REmap
A Renewable Energy Roadmap

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#REmap

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Outline

- Snapshot of global renewable energy development
- Global REmap and decarbonization study for G20
- Examples of REmap country/regional study
- REmap for APEC

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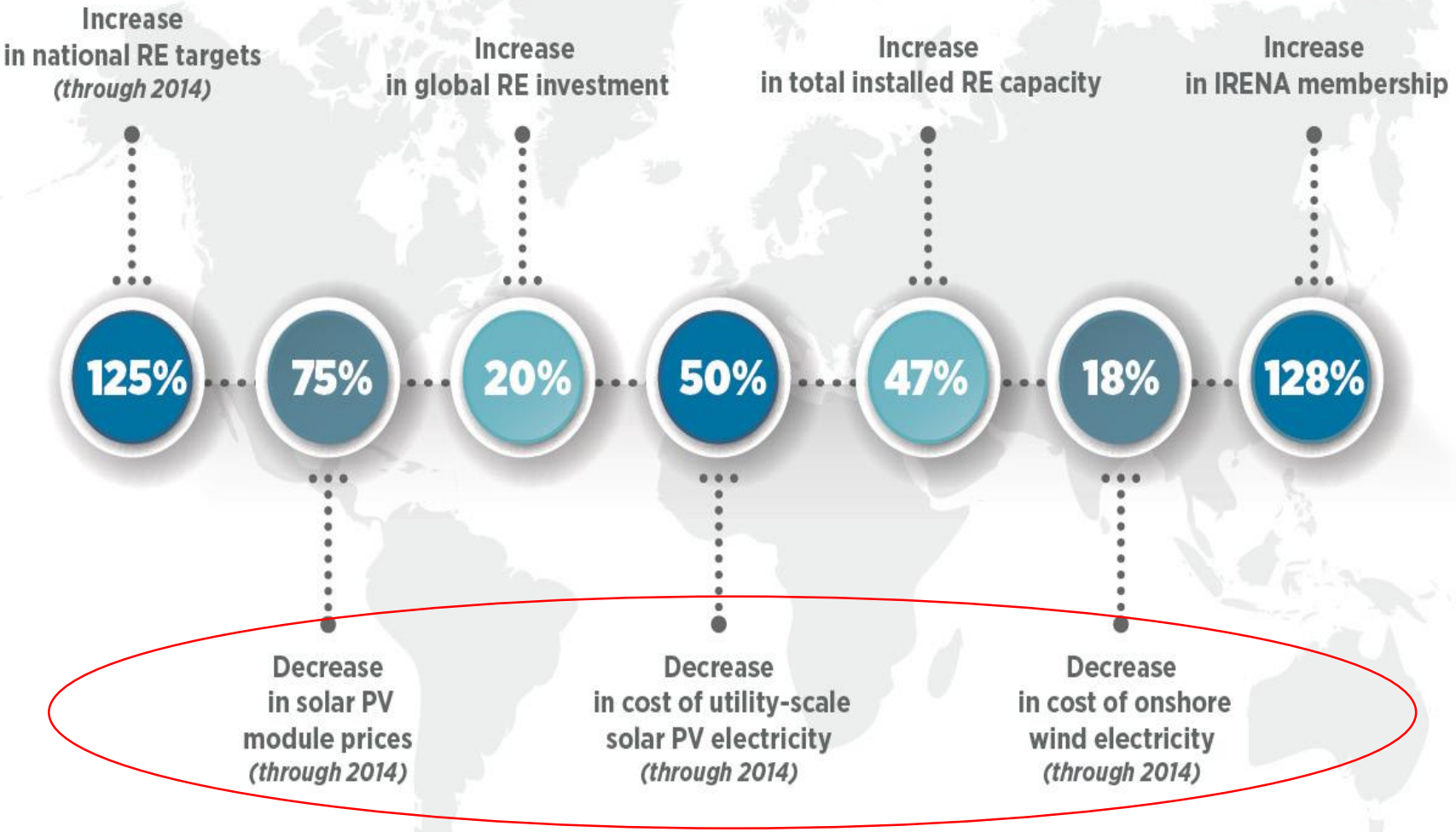
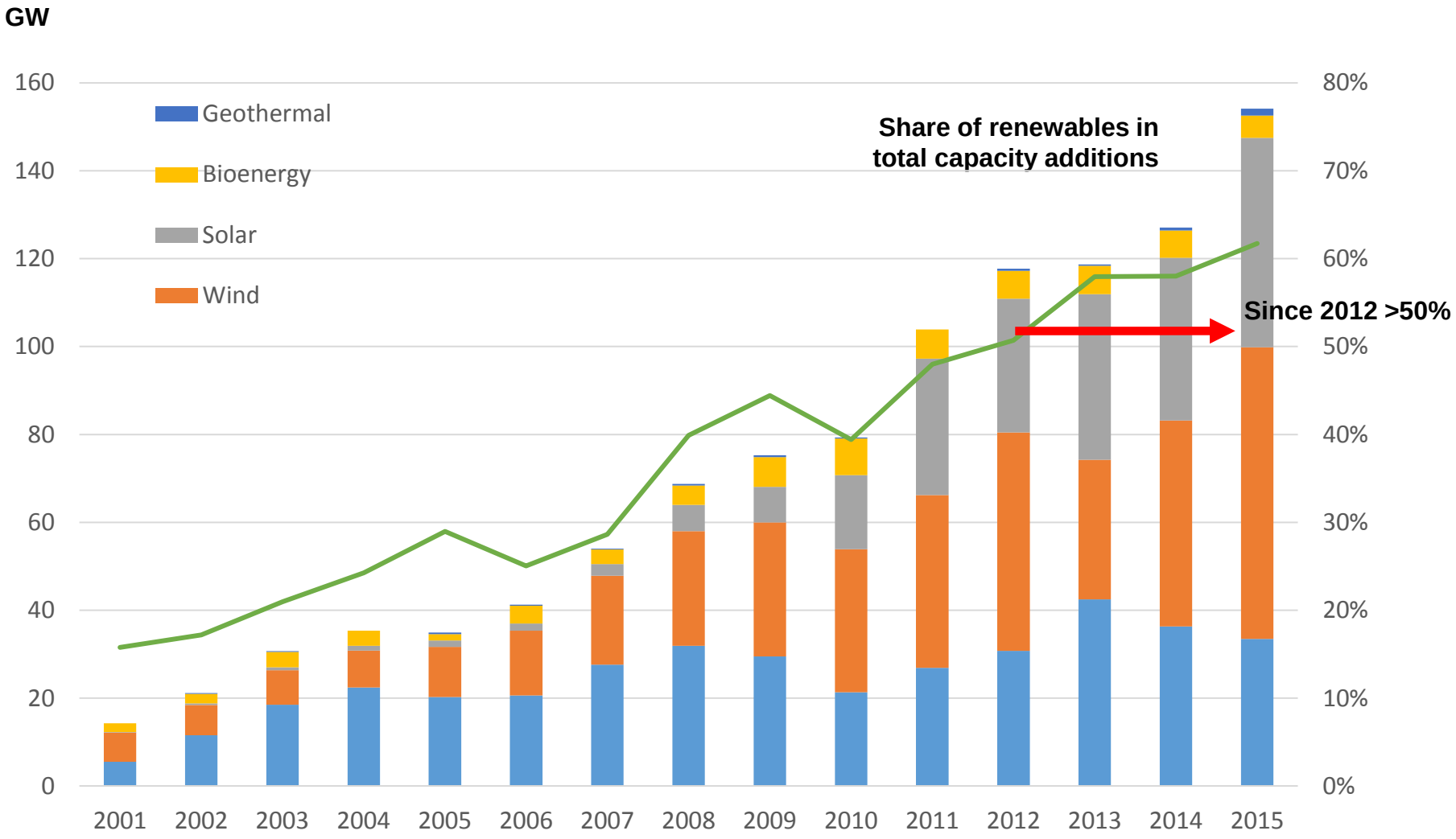
Snapshot of Global Renewable Energy Development

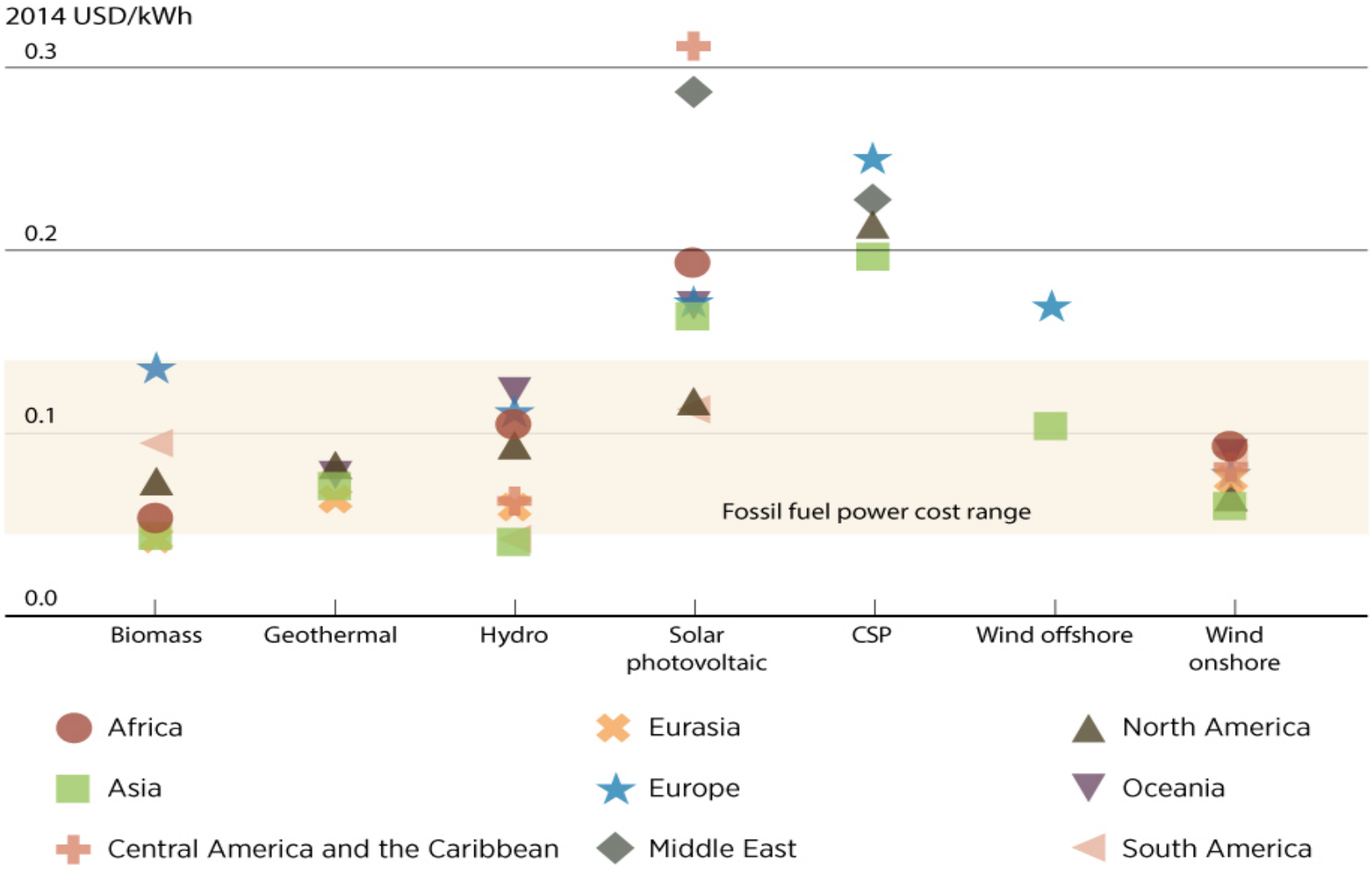
RENEWABLE ENERGY (RE) IN THE LAST 5 YEARS:



