WEBINAR

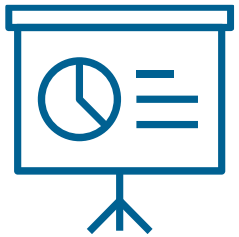
Accelerating Southeast Asia's Energy Transformation: Vision for Transformative Energy Policies

THURSDAY, 13 AUGUST 2020 • 14:00 – 15:30 (GMT+7)

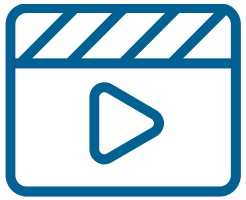
Please make sure to **mute** yourself during the session to avoid background noise

If you encounter any technical issues, please write your issue in the **chat box**

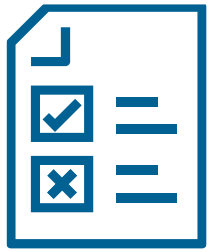
If you have **Questions** to the speaker please use the **Q&A and we will respond after the event**



The slides will be shared via email after the end of the webinar



A recording of the webinar will be available



Tell us how we did in the survey to help us improve

AGENDA

Accelerating Southeast Asia's Energy Transformation: Vision for Transformative Energy Policies

1. Opening Remarks
2. Message from the UK COP26 Presidency
3. Presentations
4. Good Practices from the region
5. Panel Discussion

Opening Remarks

Gauri Singh

Deputy Director General,
IRENA

Dr. Nuki Agya Utama

Executive Director,

ACE

Message from UK COP26 Presidency

Ken O'Flaherty

UK COP 26 Ambassador for
Asia Pacific and South Asia

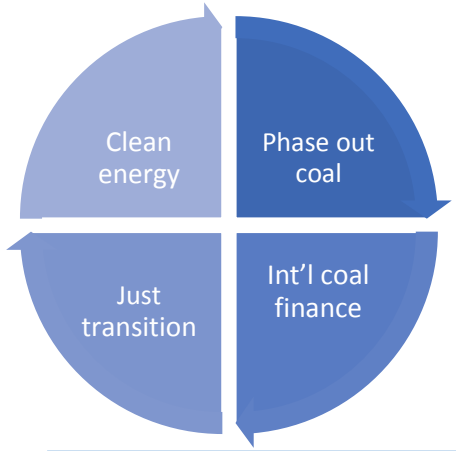
UN CLIMATE CHANGE CONFERENCE UK 2021

IN PARTNERSHIP WITH ITALY

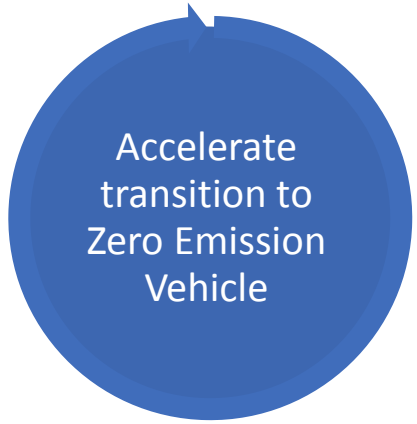
Overview of COP26 campaigns

UN CLIMATE CHANGE CONFERENCE UK 2021
IN PARTNERSHIP WITH ITALY

Energy Transition

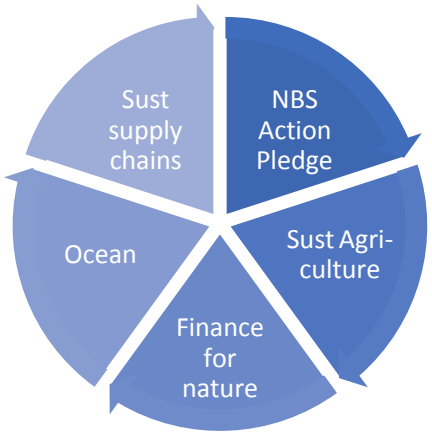


Transport



Energy Efficiency

Nature Based Solutions



Adaptation & Resilience

Finance

Global public Commitments

Mobilisation

Reporting

Risk management

Returns

Presenters

Ricardo Gorini

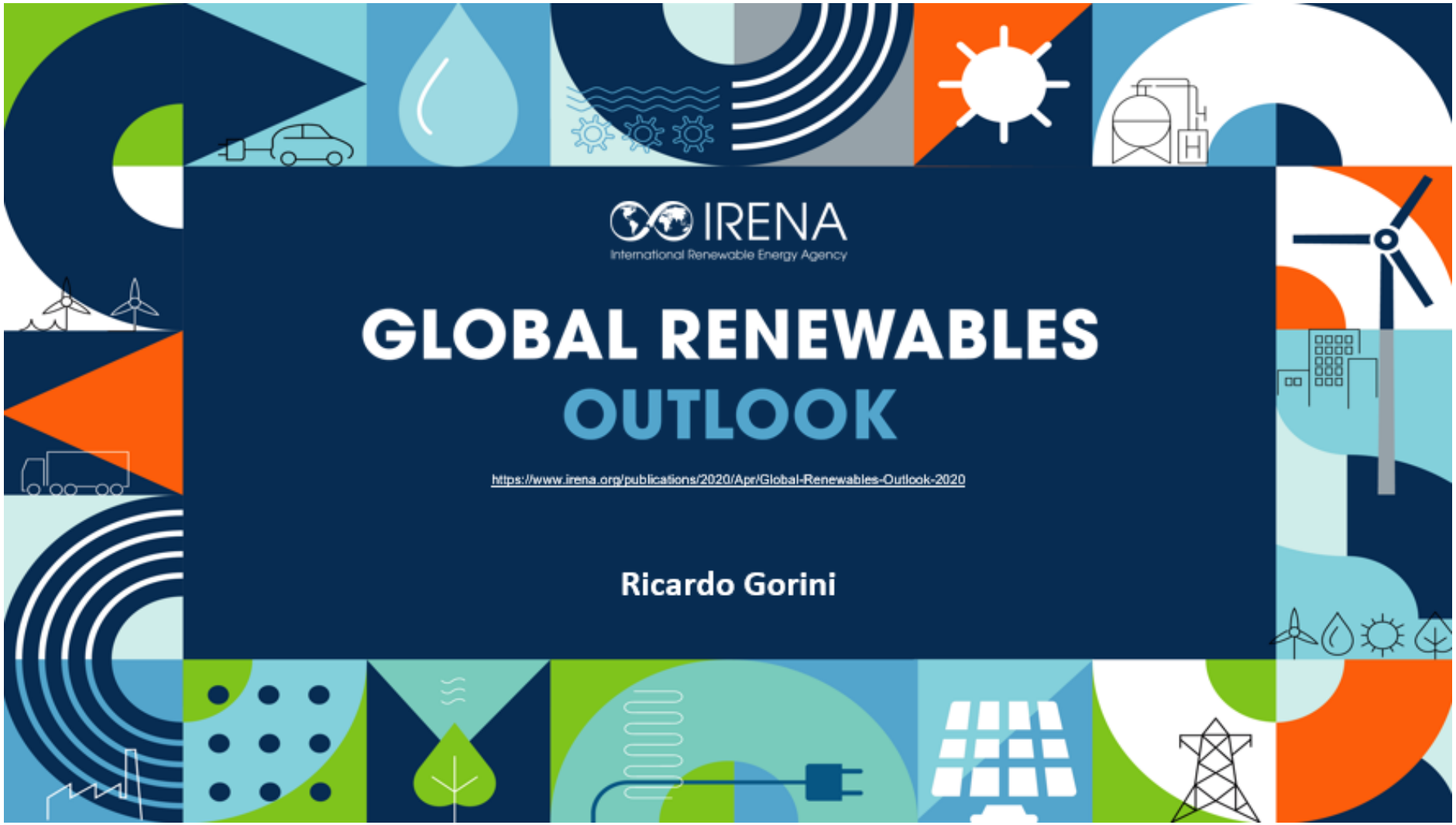
Senior Programme Officer, Renewable Energy Roadmap, IRENA

Michael Renner

Programme Officer, Policy, IRENA

Michael Taylor

Senior Analyst, Renewable Energy Cost Status and Outlook, IRENA


IRENA
International Renewable Energy Agency
GLOBAL RENEWABLES
OUTLOOK
https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020
Ricardo Gorini

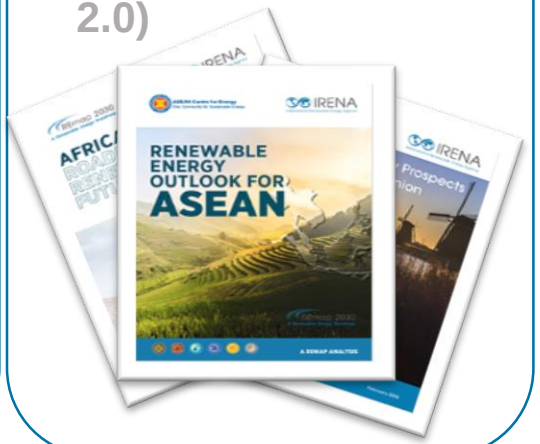
REmap products

Global

- Status of the energy transition
- Perspective for the global energy system to 2050 based on current and planned policies (the Reference Case).
- Detailed REmap transition pathway to 2050 – an energy pathway aligned with the well-below 2oC target of the Paris climate goals.
- **6 global reports (‘14, ‘16, ‘17, ‘18, ‘19, ‘20)**

Regional

- Assessment of technology options and regional disaggregation
- Identification of key technologies and trends, and cross-country opportunities
- 3 regional reports (Africa, ASEAN and EU)
- **3 in preparation (SEE, CA, ASEAN 2.0)**



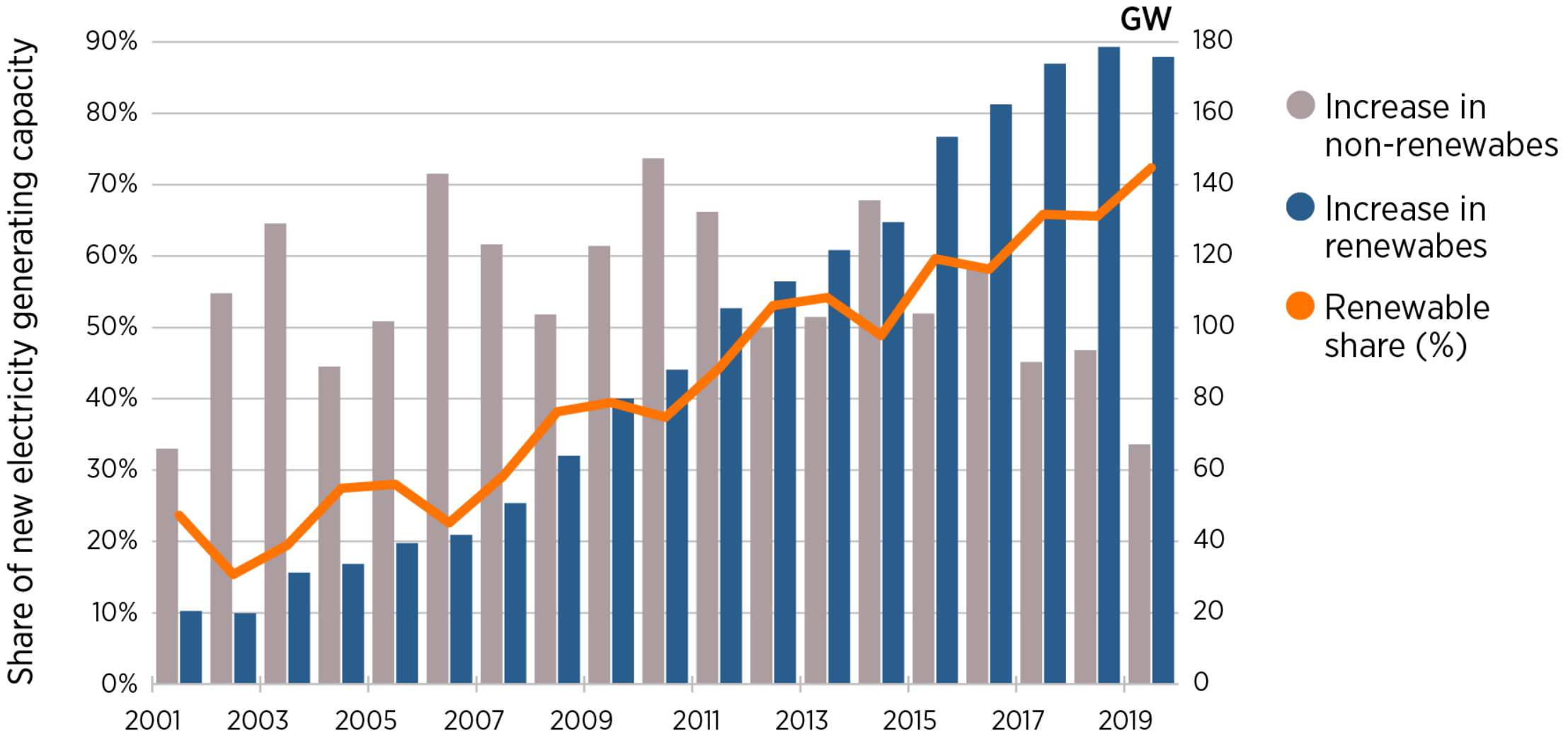
Country

- Insights for policy and decision makers for areas in which action is needed at a country level
- 13 country reports for major economies
- **2 near finalization, 2 more in pipeline**

Thematic

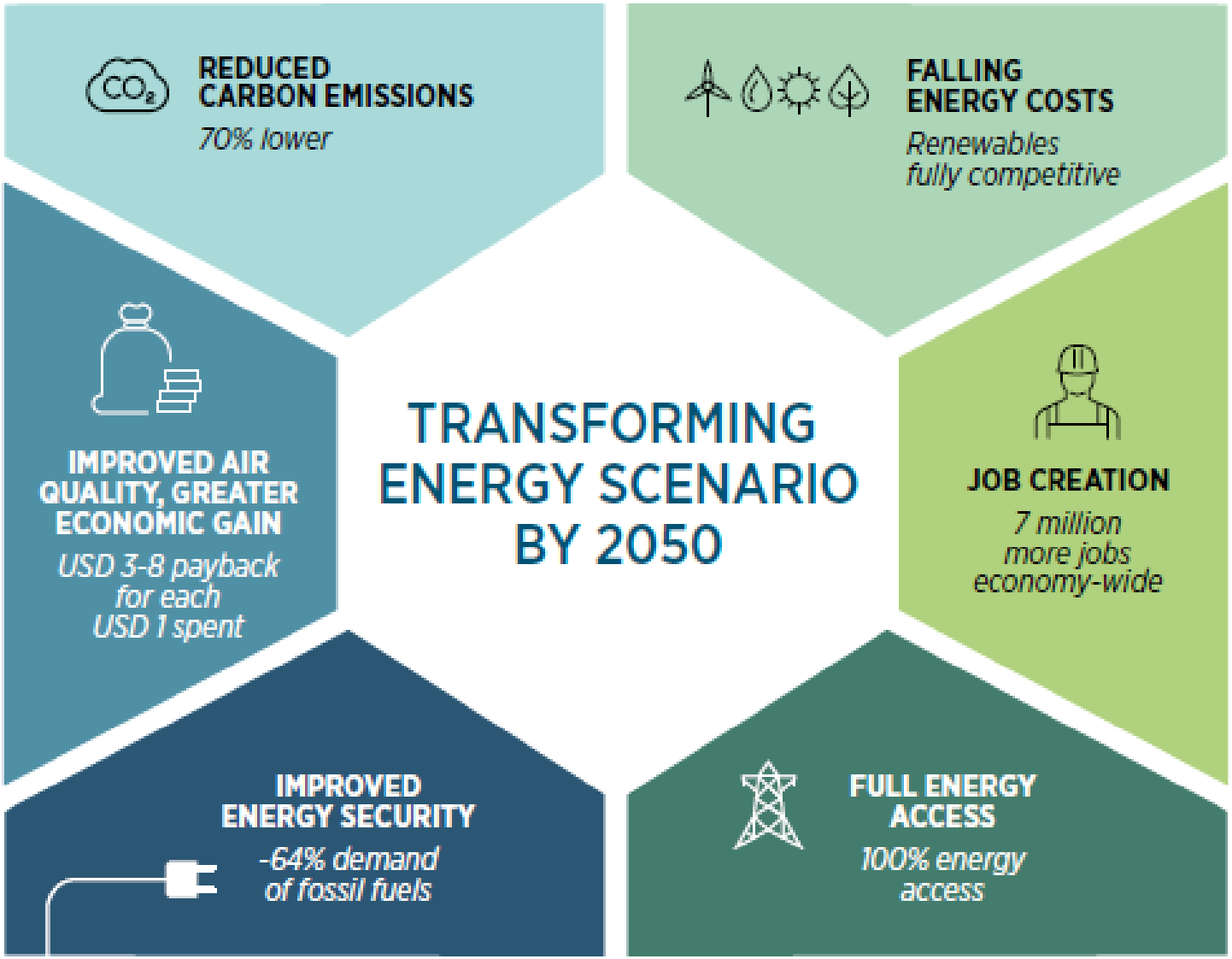
- Provide detailed technical and economic analysis on specific topics (i.e. Future of Wind/Solar PV,RE investments, stranded assets, district heating and cooling etc.)
- **9 thematic studies**

