2022

ENERCON

THE 3RD INTERNATIONAL CONFERENCE ON ENERGY AND ENVIRONMENTAL ECONOMICS

University of the Philippines LOS BAÑOS

UP OIL

SEAMEO SEARCA

The CASE of Southeast Asia's Archetype Pathways for energy transition

Dr. Supawan Saelim

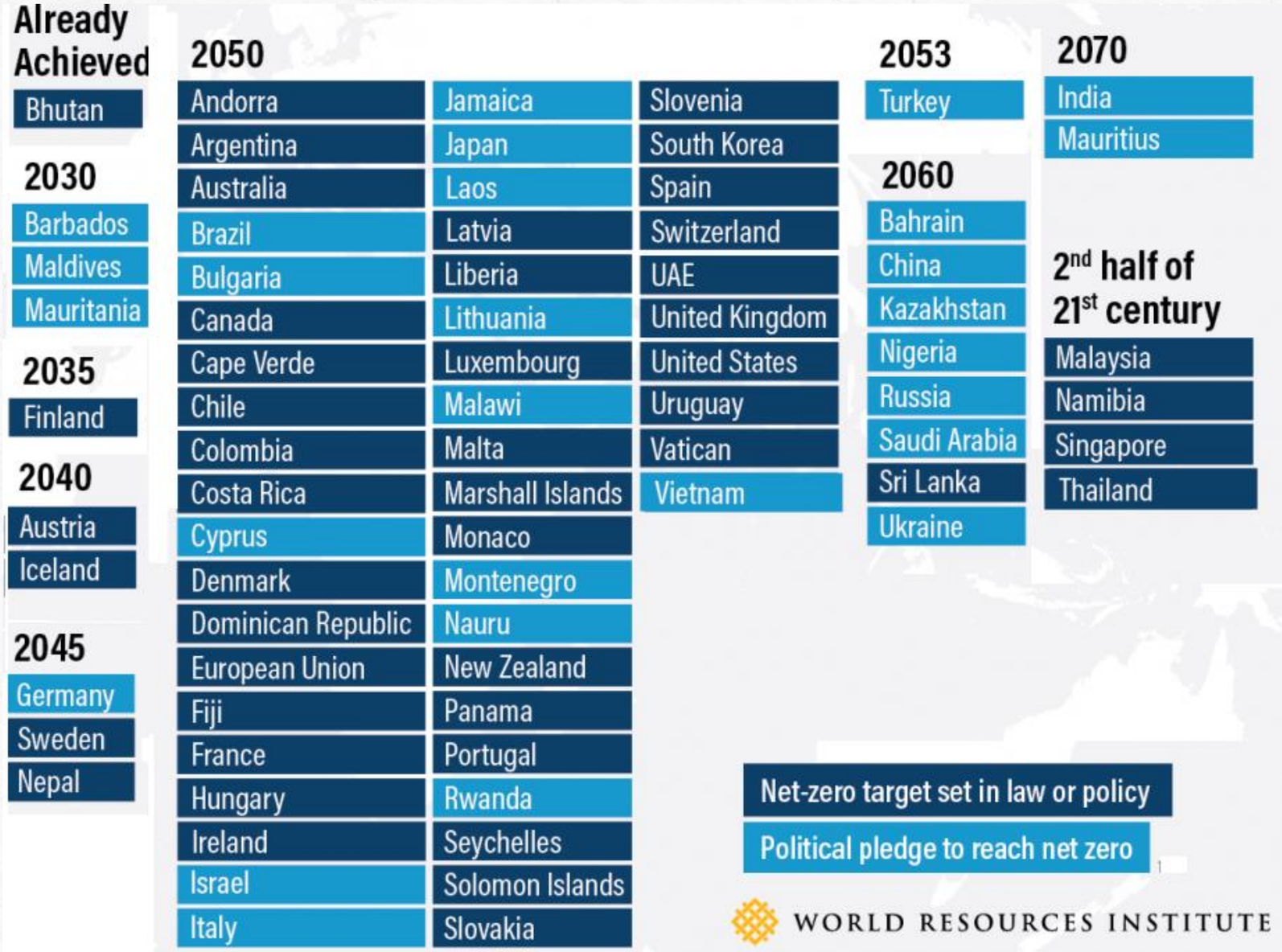
Agora Energiewende

Presented on 28 July 2022

Recent Trends

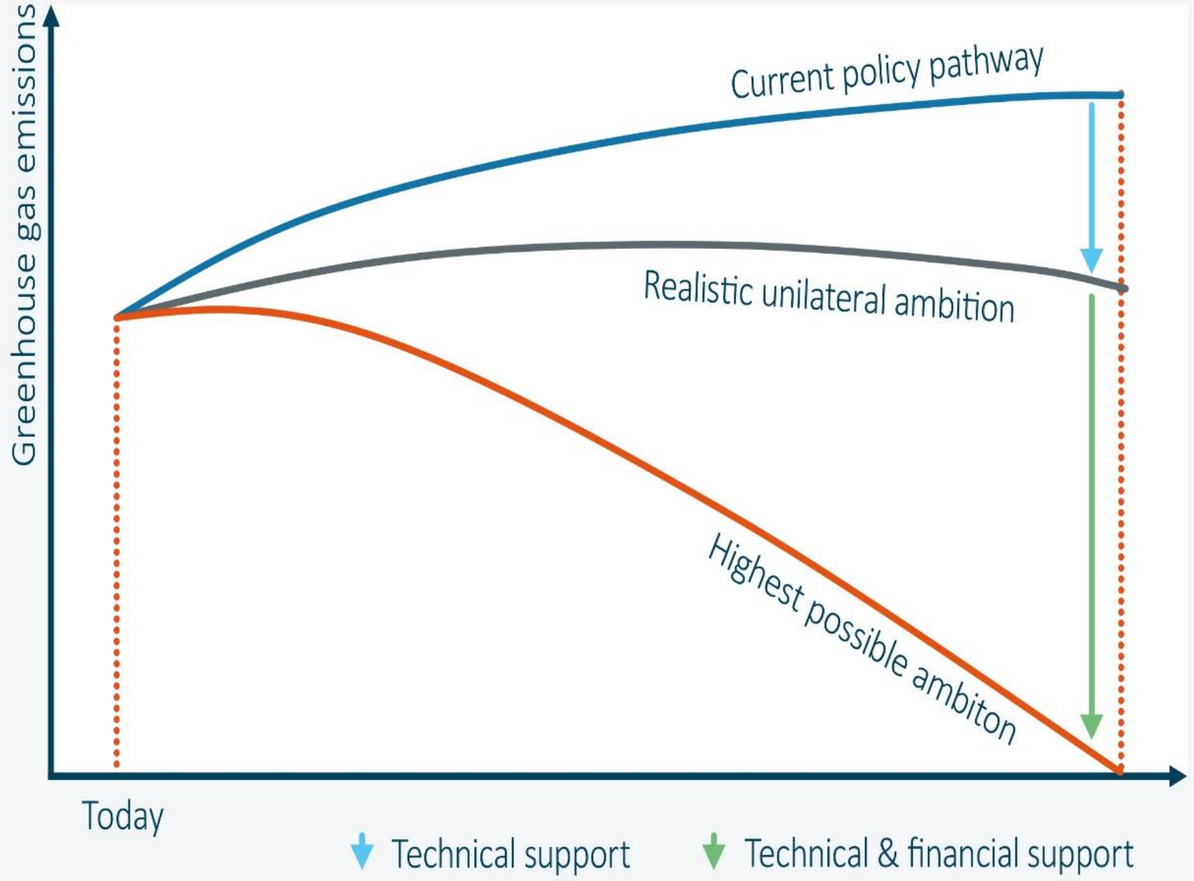
Increasing net-zero pledges

- 74 countries pledged to net-zero emissions commitment
- 2021 is the year of net-zero commitments (over 29 countries announced the target this year, including Thailand and Vietnam)



Source: WRI (2021) and WRI (2022)

