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Transitioning the global energy system

ICEF – online participation

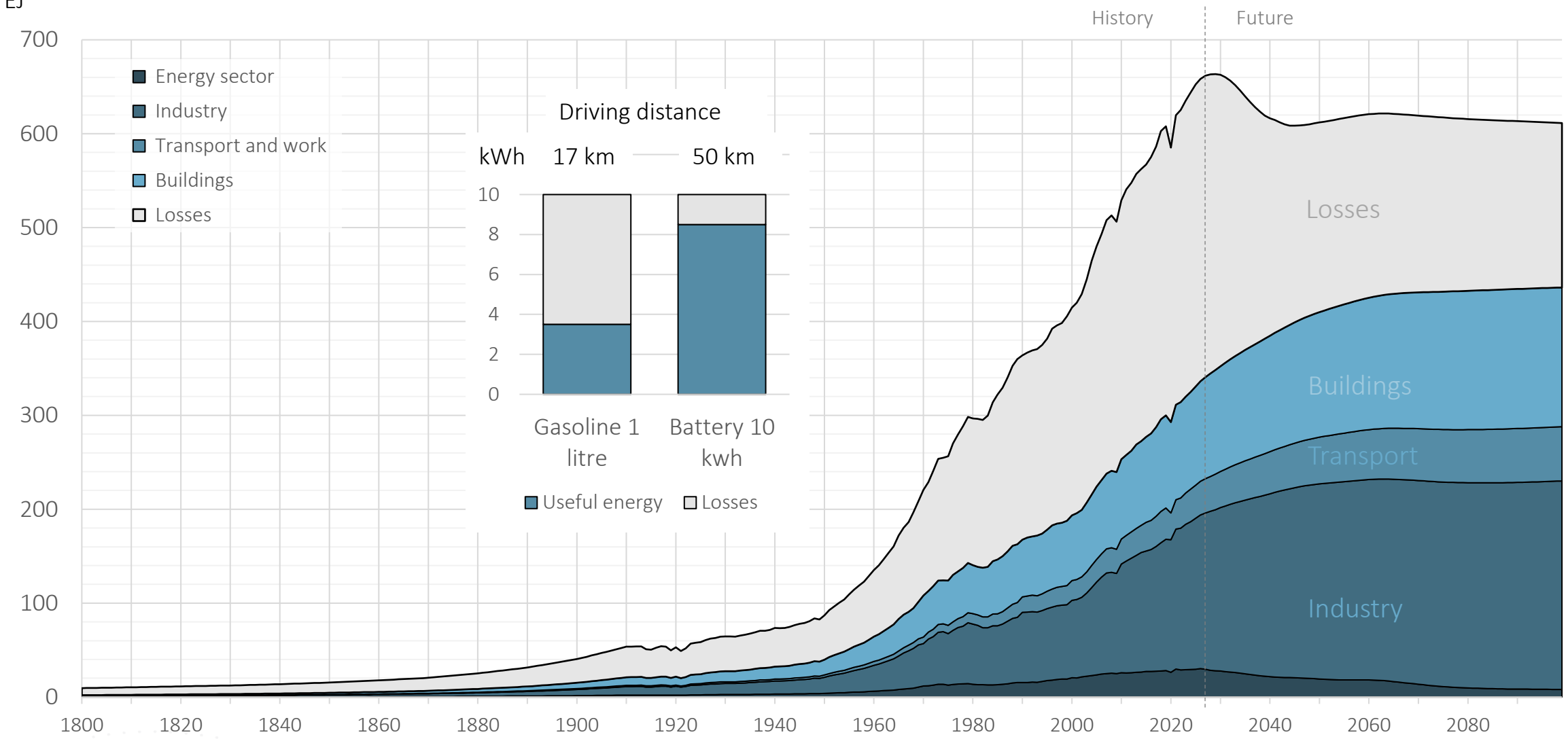
Tokyo

Jarand Rystad, CEO, Rystad Energy

October 9th, 2024

Primary energy will peak, but end users still get access to more energy

Primary energy consumption in the 1.6 DG scenario, by end user segment



Source: Rystad Energy Energy Scenario Cube – 1.6 DG

