

Global Renewables Revolution



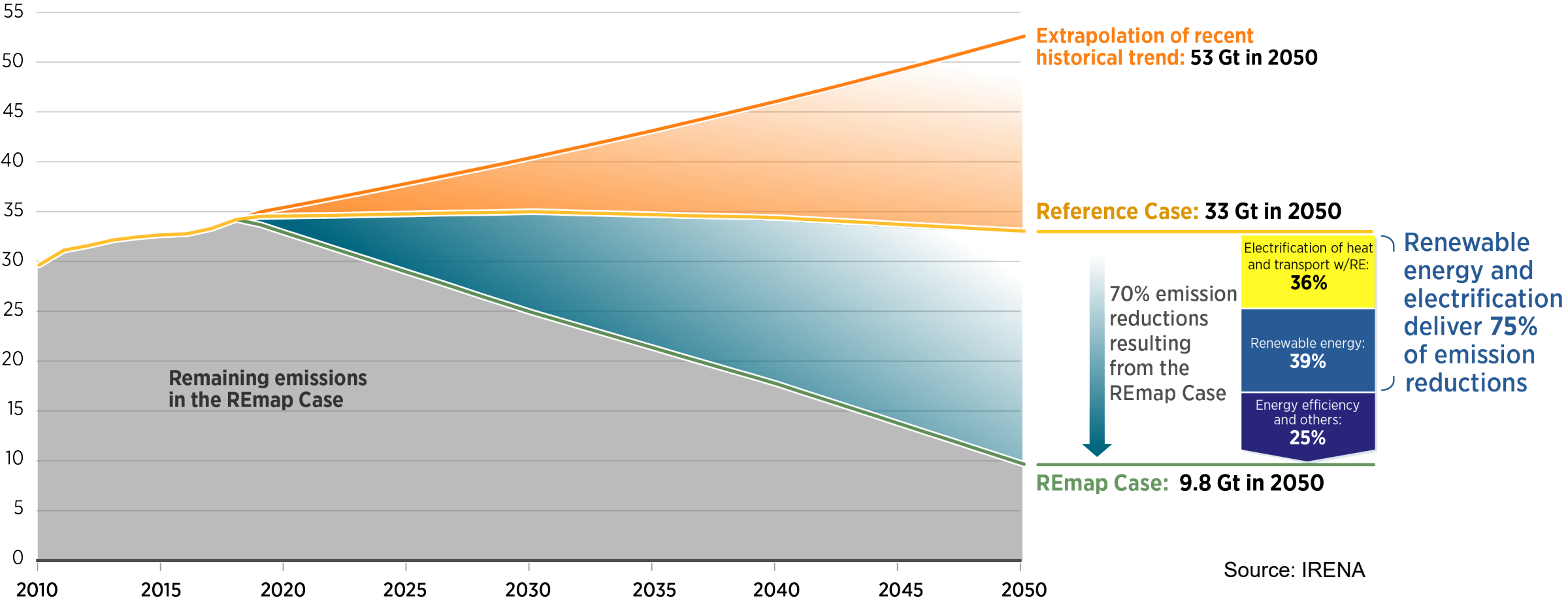
Dolf Gielen
Director, Innovation and Technology
REvision webinar, Tokyo, 4 March 2020

Market trends 2019 (preliminary data)

PV module shipments	121 GW (+23%)
Wind capacity additions	>58 GW (+15-20%)
EV sales	2.3 mln (+4%)
Battery cell production	200 GWh
Fuel cell capacity additions	1.1 GW
Hydrogen electrolyser announcements	>500 MW
Ethanol production	128 mln m ³ (+1%)

Renewables & electrification can deliver 75% of energy-related CO₂ emission reductions needed

