IRENA
International Renewable Energy Agency

International Renewable Energy Agency

Brief introduction

Nicholas Wagner
Renewable Energy Roadmaps (REmap), Innovation and Technology Centre, IRENA
APEC, 12 Sept. 2018

About IRENA

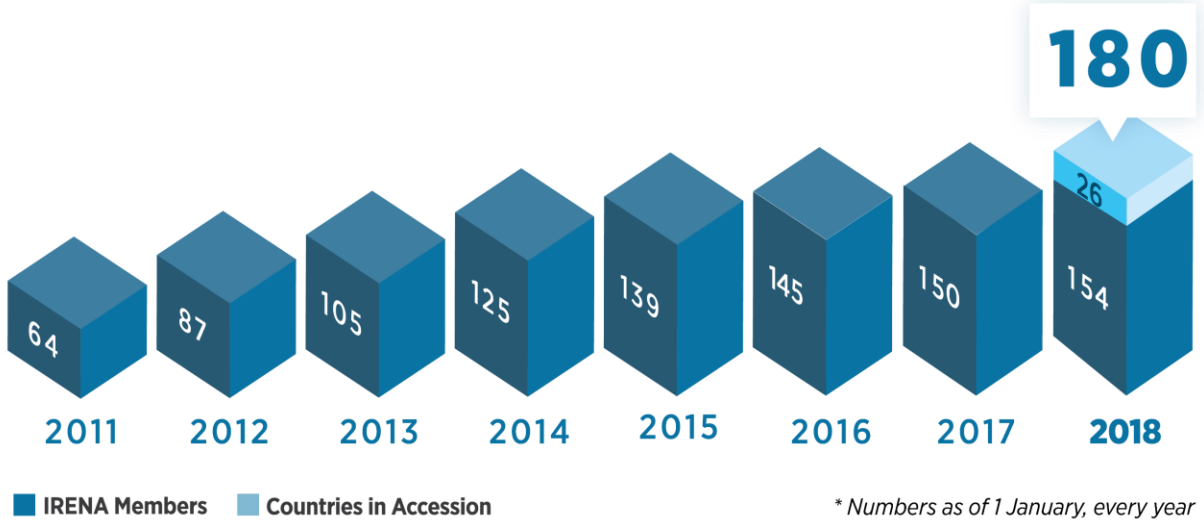
Established in 2011.

158 Members
24 States in accession.

Mandate: to promote the widespread adoption and sustainable use of all forms of renewable energy

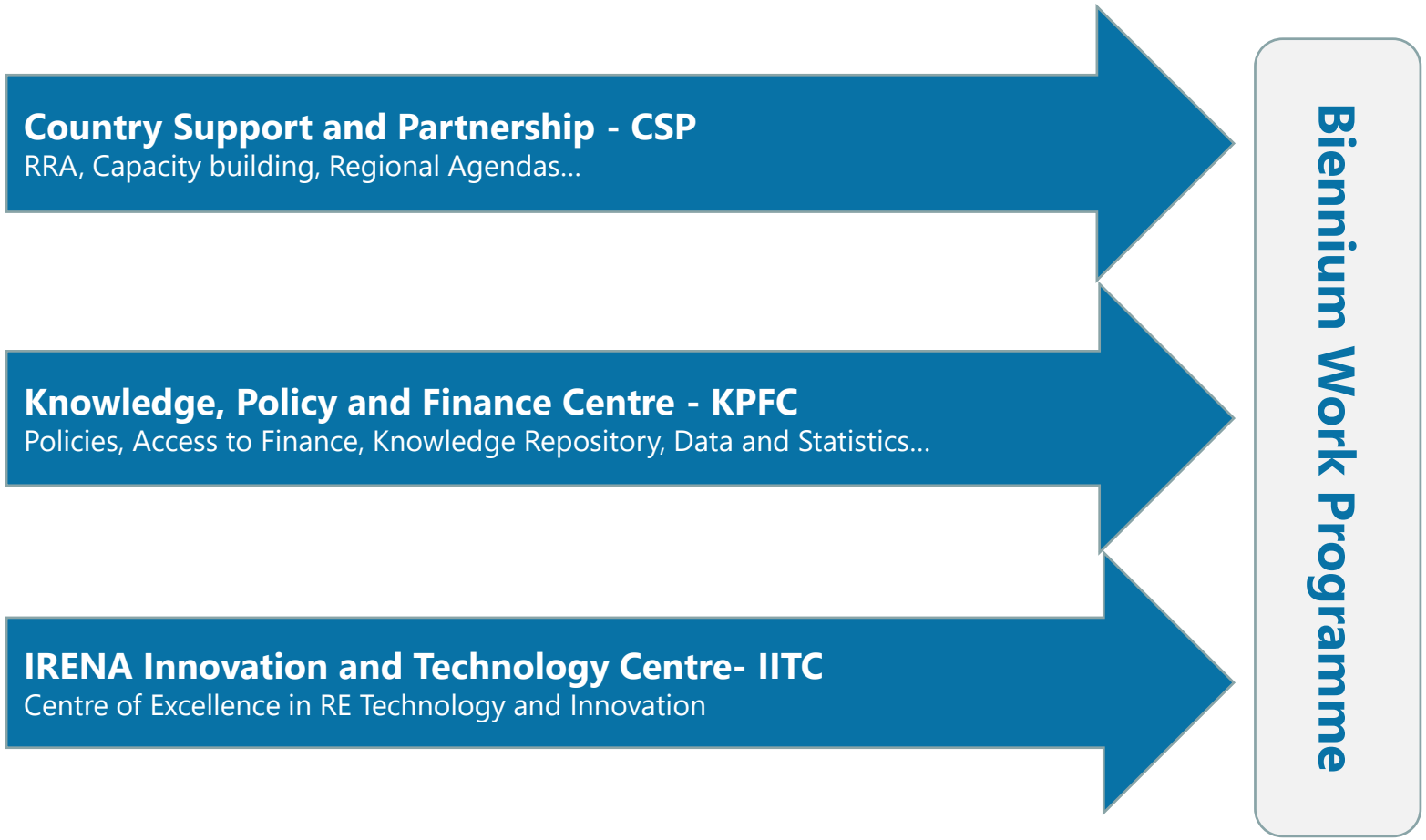
IRENA serves as:

- Centre of excellence for knowledge and innovation
- Global voice of renewables
- Network hub
- Source of advice and support



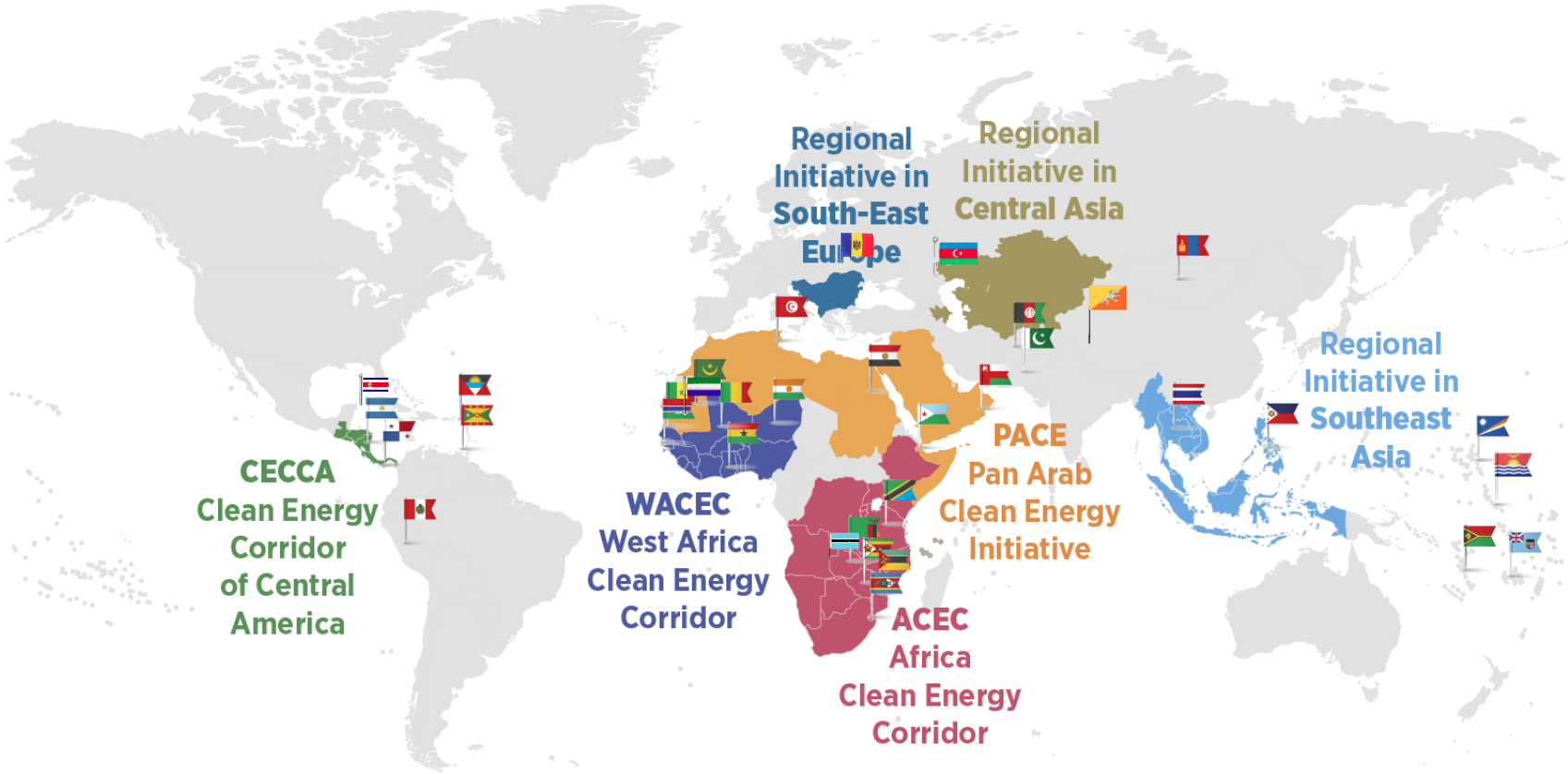
Headquarters in Masdar City, Abu Dhabi, UAE; **Innovation and Technology Centre** – Bonn, Germany; **Permanent Observer** to the United Nations – New York, USA

IRENA Programmatic Divisions



Some of IRENA's Regional and country engagement

Regional Engagements



Renewable Energy Roadmaps (REmap)

- 70 countries – G20, EU, ASEAN, select countries in LAC and Africa
- Three regional analyses: EU, Africa, and ASEAN
- 13 Country roadmaps and outlooks

Renewable Readiness Assessments (RRA)

