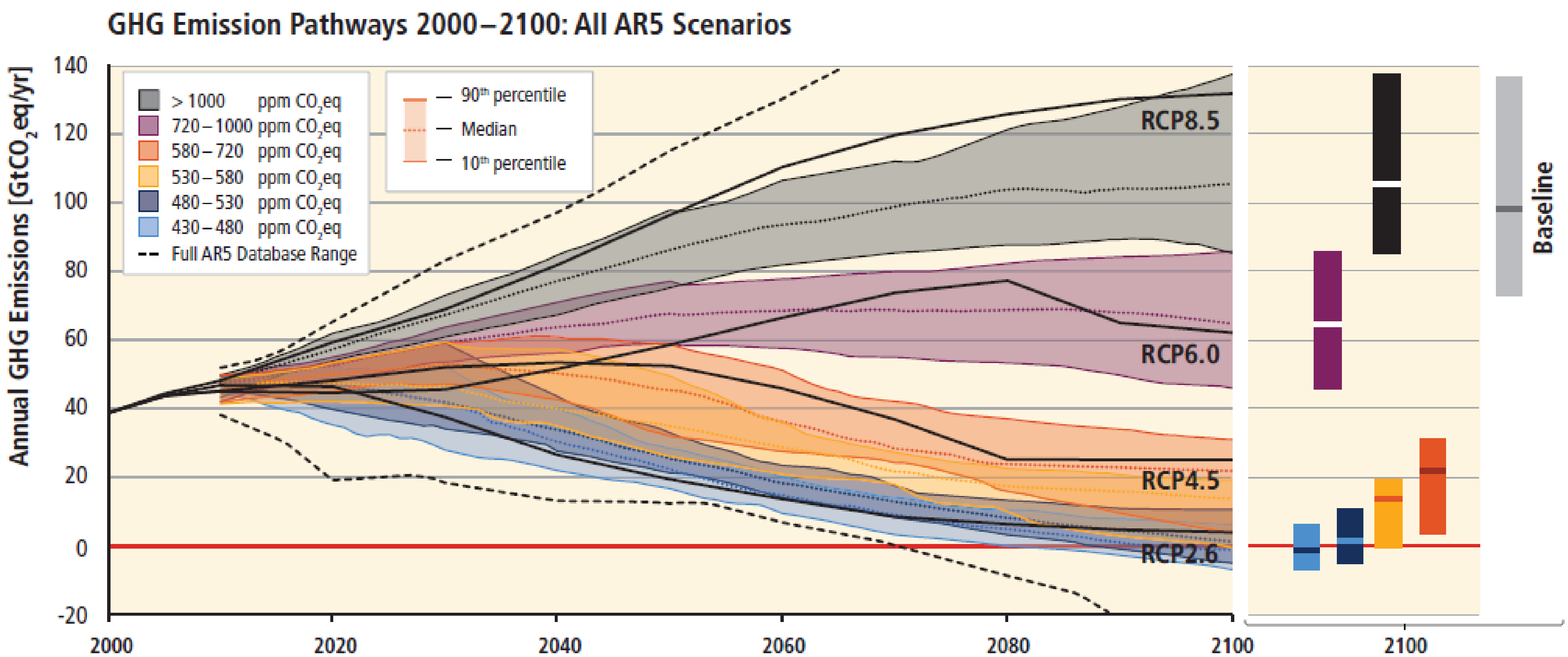
Rethinking basic materials – the GIST research programme and more

LCS-Rnet 8th Meeting, Wuppertal 6-7 September

LARS J. NILSSON

SPM.4 Mitigation pathways and measures in the context of sustainable development



GHG mitigation option categories for industry and materials

- Service demand reduction (e.g., switching from private to public transport, new product design with longer life)
- Product-Service efficiency (e.g., through car sharing, or higher building occupancy)
- Material efficiency in (a) manufacturing (e.g., through reducing losses, recycling, re-using) and (b) in product design (e.g., through extended product life or light-weight design)
- Energy efficiency (e.g., through furnace insulation, process integration, variable speed drives)
- Emissions efficiency (e.g., from switching to non-fossil fuel electricity supply, renewable feedstock, or CCS)

Adapted from IPCC, AR5 WGIII, 2014

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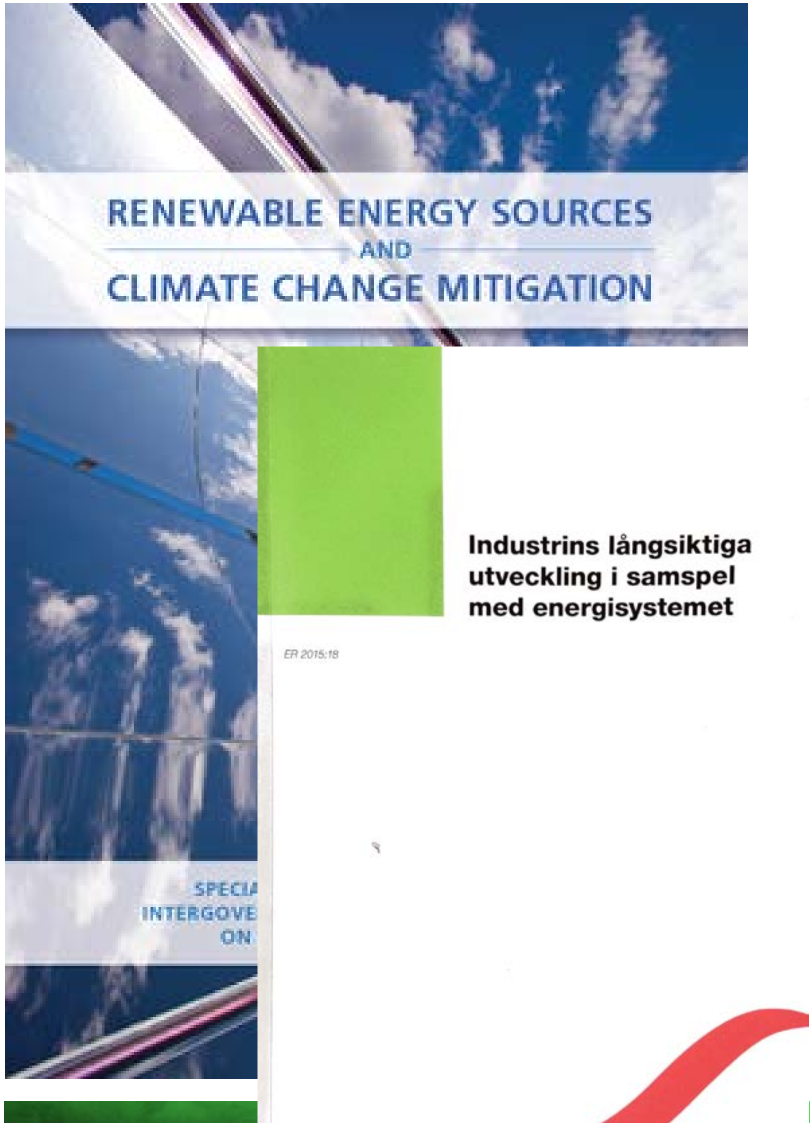