Renewables continue to dominate new capacity expansion



Renewables now account for one third of global power capacity today

Transforming the energy landscape

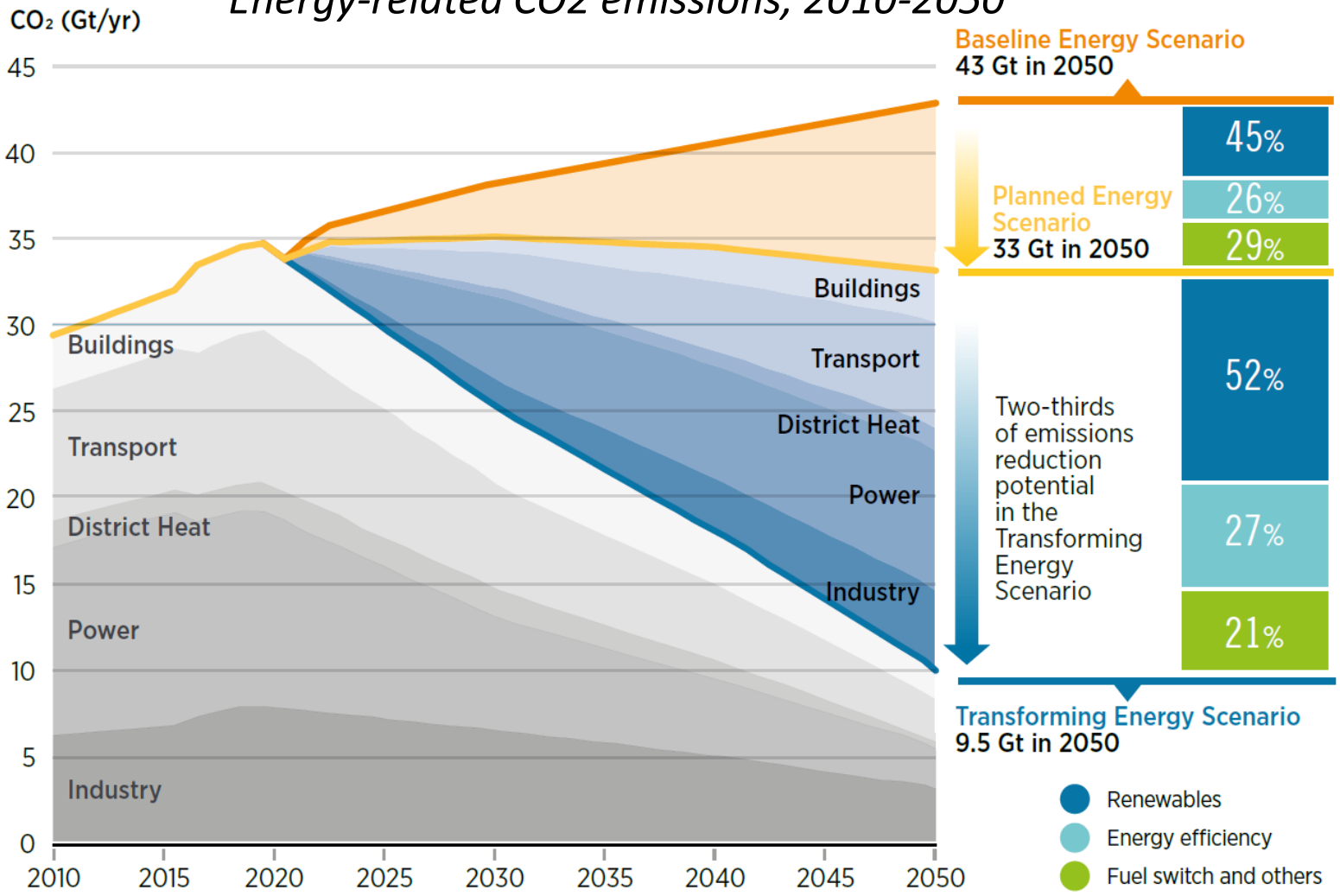


1. Emission reduction
2. Increased competitiveness
3. More jobs
4. Universal access
5. Air quality
6. Energy security

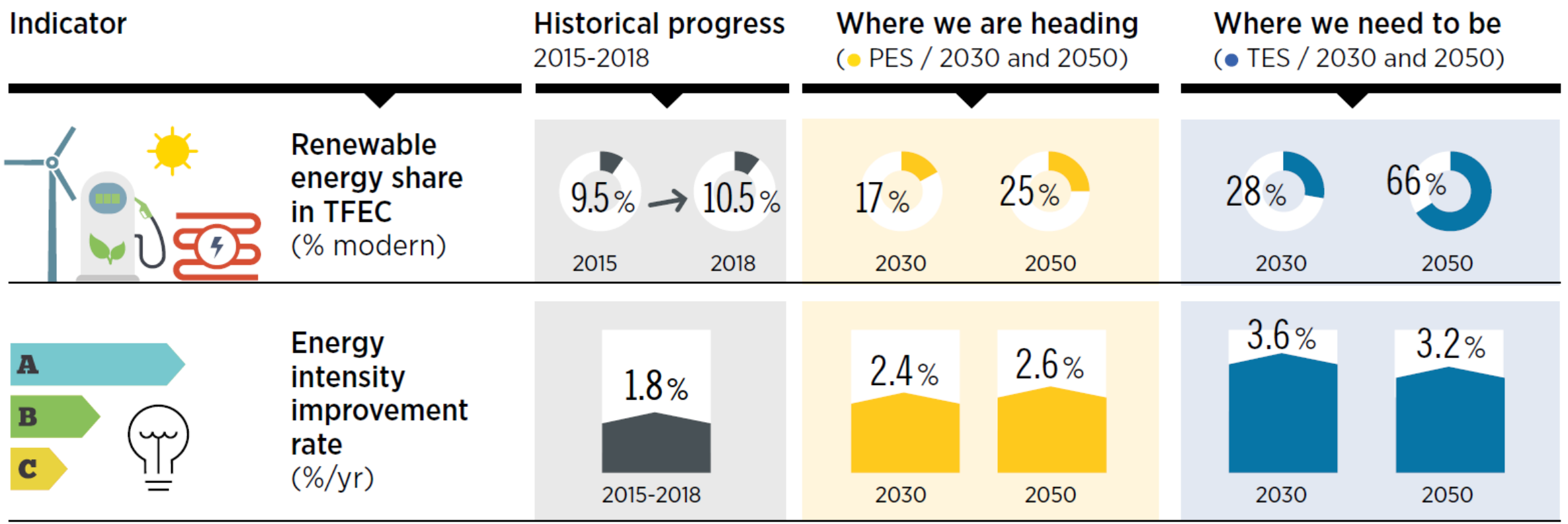
Renewables and efficiency key to meeting global climate goals

- **To achieve the Transforming Energy Scenario, energy-related CO_2 emissions need to fall by 3.8% per year on average until 2050.**
- **Annual energy-related CO_2 emissions would need to decline by 70% below today's level by 2050.**
- **Over half of the necessary reductions come from renewables and one quarter from energy efficiency measures.**
- **When including direct and indirect electrification (such as green hydrogen and technologies like EVs), the total reductions increase to over 90% of what is required.**

Energy-related CO2 emissions, 2010-2050

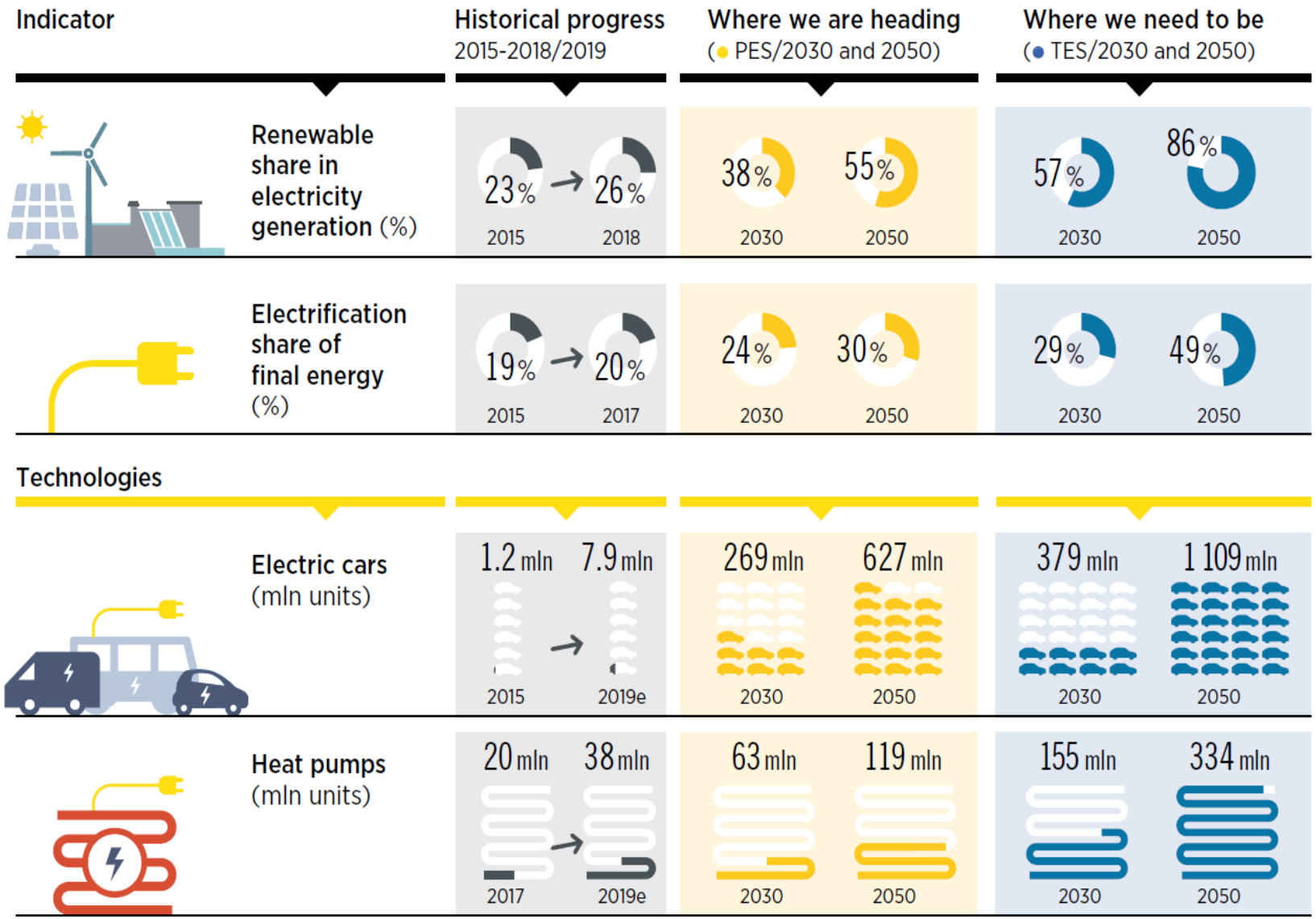


Renewables in the world's energy mix: Six-fold increase needed



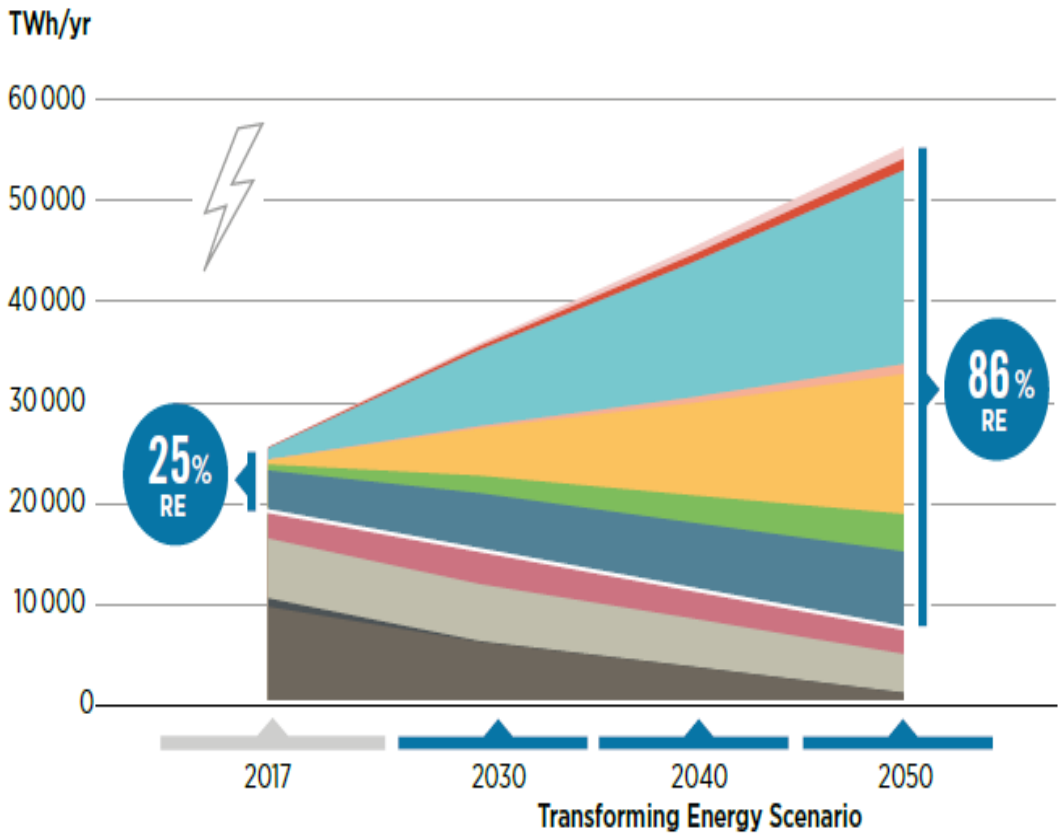
- **Energy efficiency improvements must be scaled up** rapidly and substantially.
- **Renewable energy and energy efficiency together offer over 90% of the mitigation measures** needed to reduce energy-related emissions in the Transforming Energy Scenario.

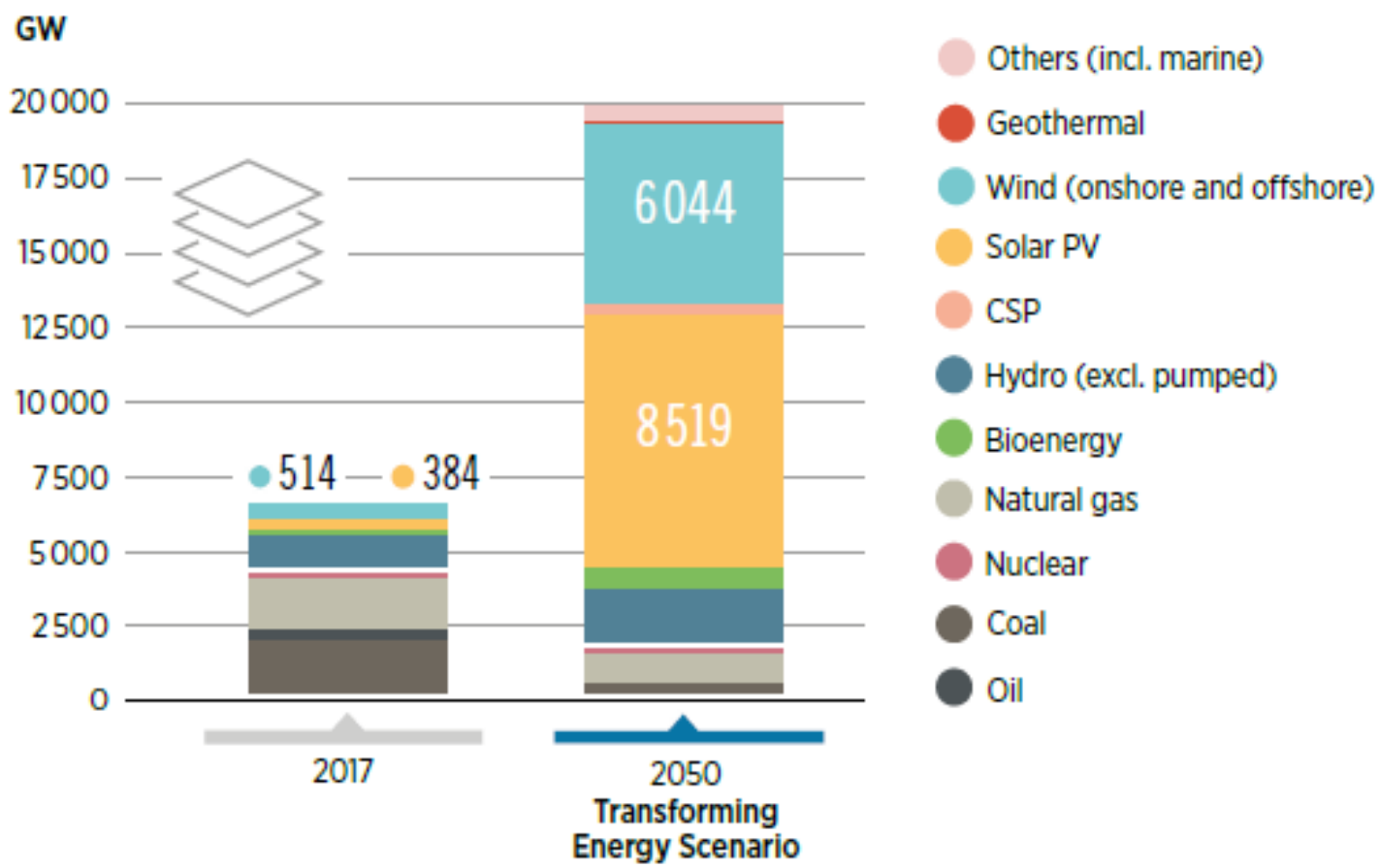
An increasingly electrified energy system



- **Renewable power generation technologies are setting records for low costs and new capacity** despite falling renewable energy subsidies and slowing global GDP growth.
- **The rate of growth in the percentage share of electricity** (percentage point "ppt") **in final energy needs to quadruple**, from an increase of 0.25 ppt/yr to 1.0 ppt/yr.
- **The electrification of end uses will drive increased power demand to be met with renewables**