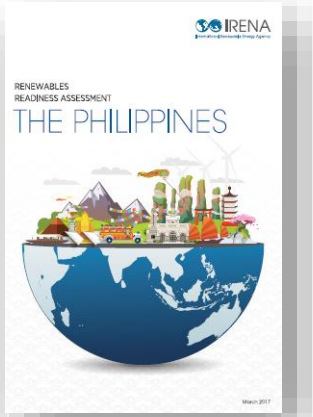
- 22 complete or in progress

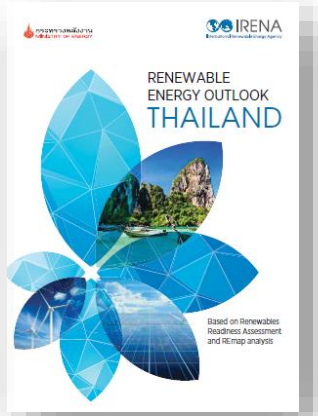
Renewable Market Analysis

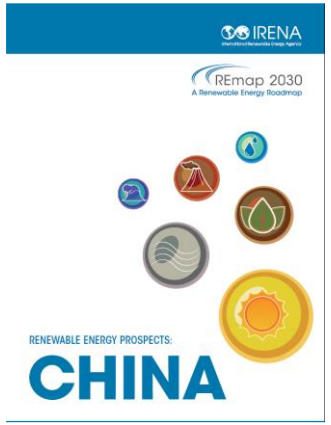
- GCC, LA, SEA, SEE

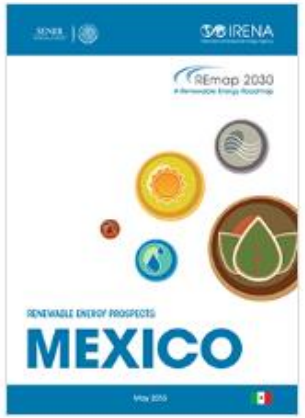
IRENA in ASEAN and APEC

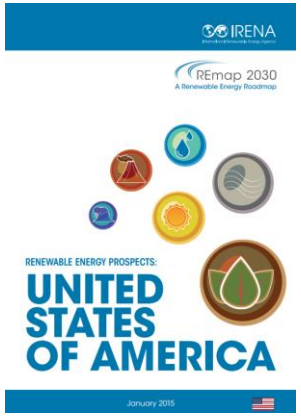
In-Country Collaboration



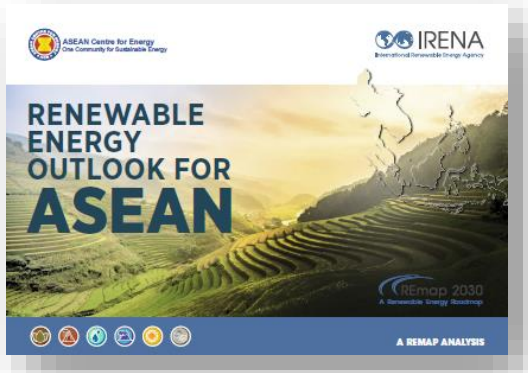


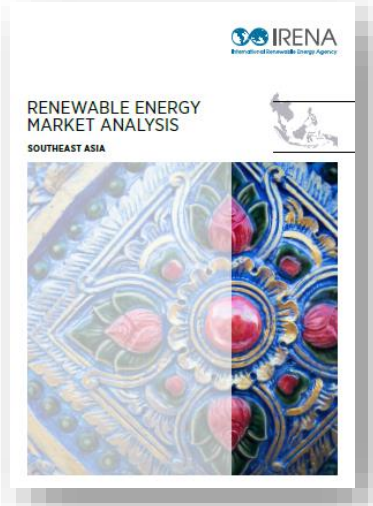






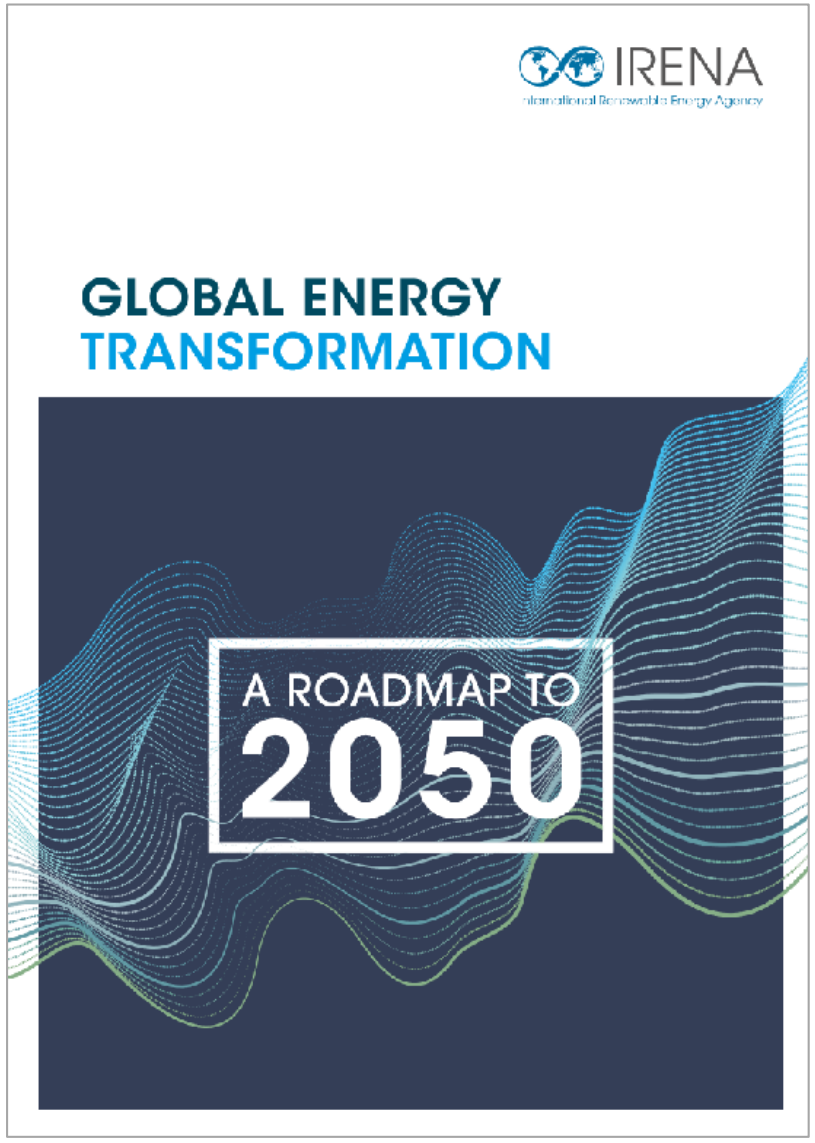
Regional Initiatives





ASEAN-IRENA MOU
at 36th AMEM
(October 2018)

Global Energy Transformation: A Roadmap to 2050

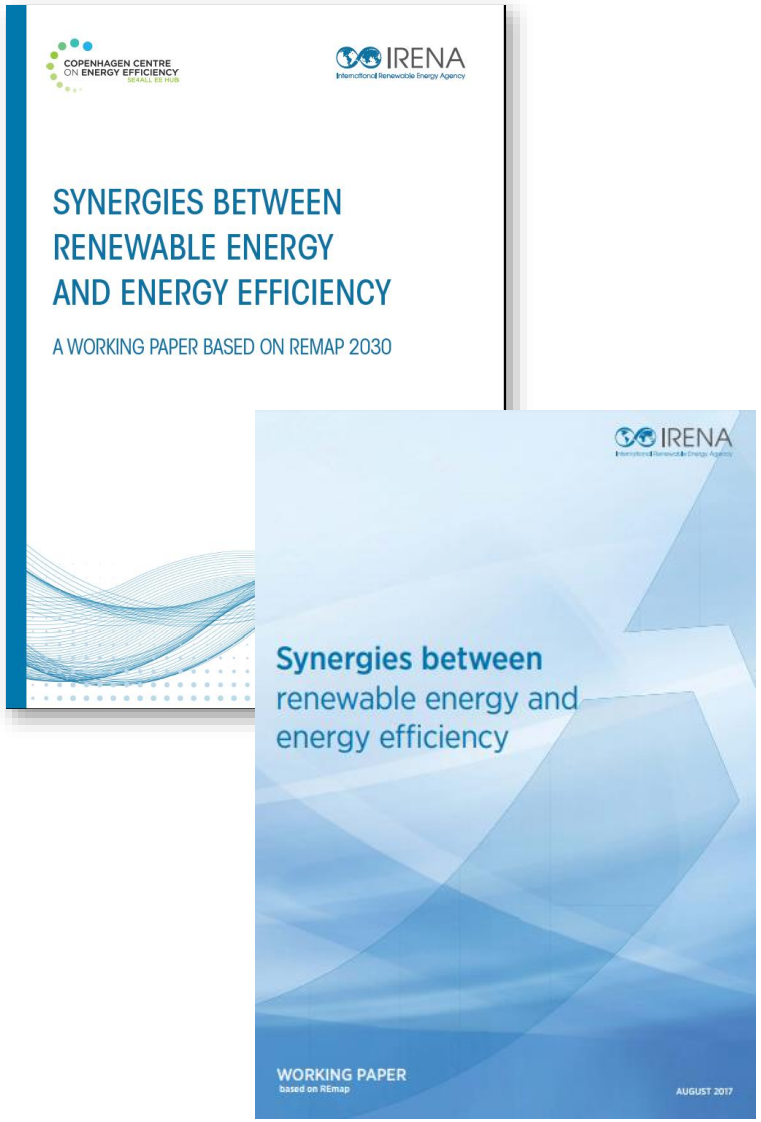


A long-term pathway to energy system decarbonization:

- In line with the Paris Agreement goal of keeping global warming well-below 2C.
- Based on high energy efficiency and renewable energy
- Renewable shares, EI improvement
- Combines IRENA REmap techno-economic analysis and macroeconomic model analysis
- G20 country focus

Second edition released in April, 2018 at the Berlin Energy Transition Dialogue.

Renewable Energy and Energy Efficiency Synergies



Two technical papers focused on synergies between renewable energy and energy efficiency

- Joint-paper with C2E2 (2015) focused on larger context of 2030 targets
- IRENA paper (2017) diving into more depth on joint synergies for China, India, Germany, Japan and USA

Thank you!

Nicholas Wagner

nwagner@irena.org

www.irena.org

www.twitter.com/irena

www.facebook.com/irena.org

www.instagram.com/irenaimages

www.flickr.com/photos/irenaimages

www.youtube.com/user/irenaorg

Global Energy Transformation

Nicholas Wagner
Renewable Energy Roadmaps (REmap), Innovation and Technology Centre, IRENA
APEC, 12 Sept. 2018

Presentation focus

IRENA
International Renewable Energy Agency

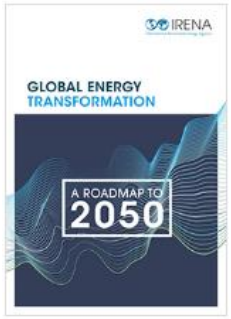
i. **Global view to 2050**

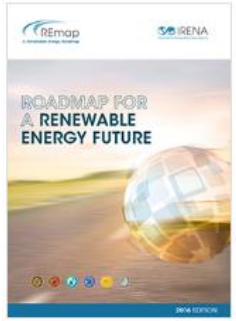
ii. APEC view 2030 (2050)

iii. ASEAN view to 2030

iv. Renewable energy and energy efficiency synergies

REmap engagement process





- Design of technology pathways and RE options in all sectors
- Assessment of economic, social, environmental metrics at a global level
- **4 global reports**

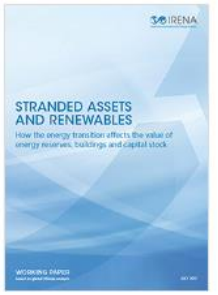
Global Reports

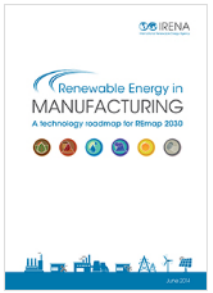
Thematic reports

Country Reports

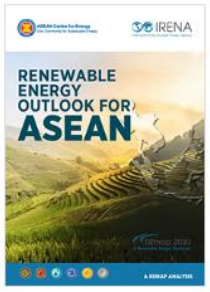
Regional Reports

- Provide detailed technical and economic analysis on specific topics (i.e. RE investments, stranded assets, subsidies, etc.)
- **9 thematic/technical reports**

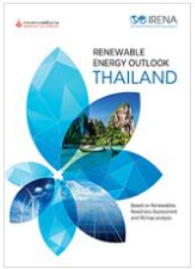




- Insights to policy and decision makers for areas in which action is needed at a country level
- **12 country reports** for major economies



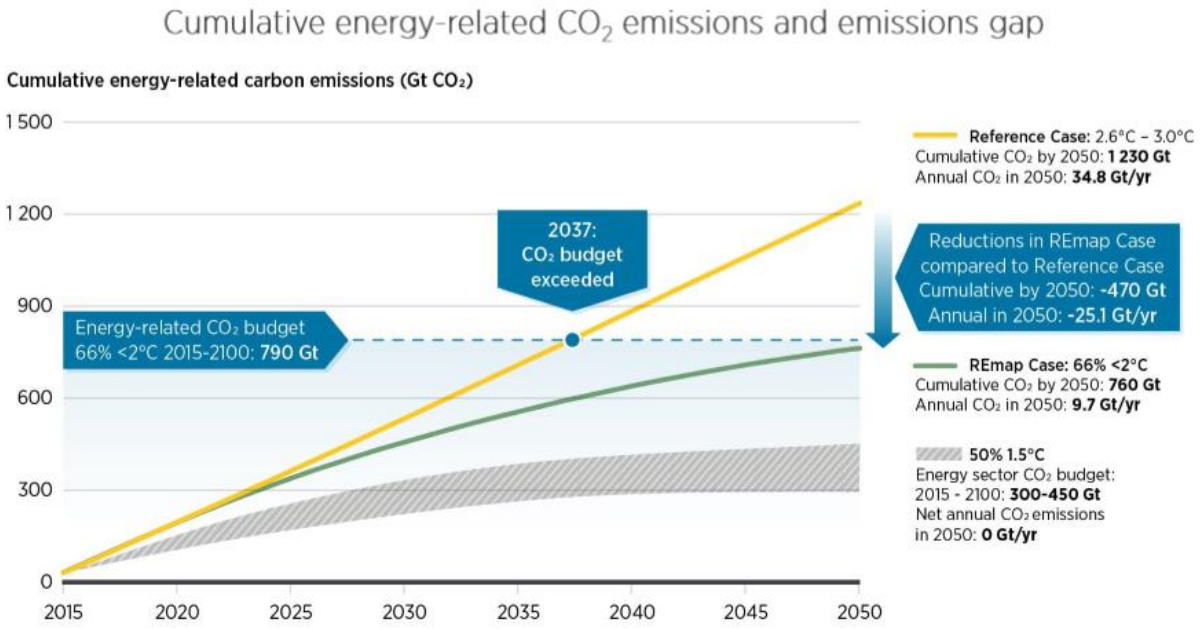
- Assessment of technology options and regional disaggregation
- Identification of key technologies and trends, and cross-country opportunities
- **3 regional reports** (EU,ASEAN and Africa) and one under development (South-East Europe)



The case for an energy transformation

IRENA
International Renewable Energy Agency

ENVIRONMENTAL CASE



- Meeting the global objective to limit global temperature rise below 2 degrees Celsius
- Renewable energy & energy efficiency can provide over 90% of the reduction in energy-related CO_2
- Energy-related CO2 budget exceeded in under 20 years