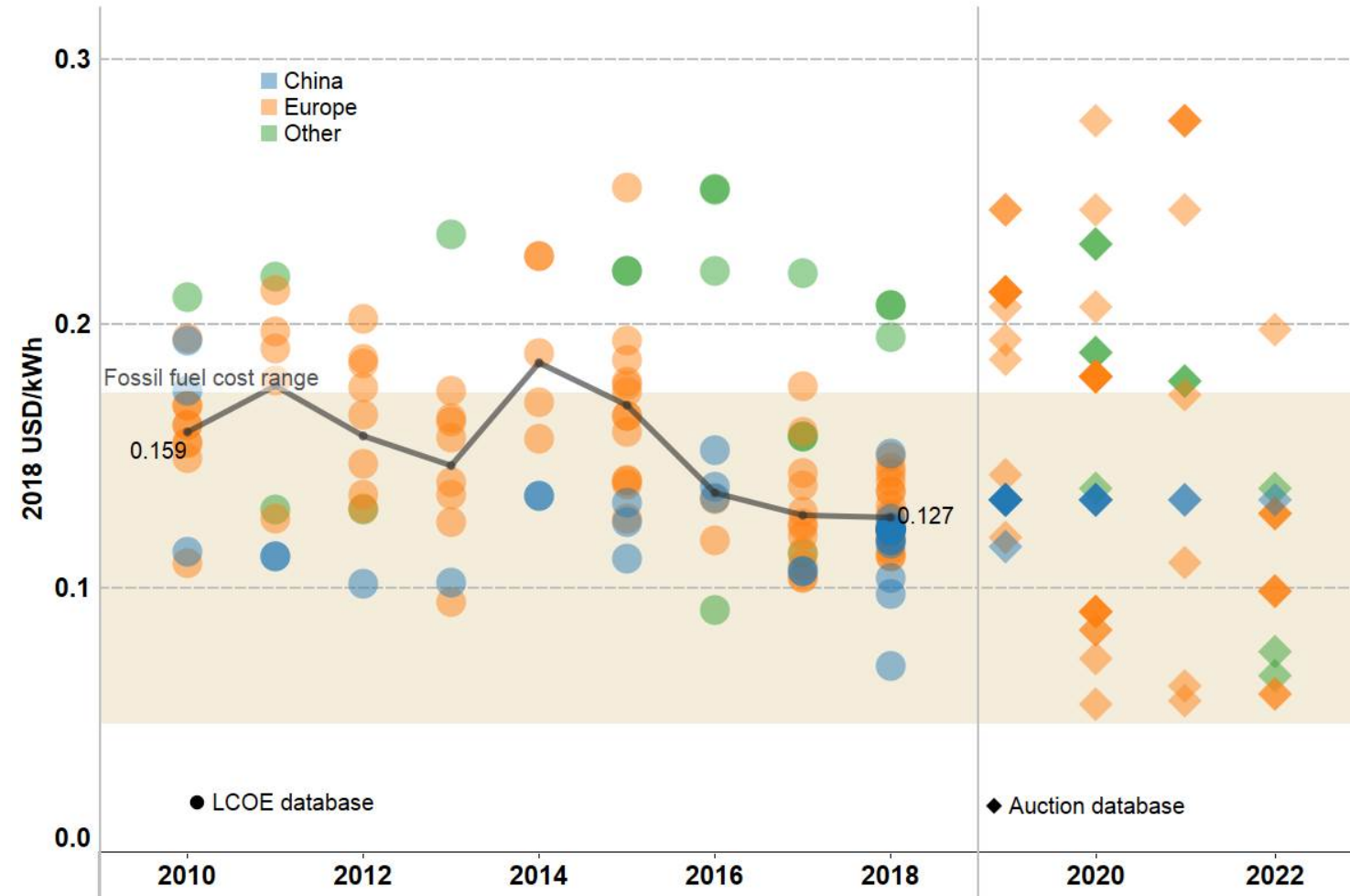
Annual energy-related CO₂ emissions, 2010-2050 (Gt/yr)



