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# Energy transition and the role of hydrogen – Examples from Oman and Germany

13. March 2024

# IEA - World Energy Outlook 2023

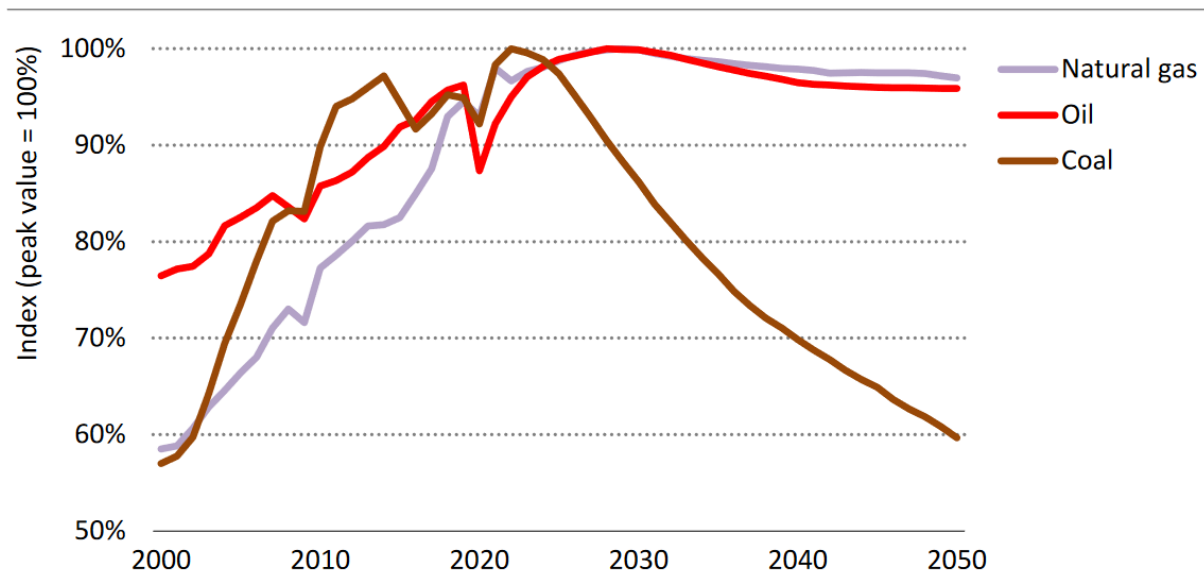


Explores different main scenarios:

- **Stated Policies Scenario (STEPS)** based on the governments latest policy settings
- **Net Zero Emissions by 2050 (NZE) Scenario** which limits global warming to 1.5 °C.

The Clean energy momentum in STEPS is now sufficient for fossil fuel demand to peak before 2030

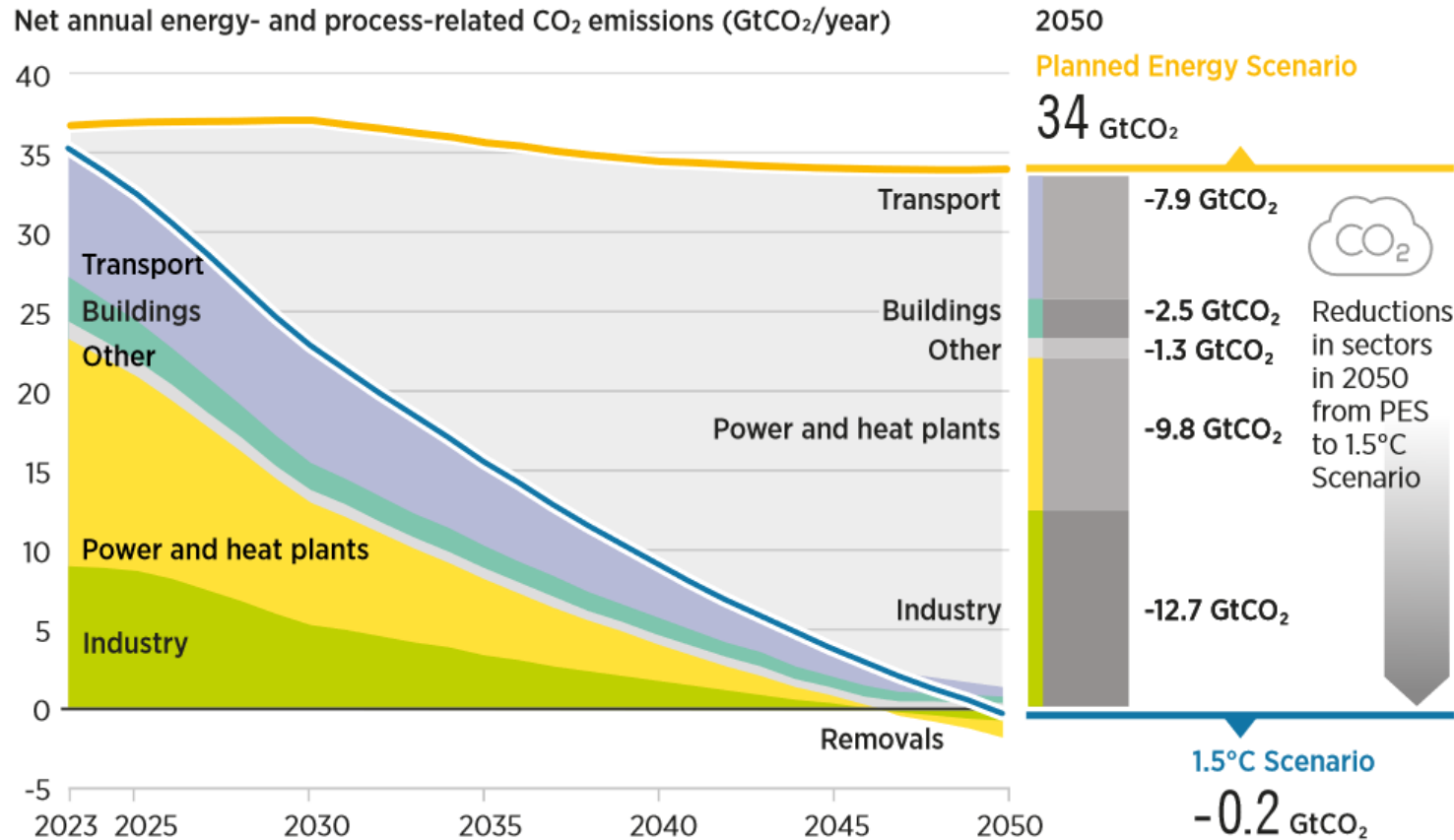
**Figure 1.1** ▶ Fossil fuel consumption by fuel in the STEPS, 2000-2050



IEA. CC BY 4.0.