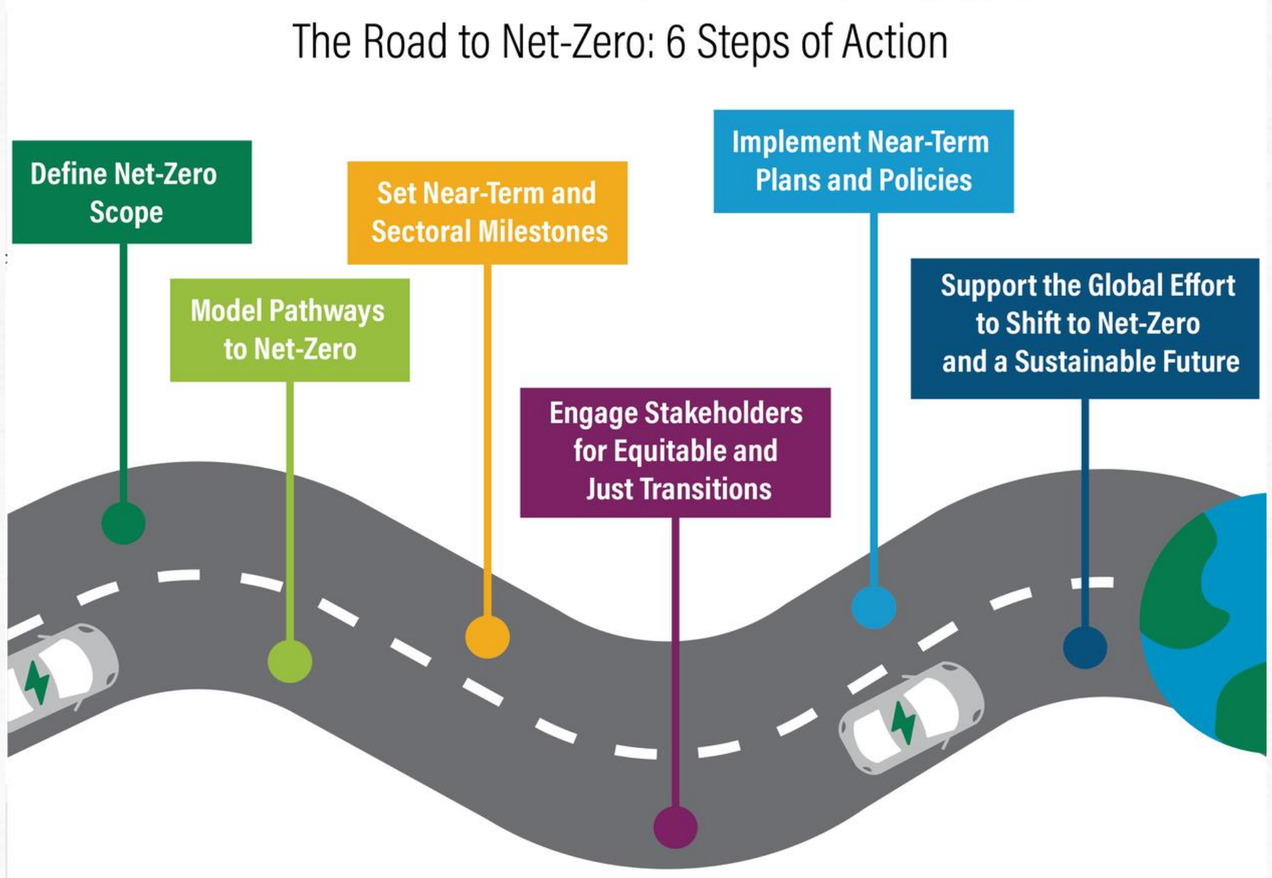
What do climate neutral pledges mean for emerging economies?



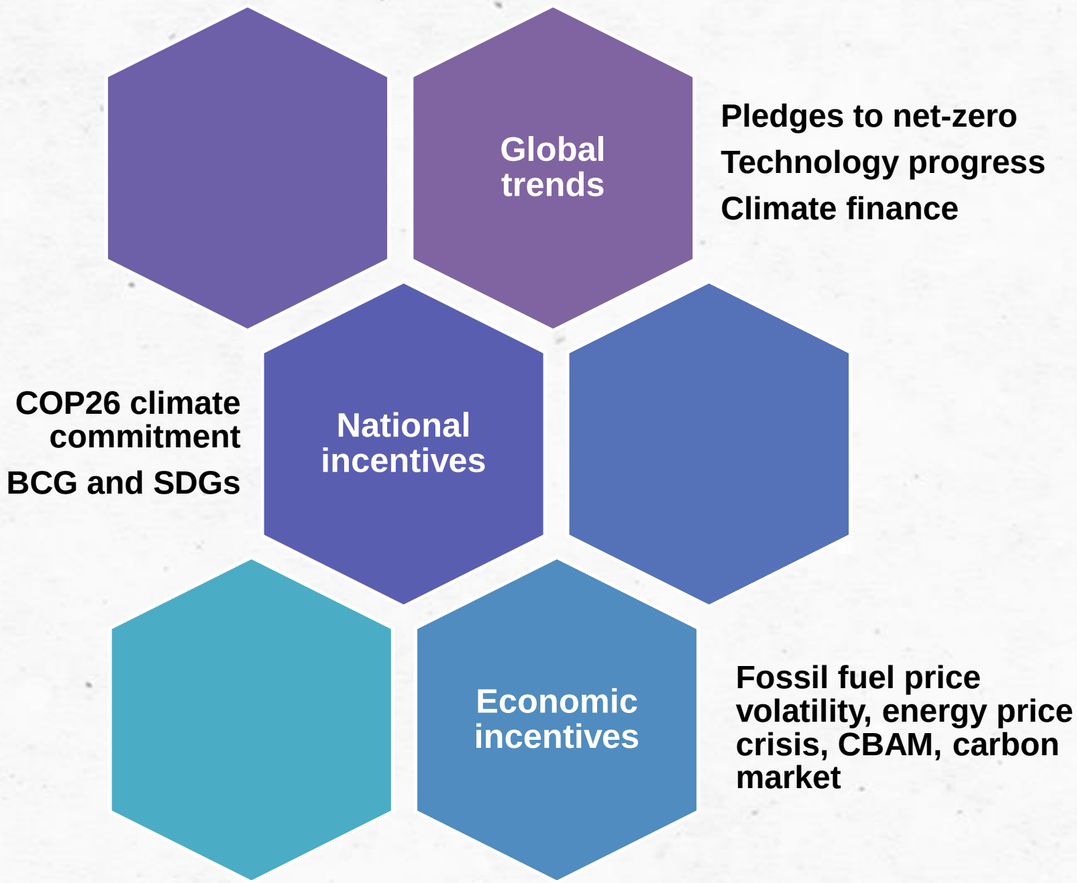
Source: NewClimate Institute, 2019

- 2050 climate net-zero pledges by industrial countries are only consistent with 1.5°C pathways if balanced **by massive finance and technology transfers to emerging economies.**
- At the same time, **emerging economies** will need to **identify their current realistic ambitions** in order to **define the nature of the support needed** to lift amibitions to the maximum technical possibility.
- The $100 billion per year in **climate finance towards emerging economies**, committed to in Cancun in 2010 and reaffirmed in Paris, will continue to 2025, when it will become the floor for a new collective quantified goal.