VARIOUS PUBLICATIONS

- SRREN 2011, Ch 8 on Integration
- Decarbonising industry in Sweden (2012 for EPA roadmap); Electrofuels – a review (2013 for FFF); Industry and net-zero emissions 2050, (in Swedish, 2013 for M-Env)
- Decarbonising industry in the EU - climate, trade and industrial policy strategies (2015, book chapter)
- Decarbonising the energy intensive basic materials industry through electrification – implications for future EU electricity demand (2016, Energy)
- Industrins långsiktiga utveckling i samspel med energisystemet (ER 2015:18, for SEA)
- Global climate policy and deep decarbonization of energy-intensive industries (2016, Climate Policy)
- Electricity-based plastics and their potential demand for electricity and carbon dioxide (2016, JCP)
- The characteristics of energy intensive processing industries towards deep decarbonization: implications for transitions research (2016, submitted)

With Åhman, Nikoleris, Palm, Lechtenböhmer, Wesseling, Ericsson, Johansson, Coenen, Worrell etc.

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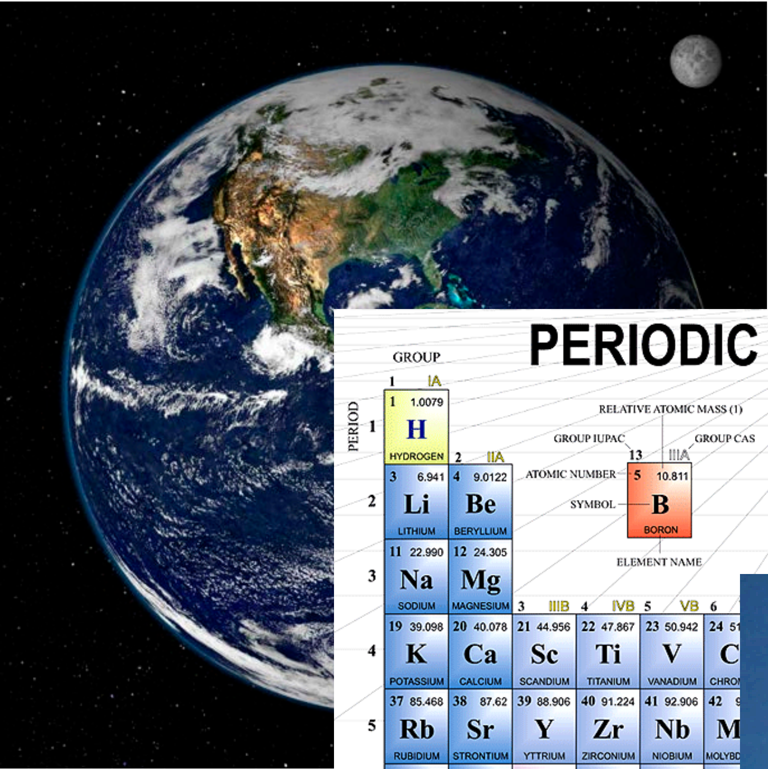
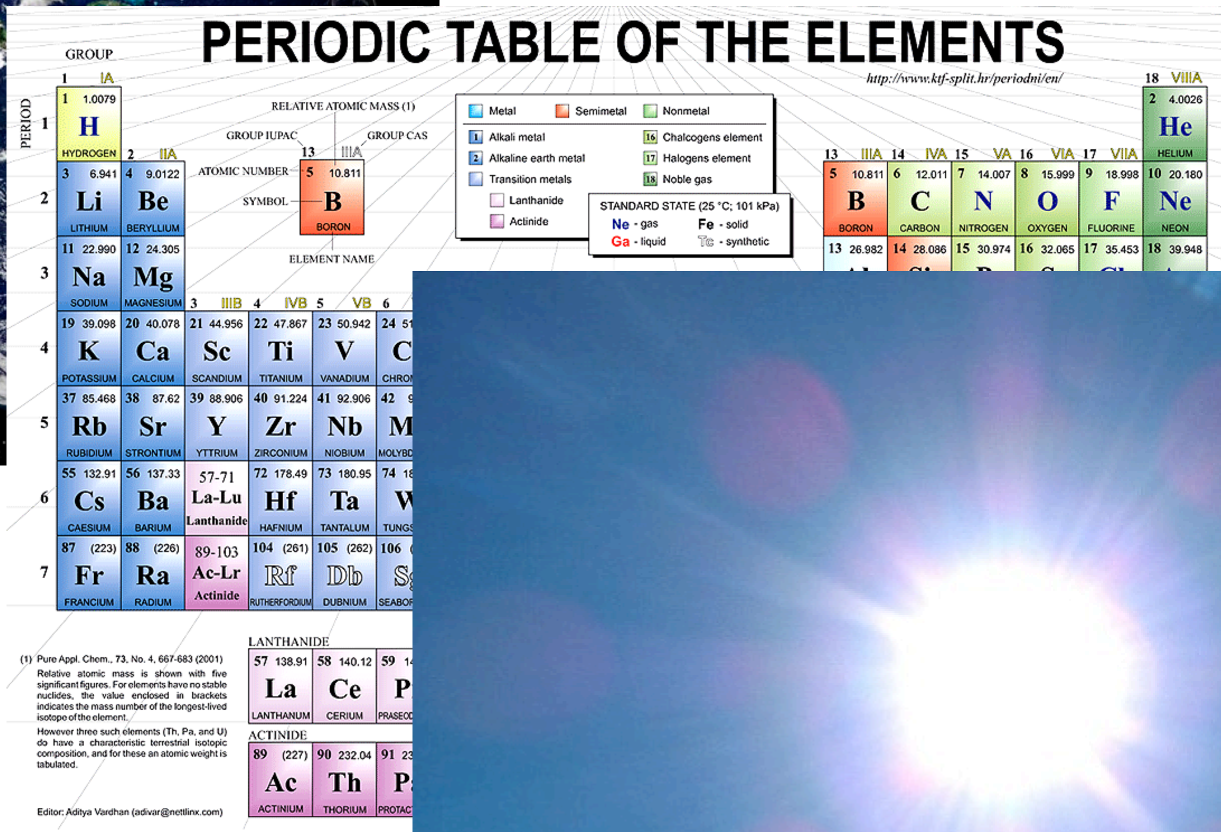
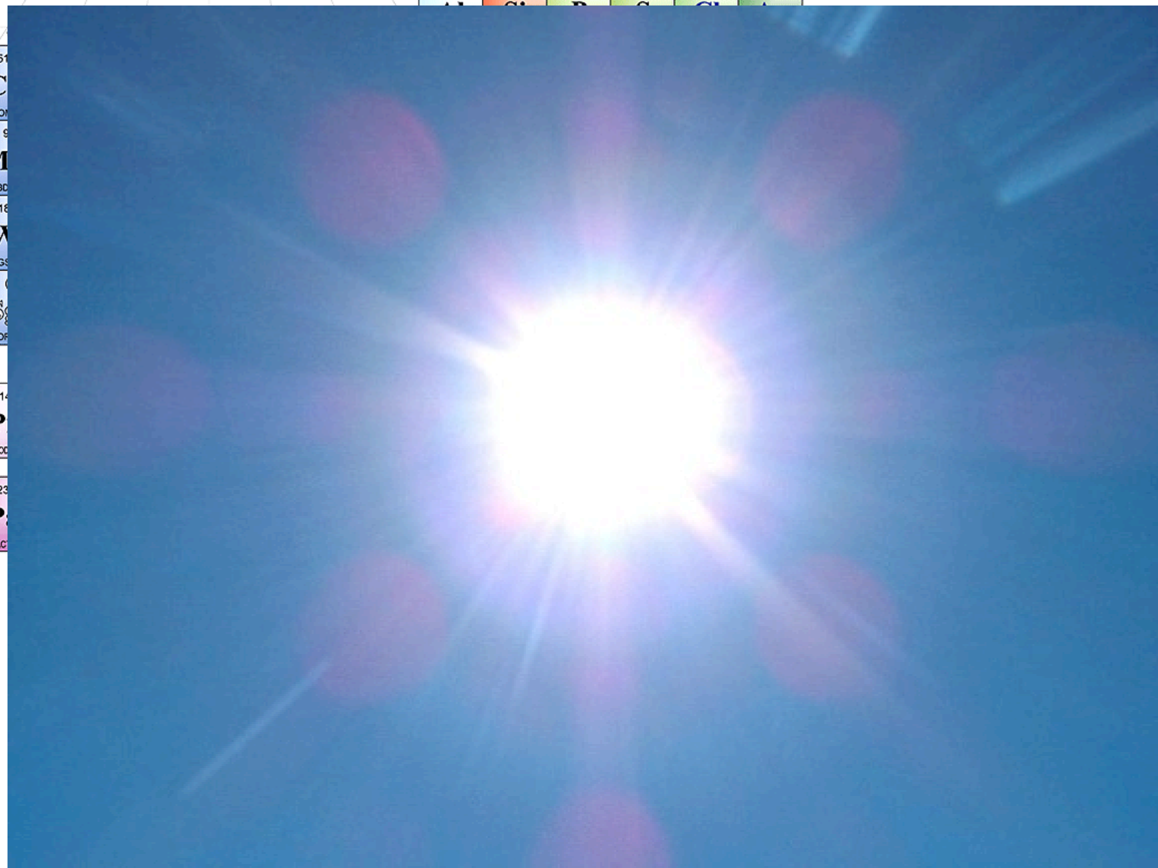
What do we have to work with?