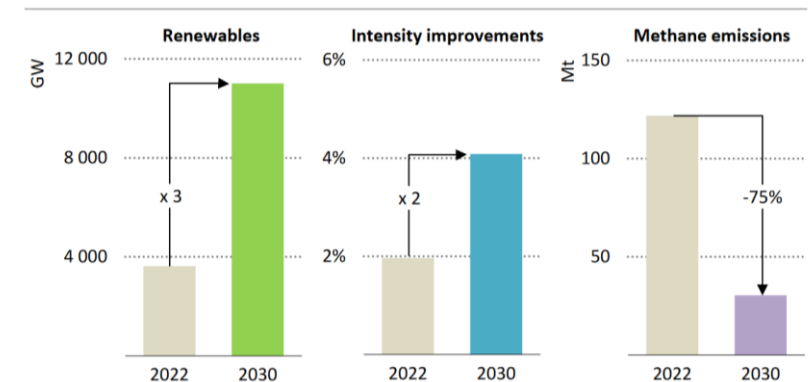
- More E-vehicles
- Less new coal- & natural gas-fired power plant globally
- Heat pumps replacing residential gas boilers (mainly Europe and US)

# Are we on track?



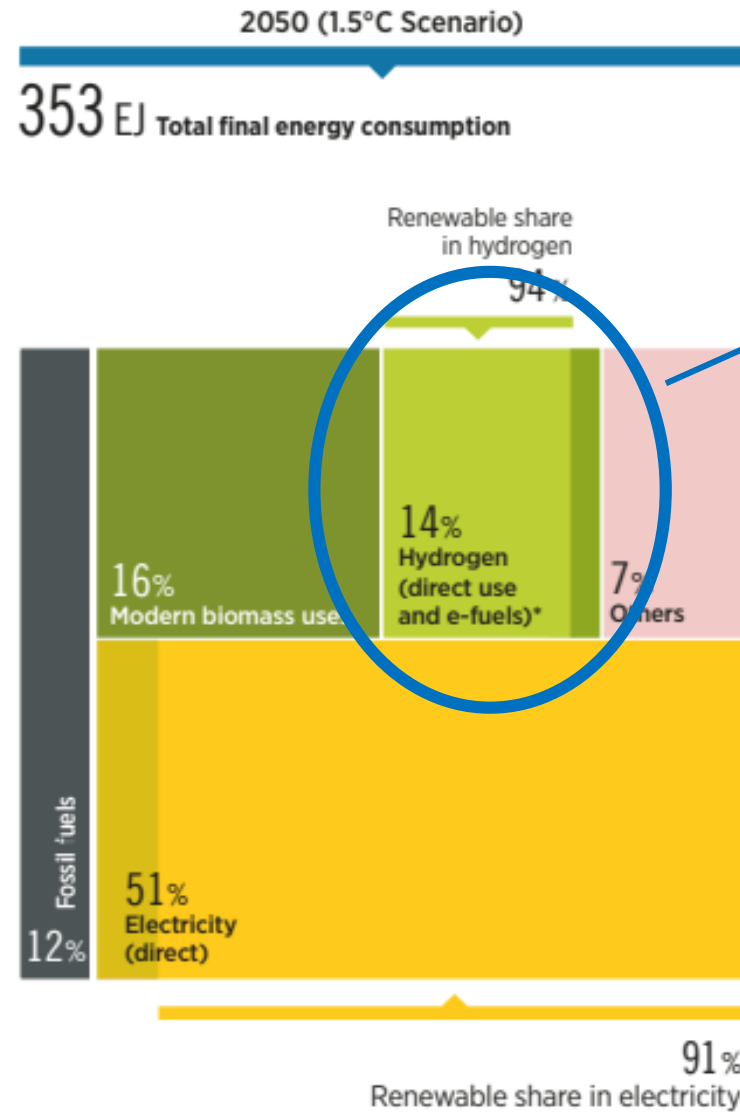
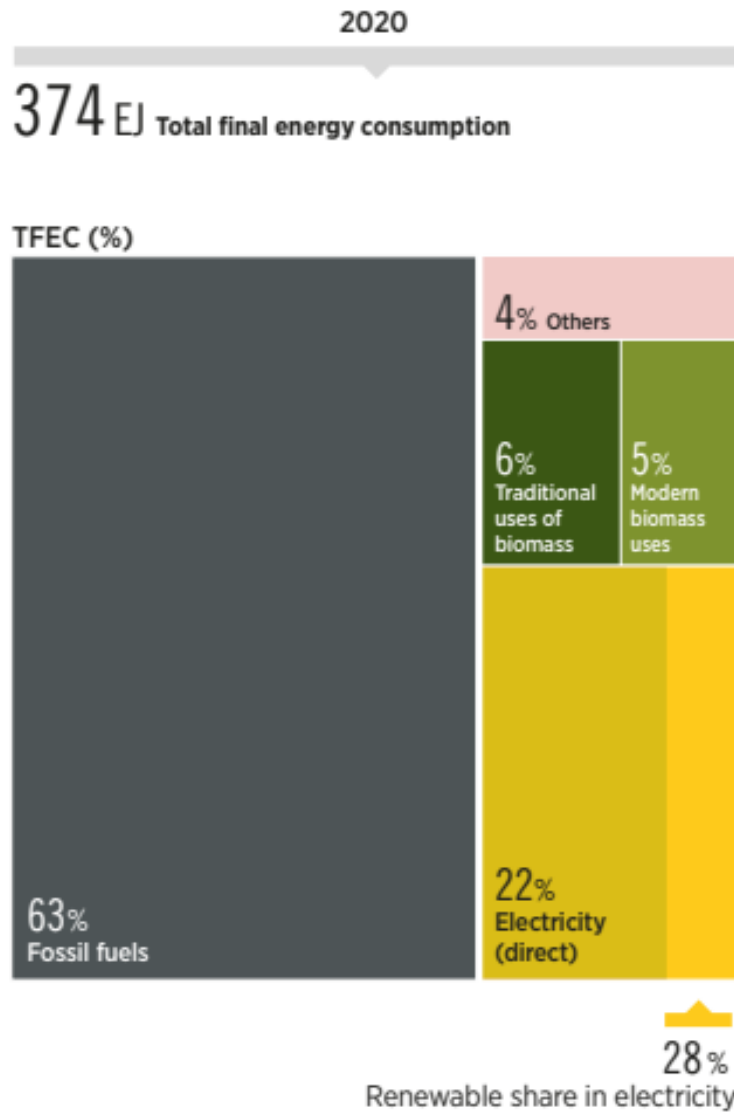
Today: Investment in oil & gas double the level required for NZE Scenario in 2030.

