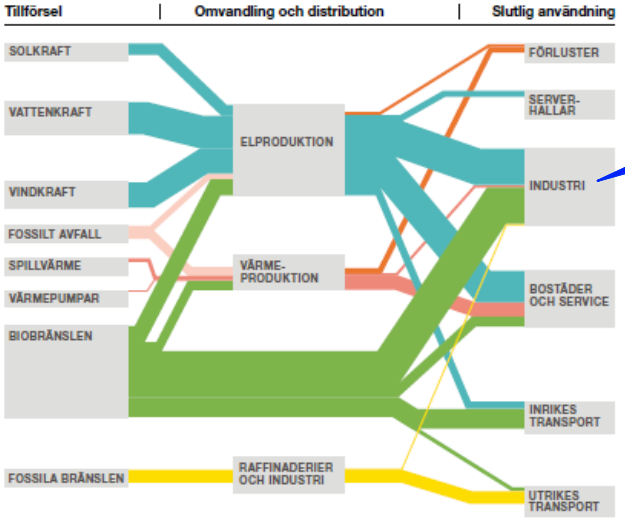
vivace

BETYDER LIVLIGT

I Vivace är energi en språngbräda för tillväxt på klimatets villkor. Sverige vill vara en global föregångare inom klimatlösningar och miljöteknik för ett hållbart globalt energisystem. Energipolitikens fokus är klimatsmart forskning och innovation, demonstration och kommersialisering på bred front.

Användning 326 TWh 2050

Energisystemet i Vivace 2050



Vad händer i industrin?
Hur sker omvandlingen i praktik?

Roadmaps

Figure 1: Roadmap methodology

Motivation for electrification of process industries

Swedish industry is a major energy consumer (145 TWh in 2013), 38% of total energy usage

Significant share of electricity in Swedish energy industry but **relatively constant** over time (from 21% to 26% in the last 40 years)

Similar trends in the rest of Europe

Potential **economic**, **security of supply** and use, and **environmental** gain

(but depends also on the **evolution of the power sector**!)

Identified in Swedish Energy Agency's **strategic priority areas** for decarbonisation

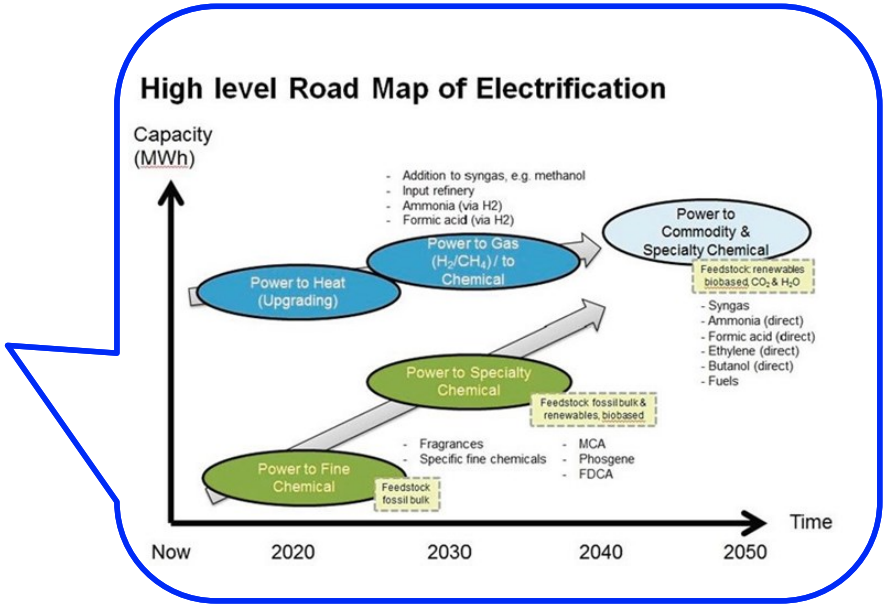
But **not studied in detail** (i.e., beyond **top-level screening**, e.g., extreme scenarios for complete electrification of process industry in EU)

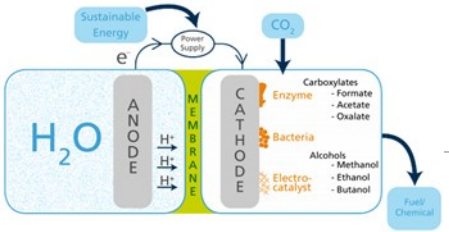
Objectives

- Enhance the **knowledge** about opportunities for process electrification (short-to-long term) in Swedish industry (focus on energy-intensive process industries)
- Perform **techno-economic** and **environmental** assessment of implementation of these technologies under possible future energy market conditions
- **Compare** electrification with **other decarbonisation** options (e.g., feedstock switching, CCS, efficiency measures)

Electrification - Relevant technologies

- Pressure driven membrane separation operations
- Heat pumps (e.g., for low-grade heat)
- Electro-thermal technologies (from conventional convection to advanced plasma technologies)
- Power-to-XXX
- Direct chemical transformations (e.g., bioelectrochemical systems)





TASKS

- T1: **Data collection** regarding technical characteristics of existing and emerging technologies
- T2a: Identification and characterisation of **thermal and material loads** of the respective operations (inventory analysis complemented by modelling)
- T2b: Consequences of implementation under different energy market scenarios (Process modelling, Process integration, **ENPAC**)
- T3: **Interplay of electrification** with the electric power/balancing markets and biofuels/gas markets
- T4: Detailed **technoeconomic and environmental** analysis for selected electrification technologies in industry (chemical/refining, pulp and paper)
- T5: Synopsis and identification of **future research**, **dissemination of results**

Industrial sector

Power sector
-existing modelling package

Transportation sector

Sectorial linkages to meet vRE variations

Power plant investments to meet new electricity

Energy system consistent with climate targets

Distribution of biomass resources

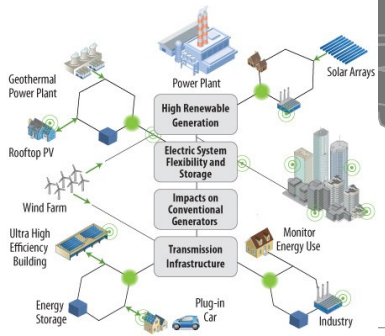
Dispatch model EPOD

Investment model ELIN

Scenarios

Resources description

Power plant data base



Task 3
In collab. with Lund/EESS and EnTech