Actions and drivers for the energy transition

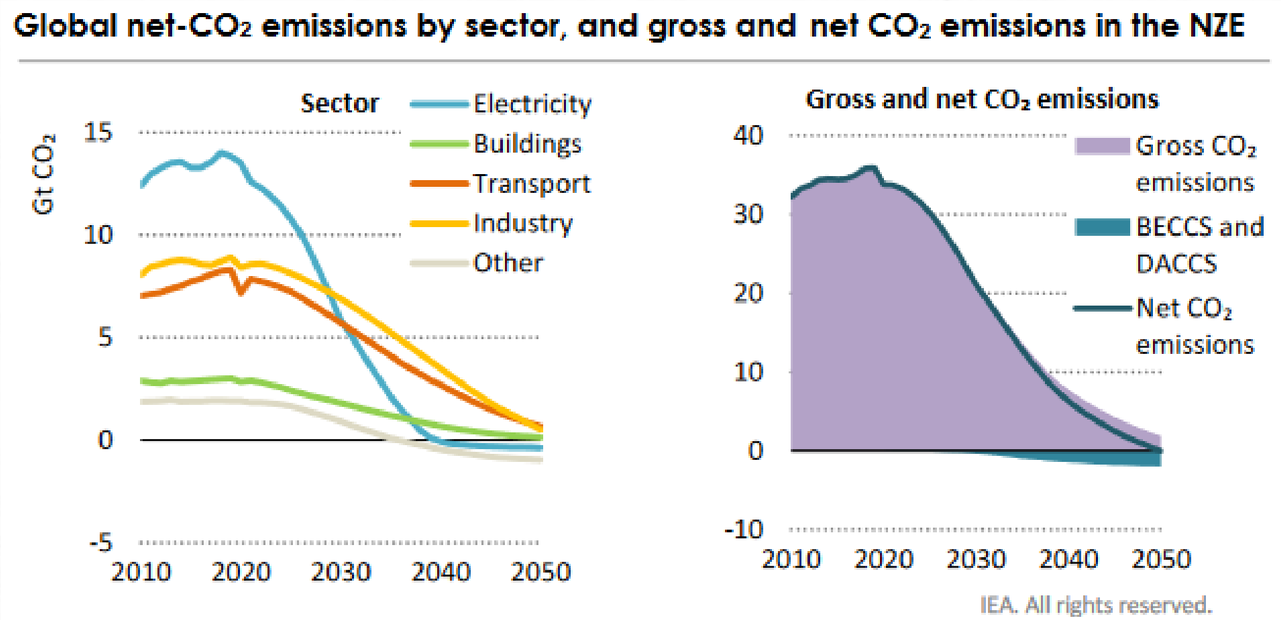


Source: WRI (2022)



BCG = Bio-circular-green economic model prioritized in Thailand
SDG = The UN's Sustainable Development Goals

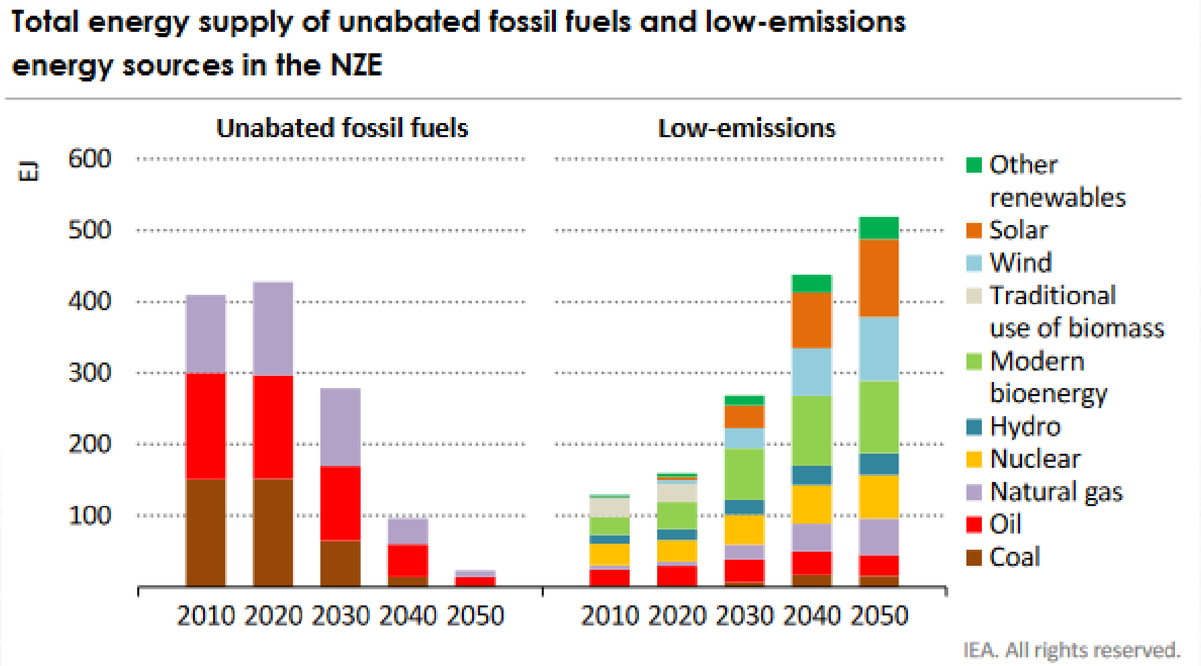
The IEA's net-zero emission by 2050 (NZE) pathways



Emissions from electricity fall fastest, with declines in industry and transport accelerating in the 2030s. Around 1.9 Gt CO_2 are removed in 2050 via BECCS and DACCS.

→ Emissions in the electricity declining at the largest proportion and at the fastest pace of the energy transition to achieve the 2050 net-zero target

→ Replacement of fossil fuels by low-emissions sources such as wind, solar, modern bioenergy



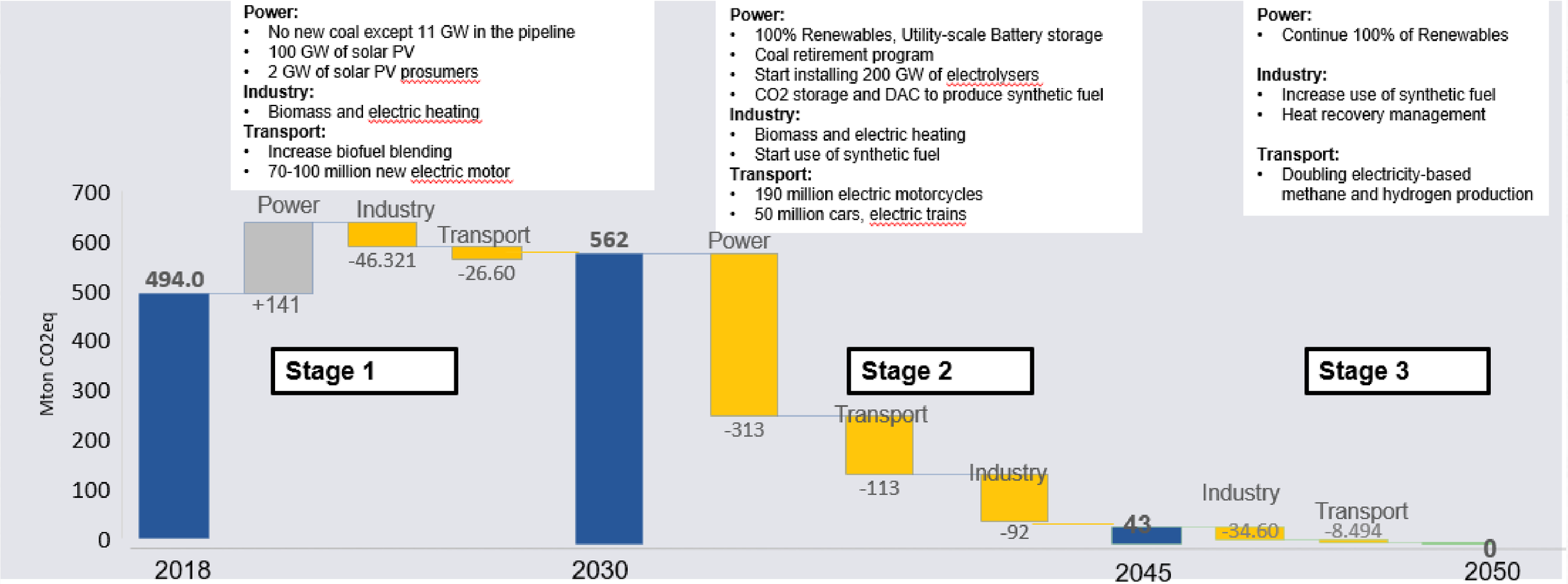
Some fossil fuels are still used in 2050 in the production of non-energy goods, in plants equipped with CCUS, and in sectors where emissions are hard to abate

Note: Still, some emissions from fossil fuels remain in industry and transport sectors by 2050 that cannot be reduced to zero but will be offset with negative emissions from bioenergy with carbon capture and storage (BECCS) and direct air capture with carbon capture and storage (DACCS)

Source: IEA (2021)