Solar PV and wind will lead the way in the power sector

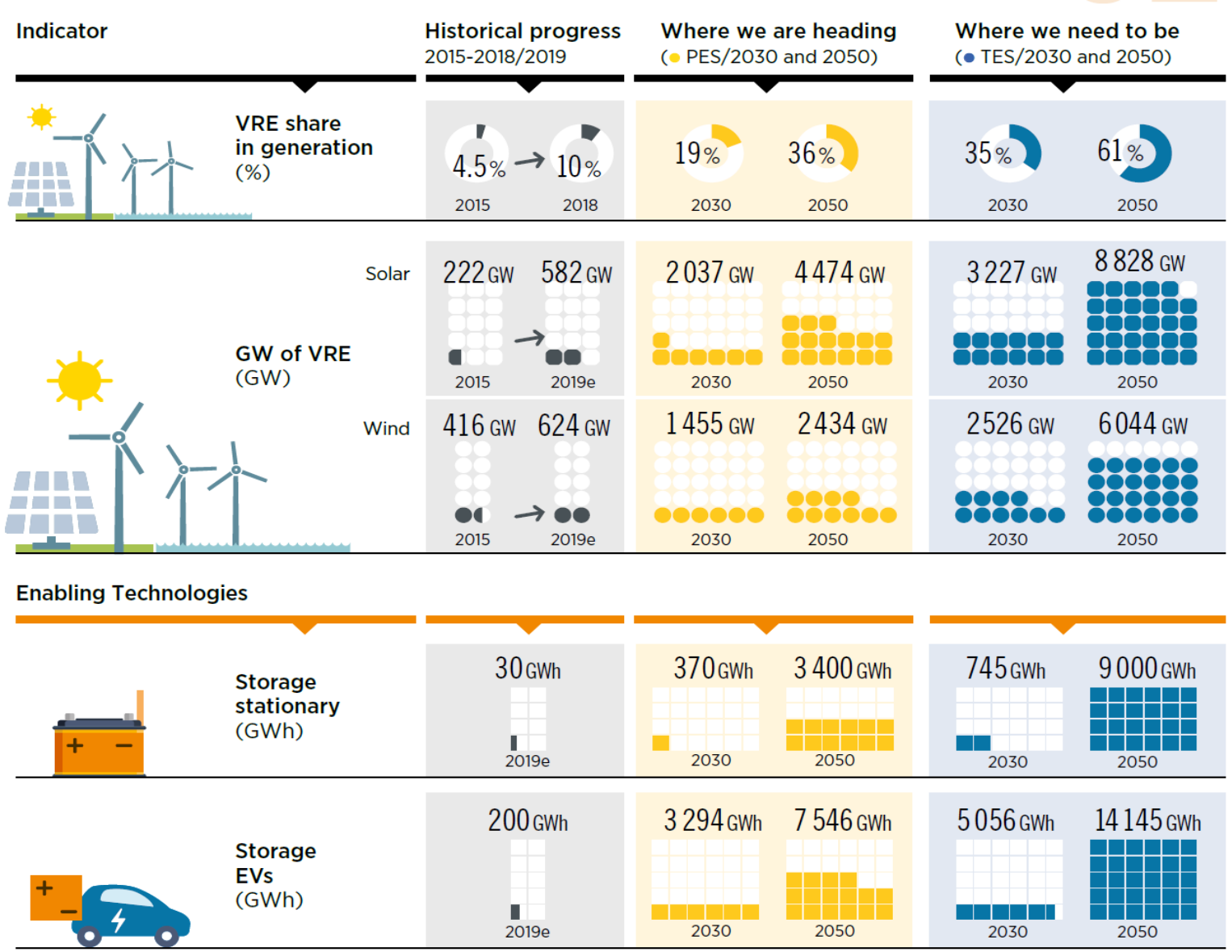




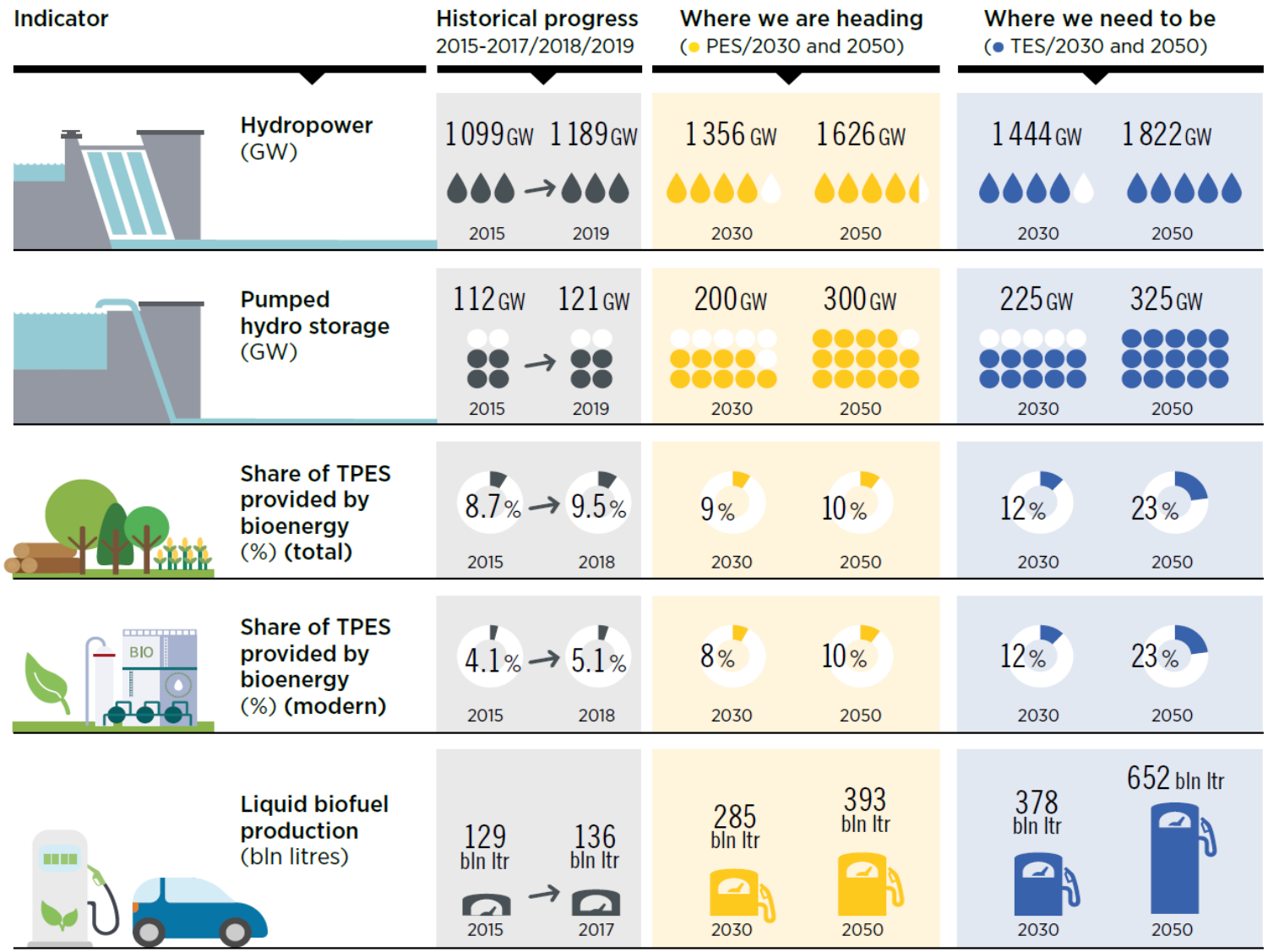
- **Wind power would be a major electricity generation source, supplying more than one-third of total electricity demand. Solar PV power would follow, supplying 25% of total electricity demand.**
- **Power system capacity would need to grow to 20 000 GW by 2050, with over 70% of it coming from solar PV and wind.**

The need for power system flexibility

- **Flexibility in power systems is a key enabler for the integration of high shares of variable renewable electricity** – the backbone of the electricity system of the future.
- **Power systems must achieve maximum flexibility**, based on current and ongoing innovations in enabling technologies, business models, market design and system operation.
- On a technology level, **both long-term and short-term storage will be important for adding flexibility**.



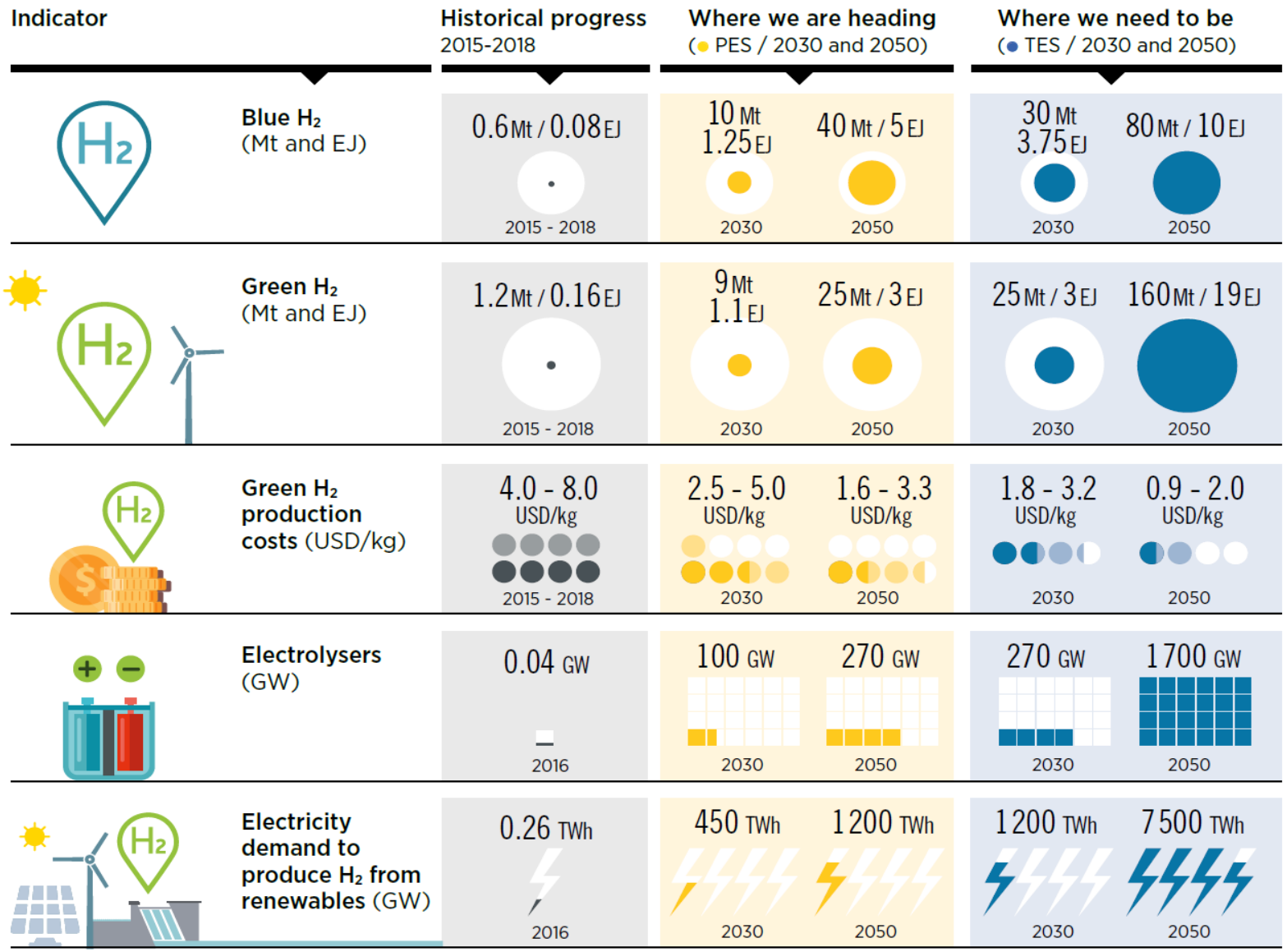
Vital to any future energy system: Hydropower and bioenergy



Note: The total bioenergy share includes traditional uses of biofuels. In PES their use is reduced considerably by 2030, but not entirely phased out, whereas in PES their use is entirely phased out by 2030.

- **Hydropower can bring important synergies to the energy system of the future.** In the Transforming Energy Scenario, hydropower capacity would need to increase 25% by 2030, and 60% by 2050.
- **Bioenergy will become increasingly vital in end-use sectors.** In the Transforming Energy Scenario, it plays an important role, particularly in sectors that are hard to electrify, such as in shipping and aviation and in industry, both for process heat and use as a feedstock.

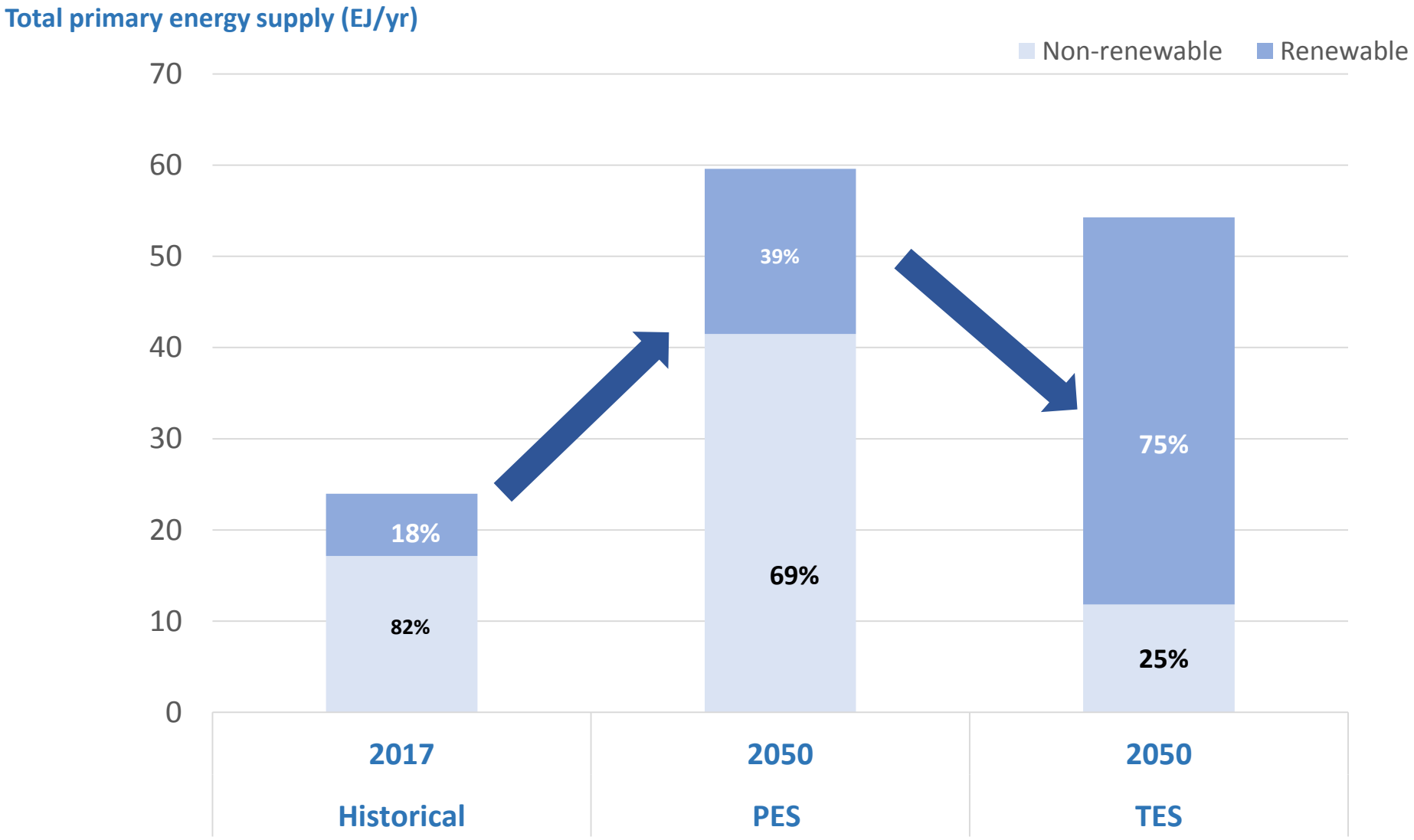
Hydrogen: A key part of future energy systems



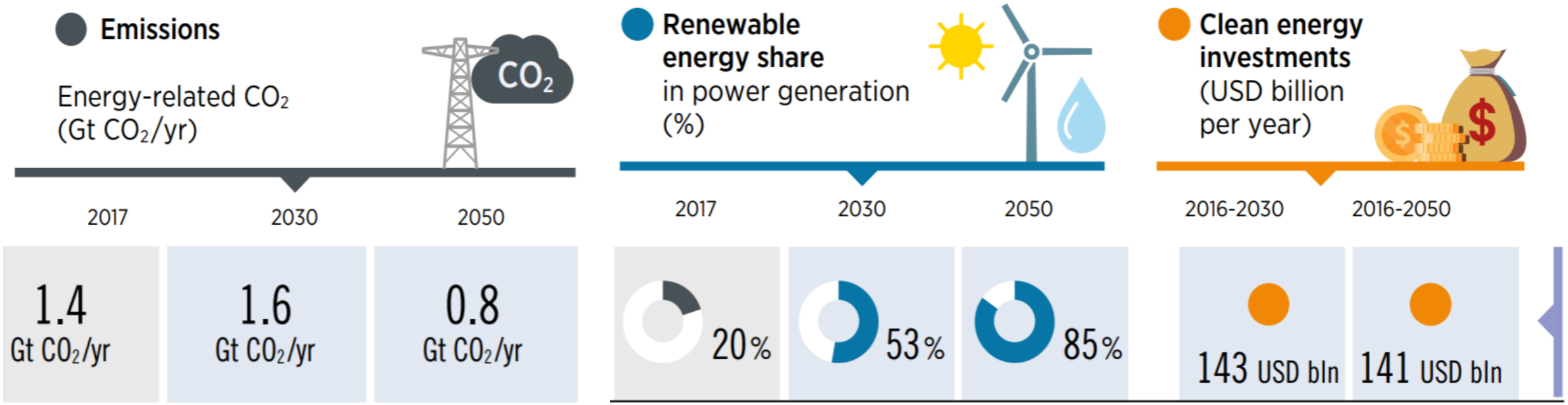
- **Hydrogen can offer a solution** for types of energy demand that are hard to directly electrify.
- **Green hydrogen will become cost competitive with "blue" hydrogen in the next few years** in locations with favourable low-cost renewable electricity.
- **Hydrogen can be processed further into hydrocarbons or ammonia**, which can then help reduce emissions in shipping and aviation.

Note: Hydrogen produced from fossil fuels without CCS is called grey hydrogen, with CCS is called blue hydrogen, and if made from renewable power through electrolysis it is called green hydrogen. RE = Renewable Energy

IRENA's Transforming Energy Scenario pathway for Southeast Asia



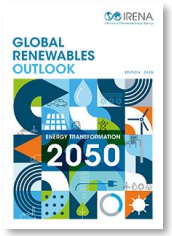
IRENA's Transforming Energy Scenario pathway for Southeast Asia



Improved energy efficiency leading to lower energy consumption per capita

Southeast Asia

Energy consumption per capita (GJ/capita)		Where we are heading			Where we need to be		
	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Consumption (TFEC) per capita	28	29	35	40	29	33	35



Global energy decarbonisation: Swift action needed in all sectors

Power

ACCELERATE RENEWABLE CAPACITY ADDITIONS TO GENERATE ADEQUATE POWER WITH LOW-CARBON TECHNOLOGIES

1) Identify and map renewable energy resources and develop a portfolio of financeable projects for the medium to long term.
2) Construct no new coal power plants and plan and implement an end-of-life phase-out of coal capacities.

UPDATE GRID PLANNING TO ACCOMMODATE RISING SHARES OF VARIABLE RENEWABLE ENERGY (SOLAR AND WIND)

1) Develop a flexible power system (with flexible supply, storage, demand response, power-to-X, electric vehicles, digital and ICT technologies, etc).
2) Update grid codes.
3) Deploy micro-grids to improve resilience and expand energy access with renewable sources.
4) Deploy super-grids to interconnect regions.
5) Deploy cost-reflective tariff structures by properly readjusting the balance between volumetric charges (USD/kWh), fixed charges (*e.g.* USD/meter-month) and, where applicable, demand charges (USD/kW).

SUPPORT DISTRIBUTED ENERGY RESOURCE DEPLOYMENT

1) Incentivise energy consumers to become prosumers.
2) Support regulatory and pricing policies, including rights to generate and sell electricity, tariff regulation and grid-arrival policies.
3) Enable energy aggregators to foster use of distributed energy resources.

Transport

REDUCE TRANSPORT VOLUME AND CONGESTION

1) Adopt advanced digital communication technologies to improve urban transport planning and services (*e.g.* re-routing to reduce traffic congestion).
2) Promote mobility services (*e.g.* automonous driving, vehicle-sharing).
3) Accelerate the shift from passenger cars to public transport (electric railways, trams or buses).
4) Deploy low-emissions city trucks.

ACCELERATE THE SHIFT TO ELECTRIC MOBILITY

1) Set minimum standards for vehicle emissions.
2) Give electric vehicles (EVs) priority in city access.
3) Incentivise the development of charging infrastructure.
4) Strengthen links between the power and transport sectors with integrated planning and policy designs (vehicle-to-grid services).

PRIORITISE BIOFUELS IN ROAD FREIGHT, AVIATION AND SHIPPING

1) Introduce specific mandates for advanced biofuels, accompanied by direct financial incentives and financial de-risking measures.
2) Adopt supporting policies to scale up sustainable production of first- and second-generation biofuels.
3) Eliminate fossil-fuel subsidies and implement carbon and energy taxes to increase the competitiveness of renewable-fuelled shipping and aviation.

Industry

REDUCE ENERGY CONSUMPTION IN INDUSTRIES

1) Promote circular economy (material recycling, waste management, improvements in materials efficiency, and structural changes such as reuse and recycling).
2) Establish energy efficiency standards and ramp up actual efficiency levels.

ENABLE CORPORATE SOURCING OF RENEWABLES

1) Support a credible and transparent certification and tracking system for corporate renewable energy use.
2) Consider an energy market structure that allows for direct trade between companies of all sizes and renewable energy developers, *e.g.* through power purchase agreements (PPAs).
3) Work with utilities and other electricity suppliers to provide green corporate procurement options.
4) Empower companies to invest directly in self-generation.

ACCELERATE LOW-CARBON TECHNOLOGY DEPLOYMENT FOR INDUSTRIAL PROCESS HEATING

1) Remove existing barriers and Incentivise low-carbon heating methods (*e.g.* solar thermal heating, modern bioenergy and heat pumps).
2) Support emerging biomass and hydrogen technologies. Replace fossil fuel-based with renewable-based feedstocks and process heat (*e.g.* in iron and steel subsectors, ammonia production).

Buildings

REDUCE ENERGY CONSUMPTION IN BUILDINGS

1) Establish or enhance energy-efficient building codes and standards (including for appliances and equipment).
2) Adopt retrofitting and renovation programmes, including financing schemes.
3) Incentivise retrofits and adjust construction codes in cities and states.
4) Combine energy efficiency and renewable energy measures (*e.g.* public policies to integrate these technologies in renovations of public buildings).