## Requirements:



Protracted fossil fuel use: 2.4°C instead of 1.5 °C in 2100 → Severe Climate Impacts

# Breakdown by Energy Carrier in 2025

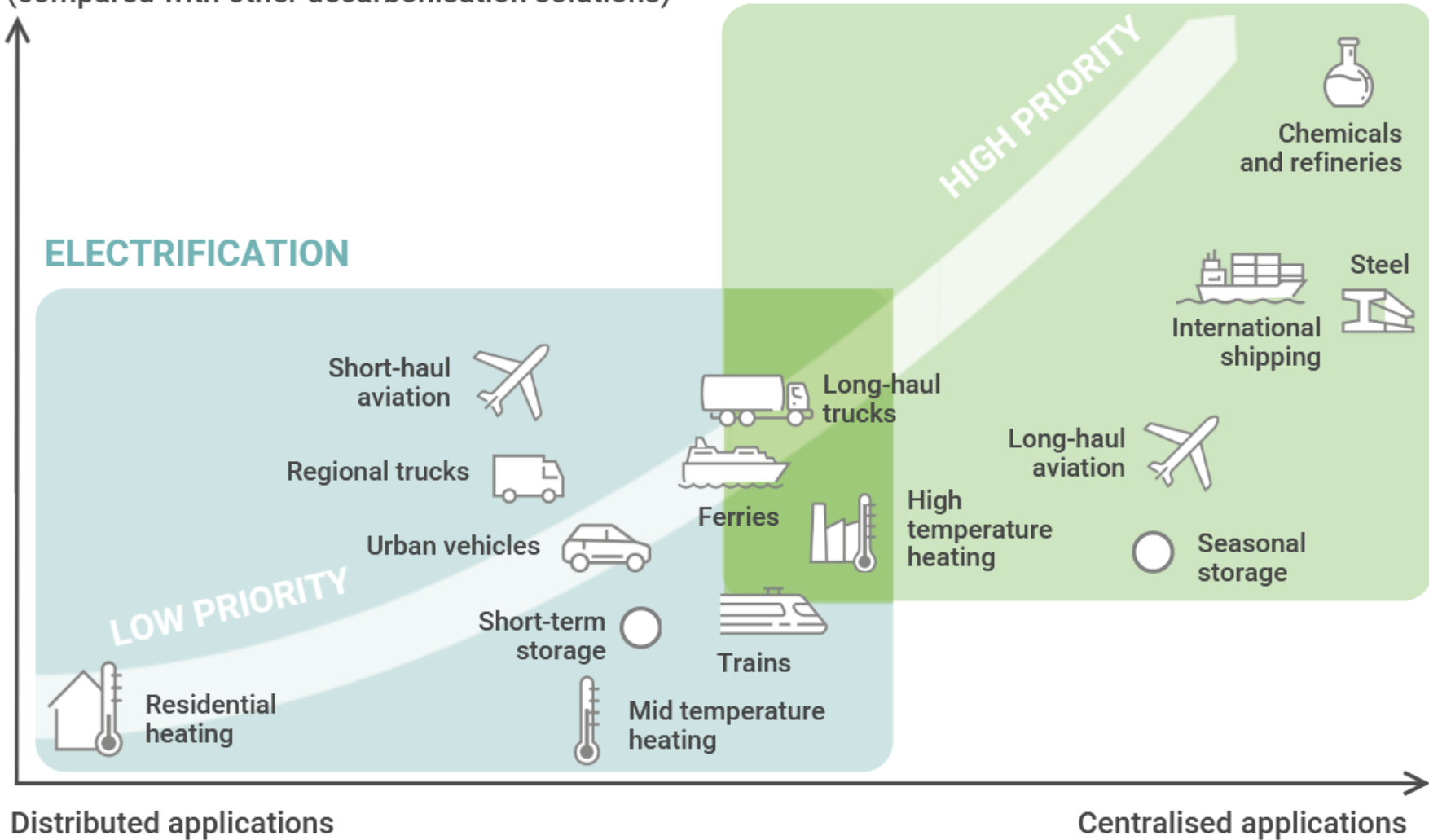


New energy carrier

# The Role of Hydrogen



Maturity of hydrogen solutions  
(compared with other decarbonisation solutions)