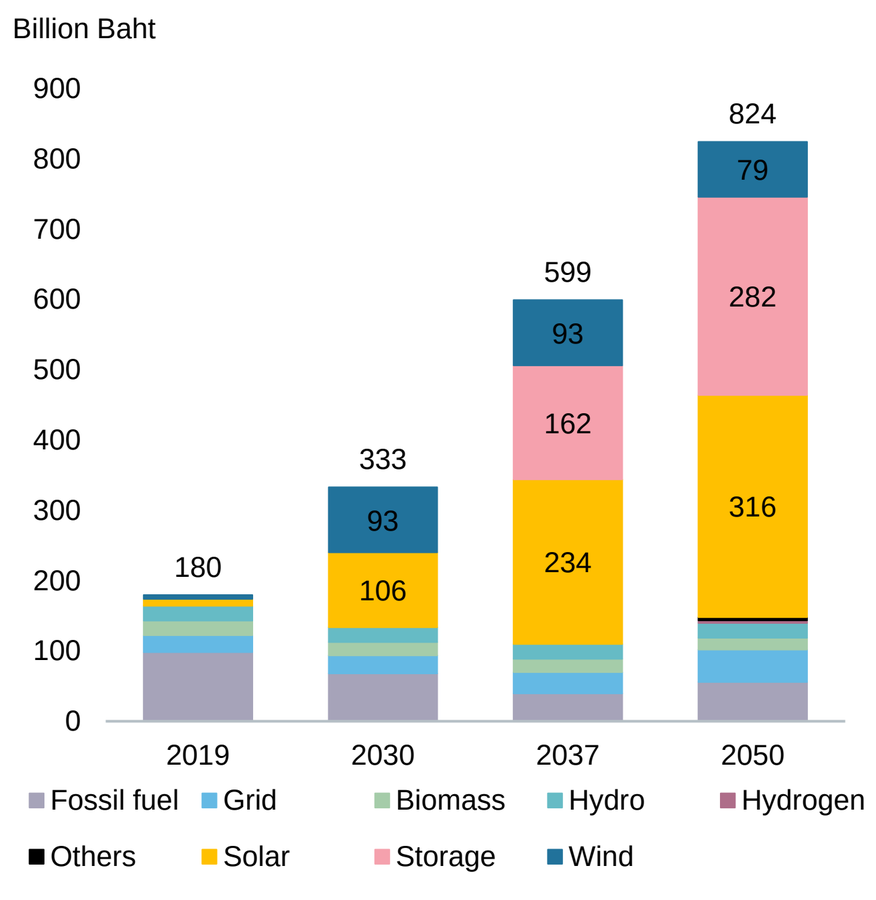
Pathway Insight from Indonesia: A consistent net-zero roadmap requires clear mid-term and long-term targets in all sectors of the economy

Reaching net-zero emissions in Indonesia in 2050 through 3 stages (IESR, Agora, LUT, 2021)

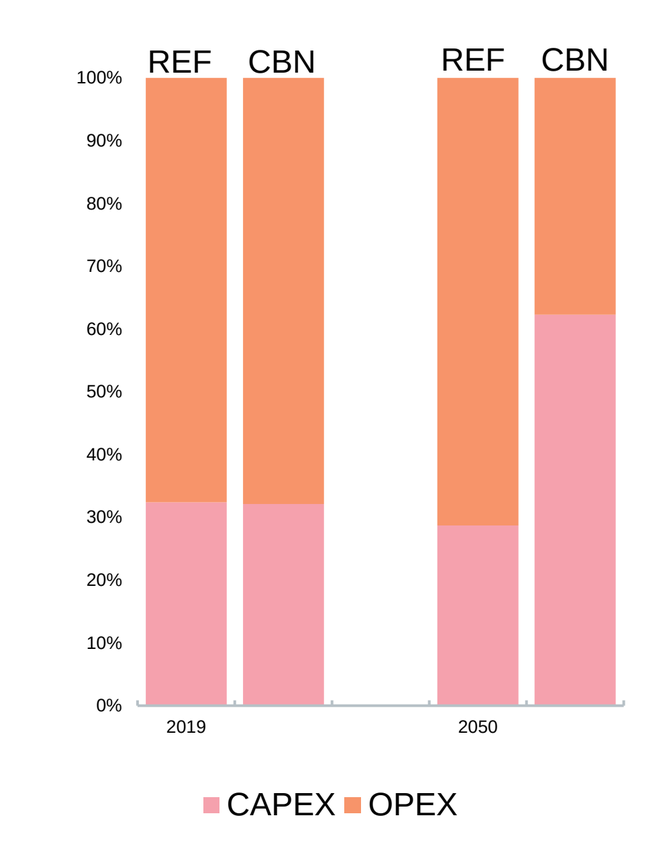


Pathway Insights from Thailand: The energy transition represents an opportunity to modernise the energy system and will require a comprehensive investment programme

Annualised investment cost



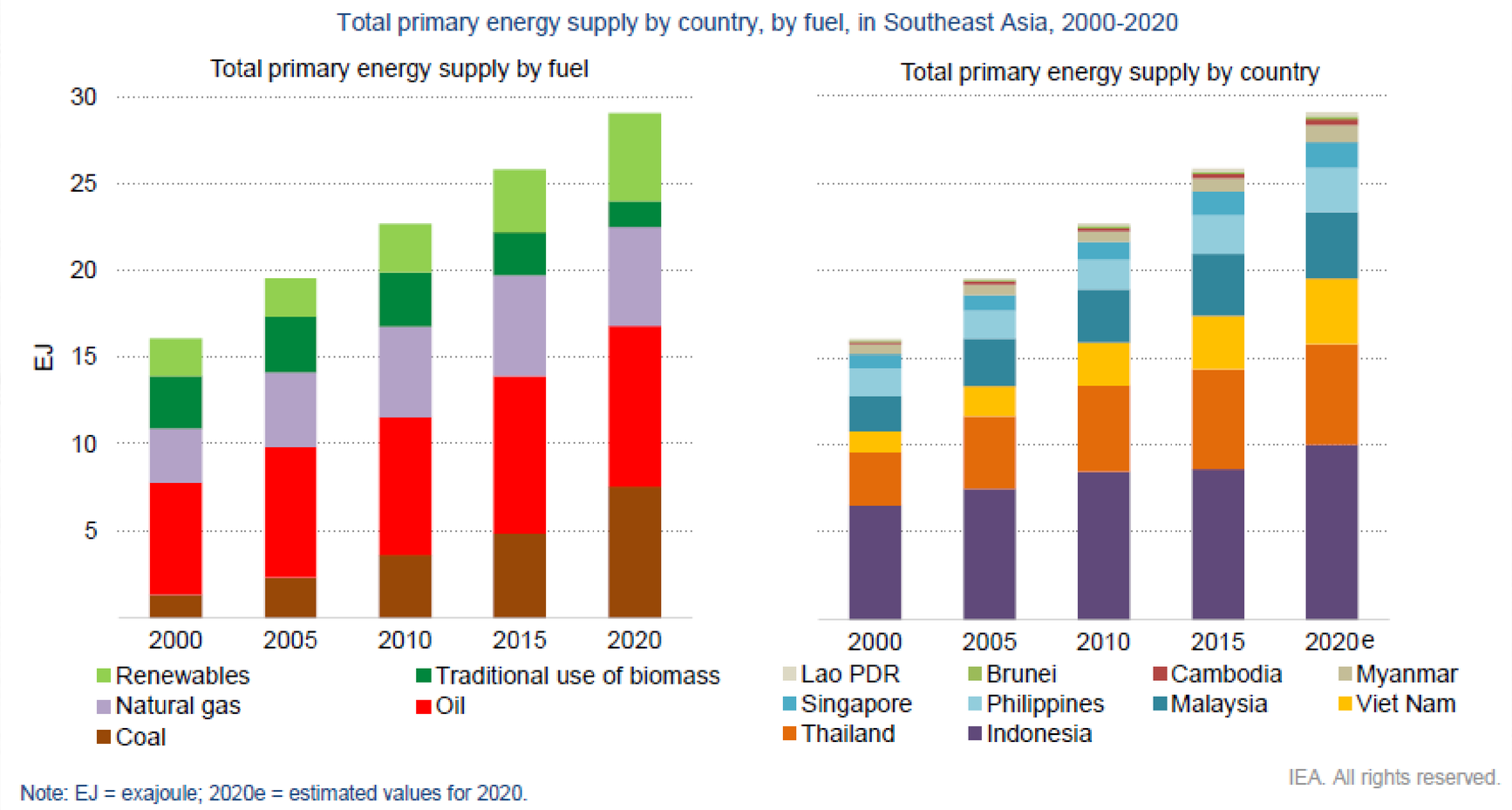
Power system costs
(reference vs carbon neutral)



- These investments are relatively evenly distributed across **cost efficient** and **mature low-carbon power supply technologies,** such as solar PV, battery storage, etc.
- Investment in **renewables and flexible technologies** leads to a change of cost structure and lower operational cost.
- **Investments** could come from both govenment and private sector.
- **Power system costs** will be less prone to the fluctuation of OPEX.

