Decarbonising the energy intensive basic materials industry

UNFCCC-TEC Thematic Dialogue, Bonn, 29 mars 2017

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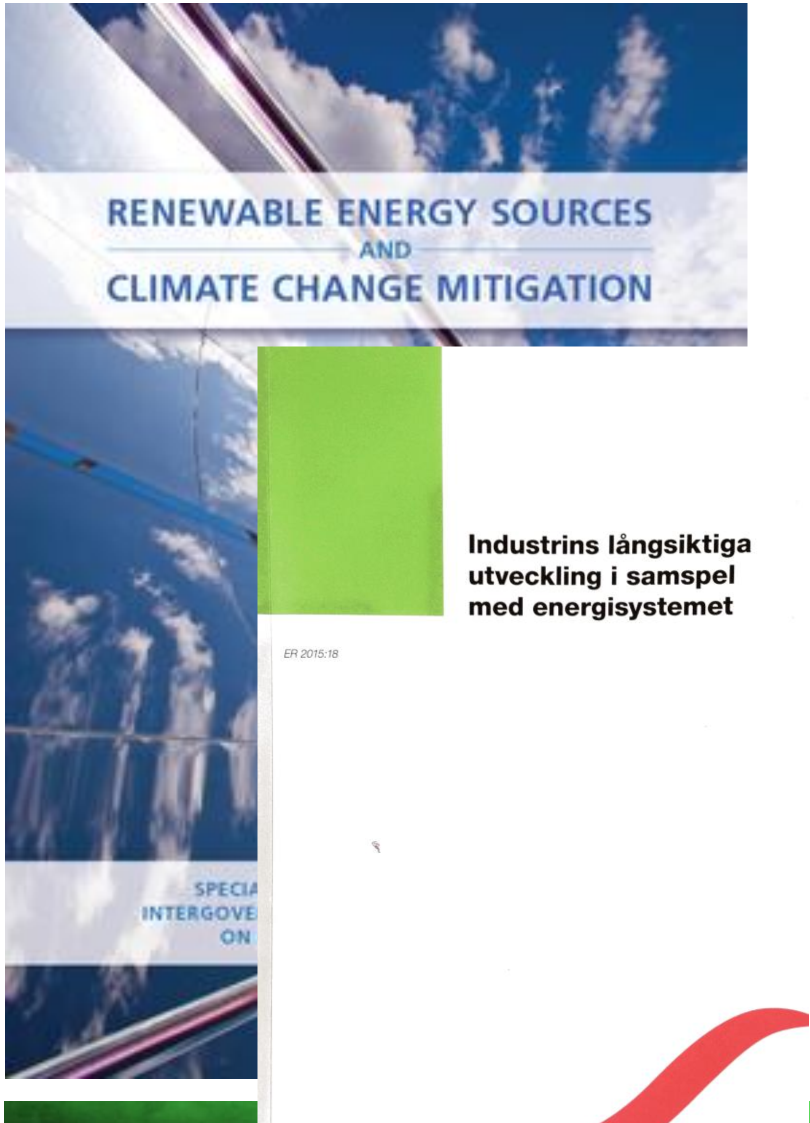
GHG mitigation option categories for industry and materials