Energy intensive basic materials

- Metals (e.g., copper and steel), minerals (e.g., lime and silicon) and various organic compounds (e.g., cellulose fibers and plastics) in a circular economy
- Mitigation through emissions efficiency:
  - Carbon Capture and Storage
  - Biobased feedstock and fuels (biogas, charcoal, wood chips, etc.)
  - Electricity and hydrogen/hydrocarbons for fuel and feedstock
- Few, if any, co-benefits but more expensive (from 30 % for bulk steel to 300 % for plastics)
- Potentially large electricity user (e.g., +1500 TWh in EU)

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Op-ed: This is how we make the steel industry fossil free

«Tillbaka Spara artikel

Skriv ut

Di Debatt

Debatt: Så ska stålindustrin bli fossilfri

Uppdaterad 2016-04-06 17:03. Publicerad 2016-04-03 21:03

Jan Moström, Magnus Hall och Martin Lindqvist Foto: Fredrik Sandberg och Claes-Göran Flinck

Stålindustrin är en av de branscher som släpper ut mest koldioxid. Vi är villiga att ta ett stort ansvar för att hitta en långsiktig lösning på koldioxidfrågan för stålindustrin och bidra till ett fossilfritt Sverige, skriver LKAB:s vd Jan Moström, SSAB:s vd Martin Lindqvist och Vattenfalls vd Magnus Hall.

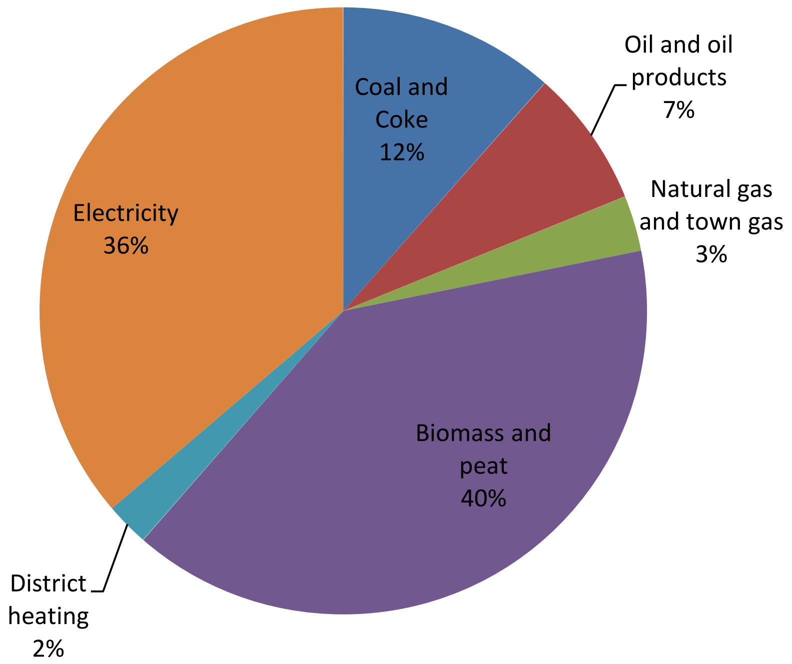
6 - 7 December 2016,
Maternushaus, Cologne,
Germany