Source: Thailand's LTES study preliminary results (Please do not cite this unfinalized version)

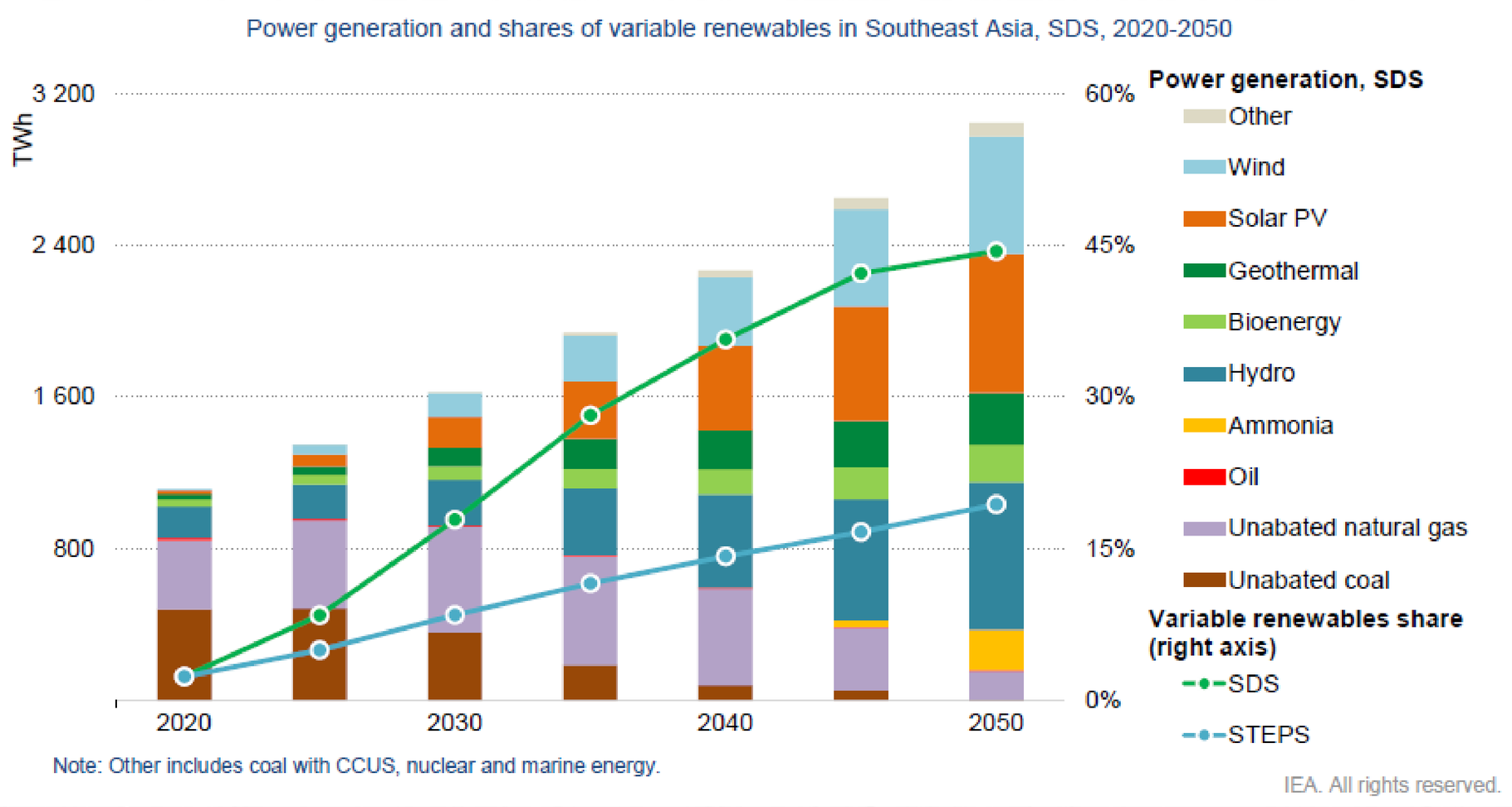
Southeast Asia's current primary energy supply at a snapshot



- Total primary energy supply in Southest Asia still relies heavily on oil, coal and natural gas, while renewable energy share is increasing
- Indonesia, Thailand, Vietnam and Philippines already consume more than 70% of primary energy supply

Source: IEA (2022)

Southeast Asia's power sector outlook



- High potential **growth of wind and solar PV** in the power generation shares in the next 30 years
- **Power flexibility** will be a higher priority for governments and regulators to accommodate the growing share of wind and solar

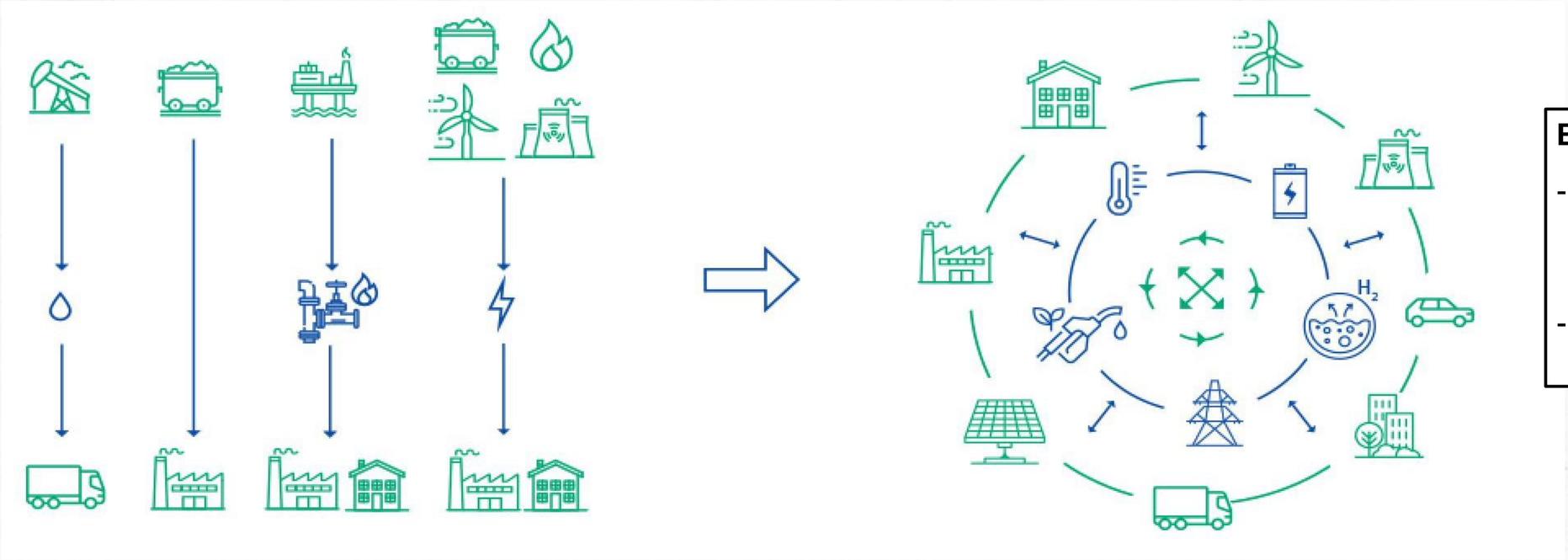
Source: IEA (2022)