BUSINESS CASE

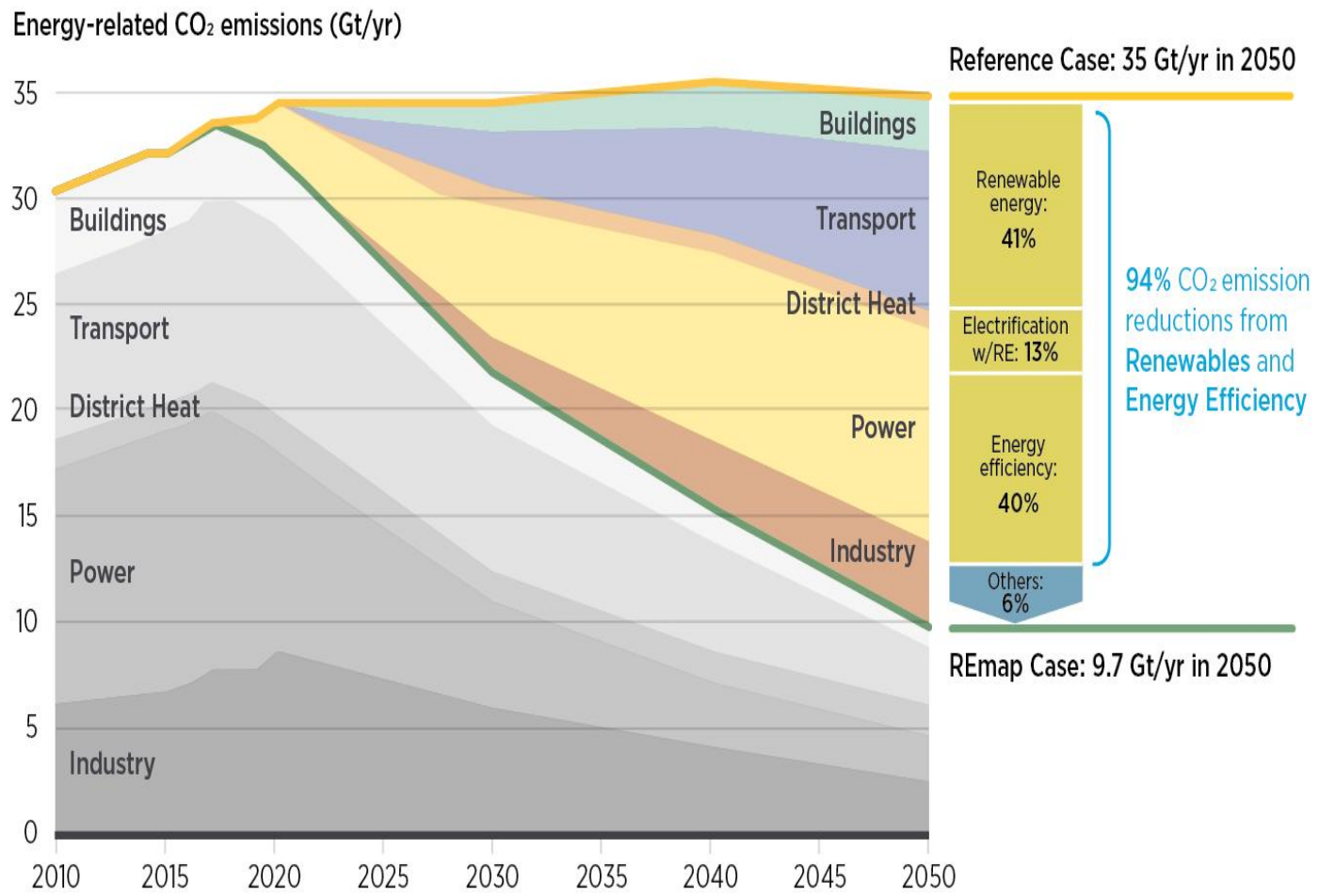
- Costs of global renewable power generation are dropping
- Increasing RE power is least-cost option

Renewable energy and energy efficiency can provide over 90% of the reduction in energy-related CO2

Annual energy-related CO_2 emissions and reductions, 2015-2050

Annual energy-related emissions are expected to remain flat (under current policies in the Reference Case) but must be reduced by over 70% to bring temperature rise to below the 2° C goal.

Renewable energy and energy efficiency measures provide over 90% of the reduction required.

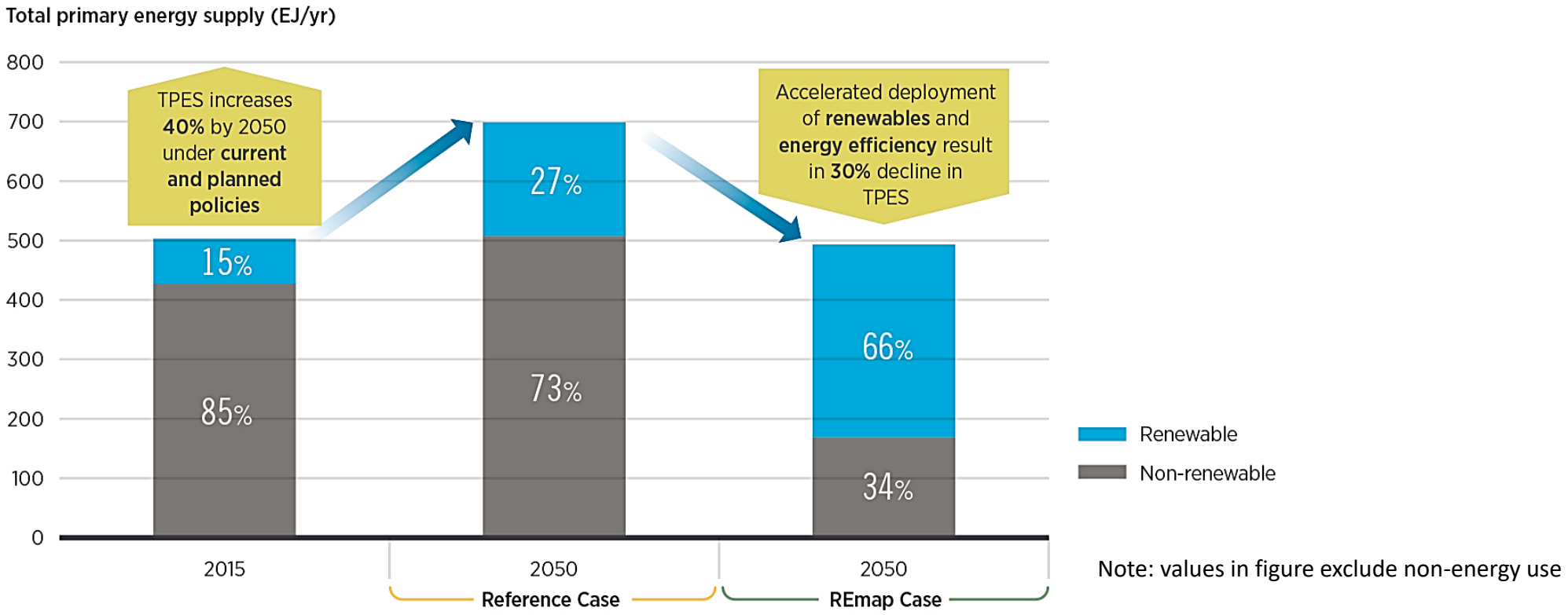


An upper limit of 2 degrees with a 2/3 chance of success:

790 Gt energy CO2 emissions budget 2015-2100

The global share of renewable energy in energy supply would need to increase to two-thirds

TPES and the share of renewable and non-renewable energy under the Reference and REmap cases

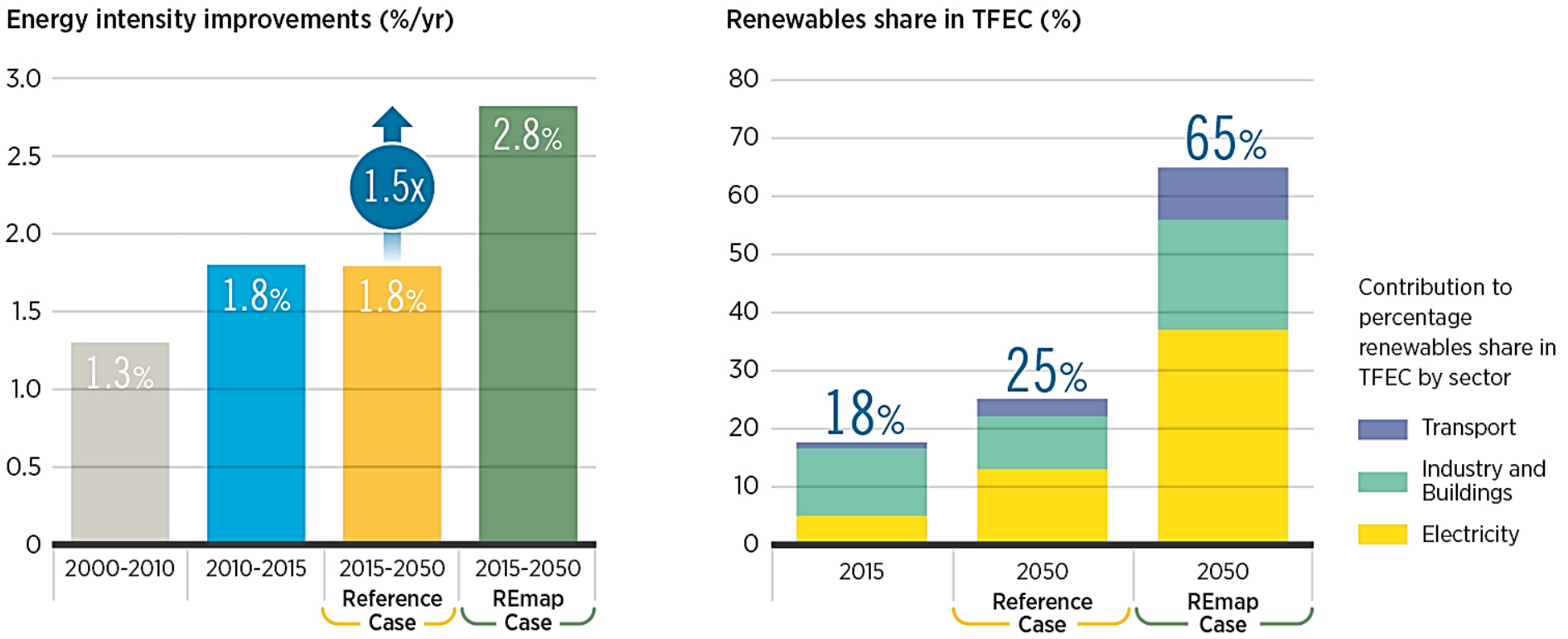


Note: values in figure exclude non-energy use

Under current and planned policies (the Reference Case) TPES is expected to increase almost 40% by 2050. To achieve a pathway to energy transition (the REmap Case), energy efficiency would need to reduce TPES slightly below 2015 levels, and renewable energy would need to provide two-thirds of the energy supply.

Significant improvements in energy intensity are needed and the share of renewable energy must rise

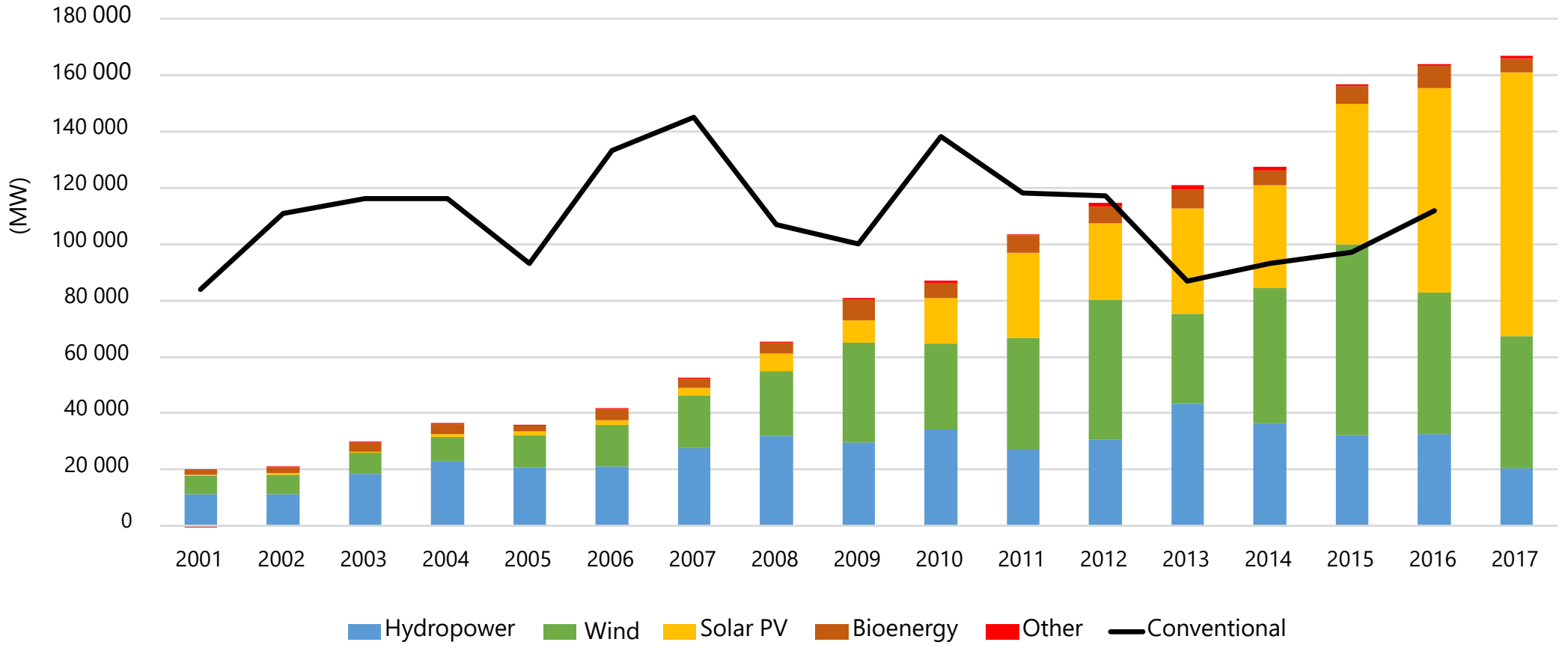
Energy intensity improvement rate and renewable energy share in TFEC, Reference and REmap cases



Source: Historical energy intensity improvement values from (SE4ALL, 2016), projections based on IRENA analysis

Both renewable energy and energy efficiency are at the heart of the energy transition and climate goals. By 2050 action in both areas must be scaled up considerably.

