The role of hydrogen in the clean energy transition

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The Power System Flexibility Campaign

- Three-year Clean Energy Ministerial work stream focused on public-private cooperation to accelerate the integration of VRE through improved power system flexibility:

- Previous stages have focused on 'hardware' while the latest phase focuses on three key enabling frameworks:
  - Market design
  - Digitalisation
  - **Sector coupling**

- Campaign is member-driven through:
  - High-level ministerial events
  - International expert workshops
  - Dedicated bilateral support to members
- Currently in final phase and continuation through a CEM initiative is in planning

Co-leads

CEM Members

New

In formalisation process

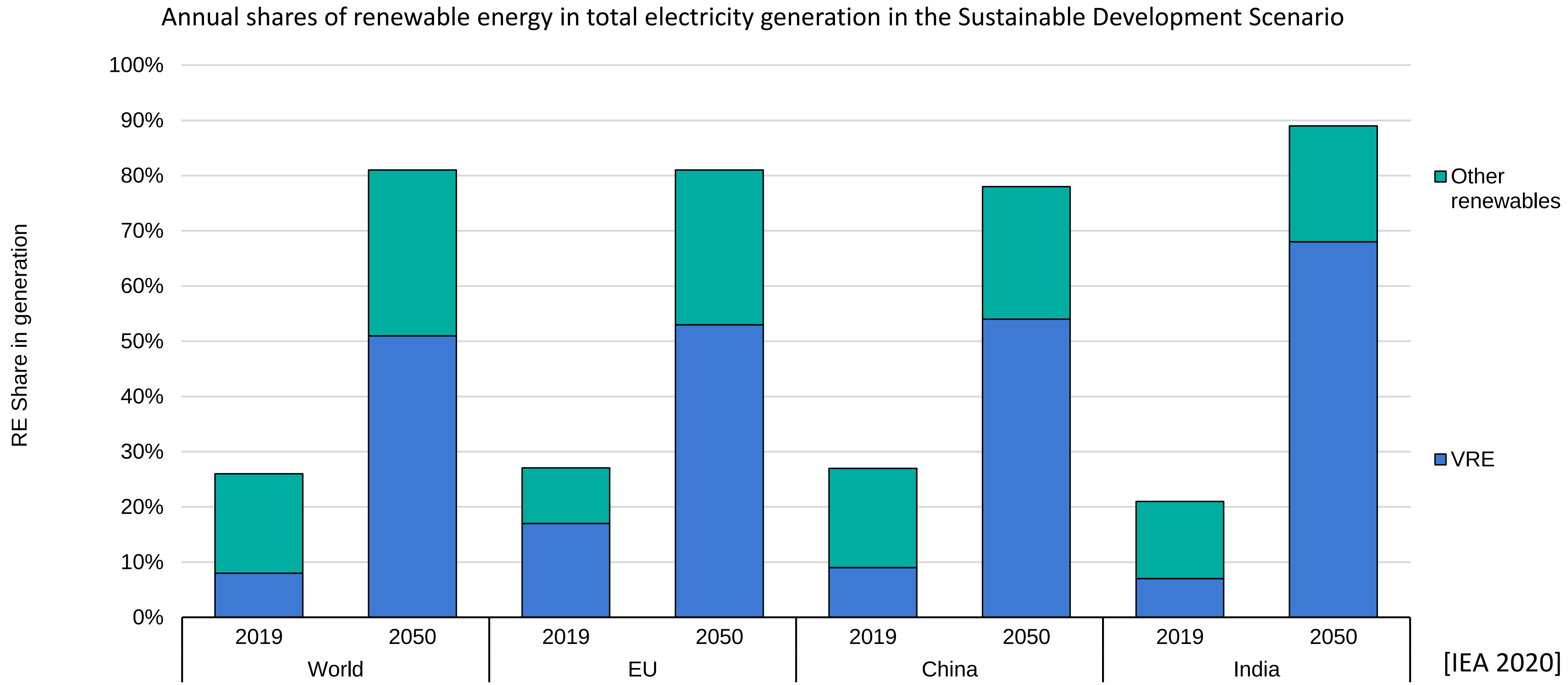
Non-government members

Associated CEM work streams

Hydrogen – A common element of our energy future?