Source: IRENA

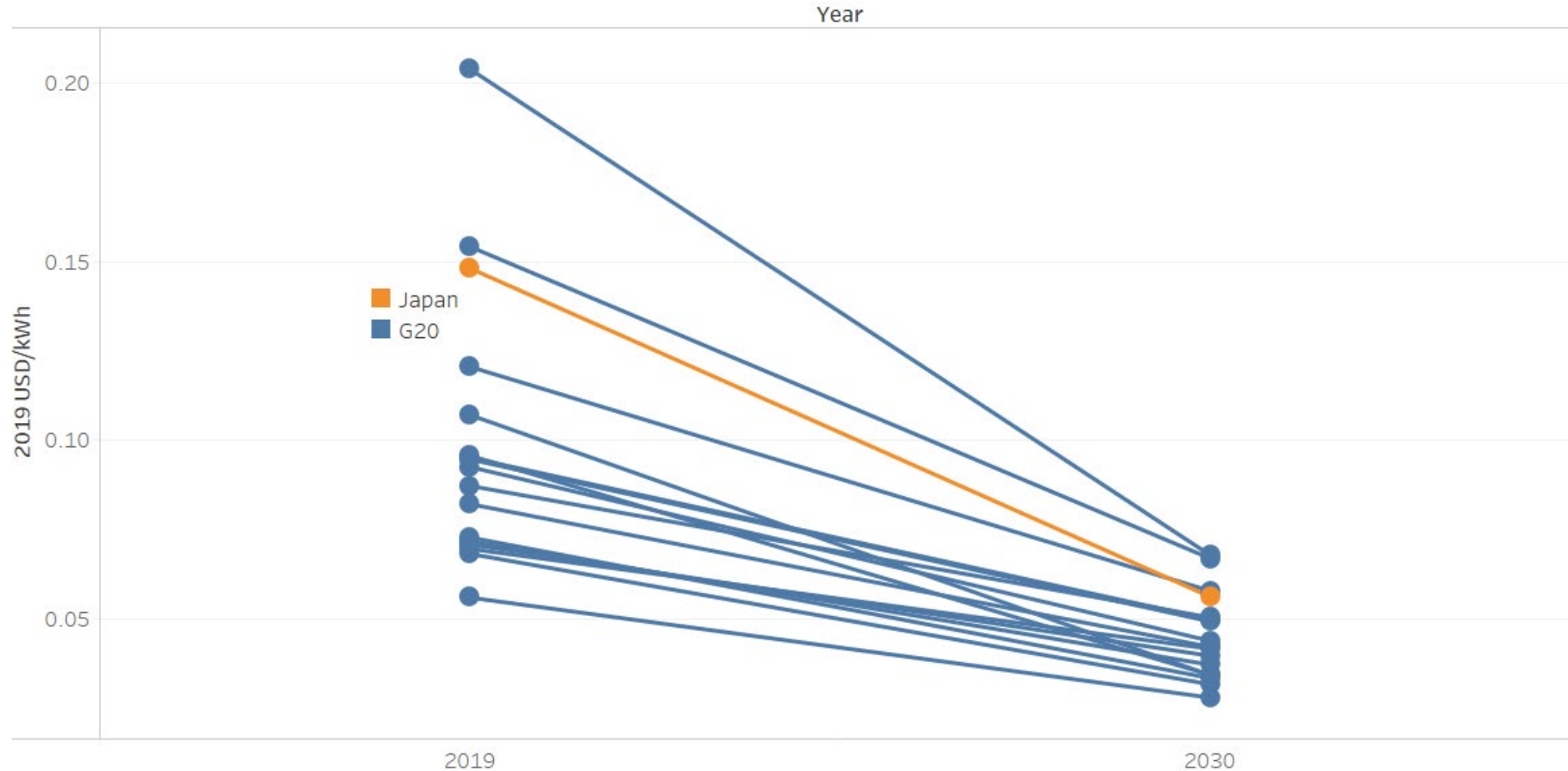
LCOE and auction price decline for offshore wind (China, Europe, Other)

- LCOE has declined rapidly by 32% to USD 0.127/ kWh since the peak in 2014
- Driven by competitive auctions and tenders, the average cost of electricity could fall by 15 % to USD 0.108/kWh, or 4 % per year, by 2022
- Projects in 2022 would predominantly span the range USD 0.06 to USD 0.14/kWh



Source: IRENA Renewable Cost Database 2019

Unlocking total installed costs can drive reductions in the LCOE of utility-scale solar PV in Japan



- Projects LCOE to decrease by 40% to as much as 68% by 2030 depending on the country
- Country-average to range from USD 0.028/kWh to USD 0.068/kWh by 2030
- Japan at around USD 0.056/kWh by 2030 (62% decline from 2019)