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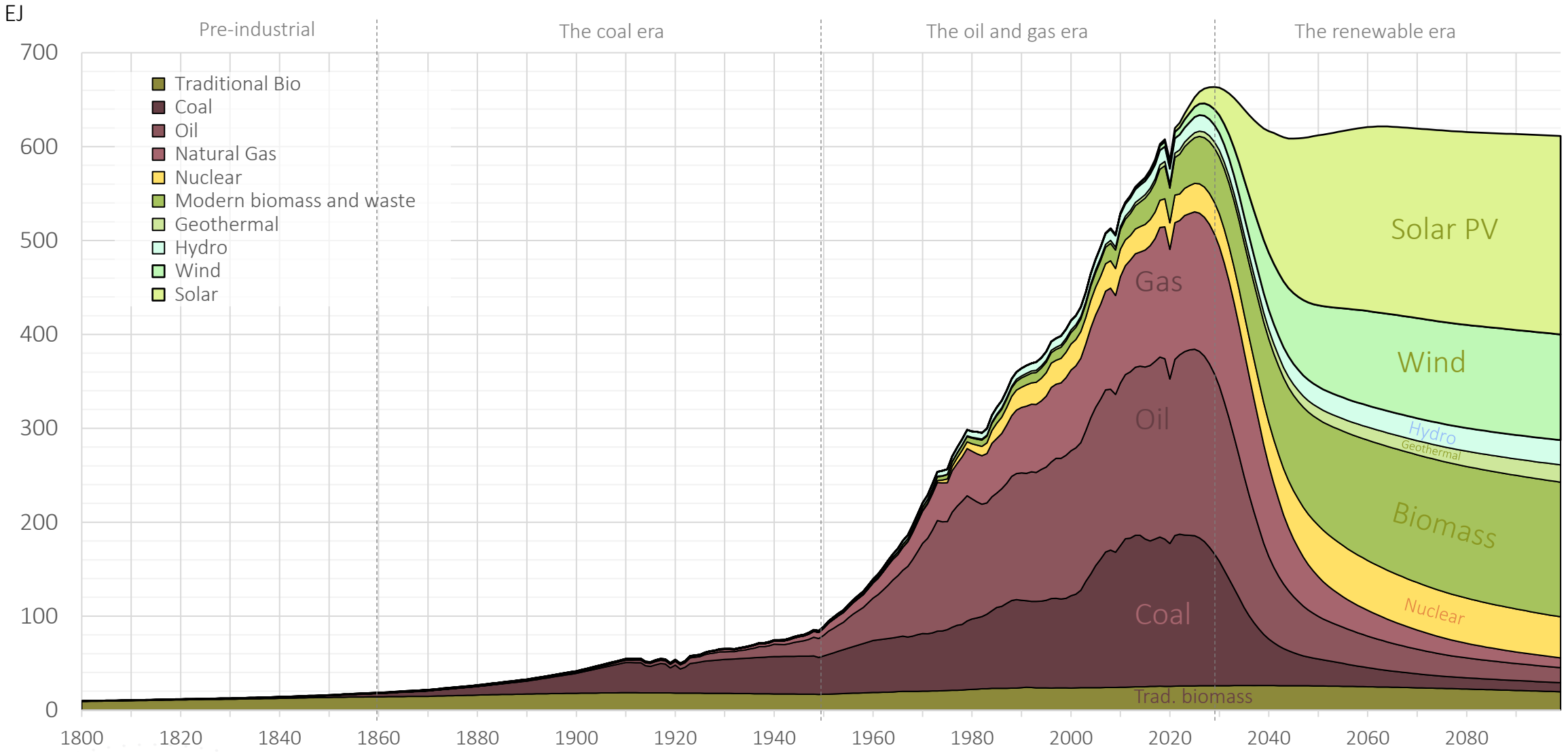
The transition from molecules to electrons means also a revolution in energy efficiency

Primary energy consumption in the 1.6 DG scenario, by primary energy source



Source: Rystad Energy Energy Scenario Cube – 1.6 DG

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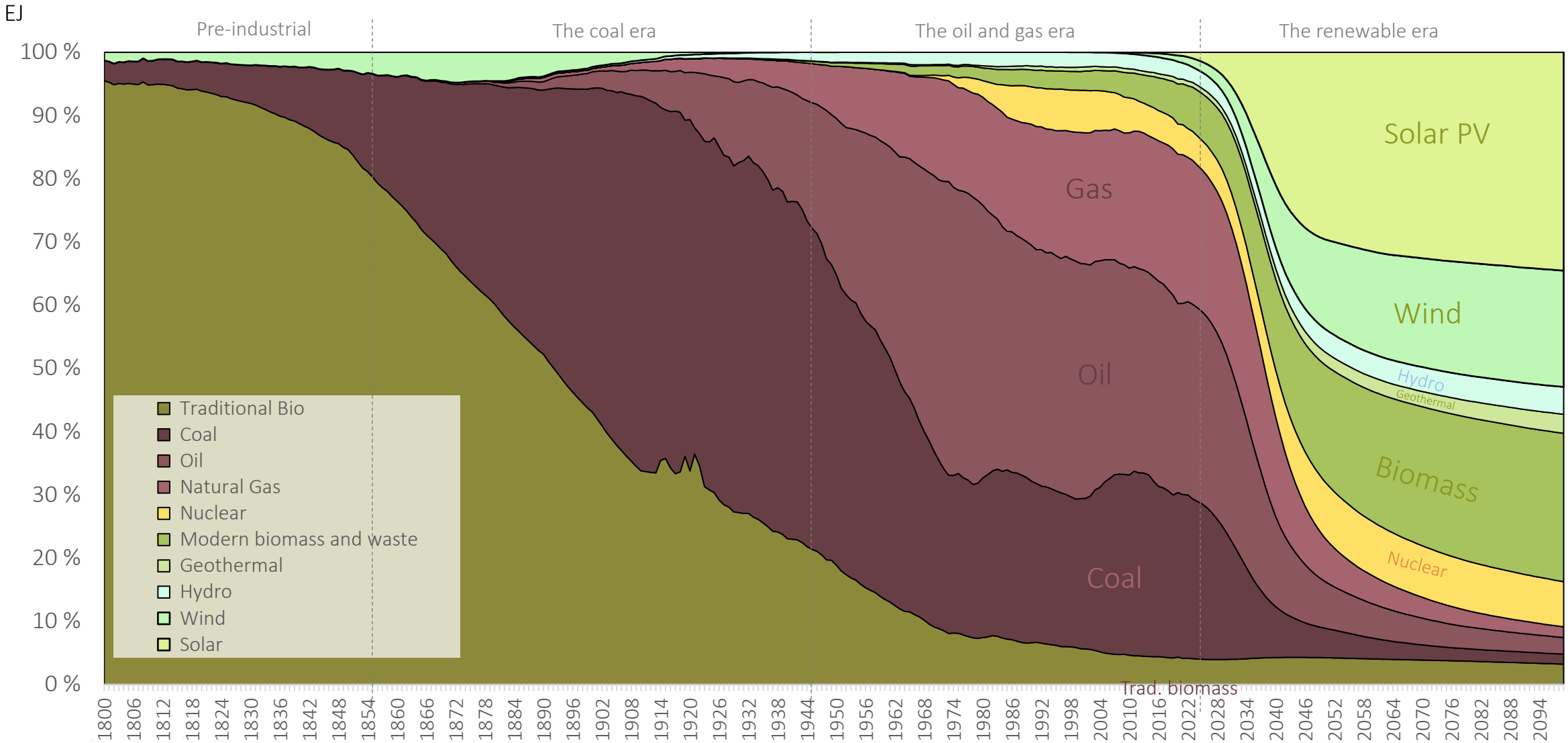