Power sector transition as a key pathway

An integrated and holistic strategy places the power sector at the core of the transition

The energy system today:
Linear and wasteful flows of energy, in one direction only

Future integrated energy system:
Energy flows between users and producers, reducing wasted resources



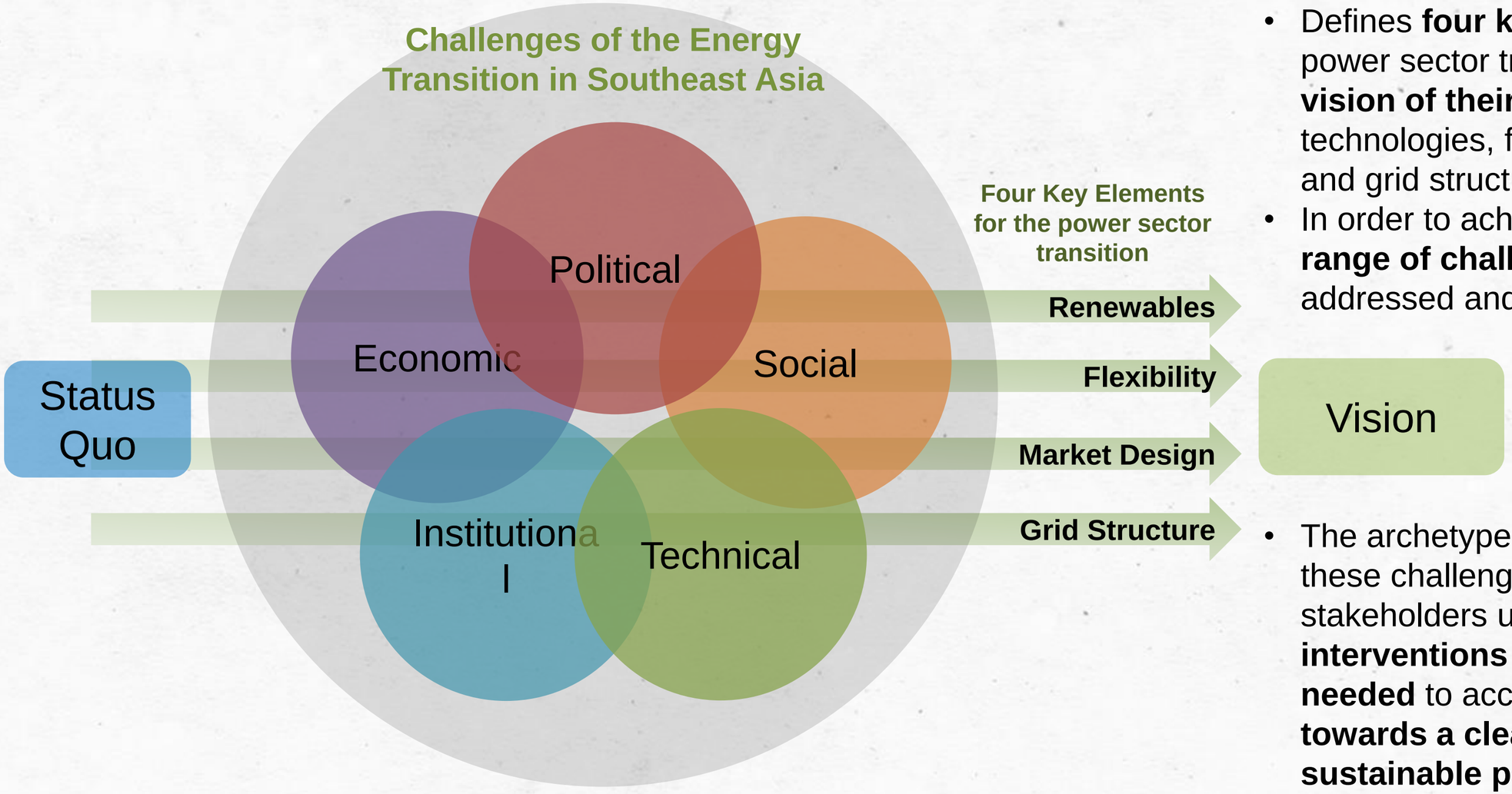
Electricity as the backbone:

- direct use where possible (electric transport, heat pumps, …)
- indirect use (synthetic fuels) elsewhere

Source: FSR EUI

What is the archetype pathway?

From status quo to long term vision



- Defines **four key elements** of the power sector transition **and the vision of their future state**: technologies, flexibility, market design and grid structure**.**
- In order to achieve this vision, a **range of challenges** need to be addressed and overcome.

- The archetype describes each of these challenges as a way to help stakeholders understand **where interventions and actions may be needed** to accelerate the move **towards a clean, affordable and sustainable power system**.

Vision insight: Thailand's energy transition

Common visions

Achieve **carbon neutral target** under National Energy Plan.

Ensure global **competitiveness of Thai industry with low-carbon content** and seize new opportunities to be a **front-runner** energy hub in the region

Ensure the use of **cost-efficient technologies**, ensure **affordability** of electricity prices, **energy security** and **just socio-economic outcomes** of the energy transition.

"More than just mitigating climate change, we can design energy transition pathways for achieving visions we want"

Source: Summary from CASE TH's LTES study, gathering inputs from key stakeholders of the energy transition in Thailand

Visions for the power sector transition

From status quo to long term vision

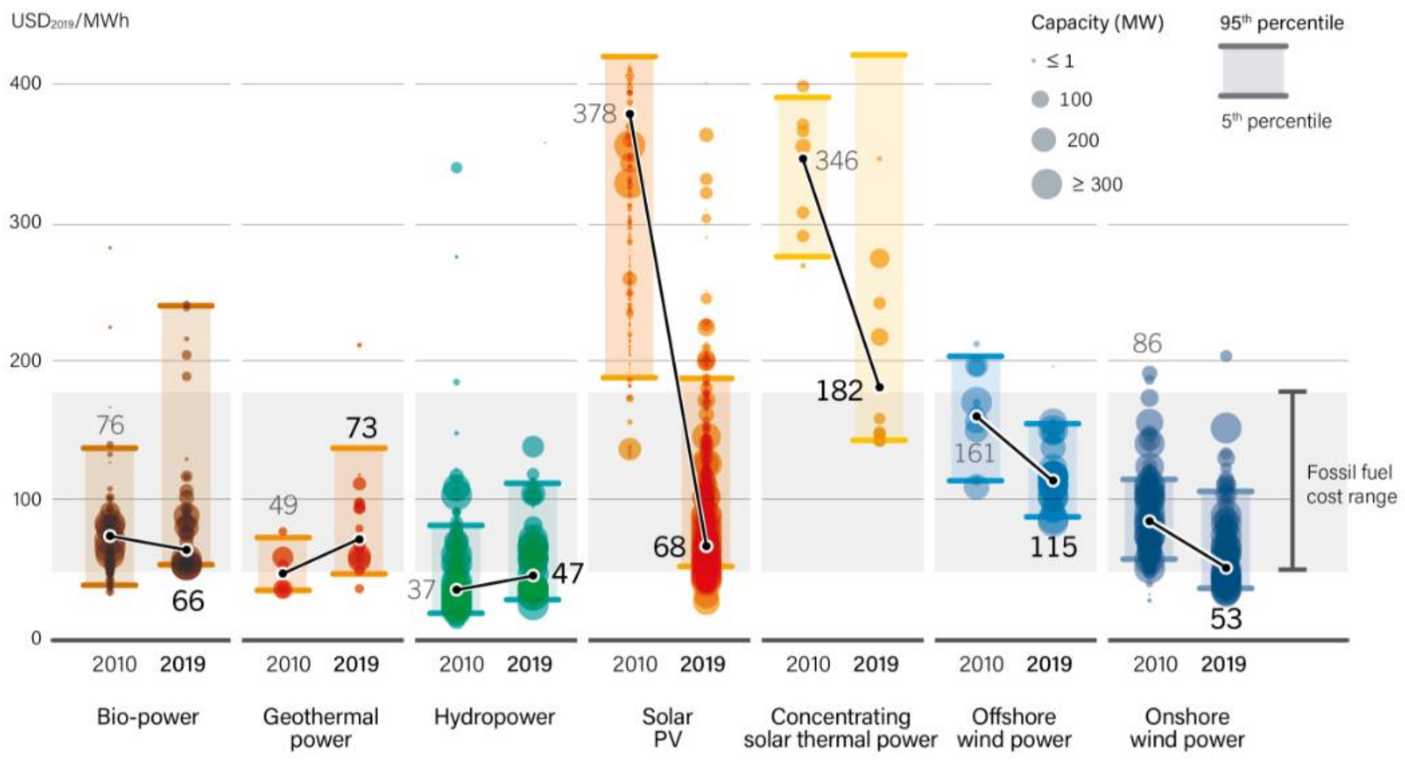
Status quo		Vision
Climate performance, security of supply and affordability of the power sector needs to be improved significantly		**In all CASE countries, a fully decarbonised, secure and affordable power system is operated.**
The power system is **dominated by large-scale fossil, nuclear and hydropower power plants.**	**Renewables** 	The power system is built around wind and solar, which are the **cheapest zero-carbon sources** of electricity.
The power system operates **with limited flexibility** as generation follows demand. Conventional power plants operate mainly as **baseload** plants.	**Flexibility** 	Power plants, electricity storage and demand are **operated flexibly**, and react to the availability of wind and solar.
'**Markets' and regulations** are designed to finance fossil/hydro/nuclear power plants and so **hinder renewables.** The economic efficiency of operating the power systems is limited, which leads to **higher costs for consumers** than necessary.	**Market Design** 	A set of **market mechanisms** provide **efficient signals** that ensures the system operates **at the lowest cost for consumers**.
Power transmission and distribution grid systems are designed in a **centralised** fashion**.**	**Grid Structure** 	Grid systems are **decentralised,** reflecting higher numbers of **distributed generation sources, and new electrified demand** in other end-use sectors such as transport, industry, and buildings.