Assumes a weighted average cost of capital of 7.5%

Solar PV cost trends

Preliminary results show total installed costs reduction in all major historical utility-scale PV markets

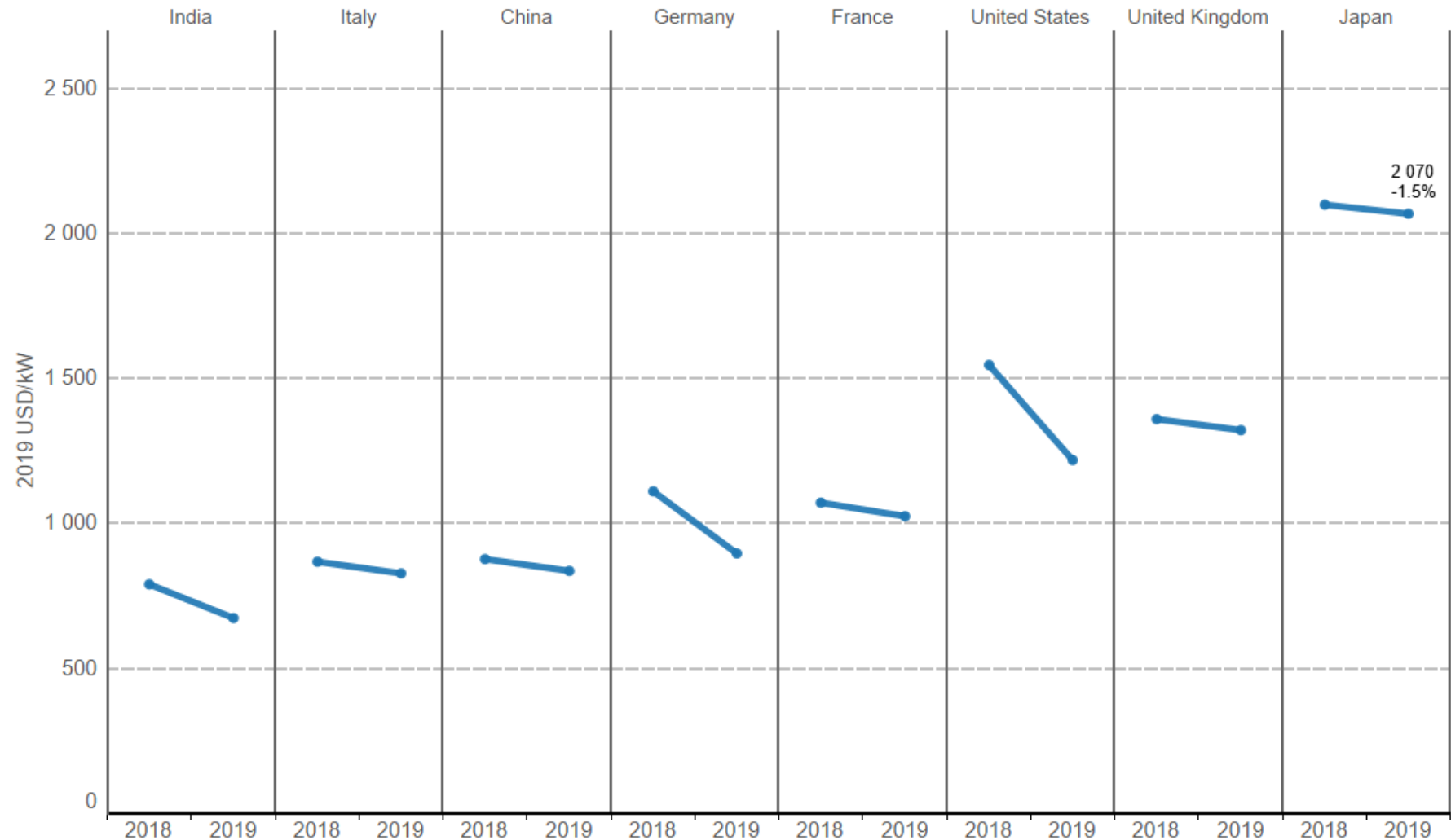
Total installed costs

Module

Inverter

Balance of system

- Japan still with high investment costs compared to other major historical markets in spite of total installed costs having declined 64% between 2011 and 2019.



