Topic 4: Energy - Transition to Renewable Energy

Dr. Supawan Saelim

EE375 - Class lecture

Setting the scene for ‘Energy’

Global and national climate commitments:

The importance of carbon neutrality and net-zero goals

The importance of Energy Resource

https://cen.acs.org › energy › Natural-gas-... ▾ แปลหน้านี้

Natural gas shortages loom for Germany's chemical industry

The scarcity of Energy Resource

https://cen.acs.org › energy › Natural-gas-... ▾ แปลหน้านี้

Natural gas shortages loom for Germany's chemical industry

https://www.bloomberg.com › articles › n... ▾ แปลหน้านี้

Natural Gas Shortage Fears Buoy US Market as Winter ...

17 ส.ค. 2565 — Natural gas prices are flirting with levels not seen in the US in almost 15 years amid mounting concerns that robust domestic and overseas ...

https://www.cnn.com › lng-global-winter-shortage-europe

Europe's scramble for gas could cause the next energy shortage

30 พ.ค. 2565 — Europe's scramble to find alternatives to Russia's natural gas is pushing the world to the brink of a winter energy shortage, with the worst ...

https://www.sciencedirect.com › article › pii · แปลหน้านี้

Oil scarcity: What have the past three decades revealed?

โดย GC Watkins · 2006 · อ้างโดย123 — Oil shortages have been predicted over the past 30 years. In fact, oil is more plentiful now in an economic sense than in 1973.

https://www.api.org › blog › 2021/02/24 ▾ แปลหน้านี้

Is the World About to See an Oil Shortage?

24 ก.พ. 2564 — It's possible we could be headed for a shortfall in global oil ... of the 2020 COVID-19 recession that oil shortages are thought unlikely.

https://www.reuters.com › business › energy · แปลหน้านี้

Halliburton says the world is entering a period of oil scarcity

6 ธ.ค. 2564 — Oilfield services firm Halliburton on Monday said the world was headed for a period of oil scarcity following years of underinvestment in ...

https://indianexpress.com › ... › Columns ▾ แปลหน้านี้

Somit Dasgupta writes: Avoiding the coal scarcity trap

10 มิ.ย. 2565 — Somit Dasgupta writes: While the government is taking steps to increase coal imports, it must ensure that domestic production does not dip ...

https://www.bbc.com › news › world-asia-... ▾ แปลหน้านี้

Coal shortage and heatwave spark India's power woes - BBC

8 พ.ค. 2565 — Last October, India teetered on the brink of a power crisis when stocks at more than half of the country's 135 coal-fired plants ran critically ...

https://timesofindia.indiatimes.com › articl... ▾ แปลหน้านี้

Coal scarcity a clear and present risk, says Crisil report

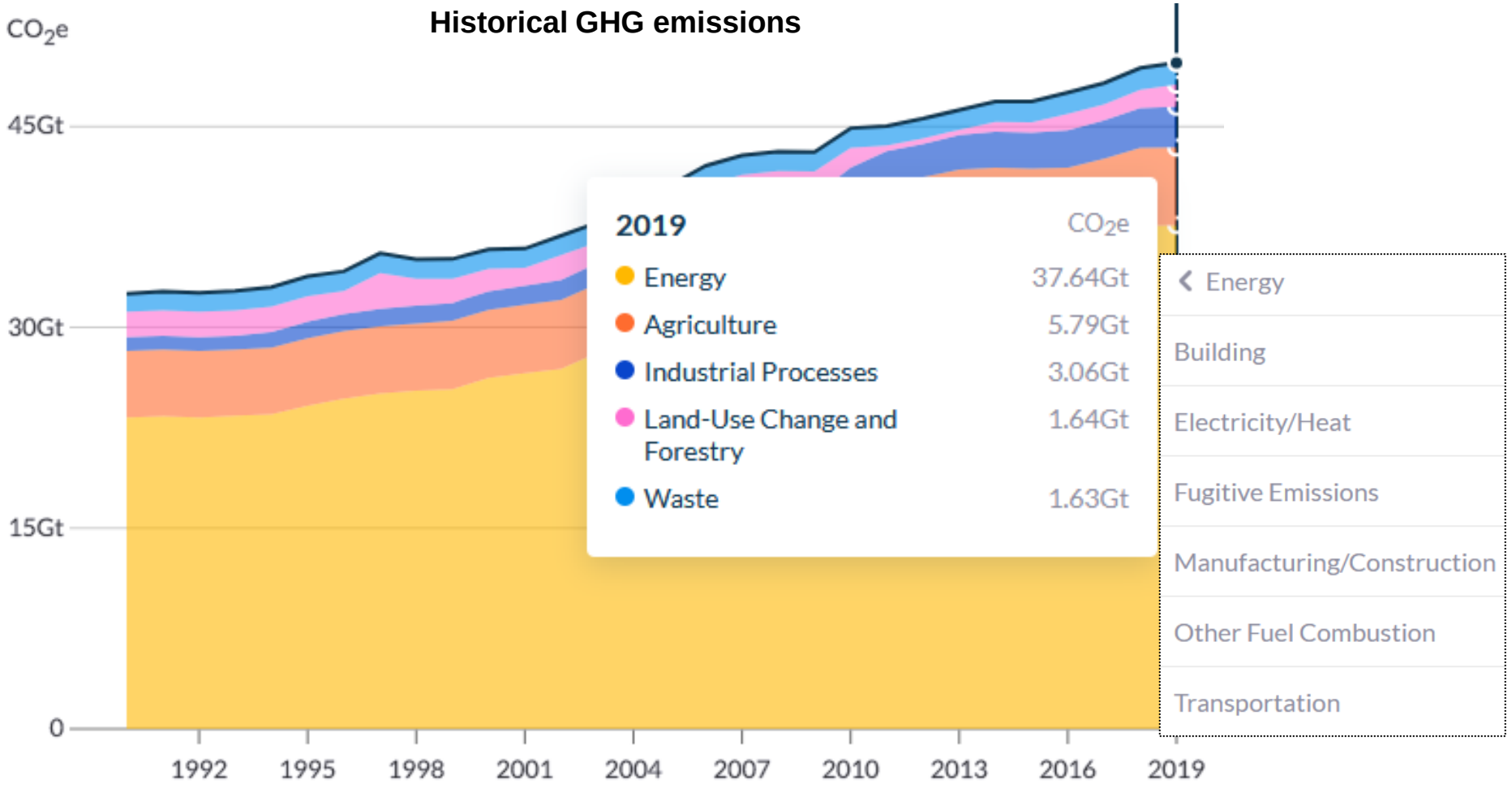
22 ต.ค. 2564 — NEW DELHI: Coal shortage at several power plants continues to linger despite record production by state-run producer Coal India.

https://cwts.ugm.ac.id › Home › Op-Ed En ▾ แปลหน้านี้

Getting to Know The Cause of Cooking Oil Scarcity in Indonesia

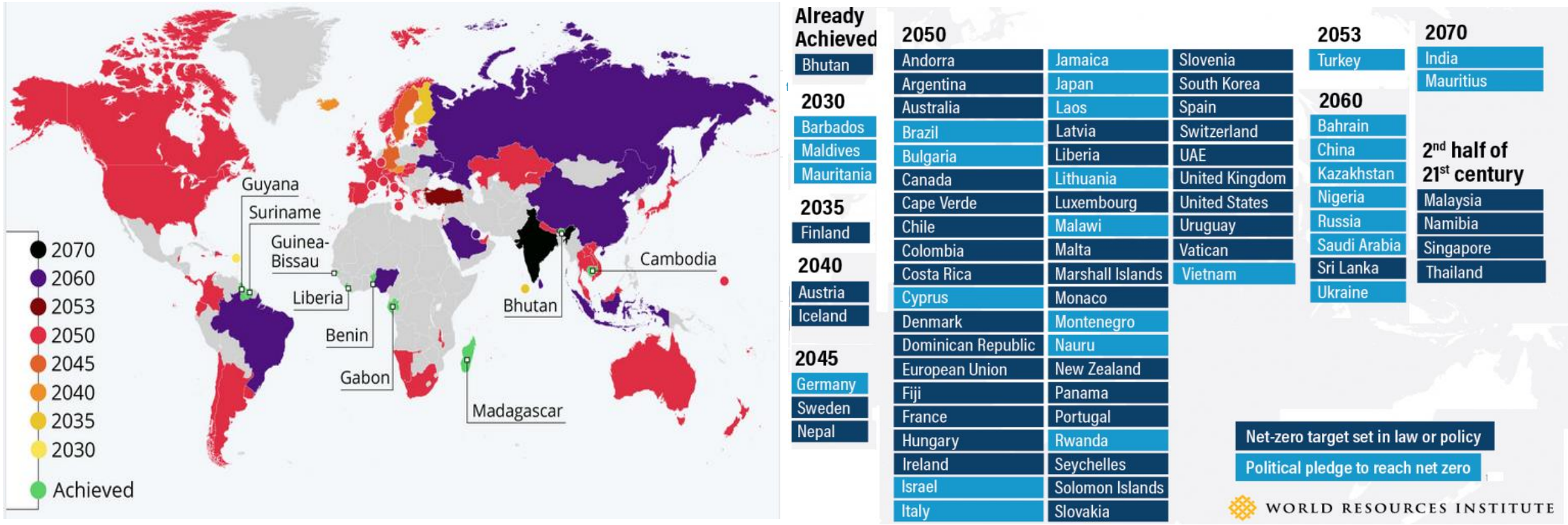
6 มี.ค. 2565 — The high demand and decreasing supply of cooking oil resulted in scarcity and an increase in cooking oil prices in most regions in Indonesia ...

75% of global GHG emissions come from energy sector– with electricity and heat generation the largest emitting sector



Source: Climatewatch Data

More countries have committed to carbon neutrality and net-zero goals



- As of 2021, there are **74 countries** announced commitments to achieve net-zero emissions. Most of them aims for achieving the targets by 2050.
- The year **2021 is the year of net-zero commitment** with over 29 countries recently pledged to net-zero target this year.
- The **pathways to achieve net-zero** will become increasingly relevant at both global and national levels

Source: Energy & Climate Intelligence Unit, illustrated by Statista

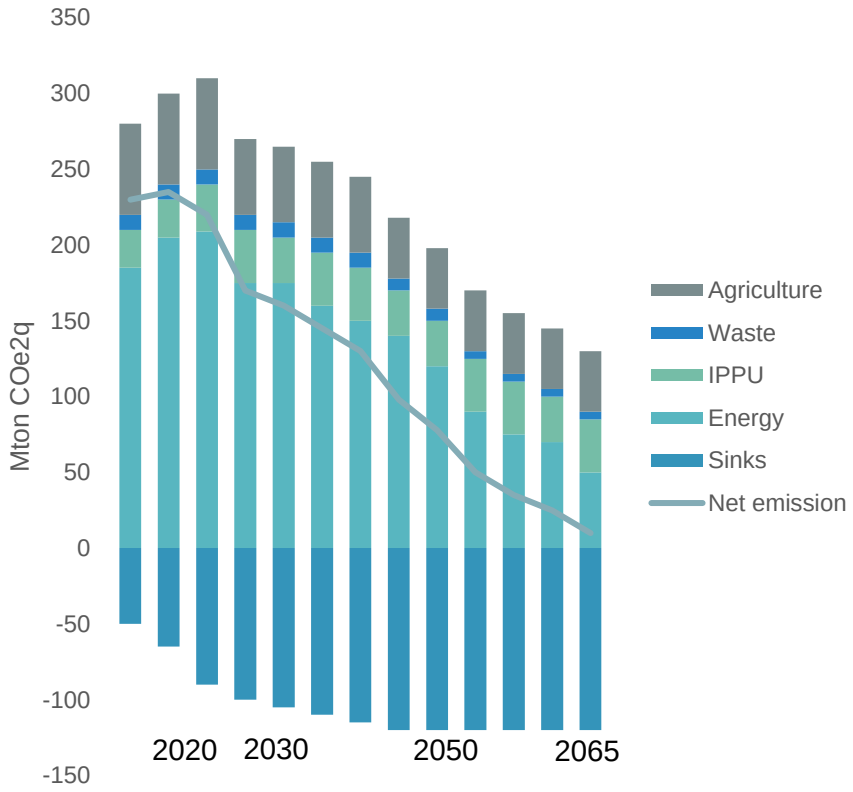
Thailand announced to achieve carbon neutrality and net zero goals and revised its National Energy Plan 2022

National Energy Plan 2022:
Policy directions for 5 energy action plans

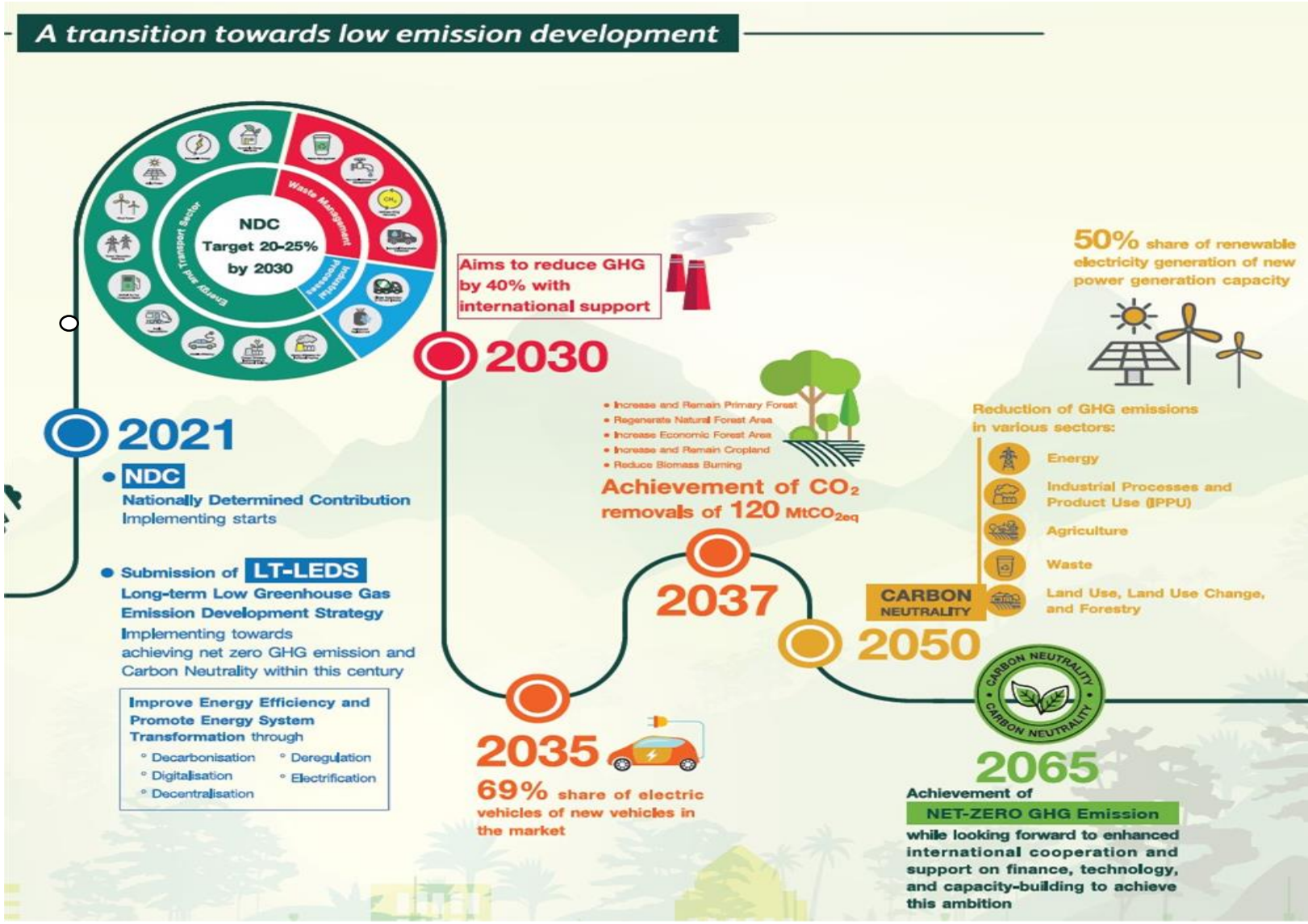
- Three main common **energy-sector transition strategies** to all net-zero pathways