Source: Rystad Energy Energy Scenario Cube – 1.6 DG

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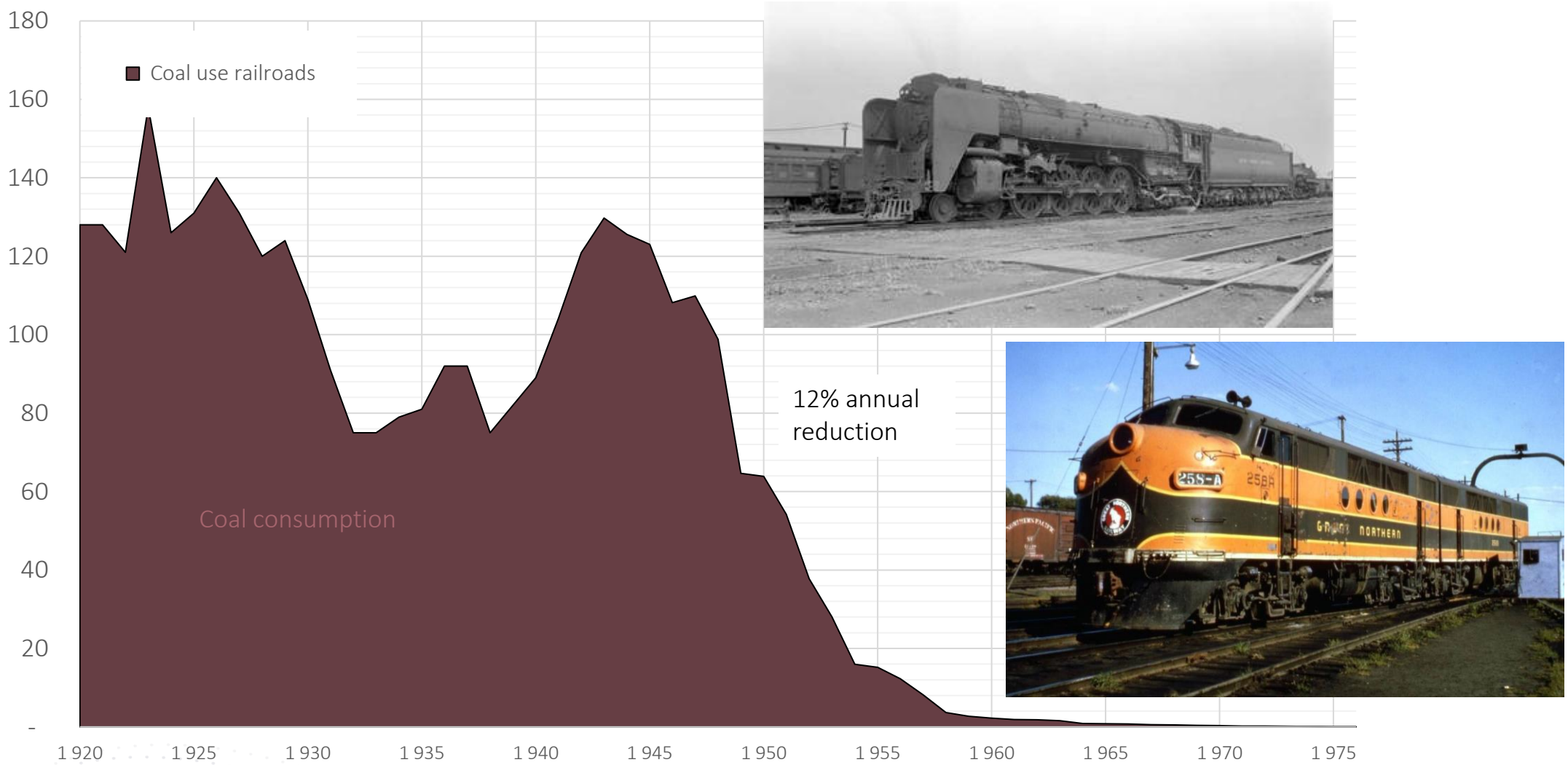
Fast transition from coal to oil and gas in railroad from 1945 to 1960

Coal consumption in railroads in US
Million metric tonnes



Source: Census; US statistical report, serie Q 388;