SUPPORT AND FOSTER DER DEPLOYMENT

1) Remove barriers that prevent prosumers from actively helping to transform the energy system.
2) Promote community ownership models and innovative financing schemes.
3) Accelerate the roll-out of smart meters.
4) Capitalise on smart-home and digitalisation schemes to allow demand management and strengthen grid services.

SCALE UP THE RENEWABLE SHARE IN THE BUILDINGS SECTOR

1) Promote low-carbon heating technologies (*e.g.* heat pumps, solar heating, modern bioenergy for heating and cooling).
2) Apply these renewable energy technologies through district heating.
3) Phase out traditional biomass as a cooking fuel and replace it with clean and efficient cookstoves (biogas, modern solid biomass, electricity).

Decarbonising the global energy system requires **swift and decisive policy action** in the power, industry, buildings and transport sectors.

IRENA International Renewable Energy Agency

South East Asia: Actions needed

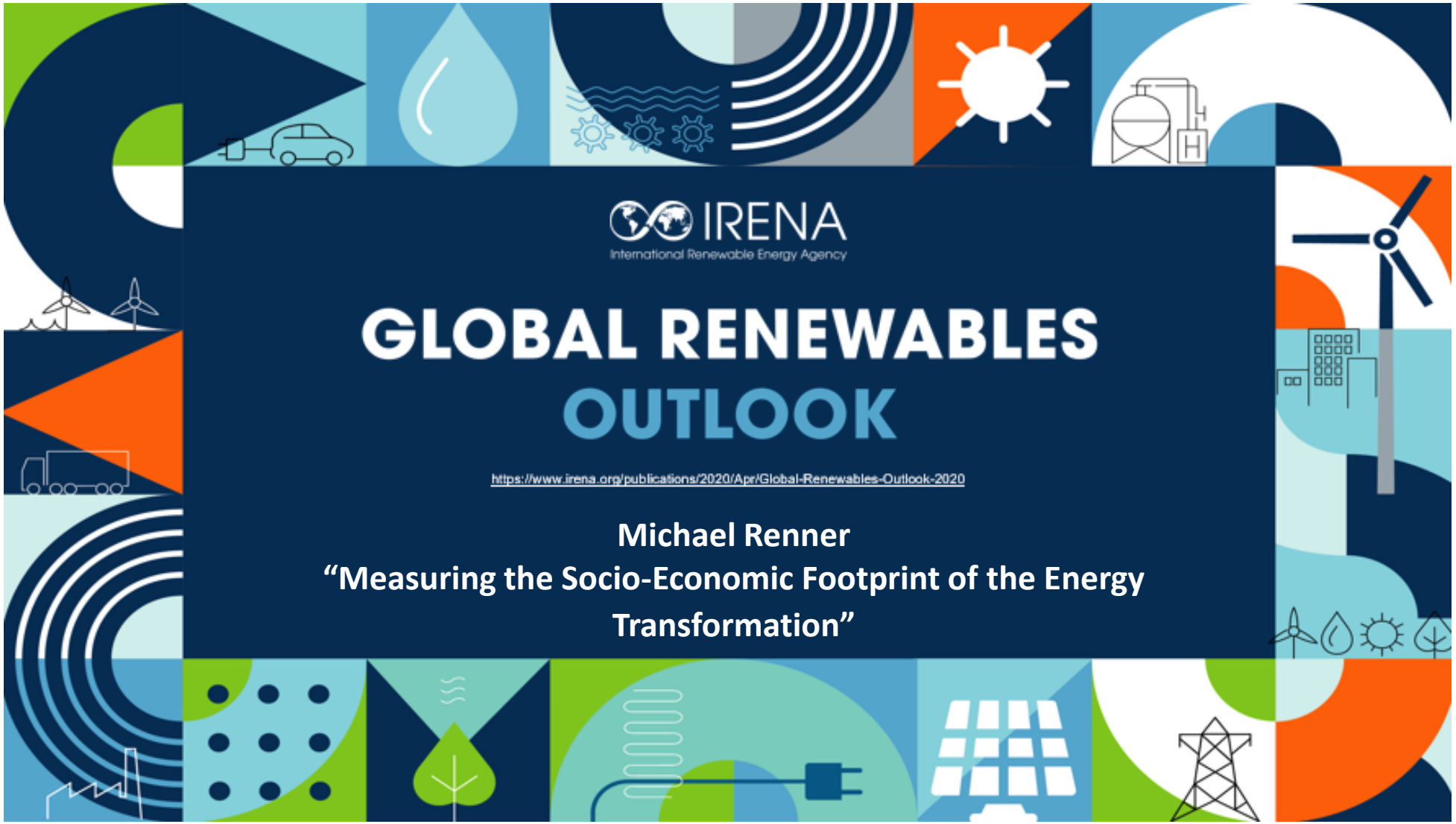
Knowledge creation with **better statistics for renewables**, and wider exchange **of best-practice and technology information** is needed across ASEAN.

End-use sector efforts should be significantly expanded as they make up two-thirds of the effort required to close the gap in realising ASEAN's **renewable energy target** for 2025, and make up a significant portion of the longer-term potential needed to transform the region's energy system over the coming decades.

Power system flexibility needs to be ensured and transmission grid capacity should be expanded and strengthened for renewables integration**. Electrification of end-uses** is also an key solution that will play a more important role in the future and it requires a resilient and robust grid.

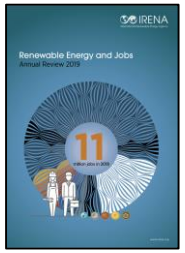
Bioenergy markets should be created by facilitating the sustainable, affordable and reliable supply of bioenergy feedstocks, and wider, efficient use of modern bioenergy across all applications, in particular to replace traditional forms .

Align energy and climate polices and plans and use those as a central pillar for post COVID recovery. Countries should align climate and sustainability targets with national energy plans, and they should value these plans beyond just the effect on the energy sector and take a more holistic, socio-economic view as the energy transition across ASEAN as is more economically and socially beneficial then business as usual.


IRENA
International Renewable Energy Agency
GLOBAL RENEWABLES
OUTLOOK
https://www.irena.org/publications/2020/Apr/Global-Renewables-Outlook-2020
Michael Renner
“Measuring the Socio-Economic Footprint of the Energy Transformation”

IRENA's socio-economic impact analysis

2011 – 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | **2019** | **2020**



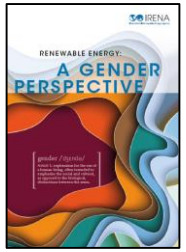
Jobs 2020 (forth-coming)

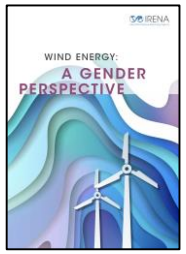
★ **Jobs – Annual Review**

★ **Leveraging Local Capacities**

★ **Measuring the Socioeconomics**

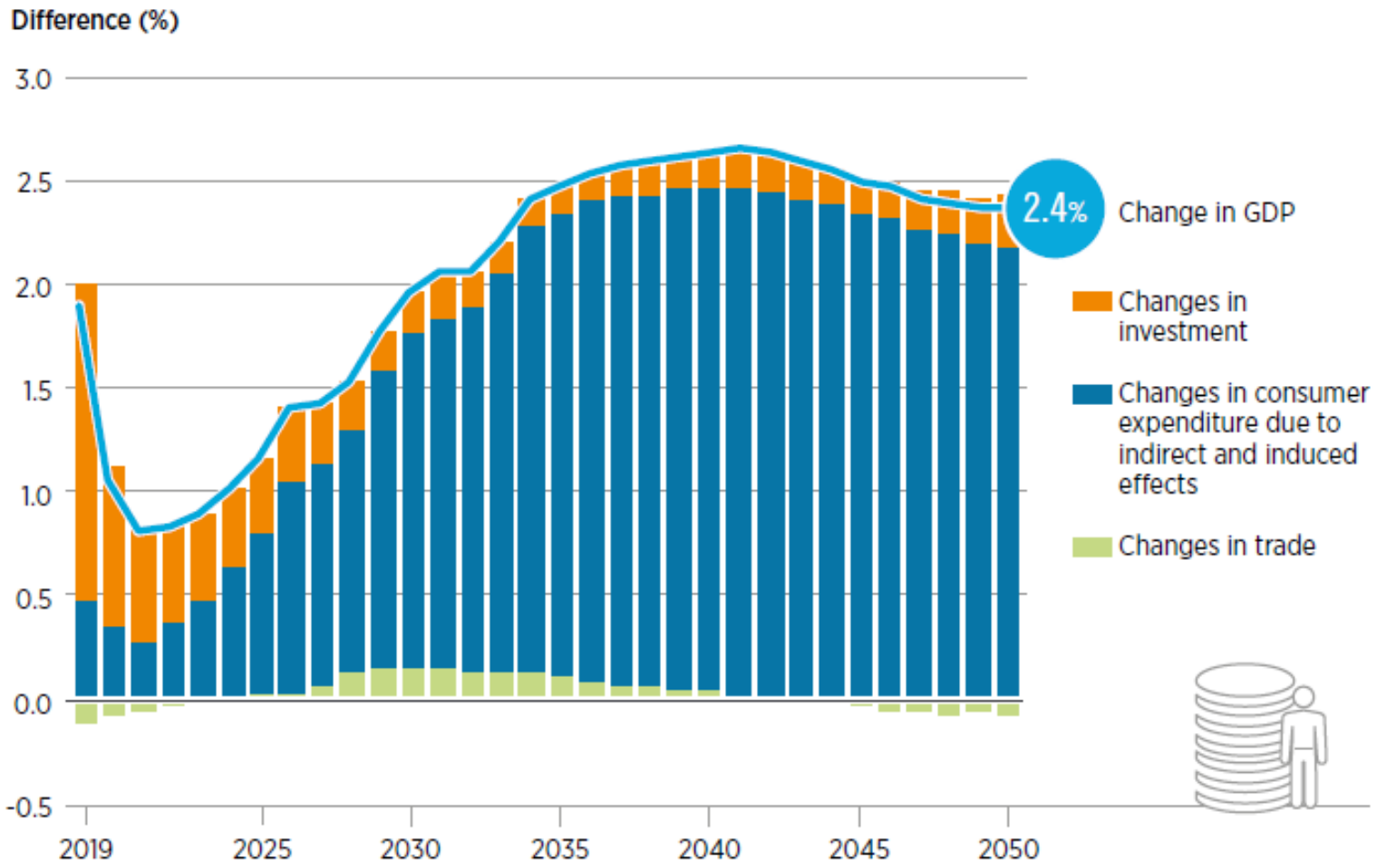
★ **Empowering Women**





The global economy, as measured by GDP, will grow

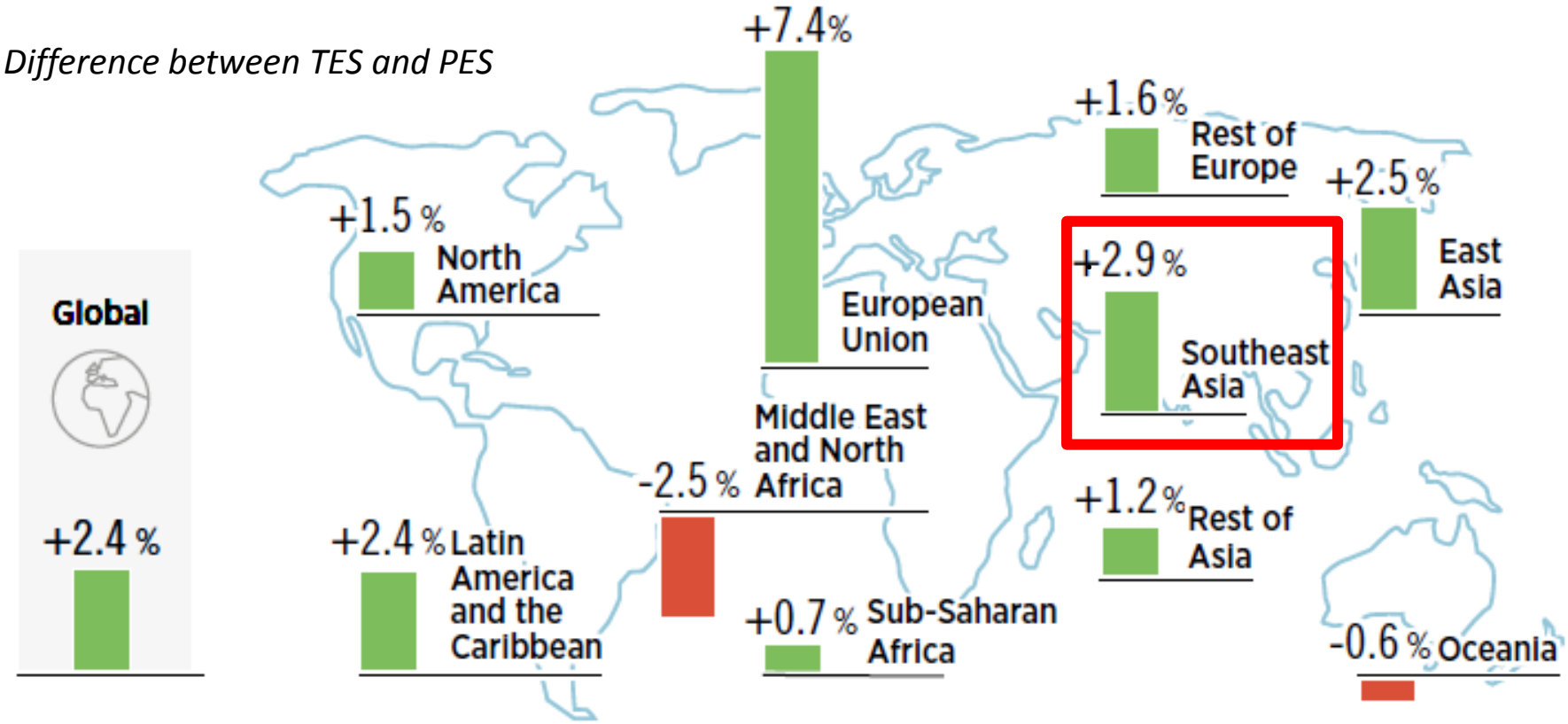
Difference in global GDP between Transforming Energy Scenario and Planned Energy Scenario



Source: IRENA analysis

- The Transforming Energy Scenario boosts global GDP in 2050 by 2.4% over the Planned Energy Scenario.
- The cumulative gain from 2019 to 2050 amounts to USD 98 trillion.

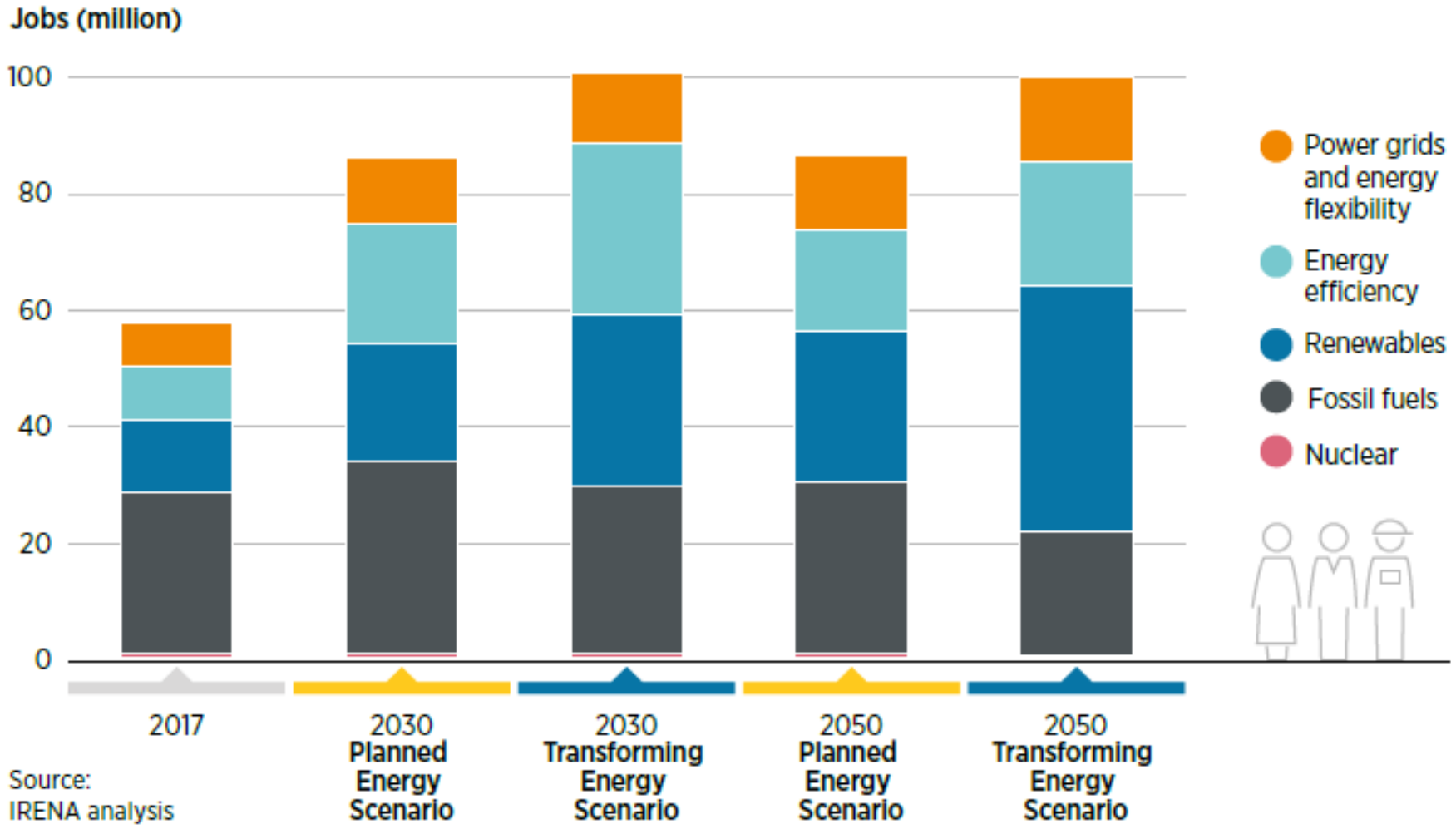
Almost all regional economies gain, including Southeast Asia



- Except for two regions, all parts of the world see their GDP rise under the Transforming Energy Scenario.
- Diverging regional GDP results arise from differences in energy roadmaps and macroeconomic structures, as well as trade patterns among regions.