Pillars of energy decarbonization		
Increase renewable energy in the power sector	Electrify of end-use sectors such as transport and industry sectors	Increase energy efficiency

Transitioning towards low emission energy system plays key role in achieving the climate goals



Source: LTS Thailand, 2021



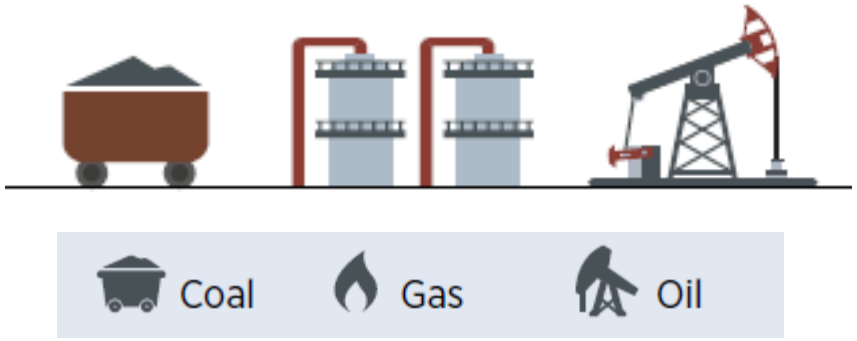
Source: Thailand Long Term GHG Emission Strategy, 2021

Transition to Renewable Energy

From Fossil Fuels to Renewable Energy

What is Renewable Energy?

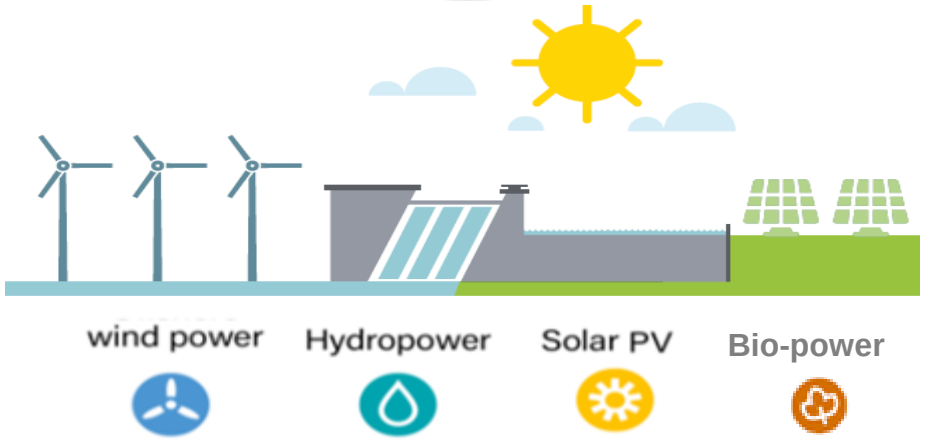
Fossil Fuels



- A one time resource (Projected to be depleted in the next 50 to 100 years)
- Global warming and air pollution

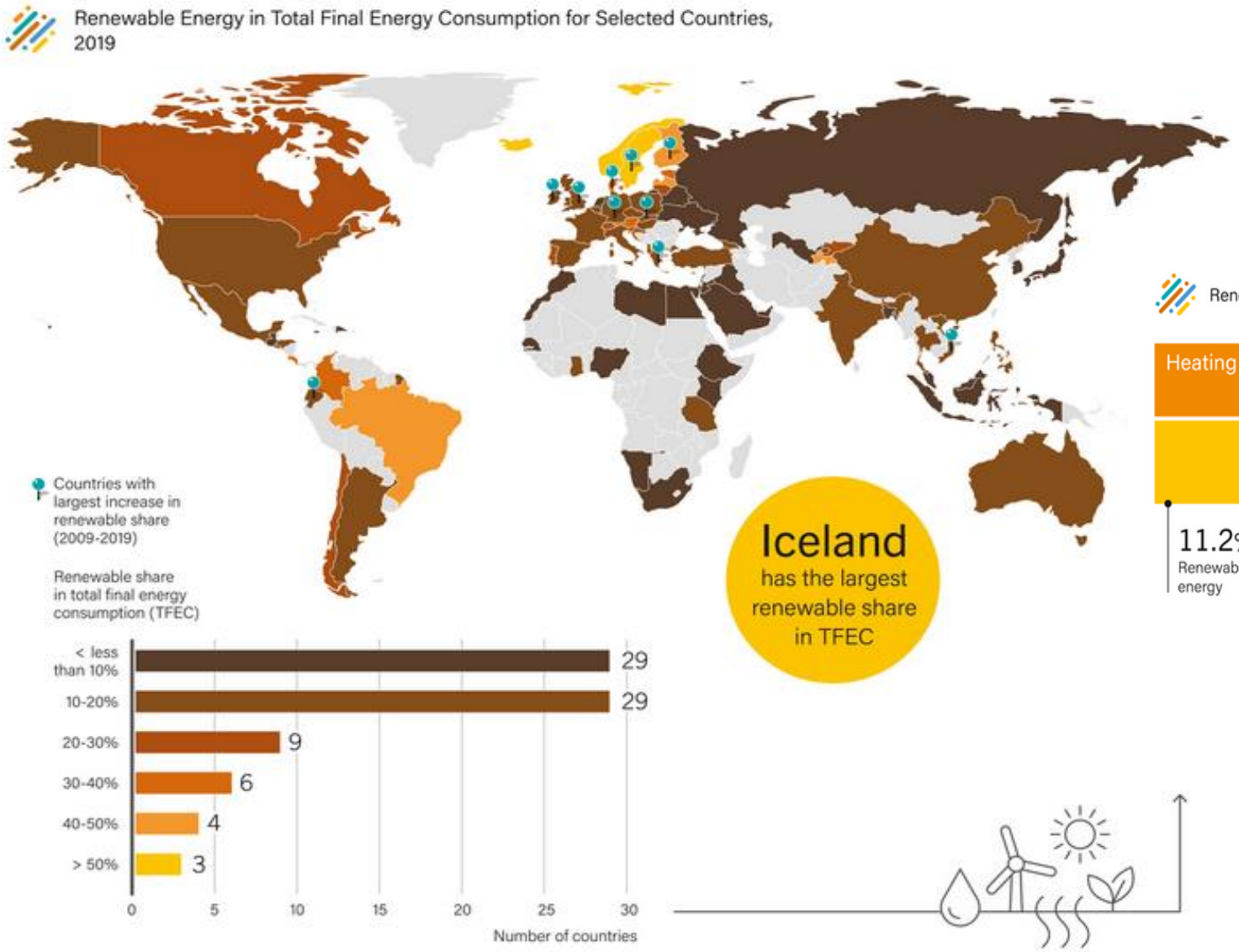
Energy Transition

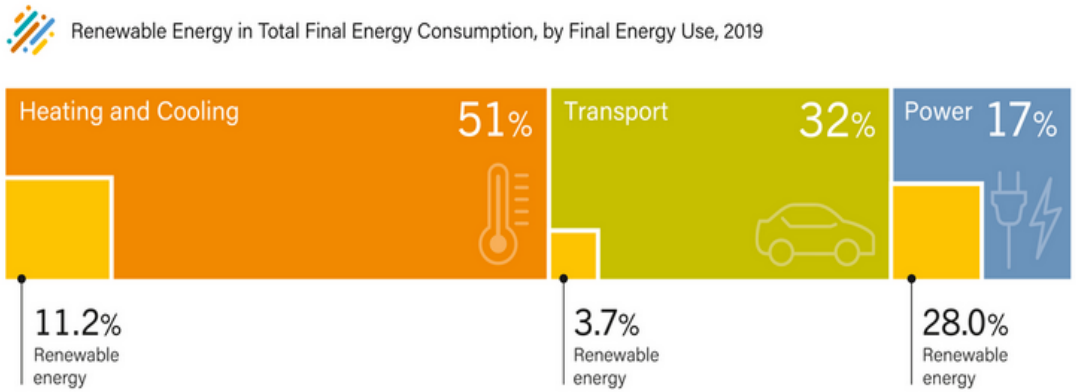
Renewable Energy



- Replenish natural resources
- Emits no or low emissions
- Job Creations

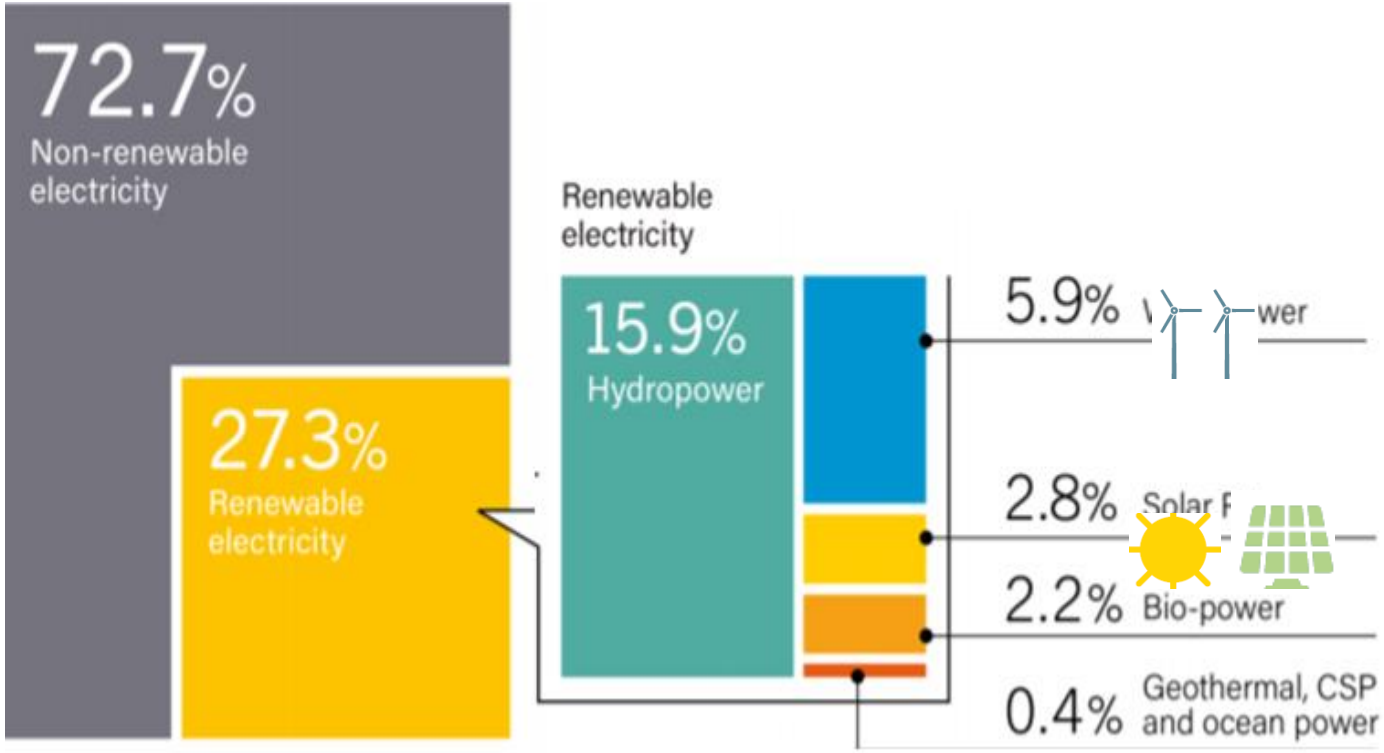
Global Renewable Energy Share





Note: This figure includes a selection of 80 nations among the largest energy-consuming countries in the world.
Source: Based on IEA data.