Hydrogen for the hard to abate sectors

# New Hydrogen Market Typography

Hydrogen production potential,<sup>1</sup> 2050, million tons per annum

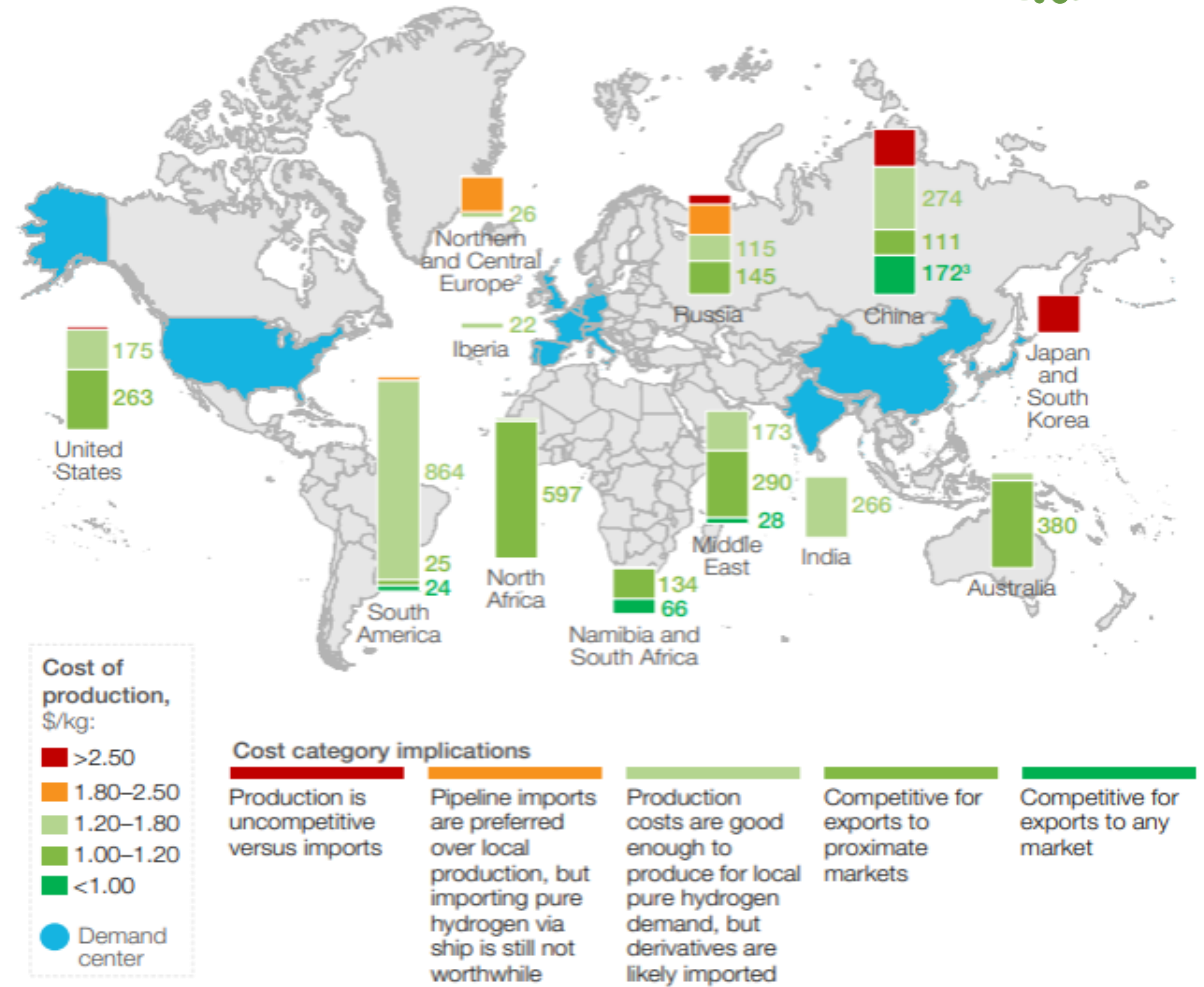
**Key demand centers:**

- EU, Japan, SEA
- USA, China, India,

Regions with high demand and low (economic) production potential  
 → **Importers**

Regions with high demand and high (economic) production potential  
 → **Prosumers**

Regions with low demand and high (economic) production potential  
 → **Exporters**



# Germany: National Hydrogen Strategy



## Availability of sufficient hydrogen and derivatives

Domestic capacity target: 5 GW → 10 GW in 2030  
Development of Import Strategy

## Efficient hydrogen infrastructure

Initial German Hydrogen network by 2028: > 1,800 km pipelines  
European Hydrogen Backbone: 4,500 km

## Establishment of hydrogen applications

industry, heavy commercial vehicles, aviation and shipping, providing system-stabilization & flexible loads in the power system

## Suitable framework conditions

Coherent legal requirements at national, European and pref. international level for planning & approval procedures, uniform standards & certification systems

# Energy transition Oman



## Oman Vision 2040

- Economic diversification
- Protection of environment & natural resources
- Labor market & employment



Royal Directive  
October 2022:  
**Carbon neutrality by 2050**

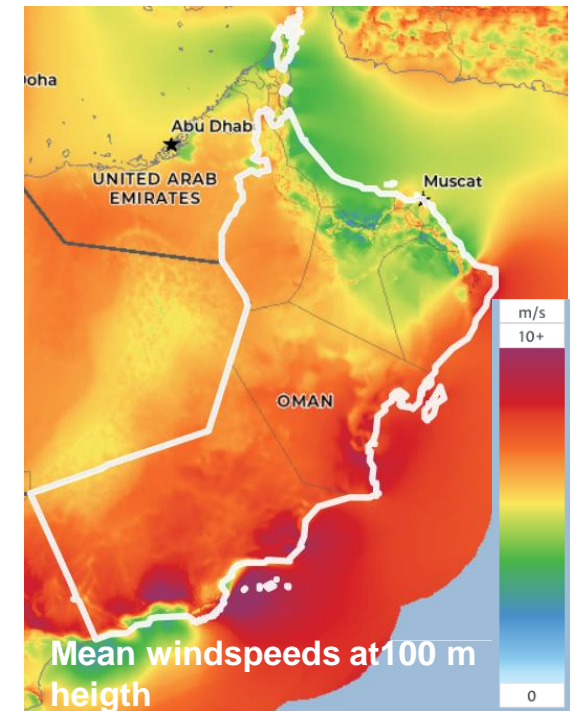
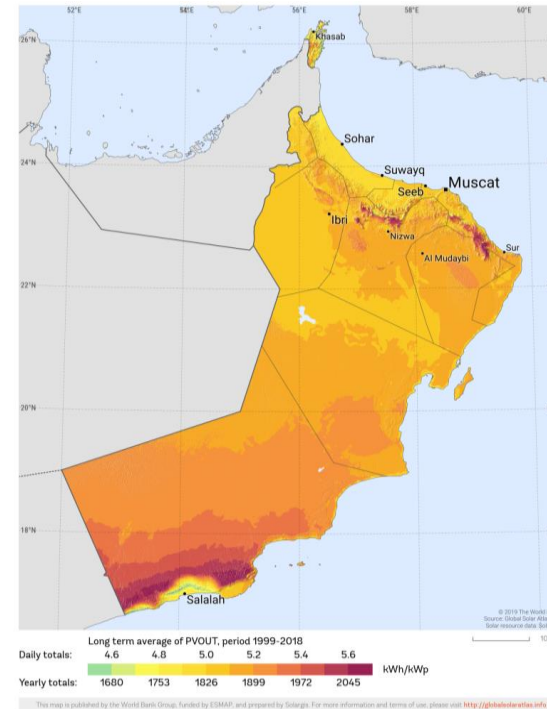
## 2021 Oman (Germany)

Total emissions: 95 Mt CO<sub>2</sub>e/a (666 Mt CO<sub>2</sub>e/a)