On-going power sector transformation



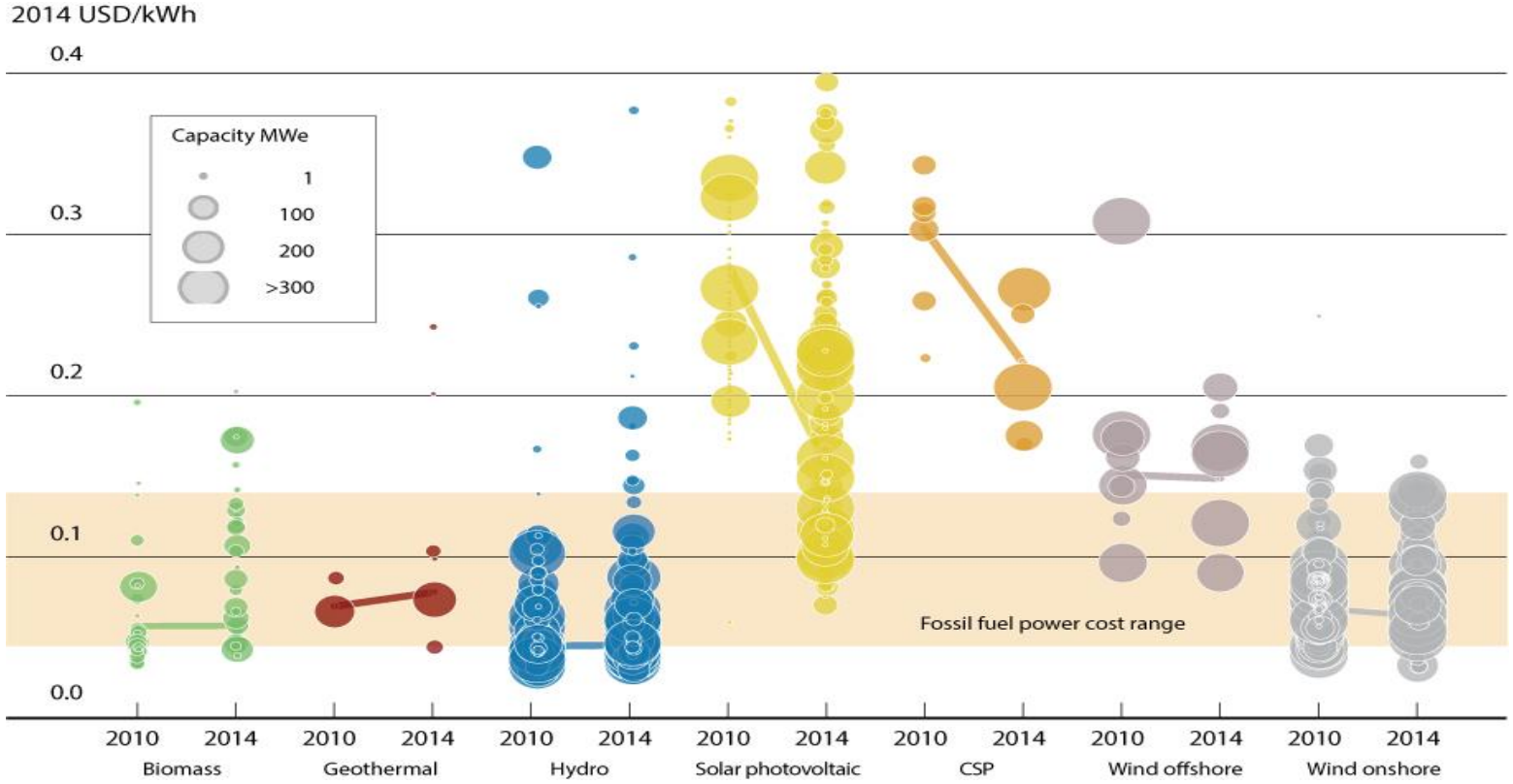
Renewables cost-competitiveness



Competing head-to-head with fossil fuels in all regions

The past and the trend

2010-2014, by technology



2015-2025

- Investment costs (2015 USD/kW): **solar PV** could fall by **57%** while **on-shore wind** by **12%**
- LCOE: **solar PV** could fall by **59%** while **on-shore wind** by **26%**

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Remap program

Current REmap work in progress

- Already 70 countries participating in the programme – near complete global coverage of energy use
- More than 30 reports have been released
  - More than 10 country roadmaps have been prepared
  - 4 regional roadmaps
  - Cross-cutting topics (bioenergy, storage, climate, sectoral deep-dives)
- New analysis with the support of German G20 Presidency
  - Explore energy sector consequences of Climate Agreement
  - Expand and deploy established REmap and macroeconomic analysis methods and datasets from 2030 to 2050 to develop global scenarios
  - Build on the G20 renewable energy toolkit and action plan

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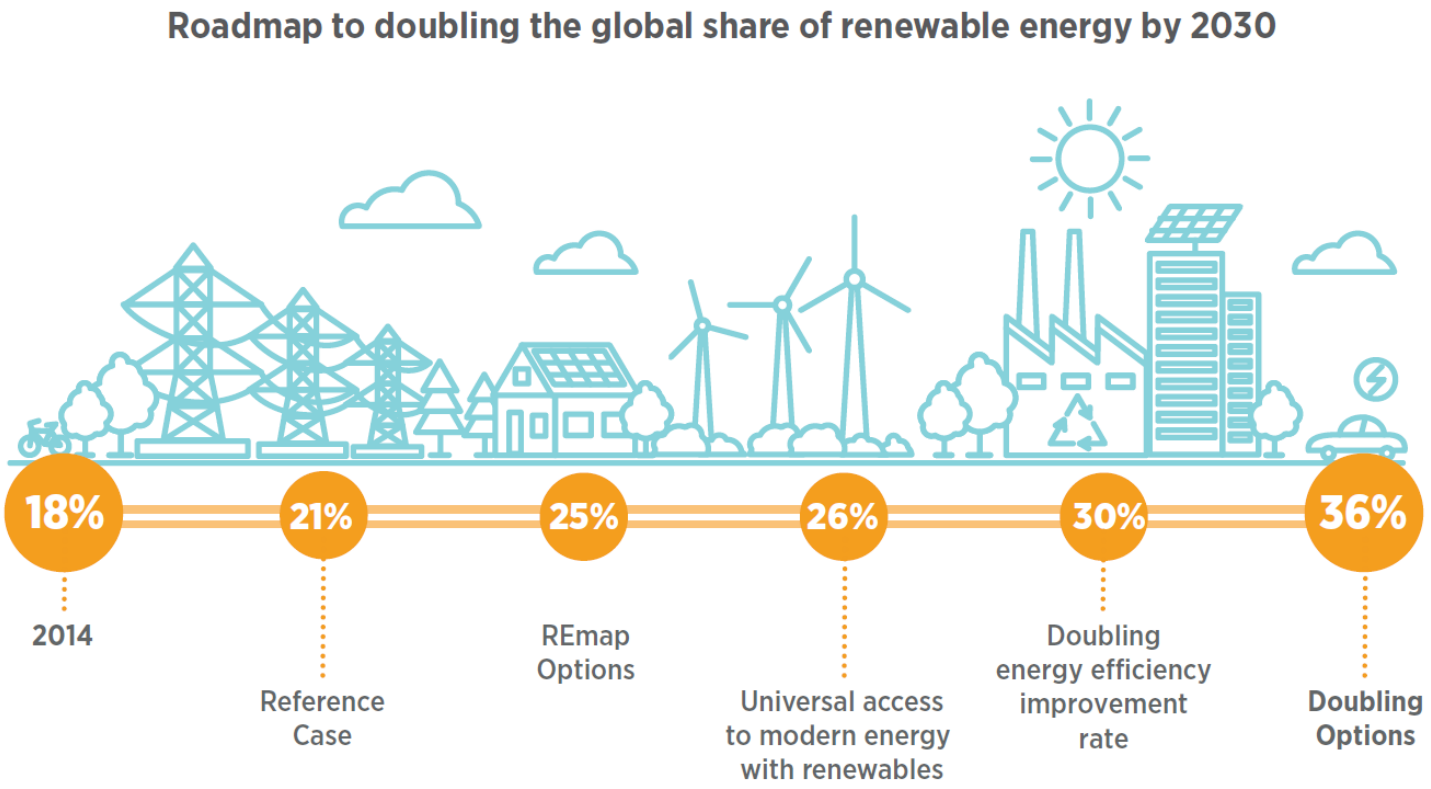
Global Remap and Decarbonization study