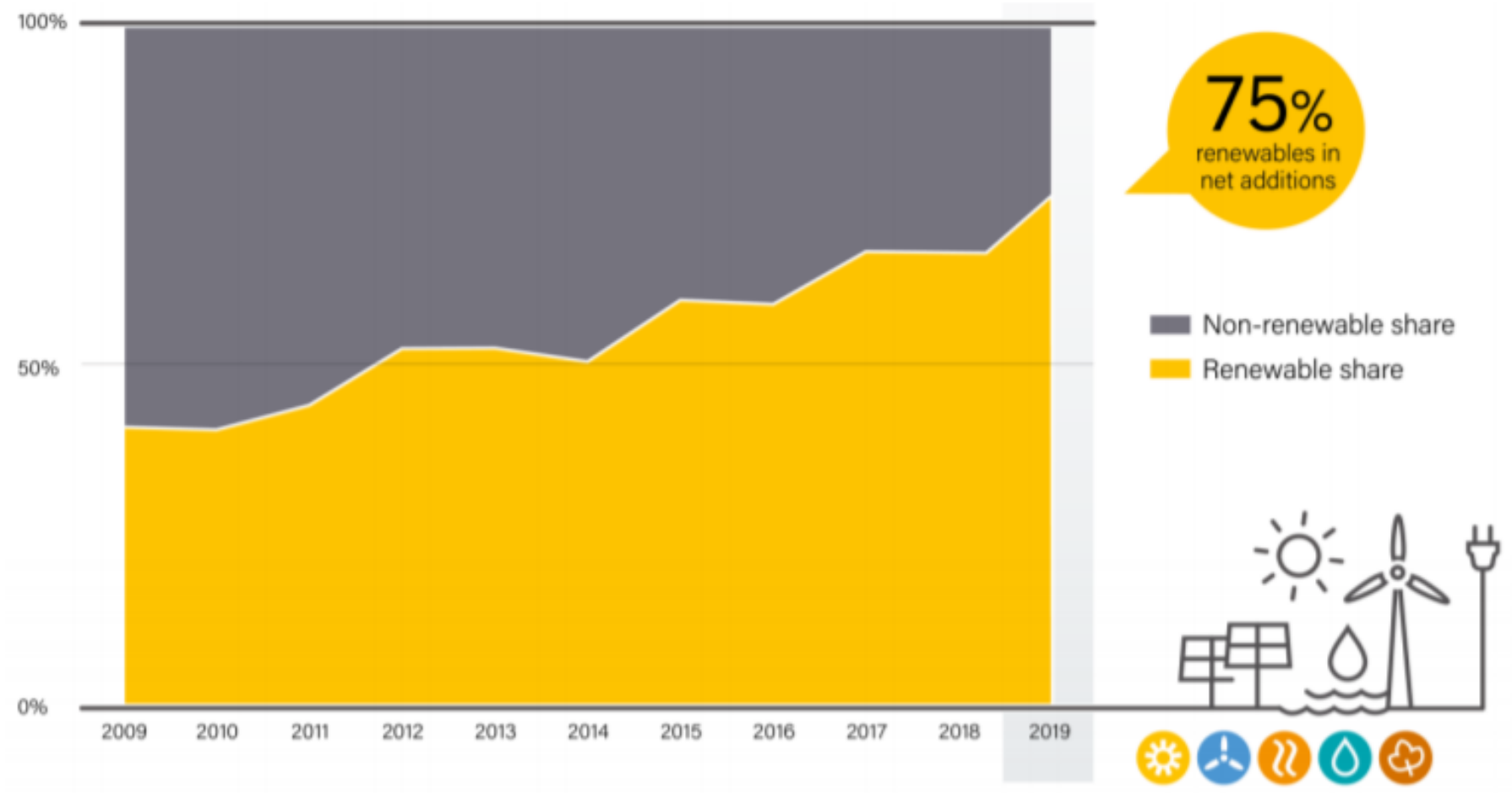
Renewable Energy Share of Global Electricity Production in 2019



POWER GW	2019
Renewable power capacity (including hydropower)	**2,588**
Renewable power capacity (not including hydropower)	**1,437**
Hydropower capacity[2]	**1,150**
Wind power capacity	**651**
Solar PV capacity[3]	**627**
Bio-power capacity	**139**
Geothermal power capacity	**13.9**
Concentrating solar thermal power (CSP) capacity	**6.2**
Ocean power capacity	**0.5**

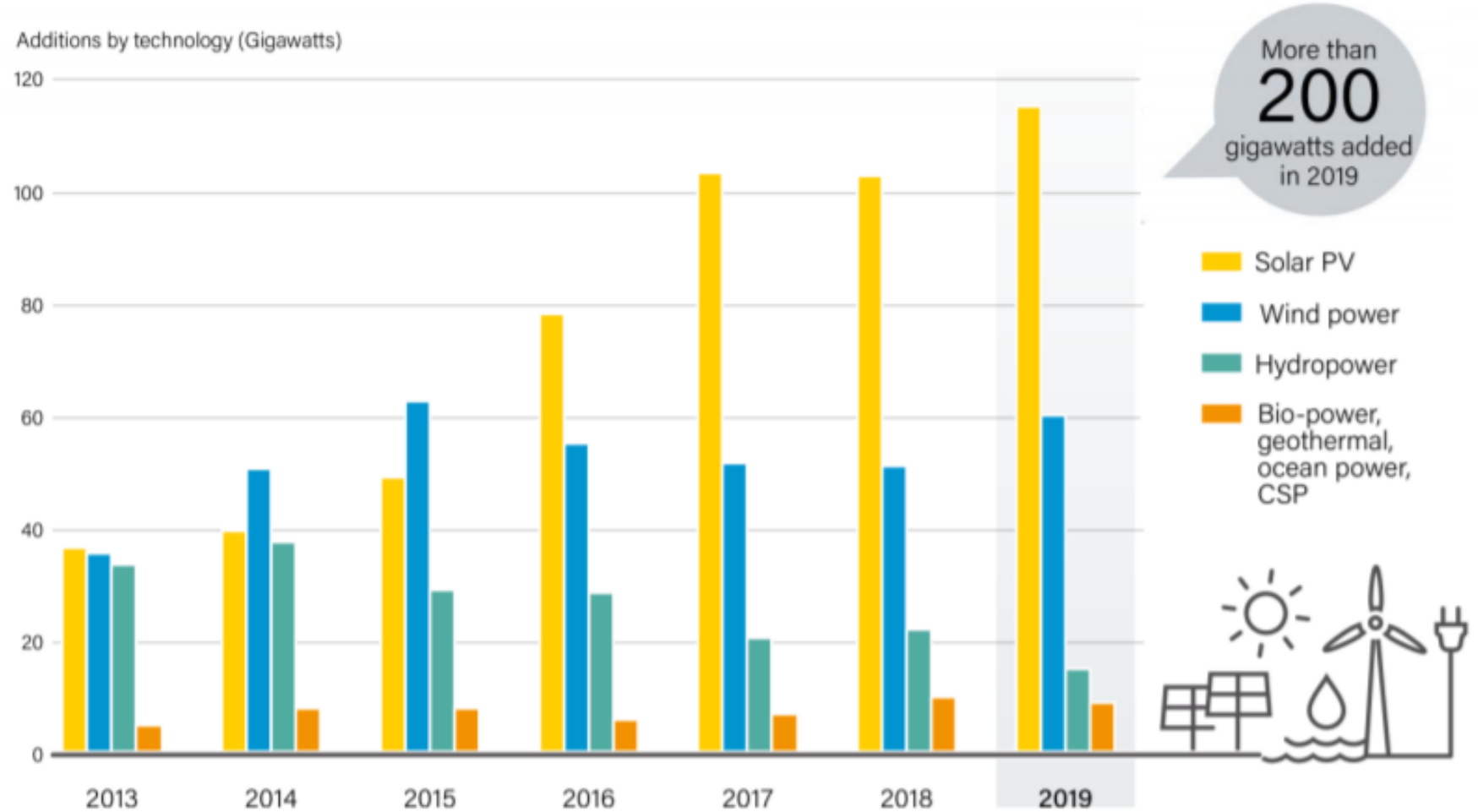
Source: REN21 (2020)

Increase of Renewables in Net Additions of Power Generation Capacity, 2009-2019



Source: REN21 (2020)

Annual Additions of Renewable Power by Technology, 2009-2019



Additions by technology in 2019:

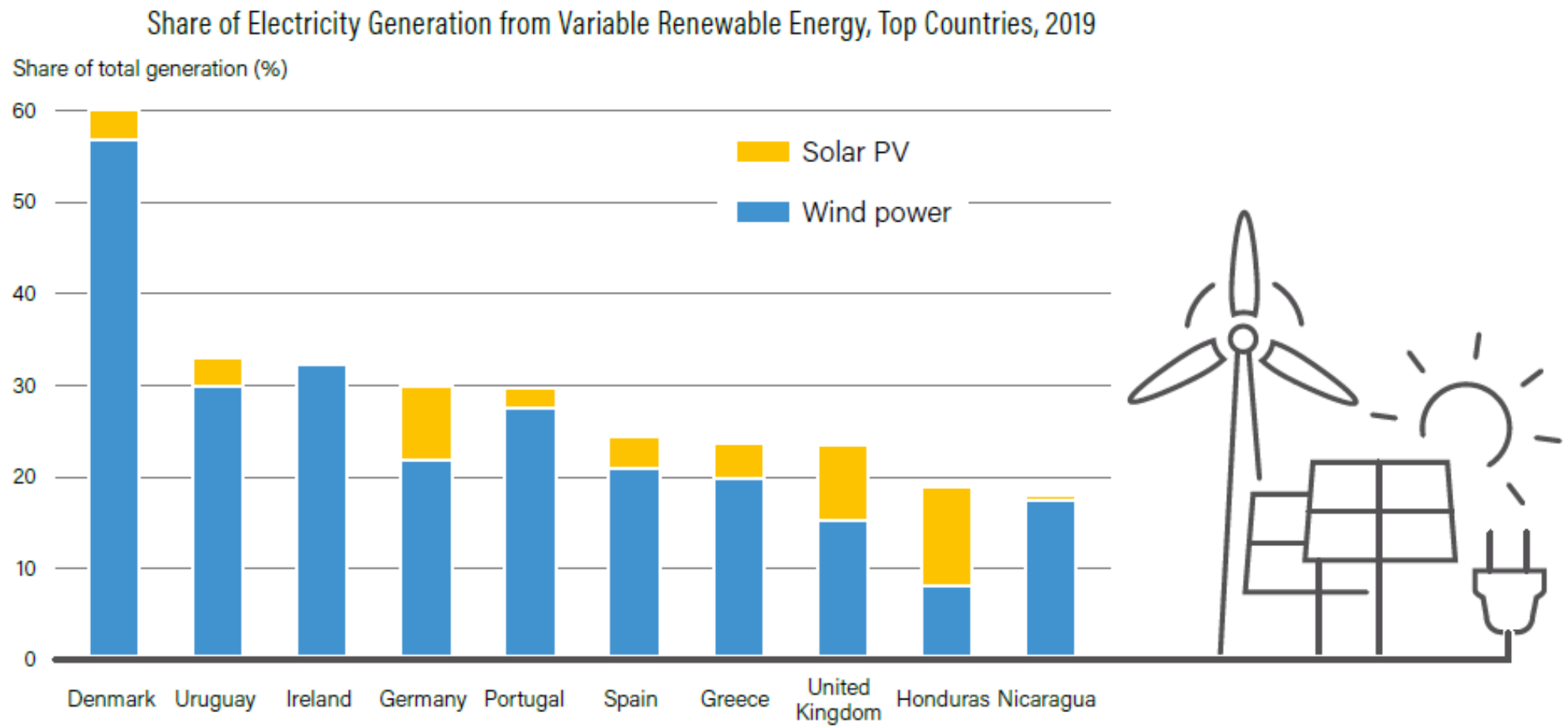
Solar: 115 GW

Wind: 60 GW

Hydropower: 16 GW

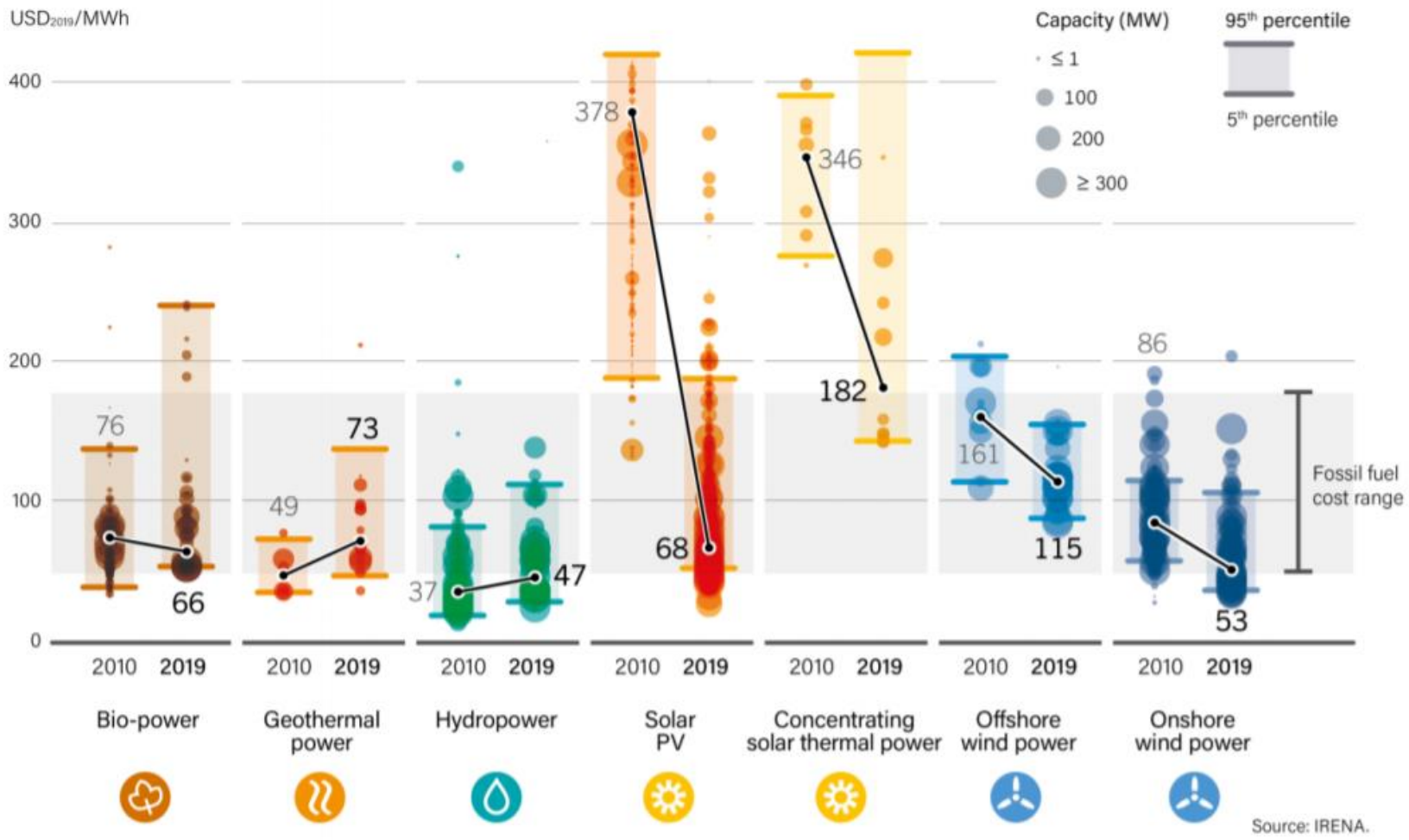
Source: REN21 (2020)

Countries with High Share of Renewables



Source: REN21 (2020)

