Energy system integration for net-zero

Nordic-Baltic Energy conference 2021: Energy delivery in the EU Green Deal, 29 June 2021

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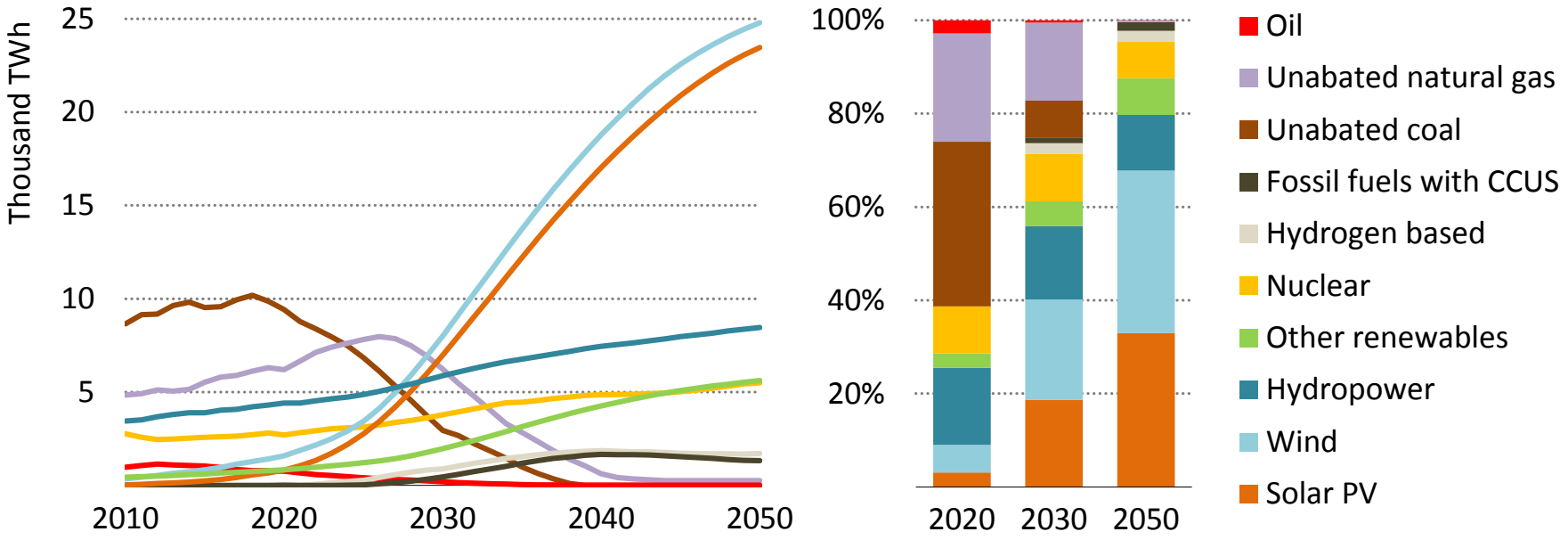
International Energy Agency

In a net-zero world, solar PV and wind dominate power supply

Global electricity generation by source in the IEA *Net-zero by 2050* scenario



At the same time, electricity rises from 20% of final energy consumption, to 49% by 2050 globally (or 62% including electricity for hydrogen). Flexibility becomes key to energy system resilience.