5th Conference on CO_2

Carbon Dioxide as Feedstock for Fuels, Chemistry and Polymers

Energy use in Swedish industry in 2013

Total use of energy carriers in industry: 140 TWh



Fossil fuels used as energy carriers (TWh)

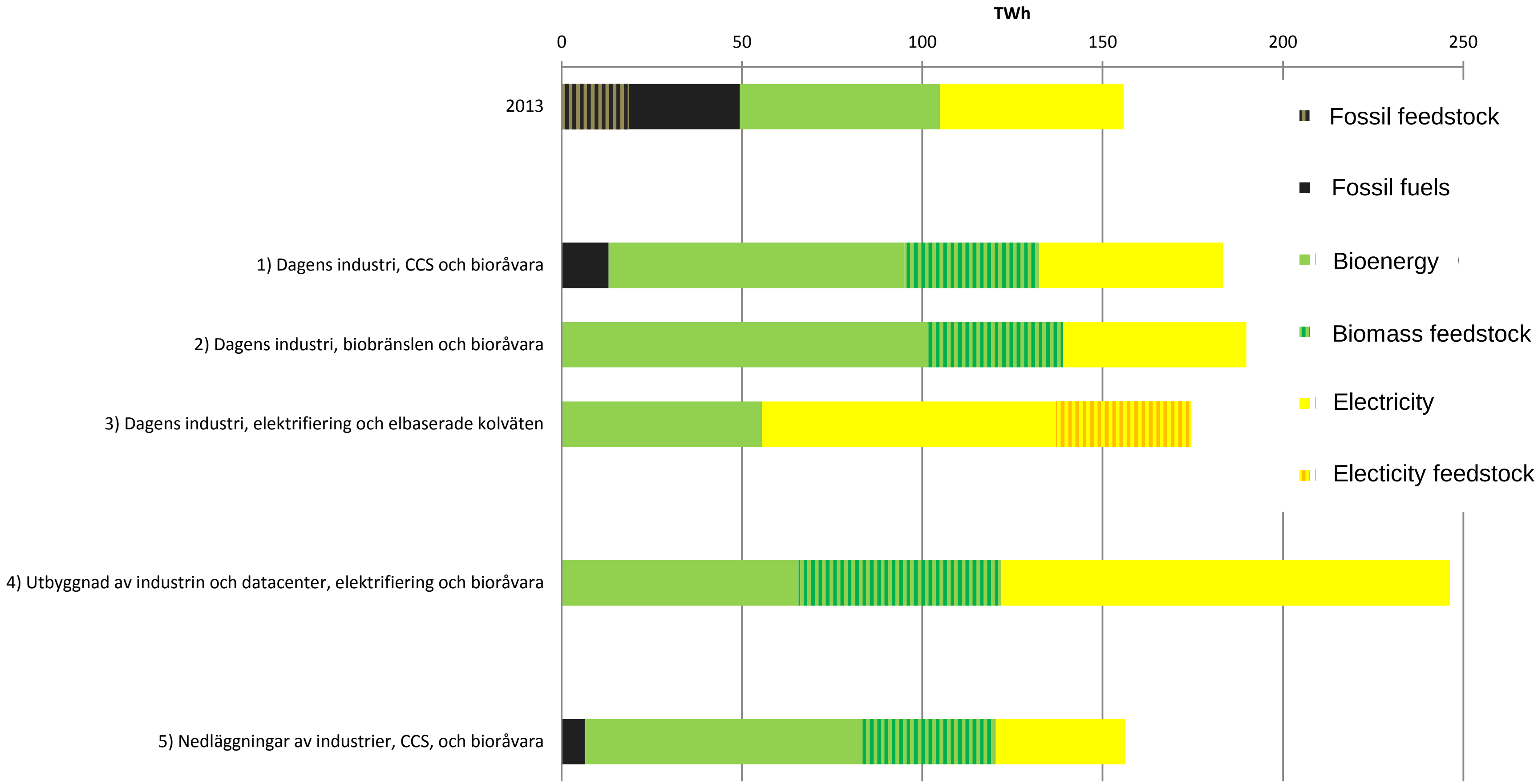
Coal and coke	16
Oil and oil products	10
Natural gas and town gas	4

In addition, fossil fuels used as raw material in the chemical industry (TWh)

Oil and oil products	19

SCB, Eurostat

Energy and feedstock use in Swedish industry 2013 and in five scenarios



Source: Ericsson et al (2015) Swedish Energy Agency report (in Swedish)