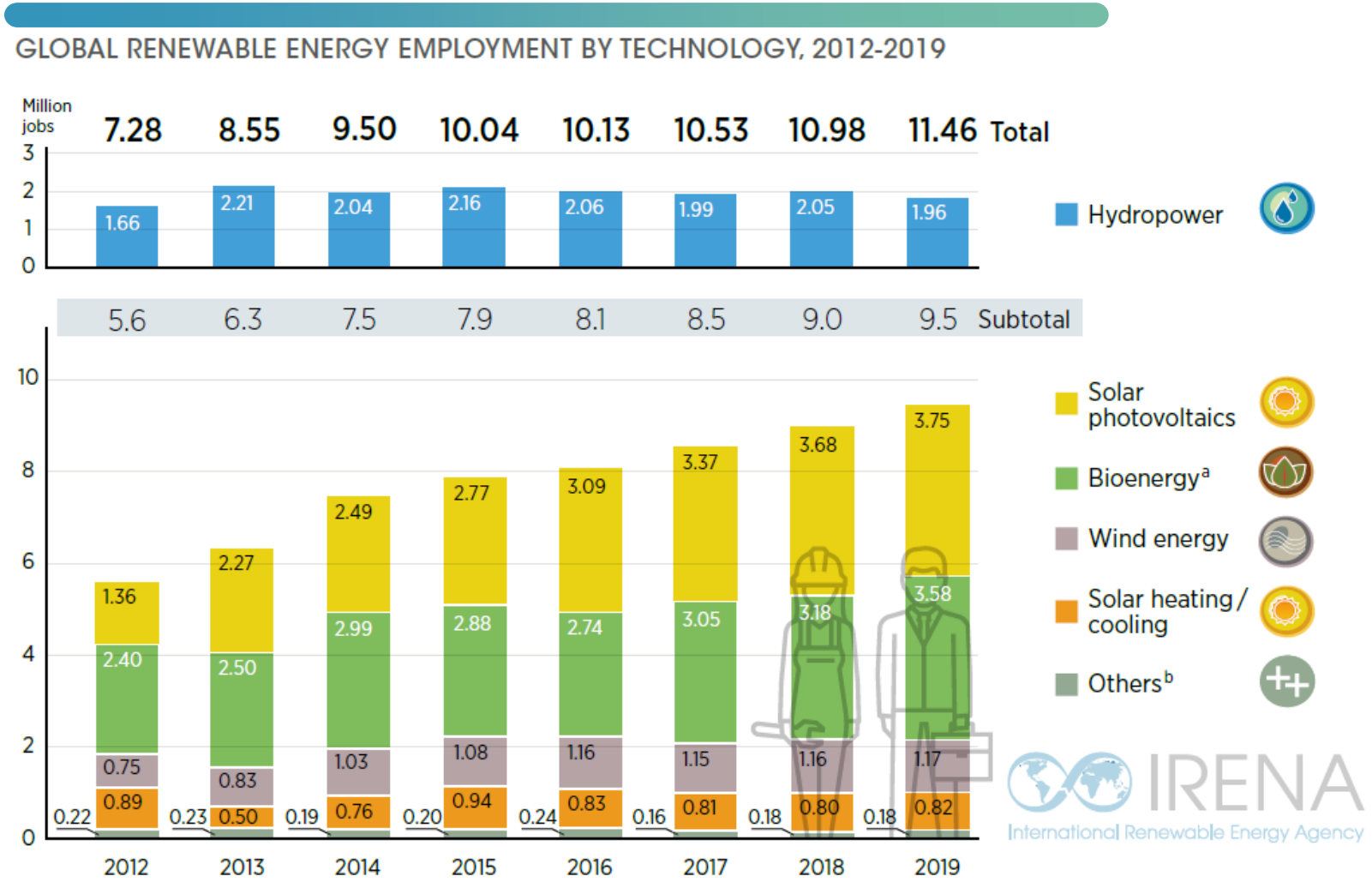
Declining Costs of Renewable Power Generation



Note: Global levelised cost of electricity (LCOE) from newly commissioned, utility-scale renewable power generation technologies, 2010 and 2019

Source: REN21 (2020)

Increasing Renewable Energy Employment



KEY NUMBERS

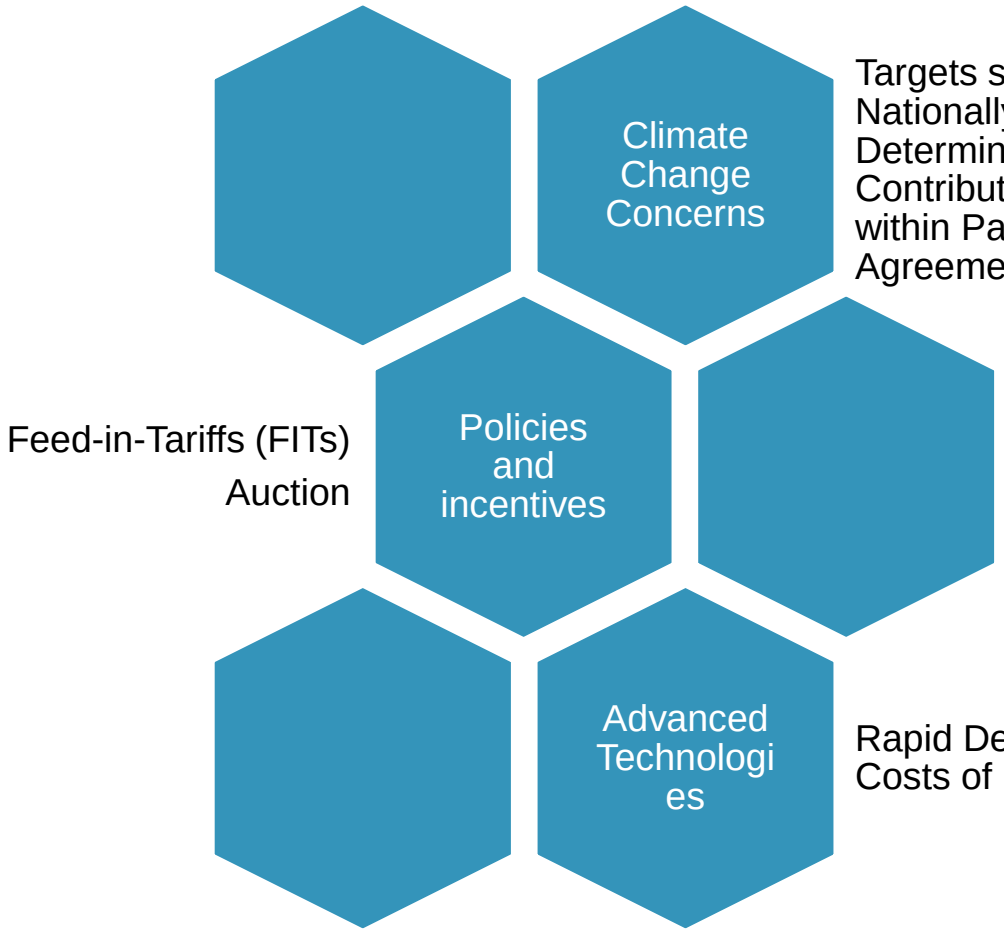
11.5 million renewable energy jobs in 2019

38% in China

3.8 million in the solar PV industry

Source: IRENA (2020) – Renewable Energy And Jobs: Annual Review

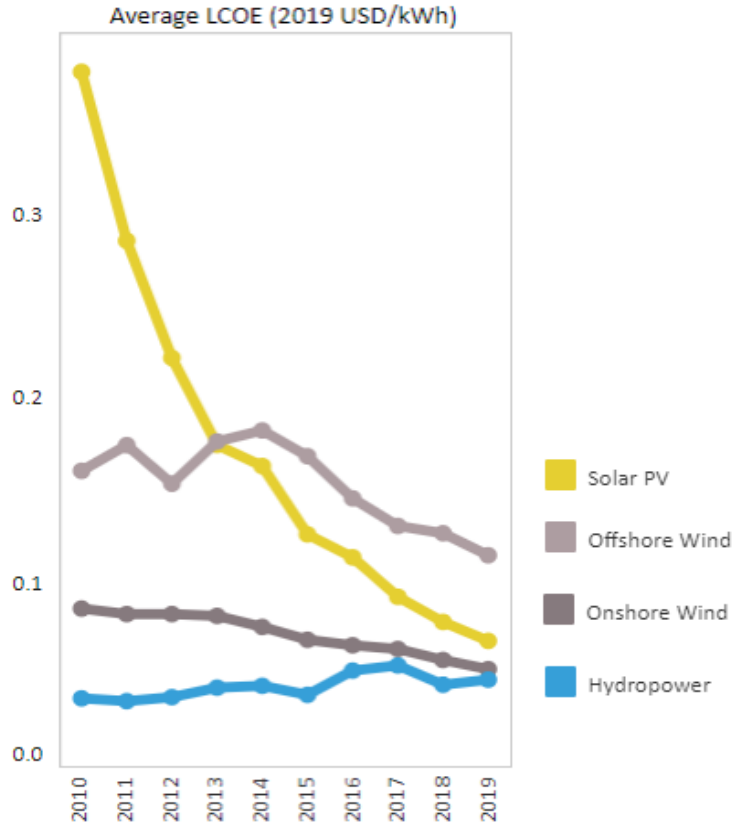
2. Drivers of Renewable Energy Growth



Targets set under Nationally Determined Contributions (NDCs) within Paris Agreement

Feed-in-Tariffs (FITs)
Auction

Rapid Declining Costs of Renewables



Renewable Energy Supporting Policies and Incentives

ASEAN countries		RE Targets	FIT	Self-consumption scheme	Competitive Bidding (or Auction)	Tax incentive	Soft loan	Capital subsidy	Tradable RECs
BRUNEI		✓							
INDONESIA		✓	✓	✓	✓	✓	✓		
MALAYSIA		✓	✓	✓	✓	✓	✓		
MYANMAR		✓				✓			
PHILIPPINES		✓	✓	✓		✓			✓
SINGAPORE		✓			✓	✓			
LM Countries	CAMBODIA				✓	✓			
	LAO PDR	✓				✓			
	THAILAND	✓	✓	✓	✓	✓	✓	✓	
	VIETNAM	✓	✓	✓		✓			

Note: ✓ means the RE targets or incentives or auction has been implemented in the country.

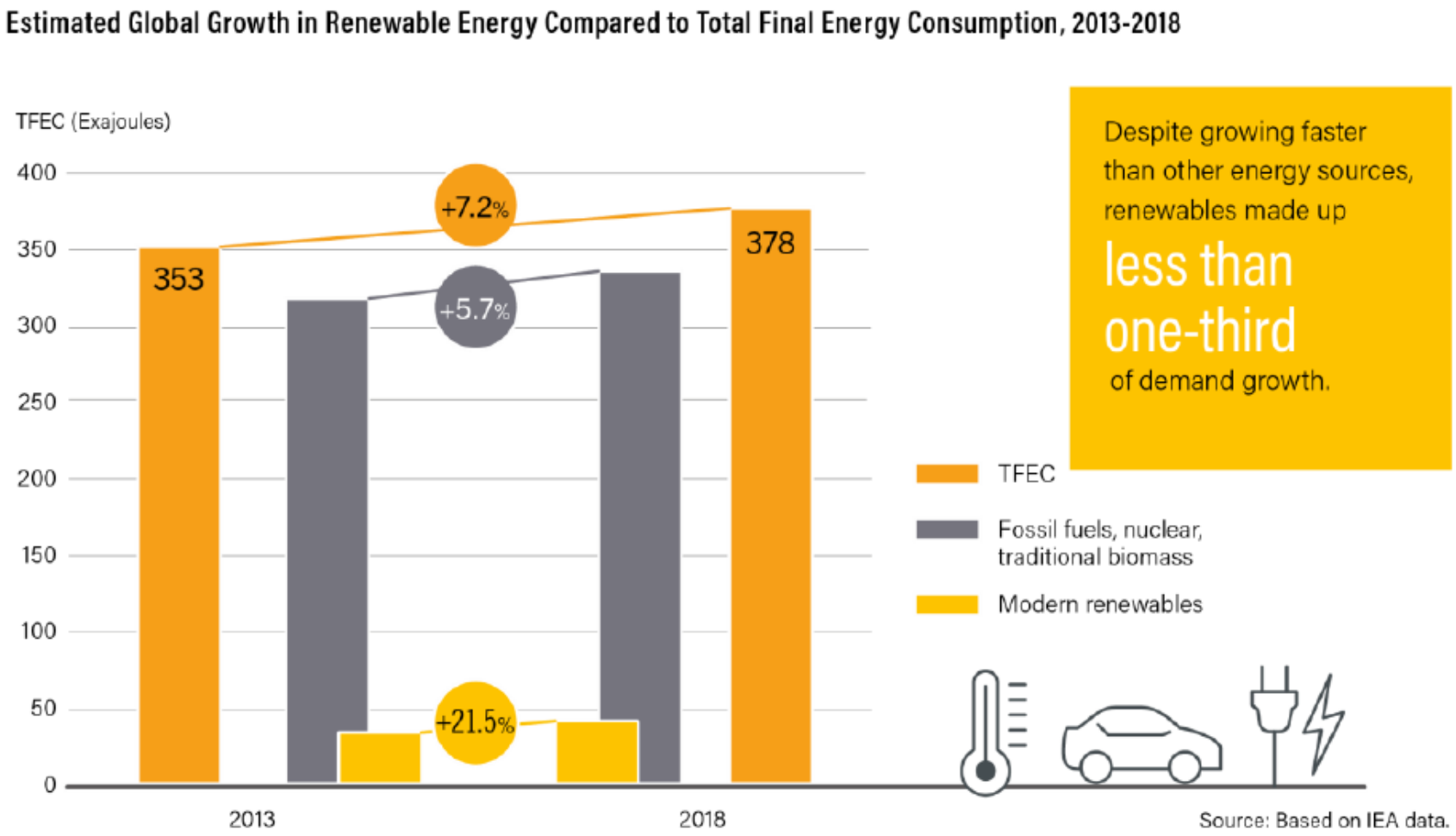
Source: USAID Clean Power Asia data collection

What is FITs

- FITs offers a guaranteed purchasing price for a specified period of time.
- For example, a fixed tariff is set for the purchase rate of electricity at a certain constant level which is independent from the fluctuation of market price for electricity throughout the support duration (e.g. 20 years)