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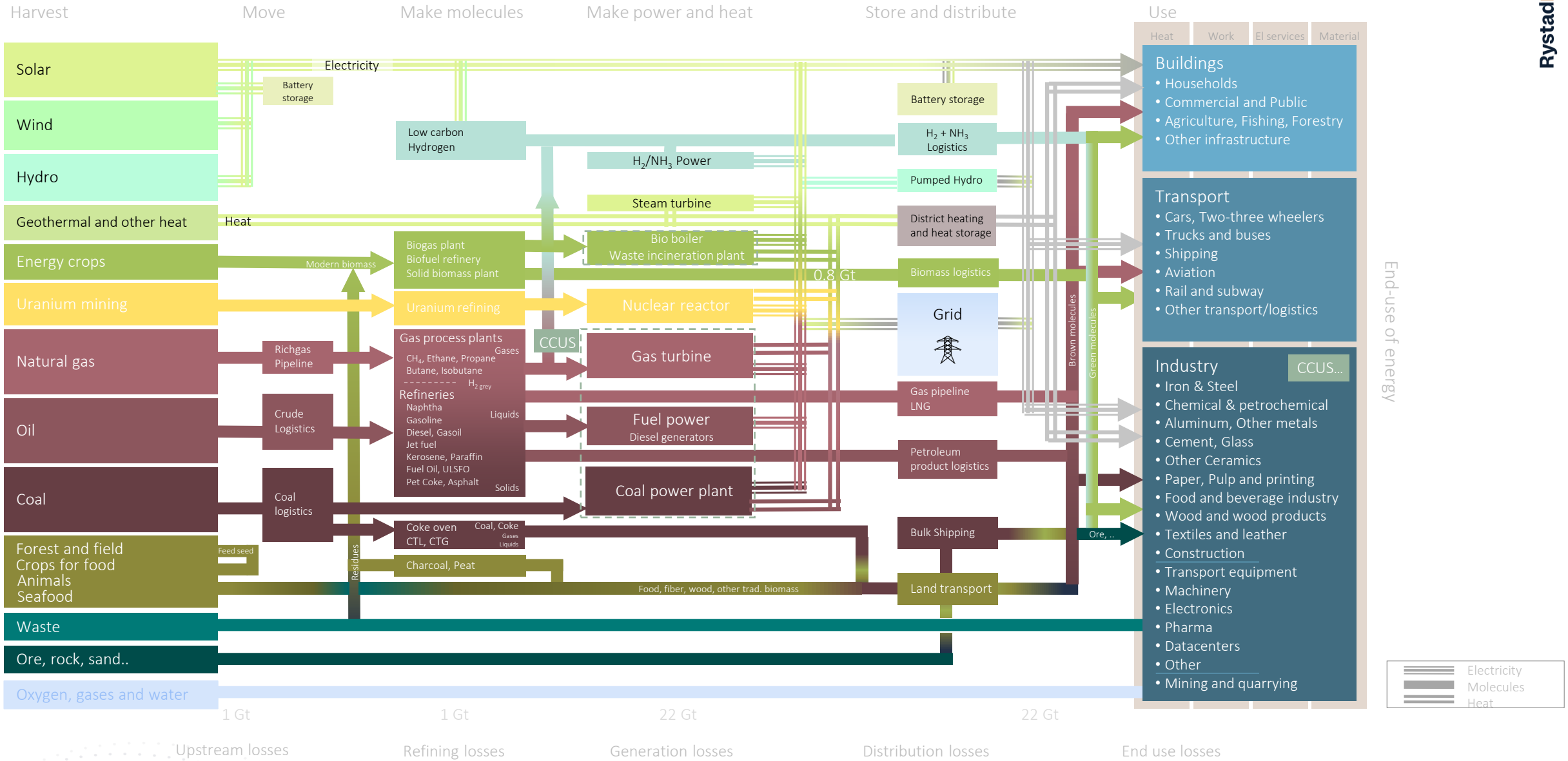
The global energy system – a holistic approach needed from energy extraction to energy consumption



Source: Rystad Energy global energy system model;

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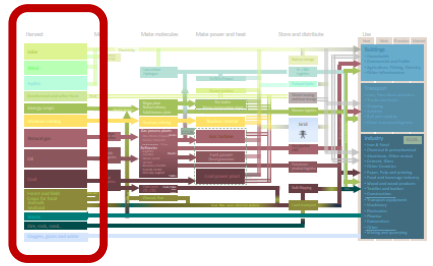
Solar reached 30 EJ in accumulated consumption in only 12 years



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Accumulated consumption of useful energy* for primary energy sources – years after reaching 1 EJ