Doubling the share of renewables

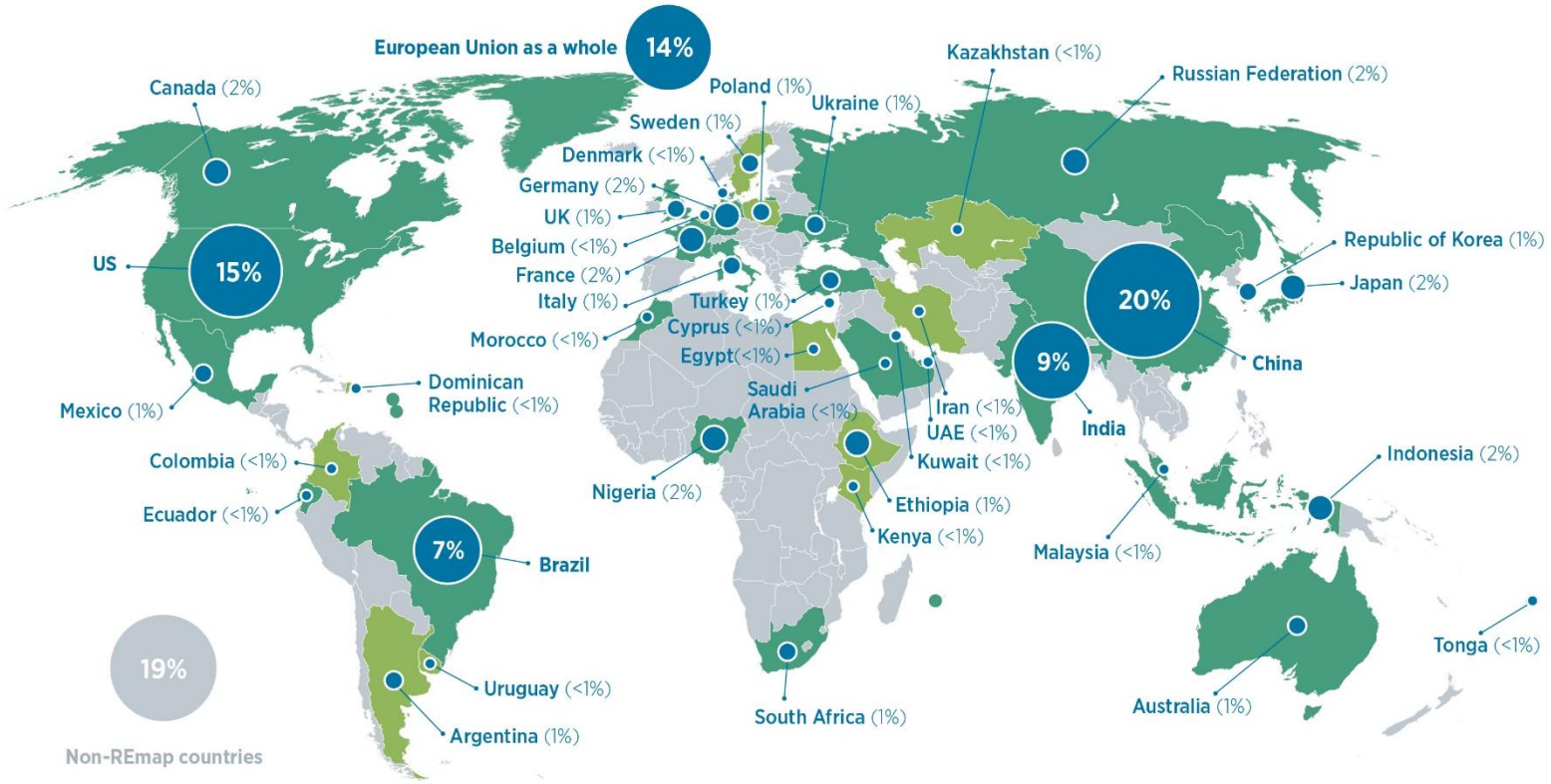


Doubling the world's renewable energy share requires concerted action, reinforcing growth in renewables with energy efficiency and universal access

REmap 2016 edition highlights

- Doubling the share of renewable energy by 2030 is critical for the achievement of sustainable energy and climate change objectives
- Doubling renewables in the world's energy mix by 2030 will lead to savings exceeding costs up to 15 times
- The transition to renewables, with greater energy efficiency, can limit the global temperature increase to below 2 degrees
- Doubling the share of renewable energy by 2030 is feasible, but only with immediate, concerted action in transport, buildings and industry

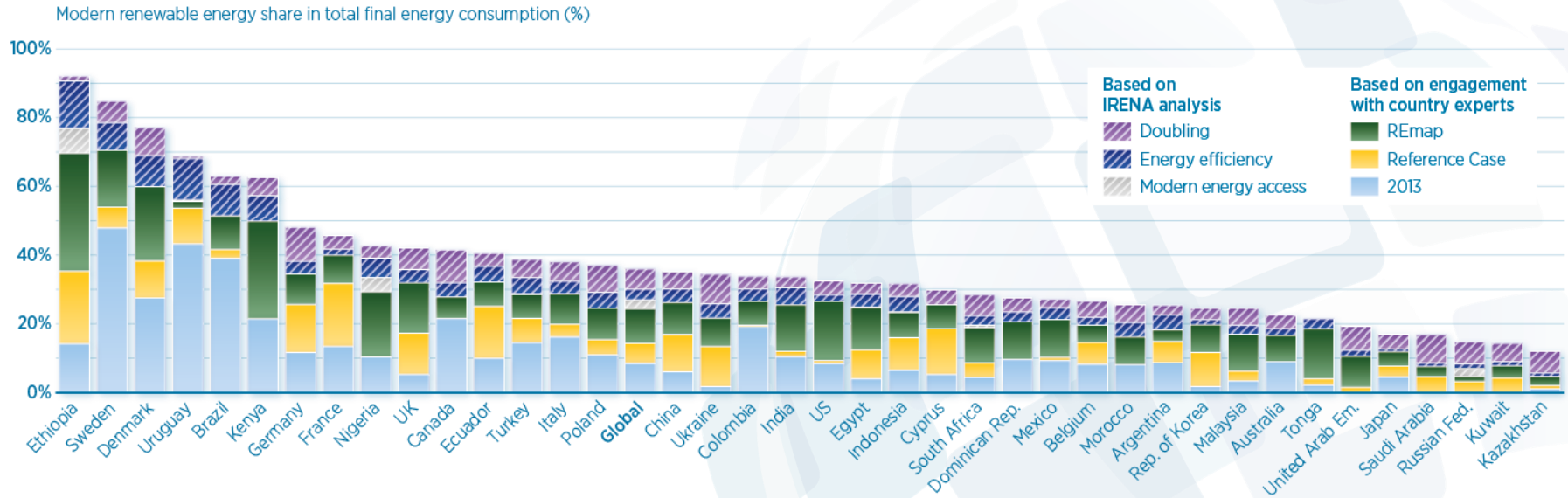
Top 5 countries account for more than half



Note: Percentages indicate how much renewable energy each country consumes of the global total in 2030 if the REmap Options are deployed.

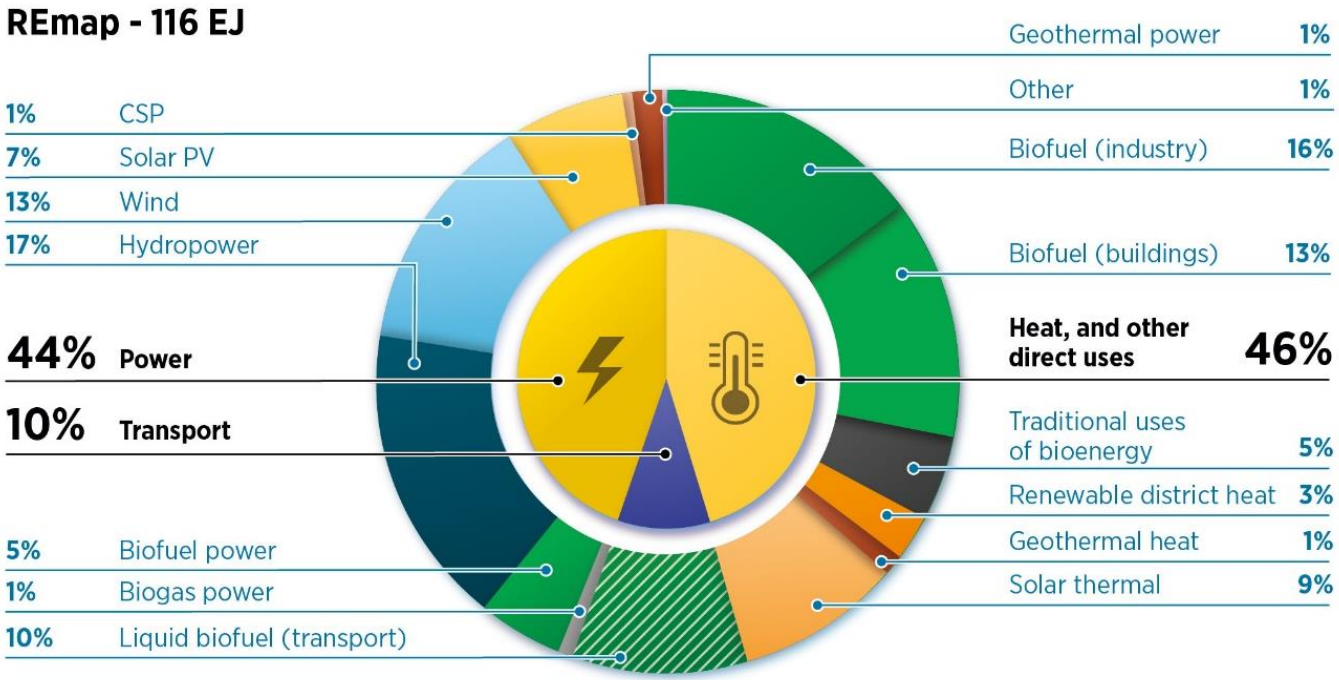
The top five countries make up more than half of renewable energy use in 2030; the next five bring this to nearly two-thirds

FIGURE 21 Share of modern renewables in energy use of REmap countries, 2013-2030



Each country will contribute to a doubling of the global renewable energy share.