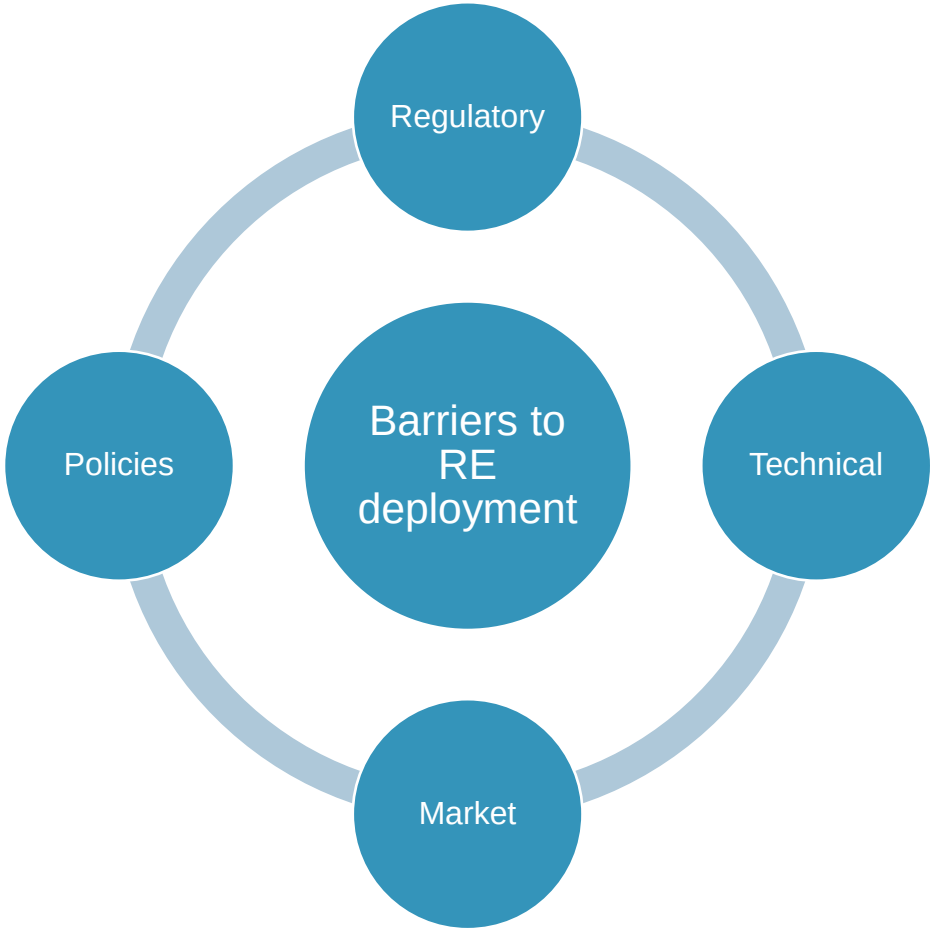
Source: USAID Clean Power Asia (2017). DESIGNING RENEWABLE ENERGY INCENTIVES AND AUCTIONS: LESSONS FOR ASEAN

Renewable Energy are Growing Fast.. But not Fast Enough



Source: REN21 (2020)

Barriers for RE Development



Regulatory barriers

- Insufficient legal framework for independent power producers
- Restrictions on siting, construction, transmission access
- Grid interconnection requirement

Policy barriers

- Subsidies to fossil fuels
- Unfavorable pricing rule

Market barriers

- Lack of experience, technical and commercial skills
- Perceived technology performance uncertainties and risk

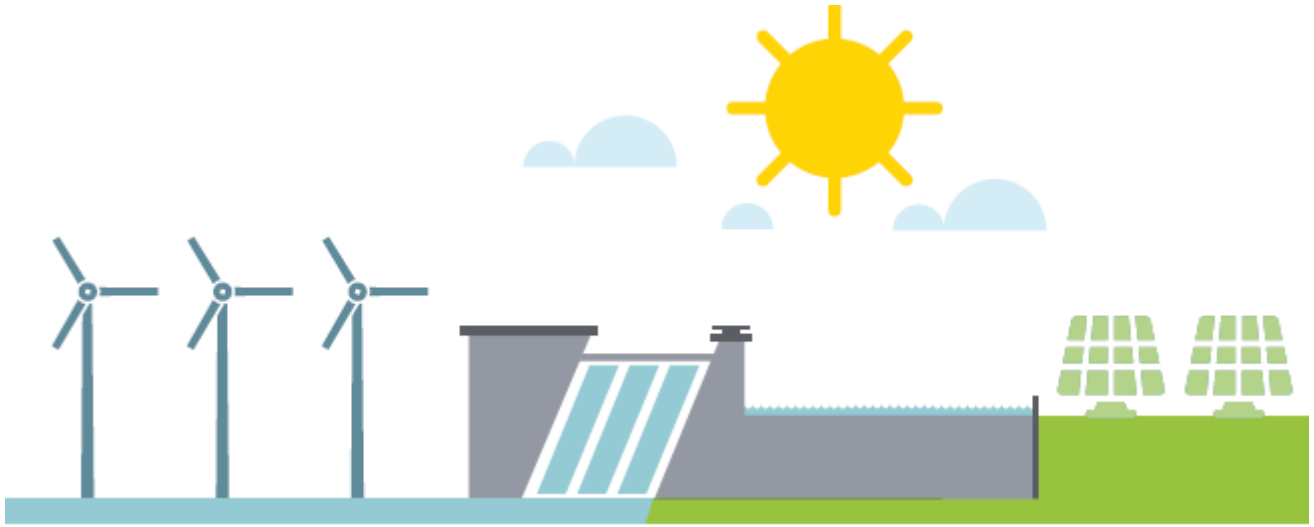
Technical barriers

- Integrating high penetration of VRE to the grid

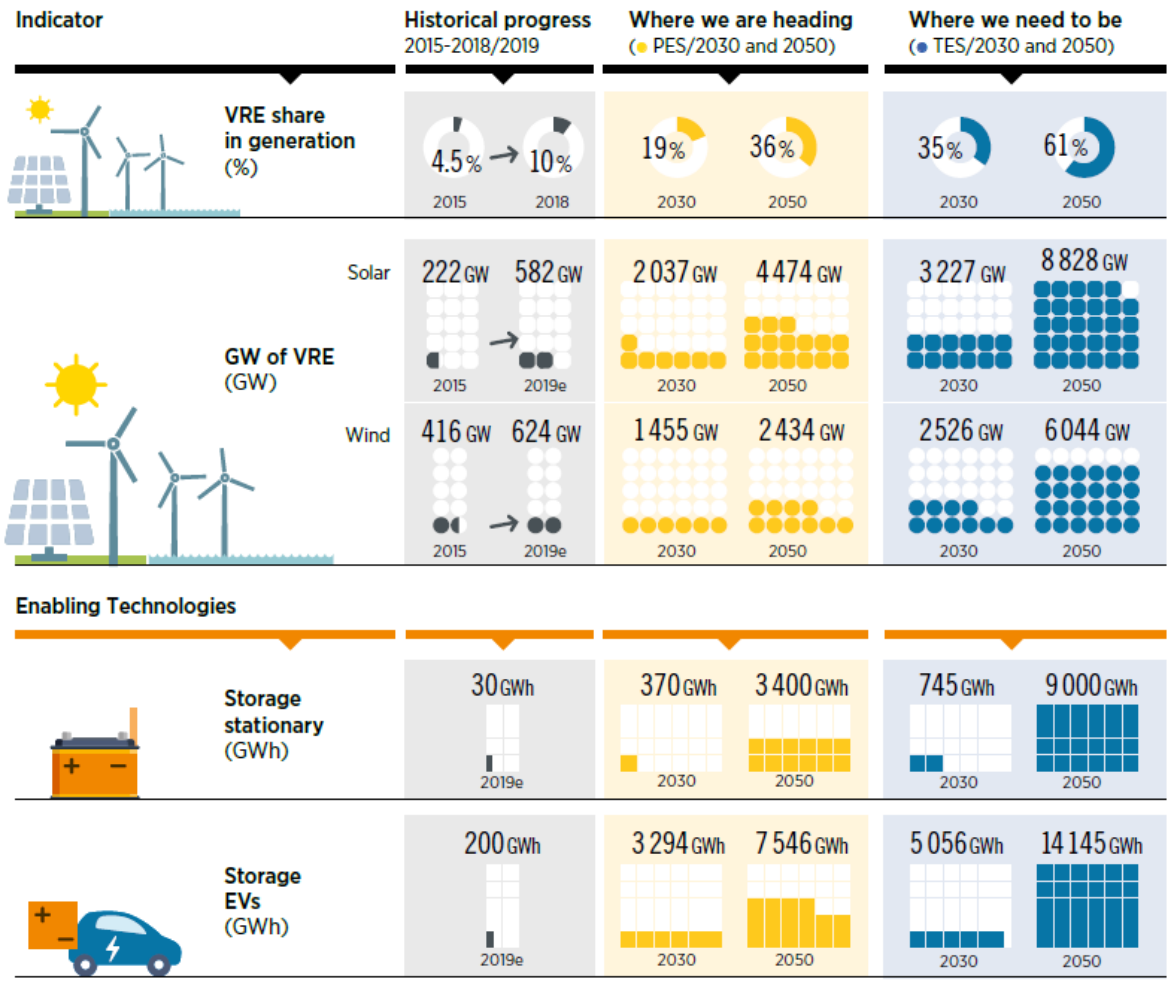
Source: IRENA (2017). “Rethinking Energy 2017: Accelerating Global Energy Transformation”

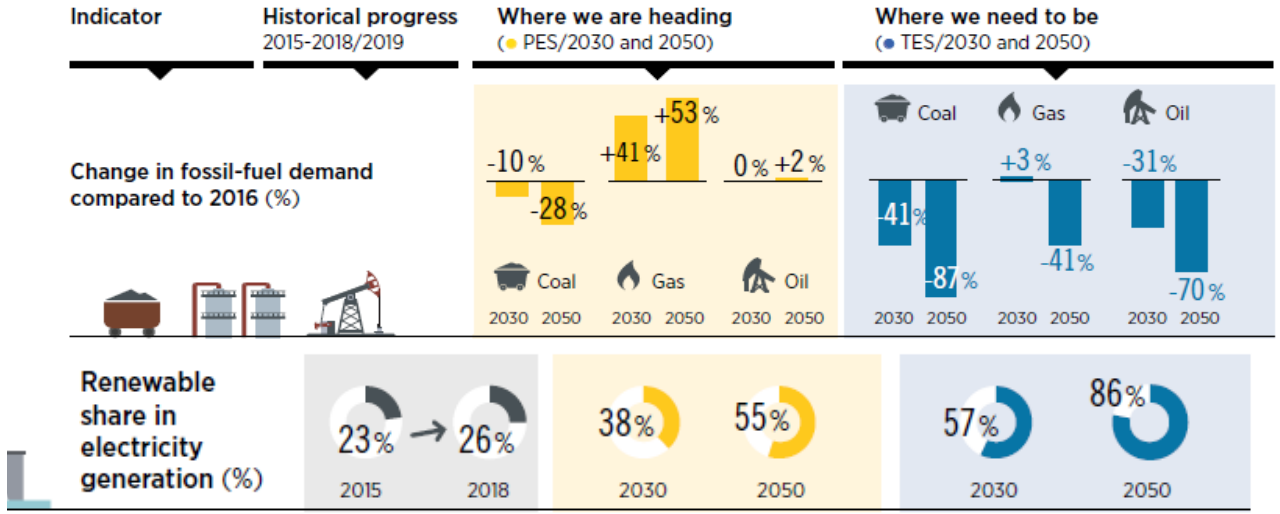
4. Global Renewable Energy Outlook

- Key indicators to global renewables outlook in 2050
- Outlook for Transforming Energy Scenario to achieve climate goals
- Global Socio-economic Impact of Transformation Energy Scenario