RE power capacity additions constantly exceed conventional power

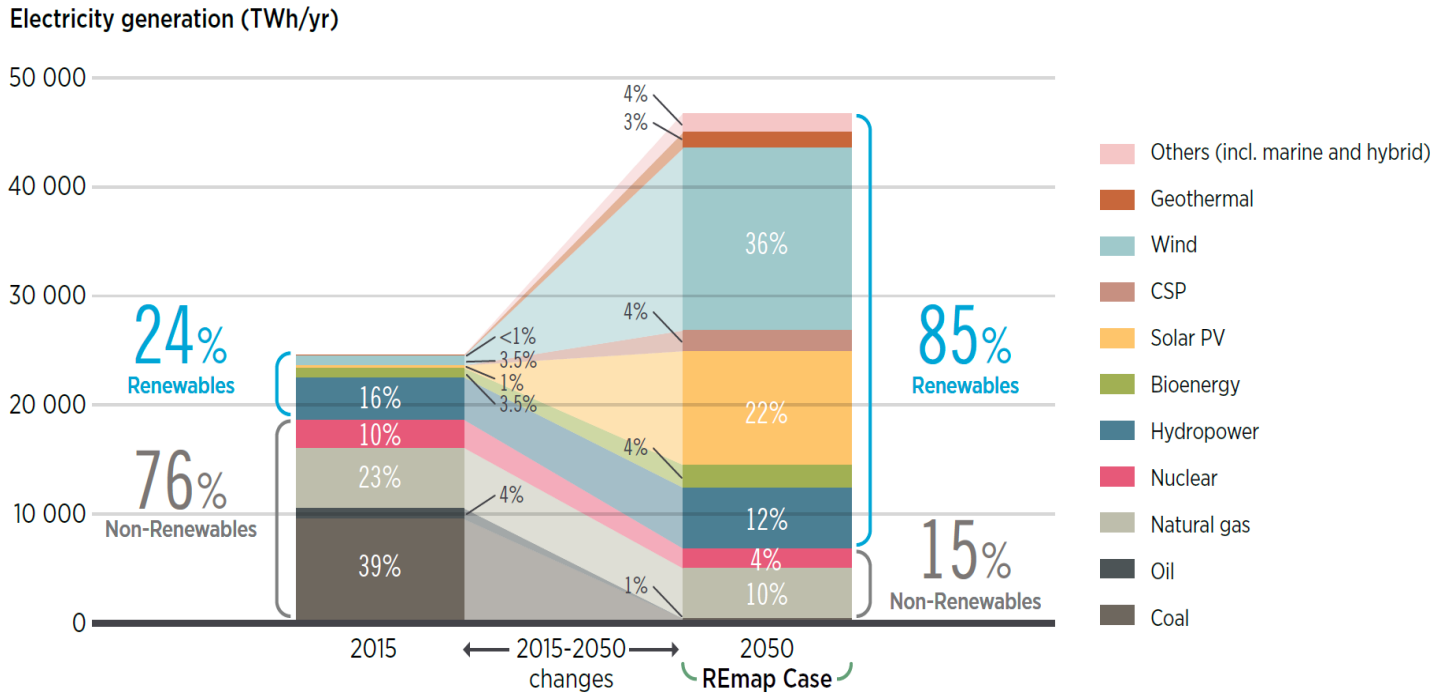


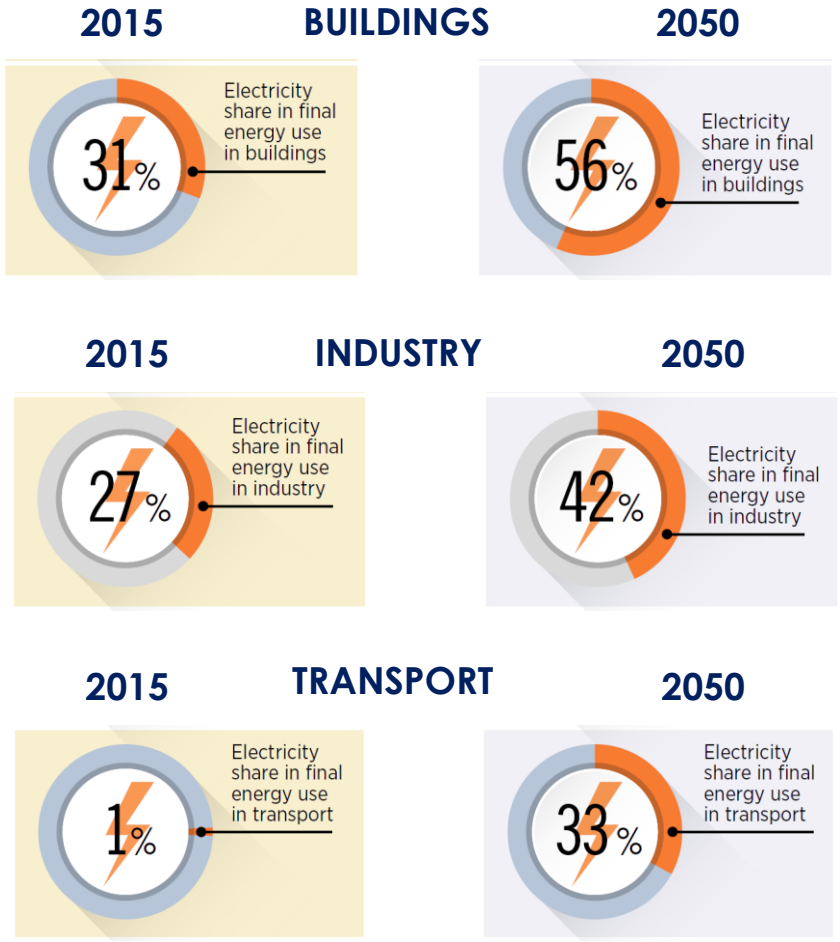
- Wind and solar PV led the uptake of RES.
- Solar PV accounted for more than 56% of total RES additional installed capacity in 2017.

Electrification of end-use sectors: key enabler for the energy transformation

Gross power generation will almost double between 2015 and 2050, due to electrification of end-use sectors, with renewables generating 85%
Transport sector will see a major growth in electrification; buildings and industry will also have an incremental electrification rate

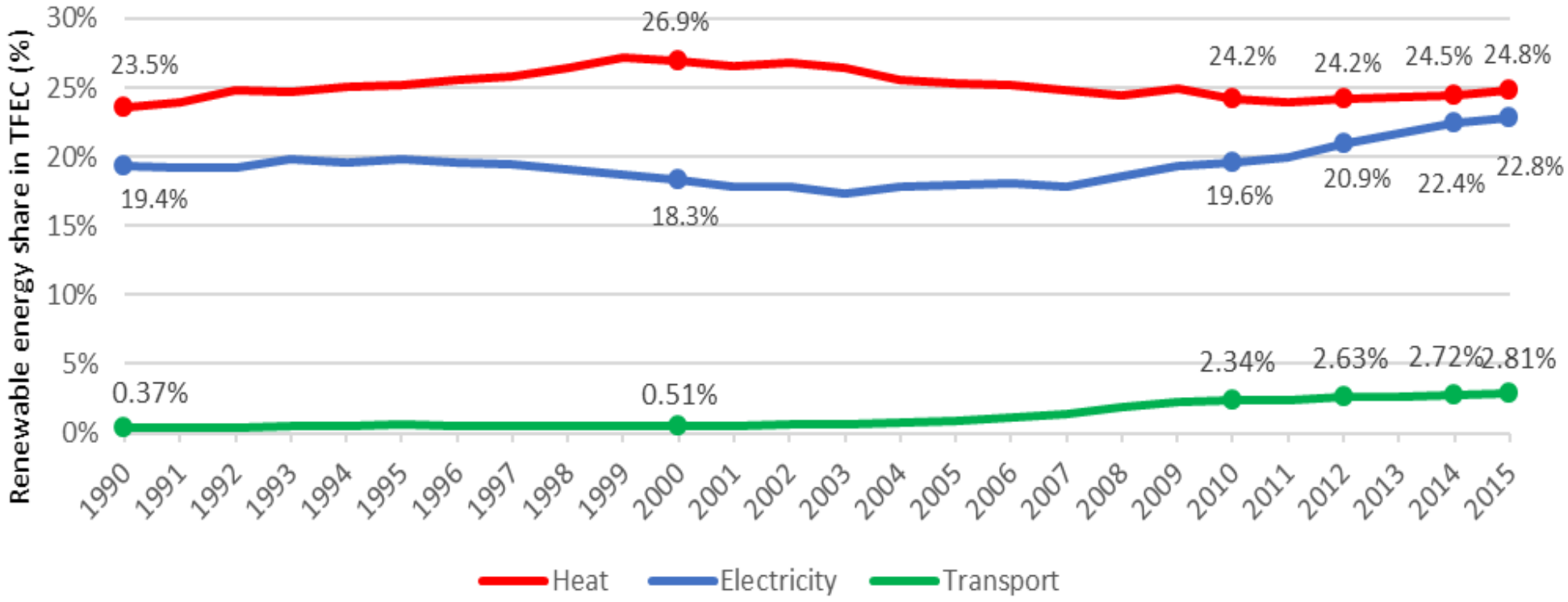
Breakdown of electricity generation by source

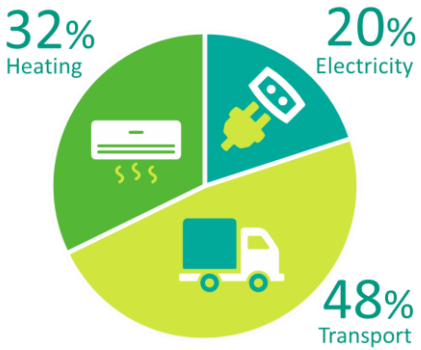




Source: IRENA (2018), Global Energy Transformation: A roadmap to 2050

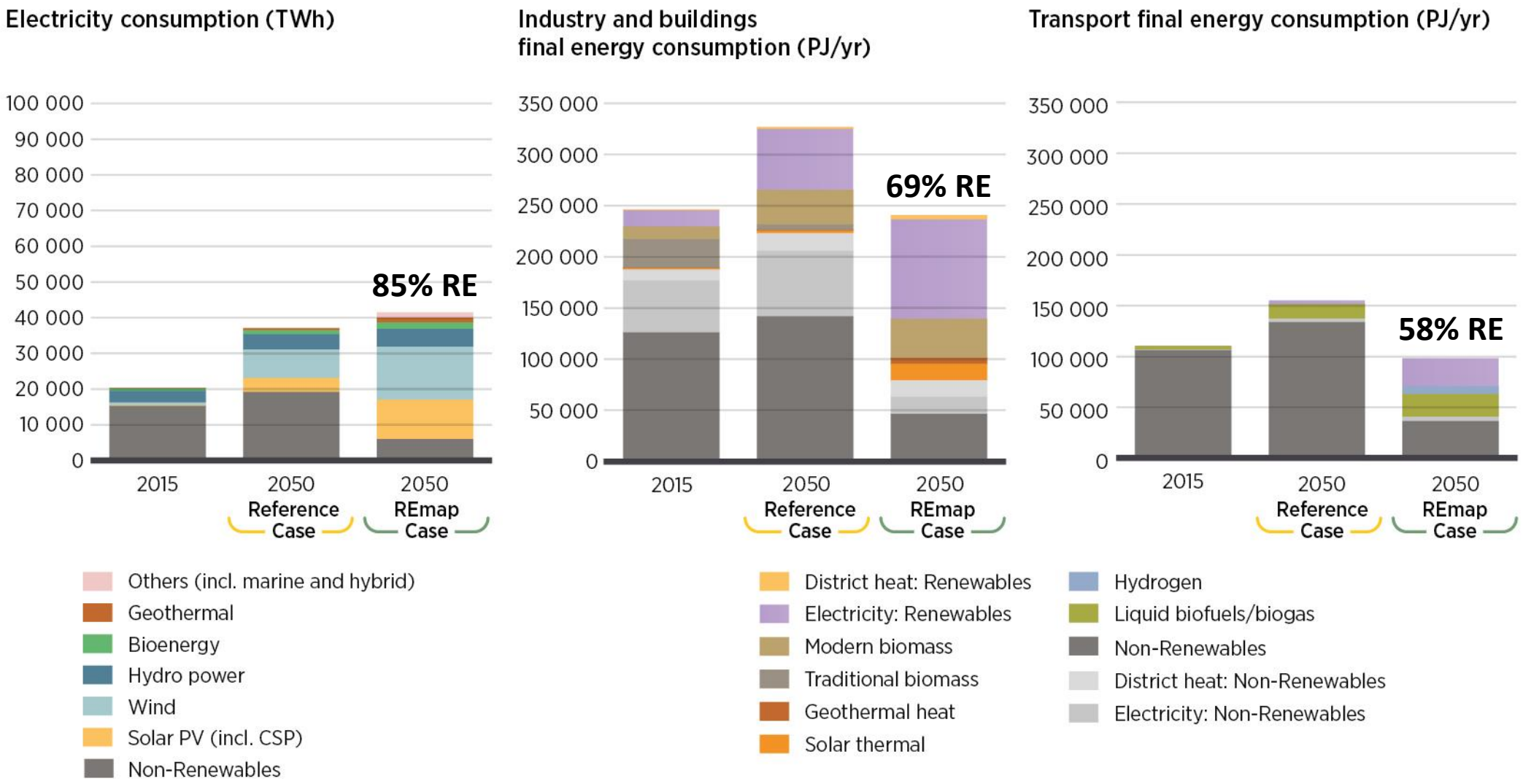
RE penetration in heating and transport requires boosted efforts