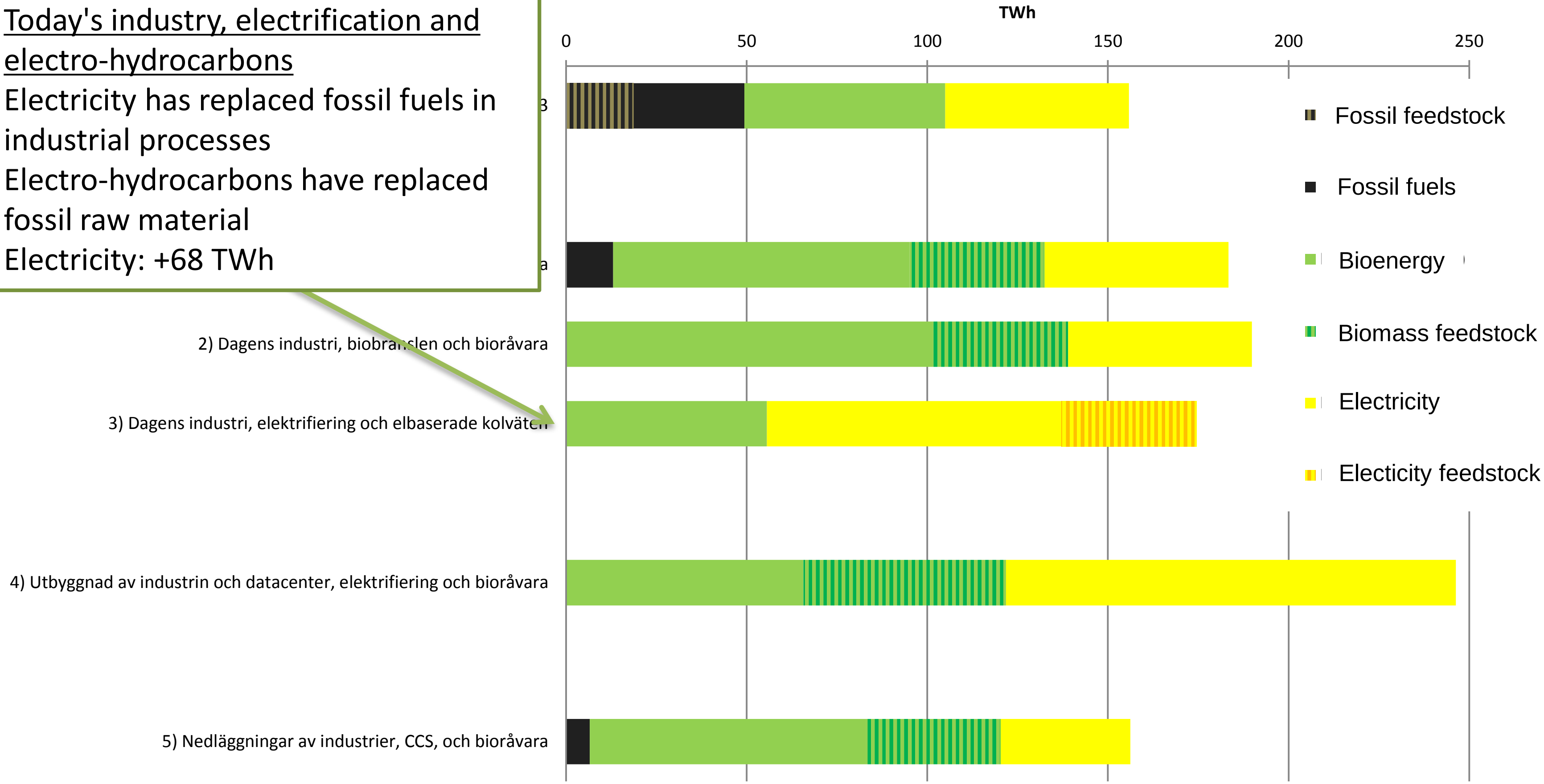
Energy and feedstock use in Swedish industry 2013 and in five scenarios

<u>Today's industry, electrification and electro-hydrocarbons</u>

Electricity has replaced fossil fuels in industrial processes

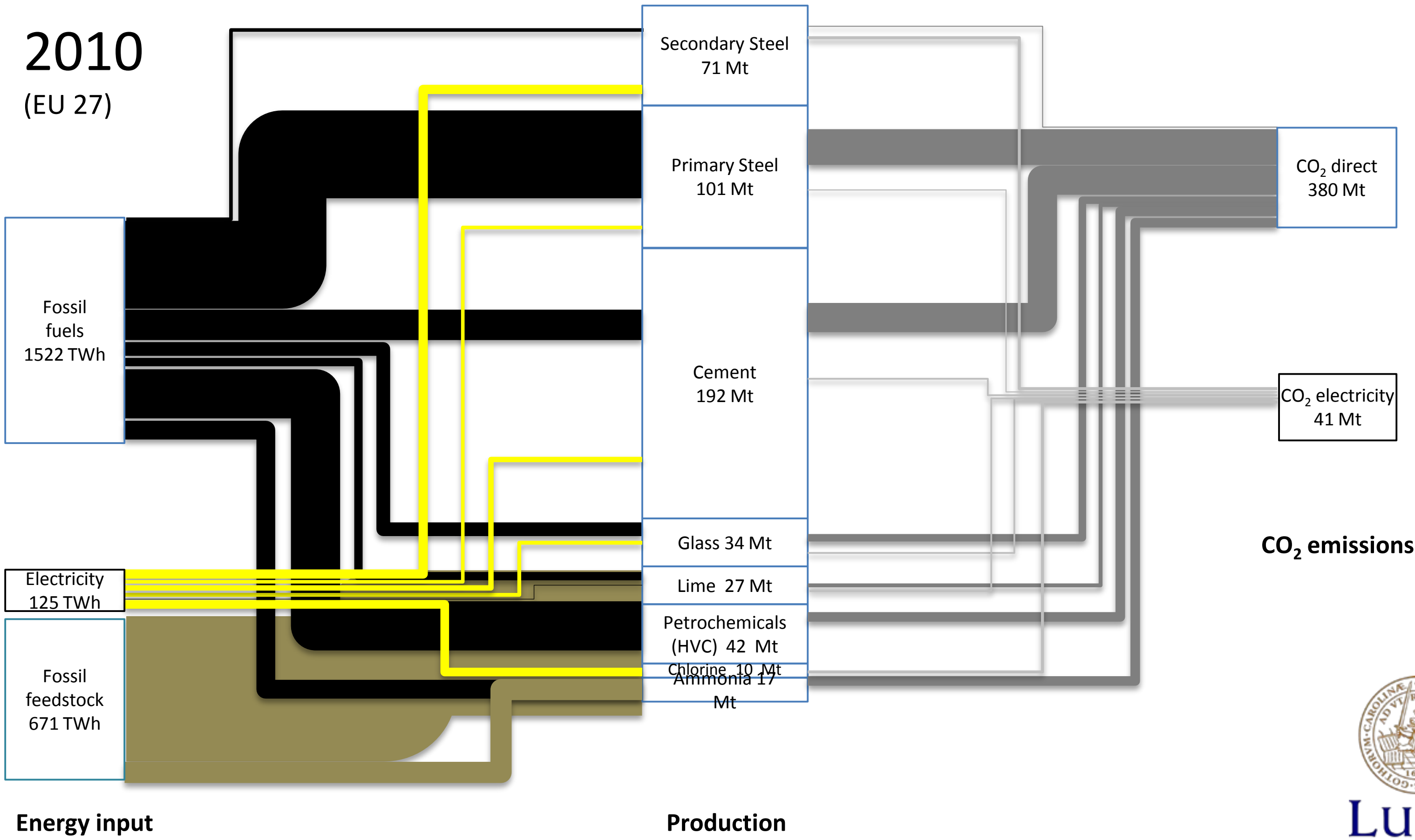
Electro-hydrocarbons have replaced fossil raw material