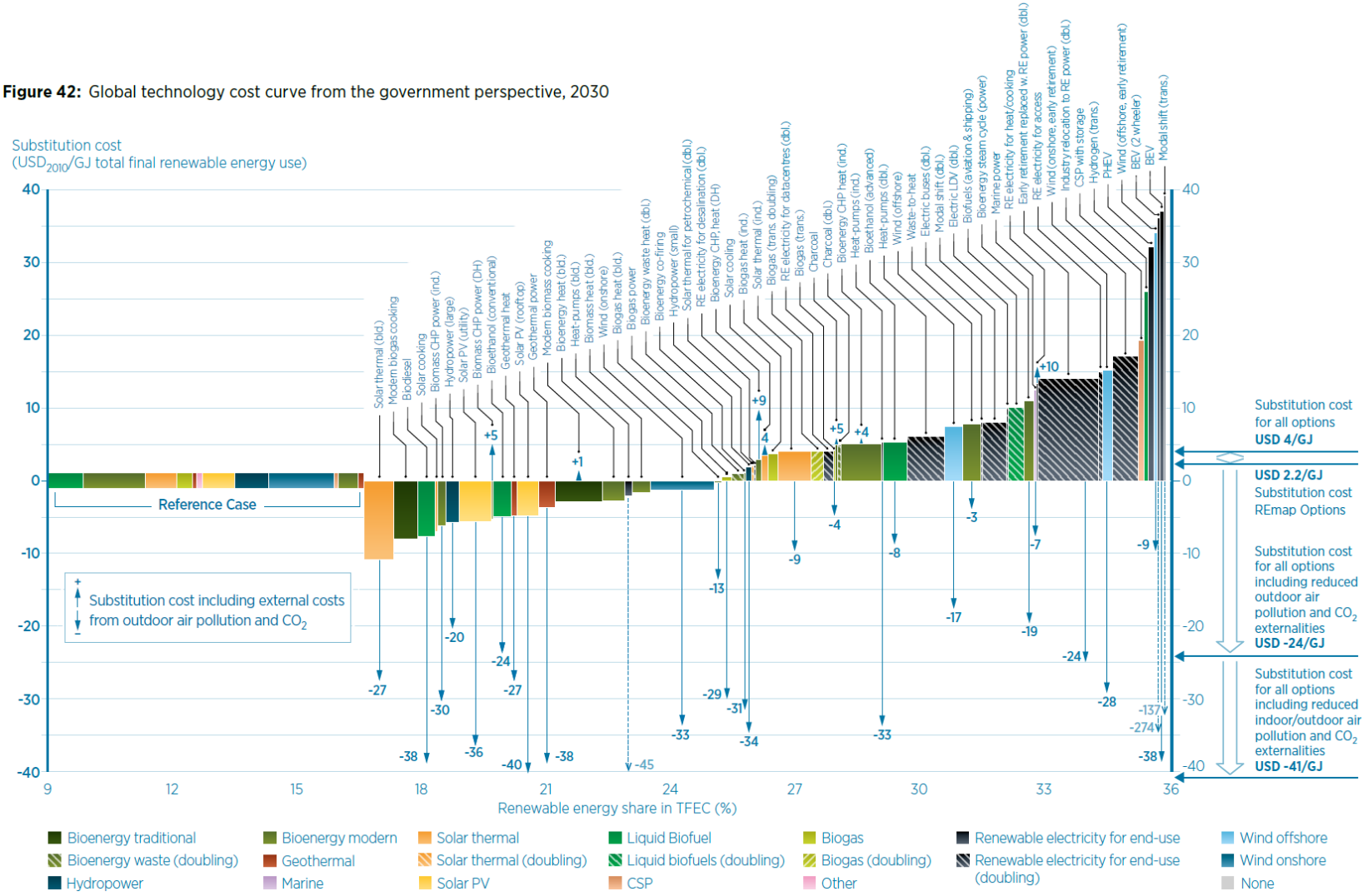
FIGURE 14 Renewable energy use in 2030 with REmap Options and with modern energy access with renewables.



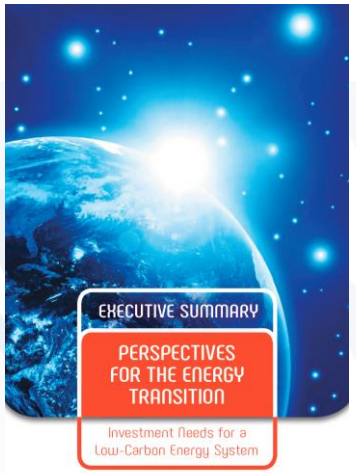
In REmap, renewables use in buildings, industry and transport as well as renewables-based district heating, would account for nearly 60% of modern renewable energy use in 2030.

FIGURE 42 Global technology cost curve from the government perspective, 2030

Figure 42: Global technology cost curve from the government perspective, 2030

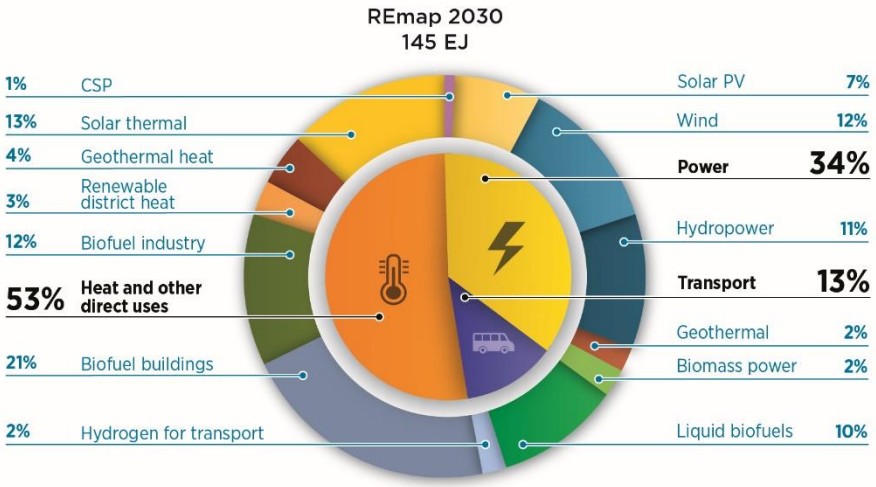


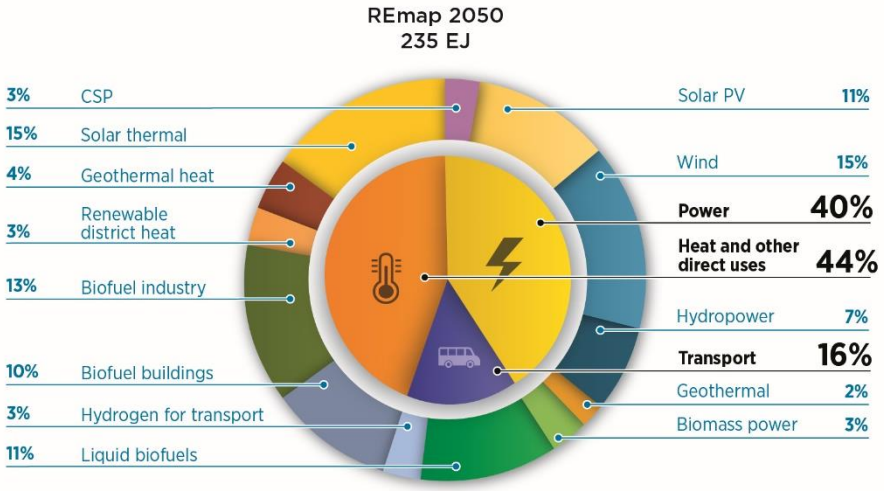
Decarbonisation study: key messages



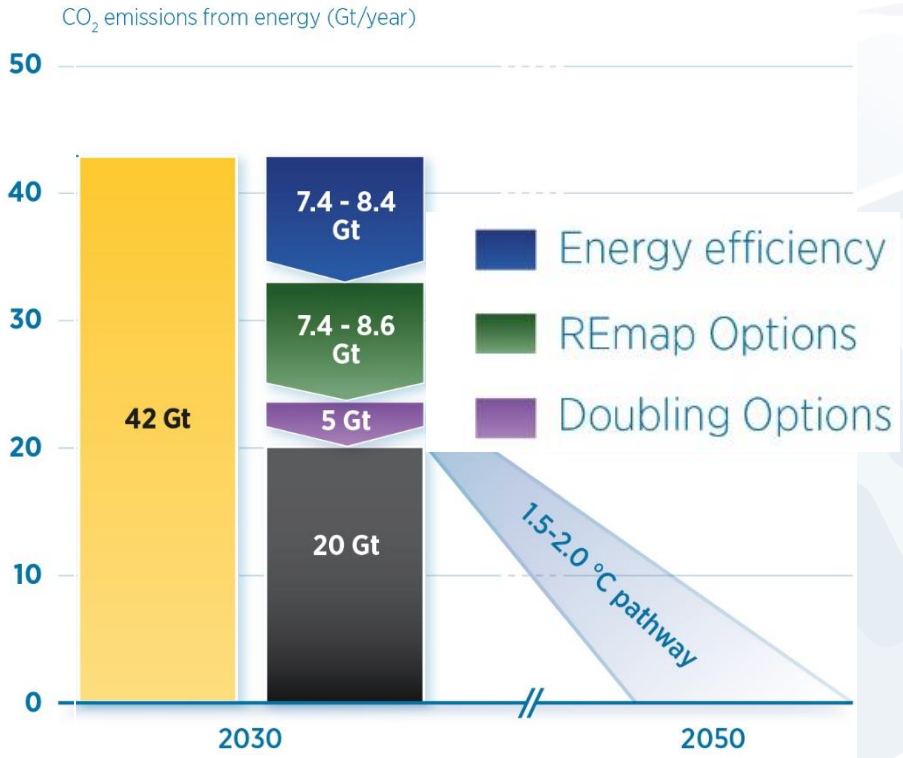
- Need to stop and reverse CO_2 concentration rise by 2050
  - Carbon intensity of energy needs to fall by 85% in 2015-2050
- Energy-emission budget: 790 Gt CO_2 from 2015 till 2100
  - This has profound impact on energy supply and demand
- Renewable energy and energy efficiency can account for more than 85% of emission mitigation
  - RE share in TPES reaches around 70% by 2050 from 15% today
  - RE share growth in TFEC accelerates to >1% per year in the next 15 years (6-fold increase compared to recent years)
  - Efficiency gains need to rise to 3% per year in 2015-2050 (from 1.8%/yr in 2015)
    (assuming tripling of the global GDP by 2050)