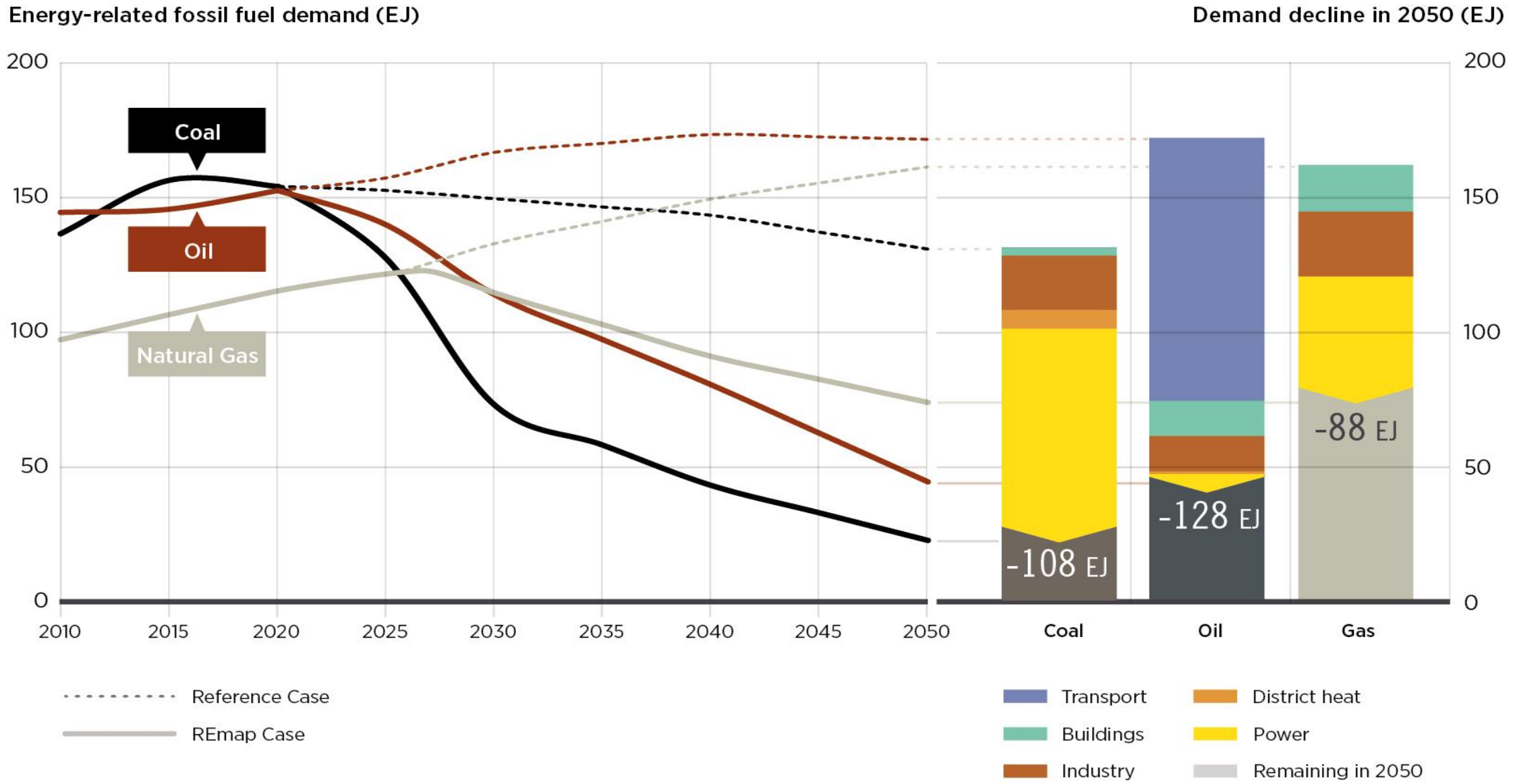


Progress in the power sector is not being matched in transport and heating – which together account for 80% of global energy consumption.

RE should scale up to meet power, heat and transport needs 40% electrification of end use

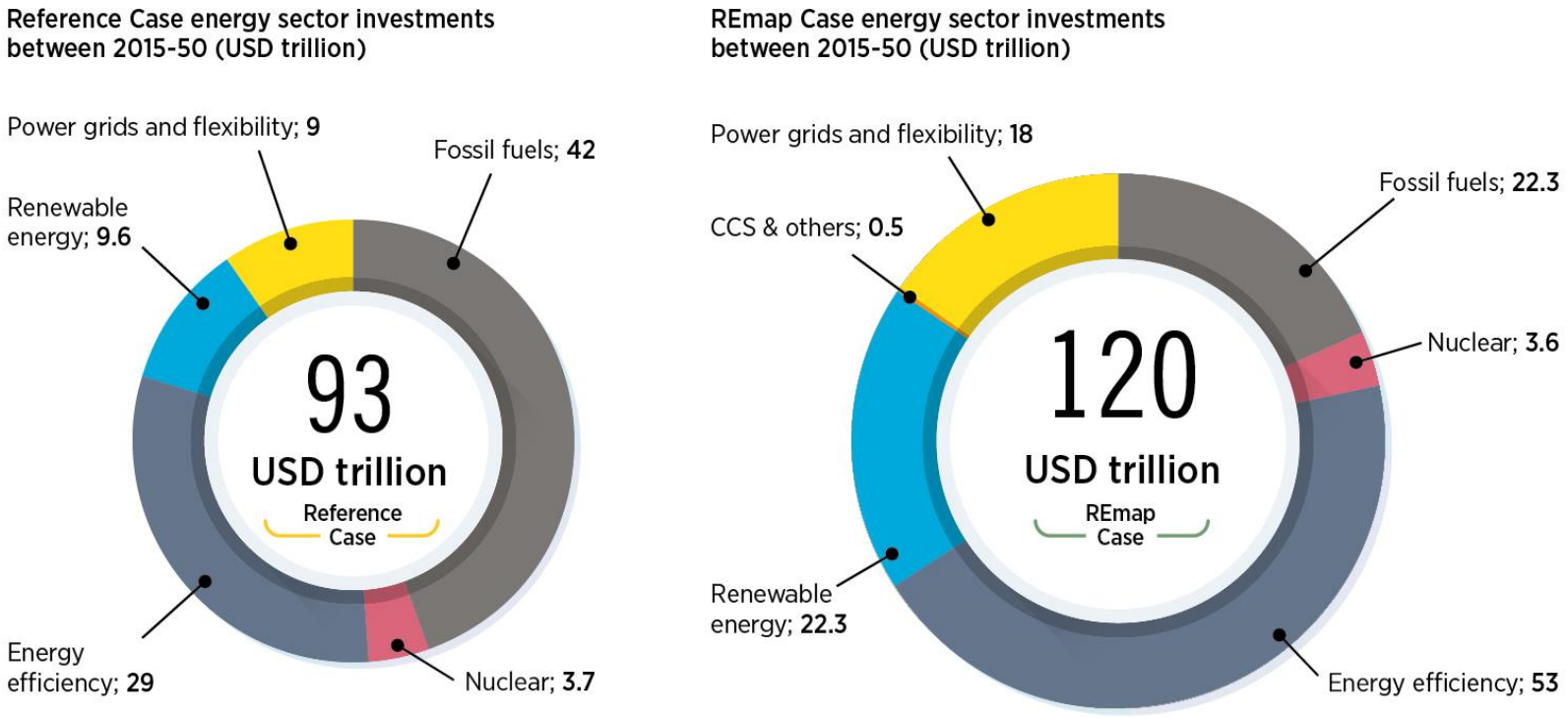


The importance of fossil fuels is declining



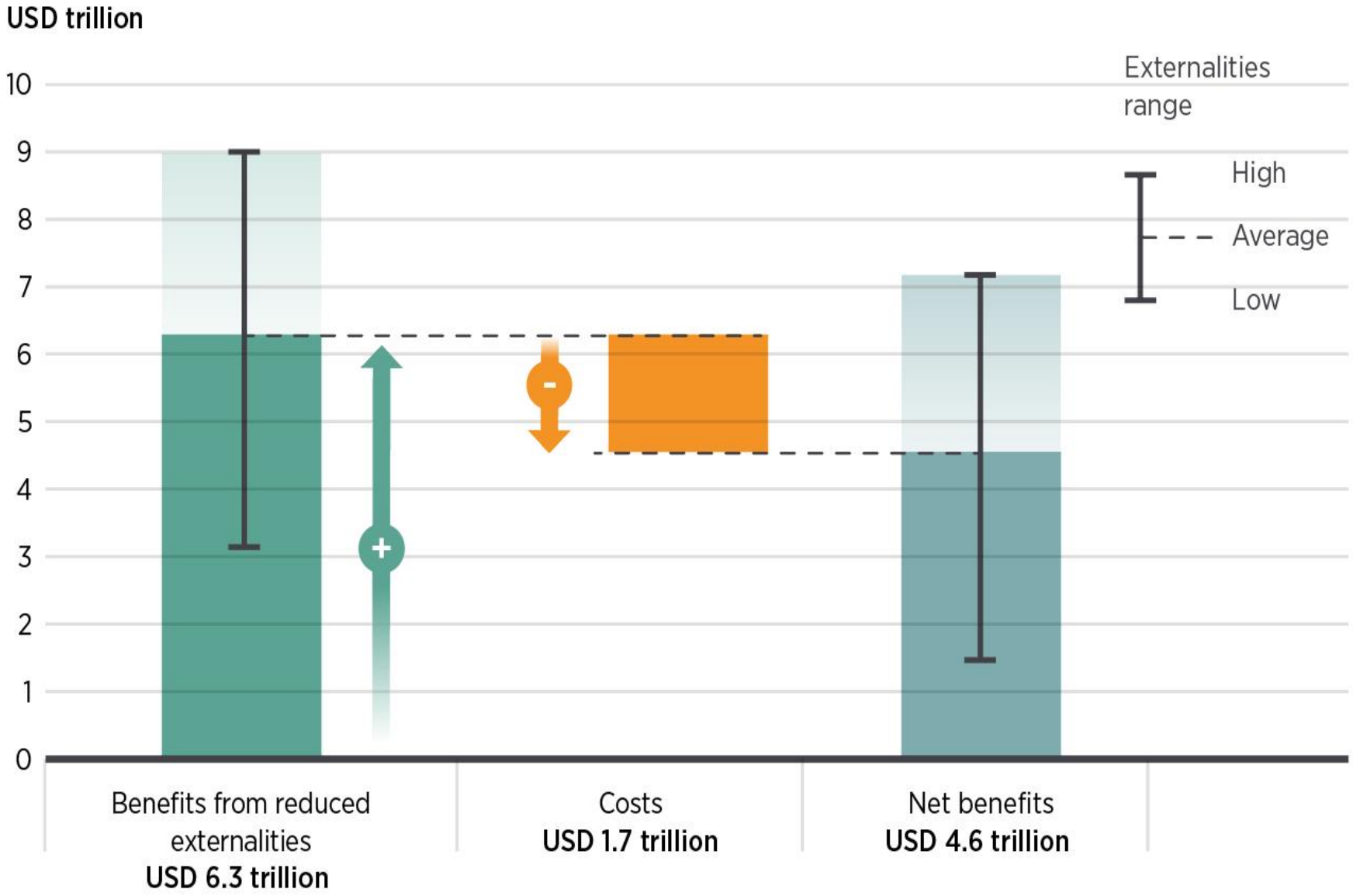
Investment will need to shift to renewable energy and energy efficiency

Cumulative investment - Reference and REmap cases, 2015-2050



Under the REmap Case, cumulative investment of USD 120 trillion must be made between 2015 and 2050 in low-carbon technologies, averaging around 2% of the period average global GDP per year. This is USD 27 trillion more than the Reference Case.

