The Future of Energy Transition with a focus on Vietnam

Murthy R Nuni
Managing Director,
Marshal Global Renewable Power, Singapore

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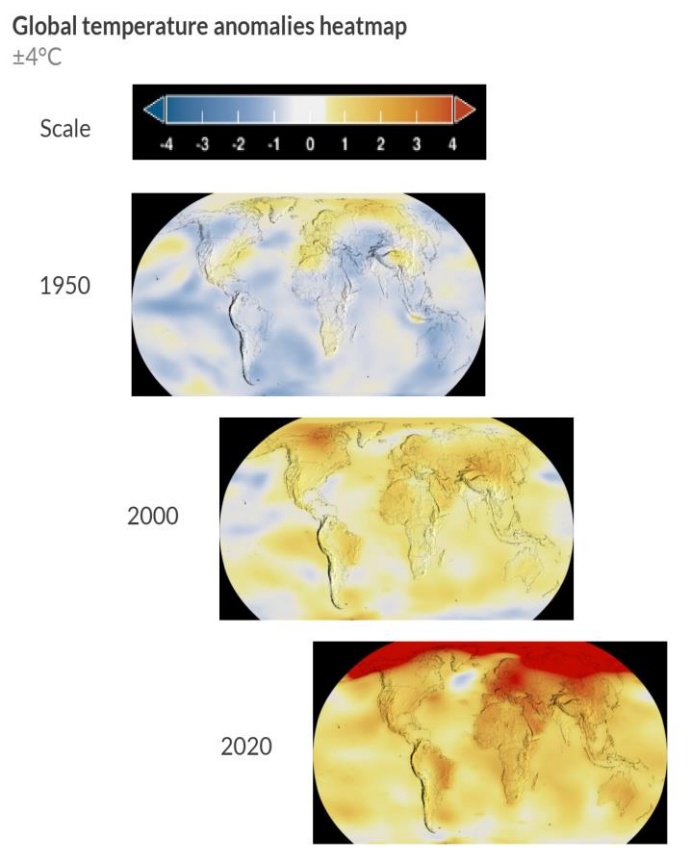
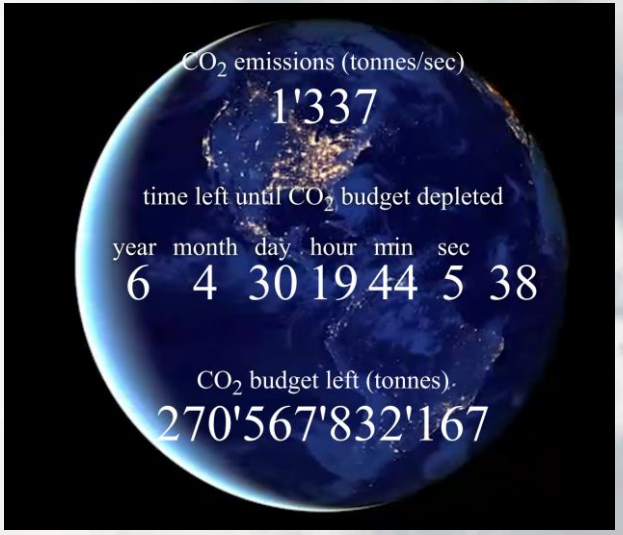
+44 207 078 3919 UK
info@marshal-funds.com

The heatmaps - changes in temperature compared to long-term average of the 20th century



IPCC Carbon Budget of 400 GT from 2020, @ 40 GT of carbon emissions per Year



GLOBAL ENERGY TRANSITION – Where we are in relation to 1.5 deg & the way forward with Electrification, Renewables, Energy Efficiency and Green Hydrogen.

Source: unsplashcom

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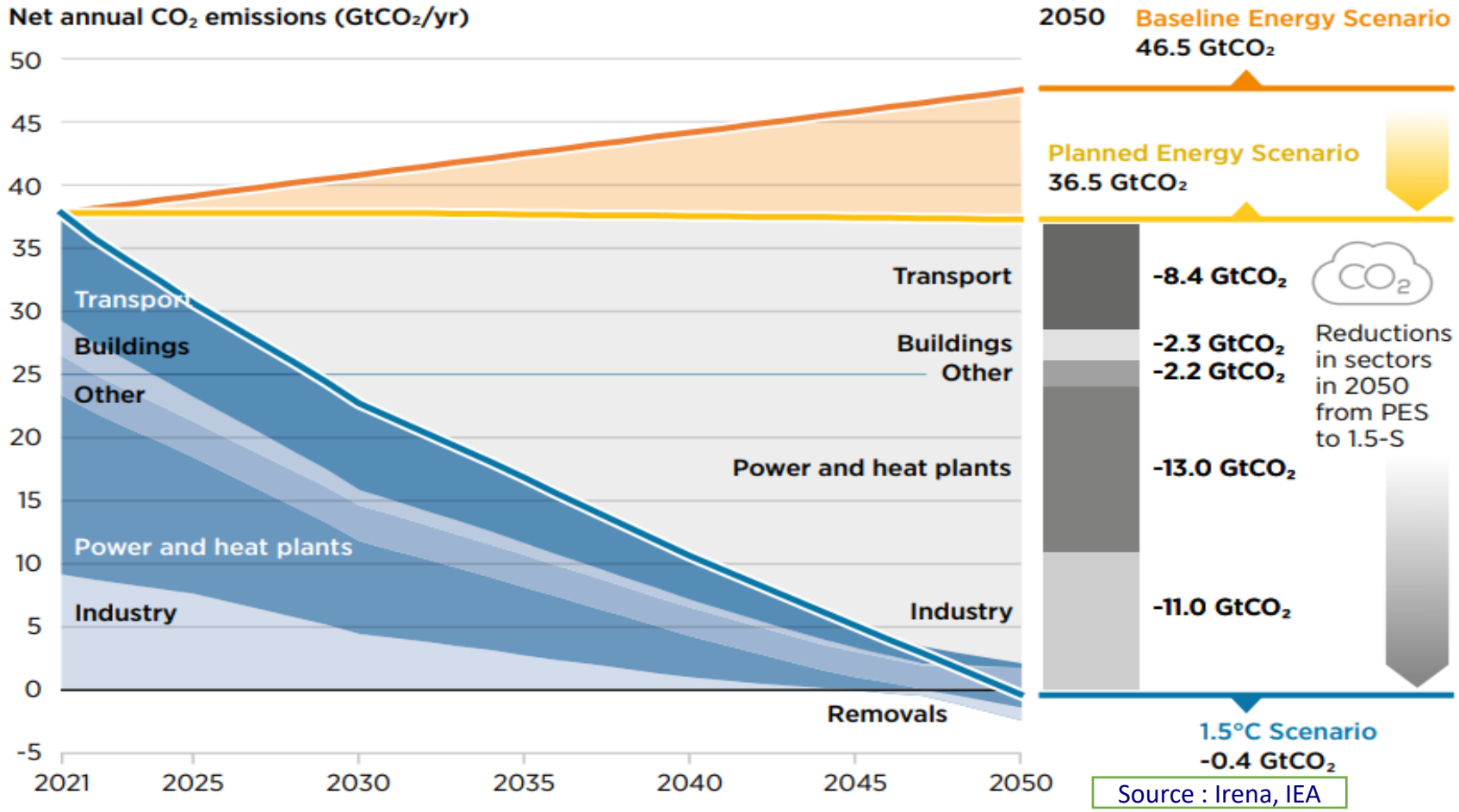
Energy Transition – where we are and where we need to be for dig the 1.5 deg climate target

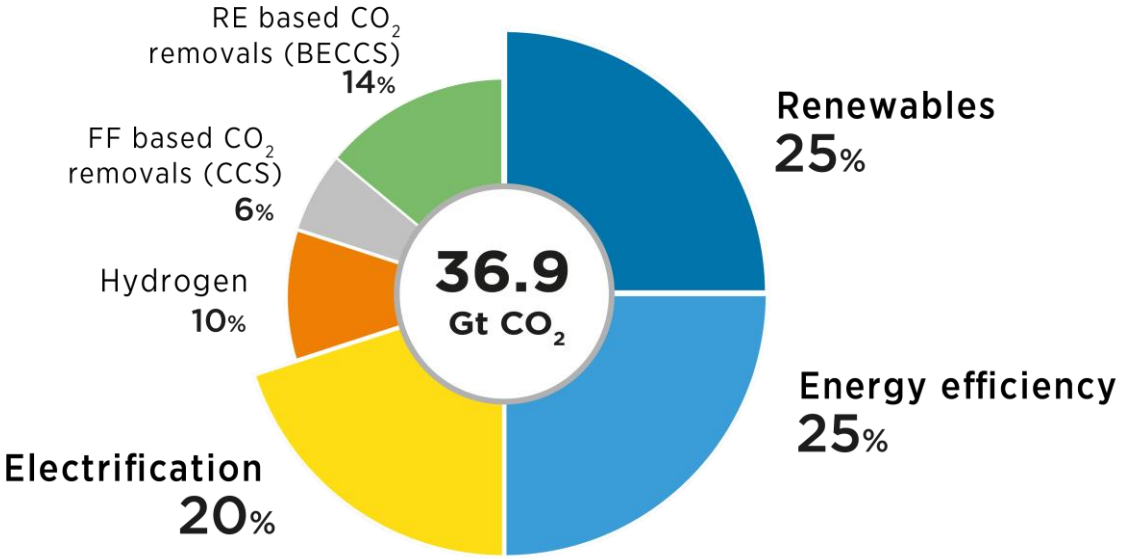
In the Planned Energy Scenario annual emissions set to reach 36. 5 gigatons of carbon dioxide (GtCO2) in 2050. For the 1.5°C Scenario, emissions need to drop to net zero.