- 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



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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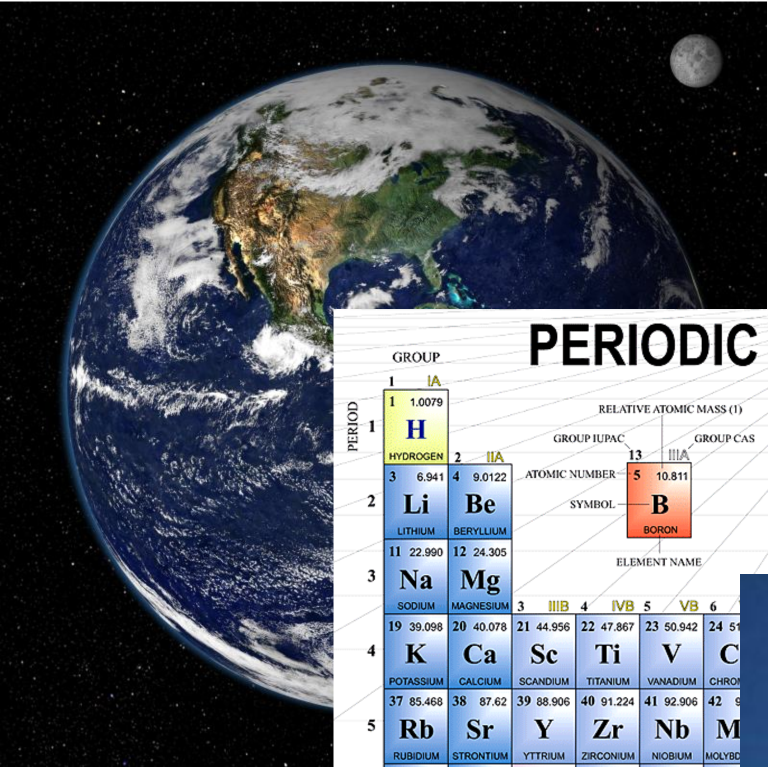
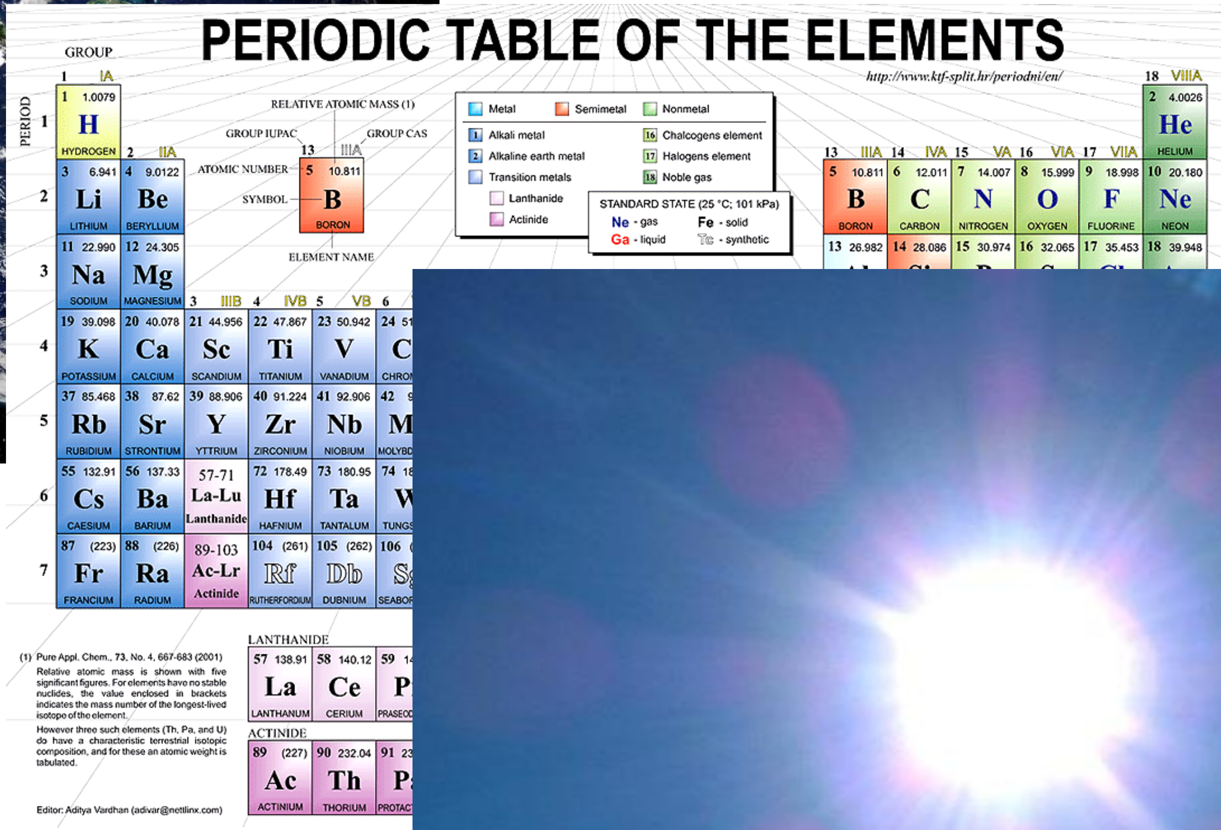
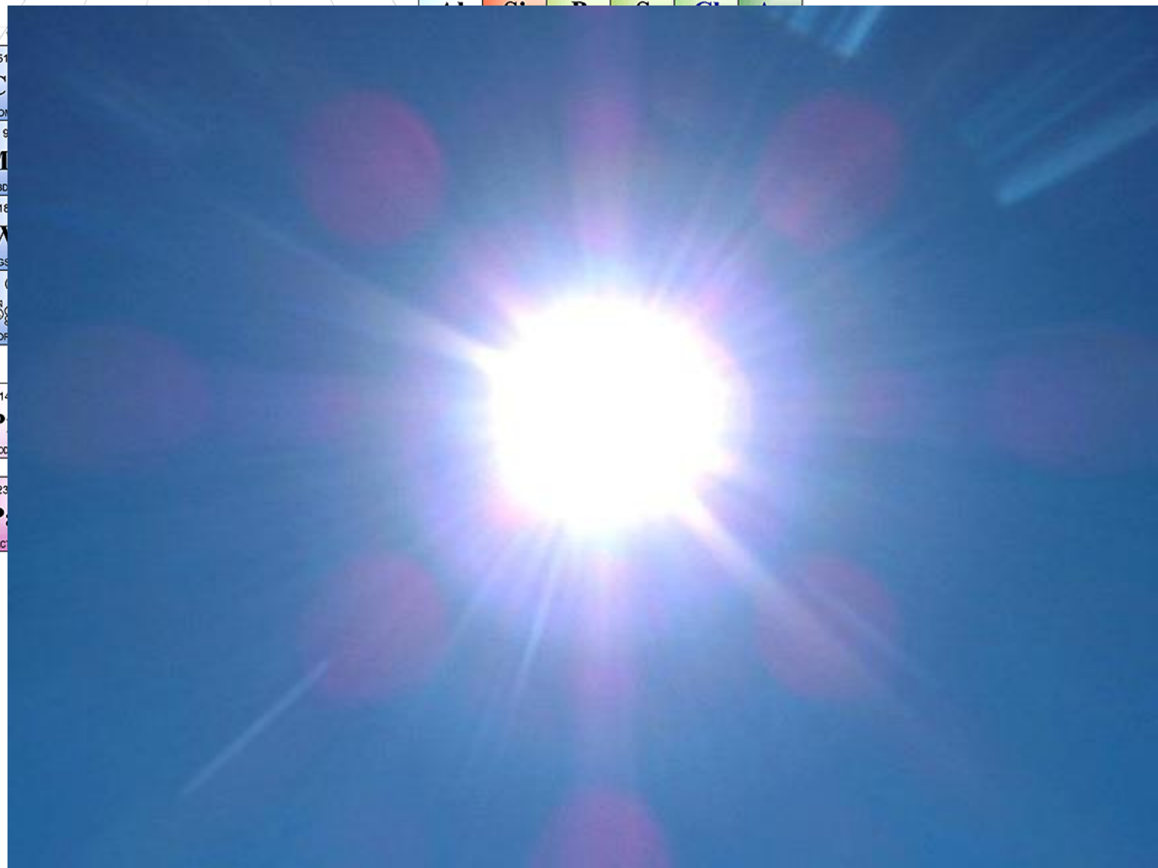
What do we have to work with?