Thank you

Backup Slides

Vision element 1: Renewables

The (future) power system is built around wind and solar



Global levelized cost of electricity (LCOE) from newly commissioned, utility-scale renewable power generation technologies in 2010 and 2019. Fossil-fuel range between 50-177 USD_{2009} per MWh, lower bound represents new, coal-fired plants in coal-producing regions in China. Source: REN21, 2020 via IRENA, 2020.

- The (future) power system revolves around a combination of wind and solar…
- Already cheap and abundant, wind and solar costs are expected to continue to decrease.
- … complemented by other renewable and storage technologies…
- Hydropower, bioenergy and geothermal are also cost competitive and are poised to play vital roles by providing dispatchable power, other energy services for heating and transport, and other non-energy services (e.g., water storage and flood mitigation by hydropower). Their potential is relatively limited, however, due to concerns around environmental and social impacts or resource availability.
- …while other non-renewable options become prohibitively expensive.
- LCOEs of new nuclear or fossil-fuels coupled with carbon capture and storage are not cost competitive when compared with renewable energies.

Vision element 2: Flexibility

Power plants, demand and storage are operated flexibly and react to renewables variability

In a power system dominated by wind and solar…

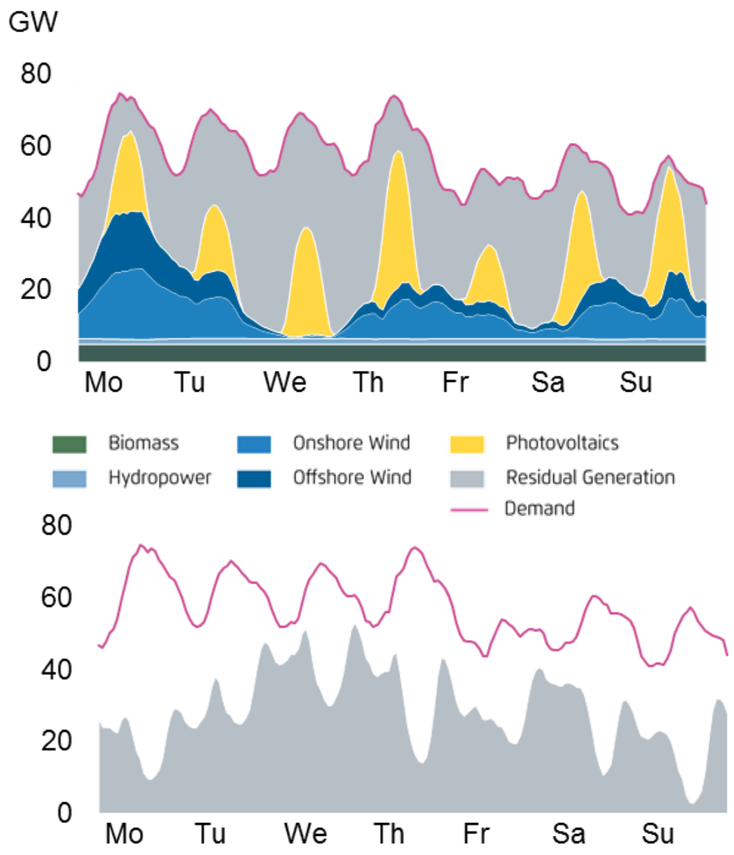
- Variable and intermittent by nature, wind and solar will add greater volatility and challenges to instantaneously matching supply with demand.

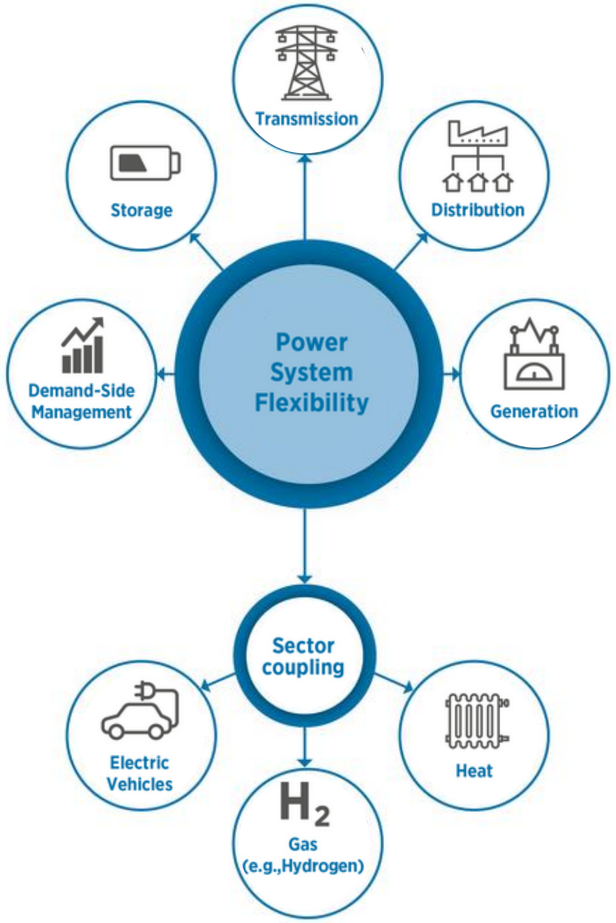
… system flexibility becomes the new paradigm…

- ‘Baseload’ operation is obsolete. Generators, storage and demand-sectors that can rapidly adjust operations according to system needs maintain system stability and reliability.

… and will rely on greater interconnectivity between and within power systems.

- ‘Smart’ sector coupling, e.g., electrification of demand sectors like transport, industry and buildings, will provide new sources of flexibility. Modern and interconnected transmission and distribution grids widen the area in which resources are shared.





Left Top: electricity generation and consumption in a sample week with 50% renewable energy share. Left Bottom: highlighting ‘residual’ generation, i.e., non-renewable generation. Source: Agora, 2016. Right: Enablers of power system flexibility in the energy sector. Source: adapted from IRENA, 2018.

Vision element 3: Market Design

M**arket and regulatory mechanisms** provide necessary signals that ensure the system operates **at the lowest cost**

In the new renewables-driven paradigm of decentralised resources, flexibility, and smart interconnected grid networks, electricity markets provide the signals needed to ensure system flexibility and long-term capacity investments at the lowest cost.