Source : Irena, IEA

Key Pillars of Energy Transition - Renewables, efficiency and electrification

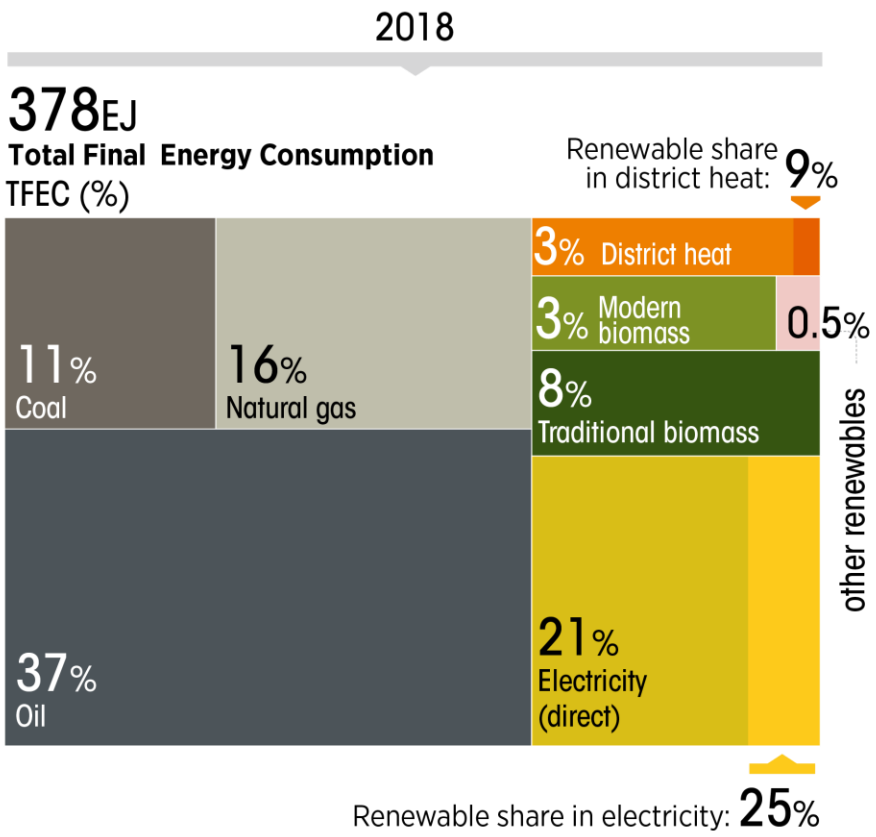
Reducing emissions by 2050 through six technological avenues

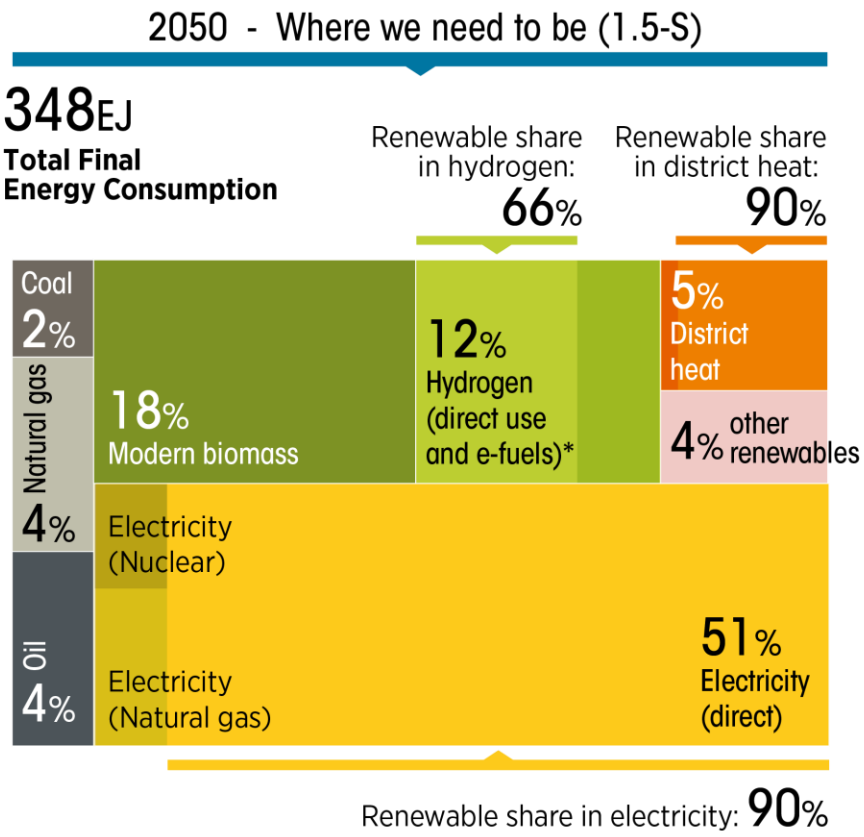


Source : Irena, IEA

- 90% of all decarbonisation in 2050 will involve renewable energy through direct supply of low-cost power, efficiency, electrification, bioenergy with CCS and green hydrogen. Ramping up renewables, together with an aggressive energy efficiency strategy, is the most realistic path toward halving of emissions by 2030.
- The decarbonization of end-uses needs to make much faster progress, with many solutions provided through electrification, green hydrogen and the direct use of renewables.

Electricity - the main energy carrier in 2050

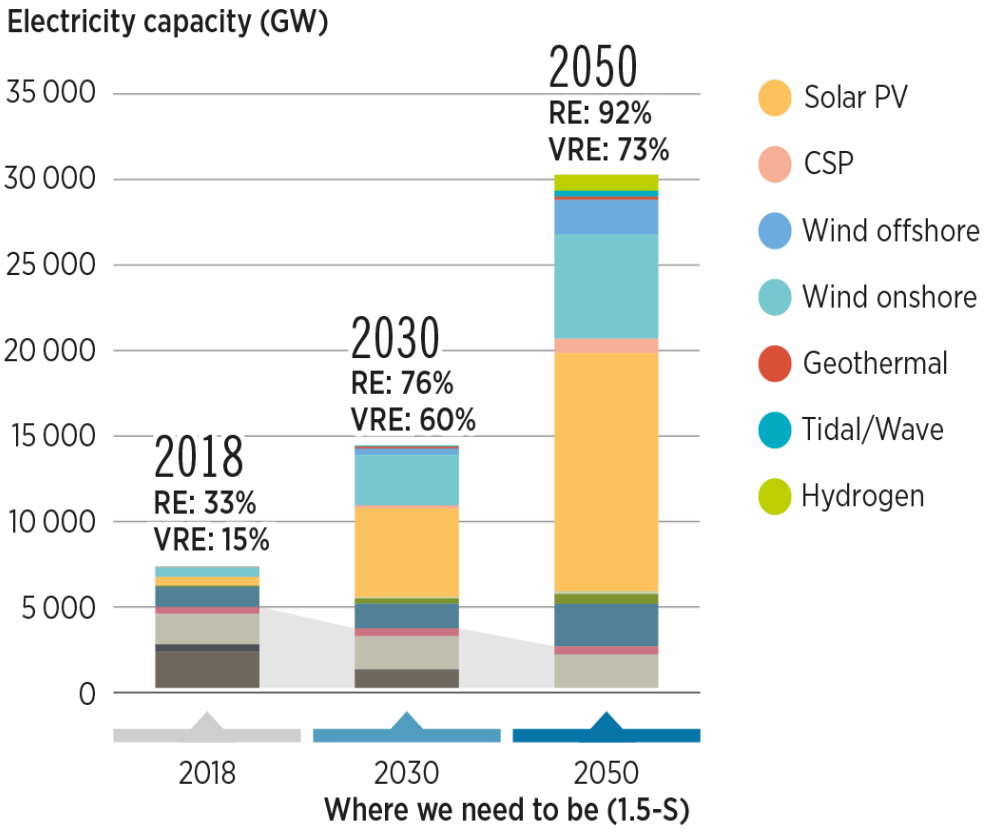




- 90% of total electricity needs will be supplied by renewables by 2050

Source : Irena, IEA

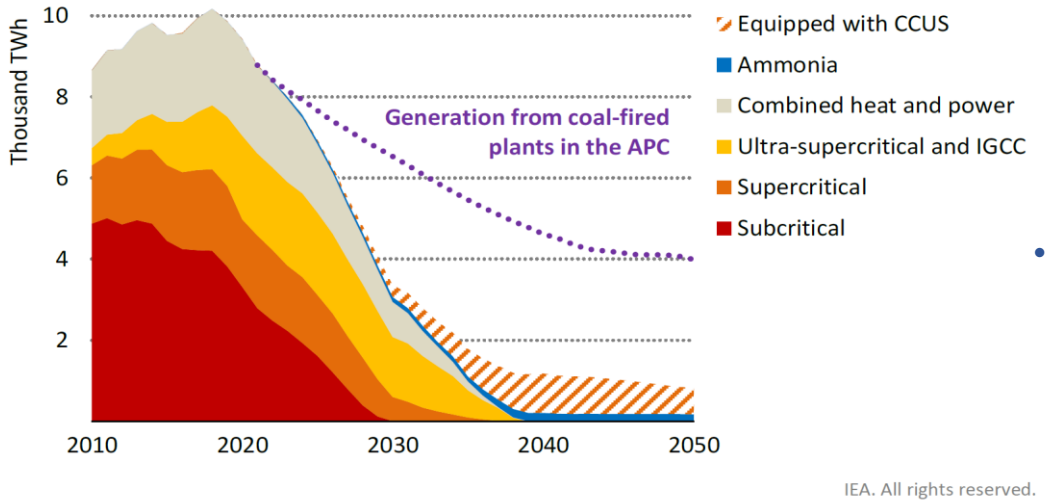
Renewables to decarbonize 90% of the power sector by 2050



- Renewables will provide **65%** of the **total electricity supply** by **2030 and 90% by 2050** respectively from over 25% in 2018
- Specific policies and measures such as **RE targets, tax incentives, pricing mechanisms**, among others are needed to increase the deployment of renewables
- Electricity generation grows three-fold from 26380 terawatt hours (TWh) in 2018 to close to 78700 TWh in 2050.