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)

Source: Lechtenböhmer, Nilsson, Åhman and Schneider, 2015, Decarbonising the energy intensive basic materials industry through electrification – implications for future EU electricity demand, SDEWES 2015

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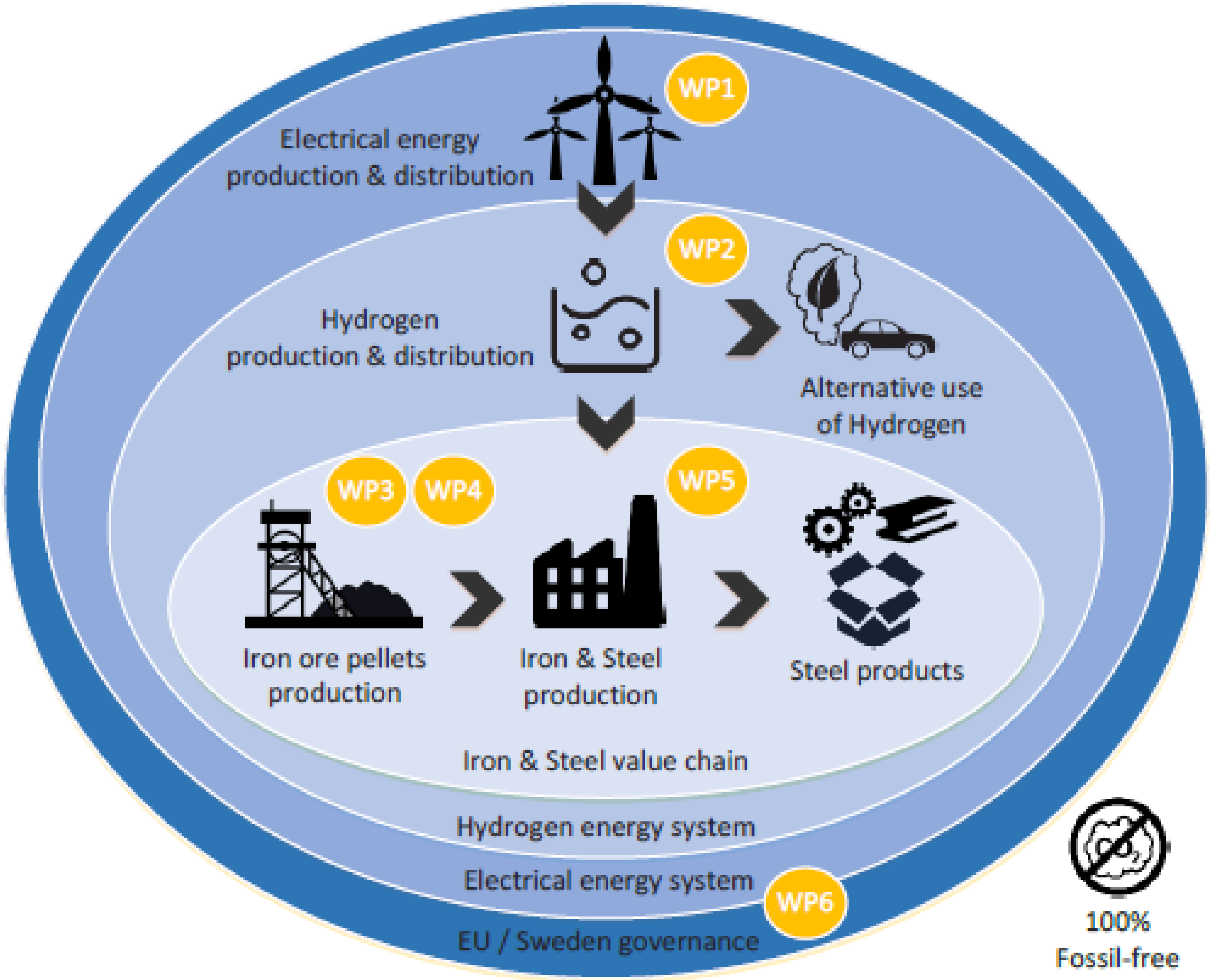
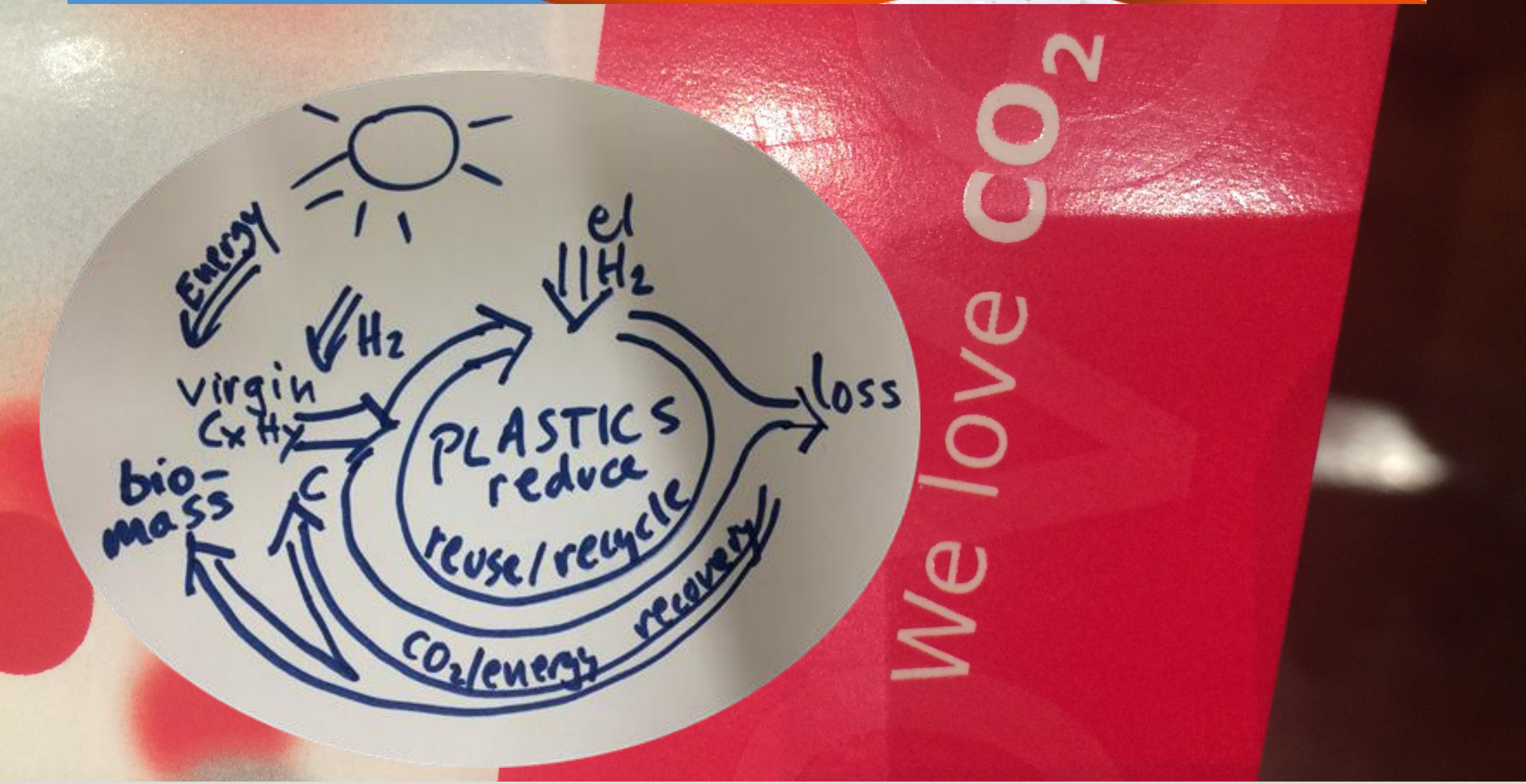
Opinion: This is how we make the steel industry fossil free



