



Renewable Energies for Industries

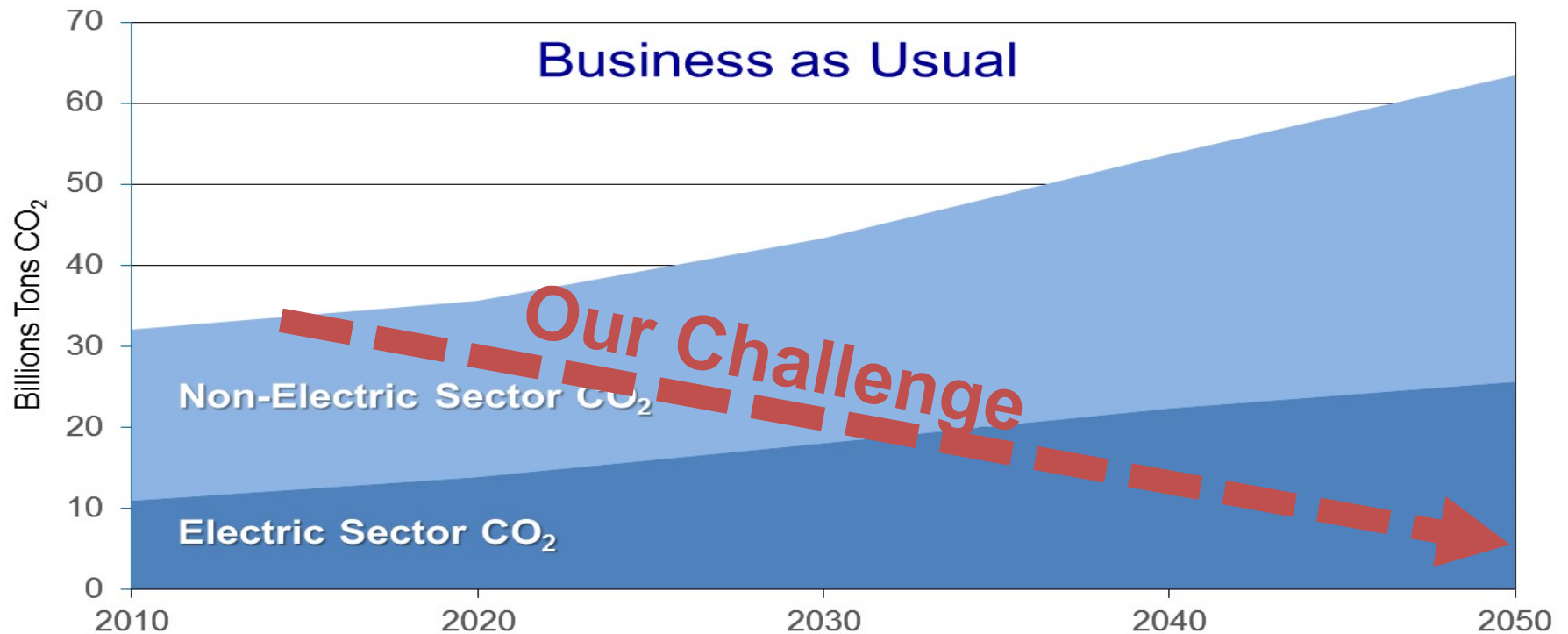
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IEA-EPRI Workshop, 29-30 Nov. 2016, Washington DC

Taking stock

- 1. The challenge gets bigger**
- 2. Heavy materials the major issues**
- 3. BECCS and bioenergy can only contribute**
- 4. Options for direct heat surge**
- 5. Massive electrification is a must**
- 6. Hydrogen to play multiple roles**
- 7. Innovation is critical**