Energy sector jobs: Renewables gain, fossil fuels shrink

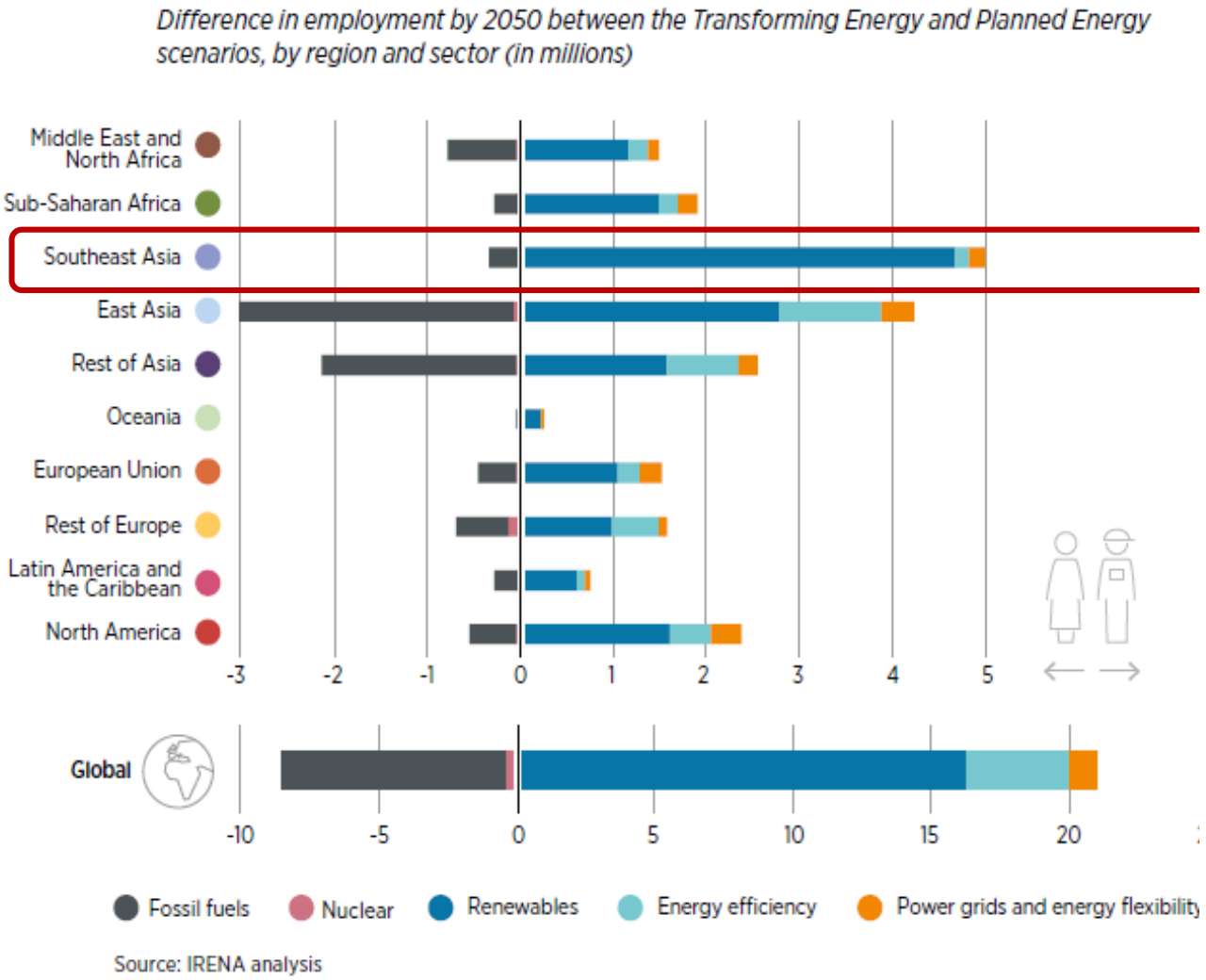
Global energy sector jobs under the Planned Energy and Transforming Energy scenarios, in 2017, 2030 and 2050

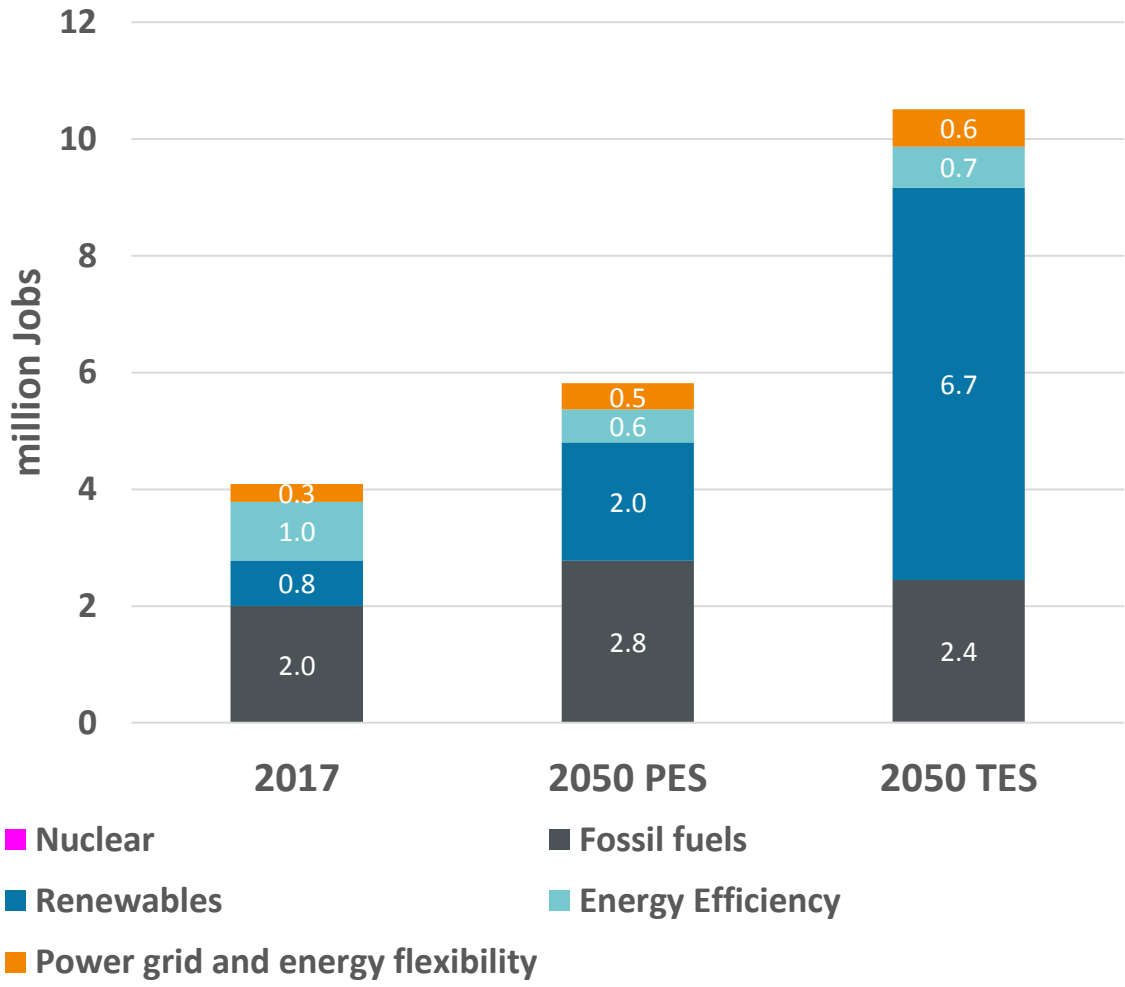


Source: IRENA analysis

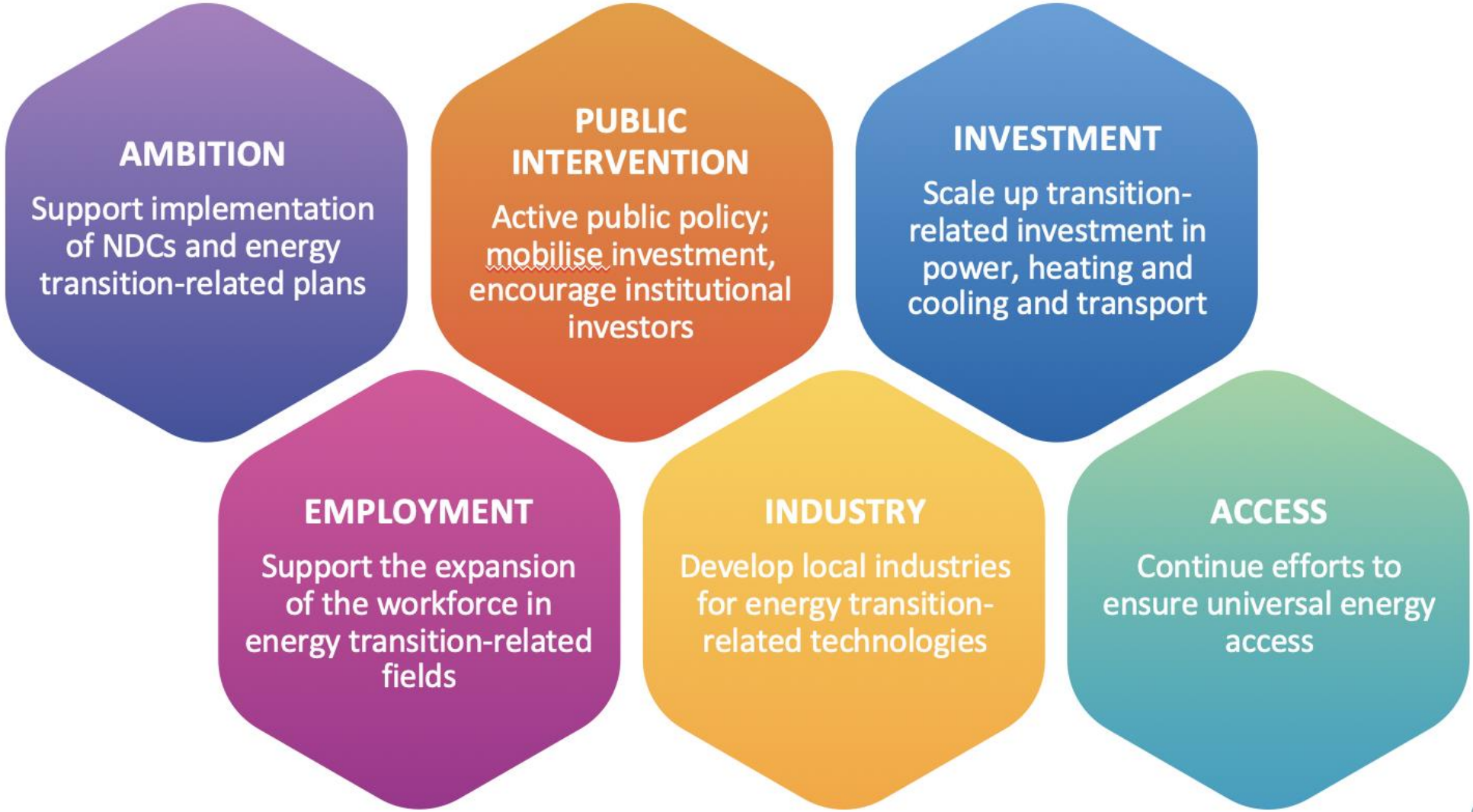
- The energy sector will employ almost 100 million people by 2050.
- Of these, 42 million jobs will be created in renewables, 21 in energy efficiency and 15 million in power grids and energy flexibility.

All regions see gains in energy sector jobs, including Southeast Asia

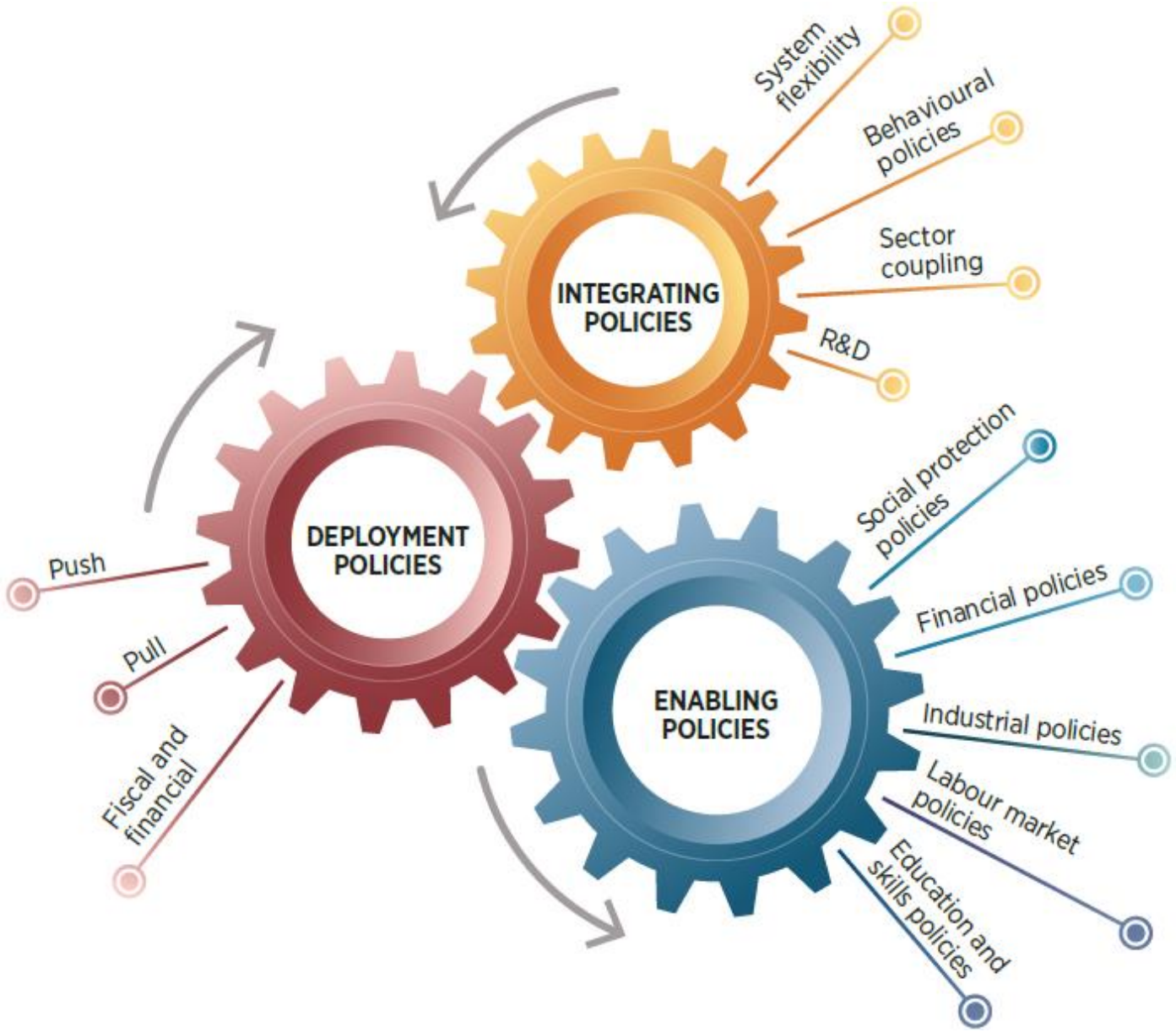




Principles and objectives for the energy transformation



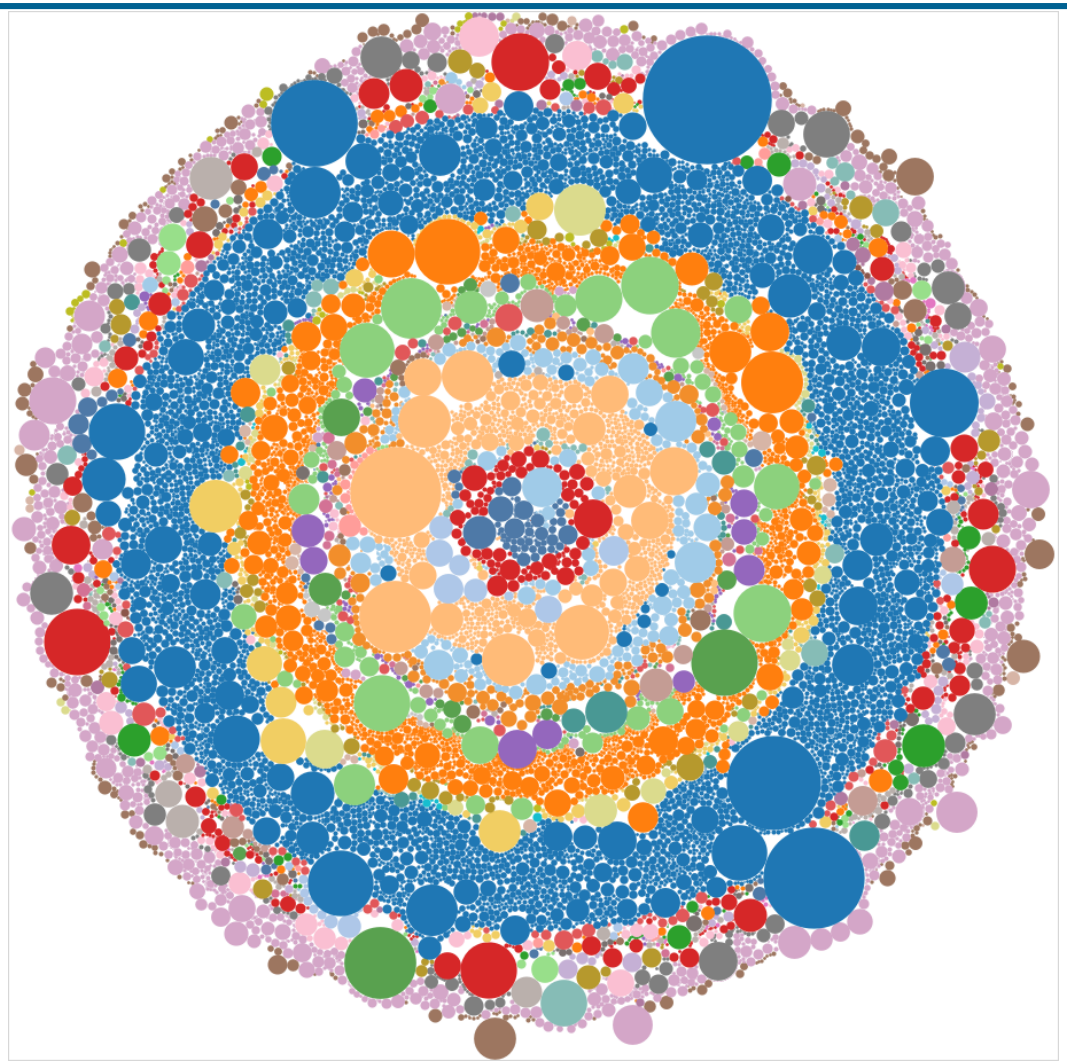
A comprehensive policy package can support the energy transformation