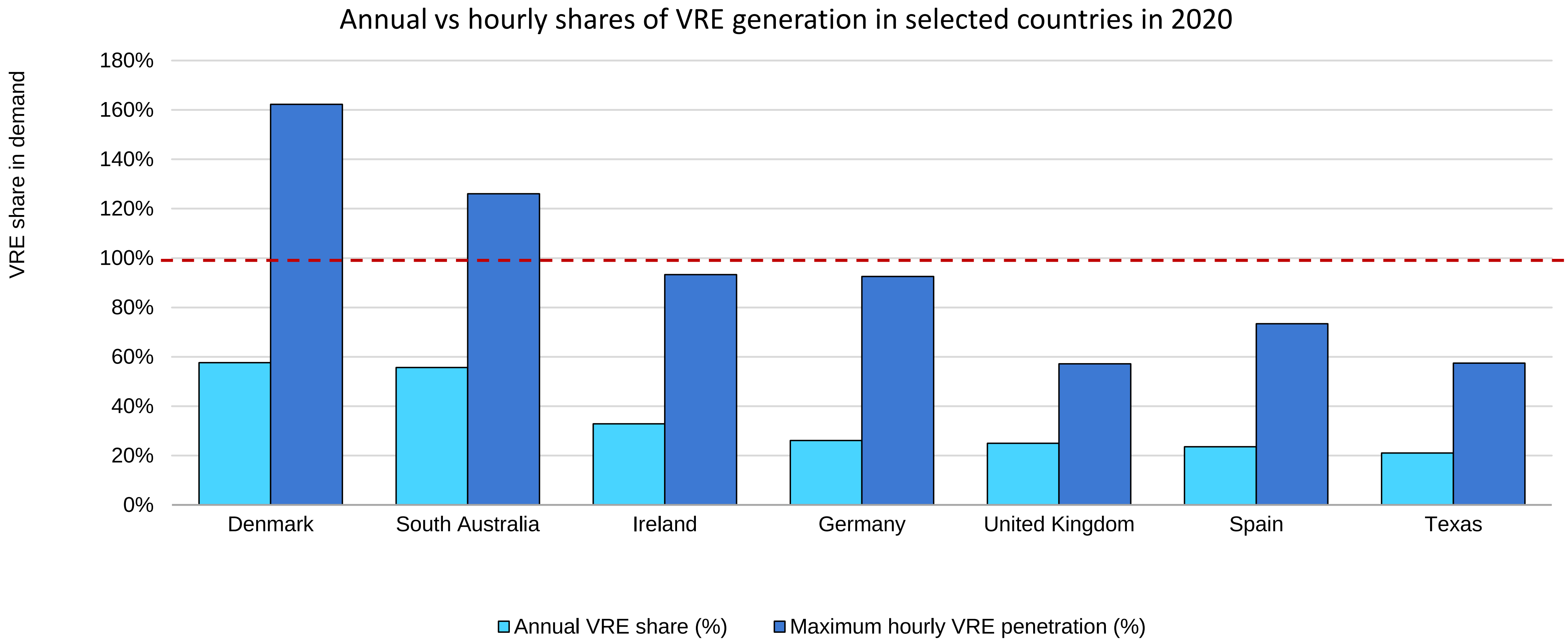
- Momentum currently behind hydrogen is unprecedented, with more and more policies, projects and plans by governments & companies in all parts of the world
- Hydrogen can help overcome many difficult energy challenges
  - **Integrate more renewables**, including by enhancing storage options & tapping their full potential
  - **Decarbonize hard-to-abate** sectors such as steel, chemicals, trucks, ships & planes
  - **Enhance energy security** by diversifying the fuel mix & providing flexibility to balance grids
- But there are challenges: **costs** need to fall; **infrastructure** needs to be developed; **cleaner hydrogen** is needed; and **regulatory barriers** persist