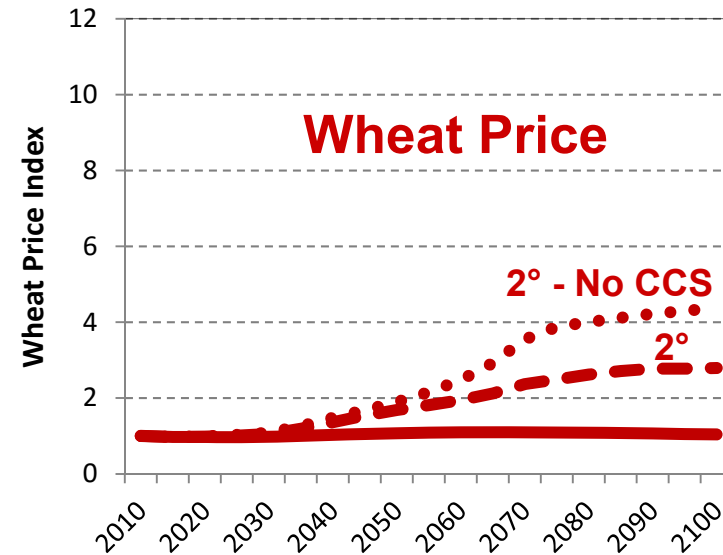
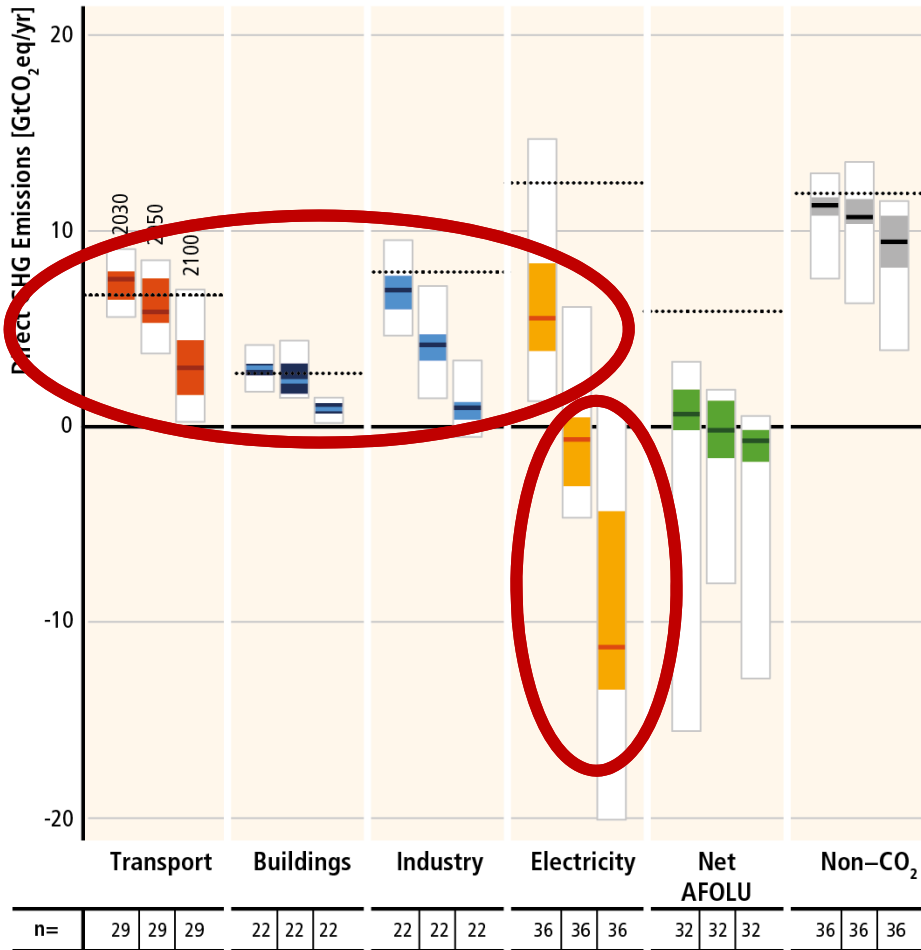
The challenge gets bigger