Hydrogen Breakthrough Iron-making Technology (HYBRIT)

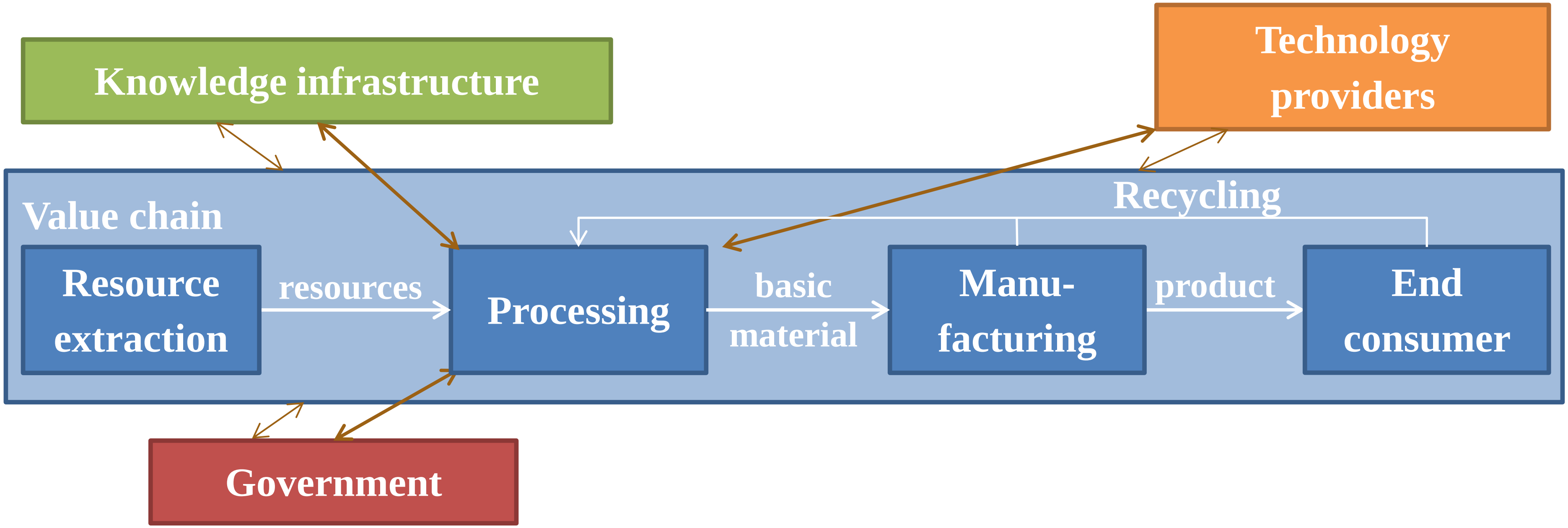
6 - 7 December 2016,
Maternushaus, Cologne,
Germany

5th Conference on CO_2
Carbon Dioxide as Feedstock for Fuels, Chemistry and Polymers



S T E P S - Sustainable Plastics and Transition Pathways

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

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Source: Wesseling, et al (2016) submitted manuscript

Policy and governance implications

- **Direction**
  - Roadmaps, strategies, etc.
- **System innovation**
  - Technology push and market pull, co-evolution with energy system
- **Deployment**
  - Risk sharing and financing
- **Institutional capacity**
  - Government expertise and ability to manage decarbonisation
- **International policy coherence**
  - Revisit CBDR, sectoral approaches, trade

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)

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