Global final renewable energy use in 2030 and 2050





Doubling renewables is critical for meeting climate objectives

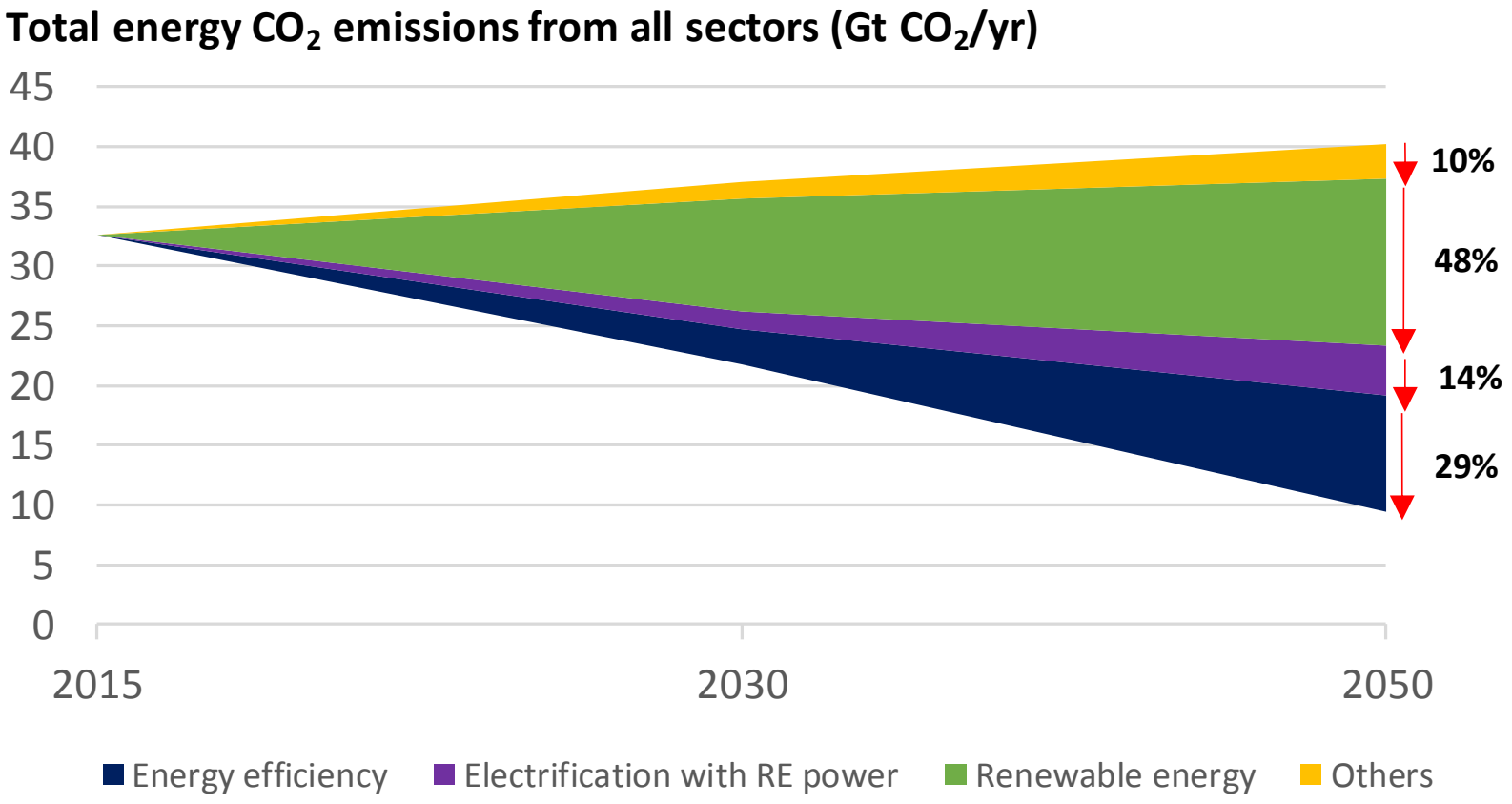


Doubling the share of renewables by 2030 would put the world on a pathway to limiting global warming to 1.5-2.0 degrees

Renewable energy reduction potential on par with efficiency potential

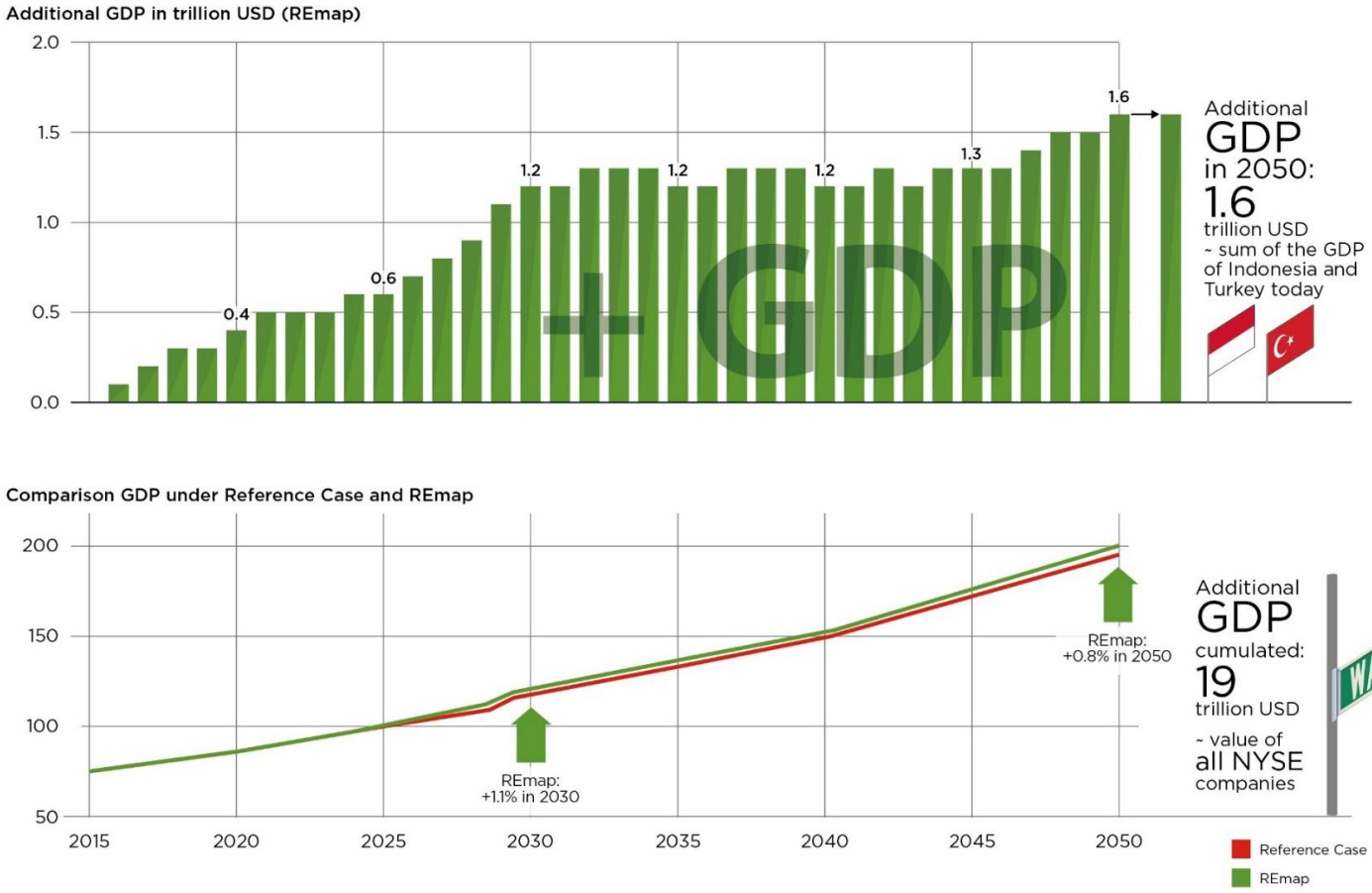
#REmap

REmap 2050 – decarbonisation of the global energy sector



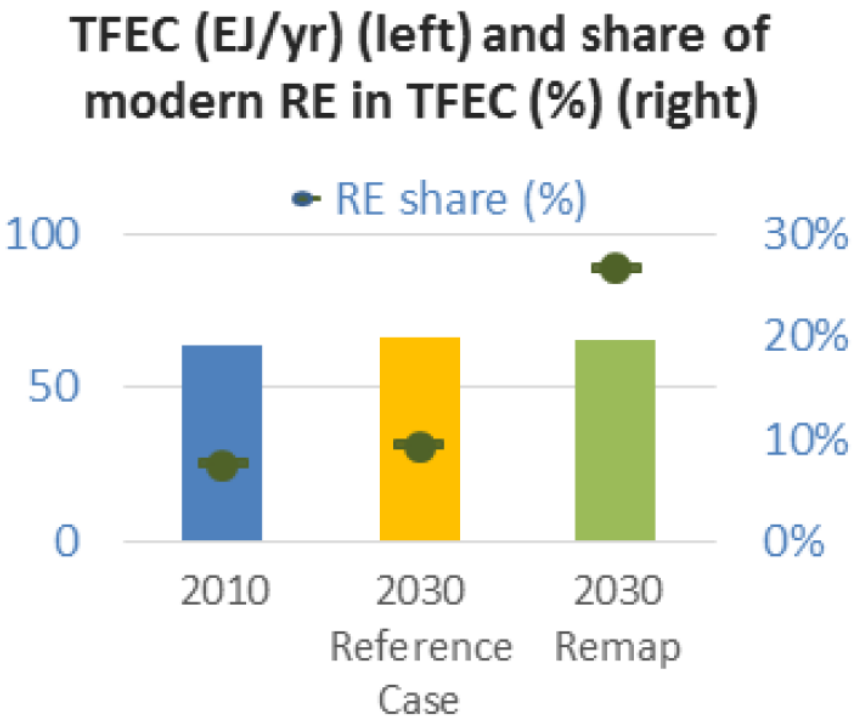
- Renewables would account for half of total emission reductions in 2050