Reduced negative externalities far outweigh the costs needed to achieve a global energy transformation



Macroeconomic impacts

USD 27 trln cumulative additional energy investments

1% GDP increase by 2050

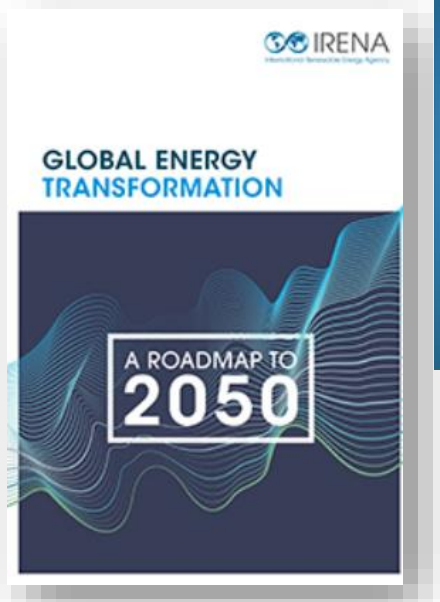
11 mln additional jobs by 2050

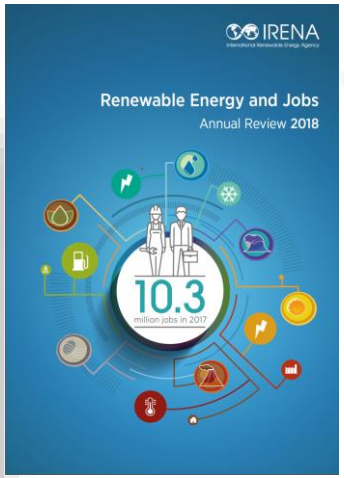
Socio-economic benefits of renewable energy

GDP
+ 1.0 %
+ 2.06
USD trillion

Jobs
+ 0.14 %
+ 11 million
in the energy sector

Welfare
+ 15 %

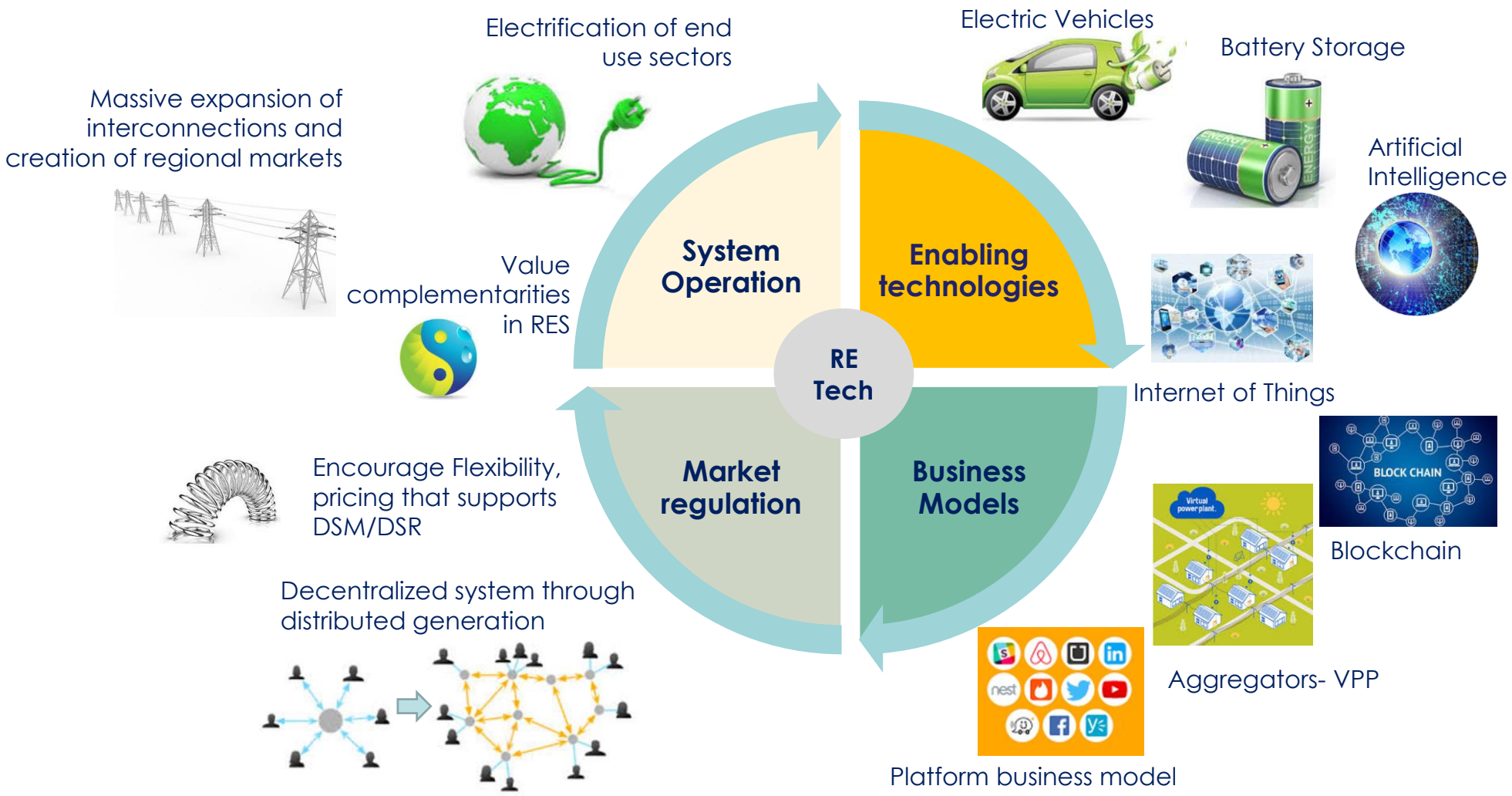




Emerging Innovations in Power Sector – Landscape report

IRENA
International Renewable Energy Agency

A Combination of Affordable RE Technologies, Digitalisation and Climate Change Policies is driving change – IRENA Innovation Landscape Assessment ongoing



Presentation focus

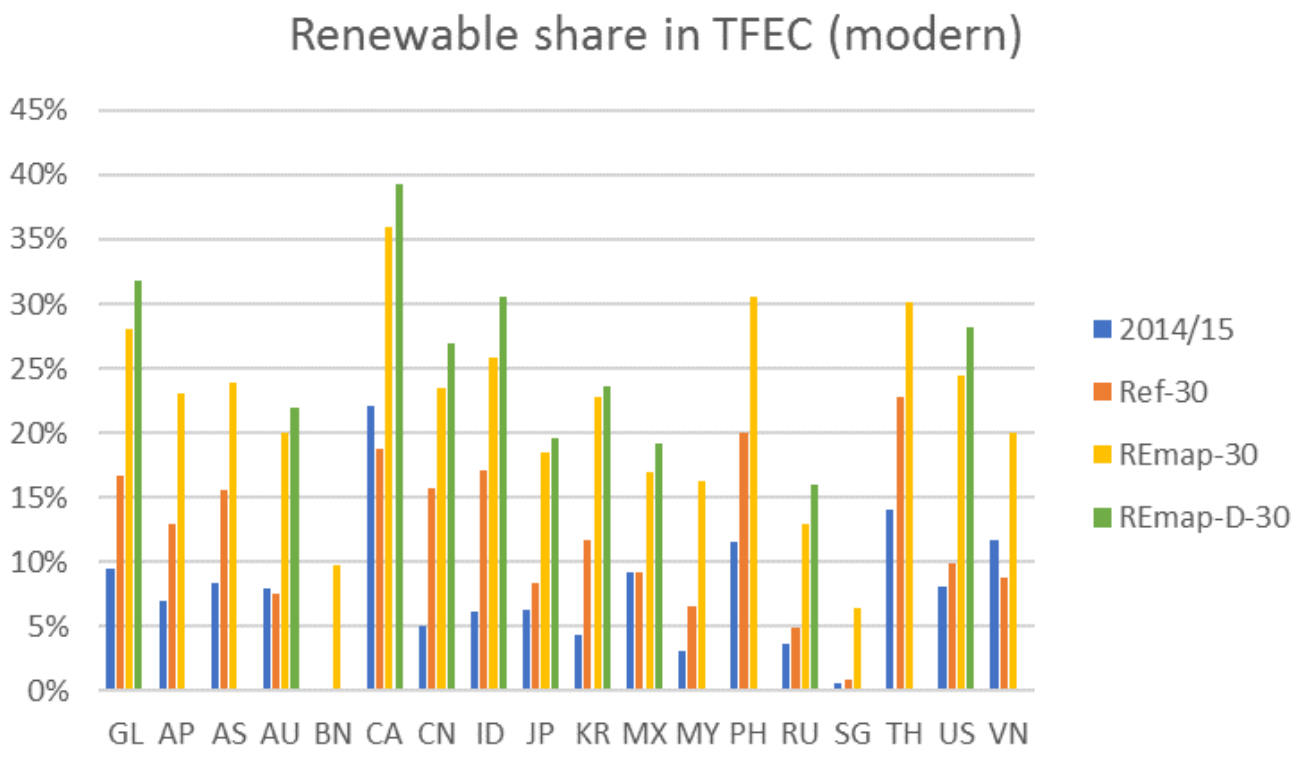
i. Global view to 2050

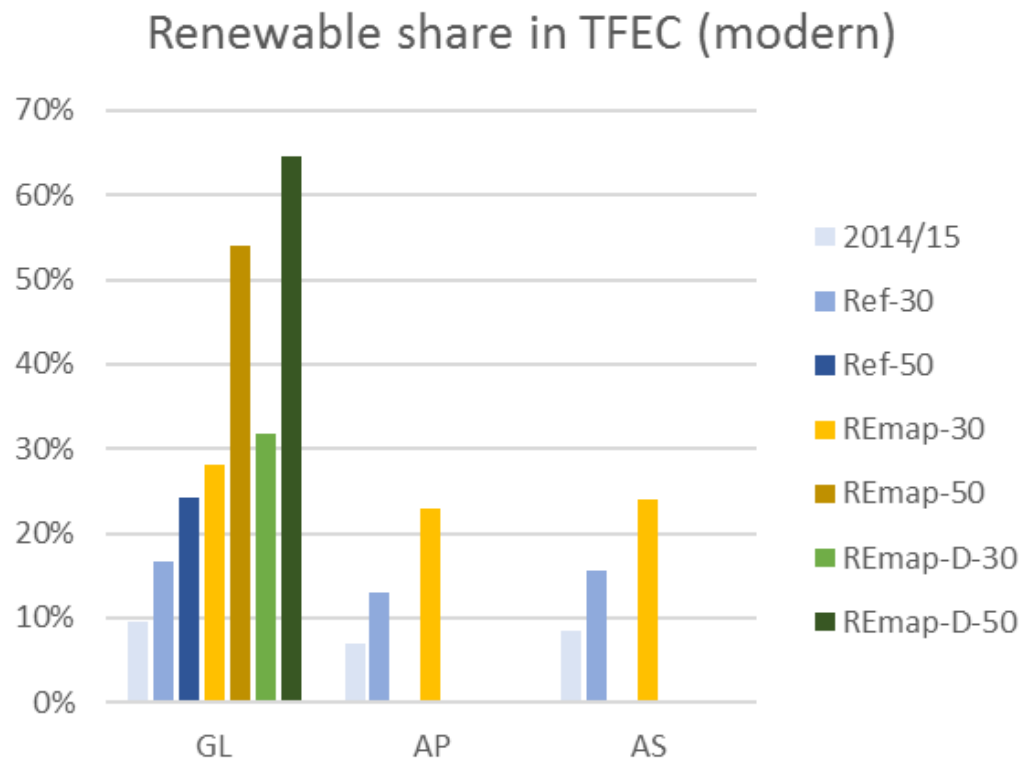
ii. APEC view 2030 (2050)

iii. ASEAN view to 2030

iv. Renewable energy and energy efficiency synergies

Modern renewable energy share in TFEC

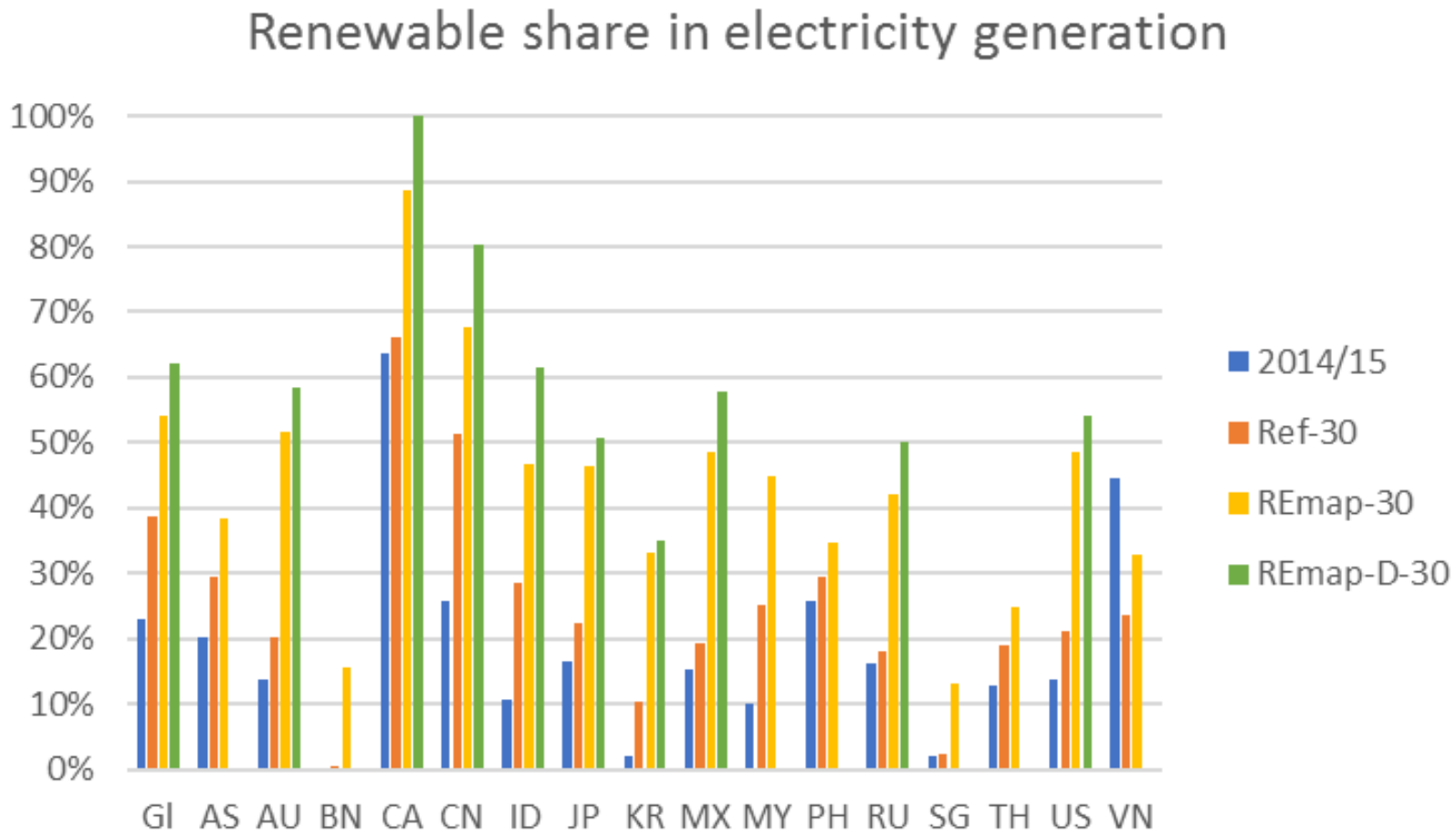




In APEC region:

- Modern renewable energy share in TFEC would increase by 75% in the Reference Case, and by 200% in REmap
- Total renewable energy share in TFEC would increase by 40% in the Reference Case, and 140% in REmap

Renewable energy share in electricity generation



- In APEC region renewable shares in power generation increase by 2030 to
  - Reference Case to around 20-30%
  - REmap Case with many in the 40-50+% range

Presentation focus

i. Global view to 2050

ii. APEC view 2030 (2050)

iii. ASEAN view to 2030

iv. Renewable energy and energy efficiency synergies

ASEAN – in a glance

» GDP US$ 2.5 Trillion
» US$ 3,882 per capita
» Growth ~4.7%

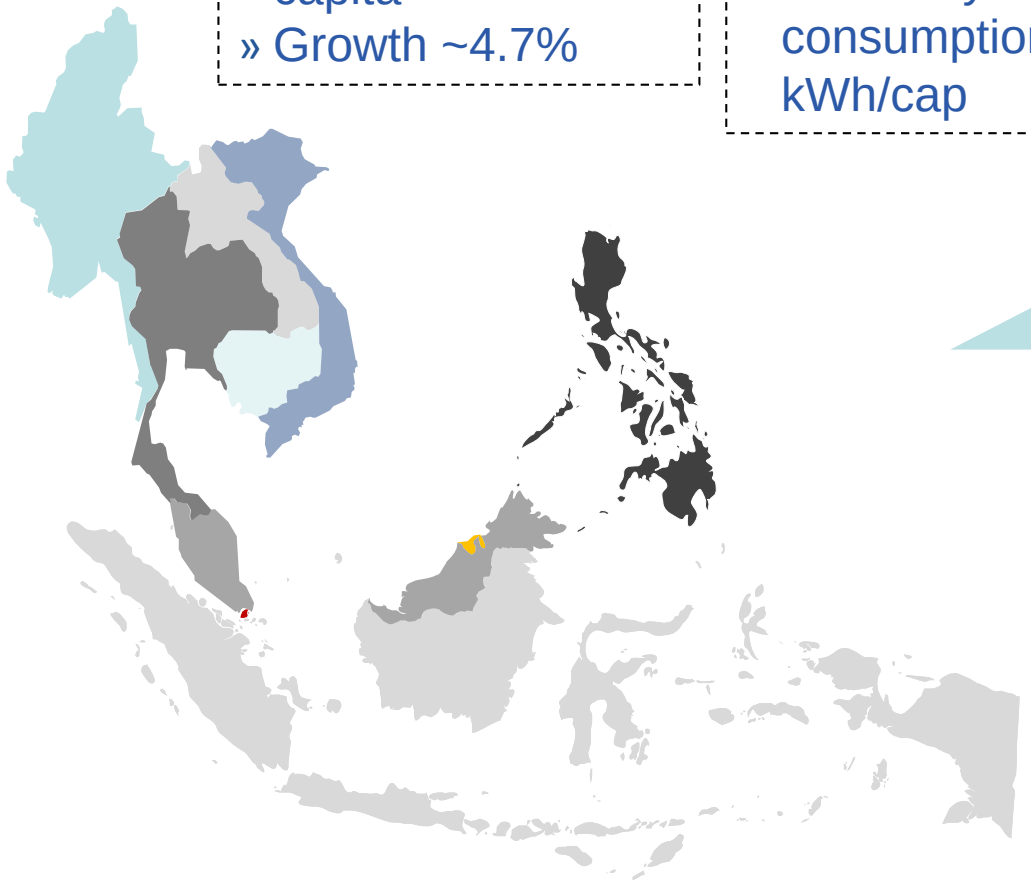
» Population 644 million

» Total trade US$ 2.37 Trillion

» ~ 14% TPES by renewables

» Electricity consumption ~1,502 kWh/cap

» ~ 60 million have no grid-quality electricity



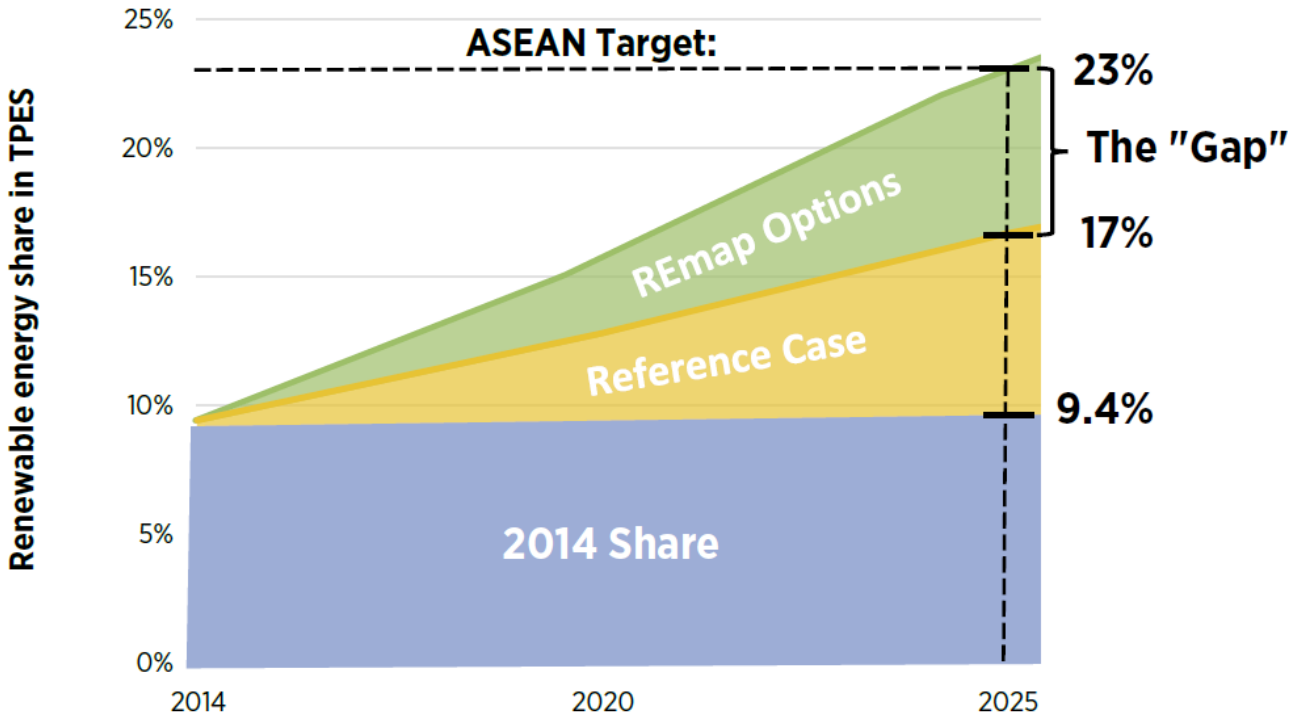
Regional Commitment on Clean Energy

Increase **RE** to **23% by 2025** in TPES

Reduce **EI** by **20% in 2020** **30% in 2025** based on 2005 level.

Renewable Energy Outlook for ASEAN (2016)

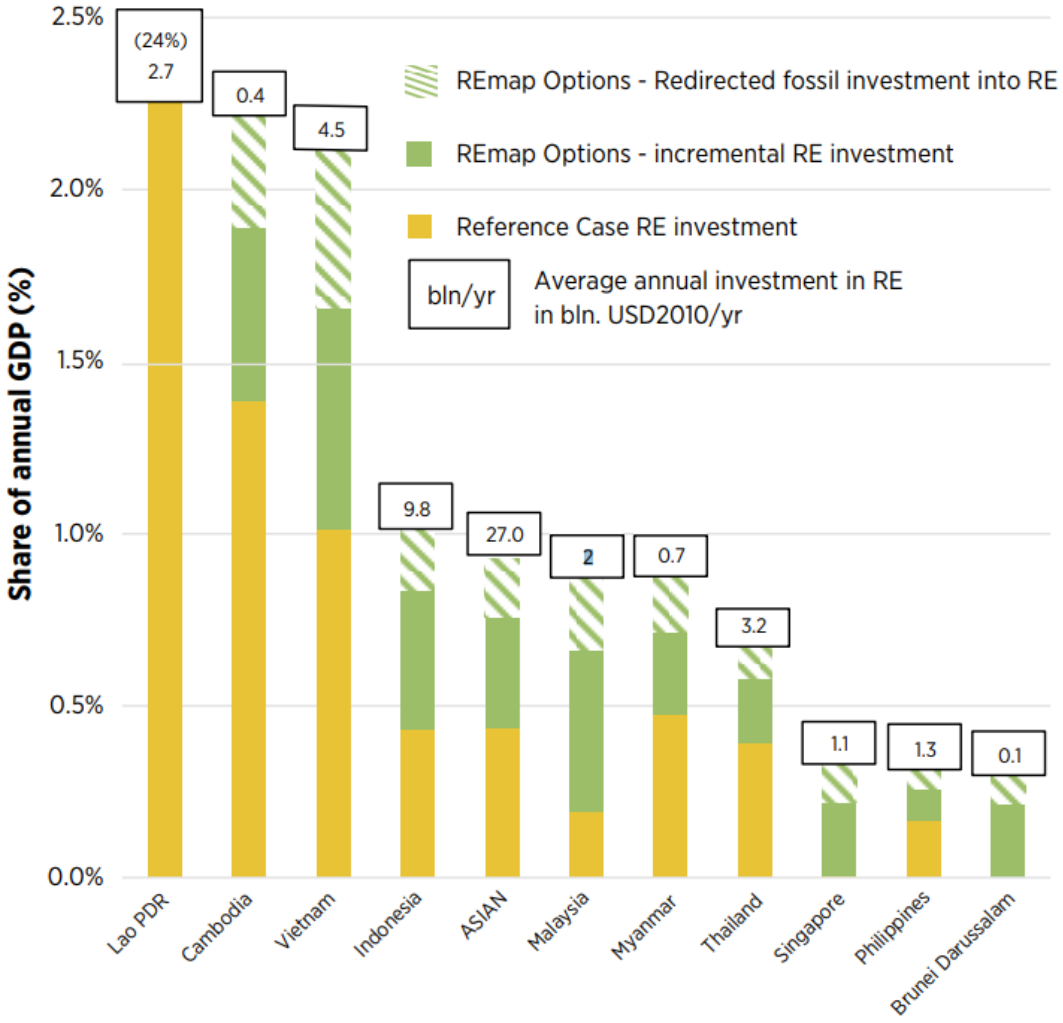
Aspirational target of 23% renewable energy share in total primary energy supply (TPES) by 2025



- 2014 – 9.4%
- 2025 Reference Case – 16.9%
- A 6% point gap to the 23% target
- REmap Options identified how to close this gap in consultation with the ten ASEAN Member States: notably solar PV, solar thermal, bioenergy
- Significant health, climate benefits
- Findings used for the 5th AEO

Renewable Energy Outlook for ASEAN - investments

- Average annual investment would total USD 27 billion to 2025
- This is split equally between the Reference Case and REmap Options for closing the gap
- One-third of the additional investment needed for REmap Options will be redirected from fossil fuels
- Three-quarters of all renewable energy investment is for power sector
- The region will need to invest on average around 1% per year of GDP



Presentation focus

i. Global view to 2050

ii. APEC view 2030 (2050)

iii. ASEAN view to 2030

iv. Renewable energy and energy efficiency synergies

Renewable energy and energy efficiency synergy

IRENA
International Renewable Energy Agency

Table 1: Effect of RE/EE on energy intensity and renewable energy share in 2030 and associated costs and savings

In 2030	Energy intensity			Renewable energy share			Incremental system costs in 2030 for REmap + EE synergy	Reduced externalities resulting from REmap and EE synergy
	Reference Case	With EE	With RE/EE (REmap + EE)	Reference Case	With EE	With RE/EE (REmap + EE)		
	MJ/USD			Renewables share of total final energy consumption			USD bln/yr in 2030	USD bln/yr in 2030
China	4.5	3.7	3.6	19.1%	28.1%	32.0%	198	−380
Germany	2.5	2.2	2.1	25.9%	35.6%	38.4%	1.2	−12.5
India	6.0	5.3	4.3	22.2%	25.9%	30.9%	−106	−175
Japan	3.7	3.3	3.0	8.2%	15.5%	18.2%	−30	−30
United States	4.5	4.1	3.9	9.0%	26.6%	30.0%	−43	−225

Thank you!