Source: IRENA Renewable Cost Database, 2019 (Preliminary Data)

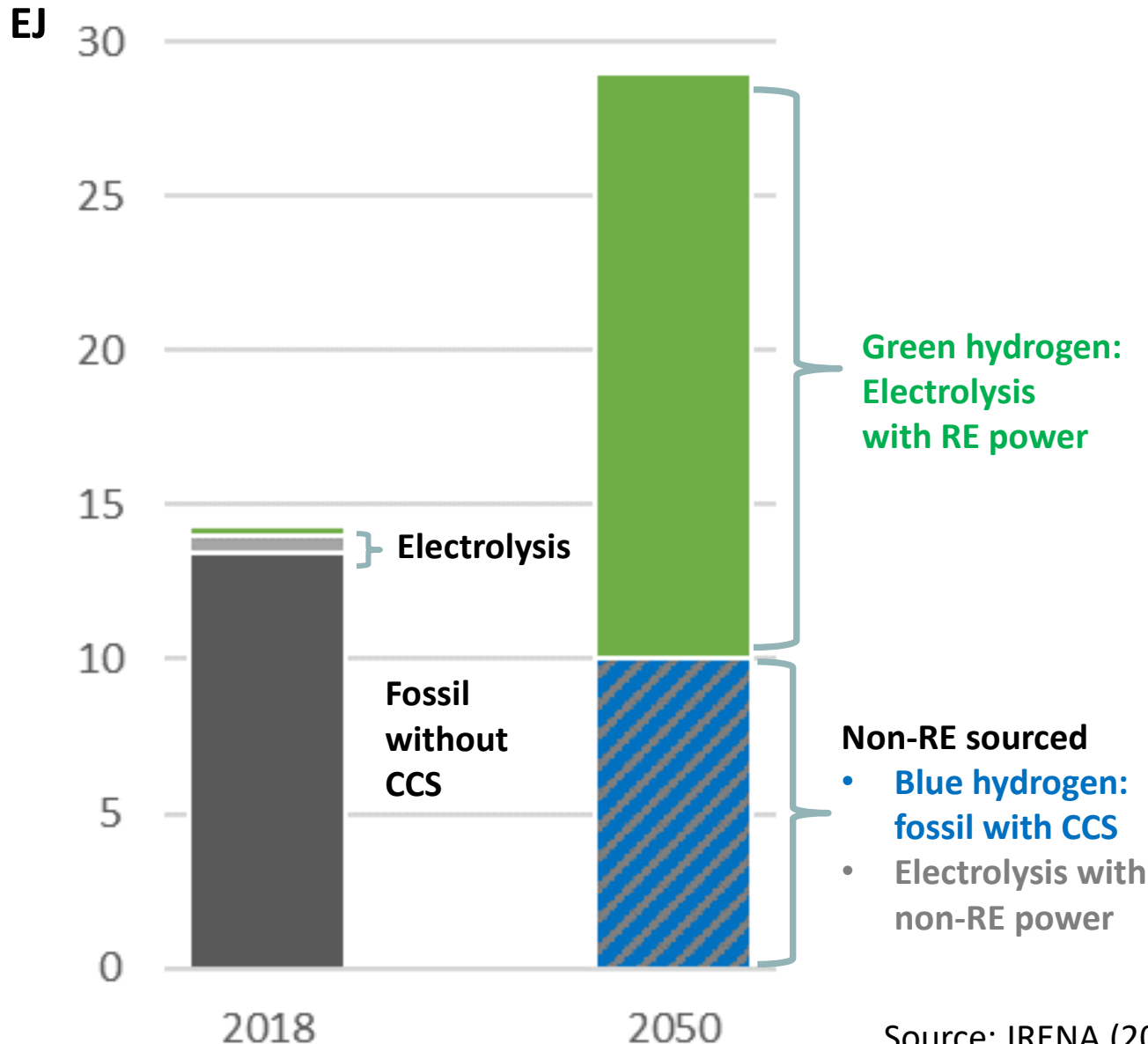
Global energy and climate relevance of hard-to-decarbonise sectors