Source : Irena

Phase out of Coal-fired electricity generation & significant scale up Renewables



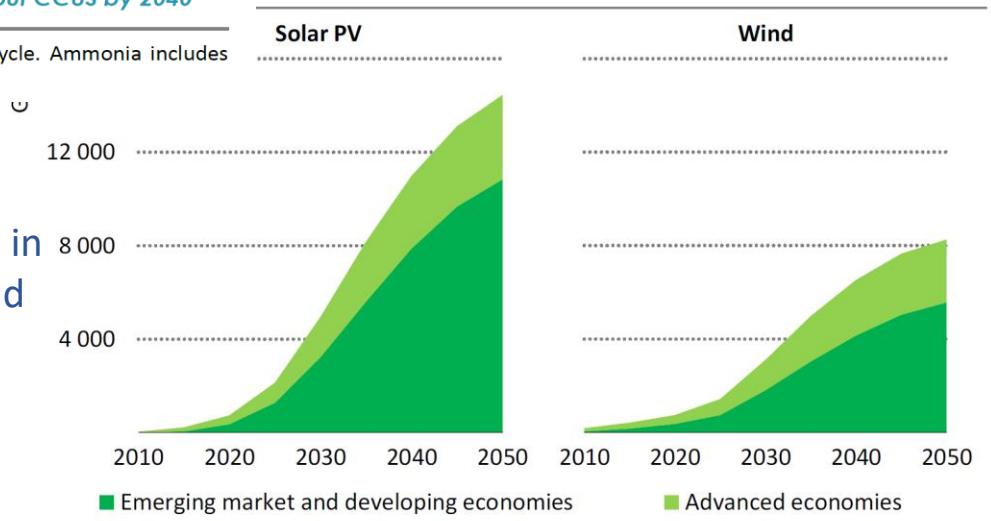
Coal-fired power accounted for 27% of global energy CO_2 emissions in 2020, and in the NZE, all subcritical plants are phased out by 2030 and all plants without CCUS by 2040

Notes: APC = Announced Pledges Case; IGCC = integrated gasification combined-cycle. Ammonia includes co-firing and full conversion of coal plants.

- By 2040, coal generation would be a quarter of today's level and eventually would be phased out by 2050

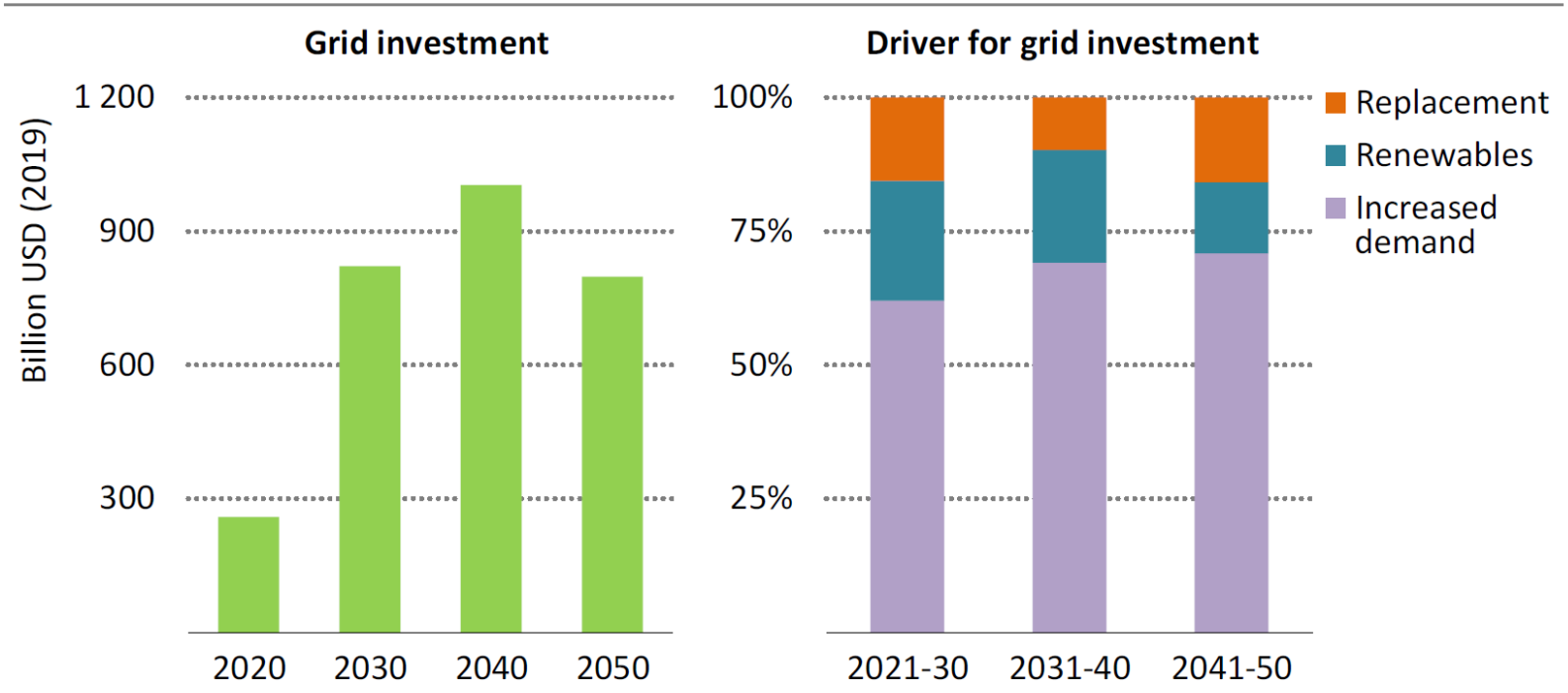
- The remaining 10% of total power generation in 2050 would be supplied by natural gas (around 6%) and nuclear (around 4%)

Source : Irena, IEA



Solar PV and wind need to scale up rapidly to decarbonise electricity, with total solar PV capacity growing 20-fold and wind 11-fold by 2050

Global investment in electricity networks



Electricity network investment triples to 2030 and remains elevated to 2050, meeting new demand, replacing ageing infrastructure and integrating more renewables

Energy Transition for Energy intensive & Hard-to-decarbonise sectors – Industrial & Long Haul Transport Sectors

Energy-intensive industrial sectors

Iron and steel

In 2017:

- Consumed 32 exajoules (EJ) of energy
- Only 4% was from renewables
- Emitted 3.1 gigatonnes (Gt) of CO_2

Chemicals and petrochemicals

In 2017:

- Consumed 46.8 EJ of energy
- Only 3% was from renewables
- Emitted 1.7 Gt of CO_2

Cement and lime

In 2017:

- Consumed 15.6 EJ of energy
- Only 6% was from renewables
- Emitted 2.5 Gt of CO_2

Aluminium

In 2017:

- Consumed 4.5 EJ of energy
- 16% was from renewables
- Emitted 0.4 Gt of CO_2

Energy-intensive freight & long-haul transport sectors

Road freight

In 2017:

- Consumed 32.3 EJ of energy
- Only 1.5% was from renewables
- Emitted 2.3 Gt of CO_2

Aviation

In 2017:

- Consumed 13.5 EJ of energy
- A negligible share was from renewables
- Emitted 0.9 Gt of CO_2

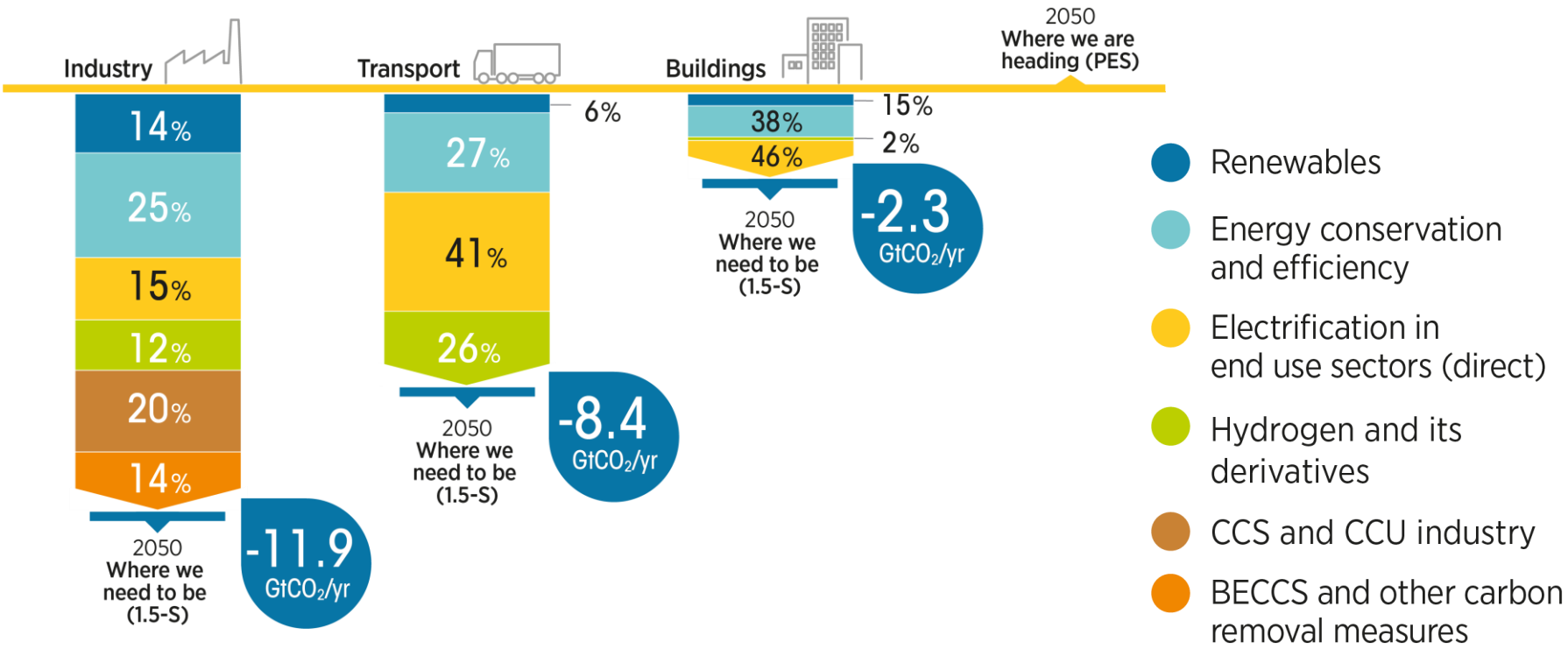
Shipping

In 2017:

- Consumed 11.3 EJ of energy
- A negligible share was from renewables
- Emitted 0.9 Gt of CO_2