As the power sector gets decarbonised, the attention must shift to direct uses of fossil fuels if « well below 2° » is to be achieved

Bioenergy and BECCS can only contribute

450 ppm CO₂eq with CCS



Source: Muratori, et al., 2016

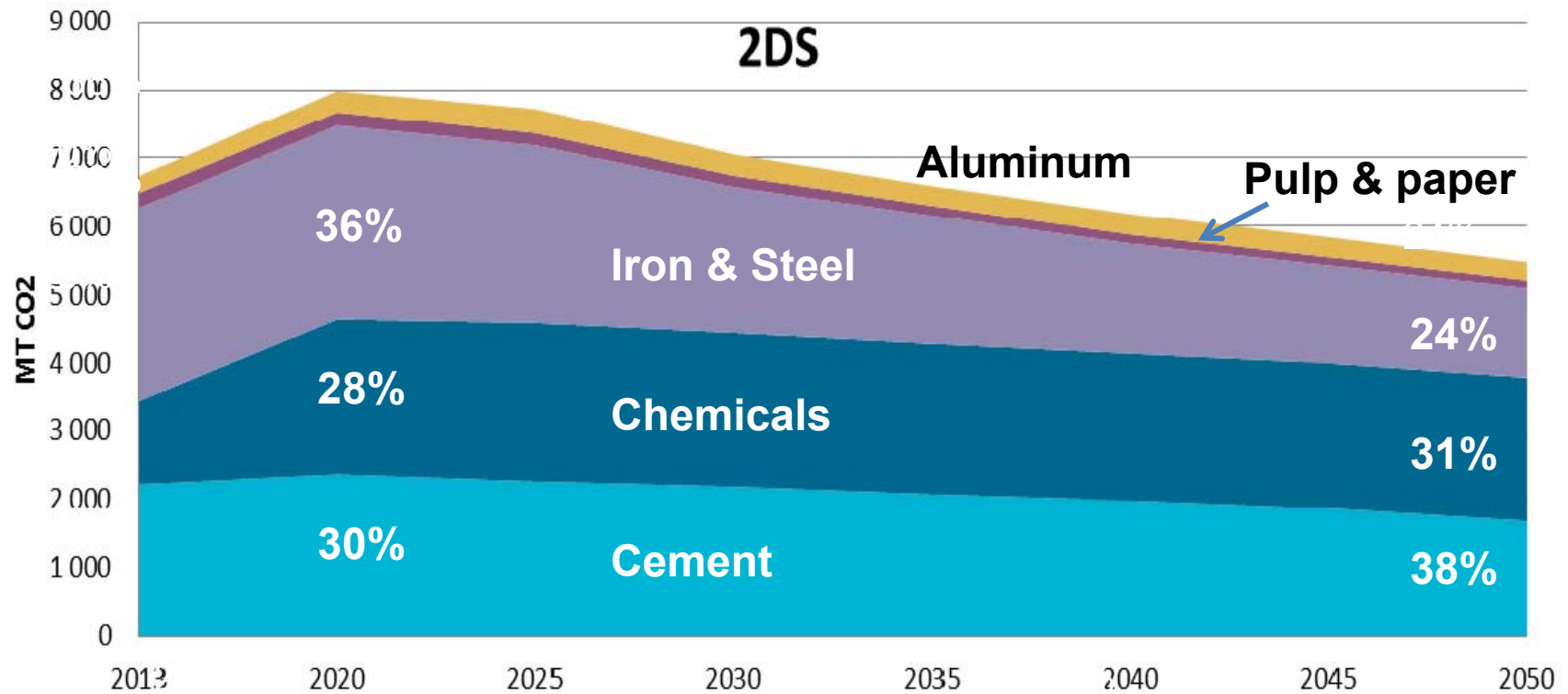
Industry may provide more BECCS options than the power sector