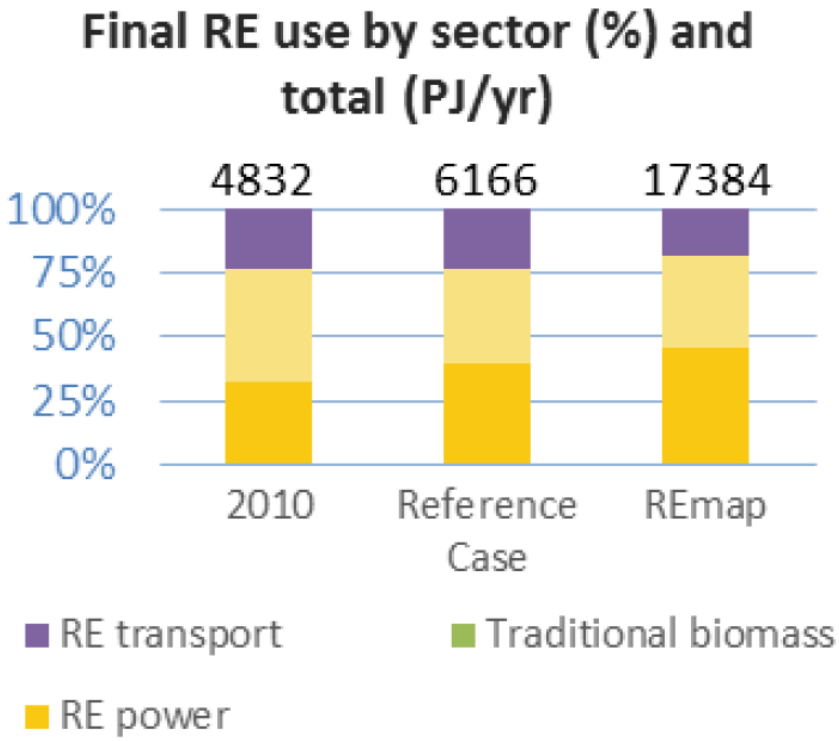
Increase in global GDP



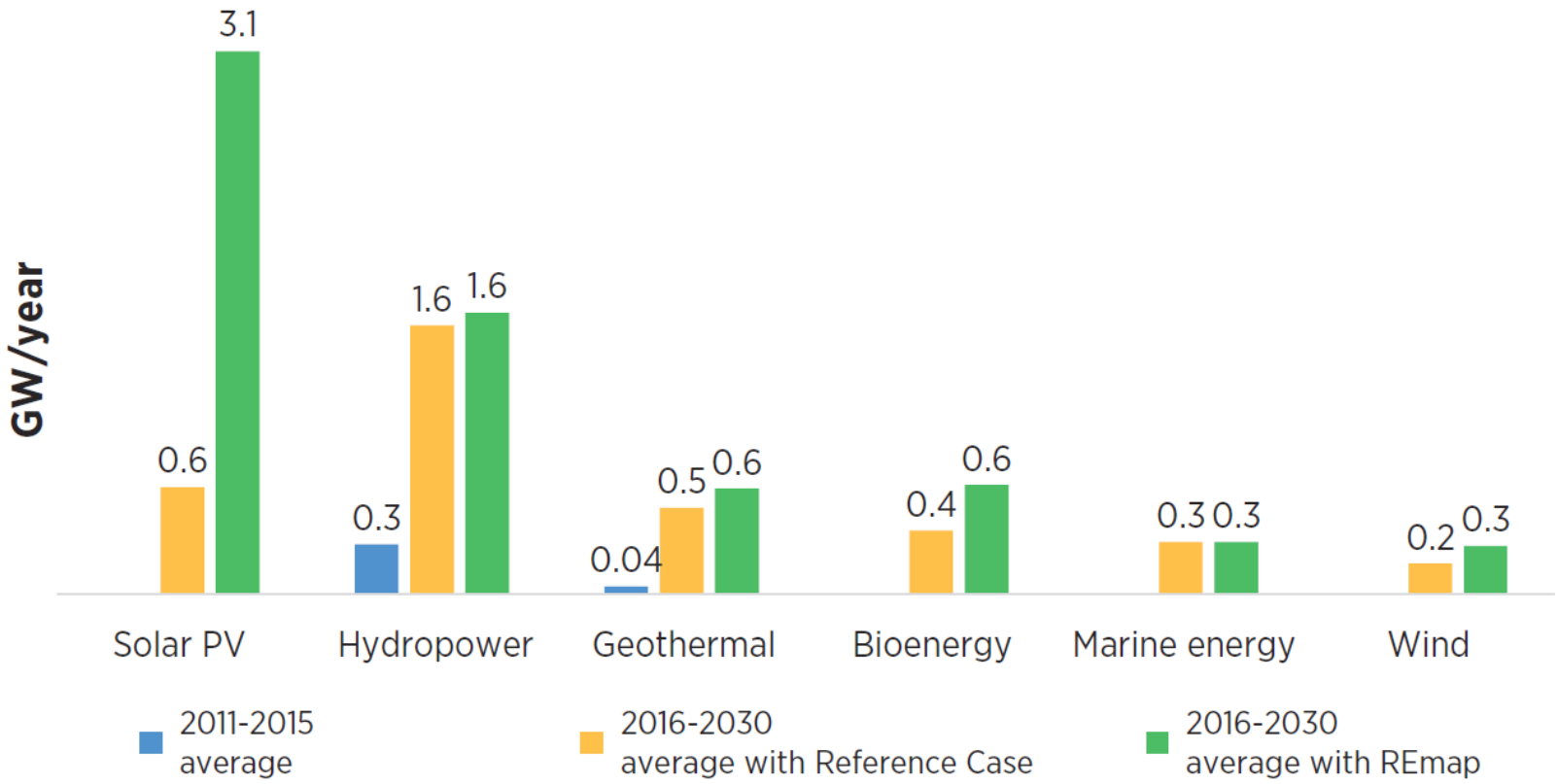
- Decarbonising the energy sector in line with REmap increases global GDP by around 0.8% by 2050 compared to the Reference Case
- That is the equivalent of almost 19 trillion USD in increased economic activity between today and 2050.

REmap US

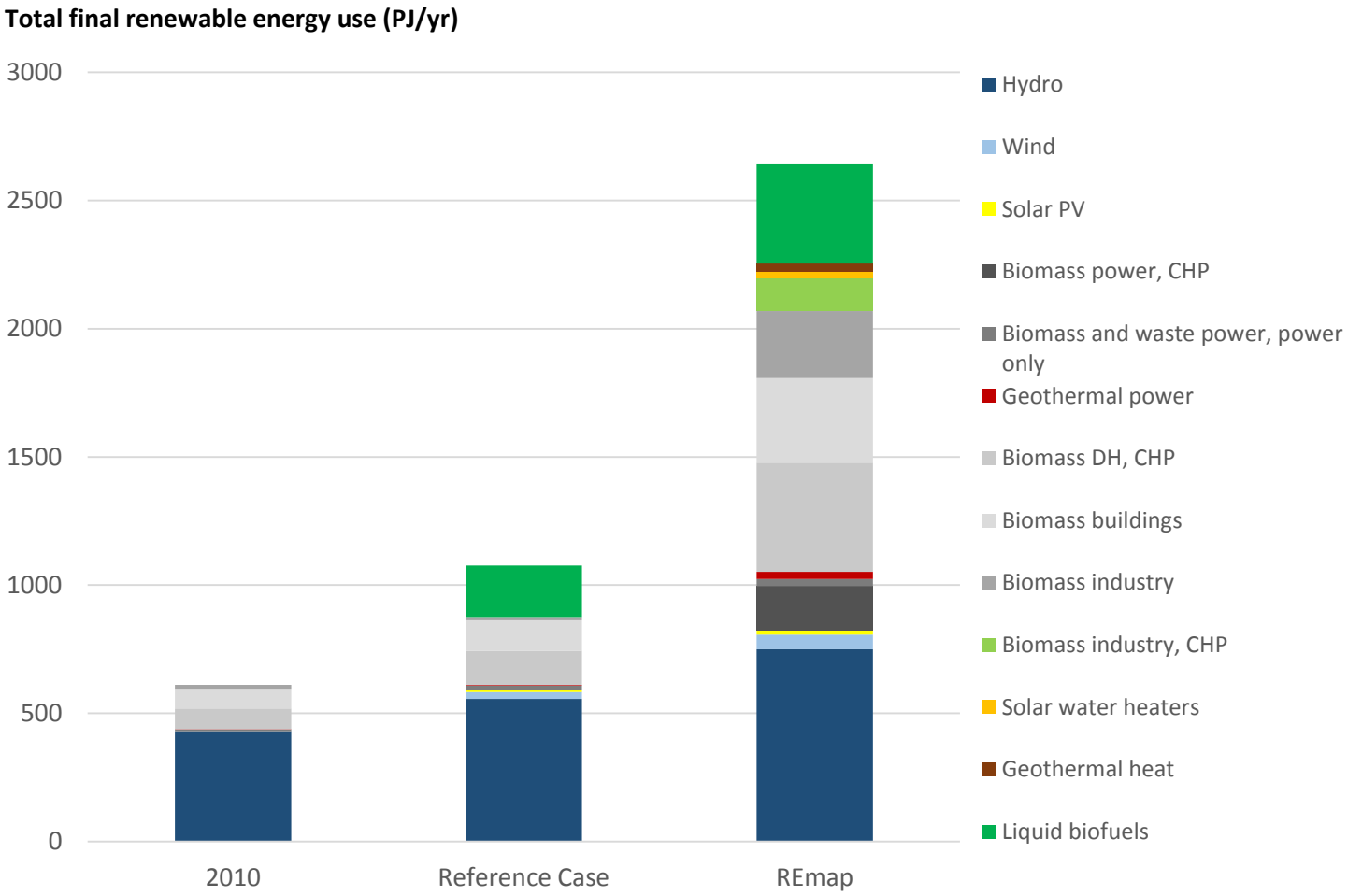

TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)
RE share (%)
100
50
0
30%
20%
10%
0%
2010
2030 Reference Case
2030 Remap


Final RE use by sector (%) and total (PJ/yr)
4832
6166
17384
100%
75%
50%
25%
0%
2010
Reference Case
REmap
RE transport
Traditional biomass
RE power