Source : Irena, IEA

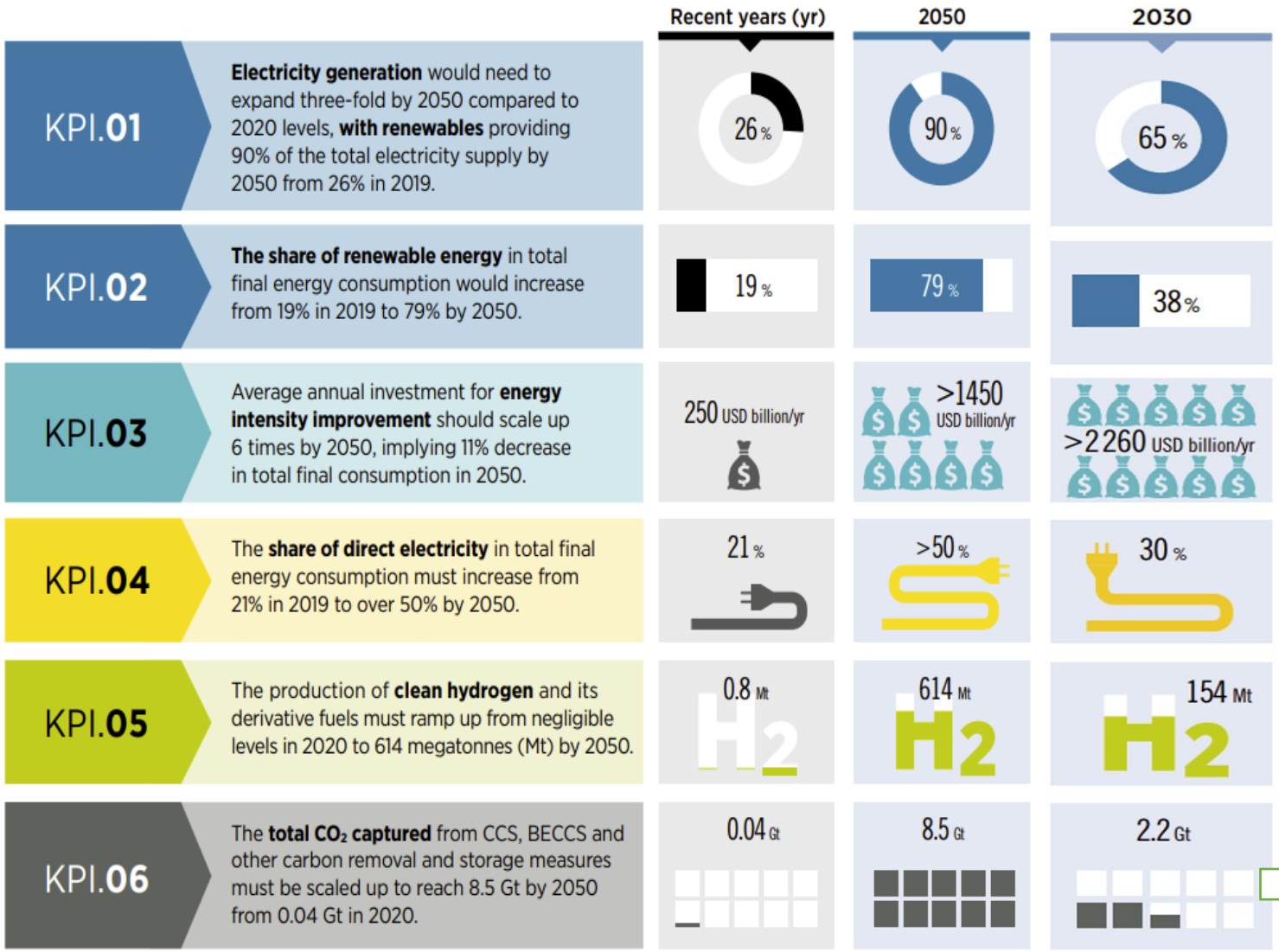
Energy Transition Solutions : Electrification and green hydrogen offer CO2 reduction solutions for end-use applications



- In transport, almost 70% of CO_2 reductions come from electrification and hydrogen.
  In industry, hydrogen and electricity combined contribute to 30% of CO_2 reduction

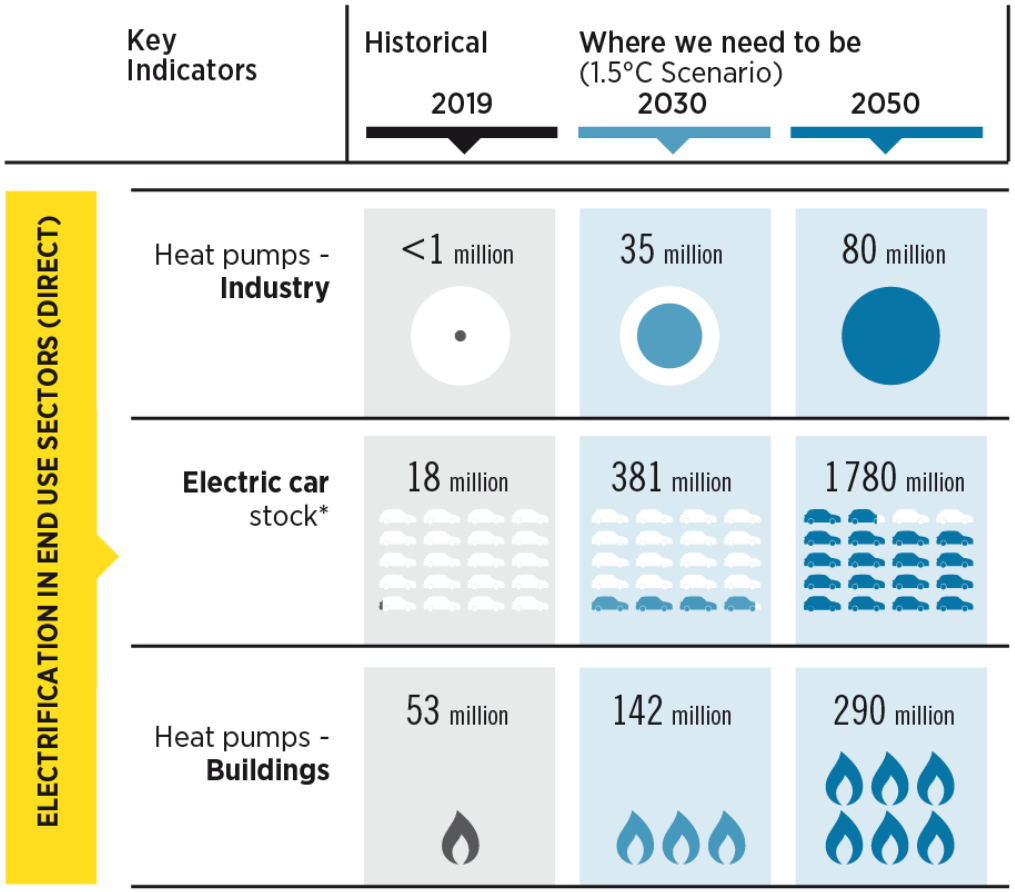
Source : Irena, IEA

Global overview: Energy Transition – where we are and where we need to be for 1.5 deg



Source : Irena, IEA

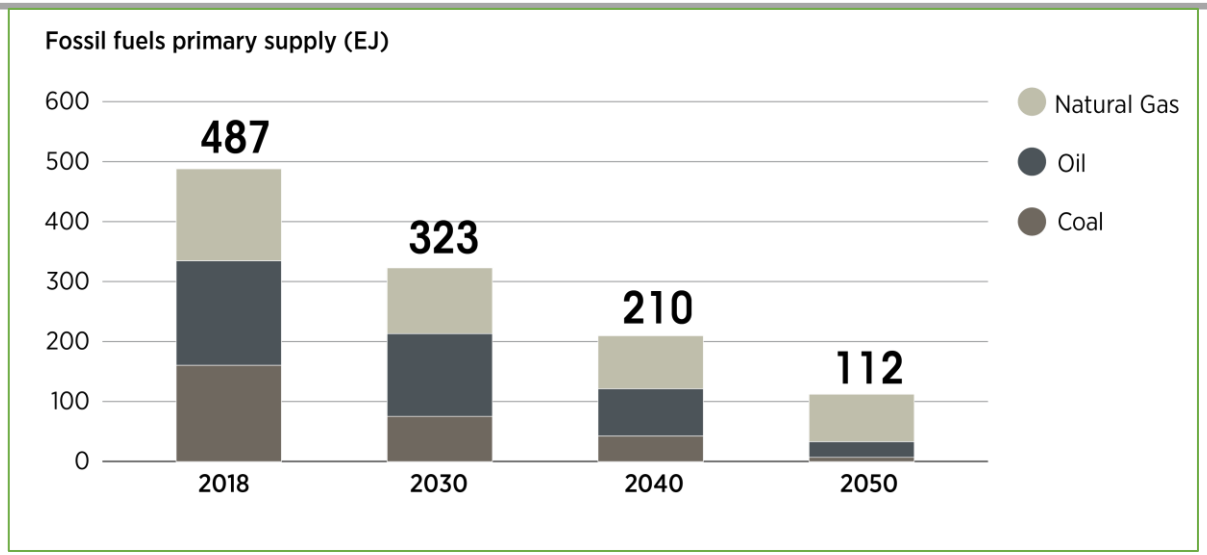
Electricity becomes the main energy carrier in future energy systems