Source: IPCC, AR5, SPM

Bioenergy and CCS may both be limited
More should be done to reduce gross emissions

Materials is the major issue

Direct CO2 emissions from industry



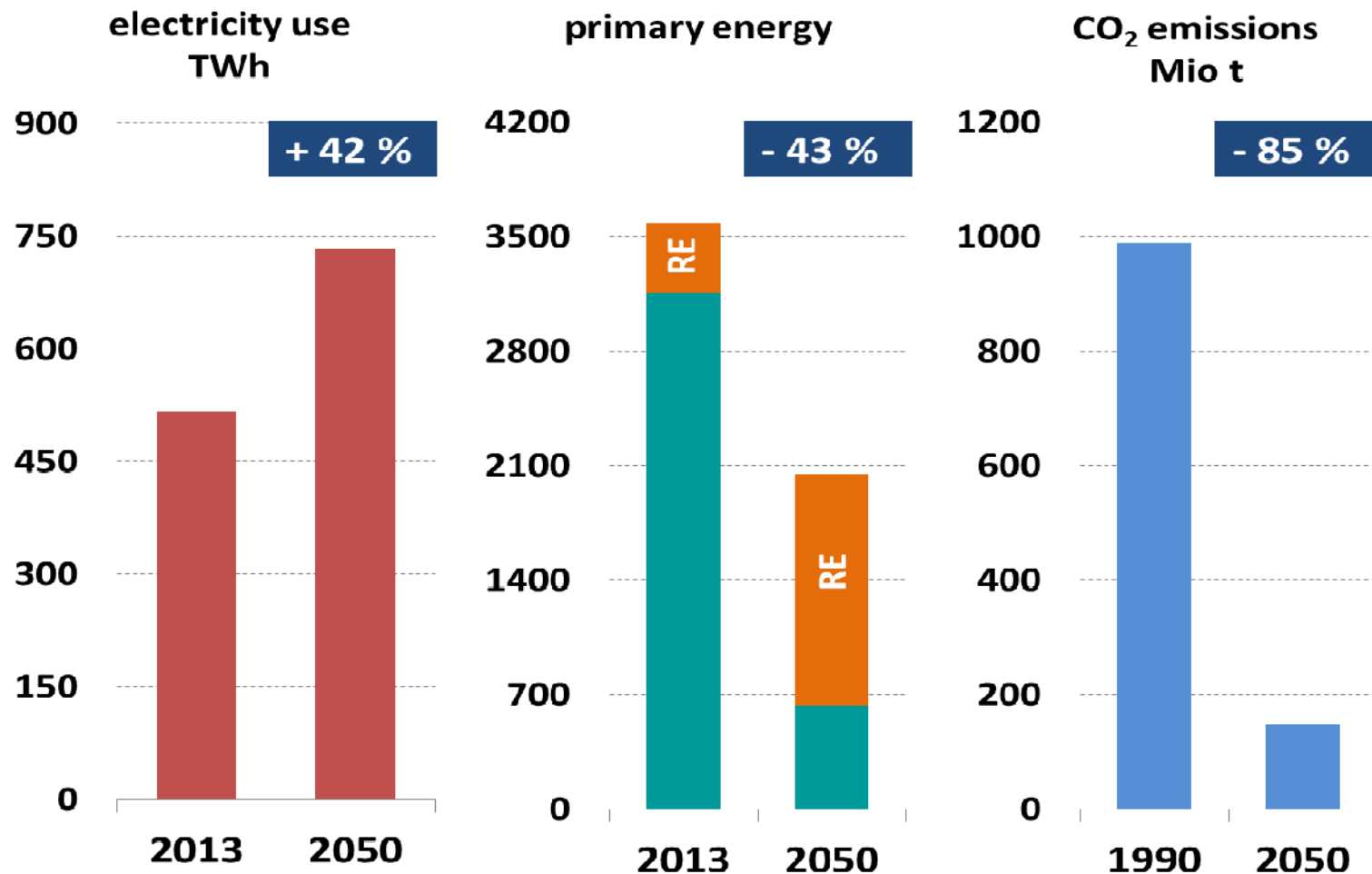
Iron & steel, chemicals and cement production still represent the bulk of industrial emissions by 2050