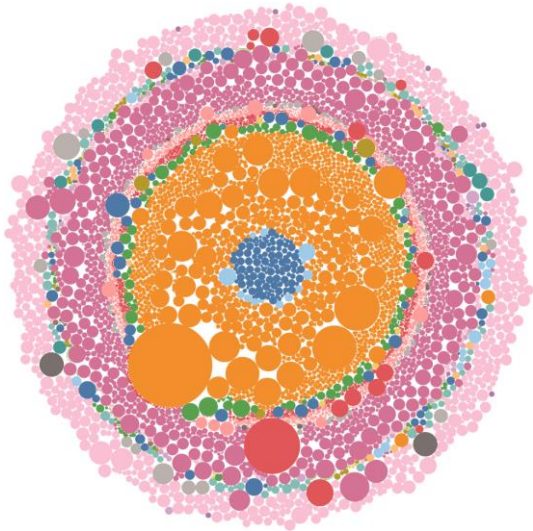
Renewable Power: Costs Continue to Fall

Michael Taylor

Power generation and PPA/tender databases

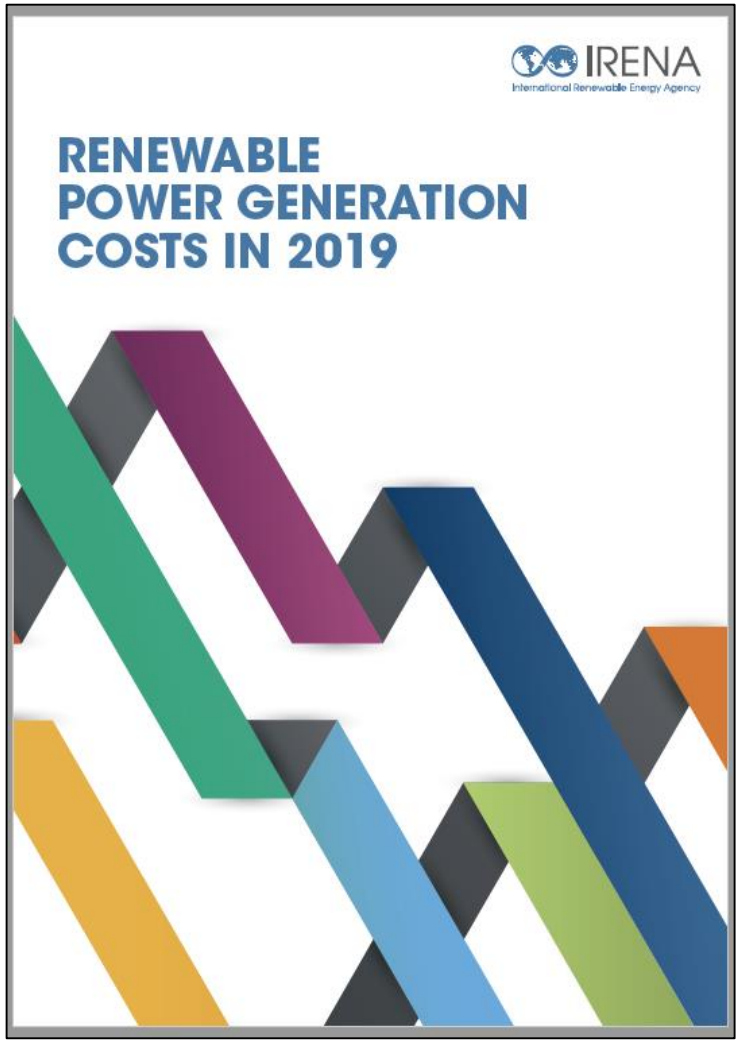


Project cost database
~18k projects
1775 GW



PPA/Auction database
~11k projects
496 GW

Costs continuing to fall for RE, solar & wind power in particular



In most parts of world RE least-cost source of new electricity:

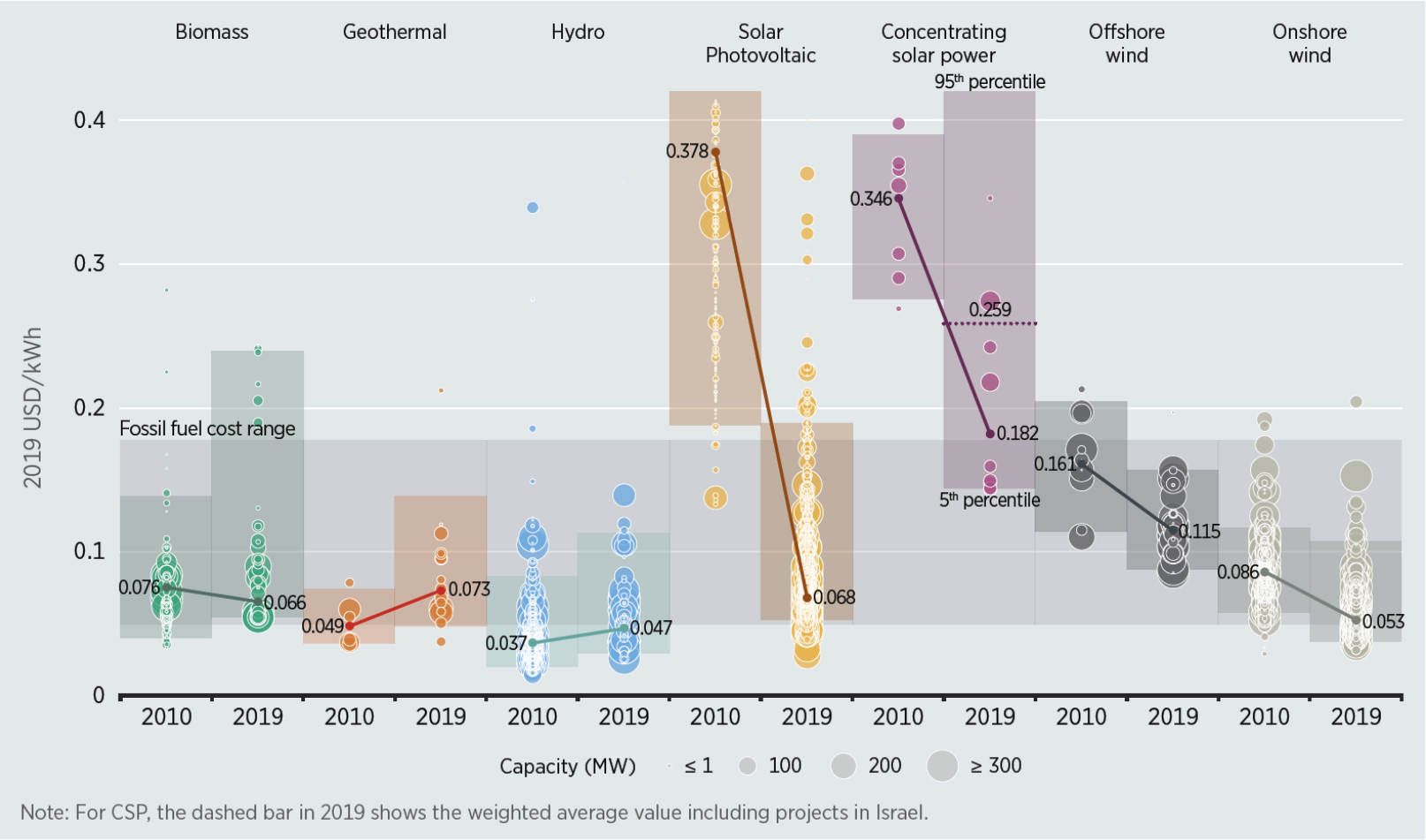
- 56% of utility-scale capacity added in 2019 cost less than cheapest new coal option

Will increasingly undercut even operating costs of existing coal

Cost reductions for solar wind are coming from:

- improved technology, economies of scale, more competitive supply chains and developer experience

Recent cost evolution: LCOE

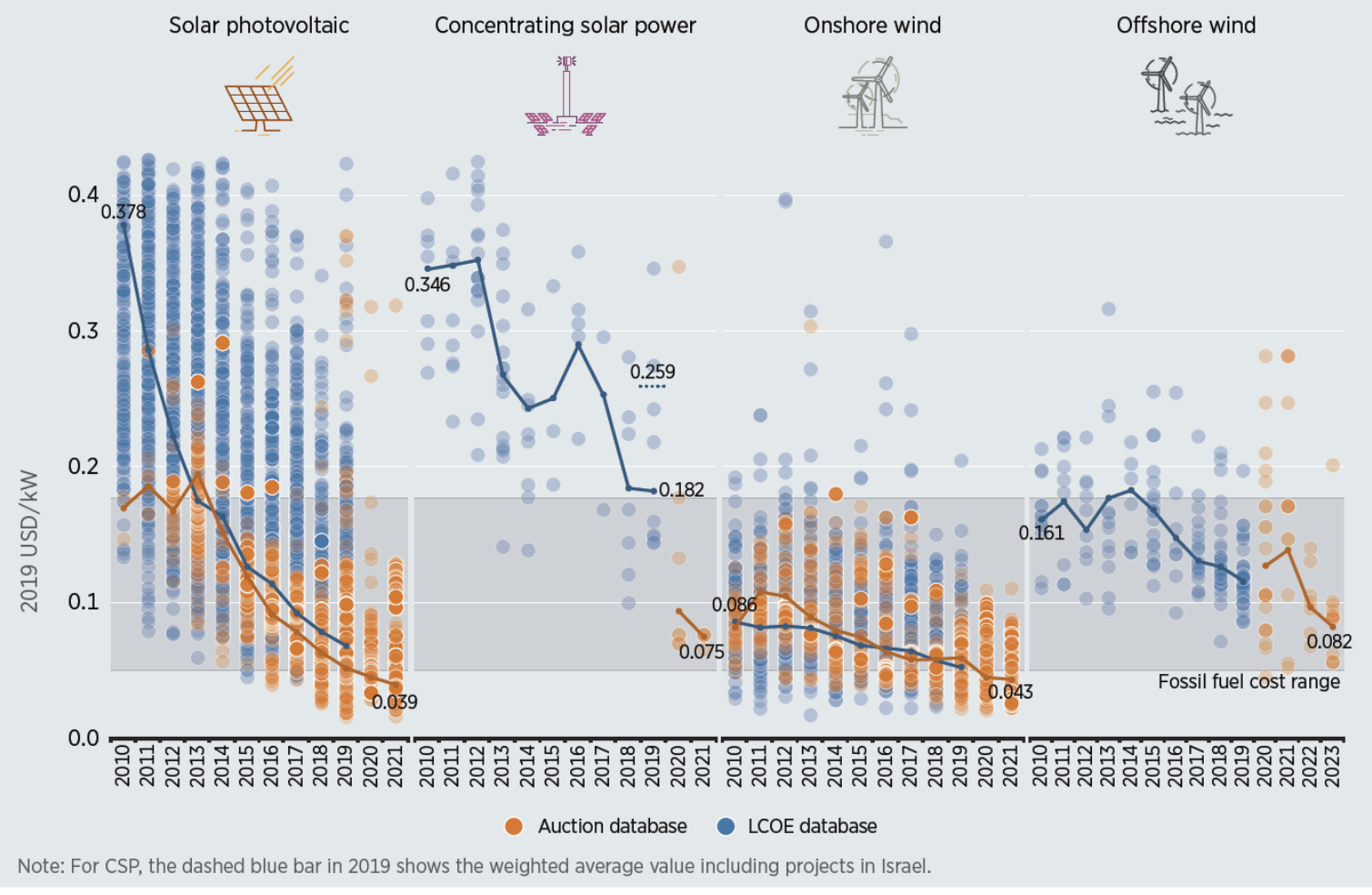


- Average LCOE of all renewable power generation technologies, except CSP fall in fossil fuel cost range in 2019
- Bioenergy, geothermal, hydro, solar PV and onshore wind all at lower end of fossil cost range

Source: IRENA Renewable Cost Database.

Note: This data is for the year of commissioning. The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted-average LCOE value for plants commissioned in each year. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world. The single band represents the fossil fuel-fired power generation cost range, while the bands for each technology and year represent the 5th and 95th percentile bands for renewable projects.

Recent cost evolution



Source: IRENA Renewable Cost Database.

Note: Each circle represents an individual project LCOE (blue dots), or an auction result (orange dots), where there was a single clearing price at auction, for the actual or estimated year of commissioning respectively. The centre of the circle is the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE, or auction values, by year. For the LCOE data, the real WACC is 7.5% for OECD countries and China, and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

- Cost reductions continue to 2021/23
- Utility-scale solar PV and onshore wind undercut cheapest new fossil fuel
- Offshore wind and CSP see step change in costs
- Offshore wind to USD 50-100/MWh
- CSP, with an even lower deployment, could fall to USD 70-80/MWh

Today's strong business case for renewable power:

Levelised Cost of Electricity Declines

	2010 - 2019	2010 - 2021/23
Solar PV	-82%	-90%
CSP	-47%	-78%
Offshore wind	-29%	-49%
Onshore wind	-39%	-50%

Source: IRENA.

Note CSP LCOE in 2019 excludes projects in Israel.

Competitive source of new power: Costs are not just falling but low

56% of utility-scale capacity added in 2019 cost less than cheapest new coal option :

- 89% of new hydropower capacity
- 75% of new onshore wind capacity
- 40% of new utility-scale solar PV capacity

With Auction/PPA data showing an improving trend, in 2021:

- Global weighted average for solar PV and onshore wind will be well below of new utility-scale solar PV capacity
- Retiring the 500 GW of least competitive existing coal plant could save USD 12-23 billion per year.

Deep Dive: Onshore Wind

Wind power costs are falling….

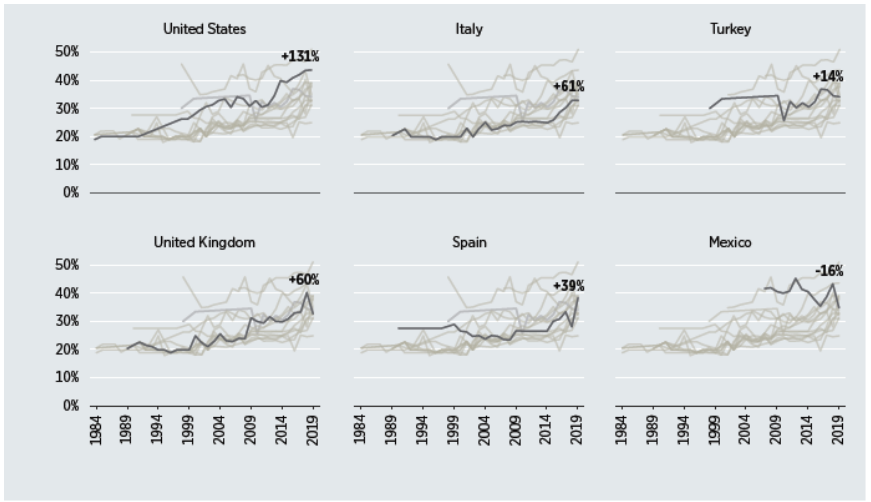
Higher capacity factors from improved technology

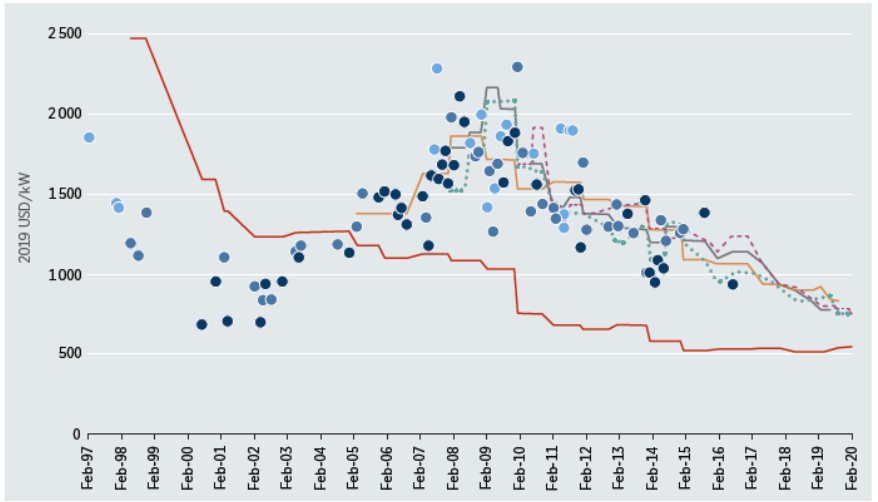
+

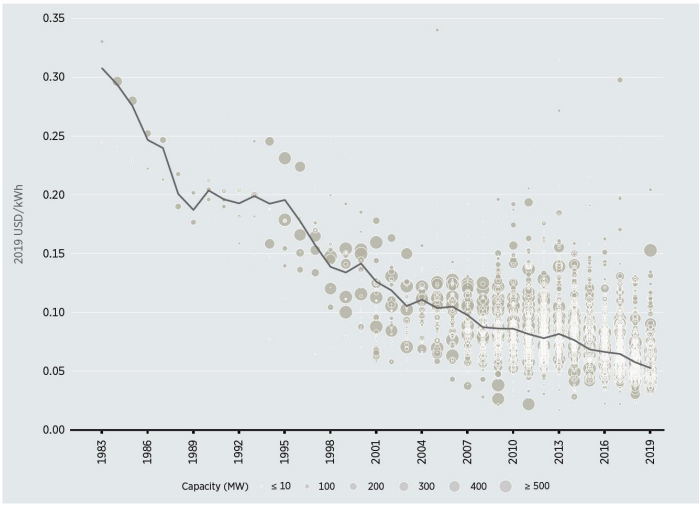
Total installed cost declines: lower wind turbine costs