Global Renewables Outlook: Key indicators



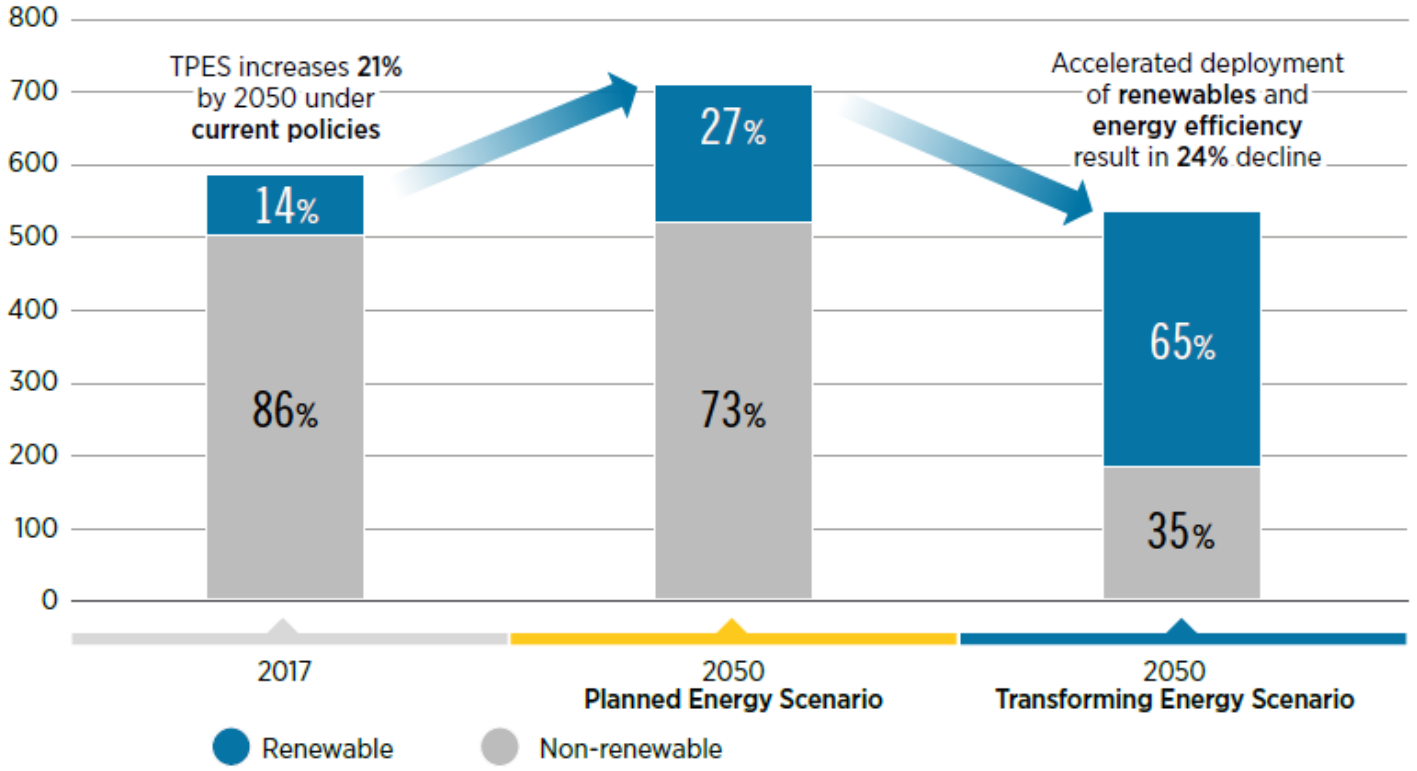


Source: IRENA (2020). Global Renewables Outlook

Global Renewable Outlook: Transforming Energy Scenario to achieve climate goals

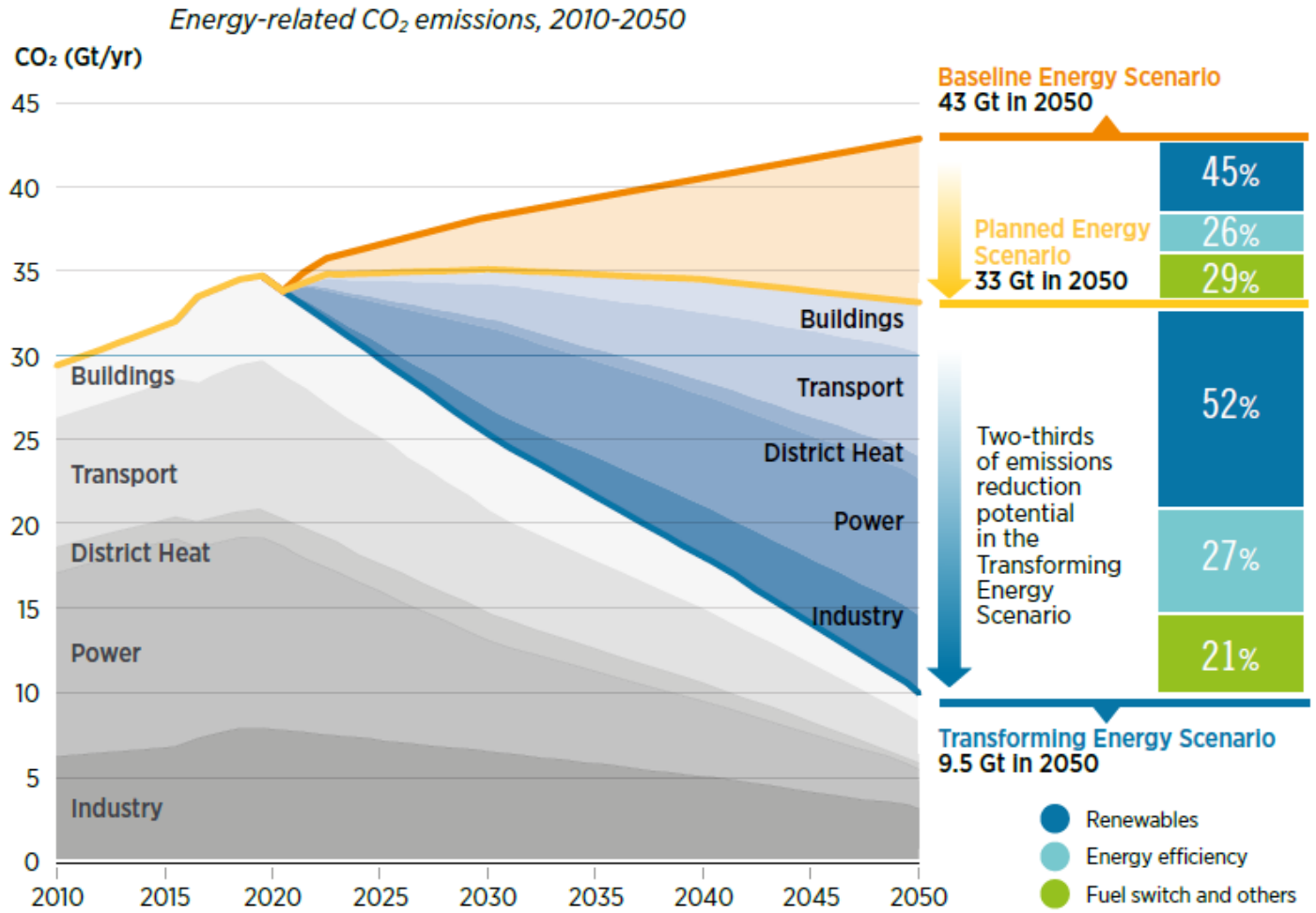
To meet agreed global climate goals, renewables would need to provide two-thirds of the world's energy supply

Total primary energy supply, renewable and non-renewable share, for the Planned Energy Scenario and the Transforming Energy Scenario, 2017, 2050



Source: IRENA (2020). Global Renewables Outlook

Emission Reductions under Transforming Energy Scenario

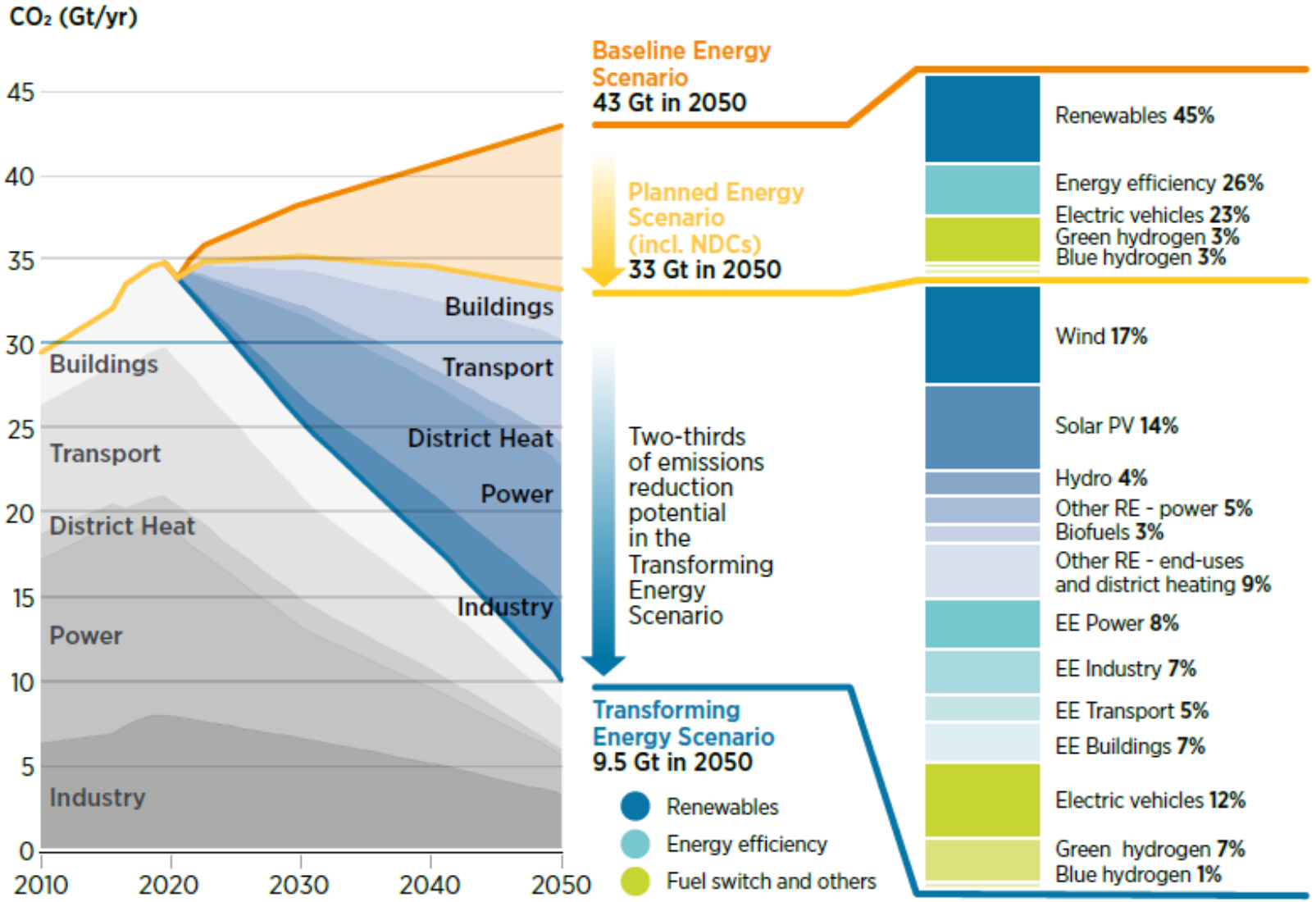


The **"Planned Energy Scenario (PES)"** is the primary reference case for this study, providing a perspective on energy system developments based on governments' current energy plans and other planned targets and policies (as of 2019), including Nationally Determined Contributions under the Paris Agreement unless the country has more recent climate and energy targets or plans.

The **"Transforming Energy Scenario (TES)"** describes an ambitious, yet realistic, energy transformation pathway based largely on renewable energy sources and steadily improved energy efficiency (though not limited exclusively to these technologies). This would set the energy system on the path needed to keep the rise in global temperatures to well below 2 degree Celsius (°C) and towards 1.5°C during this century.

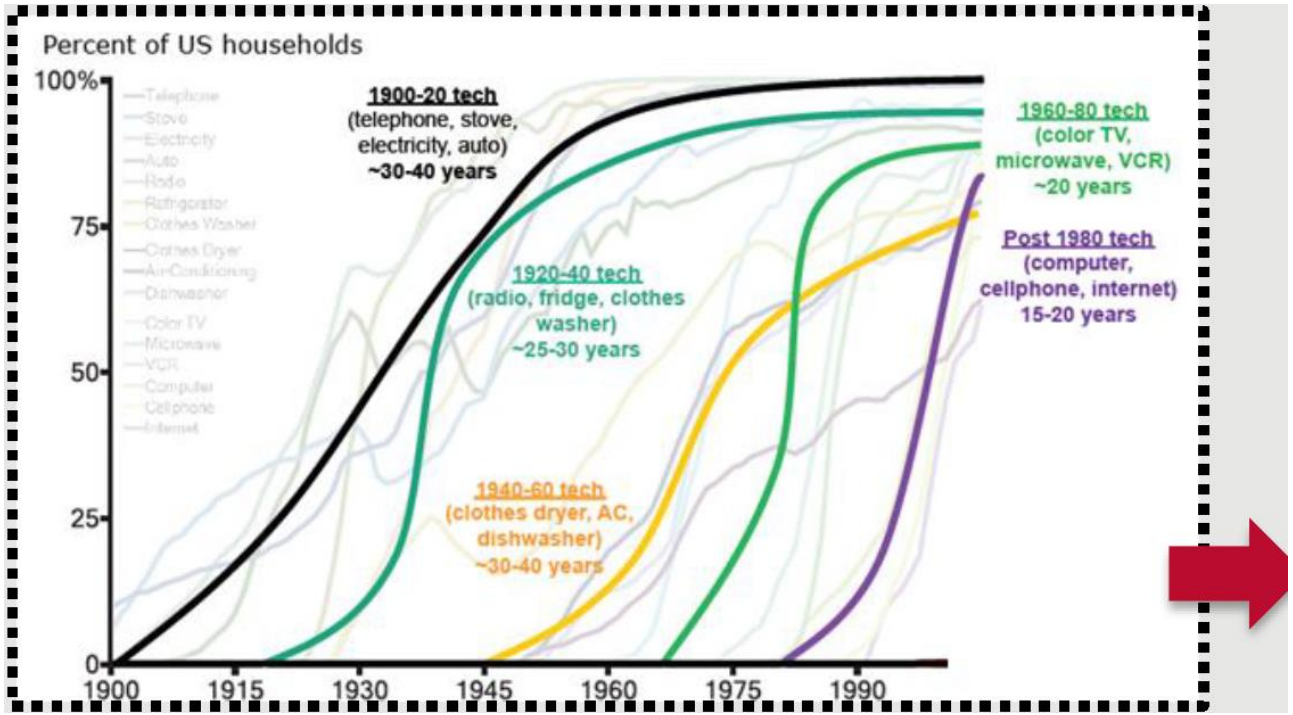
Source: IRENA (2020). Global Renewables Outlook

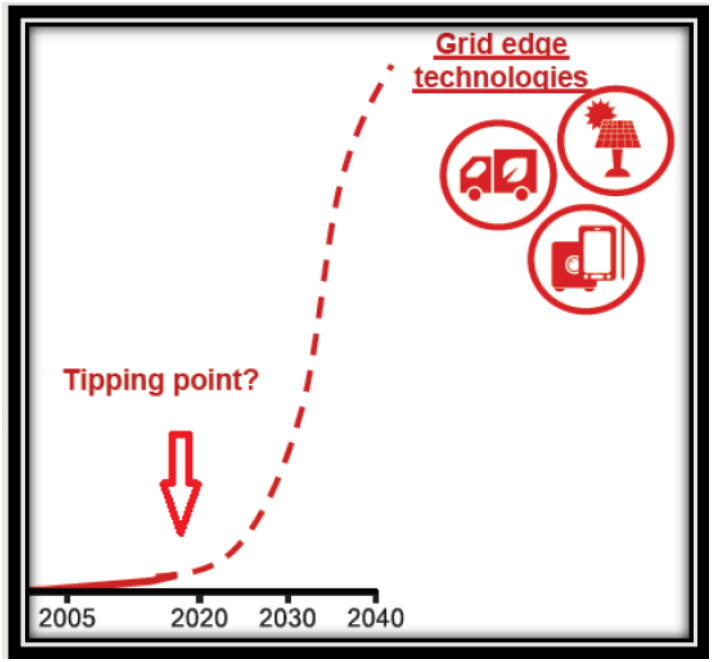
Emission Reductions under Transforming Energy Scenario, by technologies



Source: IRENA (2020). Global Renewables Outlook

Timing for Electricity Sector Transformation





Source: World Economic Forum (2017)

Energy Transformation Development:

Electrification	Increased Power System Flexibility	Conventional Renewable Sources
Meet EV demand with renewables	Enabling integration of high shares of solar and wind	Synergies between hydropower and other RE such as solar and wind
	Smart solutions with EV and storage	Bioenergy a source of fuel for power and heat generation as well as fuel used in transport

TRANSFORMATIVE ENERGY DEVELOPMENTS

The energy sector has started changing in promising ways, with widespread adoption of renewables and related technologies boding well for a sustainable future. Renewable technologies are dominating the global market for new power generation capacity. Solar PV and wind are increasingly the cheapest source of electricity in many markets, and most renewable power sources will be fully cost competitive within the next decade (IRENA, 2019c).

Renewable power generation is now growing faster than overall power demand. A new milestone was reached in 2019 when renewable electricity generation increased by more than the increase in electricity demand, while fossil-fuel electricity generation decreased. This is the first time in decades that fossil-fuel-based generation declined when overall electricity generation increased (Kåberger, 2019).