Sector	2017 Final energy use [EJ/yr]	2017 CO ₂ emissions (Direct and indirect energy & process) [Gt/yr]
Road freight	24.0	1.75
Aviation	13.5	0.85
Shipping	9.1	0.68
Iron and steel	34	3.63
Aluminium	6.0	0.85
Chemical and petrochemical	46.8	2.72
Cement	10.7	2.48
Gas sector	130.0	7.28
Total	274.1	20.24

IRENA calculations

Source of hydrogen – today and 2050

A shift to clean hydrogen with a key role for green hydrogen



Today:

About 14 EJ hydrogen produced mainly from fossil source - **green and blue hydrogen production is negligible**

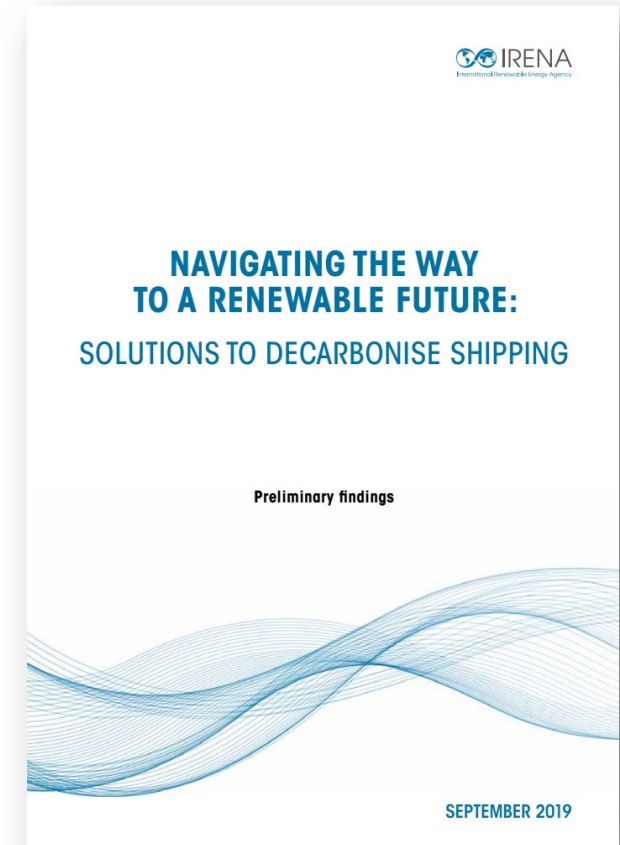
2050:

Two-thirds of hydrogen produced could come from green hydrogen

Demonstration projects with electrolysis – with increasingly bigger sizes (> 50 MW)