Options for direct heat surge



Solar heat offers many options, including for extraction and possibly chemicals

Massive electrification is a must

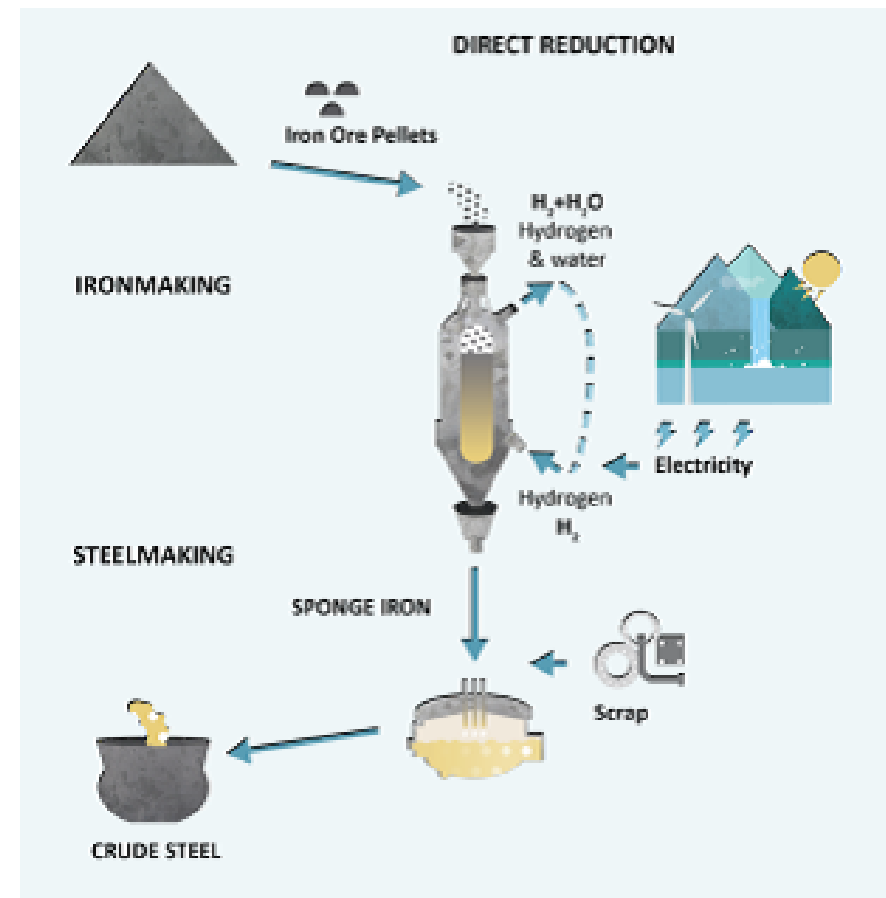


Modelling by Fraunhofer ISE suggests deep decarbonisation of Germany based on massive electrification of end-use sectors

Electricity – and hydrogen

■ CO₂-free steel making options:

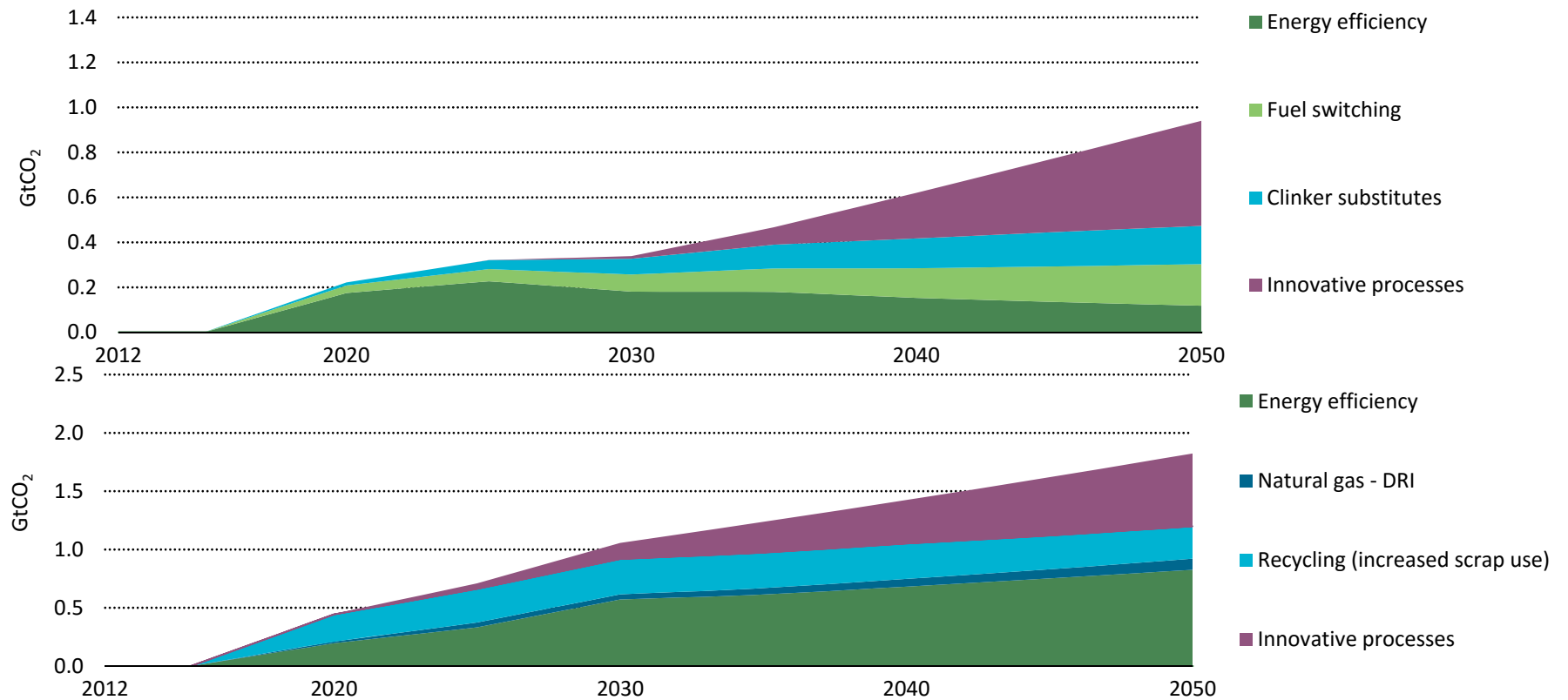
- Direct iron reduction with hydrogen from renewables and electric arcs (Hybrit Projekt)
- Electrolysis/electrowinning (ULCOwin/ULCOlysis)