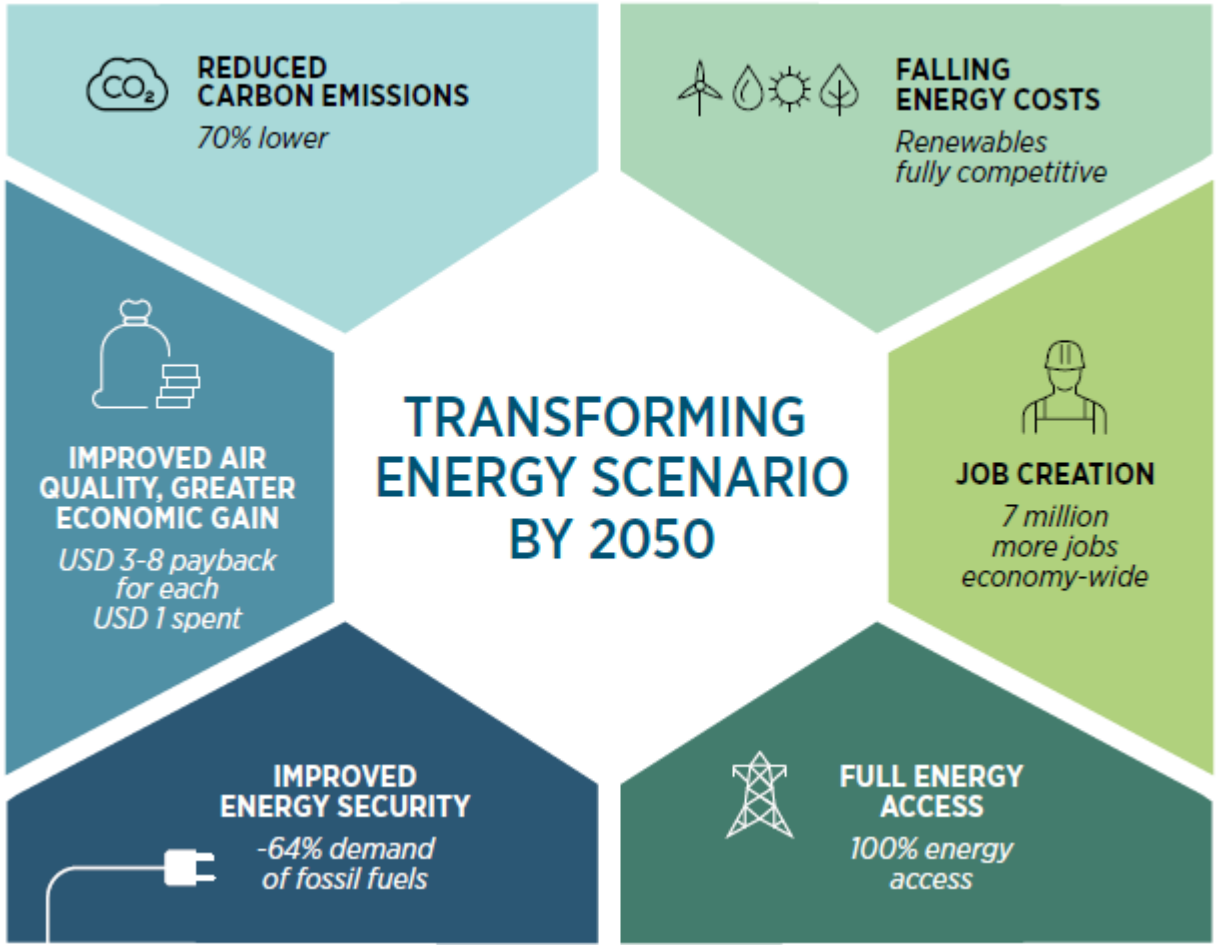
The electrification of transport is showing early signs of disruptive acceleration. Progress in accelerating the transition is seen in the rapid cost reductions of solar PV and wind (including offshore), how key enabling technologies such as batteries and electric vehicles are experiencing rapid reductions in costs, and how green hydrogen is viewed as a potential game changer.

Yet renewables are growing too slowly in major energy-consuming sectors like buildings and industry. Deployment in these areas remains well below the levels needed to create a climate-safe energy system. Slowing progress in energy efficiency and biofuels development must be turned around quickly.

The share of modern renewable energy in global final energy consumption has increased only slightly since 2010, staying around a threshold of about 10%.[1] In simple terms, while renewables are increasing, so is energy demand. In the Planned Energy Scenario, the share of modern renewable energy in final energy supply would increase to 17% by 2030 and 25% by 2050. In the Transforming Energy Scenario, this share would increase to 28% by 2030 and 66% by 2050. Therefore, the share would need to increase six-fold compared to today, and two-and-a-half times compared to the Planned Energy Scenario.

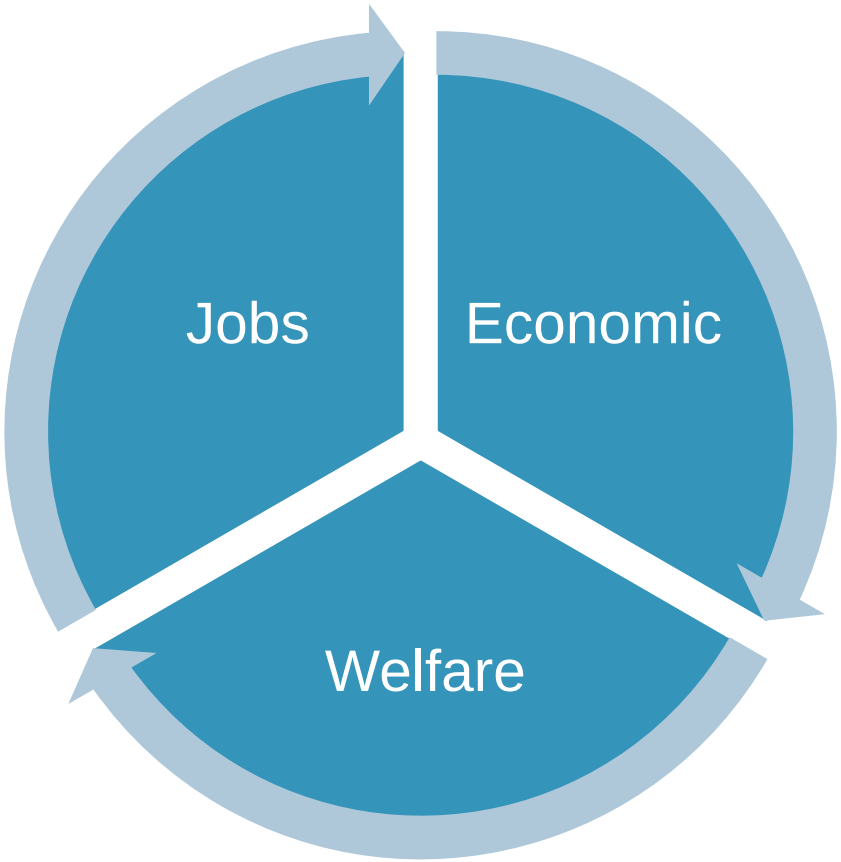
Source: IRENA (2020). Global Renewables Outlook

Key Drivers for Energy Transition



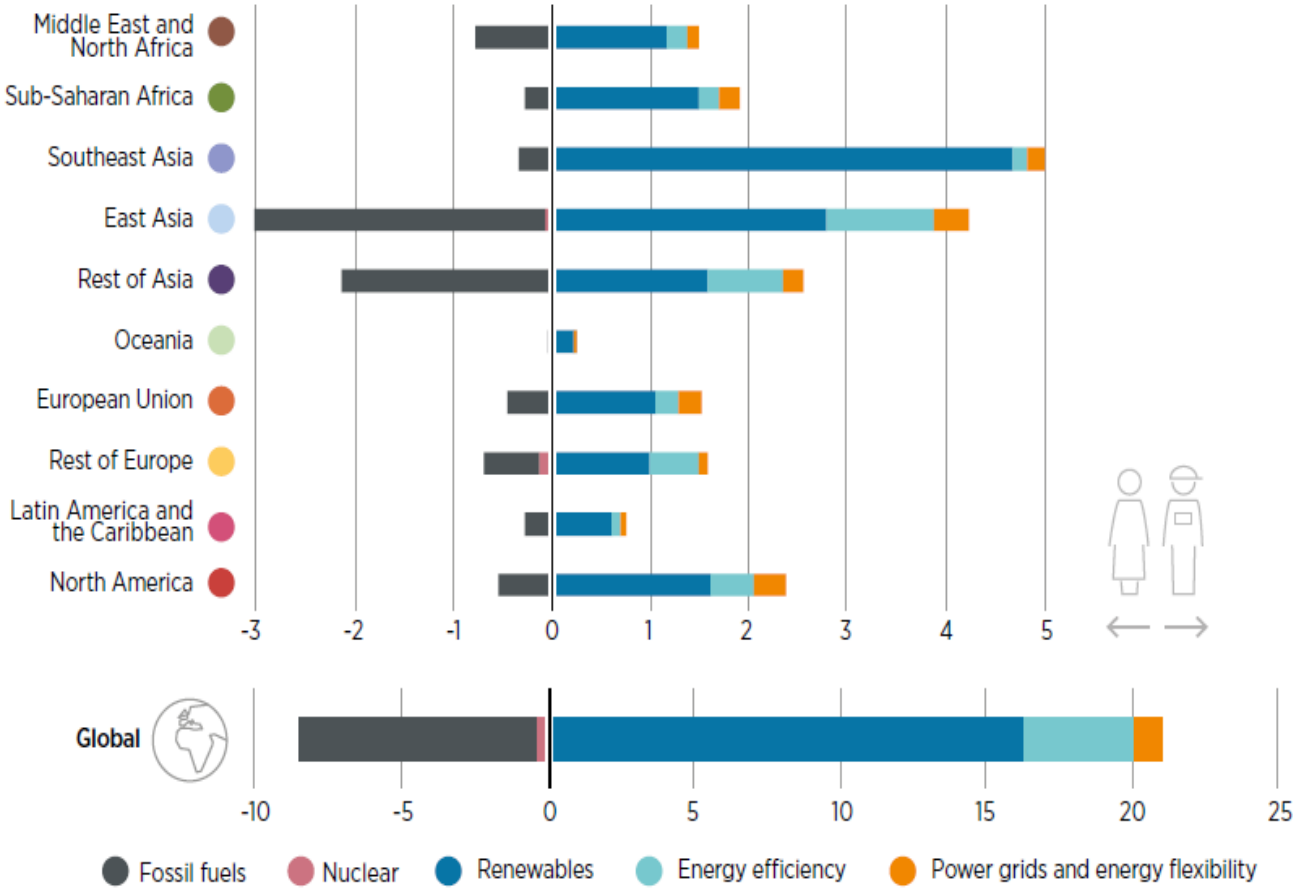
Source: IRENA (2020). Global Renewables Outlook