Key options for carbon-free shipping

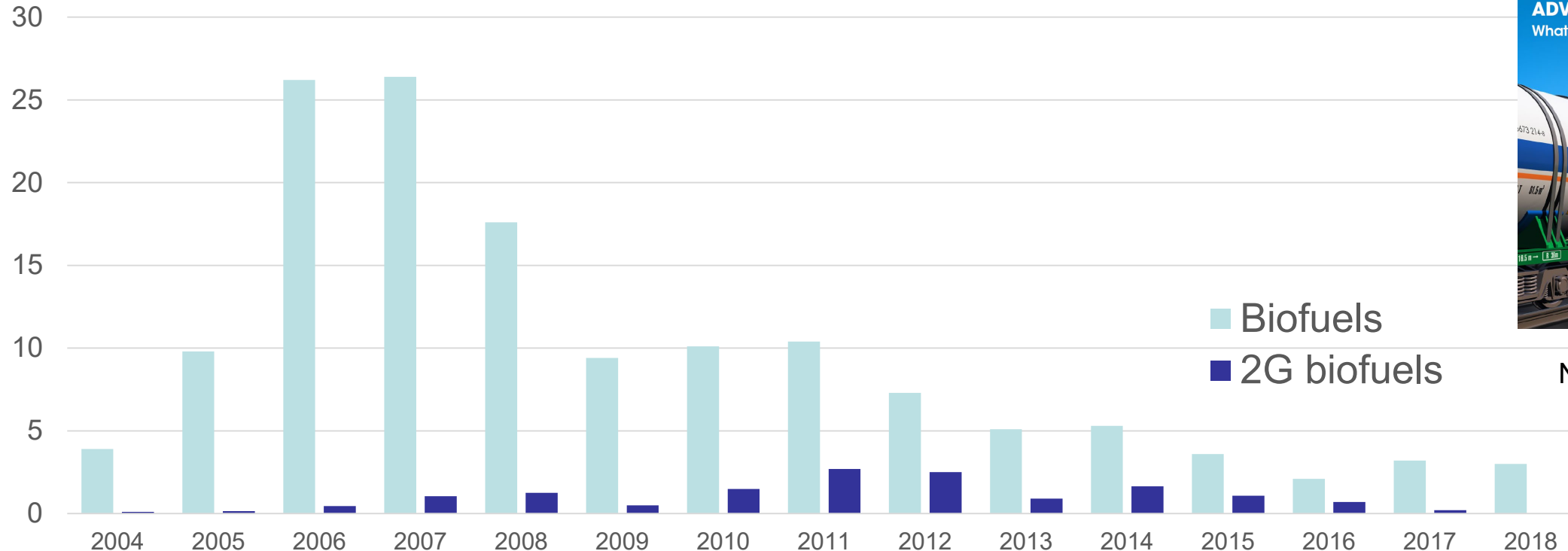
- Various fuels under consideration including:
 - Ammonia
 - Alcohols e.g. methanol
 - Biomethane
- Clean sourcing and certification is key
- Economics and upscaling needs attention
- Bunkering logistics and ship design considerations needed
- Cost for carbon free fuel double that of fossil fuels by 2030 – endogenize externalities



**Launched in October 2019 during
GMF Annual Summit in Singapore**

Global biofuel investments are on a declining trend

Annual Investments in Biofuels (billion \$)

