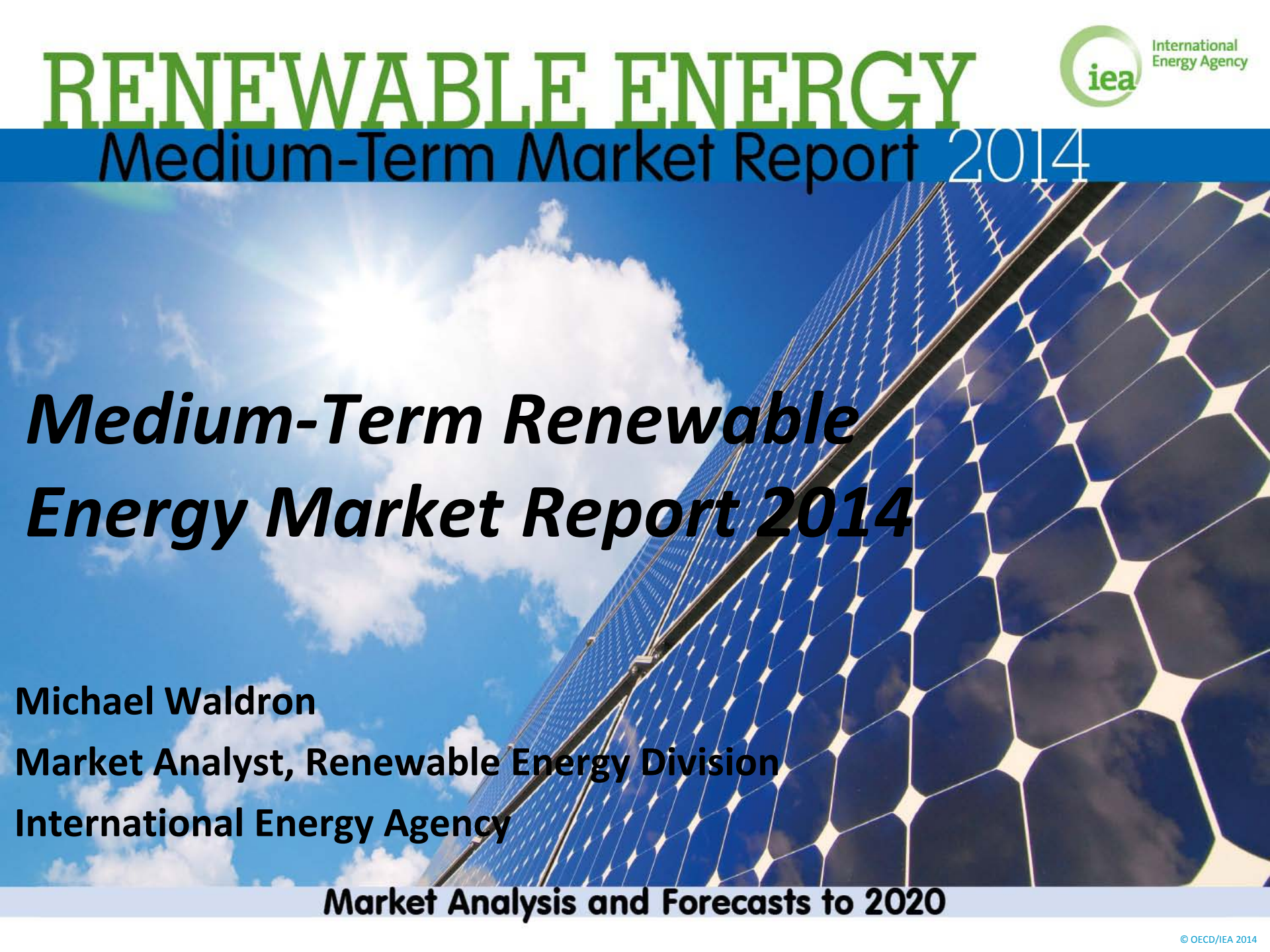