Variable Renewables to become the main building block in power systems worldwide



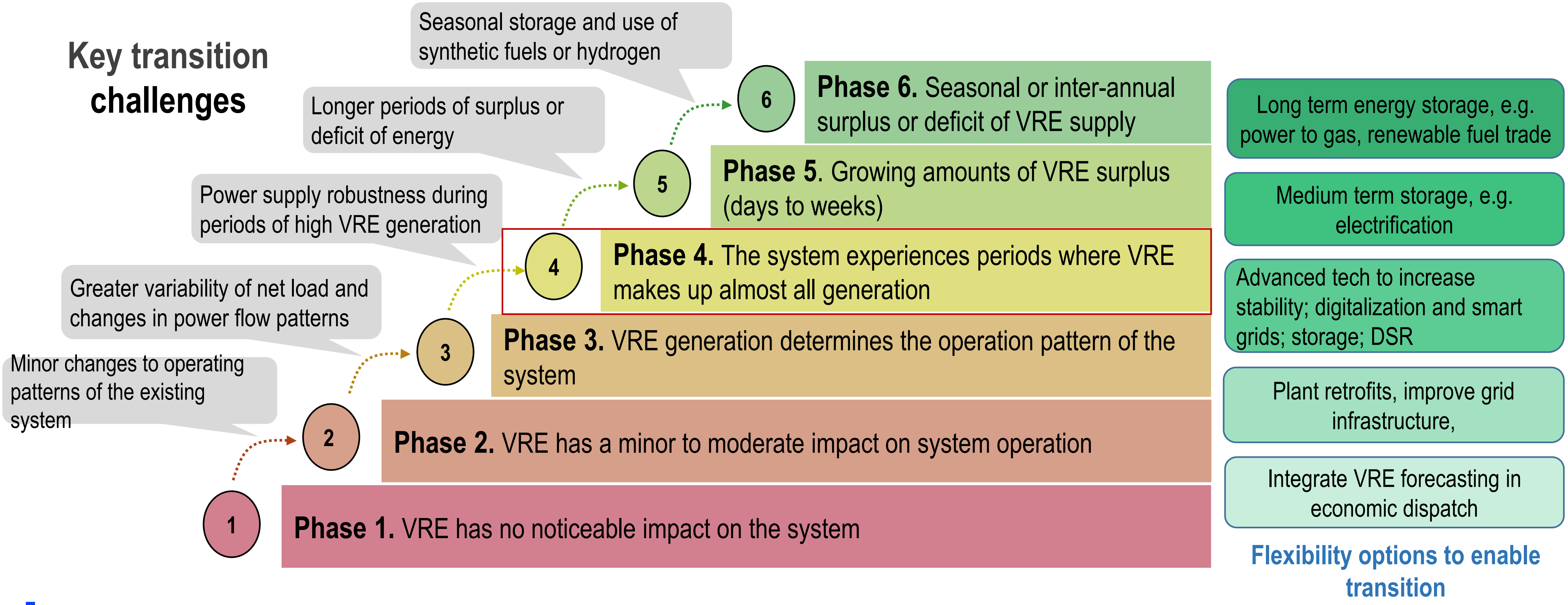
Supported by policy action, technology improvement and cost reductions, renewables are expected to cover over 80% of electricity demand by 2050. Solar PV and wind will see the greatest increase.