EJ

Gas
Wind
Nuclear
Solar PV
Hydro
Oil
Geothermal
Coal
Trad. biomass

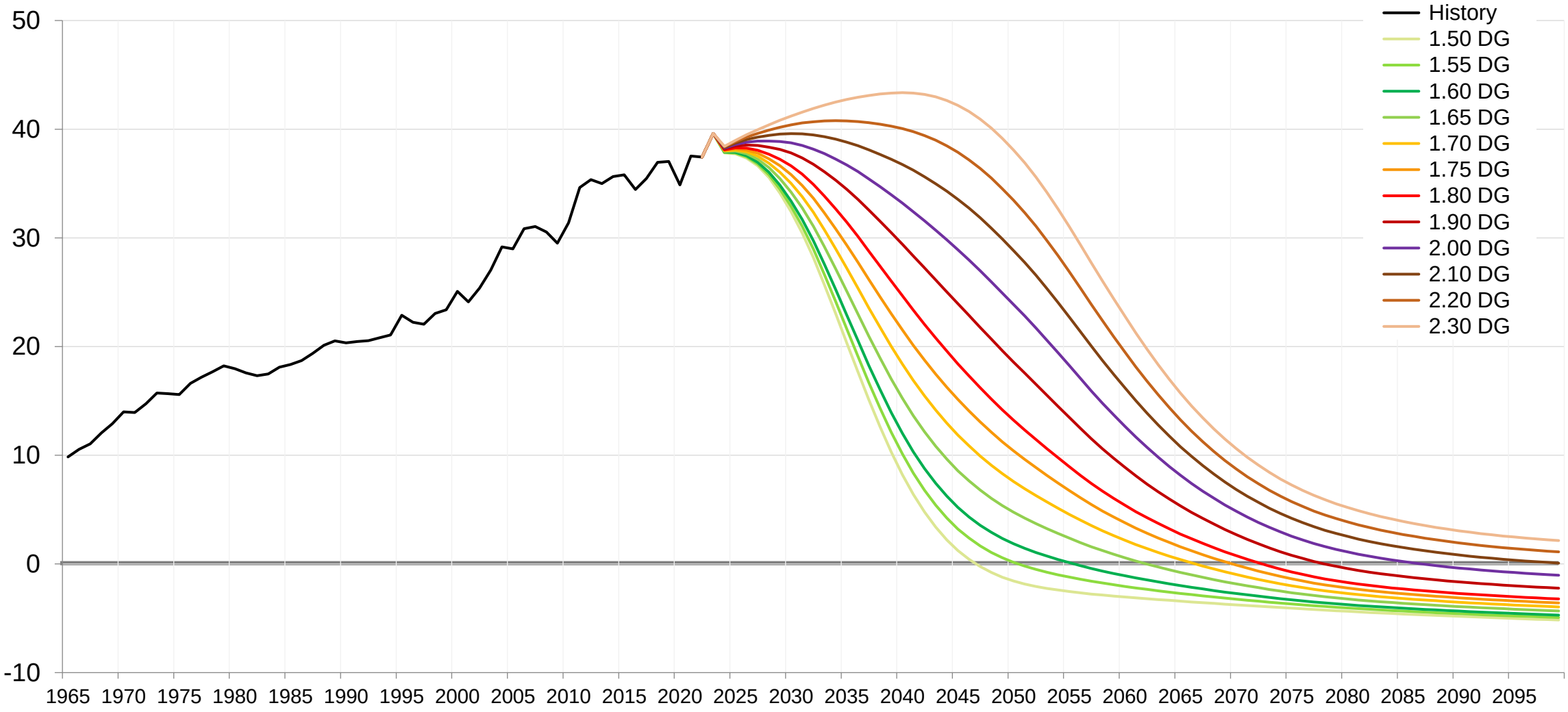
Coal
Oil
Natural Gas
Nuclear
Geothermal
Hydro
Wind
Solar

Years after reaching 1 EJ in accumulated energy consumption

* Useful energy = energy after losses in the energy system and end user applications
Source: Rystad Energy Energy Scenario Cube – Historical data including 2024

CO_2 emissions in 12 energy scenarios

CO_2 emissions, including CCUS and LULUCF
Gt CO_2



Source: Rystad Energy EnergyScenarioCube 2024

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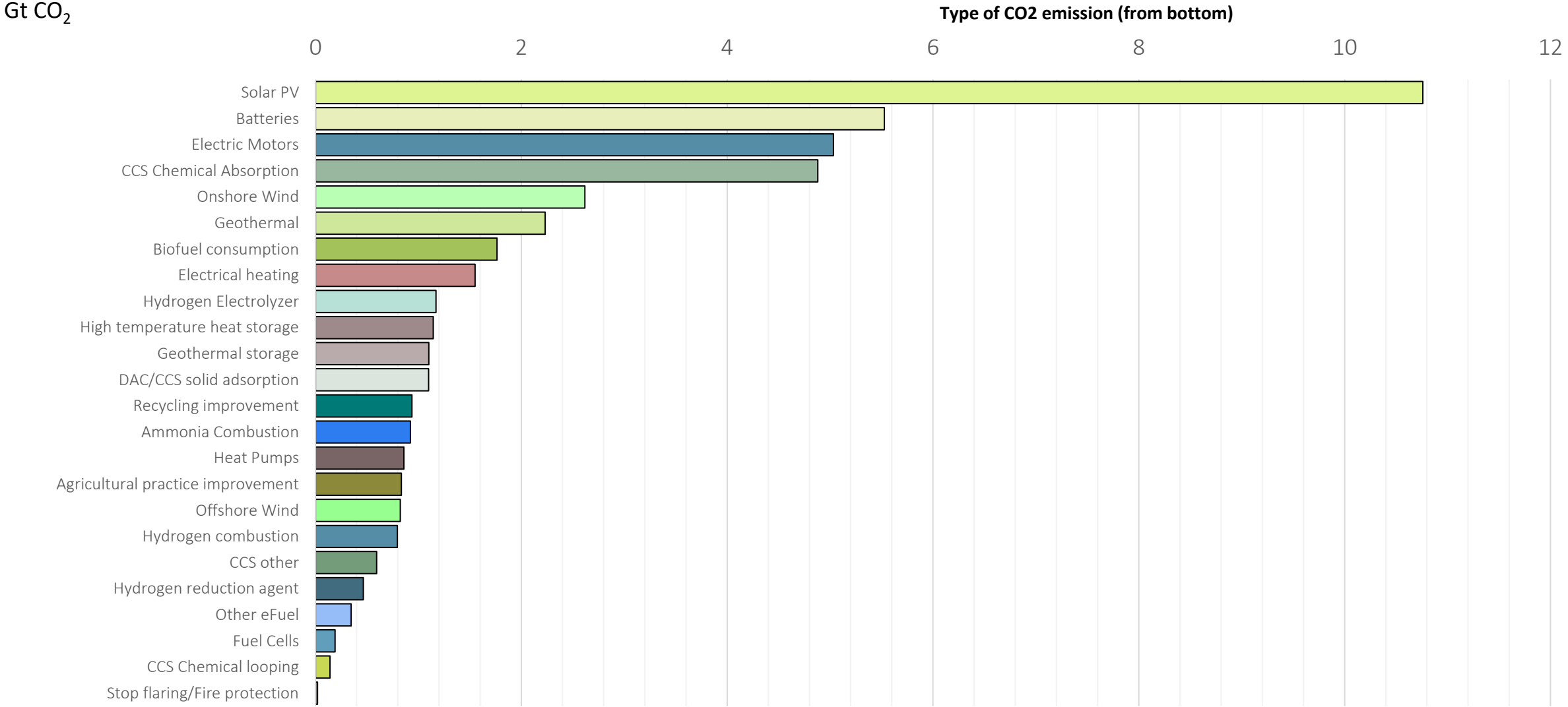
24 technologies will replace fossil fuel in the energy system