REmap Indonesia

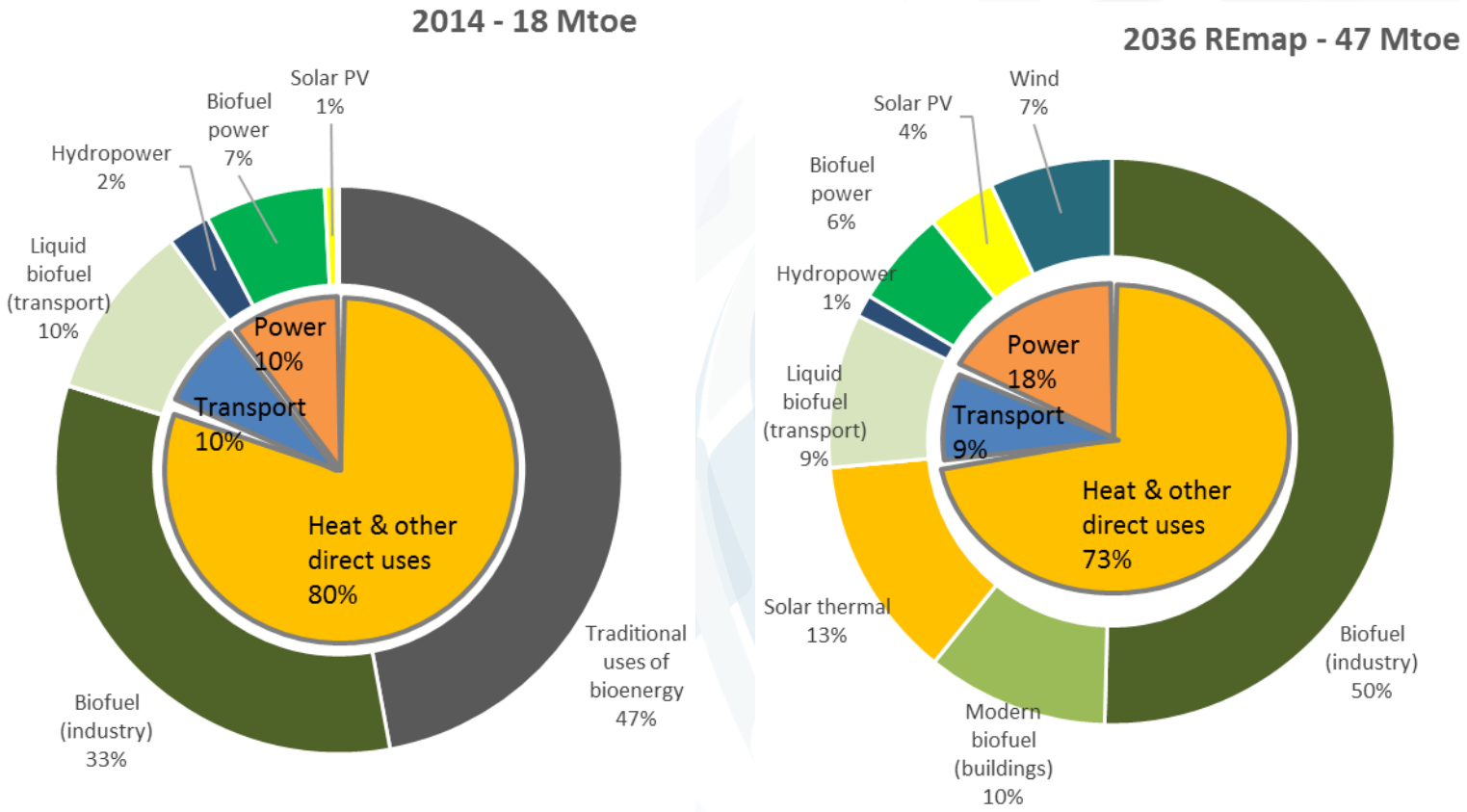


REmap Russia



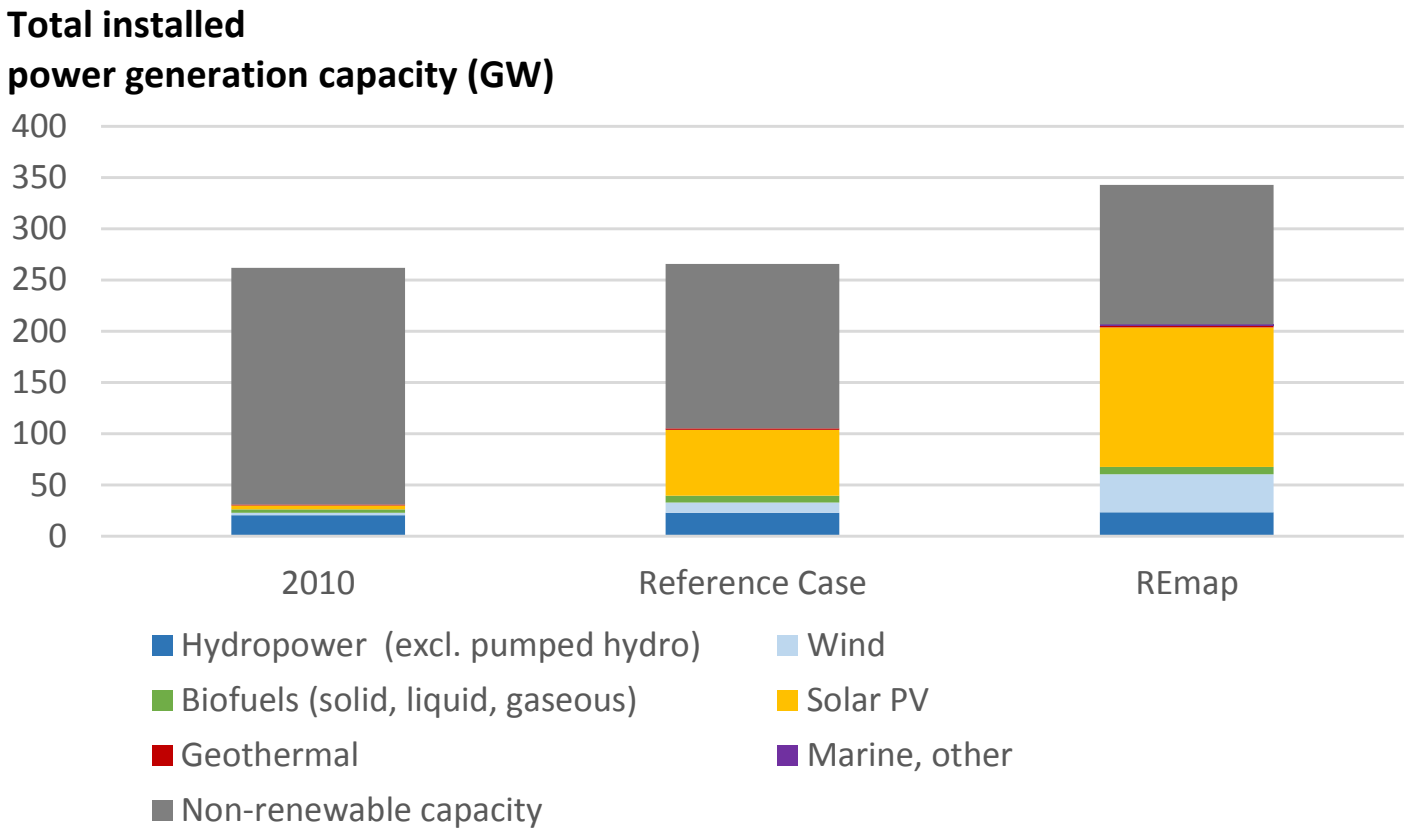
REmap Thailand

Fuel use for heat and other direct uses remains largest source of renewables, but relative importance of power sector increases



- Traditional uses of bioenergy see significant decline, and overall renewable energy consumption increases 2.5 fold

REmap Japan

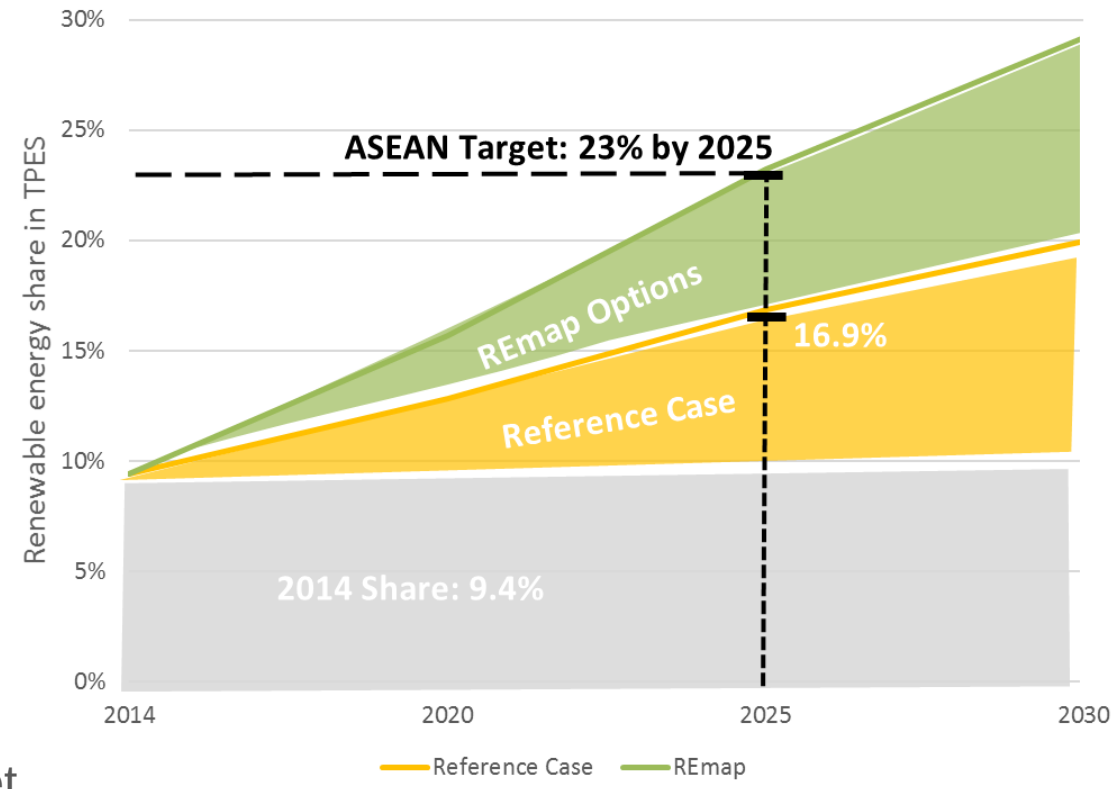


Solar PV and wind capacity account for half of all capacity in REmap 2030

ASEAN's 23% aspirational renewables target

October 2015 as part of ASEAN Plan of Action for Energy Cooperation

- 23% renewable energy share[1)] in total primary energy supply (TPES) by 2025
- ACE Energy Outlook (2015):
  - **2014 – 9.4%**
  - 2025 BAU – 10%
  - 2025 Advanced Policy Scenario (APS) – 15.4%
- IRENA Reference Case – **16.9%** (APS + latest country updates)
- **6%** point gap to the 23% target