Although no two market designs are alike, for no two power systems are completely alike, a combination of long- and short-term markets are the basis of a cost-efficient market design:

- *Future market:* Most power volumes are traded here. The futures market is primarily used for price hedging.
- *Spot market: S*hort-term oriented to level out day-to-day needs.
- *Balancing market:* Even more short-term, helps to compensate for power and voltage fluctuations in the grid.

Markets are supported by policy and regulatory frameworks where needed and appropriate, for example:

- Financing renewable energies
- Energy efficiency standards
- Long-term infrastructure planning

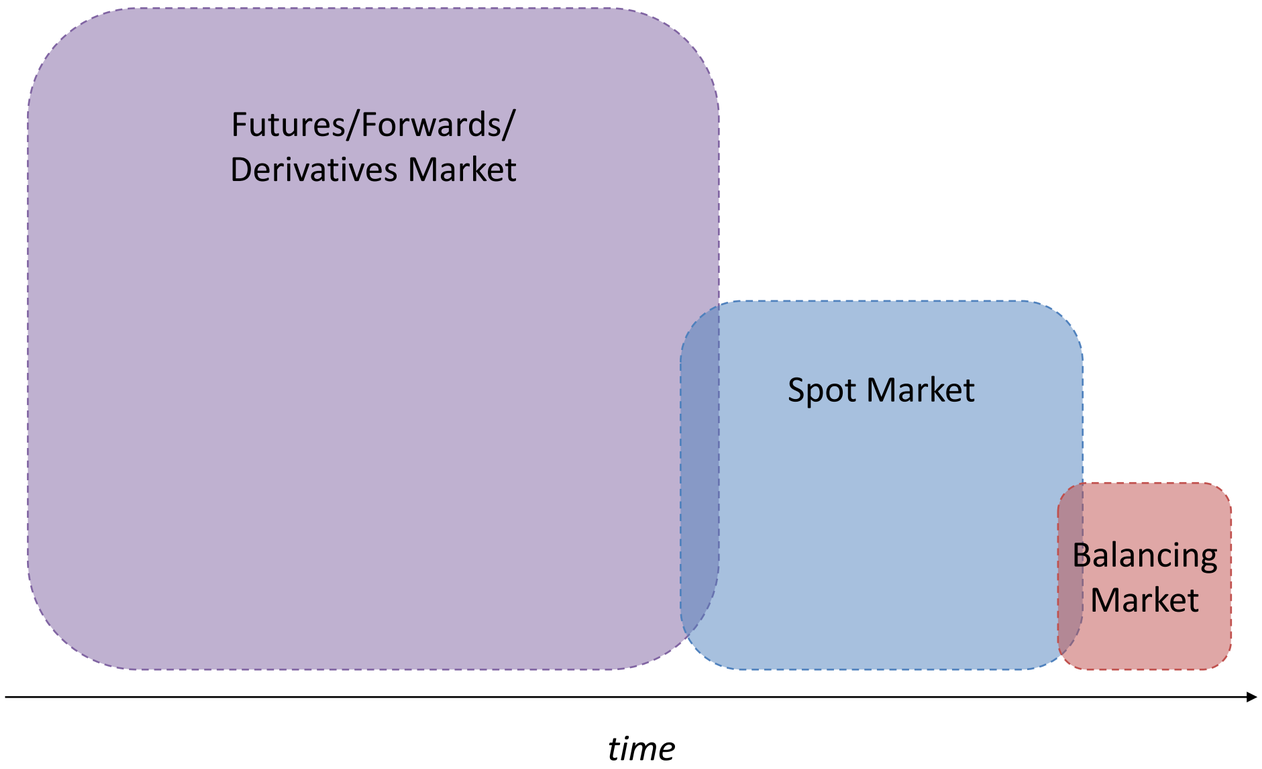
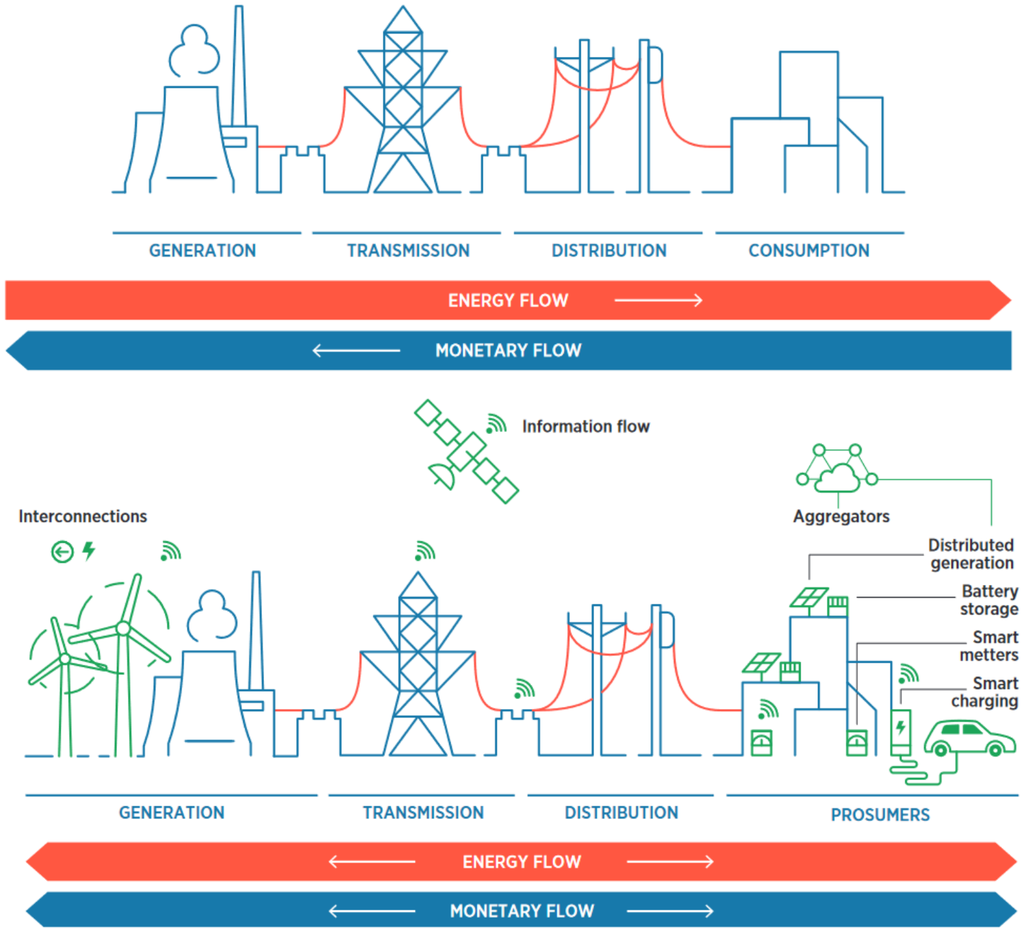


Illustration of the electricity market, which is made up of various submarkets, each with their own price signals. different markets. Size of square indicates volumes traded. Futures markets can be traded for multiple years into the future, whereas balancing markets happen at a sub-hourly scale.

Vision element 3: Grid structure

Relatively simple centralized grid systems evolve into complex decentralized and smart networks



Yesterday's (top) energy supply chain and transmission and distribution grid structures, and the Vision (bottom) with bidirectional flows of energy and money. Digitalisation permeates entire supply chain. Source: IRENA, 2019

- A power system based on renewables focuses on many more small, decentralised structures…
- As wind and solar resources are by nature less concentrated than fossil resources, yesterday's traditional transmission and distribution grid structure evolves from a centralized to a much more decentralized structure.
- … where grids play a more active role in providing flexibility …
- Long-distance interconnections and regional power trading enable power to be transported across a wider balancing area, allowing for a greater diversity of resources to balance supply and demand.
- … and manage complex bidirectional flows of energy and sector coupling with digital solutions
- As decentralized renewables feed into low-voltage distribution grids, transmission and distribution grids become bidirectional. Where power used to flow from major generators to consumers, active energy consumers, or 'prosumers', both consume and produce electricity and feed power back into the grid.
- The electrification of end-use sectors, e.g., of transport via electric vehicles, or of the heating sector, increases the complexity of the grid system. Digital solutions throughout the grid system help manage the complexity in the new ecosystem of power supply and demand.