Fossil fuel *and biomass* related CO2 emissions in the 1.6 DG scenario, by subsector (IPCC categories)



Source: Rystad Energy - energy transition solution

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Steep learning curves: Cost competitiveness of renewable energy has grown stronger

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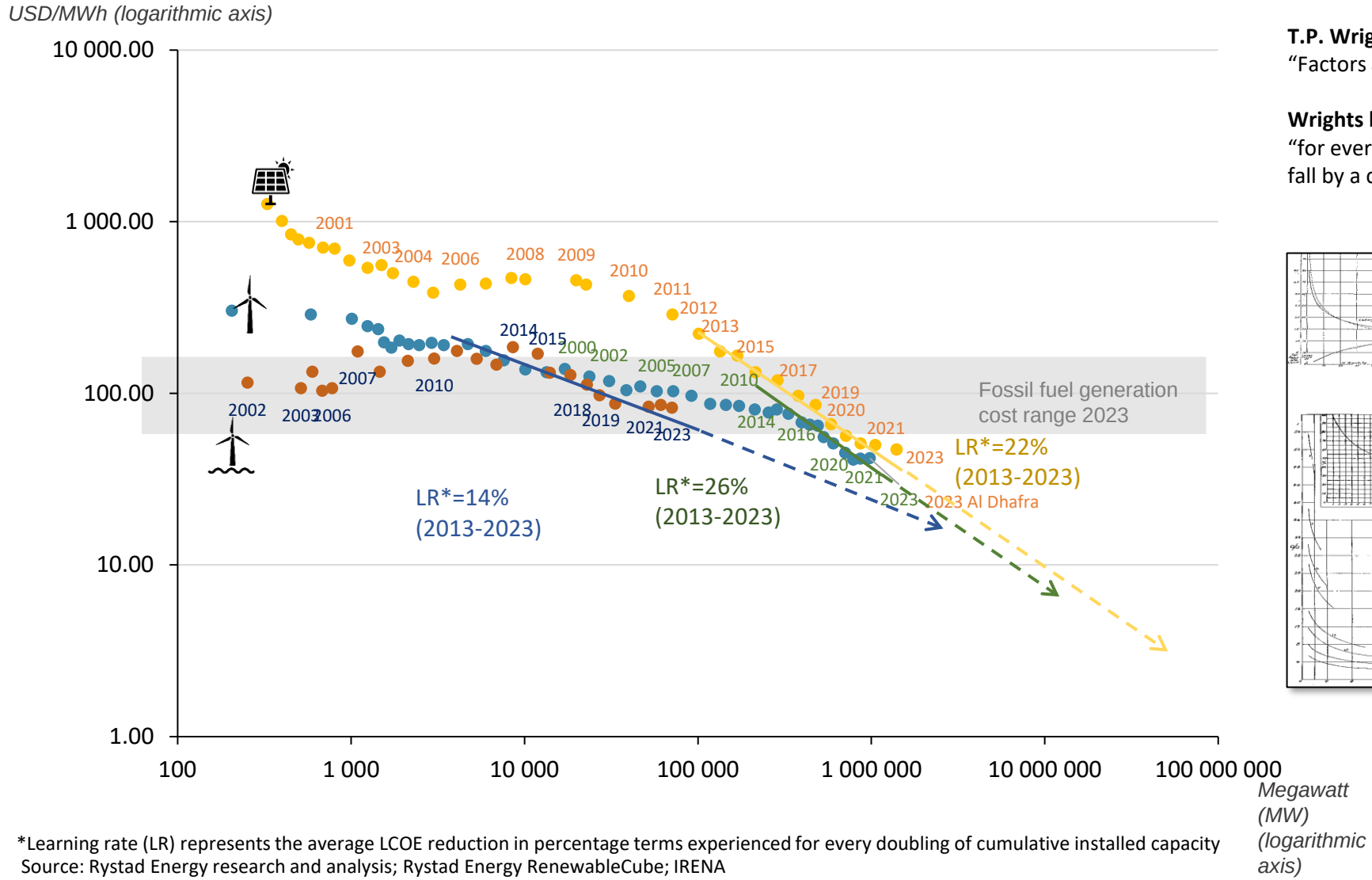
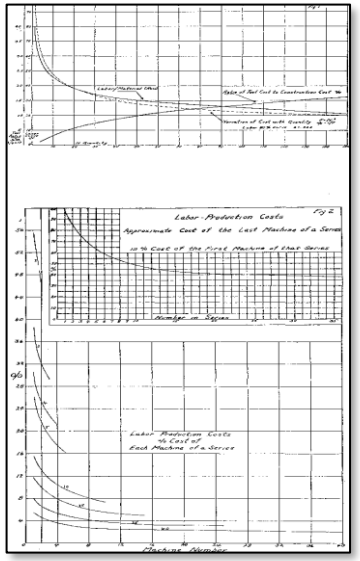
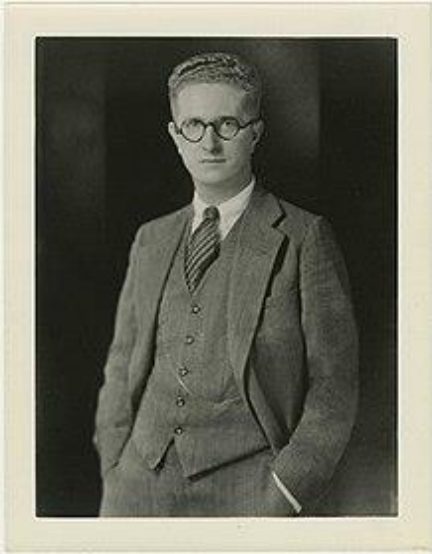
Learning curve: LCOE of global solar PV and wind projects vs. cumulative installations