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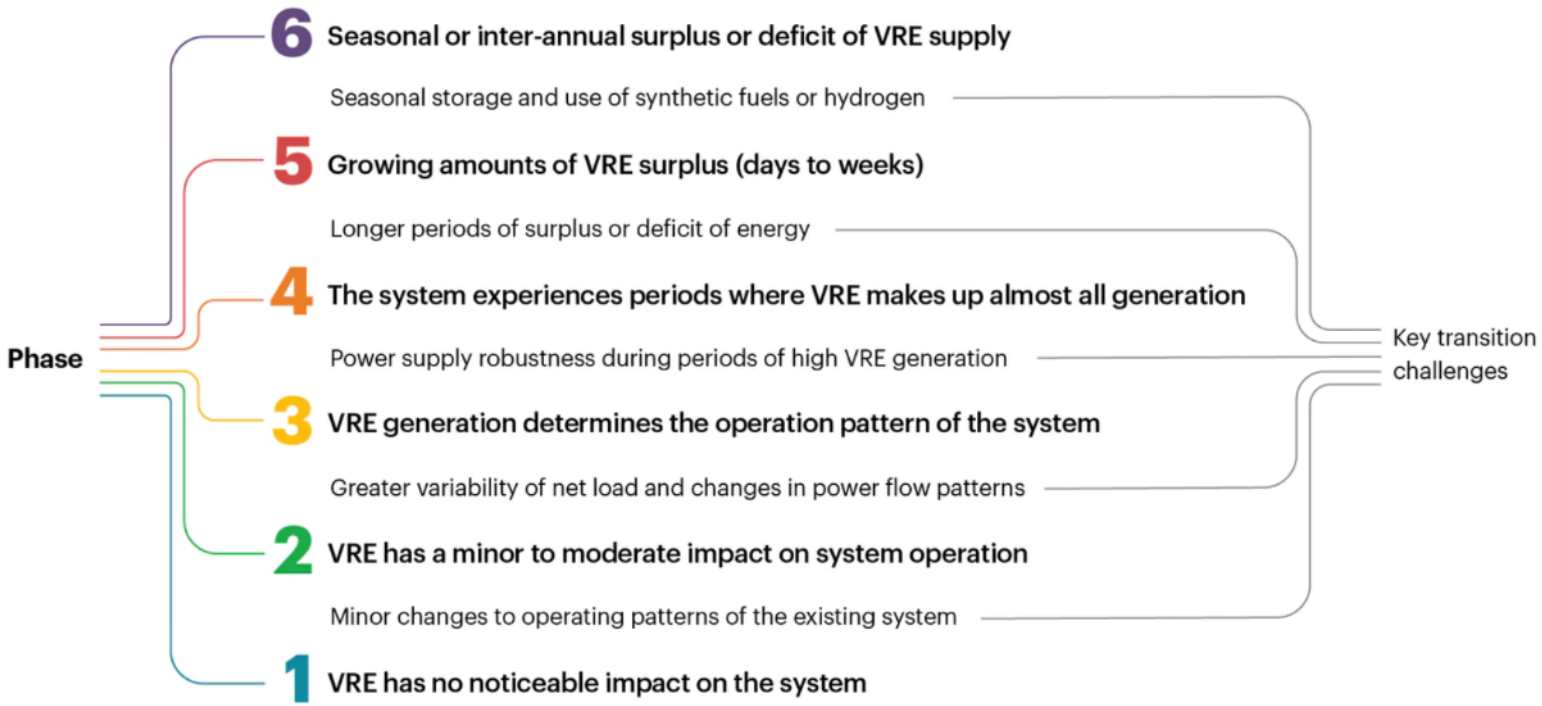
Six phases of system integration of variable renewable energy (VRE)



As you approach higher levels, hydrogen becomes a primary strategy for ensuring electricity system reliability, and CCUS can play a central role. Only a few countries have reached Level 4 today.

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Why hydrogen? Much more than just a strategy for power systems

- It produces no CO_2 when used
- It is a leading solution for several critical and interrelated challenges
    1. How to reach very high levels of variable renewable electricity through long duration storage and flexible power generation
    2. How to replace coal and gas in refining, steel, chemical production and heat cement plants
    3. How to avoid the costs and challenges of electrifying nearly all land transport
    4. How to maintain the benefits of market-based trade in energy, to balance long-term and short-term regional imbalances
    5. How to allow air transport to continue in a net-zero world without very high levels of carbon removal and bioenergy
    6. How to sidestep the challenges of full end-use electrification (including expanding the power grid to meet peak heat demand, decommissioning gaseous fuel infrastructure and switching all customers to electrical equipment).