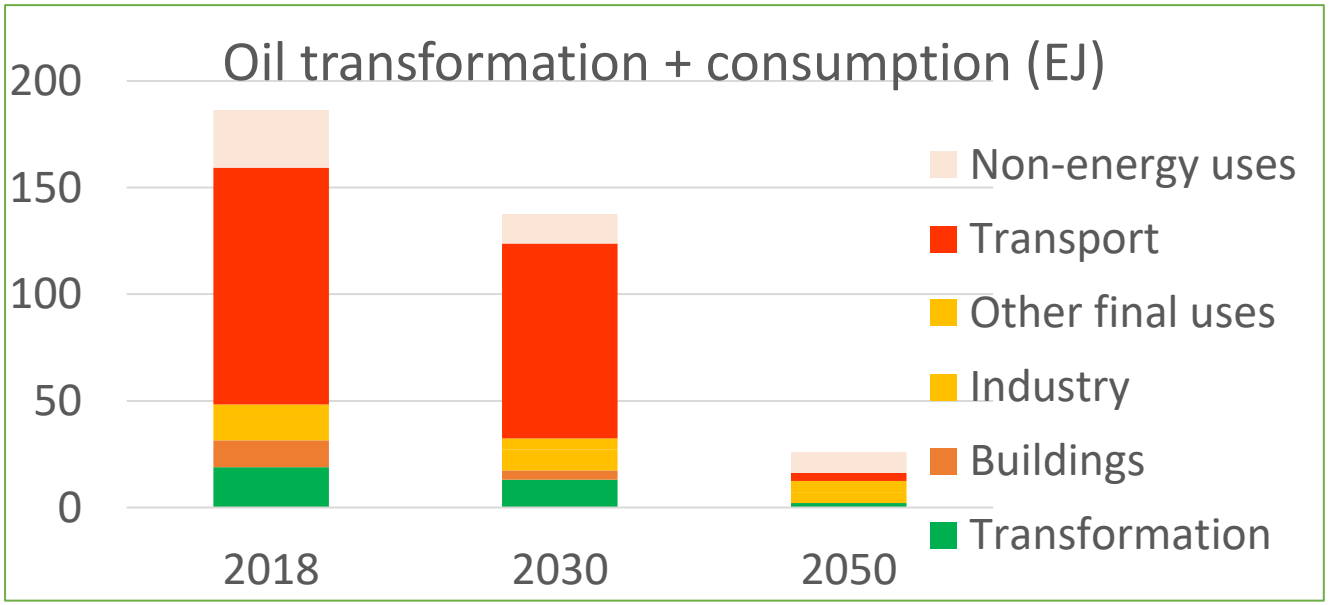
- **Global electricity demand** in end-use sectors will **rise 1.3 times** the 2019 levels to reach **Ca.31 000 TWh** by 2030.
- The share of electrification in end-use sectors like **industry**, **buildings**, **transport** to reach **28%**, **56%**, and **9%** in 2030, respectively.
- **Ramping up renewables**, together with an aggressive **energy efficiency** strategy, is the most realistic path toward halving of emissions by 2030.
- The **decarbonization of end-uses** needs to make much faster progress, with many solutions provided through electrification, green hydrogen and the direct use of renewables.
- A **comprehensive set of policies** is needed to achieve the necessary levels of deployment by 2030 and maximise benefits

Source : Irena, IEA

Fossil Fuels & Oil in all end uses to decline significantly



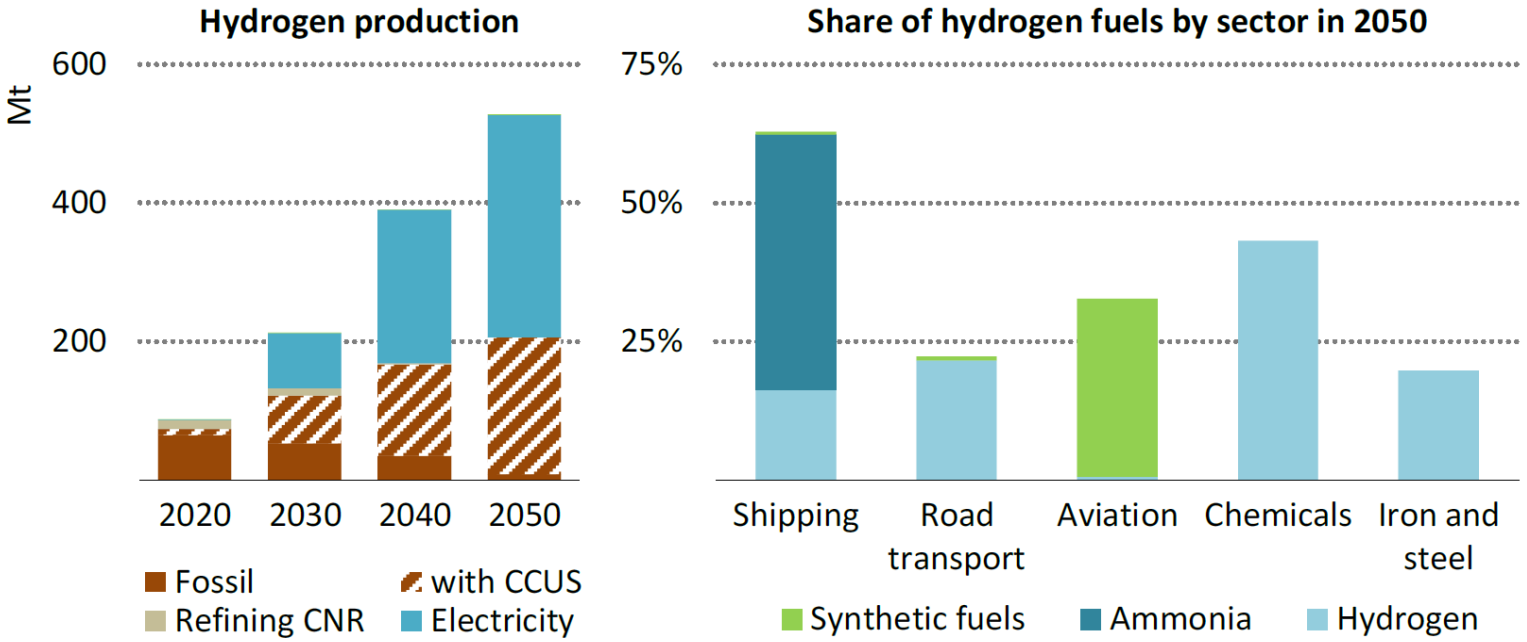
- Fossil fuel use could decline by more than 75% by 2050, based on the rapid transition measures starting now.



Source : Irena, IEA

Green Hydrogen – a Key Pillar of Energy Transition

Global production of hydrogen by fuel and hydrogen demand by sector



Hydrogen production jumps sixfold by 2050, driven by water electrolysis and natural gas with CCUS, to meet rising demand in shipping, road transport and heavy industry

Note: Refining CNR = hydrogen by-product from catalytic naphtha reforming at refineries.

Source : Irena, IEA

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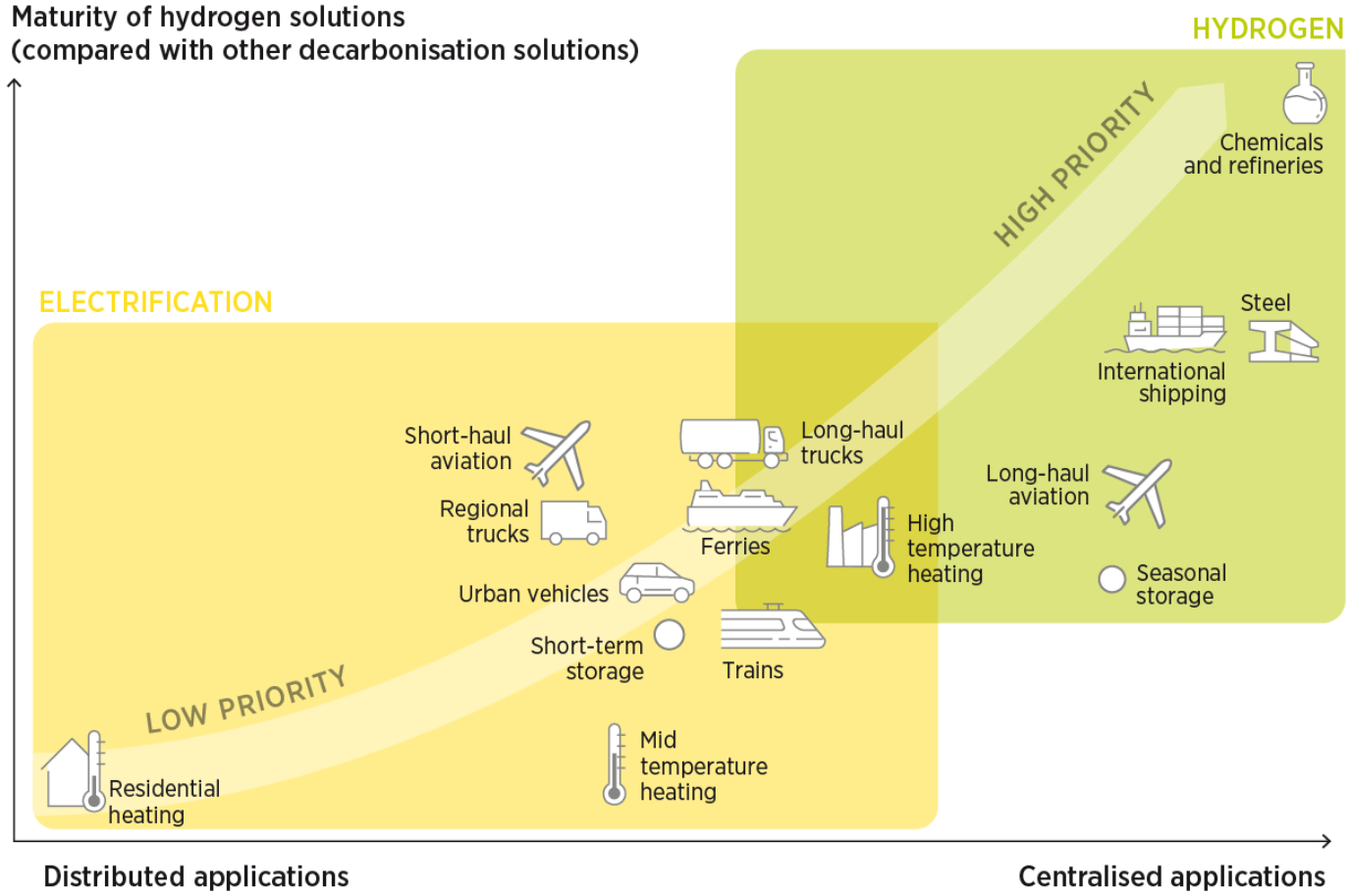
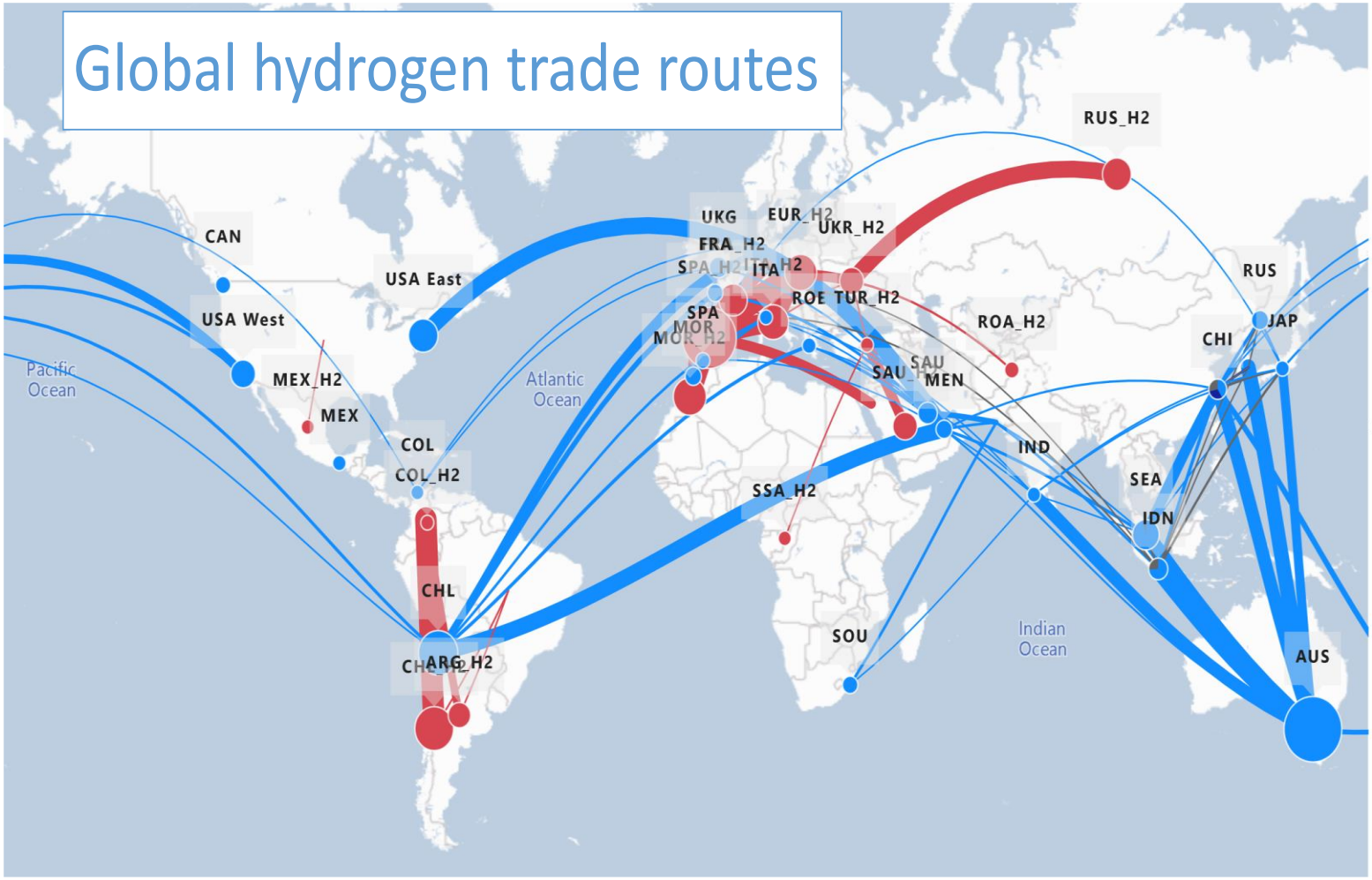
Green hydrogen to grow from niche to mainstream by 2030 & beyond