T.P. Wright published in 1936 the article:
"Factors affecting the costs of airplanes"

Wrights law:
"for every cumulative doubling of units produced, costs will fall by a constant percentage"

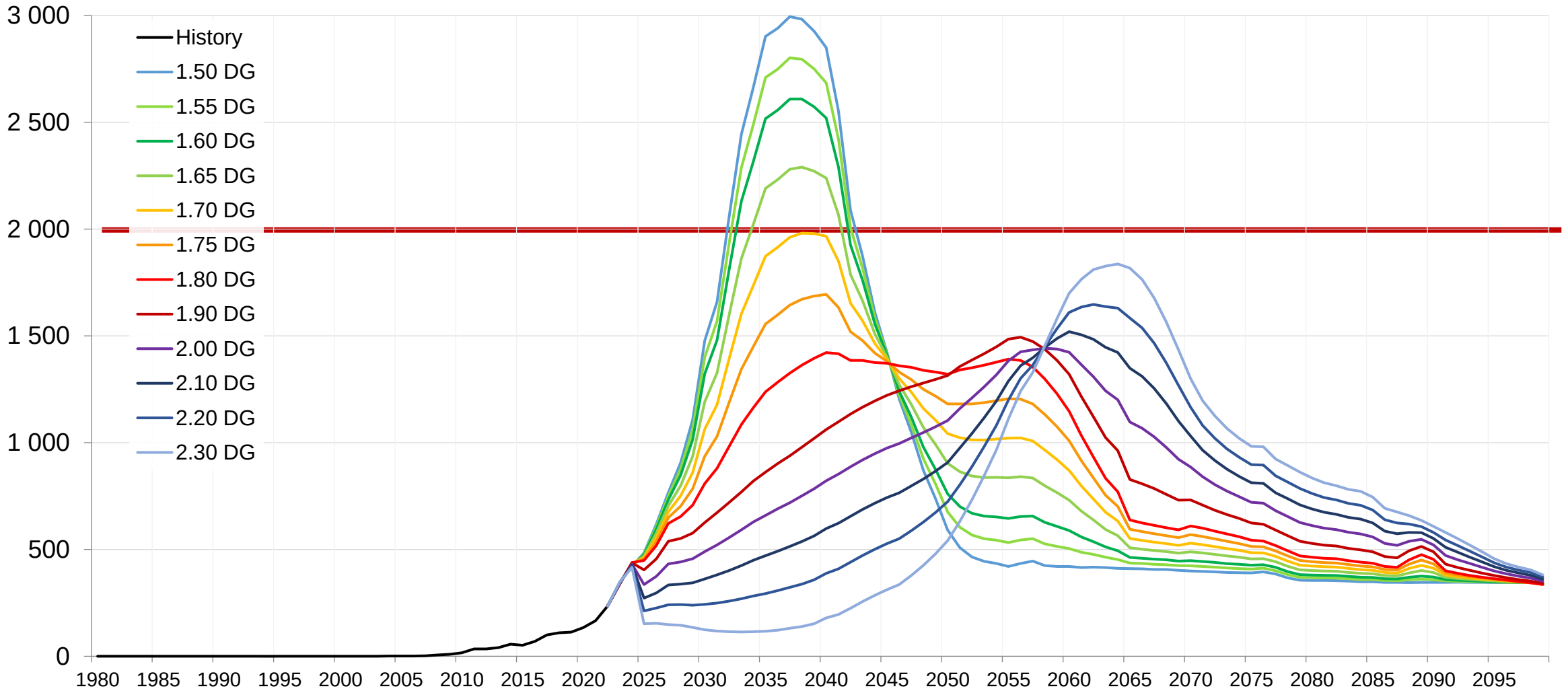




*Learning rate (LR) represents the average LCOE reduction in percentage terms experienced for every doubling of cumulative installed capacity
Source: Rystad Energy research and analysis; Rystad Energy RenewableCube; IRENA