Electricity: +68 TWh



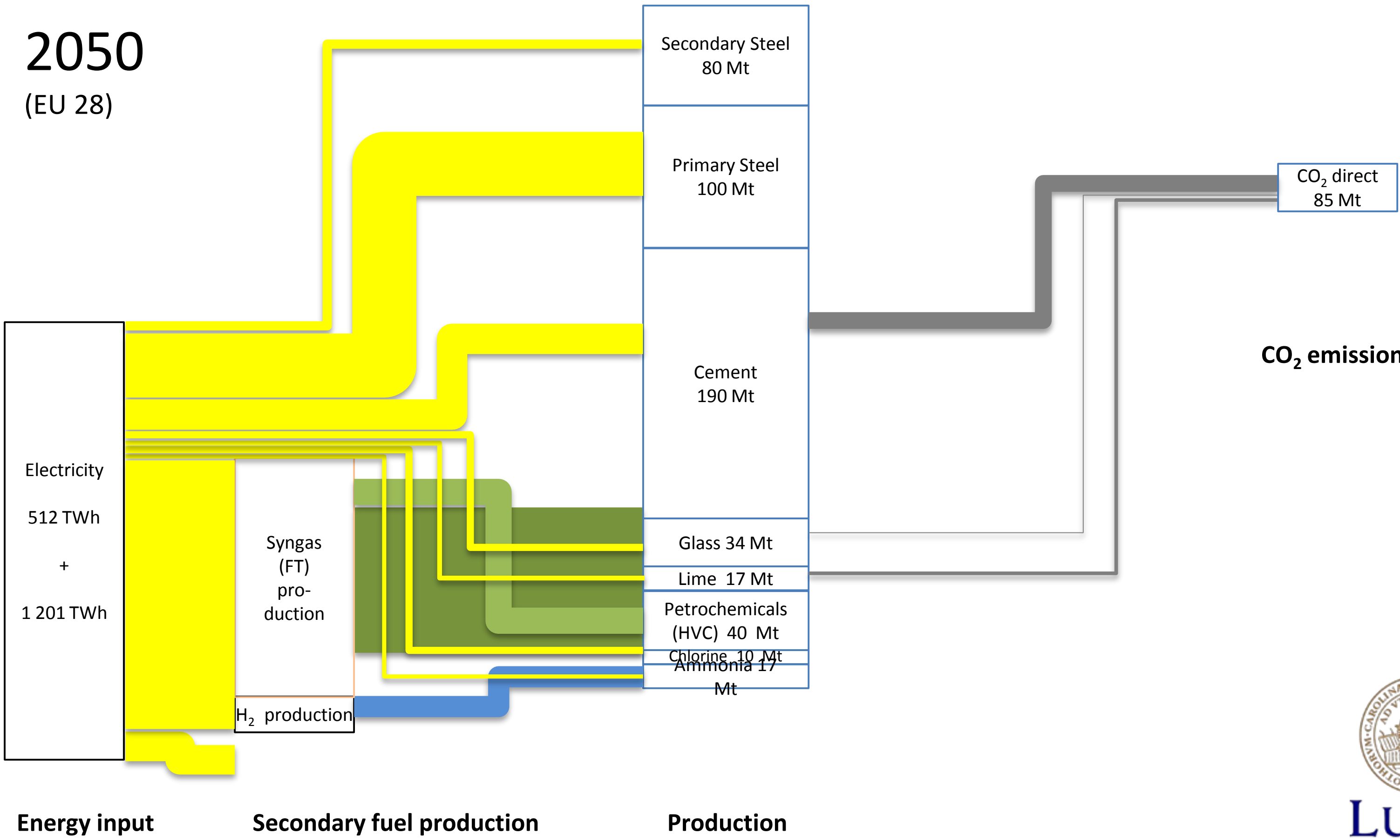
Source: Ericsson et al (2015) Swedish Energy Agency report (in Swedish)

EU energy supply and CO2 emissions 2010



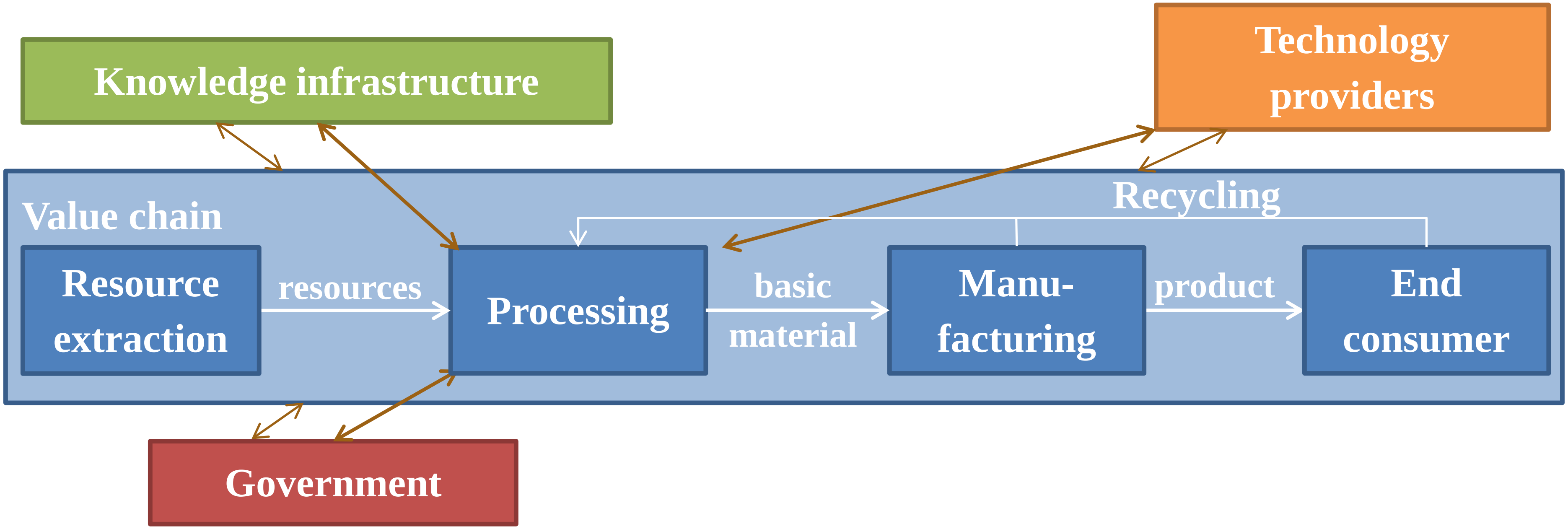
Source: Lechtenböhmer, et al (2016) in Energy (in press)