Emissions per inhabitant: 18 t CO<sub>2</sub>e (8 t CO<sub>2</sub>e)

Emission intensity: 0.62 t pro 1000 \$ BSP (0.15 t pro 1000 \$ BSP)

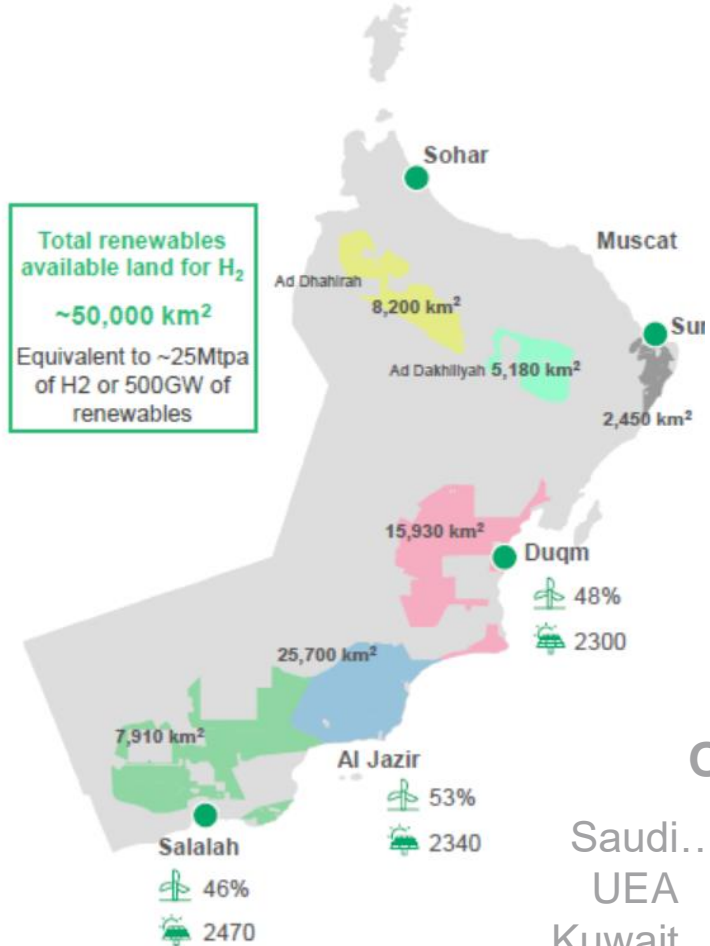
## Oman's potential for solar and wind energy One pre-requisite for green hydrogen production



<https://www.oman2040.om>

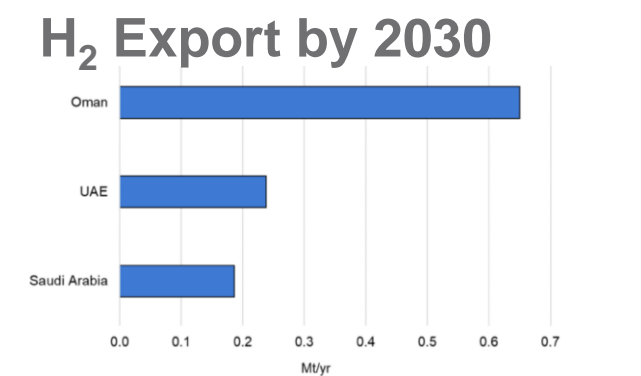
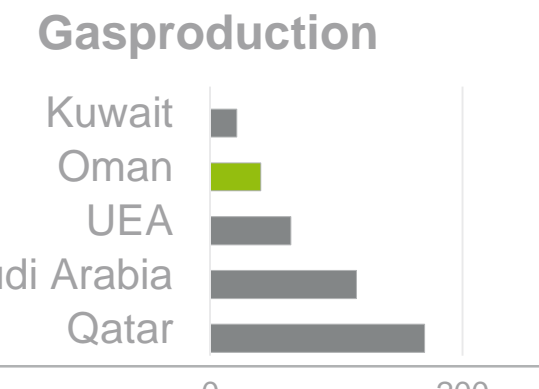
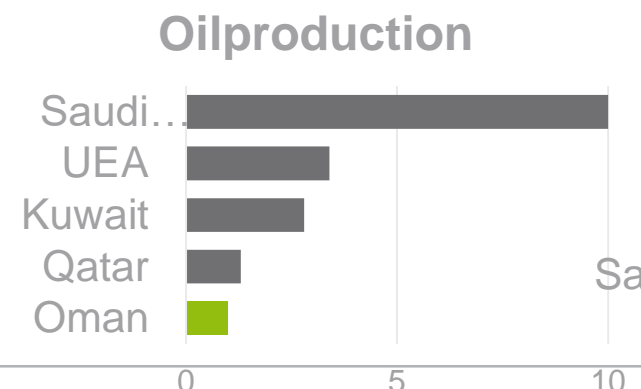


# Oman's plans for a hydrogen economy



Production targets	2030	2040	2050
H <sub>2</sub> Production [Mt/a]	1 – 1.5	3.5	7.5 -8.5
Electrolyzer Capacity [GW]	8-15	35-40	95-100
Capacity RE [GW]	16-30	65-75	175-185

<https://hydrom.om>



# Need for collaboration



- Collaboration is essential in addressing global energy & climate challenges, as no country is immune to climate risks.
- For a emerging sector like hydrogen this is even more true.
- Requires international trade and innovation & technology transfer.