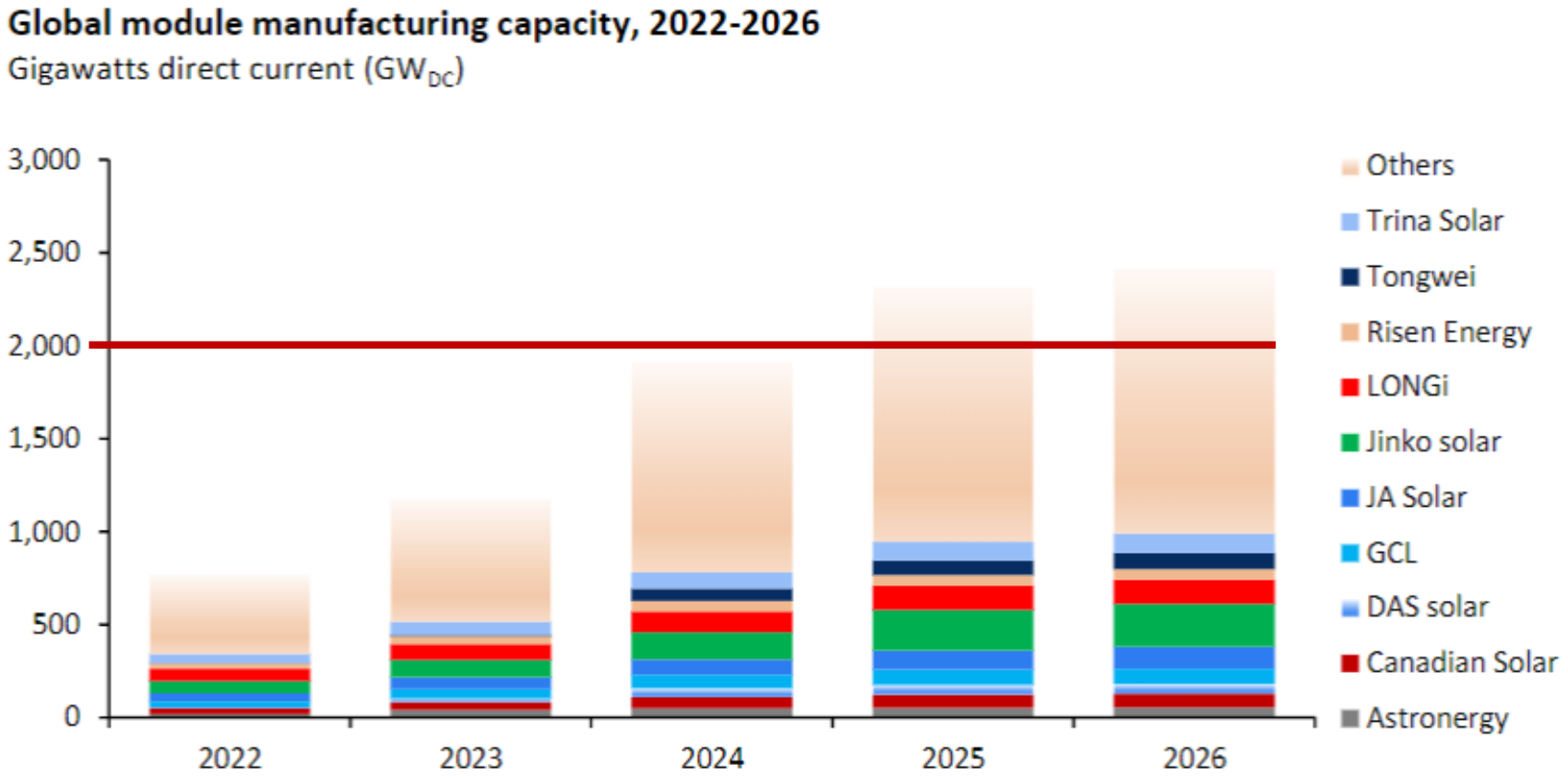
Yearly installations of new solar needed in 12 energy mix scenarios

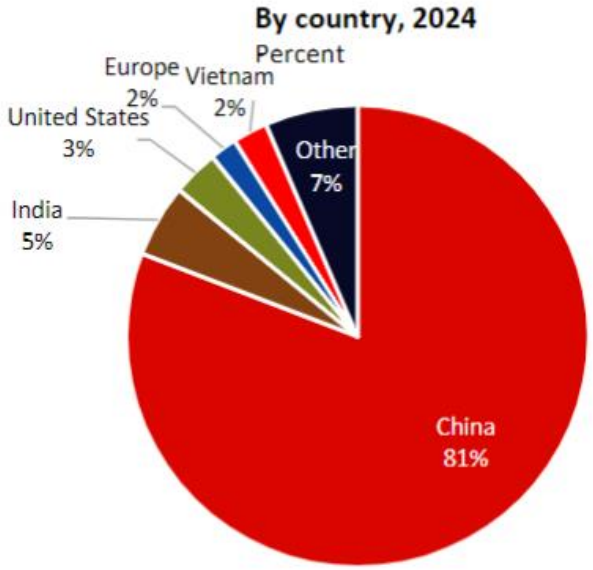
New full year operative solar capacity
GW ac



Source: Rystad Energy EnergyScenarioCube Nov 2022

Massive expansion of solar module manufacturing capacity – also players outside China





Source: Rystad Energy Solar Supply Chain Analysis dashboard; Rystad Energy research and analysis

Combining solar PV and agriculture is a new promising trend

Agrivoltaic solar farms offer "shocking" benefits beyond producing energy

Jennifer Hahn | 30 September 2022 | 26 comments

Next-gen solar parks that enable energy and food production as well as water conservation to work in synergy on the same plot can help to solve solar's growing land-use issue, according to the researchers making them a reality.

"There is this big debate around using land for solar versus using it for agriculture," said Colorado State University researcher Jennifer Bousselot. "And I just roll my eyes because you don't have to pick. They can be combined."

Rystad Energy is an independent energy consulting services and business intelligence data firm offering global databases, strategic advisory and research products for energy companies and suppliers, investors, investment banks, organizations, and governments.

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