EU energy supply and CO2 emissions 2050



Source: Lechtenböhmer, et al (2016) in Energy (in press)

Industry characteristics and innovation systems



- **Industry structure**: capital intensive, investment cycles, scale economies
- **Innovation strategies**: incremental process improvements, some products
- **Markets**: bulk commodities, cyclic, small margins (but some nichés)
- **Public policy**: safety, pollution, efficiency and shelter against disadvantages
- **Systemic lock-in**: incumbents, no markets, no push-pull, CO_2-leakage

Source: Wesseling, et al (2016) submitted manuscript

Policy and governance implications

- **Direction**
  - Roadmaps, strategies, etc.
- **System innovation**
  - Technology push and market pull, co-evolution
- **Deployment**
  - Risk sharing and financing
- **International policy coherence**
  - Revisit CBDR, sectoral approaches, trade

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The future cannot be predicted, but futures can be invented.

D. Gabor, 1963

“It was man's ability to invent which has made human society what it is.”

“Überall geht ein frühes Ahnen dem späteren Wissen voraus. ”

(Later knowledge is always preceded by an early instinctive idea)

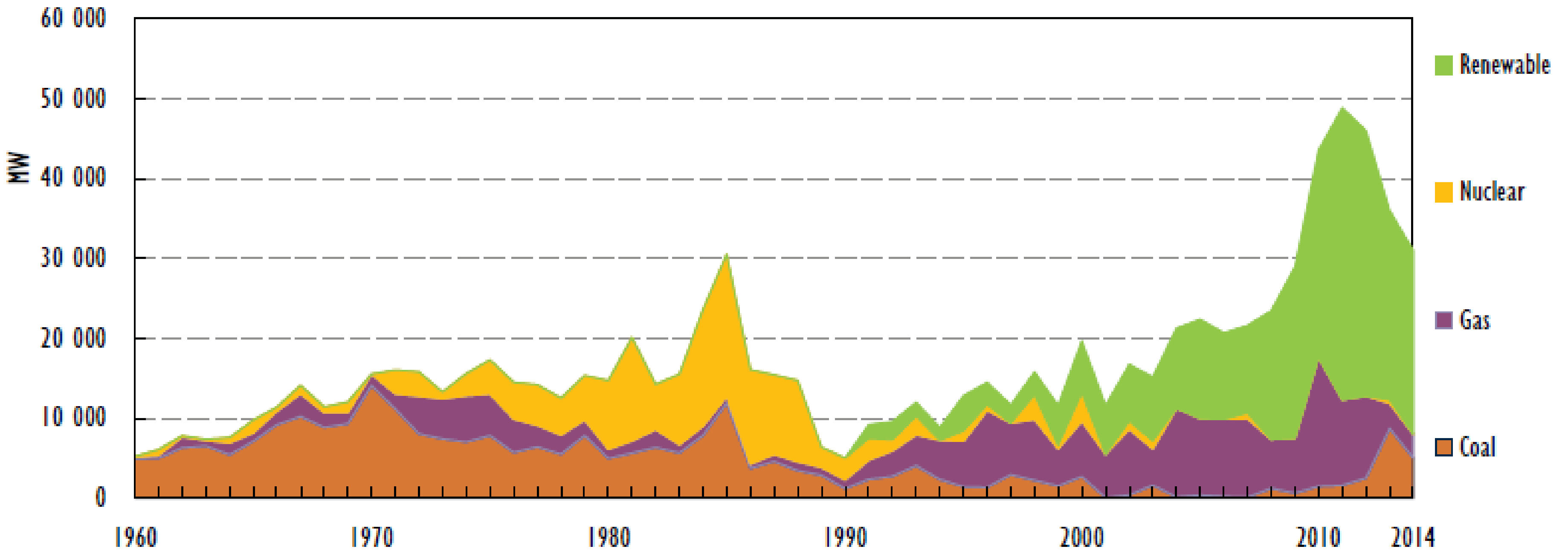
Alexander von Humboldt (1769 – 1859)