Energy Dialogues



Energy Partnerships



Hydrogen & Decarbonization  
Diplomacy





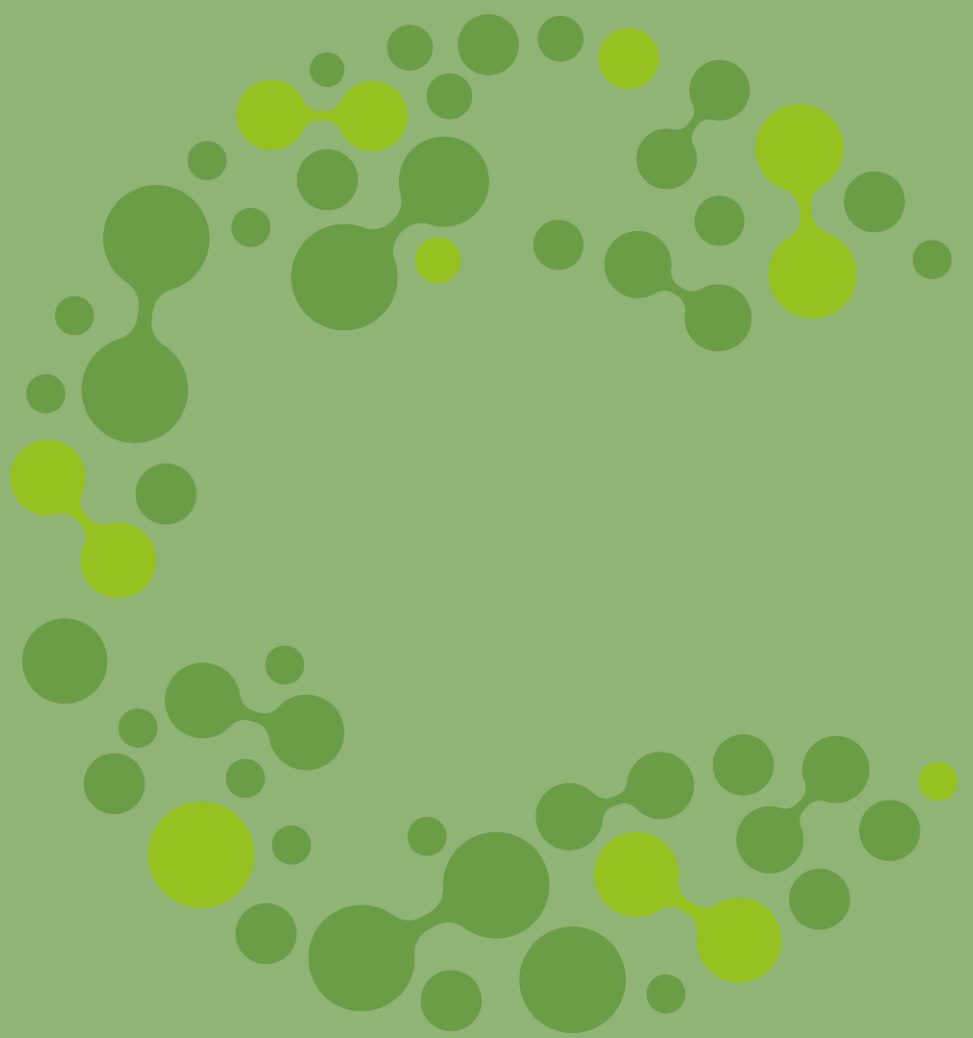
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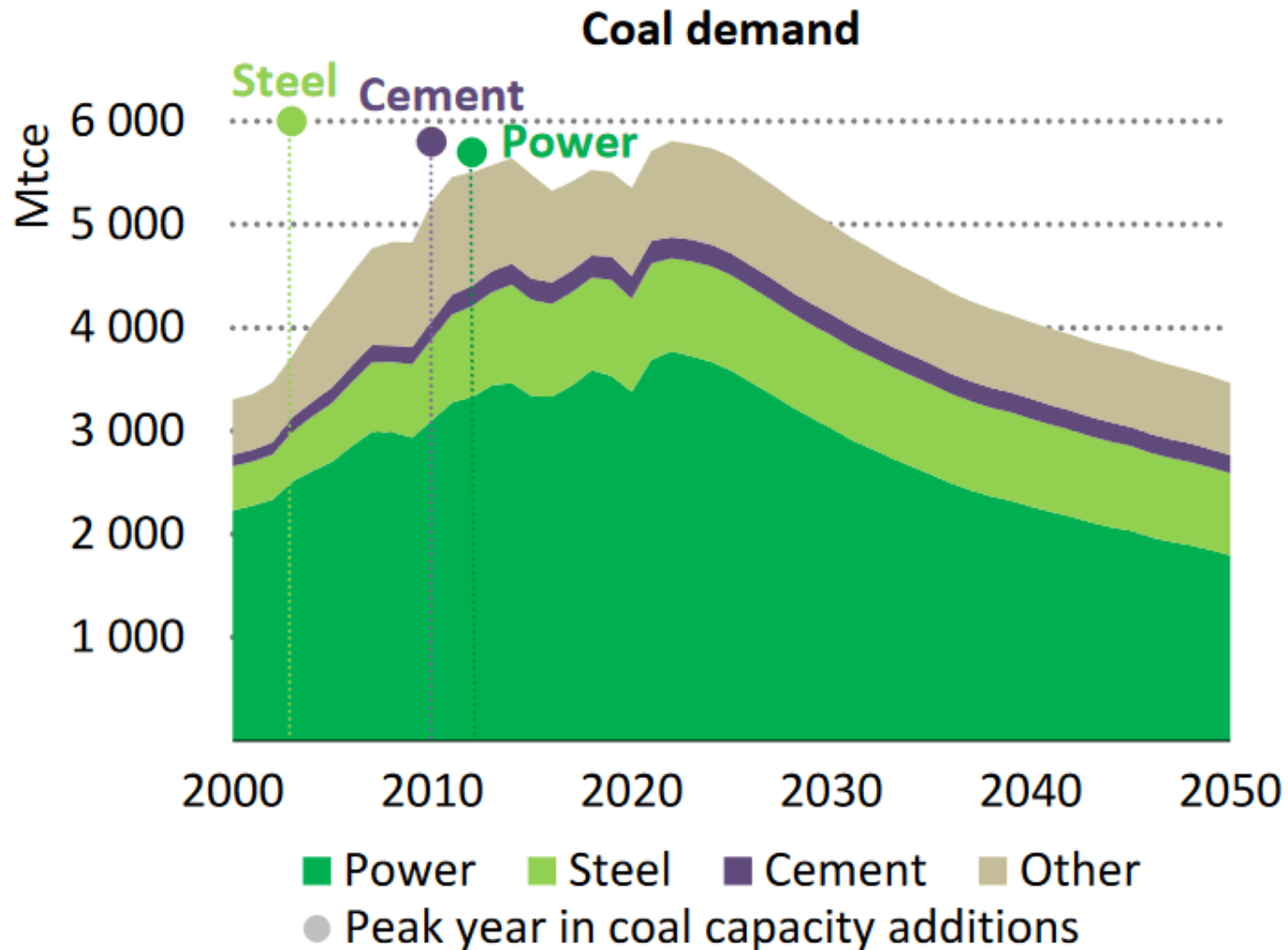
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THANK YOU