=

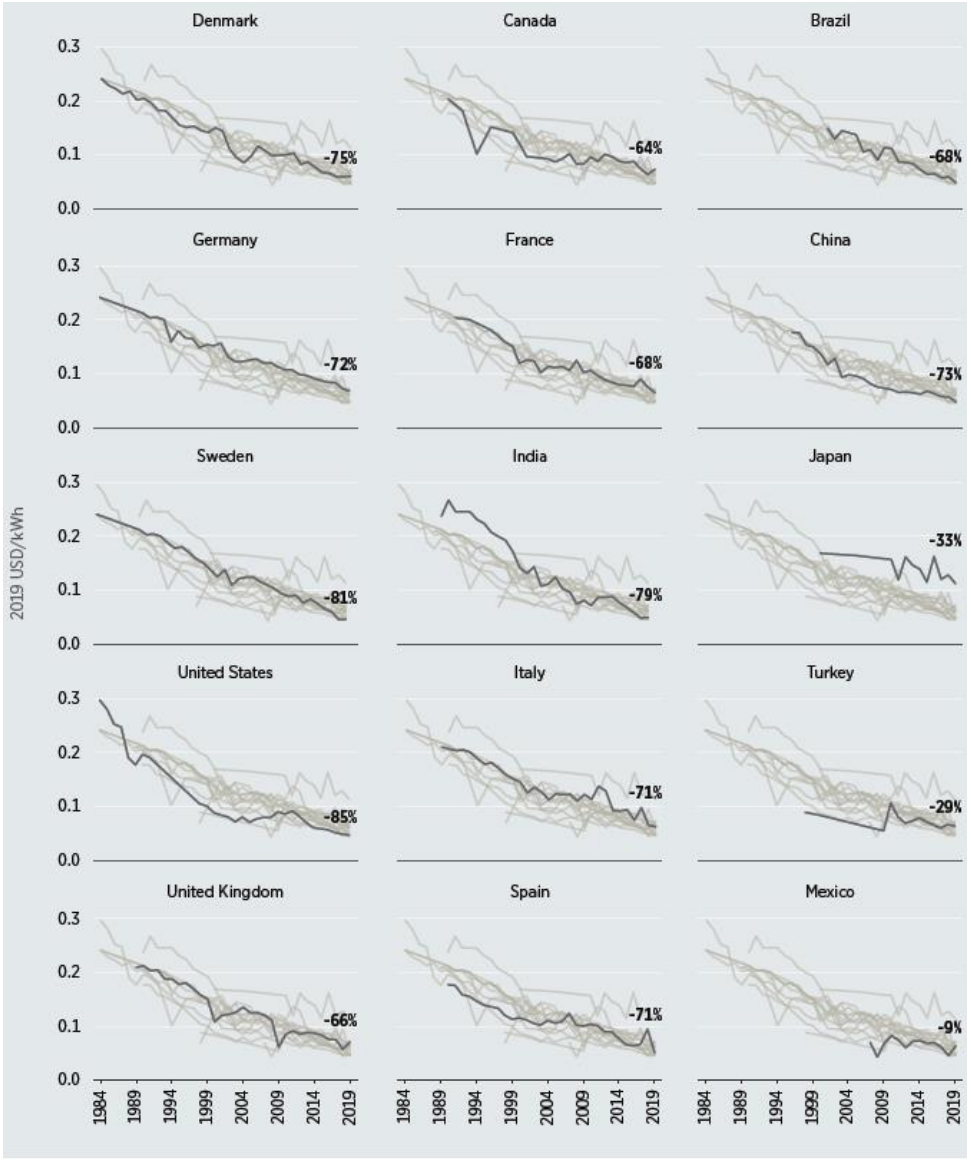
LCOEs are falling

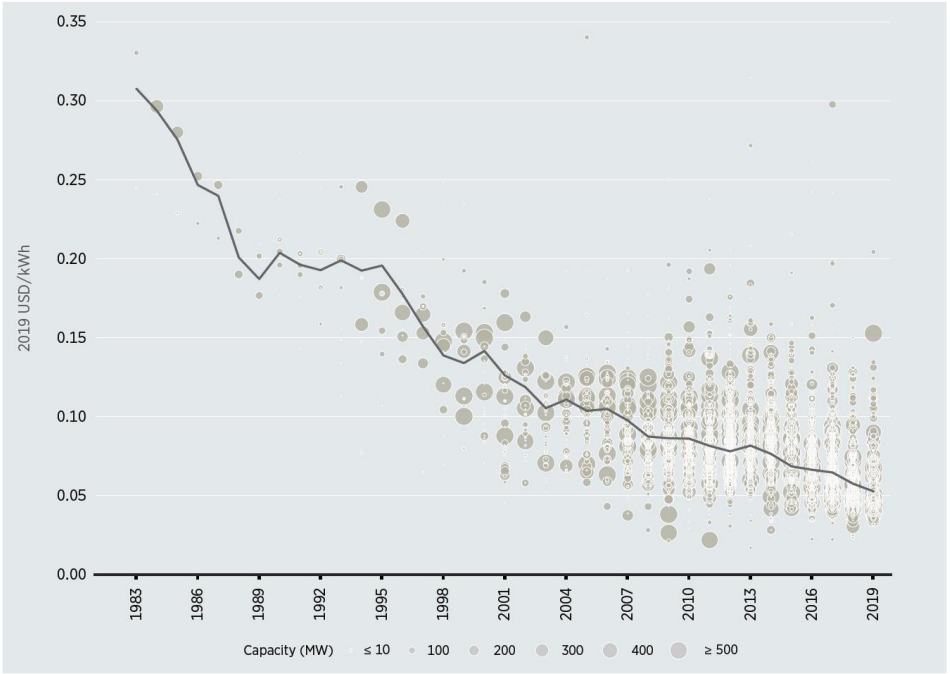






Onshore wind: Falling electricity costs





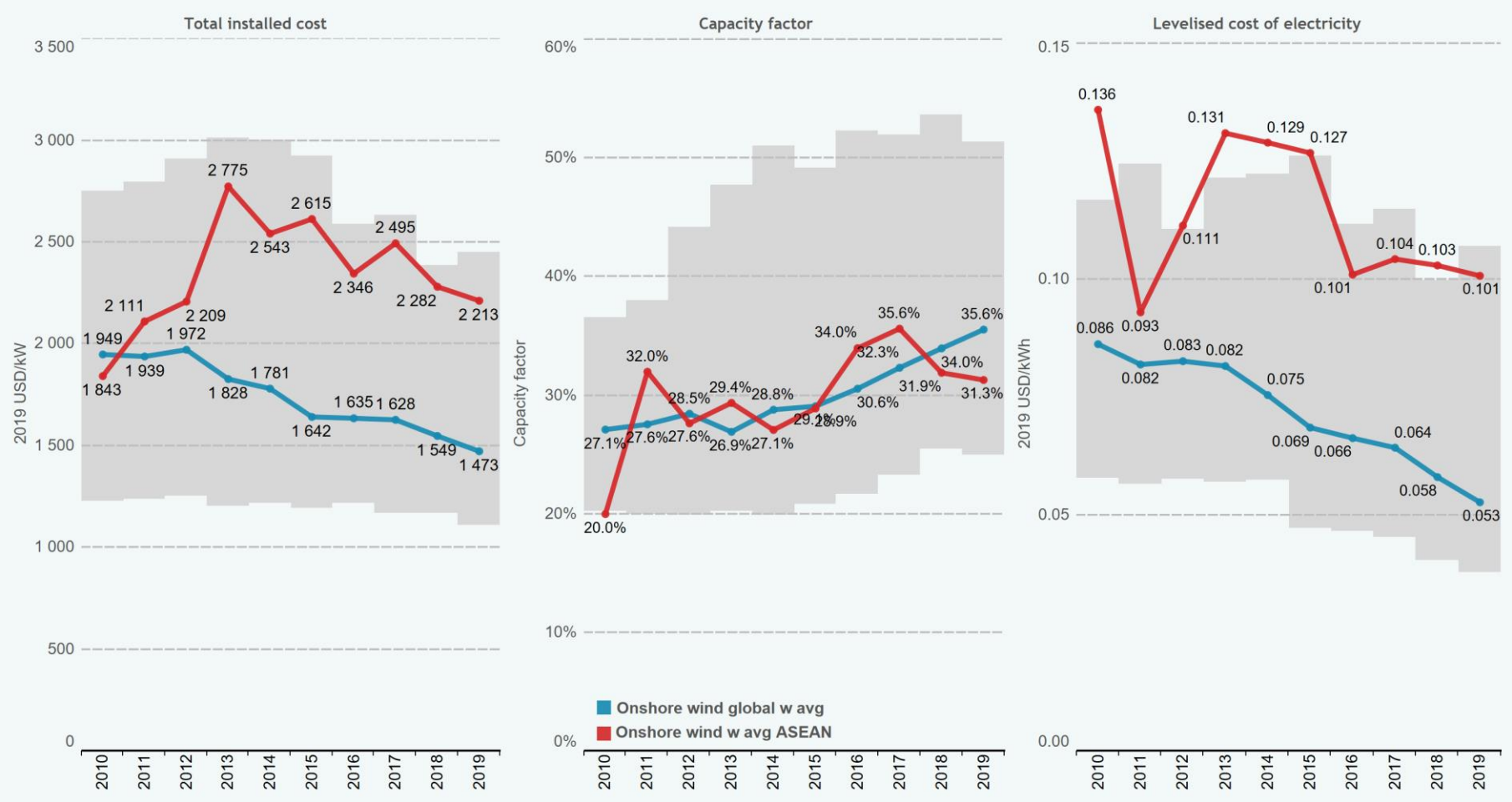
Global LCOE of onshore wind has declined by **85% between 1983-2019:**

- **USD 0.308/kWh ➡ USD 0.053/kWh**

In 2019, **three-quarters of newly added capacity** – had an LCOE below the cheapest fossil fuel

Onshore wind: ASEAN/Global cost evolution

Increasing capacity factors and reduced turbine costs have improved global competitiveness



Between 2010-2019, the global weighted average:

- Total installed cost reduced by **24% from USD 1 949/kW to USD 1 473/kW**
- Capacity factor increased by **9 percentage points from 27% to 36%**
- LCOE reduced by **39% from USD 0.086/kWh to USD 0.053/kWh**
- **Total installed costs 50% higher in ASEAN**

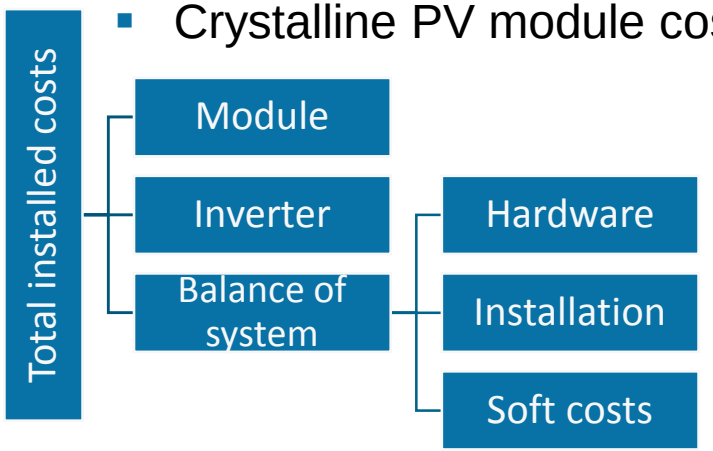
Source: IRENA Renewable Cost Database

Deep Dive: Solar PV

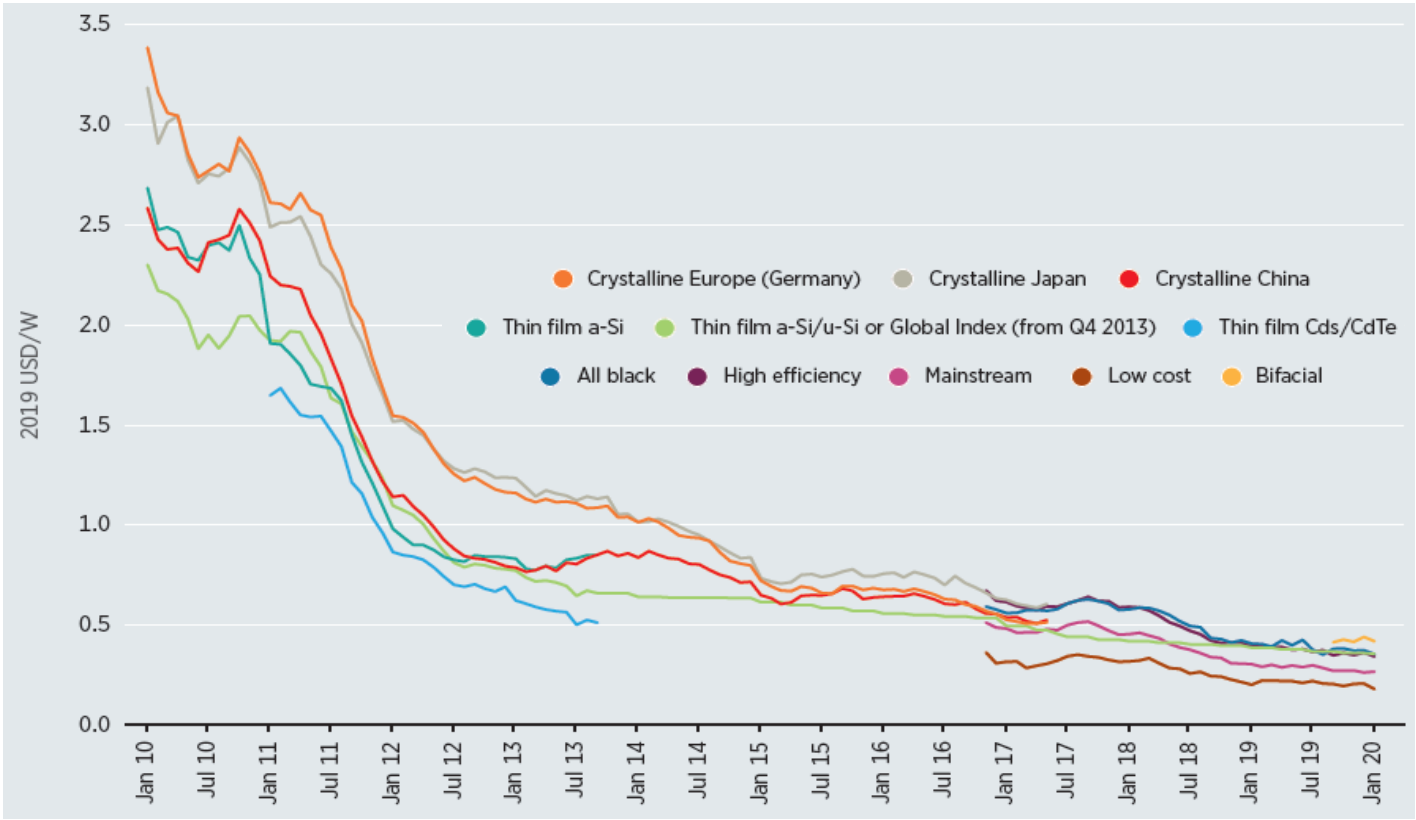
Solar PV cost trends

Module costs continue its decline, driven by manufacturing optimization and efficiency gains

- Crystalline PV module costs decline around 90% since 2010 (and 14% since 2018)

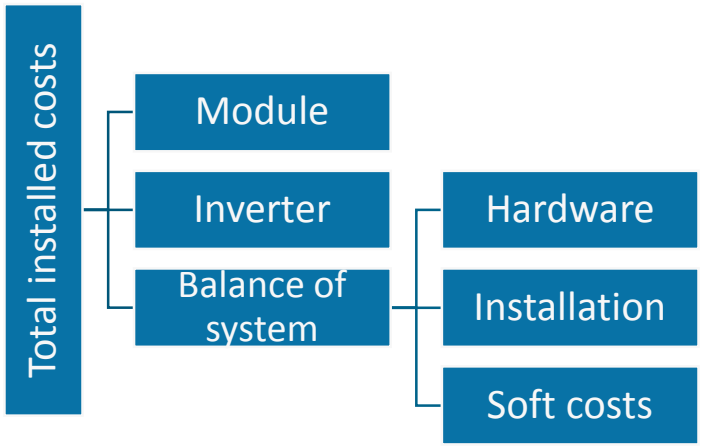


- Costs range in Dec 2019 from USD 0.21/W to USD 0.38/W
- High efficiency modules selling at USD 0.36/W
- Recently bifacial module costs within a close range of higher performing mono-facial options

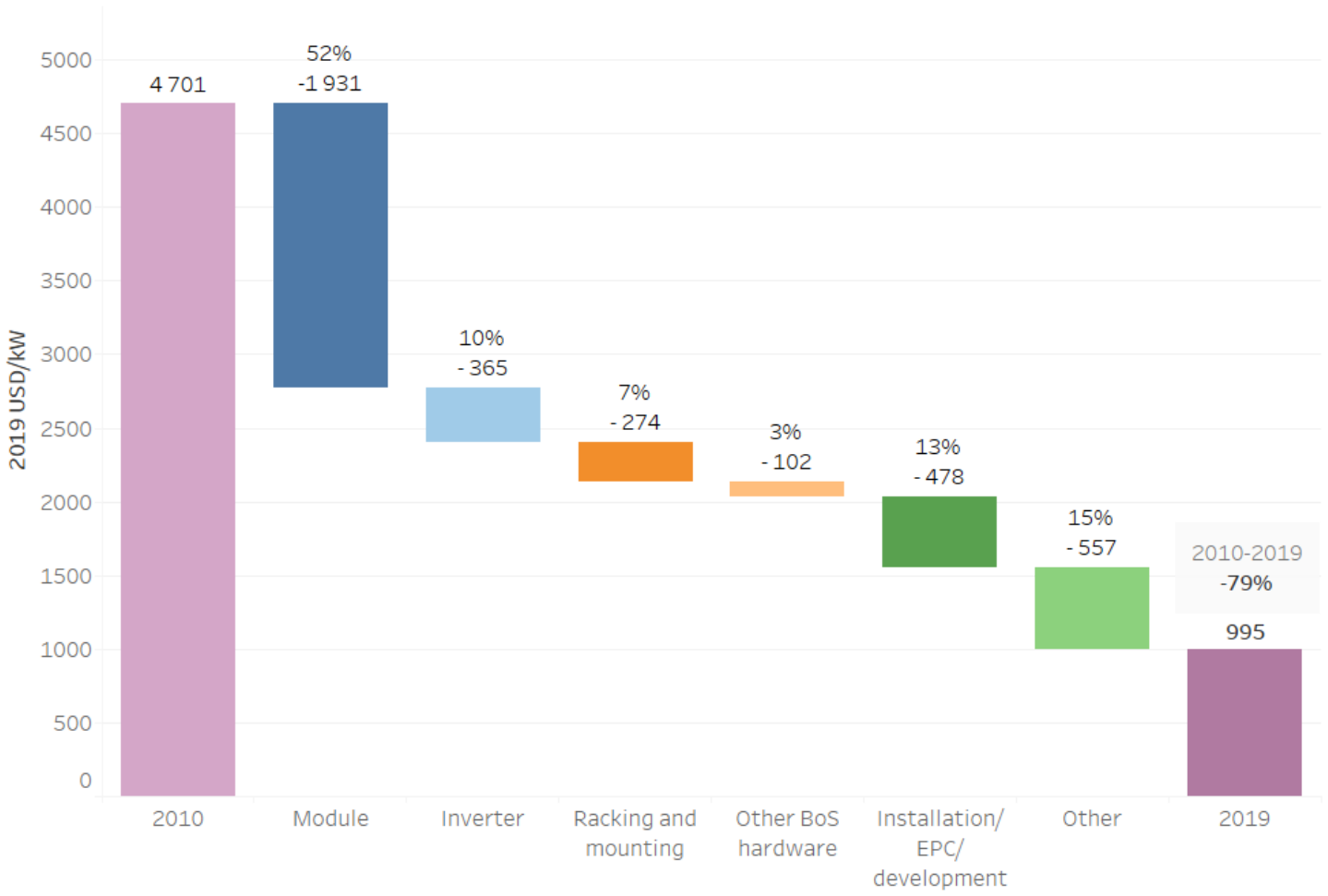


Source: GlobalData (2019); pvXchange (2020); Photon Consulting (2017).