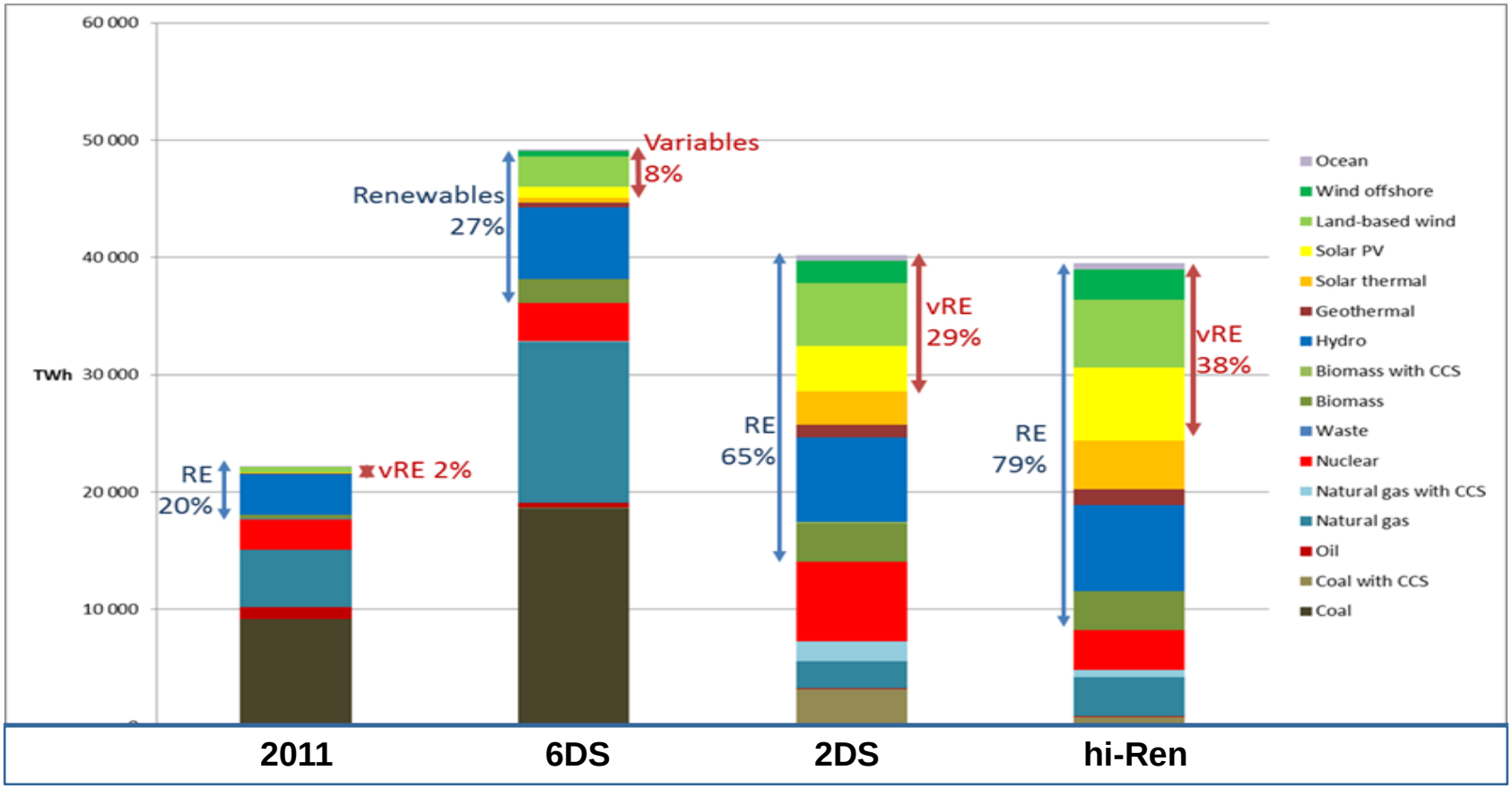