# Coal demand



Investments in coal falling rapidly (annual coal capacity additions: 100 GW (2012) - 50 GW (2022))

## Power sector (accounts 65%)

- Role shifted from bulk power towards system services.
- Average capacity factor: - 10% (expansion of RE)

## Iron and steel (accounts 16%)

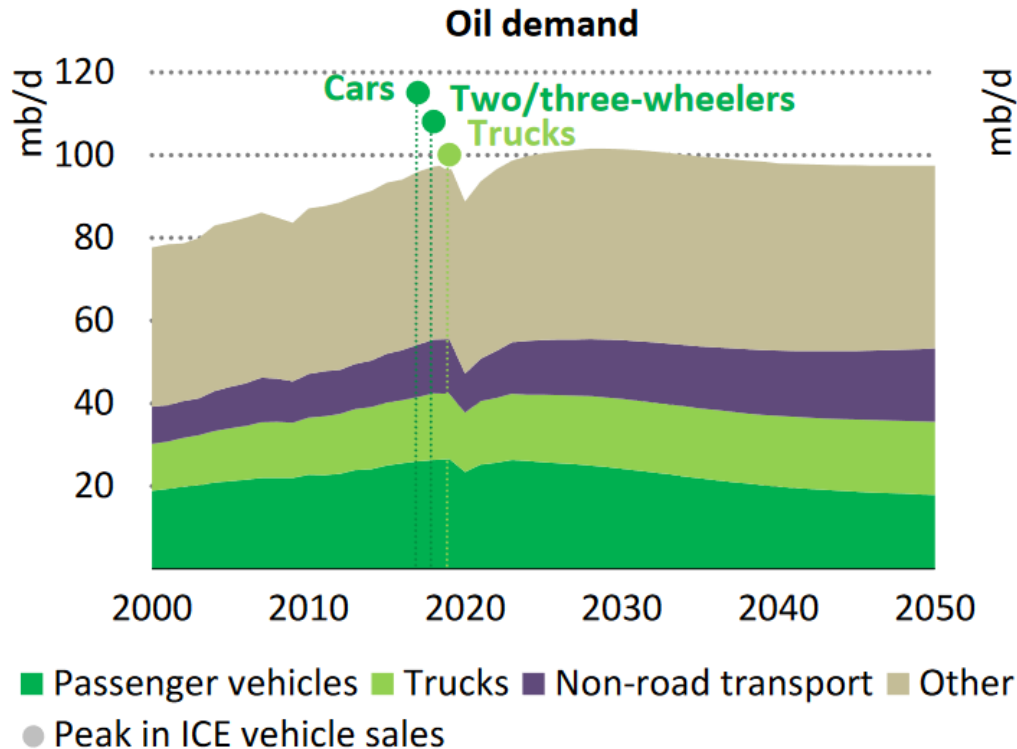
Capacity additions peaked in 2003  
coal demand peaked in 2014

Carbon intensity of steel production declined since 2015

- growth in the share of scrap-based production
- Increased use of natural gas-based direct reduced iron production instead of blast furnaces

Coal demand still increases in some emerging & developing economies, but it is more than offset by projected declines elsewhere.

# Oil demand



mb/d Demand for petrochemicals, aviation and shipping continues to increase through to 2050 in the STEPS.

only partly offsets reductions in demand from road transport, and power and buildings sectors.

Result, oil demand peaks before 2030, but decline is slow all the way through to 2050.

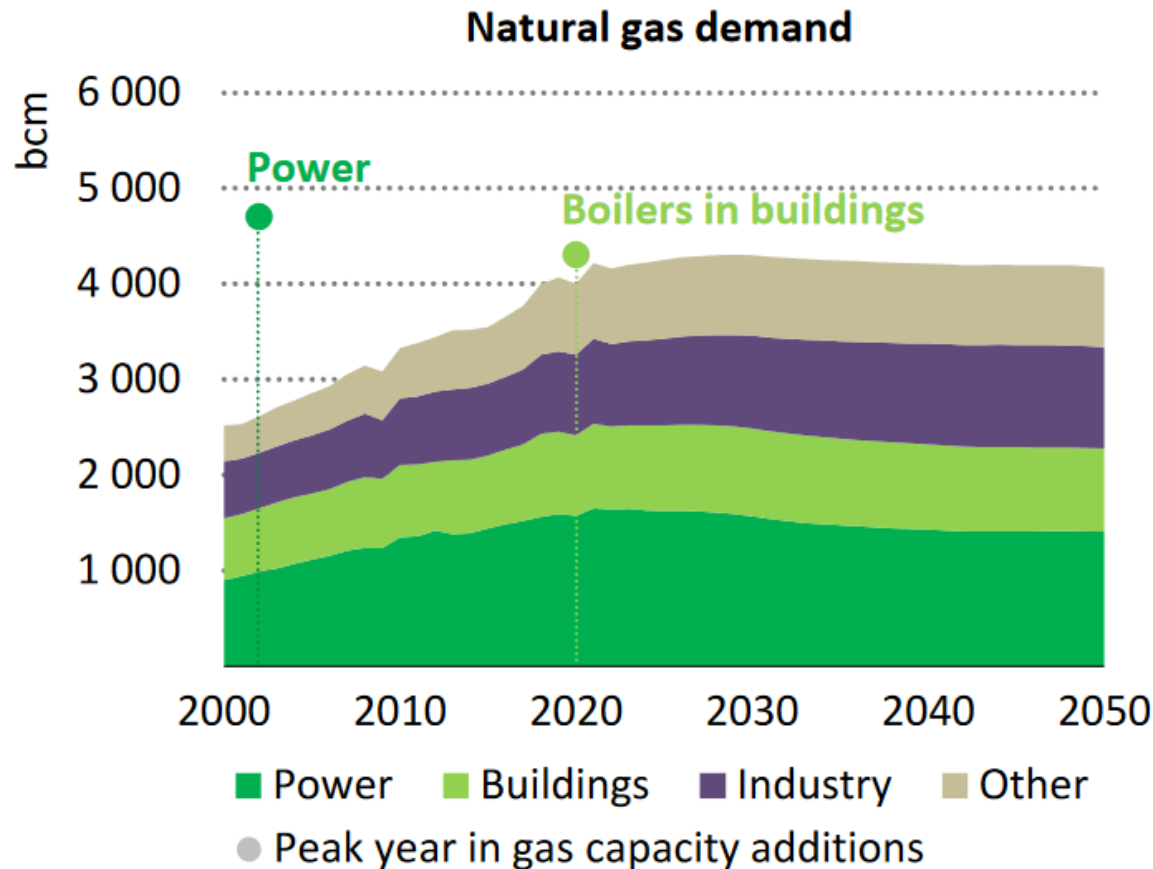
Oil demand surged by 18 million barrels per day (mb/d).