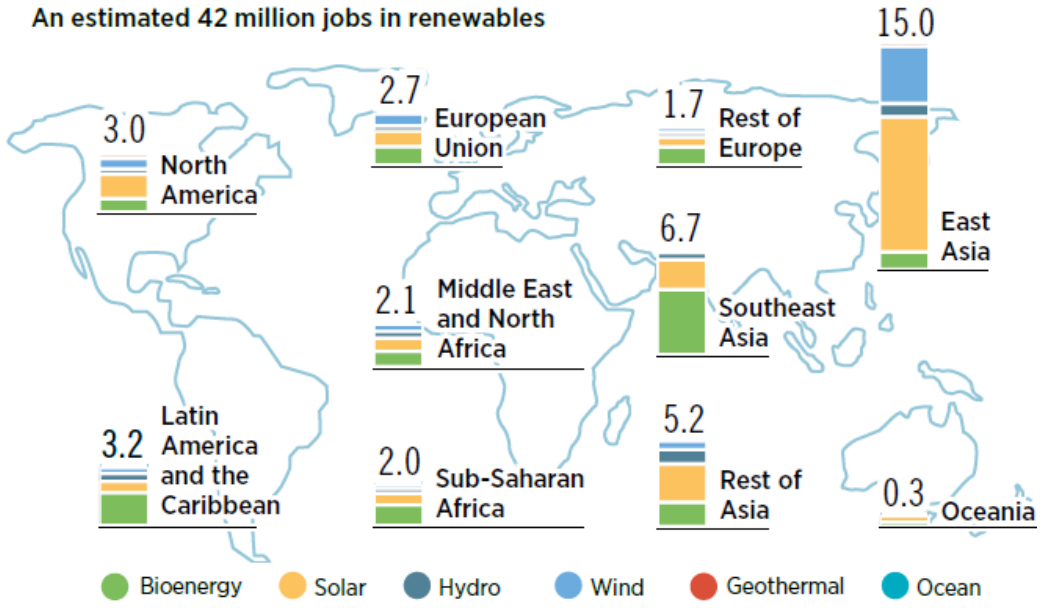
Global Socio-Economic Impact



Source: IRENA (2020). Global Renewables Outlook

Increase Jobs from Renewables

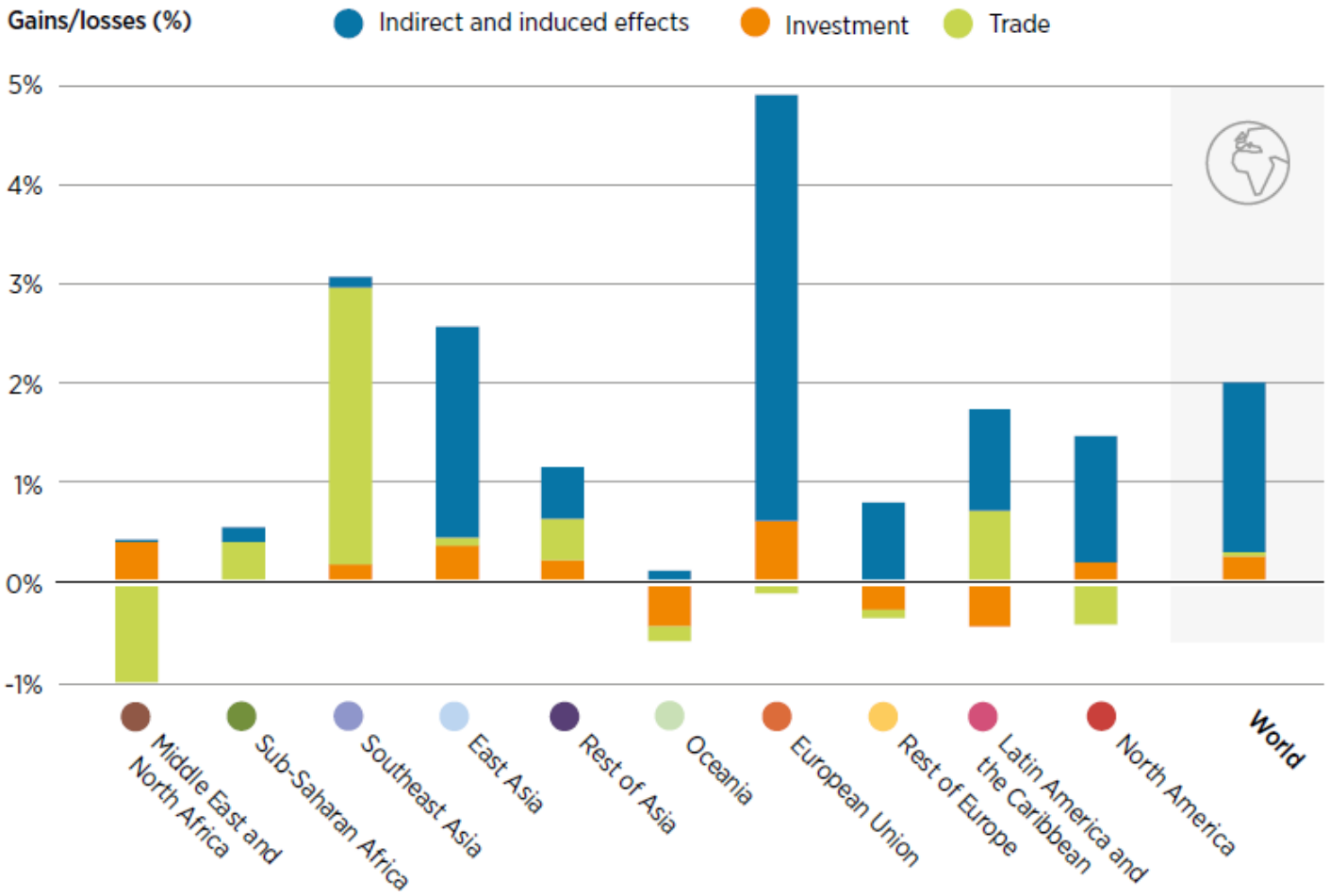


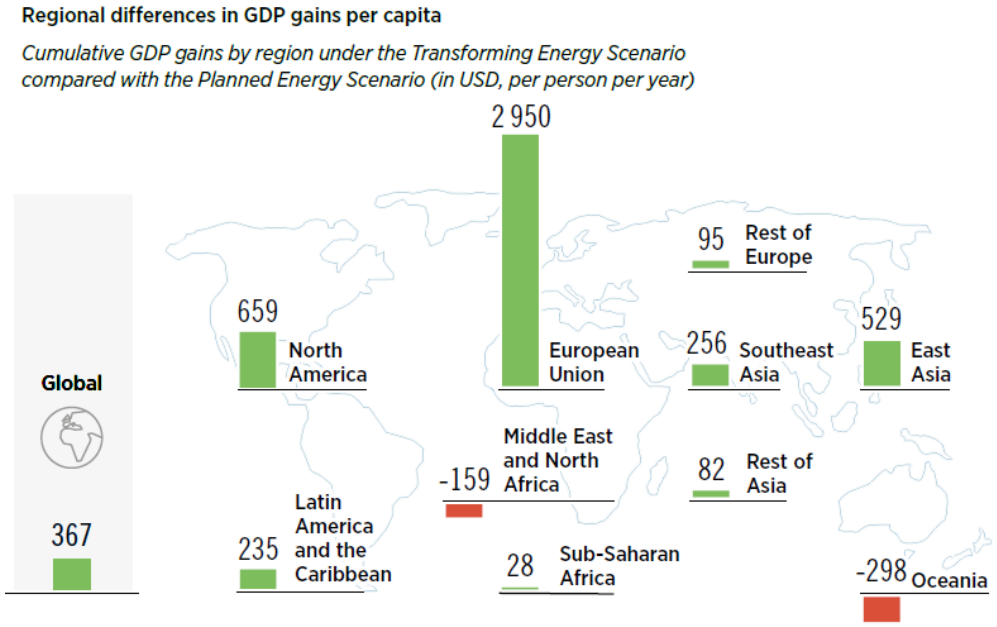


ผลกระทบต่อการจ้างงาน:
จะมีการจ้างงานเพิ่มขึ้นในโดยเฉพาะในภูมิภาคเอเชียตะวันออกเฉียงใต้

Source: IRENA (2020). Global Renewables Outlook

GDP Gains under Transforming Energy Scenario



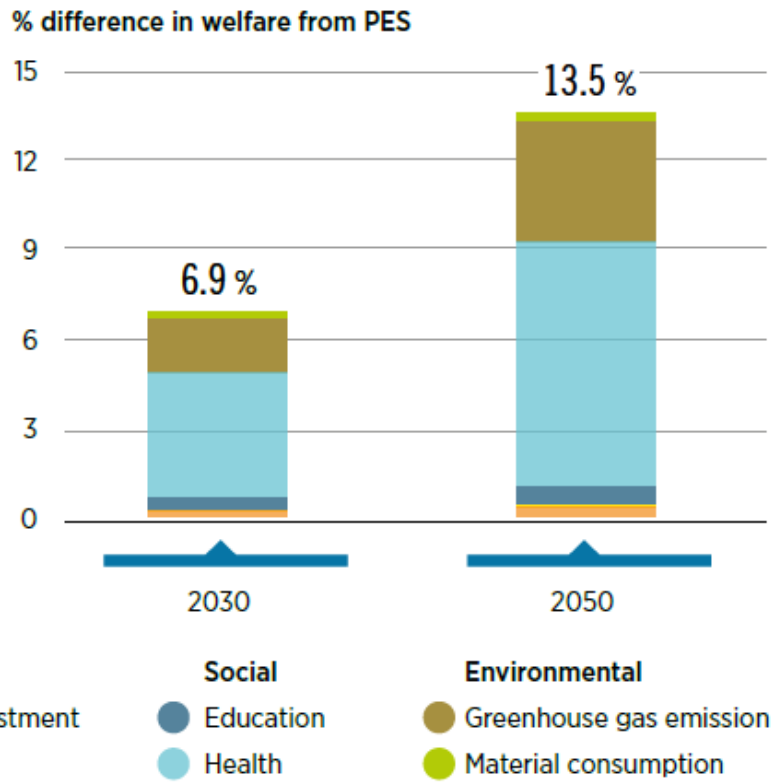


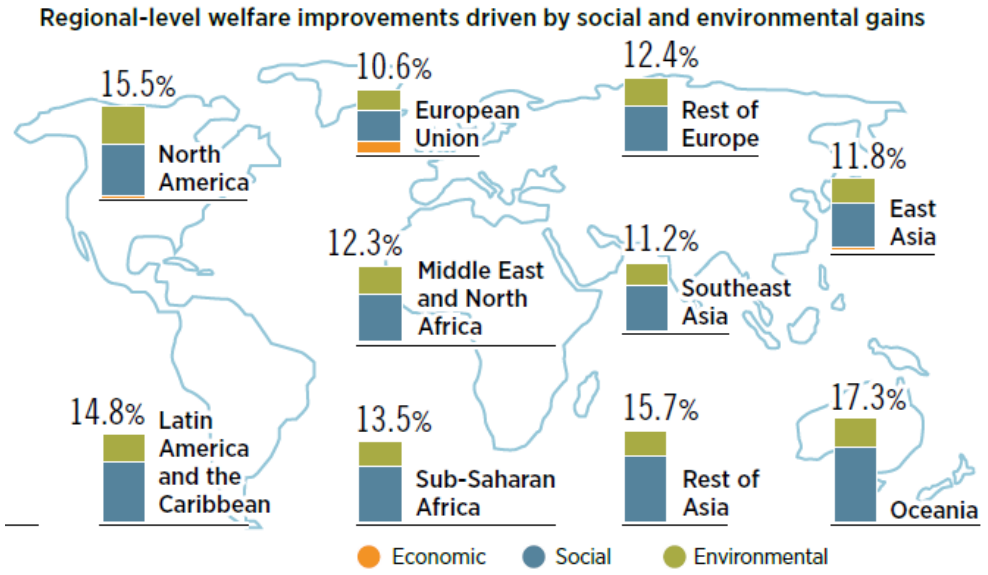
Source: IRENA (2020). Global Renewables Outlook

Welfare Gains from improved economic, social and environmental

Welfare gains: Influenced by health benefits and emission reduction

Global welfare indicator under the Transforming Energy Scenario in 2030 and 2050



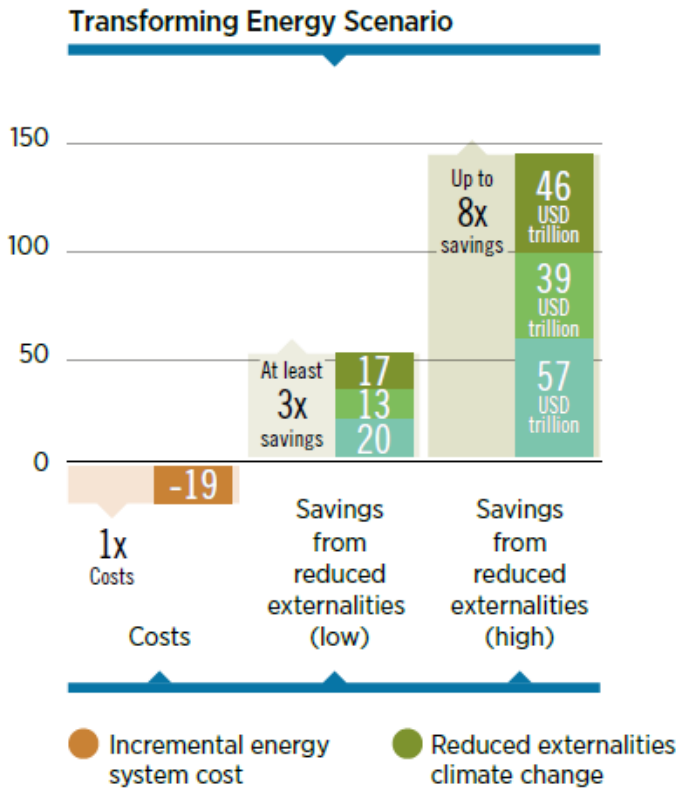


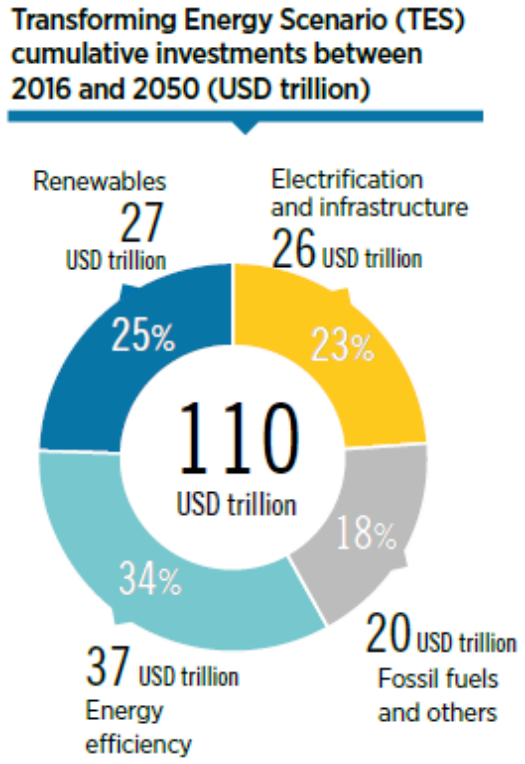
Source: IRENA (2020). Global Renewables Outlook

Benefits, costs and investments

The energy transition: Benefits compared to costs

Cumulative system costs and savings from reduced externalities for Transforming Energy Scenario for the period to 2050, and DDP for the period to 2060 (USD trillion)



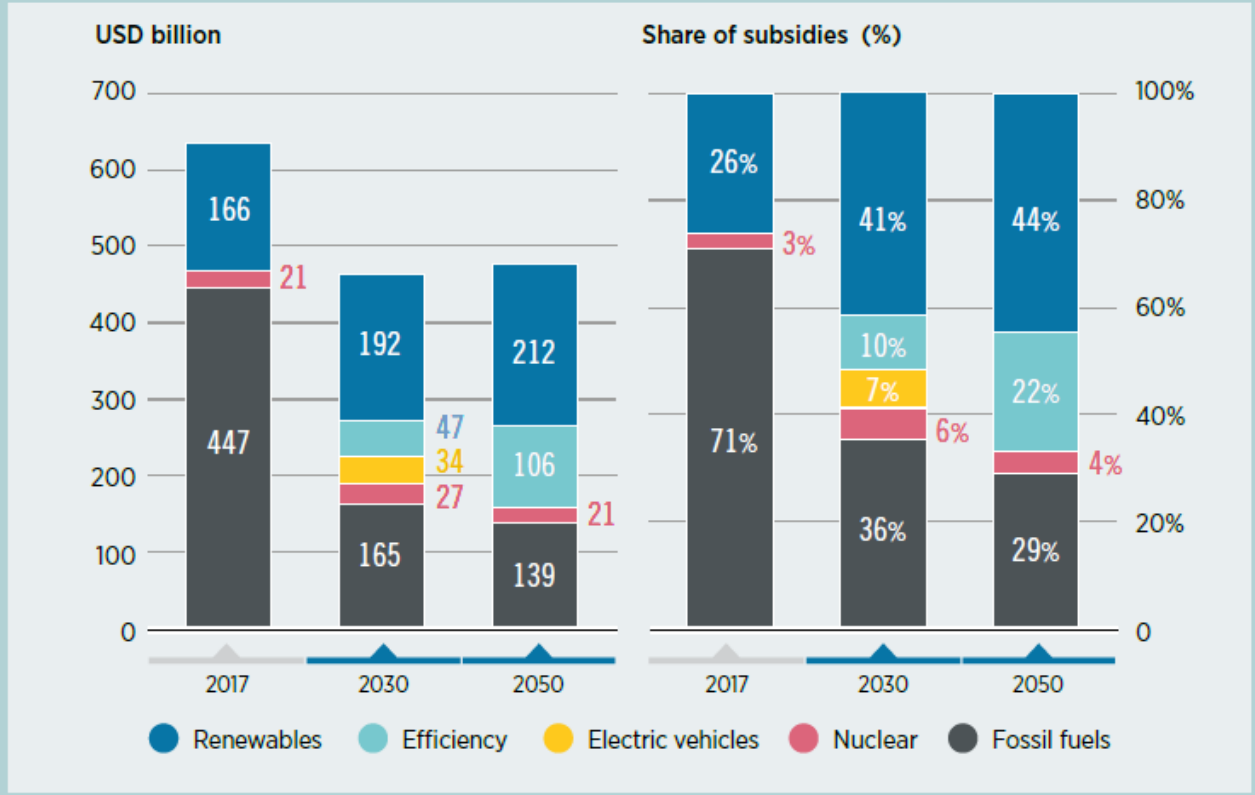


A climate-safe future calls for the scale-up, and redirection, of investment to clean energy technologies. Fossil-fuel investments need to be shifted to renewables and energy efficiency instead, while subsidies to fossil fuels must be phased out. Overall, total investment in the energy system in the Transforming Energy Scenario would need to reach USD 110 trillion by 2050, or around 2% of average annual GDP over the period (see Figure S.8). Of that total, over 80% needs to be invested in renewables, energy efficiency, end-use electrification, and power grids and flexibility. If viewed in annual terms, USD 3.2 trillion needs to be invested in the global energy system every year to 2050. That compares to recent historical investment (2014-2018) in the energy system of around USD 1.8 trillion per year (IEA, 2019c), and USD 2.9 trillion per year in the Planned Energy Scenario.

Source: IRENA (2020)

Energy Subsidies in the Energy Transformation

Figure 1.3 Energy subsidies: Overall reduction in the Transforming Energy Scenario
Total direct energy sector subsidies by fuel/source, 2017, 2030 and 2050 in the Transforming Energy Scenario



Based on IRENA (forthcoming b)

Subsidies:

- Reduce subsidies on fossil fuels
- Increase subsidies on RE

Source: IRENA (2020). Global Renewables Outlook