Policymakers should identify priorities for indirect electrification using green hydrogen with a focus on hard-to-abate sectors and devise strategies for its deployment.

Source : Irena

Global hydrogen trade in a 1.5C scenario



Source : Irena, IEA

Japan's strategies and policies for a hydrogen economy

- Japan was **the first country in the world to formulate Basic Hydrogen Strategy** in December 2017.
- Following the CN declaration by Prime Minister Suga in October 2020 **hydrogen is positioned as one of the priority areas in the Green Growth Strategy** formulated in Dec 2020, aiming to **expand the amount of hydrogen introduction and reduce the supply cost** in supply and demand

Amount and Cost Targets in Green Growth Strategies

- ✓ Hydrogen demand : up to 3 mil tones by 2030 & around 20 mil tones by 2050
- ✓ Deploy FCVs & demonstrate FC trains and FC trucks
- ✓ Demonstrate large scale hydrogen power generation
- ✓ R&D for zero-carbon steel & chemicals
- ✓ Fuel Cells development & incentives for production facility
- ✓ Scale-up international hydrogen supply chain

Domestic and international strategy formulation

December 2017 Japan formulated Basic Hydrogen Strategy

October 2020 PM Suga's 2050 CN Declaration

December 2020 Formulation of Green Growth Strategy (Positioning of hydrogen)

2021- Revising the next Basic Energy Plan and the Basic Hydrogen Strategy

Approx. $19 billion Green Innovation Fund established for R&D

FC Truck

Hydrogen Gas Turbines

Zero-carbon steel

Powerto Gas

MCH carrier

FC train JR East

Korea – Hydrogen Economy Roadmap & Action Plan

- In January 2019, the Korean government announced the 'Hydrogen Economy Roadmap that set out its targets to 2040 including Vehicles, HRS and Industry
- Korean government announced 'Hydrogen Economy Action Plan' in November 2021 to focus on the production and importation of green hydrogen.

		2018	2030	2040
Vehicles		1,800 vehicles	0.8 million vehicles	6.2 million vehicles
HRS		14 units	660 units	1,200 units
Power Generation		307MW	2.0GW	15GW
H2 Production		0.1 million tons / year	1.9 million tons / year	5.2 million tons / year
H2 Price		$7 / kg	$3.5 / kg	$2.5 / kg
		By-product hydrogen	By-product hydrogen Hydrogen extraction, Water electrolysis, Overseas production	By-product hydrogen Hydrogen extraction, Water electrolysis, Overseas production

Key milestones and actions for rapid emission reductions by 2030 for 1.5 deg

Renewable energy share in electricity generation must increase to 65% by 2030.

- *An additional 8 000 GW of renewable capacity in this decade*
- *Installed capacity of onshore wind of 3 000 GW. four times that of 2020*
- *Off-shore wind to scale-up to 380 GW, 11 times more than in 2020*
- *Installed capacity of solar PV to reach 5 200 GW. more than seven times that of 2020*
- *Hydropower capacity to increase to 1 500 GW. 30% more than in 2020*
- *Other renewable technologies to reach 750 GW, up six-fold from 2020.*

The share of direct electricity in total final energy consumption (TFEC) must rise from 21% to 30%;

- *Deployment of energy efficiency measures must increase 2.5 times, a drop in TFEC from 390EJ today to 370 EJ*
- *Expanded electrification of energy services, especially in the transport sector*
- *Improved energy efficiency standards and retrofitting of existing buildings*
- *Process changes in industry, relocation of industries. and circular economy practices*

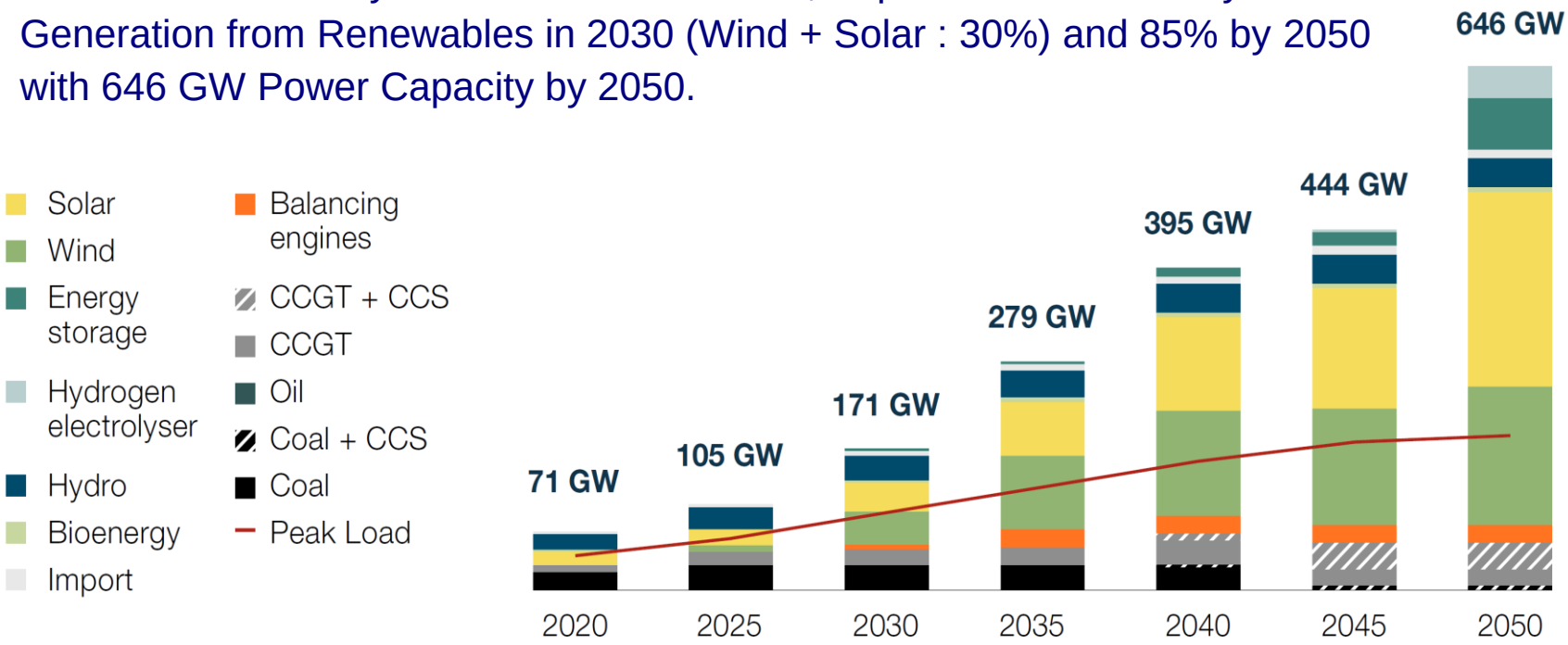
Direct renewables in end-use sectors must grow from 12% in 2019 to 19% by 2030.