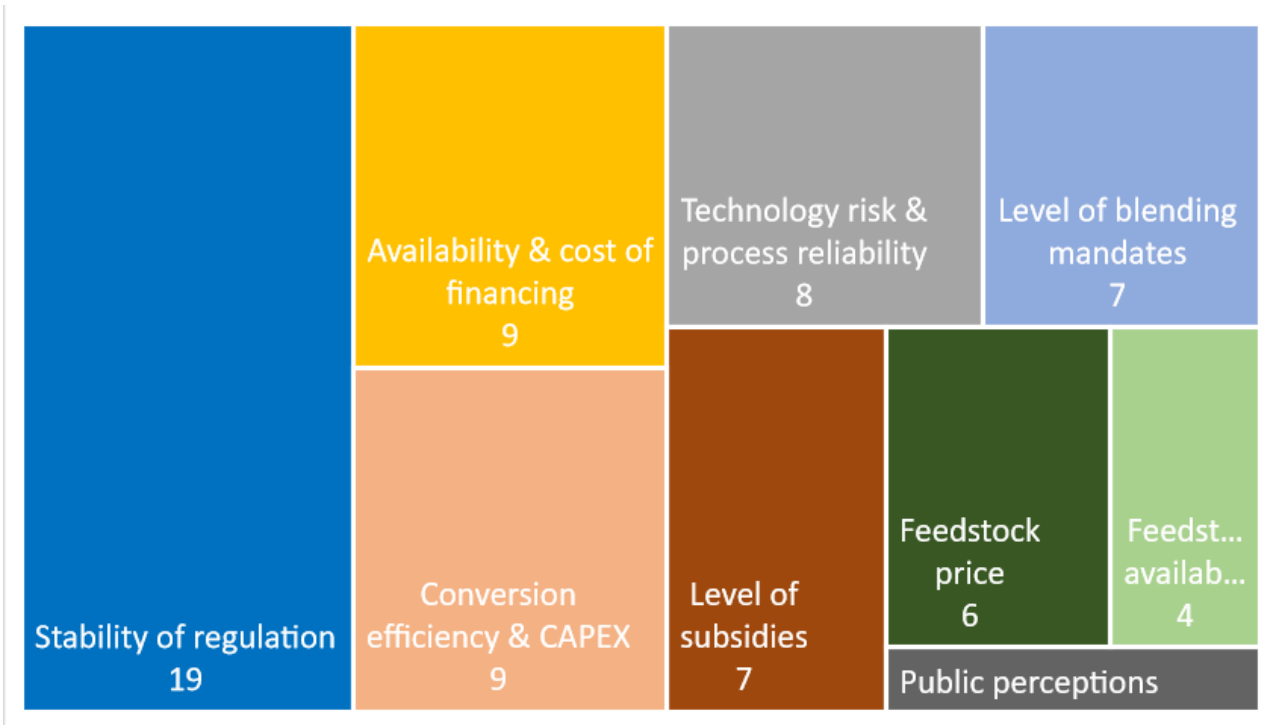


November 2019

Source: BNEF

- To achieve the 5-fold increase goal, more than 100 refineries should be developed annually at an investment cost of USD 20+ billion.
- More than 10% of bioliquids should be allocated for aviation but the buildout of biojet refineries is slow.

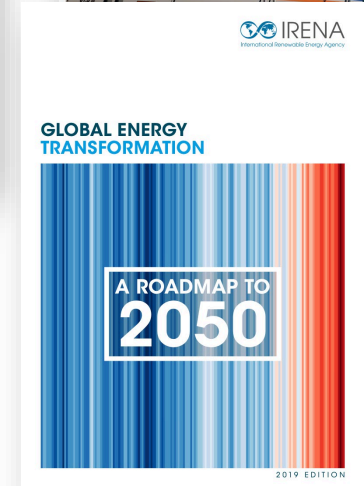
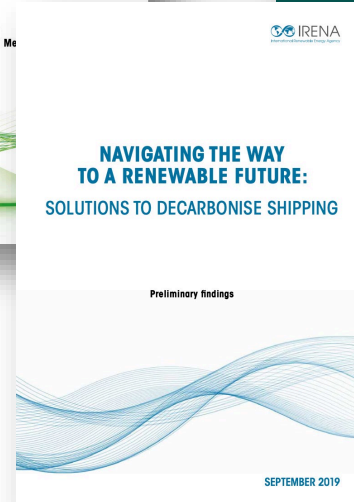
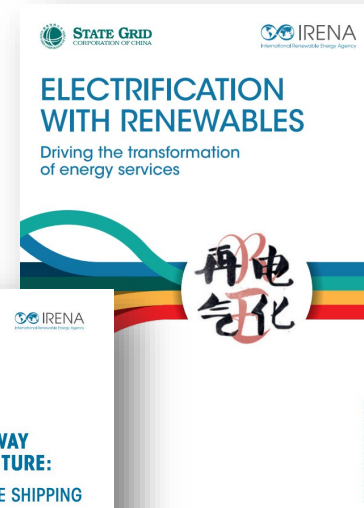
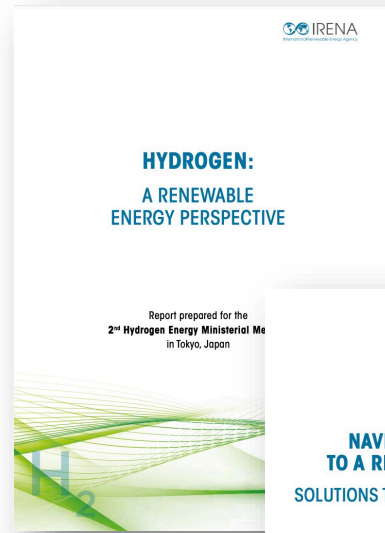
What really matters? - Ranking the barriers



Area is in relation to perceived importance.

Source: IRENA survey

- **Stability of regulation** is clearly the most important barrier to investments followed by the cost and availability of **financing** and level of **conversion efficiency & capex**.
- The three issues of **policy stability, mandates** and **subsidies** (46%) are all dependent on regulation and thus subject to societal preferences and political control.
- The second largest "block" relates to **cost competitiveness** of advanced biofuels production, formed jointly by "conversion efficiency & CAPEX" and "feedstock price".



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