Hydrogen may play multiple roles as energy vector and as processing agent

Innovation is critical

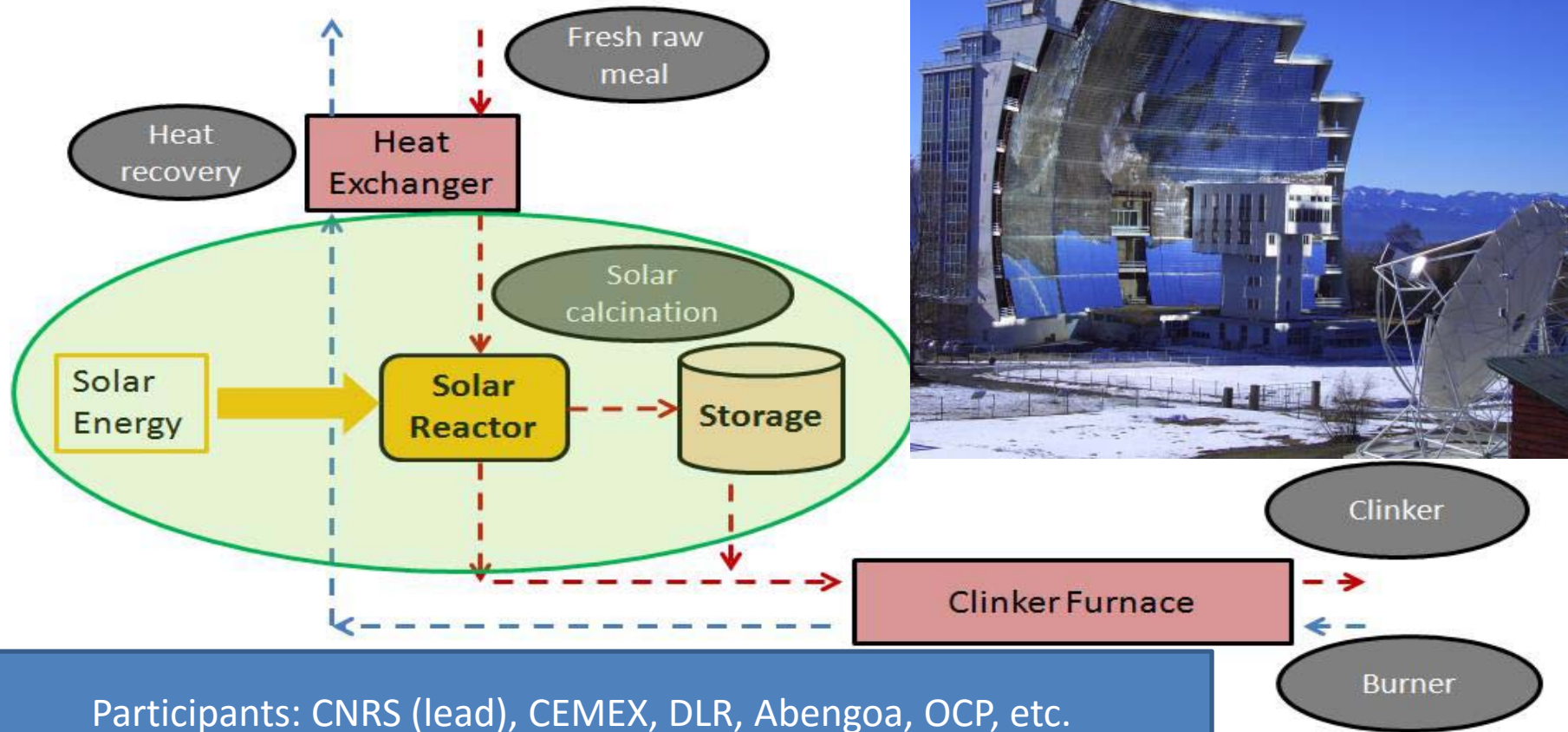
CO2 emission reductions from selected sectors in the 2DS



**Achieving the 2DS requires significant industrial innovation
 “Well below 2°C”, esp. if CCS is limited, requires even more**

Innovation is critical *(Did I say it already?)*

EU-backed SOLPART: high temp particle heating for industries



Participants: CNRS (lead), CEMEX, DLR, Abengoa, OCP, etc.

The project aims at developing a 800-1000°C solar process for energy intensive industries such as cement factories, phosphates...

How to get there?

- 1. Carbon price no silver bullet**
- 2. Sector coupling may help manage variability**
- 3. Integrate efficiency and renewables uptake**
- 4. Work with equipment manufacturers**
- 5. Procurement key to kick-start deployment**
- 6. Governments to support innovation**
- 7. Efficiency?**