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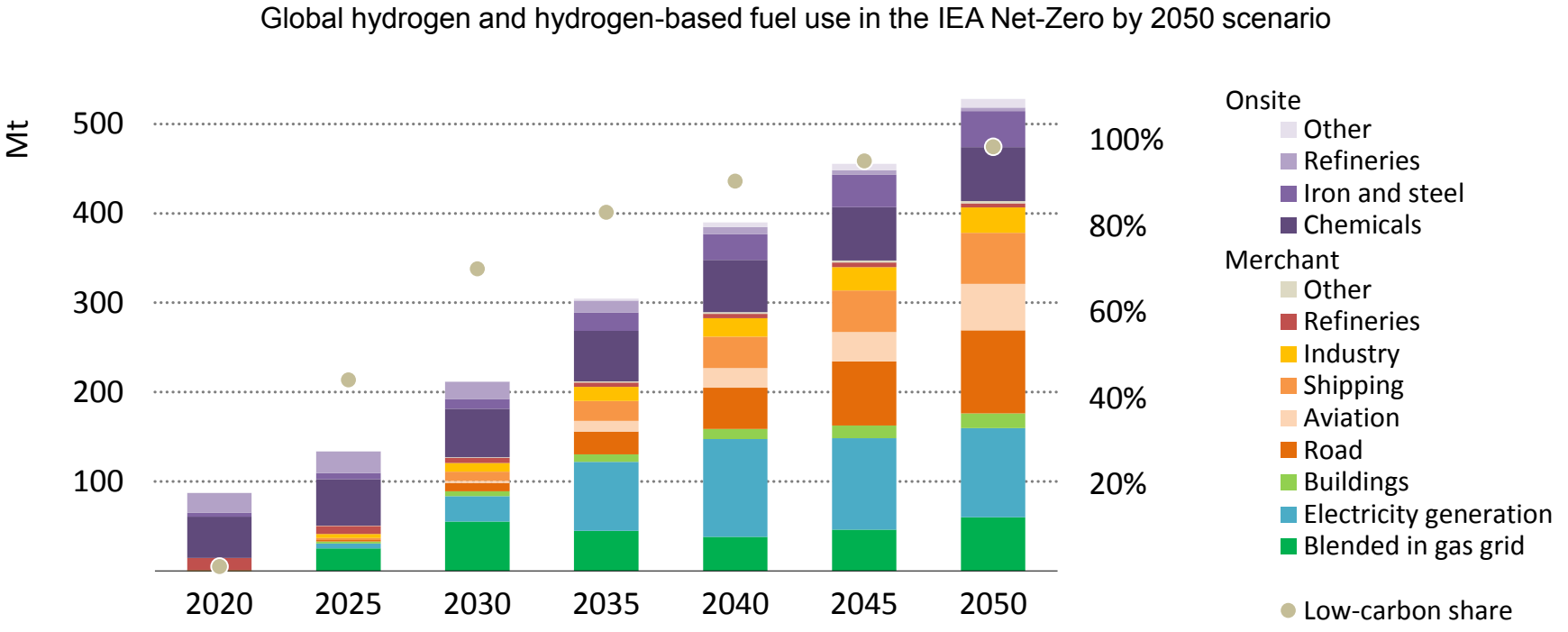
IEA net-zero by 2050 pathway: hydrogen use expands rapidly



Today, hydrogen use is mostly for refineries and heavy industry, and the associated CO_2 emissions are large. The future opportunity lies in a much wider range of sectors, but it must all be low-carbon to meet climate goals.

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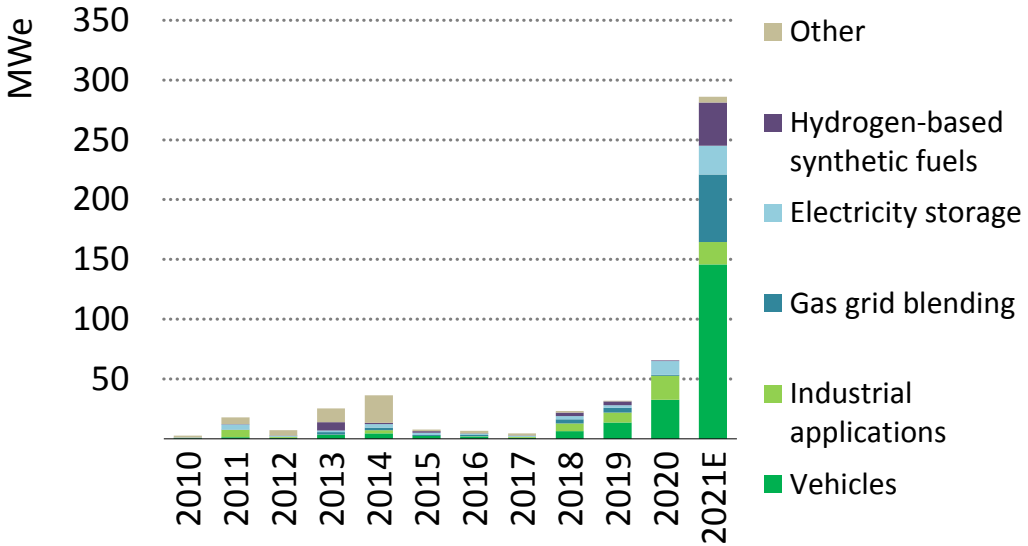
So where are we today?

- Momentum is unprecedented. If this is just another hype cycle, it's a very big one!
- In the last few years, 12 countries plus the EU have published hydrogen strategies. 18 are under development
- Hydrogen companies have raised around $8 billion in equity since 2019
- Record levels of project development and record electrolyser sizes commissioned
- Electrolyser manufacturing capacity is rising from around 3 GW to around 9 GW
- New CCUS projects for hydrogen announced

Electrolyser additions for clean energy production



World Energy Investment 2021

- Costs of low-carbon hydrogen remain high compared to natural gas (1.5-7x), mainly due to input costs

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