Nicholas Wagner

nwagner@irena.org

www.irena.org

www.twitter.com/irena

www.facebook.com/irena.org

www.instagram.com/irenaimages

www.flickr.com/photos/irenaimages

www.youtube.com/user/irenaorg

Key focus areas to foster the Global Energy Transformation

1. Tap into the strong synergies between energy efficiency and renewables
2. Plan a power system with high shares of renewable energy
3. Increase the use of electricity in transport, buildings and industry
4. Foster system-wide innovation
5. Align socio-economic structures and investment with the transition
6. Ensure that transition costs and benefits are fairly distributed

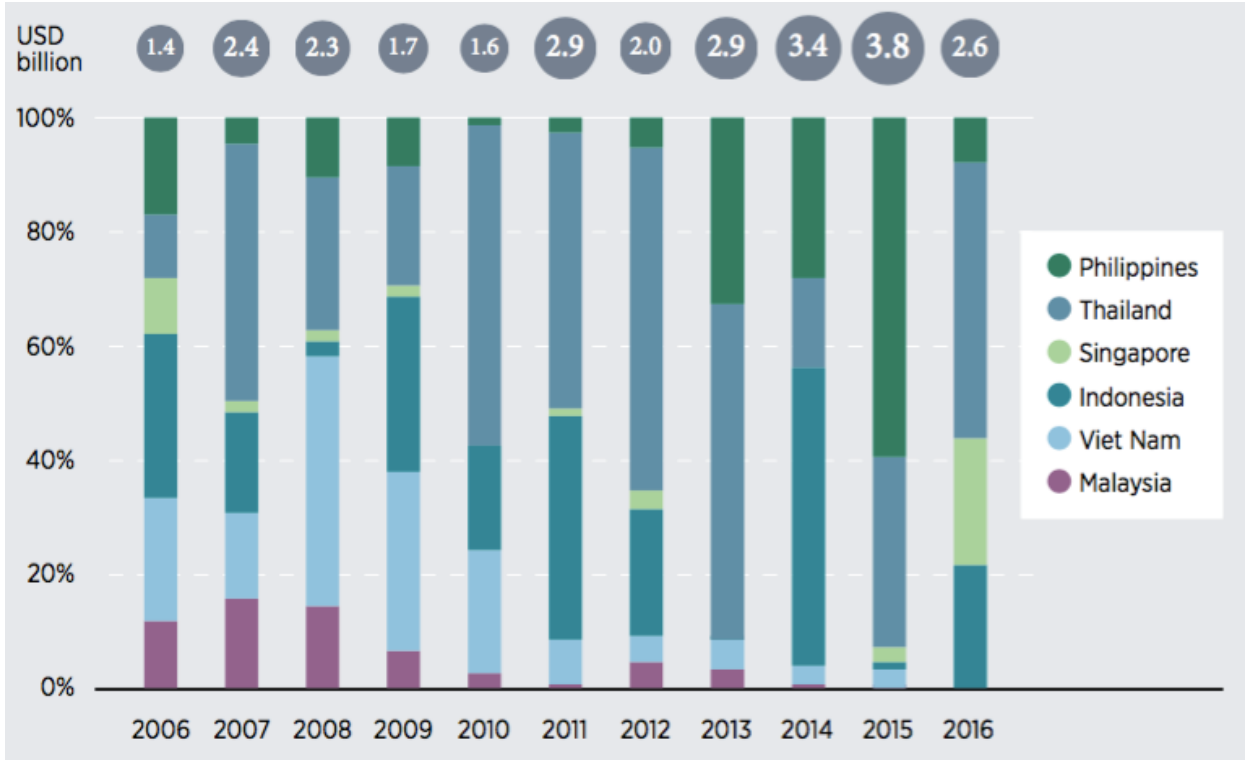
Investment by country

Leading destinations **2006-'16**:
1. Thailand ($10bn, 40%)
2. Indonesia and Philippines (~20% of total each).

Leading destinations in **2016**:
1. Thailand ($1.3bn, >50%)
2. Indonesia ($577m)
3. Singapore ($575m).

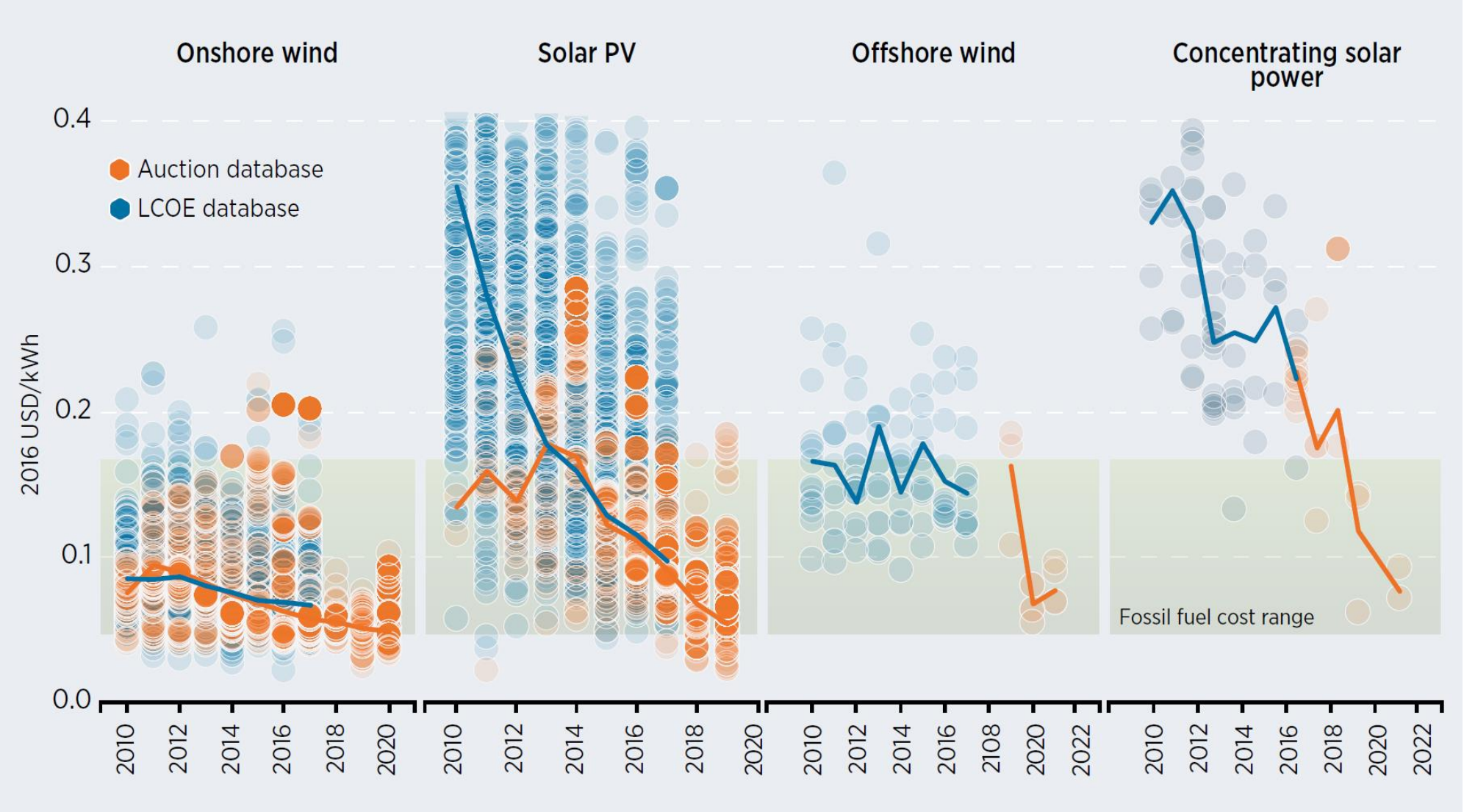
- Decreases recorded in Malaysia, Viet Nam; dramatic increases recorded in Philippines.
- Malaysia attracted $400m in 2016 in solar manufacturing.

Investment in renewable energy in the power sector by country, 2006-2016 (USD bn)



Note: Based on power sector asset finance data for Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam

Further cost decline expected in solar and wind

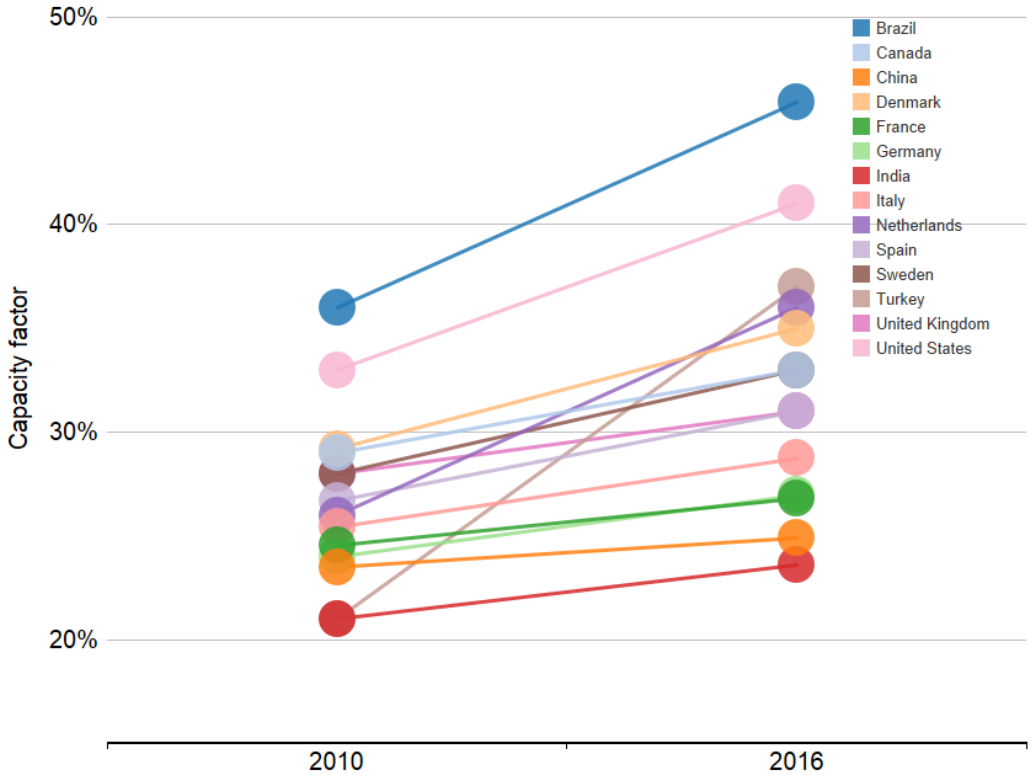


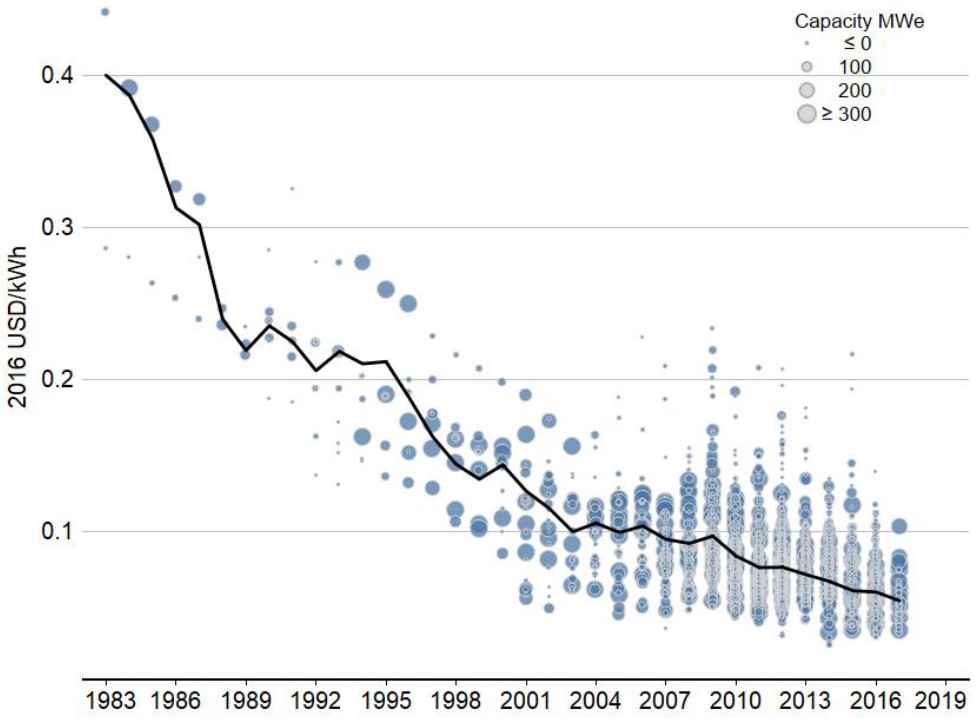
IRENA costing database of 15000 large scale RE power projects and 1.5 million rooftop PV systems

Covering half of all existing and planned RE capacity

Cost trends in wind power

Reduced turbine costs & higher capacity factors –> lower LCOE





- Wind turbine costs halved by 2017 compared to 2009
- Capacity factors increased by 45% from 1983 to 2017 and by 10% from 2010 to 2016
- LCOE of onshore wind declined by 85% from 1983 to 2017 and by 25% from 2010 to 2017

Large variation between countries

- **Wide range of economic and capital market development** → Different capital mix and renewable investment landscape.
- More advanced economic & capital markets development: Indonesia, Malaysia, Philippines, Singapore and Thailand.
- More reliant on traditional donor and development banks: Cambodia, Lao PDR, Myanmar and Viet Nam.
- Next growth market?

Total stock market capitalization and levels of GDP in Southeast Asian countries