- *Hydrogen consumption to reach a minimum of 19EJ by 2030*
- *Total consumption of bioenergy and feedstock in industry to increase to 25 EJ in excess of 2.5 times of 2019*
- *Solar thermal, Geothermal and district heating solutions to be scaled up to 60 EJ, 1.3 times the 2019 levels.*
- *Biofuel's share for energy consumption in transport to increase from 3% in 2019 to 13%*
- *Increase ambition on biojet to reach 20% of total fuel consumption by 2030.*

Notes : *GW = gigawatt; Gt = gigatonne; CCS = carbon capture and storage:, BECCS = bioenergy combined with carbon capture and storage. In 2019, CO2 emissions from fossil fuels include coal (15GtC02), oil (12 GtCO,). Natural gas (7GtCO,) and process emissions (3 GtC02).*

ENERGY TRANSITION IN VIETNAM :
Power System Modeling for Net Zero emissions

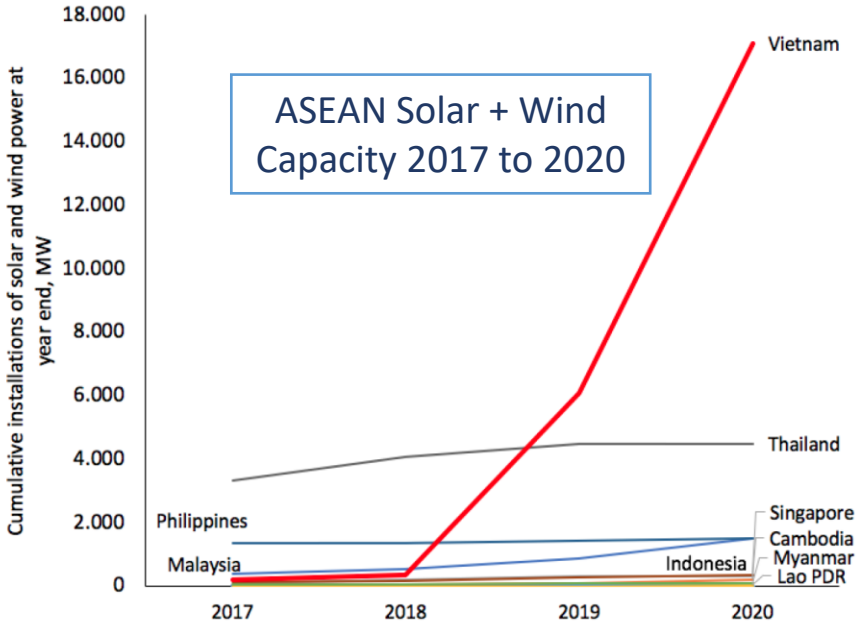
- A Net Zero Power System Model for Vietnam, requires 50% Electricity Generation from Renewables in 2030 (Wind + Solar : 30%) and 85% by 2050 with 646 GW Power Capacity by 2050.



- The Net Zero Power System of 646 GW by 2050 will comprise of 239 GW of Solar, 171 GW of Wind, with 52 GW of Hydrogen production with Renewables.
- Green hydrogen as a sustainable fuel will displace natural gas, allow balancing engines to run using carbon neutral fuels. Locally produced green hydrogen will ensure long-term sustainability, security and decarbonize energy-intensive sectors, such as mobility and heavy industry.

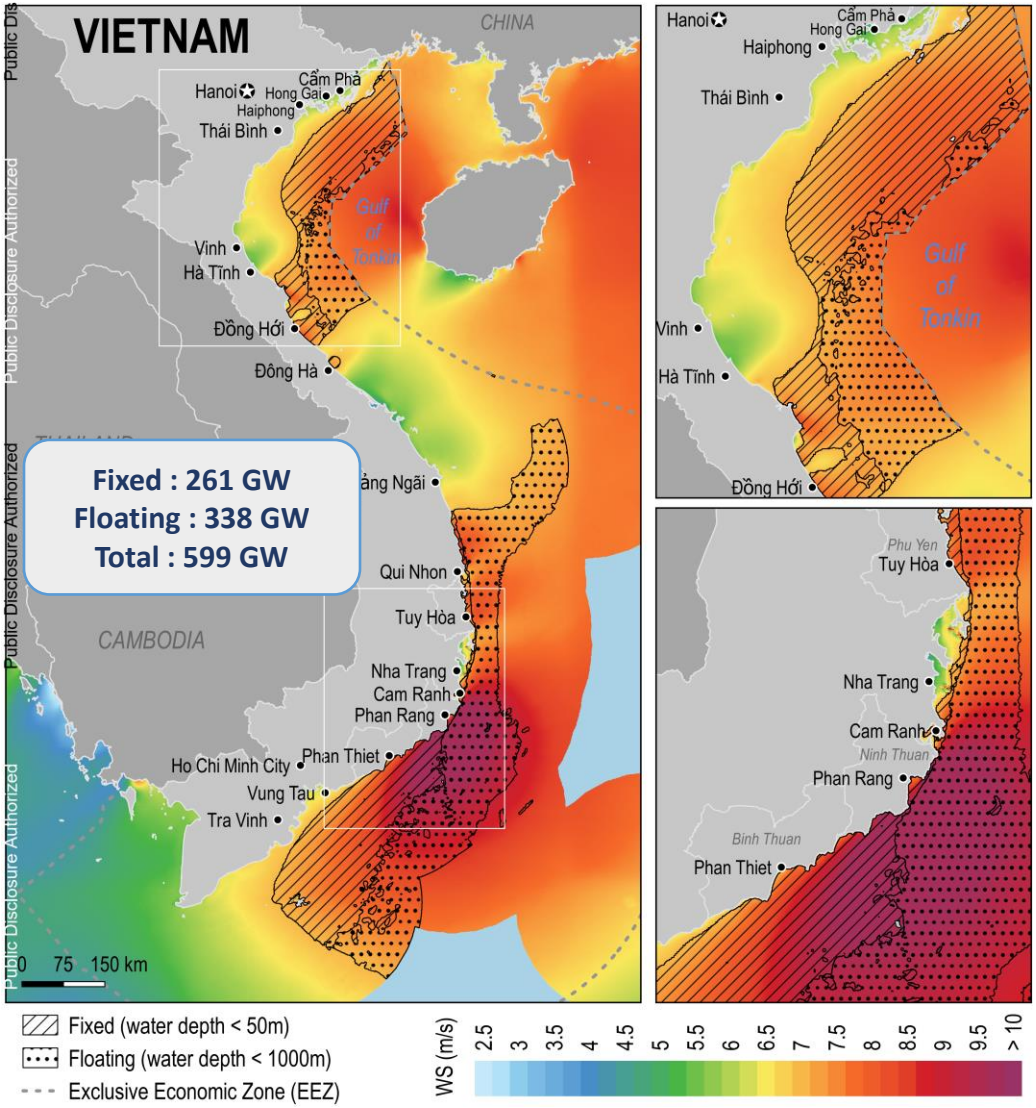
Source : IEA, Wartsila

Vietnam leads Solar & Wind Capacities in ASEAN



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Indonesia	1	1	1	1	1	1	144	154	154	154
Phillipines	33	33	337	427	427	427	427	443	443	453
Thailand	112	223	225	234	507	628	1,103	1,507	1,507	1,523
Vietnam	31	53	53	136	160	205	237	375	600	3,980

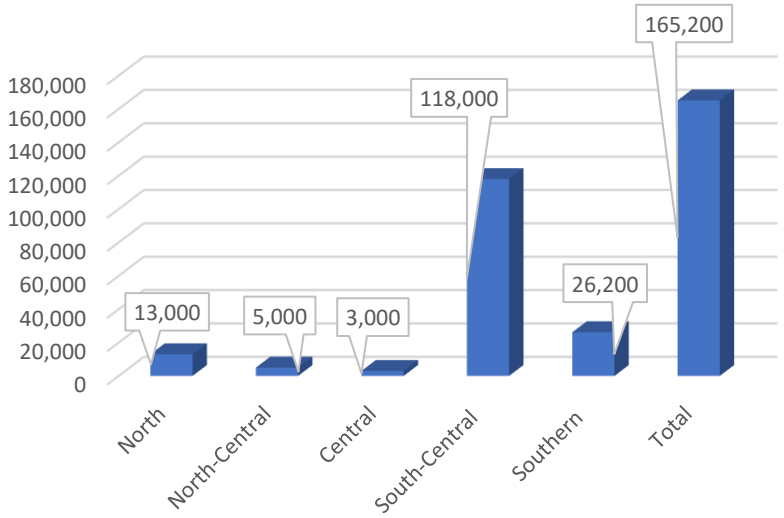
Vietnam's long coastline offers excellent potential for offshore wind for H2 Production for the region



Technical Potential of Offshore Wind along the Vietnam coast is 599 GW

(World Bank estimates - *criteria Wind speed > 7m/s and seabed depth ≤ 1000m}*

Vietnam PDP Power potential of 165 GW from Offshore Wind Region wise



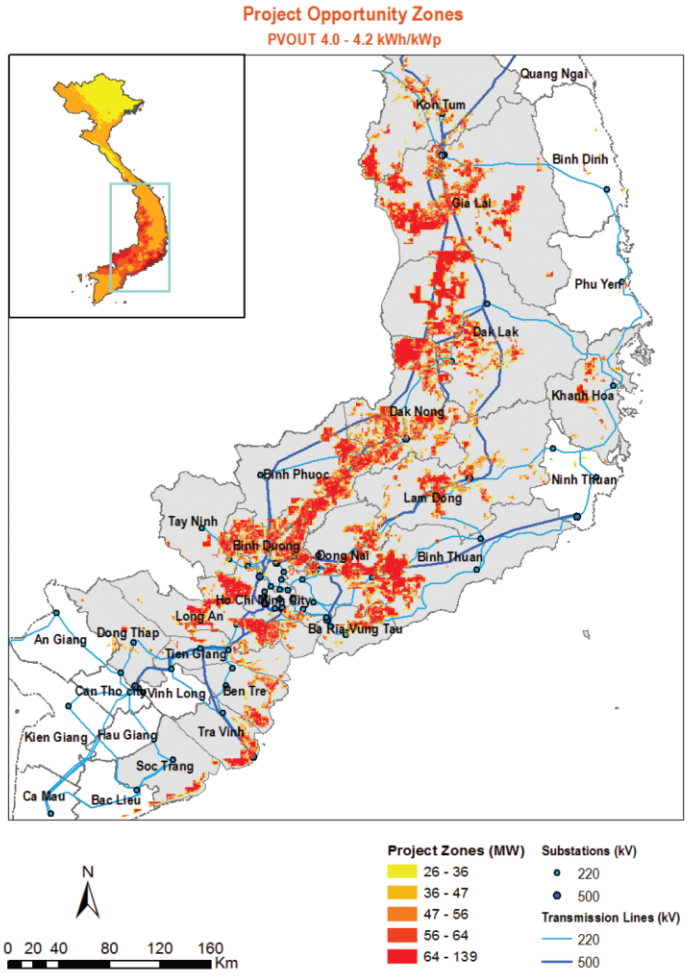
Vietnam's Solar Potential at 327 GW as per World Bank Suitable for H2 Production for the region