Road transport drove increase (accounts now for 45%)

Global car fleet expanded by more than 600 million cars over the last 20 years & road freight increased by 65%.

The rise in electric vehicle (EV) sales (1 in 25 cars sold was electric in 2020, now 1 in 5) is now impacting the demand.

# Natural gas demand



Capacity additions: > 100 GW (2002) to 30 GW in 2022.

Sales of gas-fired boilers for space heating declines especially in advanced economies, large impact as space heating is one of the large contributors to the demand.

## Wave of new LNG export projects impacts gas markets

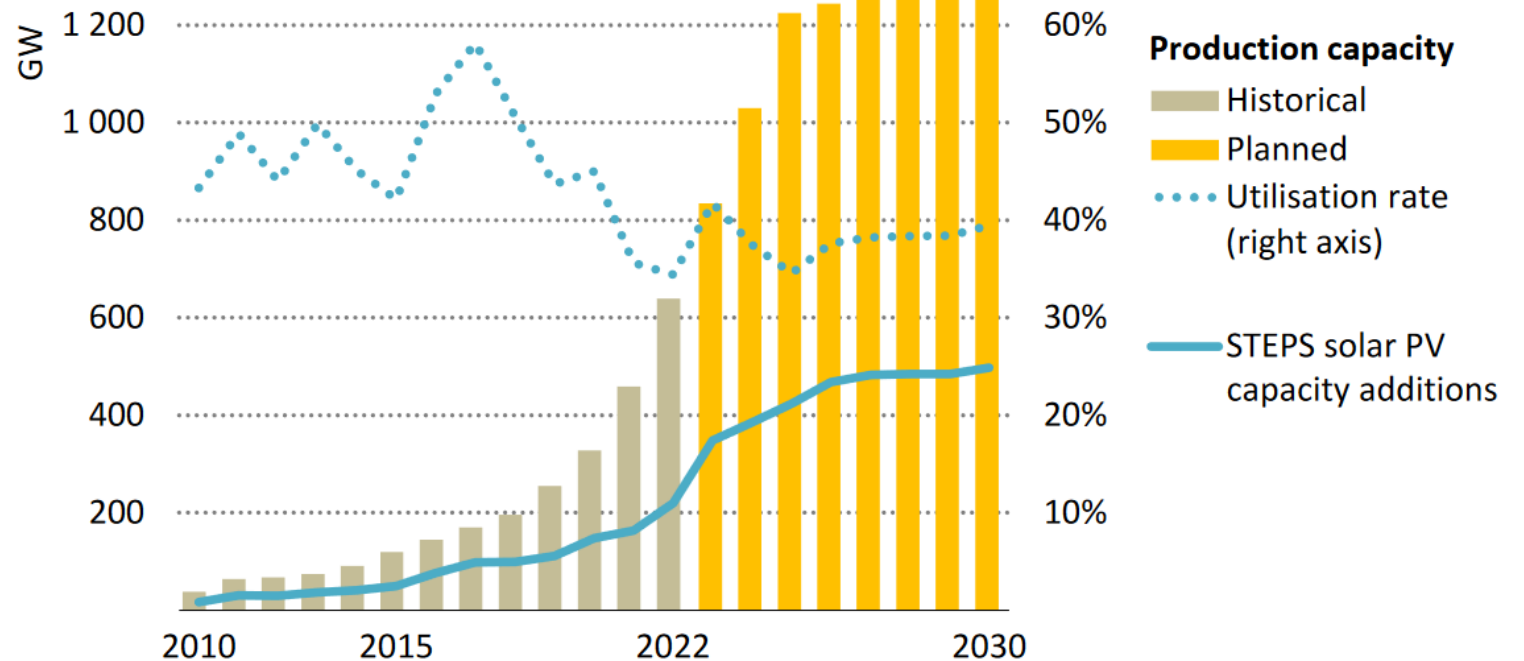
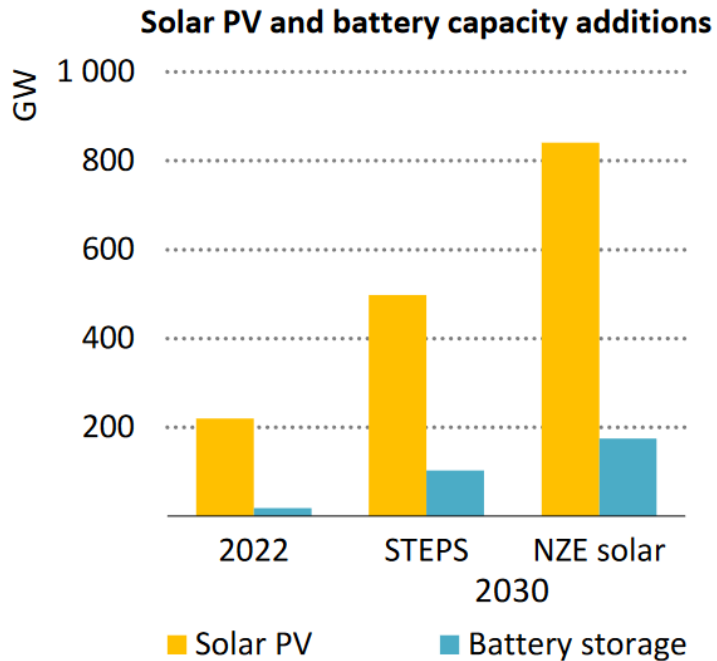
Projects in construction or after FID will add 250 billion m<sup>3</sup>/a of liquefaction capacity by 2030 ≈ almost half of today's global LNG supply.

Mainly in US and Qatar.

About 1/3 of the new gas for short-term market.

Since for mature markets a declining demand is predicted & emerging markets may lack the infrastructure to absorb much larger volumes if gas demand oversupply could become an issue.

# Contribution of solar



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- Robust and digitalized grids: with battery storage & demand response measures for short-term flexibility,
- Diversification and innovation to manage supply chain dependencies for clean energy technologies and critical minerals (e.g. mineral substitution & recycling to ease demand pressures).