From annual VRE shares to instantaneous VRE penetration



As countries and regions are attaining higher shares of VRE generation, they are also experiencing much higher instantaneous VRE infeed levels in certain periods of the year

Characteristics in different phases of system integration of VRE



Key challenges in each phase that should be addressed for moving up to higher phases of VRE integration

Source: World Energy Outlook 2018

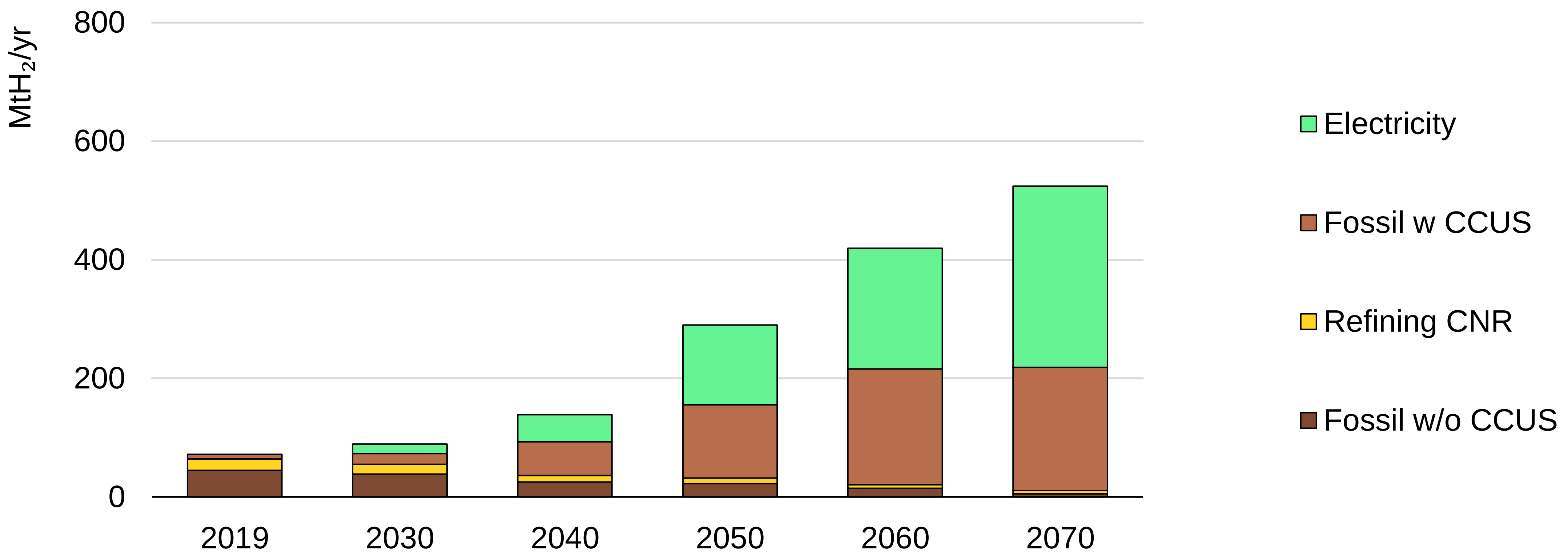
The system’s flexibility needs are growing and changing

Flexibility type	Ultra short term flexibility	Very short term flexibility	Short term flexibility	Medium-term flexibility	Long-term flexibility
Timescale	Subseconds to seconds	Seconds to minutes	Minutes to days	Days to weeks	Months to years
Issue	Ensure system stability (voltage, transient and frequency stability) at high shares of non-synchronous generation	Short-term frequency control at high shares of variable generation	Meeting more frequent, rapid and less predictable changes on the supply/demand balance	Addressing longer periods of surplus or deficit of variable generation	Balancing seasonal and inter-annual availability of variable generation

Understanding the type of type of flexibility challenges to be expected also gives policy makers an idea of how to go about changing the policy land-scape proactively