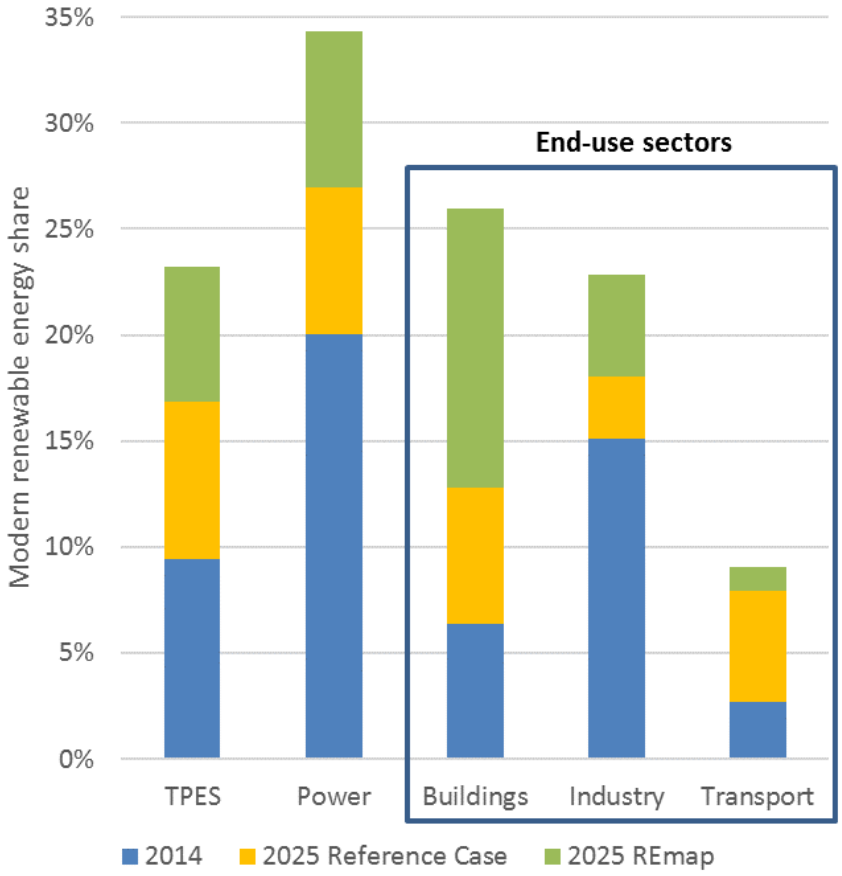


1) excluding traditional uses of bioenergy, including all hydropower

REmap ASEAN: renewable energy share by sector

Renewable shares increase in all sectors, but mostly in end-use sectors

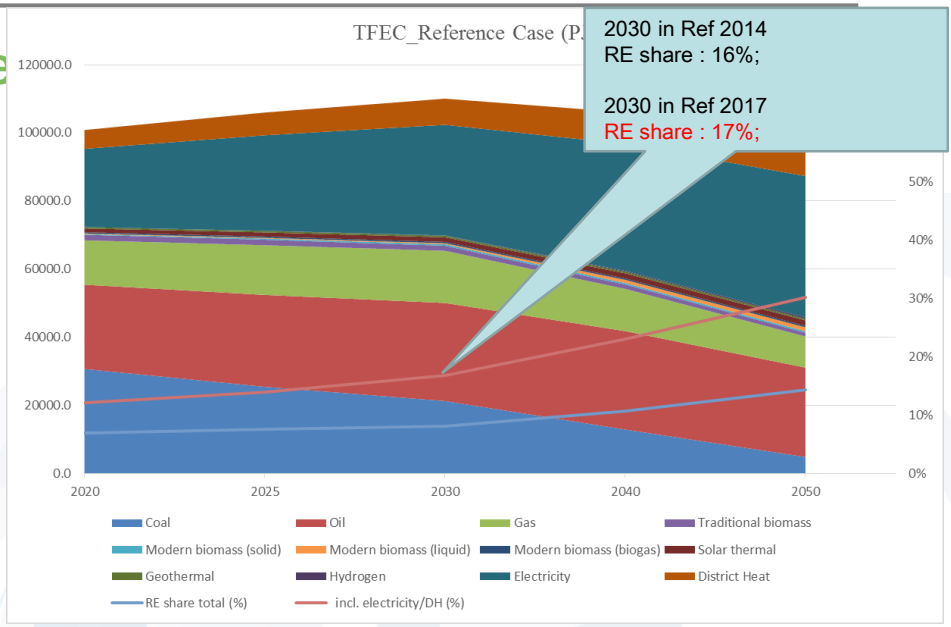
- Power sector – highest share of renewable energy at 34%
- Buildings –largest increase in share due to the substitution of traditional uses of bioenergy
- Industry – large untapped potential compared to the Reference Case
- Transport – largest growth in renewable energy use according to the Reference Case

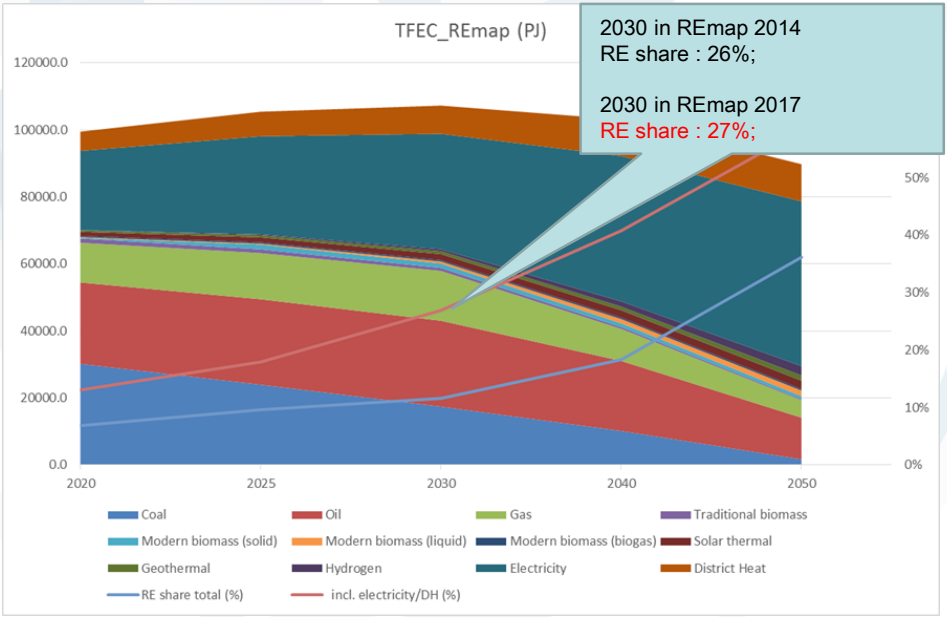


Note: End-use sectors include the consumption of electricity sourced from renewables. Shares presented in figure exclude traditional uses of bioenergy.

China REmap: TFEC in Reference Case and REmap (on-going)

- China's TFEC is projected to flatten between 2016 and 2020 and reach to peak in the following decade to 2030. Total TFEC in 2050 is 97 EJ with Reference Case; -7% (90 EJ)with REmap
- Total REmap 2030 fossil fuel consumption in final sector is expected to slow down at a slower rate
- Coal is reduced significantly in the end use sectors, substituted by RE, natural gas and electricity
- Total renewable energy consumption in final-use sectors (excluding renewable electricity and district heat) will see an increase from about 5 EJ/year to 6.5 EJ/year in REmap 2030 and 10.1 EJ/year in 2050.
- RE share in 2030 and 2050 REmap reaches 27% and 36% respectively.



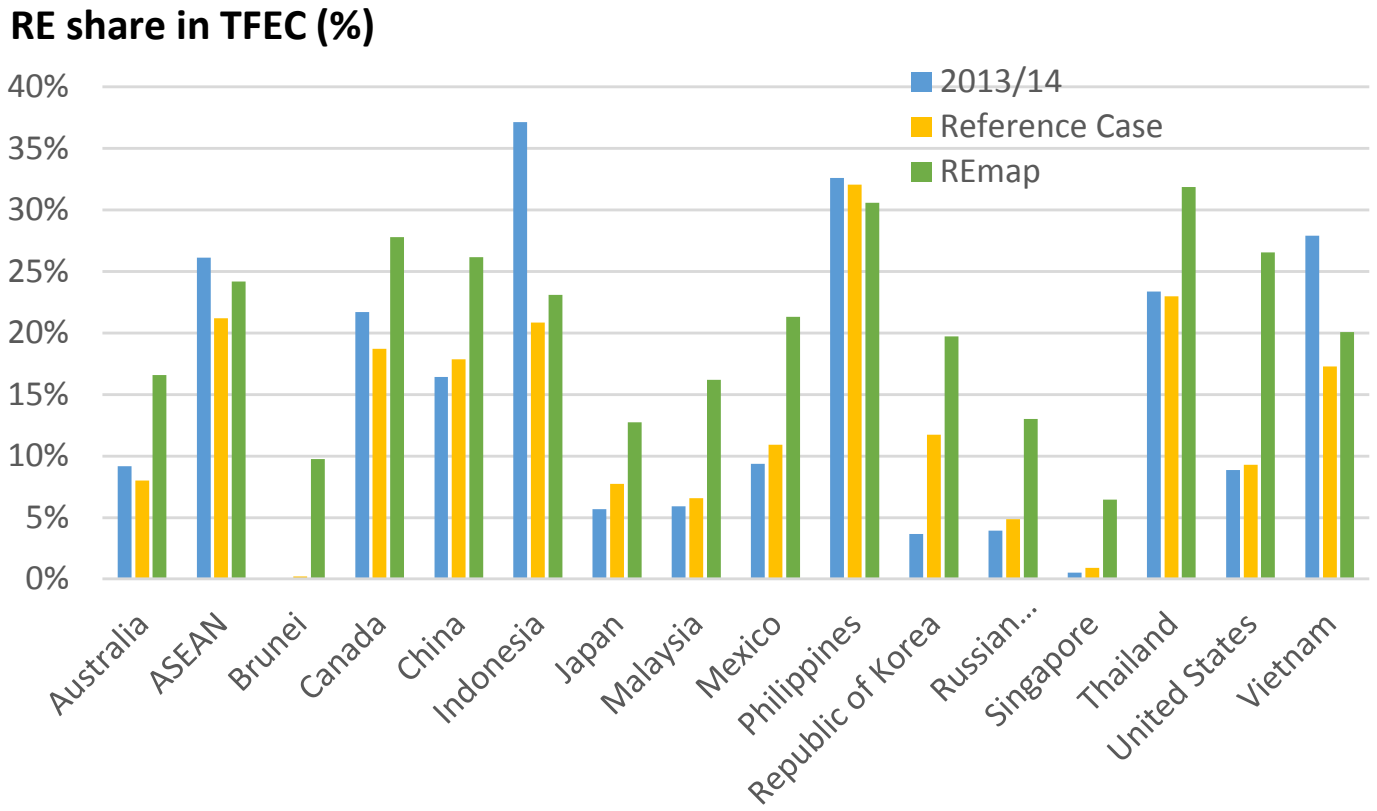


Recent developments from REmap in the APEC

- All APEC members are participating in the REmap programme (excluding Chile, New Zealand, Papua New Guinea, Peru)
- Detailed country & regional reports released for
  - ASEAN, China, Indonesia, Mexico, US
  - Russia, April 2017
- Joint REmap/RRA study for Thailand

March 2017

Renewable energy share in APEC members



Potential for additional renewable energy in all countries is identified, with great differences between countries in starting points, local capabilities, and realistic deployment potential

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REmap

ROADMAP FOR A RENEWABLE ENERGY FUTURE