Total installed cost reduction drivers: Utility-scale solar PV

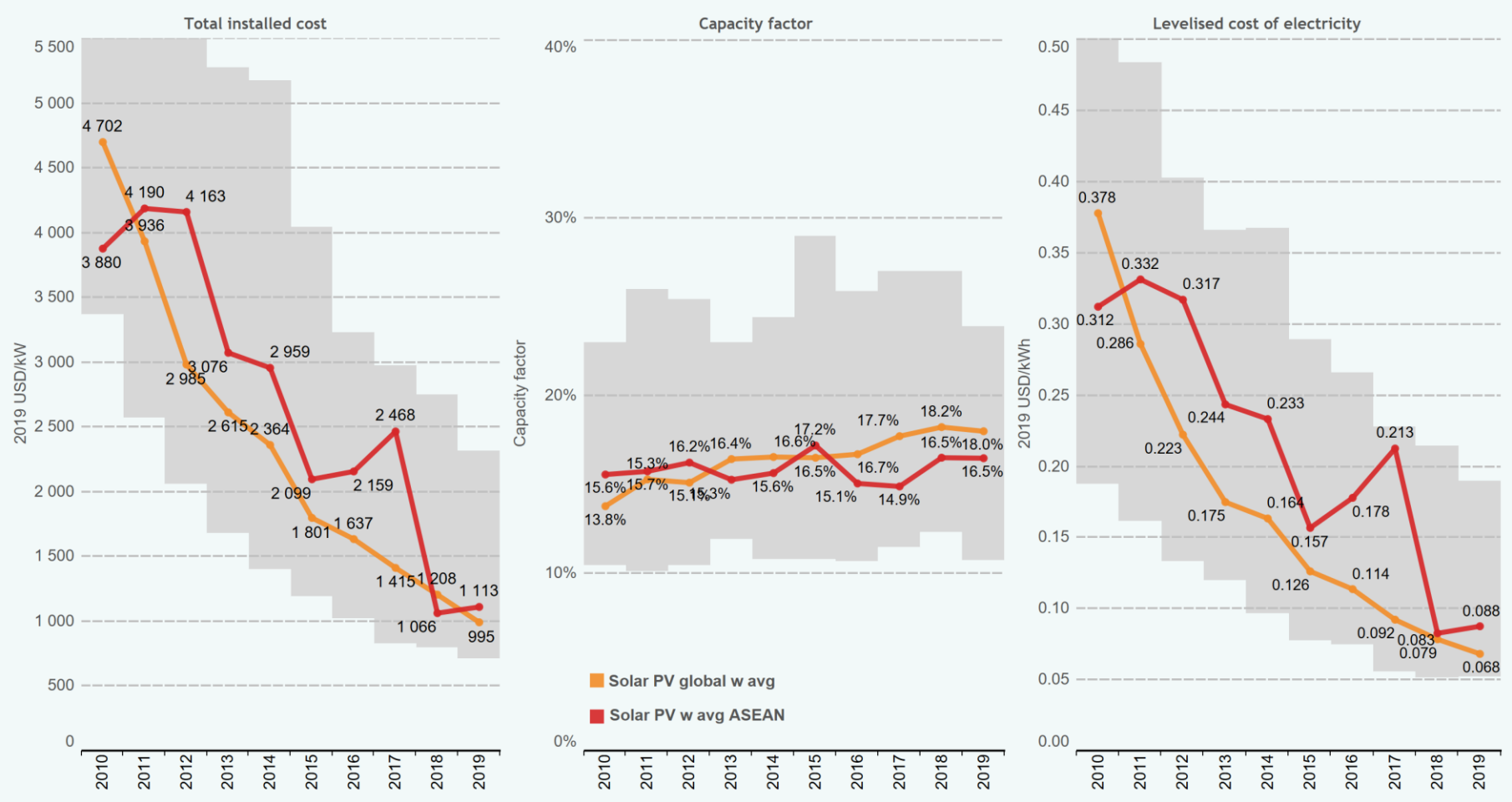


- Modules and inverters accounted for 62% of the global weighted-average total installed cost decline
- BoS costs are also an important contributor



Recent cost evolution: Solar PV

The global w. avg LCOE of utility-scale PV has declined 13% YoY in 2018-2019 to USD 0.068/kWh



- Total installed costs w. avg. declined 13% from 2018 and 79% from 2010.
- Shift of w. avg. to lower end of the 5th and 95th percentile ranges
- Cost reduction drivers
  - lower module costs
  - sustained BoS decline
- ASEAN PV becoming increasingly competitive

Source: IRENA Renewable Cost Database

Renewables are increasingly competitive

The winners are customers, the environment and our future

www.irena.org
mtaylor@irena.org

IRENA
International Renewable Energy Agency

Good Practices from the region

Dr. Hariyanto

Director, Energy Conservation, MEMR Indonesia

Nguyen Hoang Linh

Senior Expert, Planning Division, Electricity and RE Authority, MOIT Vietnam

Jonathan Goh

Director of External Relations, Energy Market Authority, Singapore

Dr. Tharinya Supasa

Senior Officer of Energy Policy Planning and Modelling, ACE

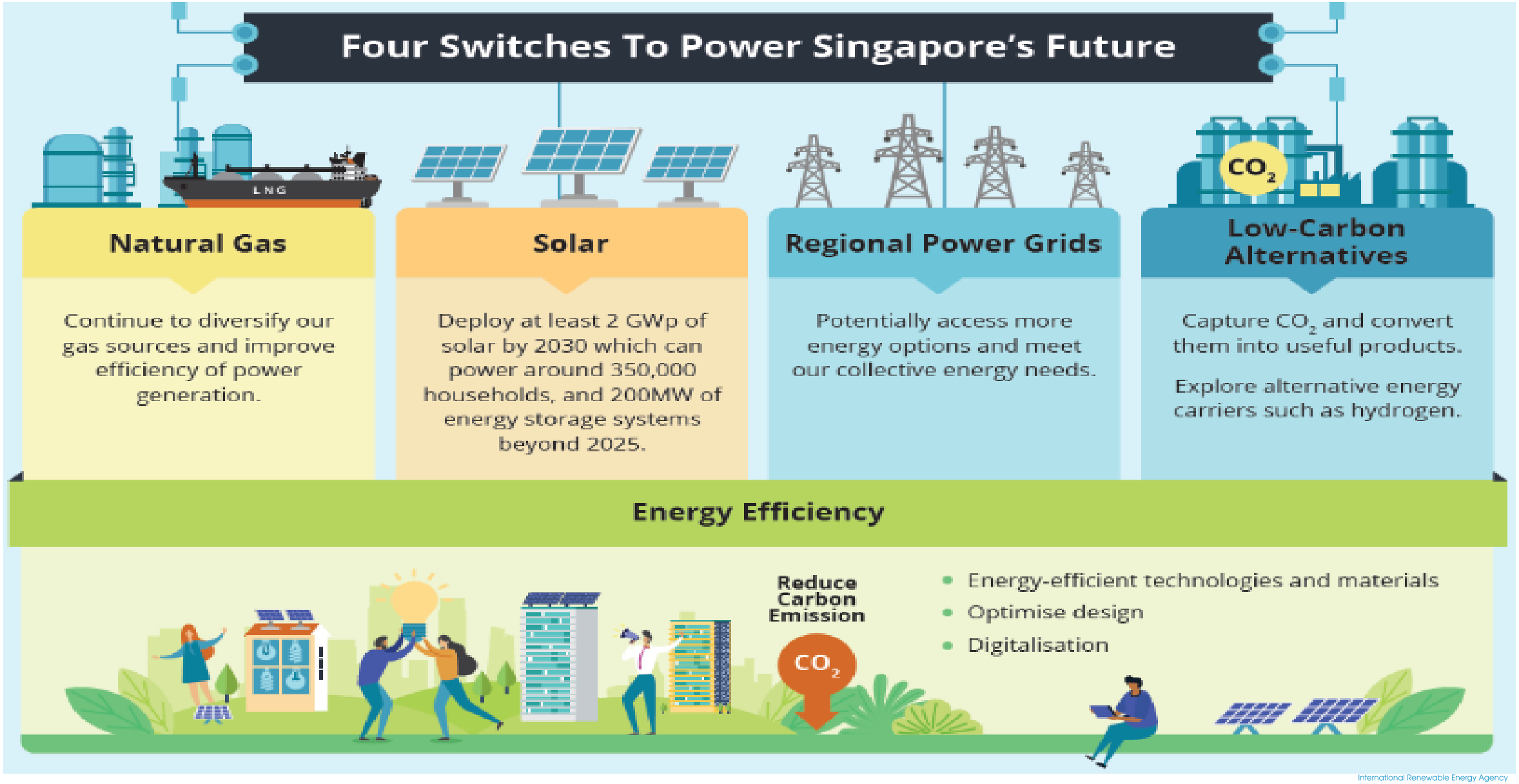
Singapore's Policies for Energy Transformation

Jonathan Goh

Director, External Relations Department

Energy Market Authority, Singapore

The Singapore Energy Story

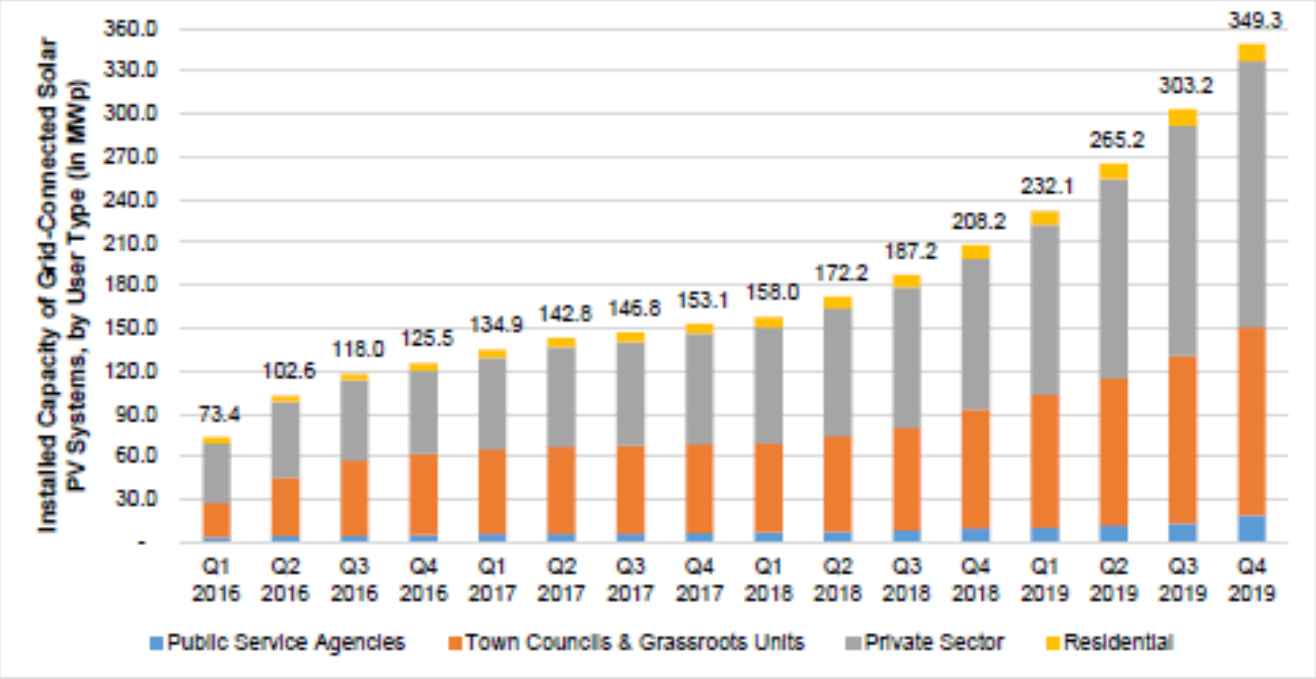


Solar in Singapore: 2 GWp by 2030

Since 2008 to end-2019:

- The number of grid-connected installations has increased from **30 to 3,504**;
- The installed capacity has increased from **0.4 to 349.3 MWp**.

Figure 1: Installed Capacity of Grid-Connected Solar PV Systems (in MWp), 1Q 2016 – 4Q 2019 (as at end of each quarter)



We have achieved our 2020 solar deployment target of 350 megawatt-peak (MWp) in 1Q 2020. **However solar still only meets <1% of our total electricity demand.** We are doing more to facilitate the sustainable entry of solar, to raise its adoption in our system to at least 2 GWp by 2030

Solar Developments in Singapore

Rooftop Solar PV

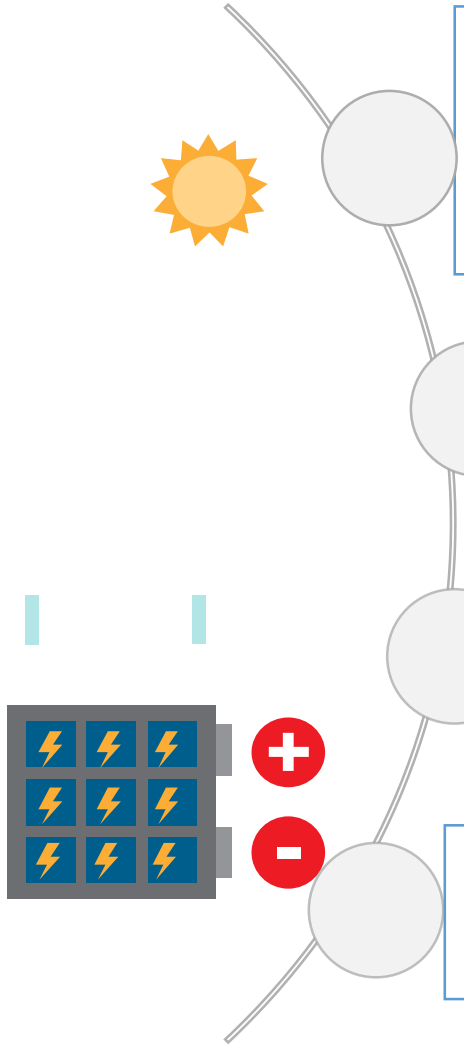
Through the existing SolarNova Programme, we will continue to aggregate solar rooftop spaces and maximise the deployment of solar panels across Government buildings

Floating Solar PV

To create new space for solar deployment; a 60 MWp floating platform will be operational in 2021

Deployment of Energy Storage Systems in Singapore

ESS is a game-changing technology that can enable higher levels of solar adoption, as well as increase system efficiency through peak-shaving of electricity demand.



In Oct 2018, Singapore's Energy Market Authority (EMA) rolled out the ACCESS (ACCelerating Energy Storage for Singapore) programme to facilitate the deployment of Energy Storage Systems in Singapore. ACCESS partners can work with EMA to **pilot use cases and design business models** to operate ESS.

In Oct 2018, EMA published a **policy paper on ESS** to provide regulatory clarity for the industry. The existing framework allows ESS to participate in the energy, regulation and reserves markets.

To meet the increasing solar PV capacity, the aim is to deploy **200 MW of ESS** beyond 2025

EMA continues to work with industry to facilitate new ESS and related technologies such as Vehicle-to-Grid (V2G) and Virtual Power Plants (VPP)

Advancements in H2 and CCUS are Critical for Decarbonisation

Natural Gas

- Improve the efficiency of combined-cycle gas turbines
- Encourage adoption of more efficient gas generation technologies

Solar

- Maximise rooftop solar PV deployments
- Further deployment of floating solar PV on inshore reservoirs
- Deployment of Energy Storage Systems (ESS)

Regional Power Grids

- Explore electricity trading with regional power grids
- Accessing a wider pool of electricity from various sources

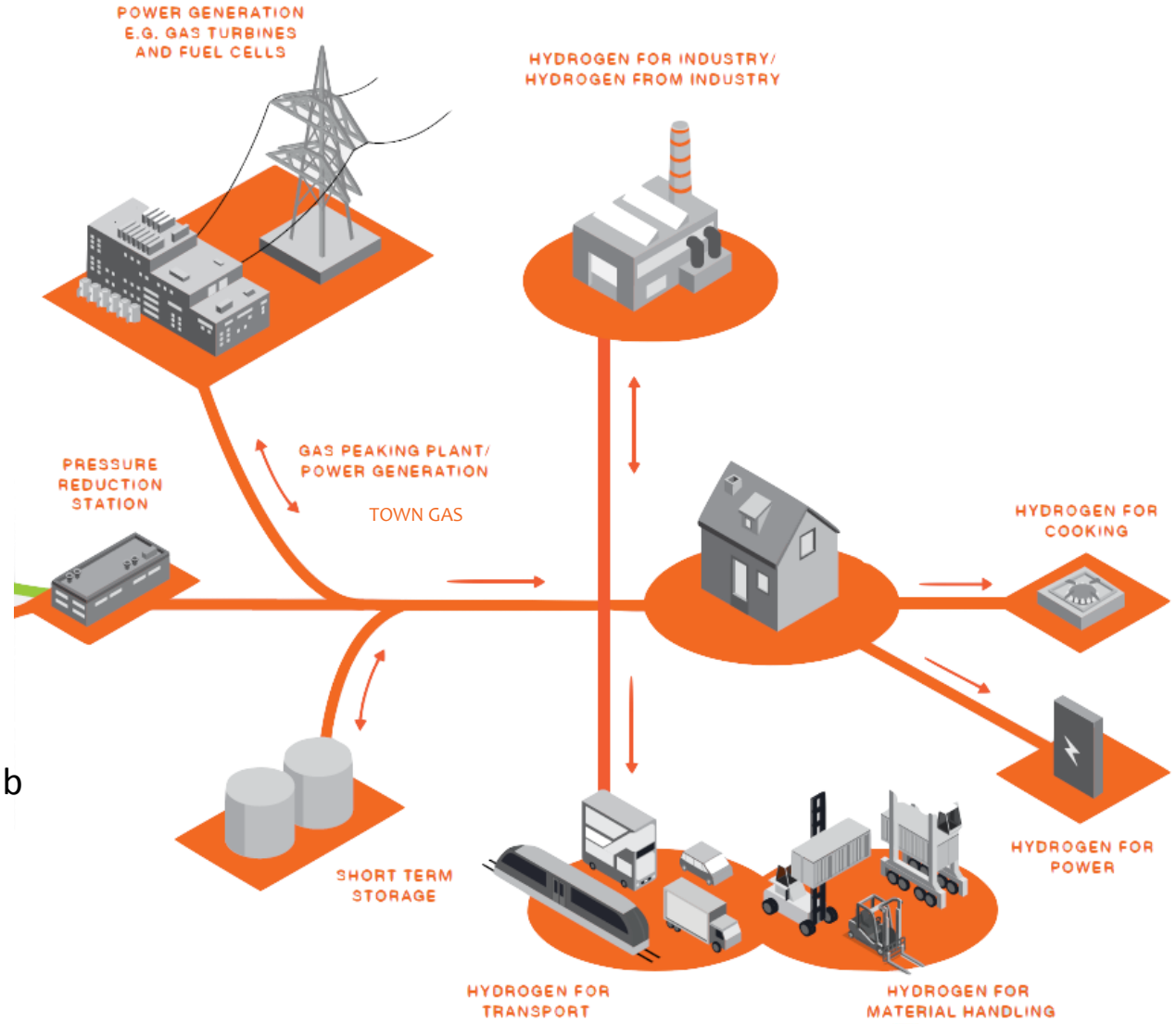
Low-Carbon Alternatives

- Assess large-scale renewable hydrogen imports and deployment
- Develop CCUS technologies

Singapore's Interests in Hydrogen

Green and blue hydrogen ("renewable hydrogen") present potential opportunities for Singapore:

- Large scale, low cost production in renewable-rich countries
- Can be transported over long distances in many forms
- Cleaner power and fuel
- Clean feedstock for CCU
- Potential green hydrogen trading hub



Singapore's Interests in Hydrogen

NCCS NATIONAL CLIMATE CHANGE SECRETARIAT SINGAPORE | STRATEGY GROUP PRIME MINISTER'S OFFICE

EDB singapore

ENERGY MARKET AUTHORITY
Smart Energy, Sustainable Future

- Government agencies commissioned KBR and Argus to conduct a feasibility study on H_2 imports and downstream applications in Singapore.
- The study aims to:

Assess potential sources of hydrogen imports up to 2050

Identify suitable downstream applications for renewable H2

Identify R&D opportunities to develop and advance hydrogen technologies in Singapore ("build vs. buy")

Recommend policy and regulatory solutions to address barriers

Singapore's Interests in CCUS

- Singapore is studying how to reduce CO2 emissions from industrial and power generation sectors through CCUS.
- Singapore is developing R&D initiatives to lower the cost of CCU and exploring potential international partnerships in this area.
- Recently completed CCUS study for Singapore showed significant potential for CCUS for the medium and long-term (2030 / 2050).

CAPTURE & PURIFICATION

Necessary pre-cursor for CCU

STORAGE

In geological sub-surface formations and enhanced oil recovery

UTILISATION

MINERALISATION

BIOLOGICAL

CHEMICAL

Commercially valuable products

CARBON AGGREGATES

Building materials; Sand/cement replacement

SYNTHETIC FUELS

Drop-in replacement for conventional fossil fuels

CHEMICALS

Includes carboxylates, methanol, etc.

Good Practices from the region

Dr. Hariyanto

Director, Energy Conservation, MEMR Indonesia

Nguyen Hoang Linh

Senior Expert, Planning Division, Electricity and RE Authority, MOIT Vietnam

Jonathan Goh

Director of External Relations, Energy Market Authority, Singapore

Dr. Tharinya Supasa

Senior Officer of Energy Policy Planning and Modelling, ACE

Panel Discussion

Moderator

Dr. Hoyyen Chan

Senior Officer of Sustainable Energy, Renewable Energy, and Energy Efficiency, ACE

Panelists

Michael Williamson

Chief, Sustainable Energy development Section, UNESCAP

Prof. Sulaiman Shaari

Secretary General, Asian Photovoltaic Industry Association

Liming Qiao

Asia Director, Global Wind Energy Council

Closing Remarks

Dr. Nuki Agya Utama

Executive Director,

ACE

THANK YOU FOR JOINING US!

SEE YOU IN OUR NEXT WEBINARS

www.irena.org