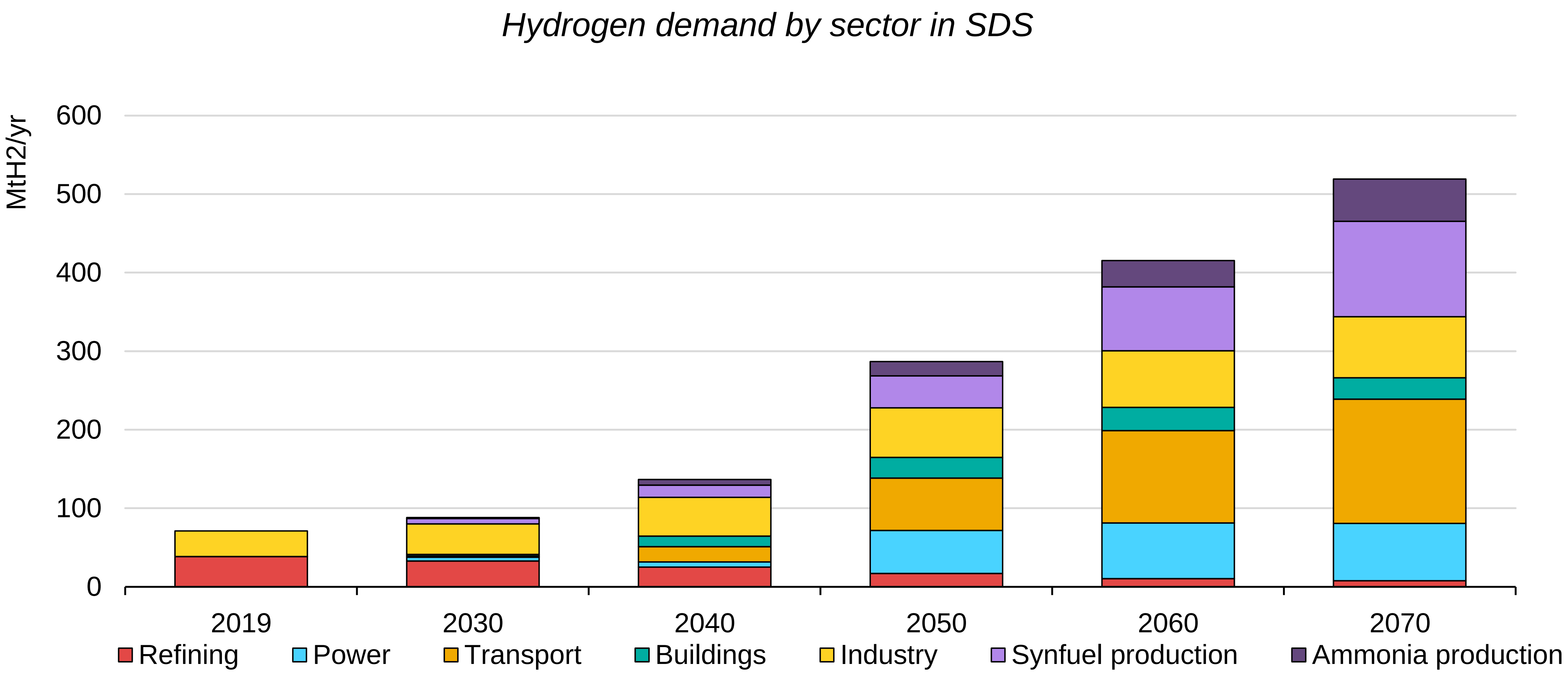
Cleaning hydrogen production

Global hydrogen production by technology in SDS, 2019-70



In the SDS, almost all hydrogen production is based on low-carbon technologies compared with the current dominance of unabated fossil fuels.

Hydrogen use should grow and expand into new applications



In the SDS, hydrogen demand grows 7-fold by 2070. Hydrogen and derived fuels account for 13% of global final energy demand, mostly used in transport and industry.

Making sense of sector coupling and the system's flexibility needs

- An increasing number of countries are adopting net-zero targets, an power sector decarbonisation will be one of the main building blocks for this
- So far there is better understanding of the short and very short term flexibility needs, but the question of long-term storage still remains open
- Long-term power sector decarbonisation scenarios show the need for dispatchable capacity, here synthetic fuels can play a role to enable low-carbon dispatchable generation
- To ensure that low carbon dispatchable generation is available by 2035, we need to start acting now, understanding their role in the power system and adapting the policy framework
- There are additional benefits, like maintaining the share of synchronous generation on the system
- Many of these models will depend on local resource availability and local infrastructure