Lund University

Extra slides

Future energy systems will be different from today

Figure 1.3 • Capacity addition in OECD Europe by technology, 1960-2014

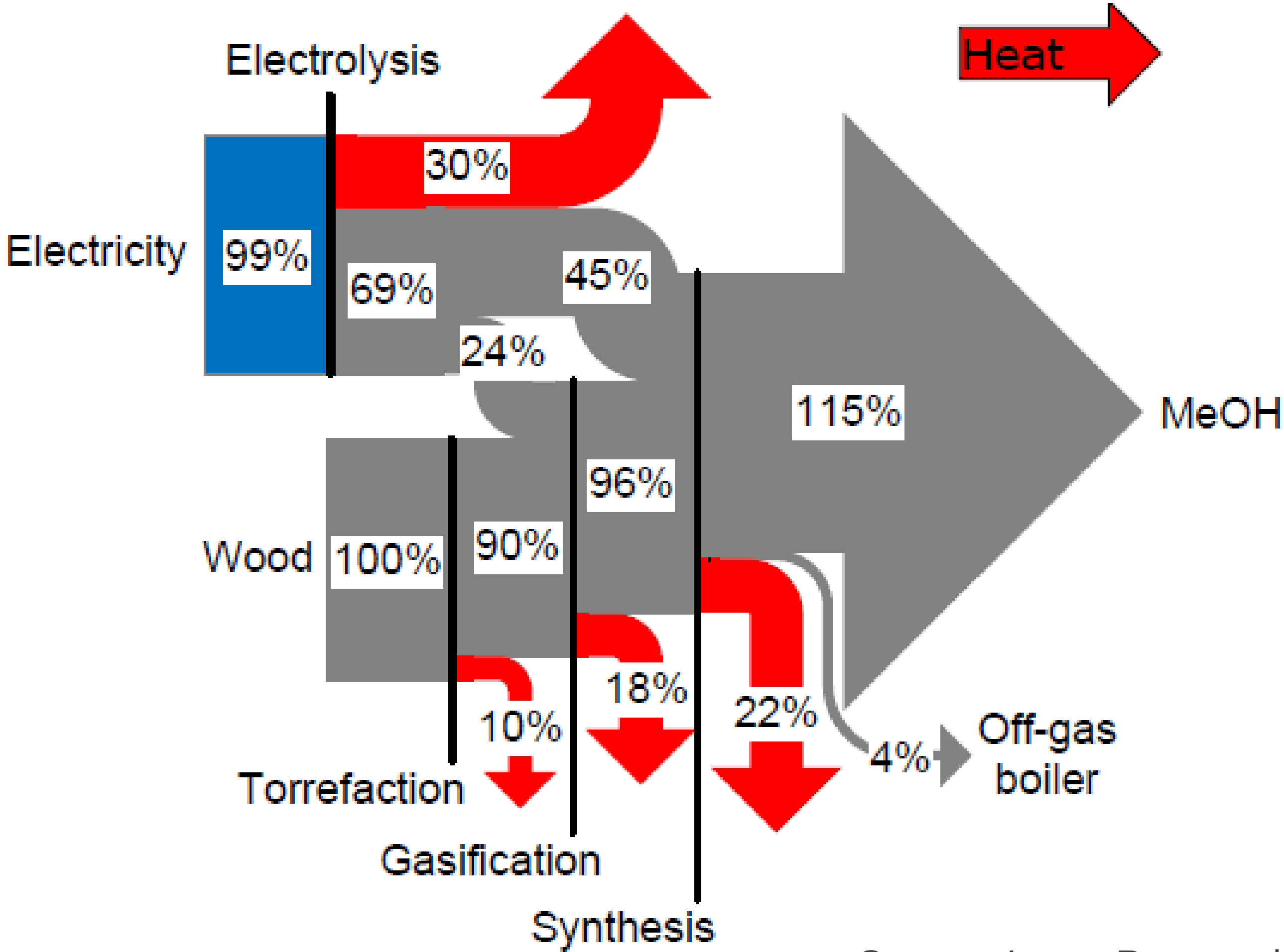


Note: MW = megawatt.

Key point* • *Market-based investments have mainly produced gas-fired power plants, while coal and nuclear have been built under a regulated framework, and renewables have been installed with support schemes.

100 % renewables in Denmark 2050

Biofuel plants integrating electrolysis of water



Source: Lasse Røngaard Clausen , DTU

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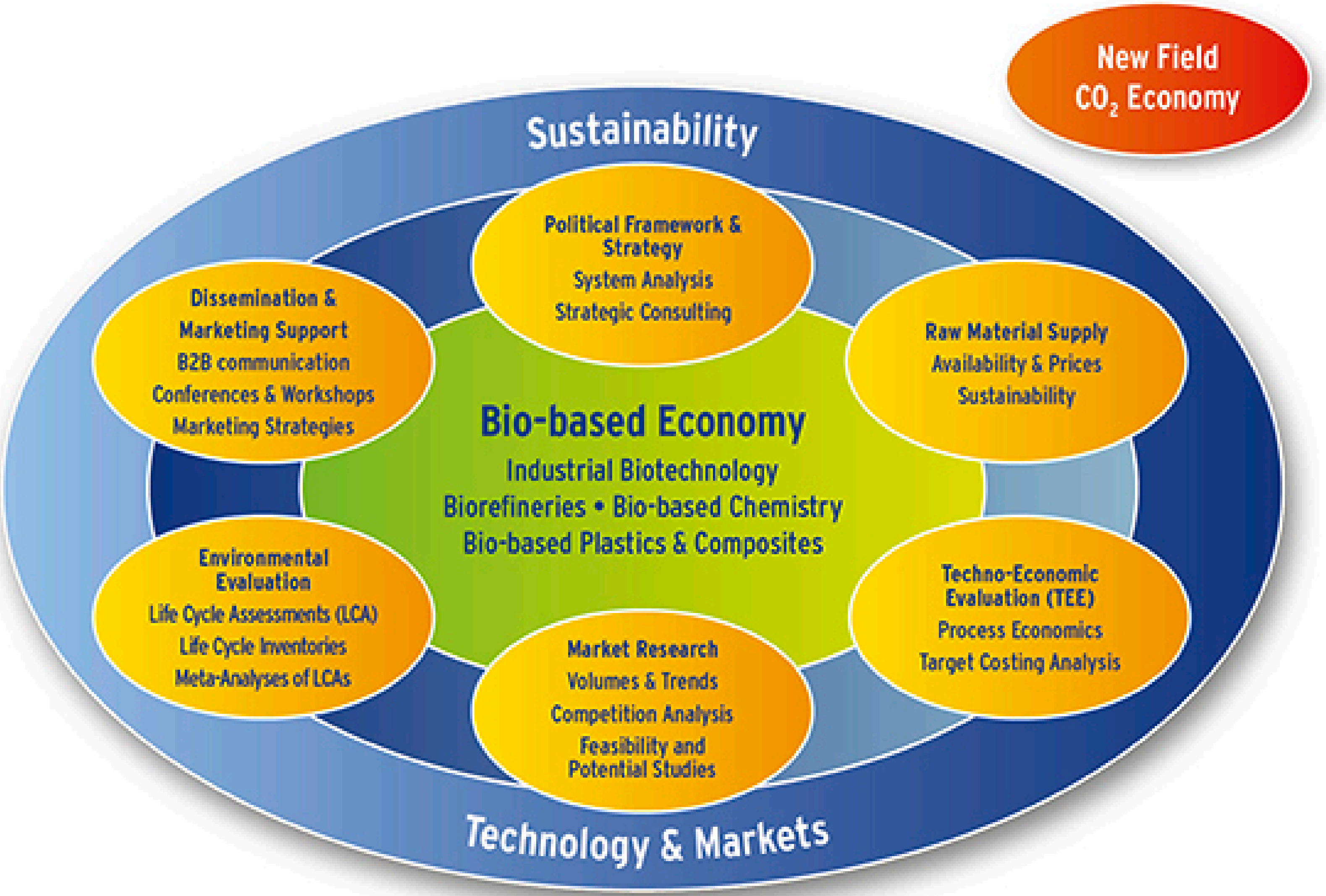

Nova institute

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Basic materials – Economics and costs

Mitigation costs for attaining ”zero emissions” are uncertain and high (>150USD/ton)

A cost of **100 USD/ton CO_2** equals:

- 4 % of selling price for high strength steel
- 30% for bulk steel
- 100% for cement
- Willingness to pay for bioenergy becomes 3 times higher than for pulpwood

EII **share of GDP** relativley small in developed economies (2 % in the EU) and the cost for basic materials in finished products is small

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