TABLE A2.2. Provinces and potential installed solar PV capacity (GW): good potential

NAME OF PROVINCE	CAPACITY (GW)
Gia Lai	54.69
Dak Nong	44.60
Dak Lak	40.75
Binh Phuoc	27.80
Dong Nai	25.05
Binh Duong	22.81
Long An	21.06
Lam Dong	20.22
Kon Tum	17.66
Binh Thuan	13.11
Ba Ria-Vung Tau	7.19
Ben Tre	6.91
Tra Vinh	6.34
Khanh Hoa	5.59
Tay Ninh	3.65
Tien Giang	3.17
Soc Trang	3.02
Ho Chi Minh city	2.82
Dong Thap	1.17

Source: World Bank.

FIGURE A2.3. Zones with good solar PV irradiation

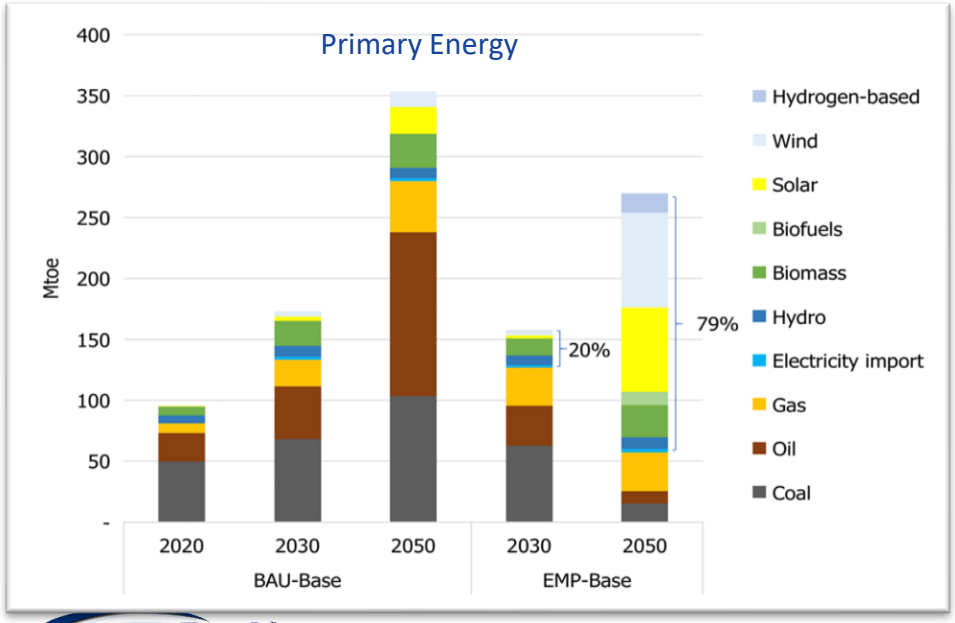


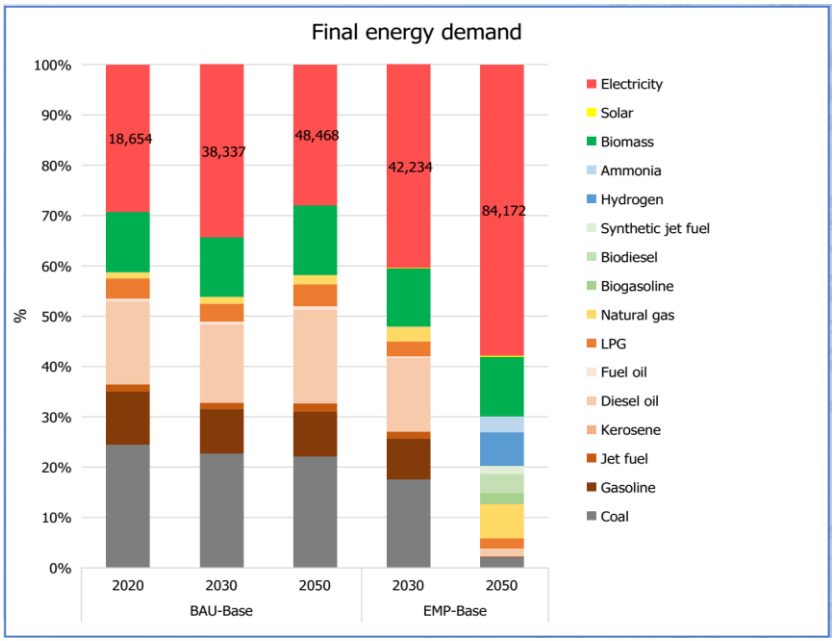
Vietnam Net Zero Targets & JETP

- Vietnam pledged Net Zero by 2050 during COP26 in Glasgow. (in comparison China & India pledged Net Zero by 2060 & 2070 respectively). Following COP26 Vietnam revised its power development plan to scale up Renewables significantly in the energy Mix, introduce Green Hydrogen & low carbon fuels and phase our coal power plants from 2030.
- JETP : Vietnam signed the *Just Energy Transition Partnerships (JETP) in December 2022 with IPG countries and GFANG – Private financial Institutions for a total commitment of US$ 15.5 Bn, aimed to bring forward the peak emissions from 2035 (*240 MtCO2e) to 2030 (170 MTCO2e) and achieve energy transition to Net Zero by 2050.

Pathways to Net Zero by 2050 :

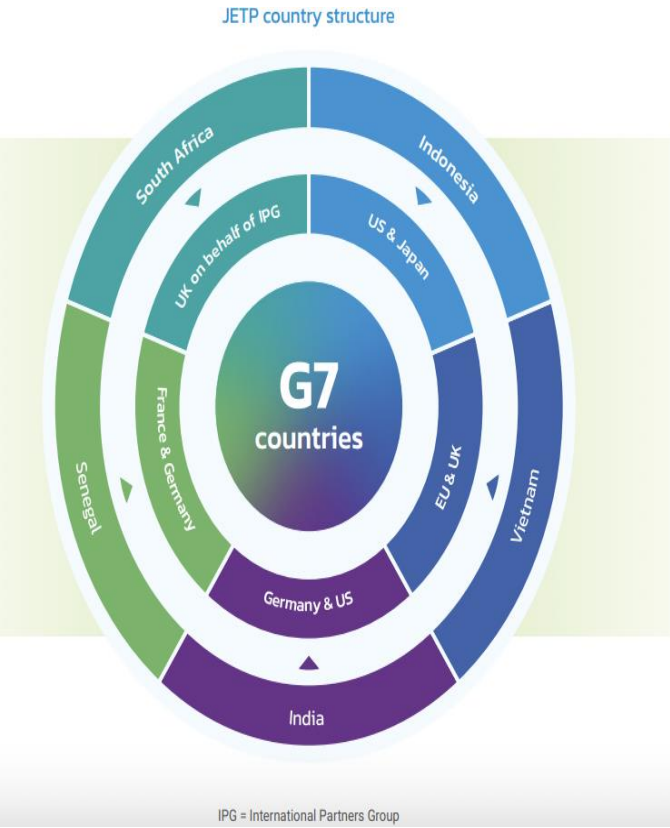
Scale up Renewable Energy
Green Hydrogen
E – Fuels
Industrial Decarbonization
Increase share of Electricity in Final energy Demand





JETP Funding Comparison : Vietnam and Indonesia

JETP Funding Features	Vietnam	Indonesia
Committed Funding	$15.5 billion	$20 billion
Targets Set	Net Zero **2050**	Net Zero **2060**
Peak Power Sector Emissions	**170 megatons** by 2030 a reduction of 30% from 240 MT.	**300 megatons** by 2030
Increase Renewable energy in the Power Mix	**47 percent** of electricity generation by 2030 from a prior target of 36%	**34 percent** of Power generation compared to a prior target of 31% by 2050
Peak Coal Capacity	**Limit Peak coal capacity to 30.2 GW** a steep reduction from 37 GW	Expect to retain **50 GW coal-fired power** plants in 2030.
Projected Peak GHG Emissions Date	**2030 from 2035**	**By 2030**
Emissions saved with JETP Funding	500 Mega Tons by 2035	



Summary & Conclusions

- Global Energy Transition :
  - Ambitious Net Zero Targets will be required to be mandated and implemented to limit Global Warming at the 1.5 deg level compared to historical.
  - The energy sector is the source of around three-quarters of greenhouse gas emissions today and holds the key to averting the worst effects of climate change
  - Key Pillars of Energy Transition : Electrification, Significant scale up of Renewables and Energy Efficiency together with Hydrogen and other flexible energy systems with complete phase out of fossil fuel power projects.
  - The US Inflation Reduction Act, EU Green Deal and the various Hydrogen Mission's by Nation States will enable Hydrogen to emerge Mainstream in Decarbonization efforts
- Energy Transition in Vietnam
  - Vietnam emerged as the clear leader in new installations of Wind and Solar Capacities among ASEAN countries in recent years and holds immense potential for significant scale up of Renewables to achieve the Net Zero Targets by 2050.
  - The COP26 Net Zero Pledge and the JETP agreement are the right steps by policy makers to set the framework for achieving Net Zero
  - Net Zero by 2050 by Vietnam will require even more ambitious targets to electrify the energy system, scale up Renewables and implement a Hydrogen based economy.