An Energy Revolution is needed

ETP 2014

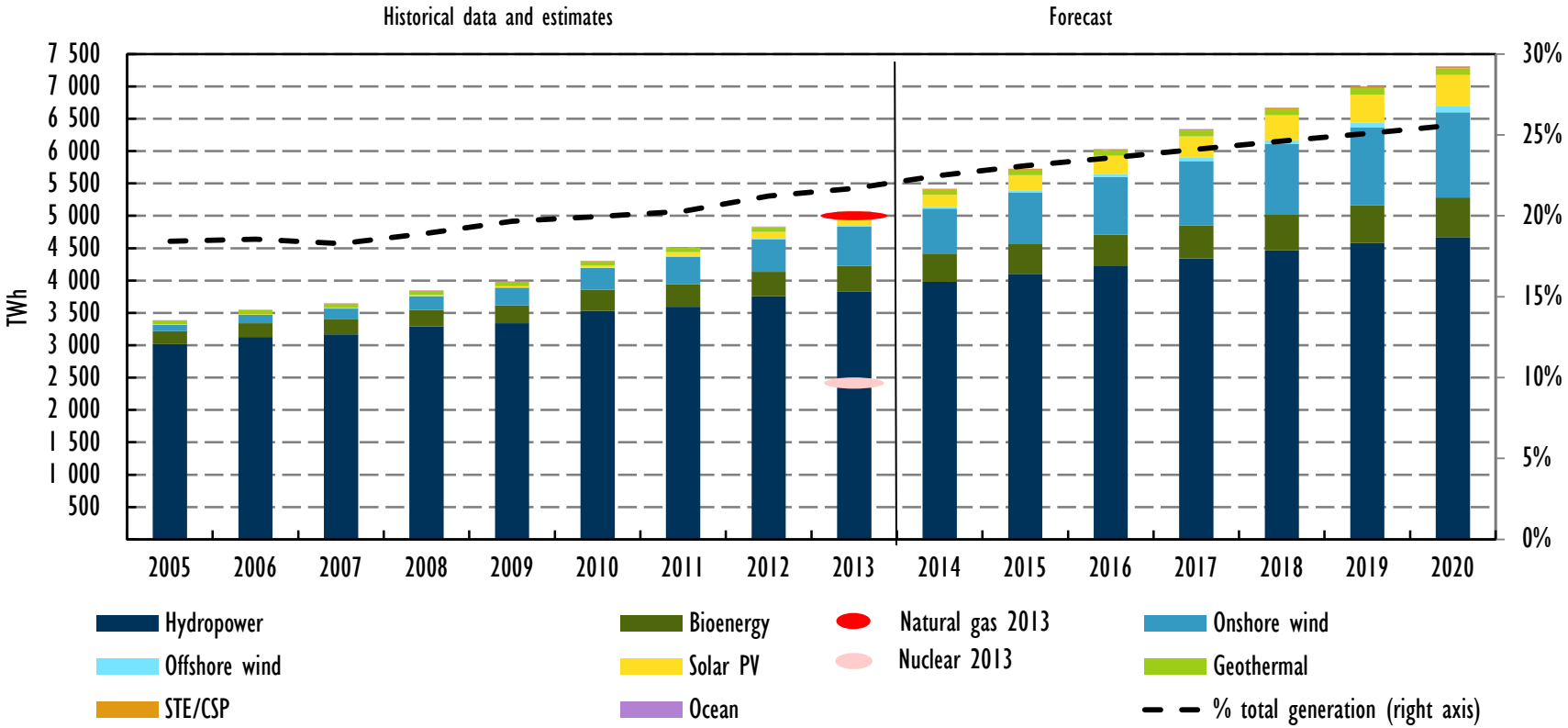


- Generation today:
  - Fossil fuels: 68%
  - Renewables: 20%
- Generation 2DS 2050:
  - Renewables: 65 - 79%
  - Fossil fuels: 7-20%

International Energy Agency

Strong momentum for renewable electricity

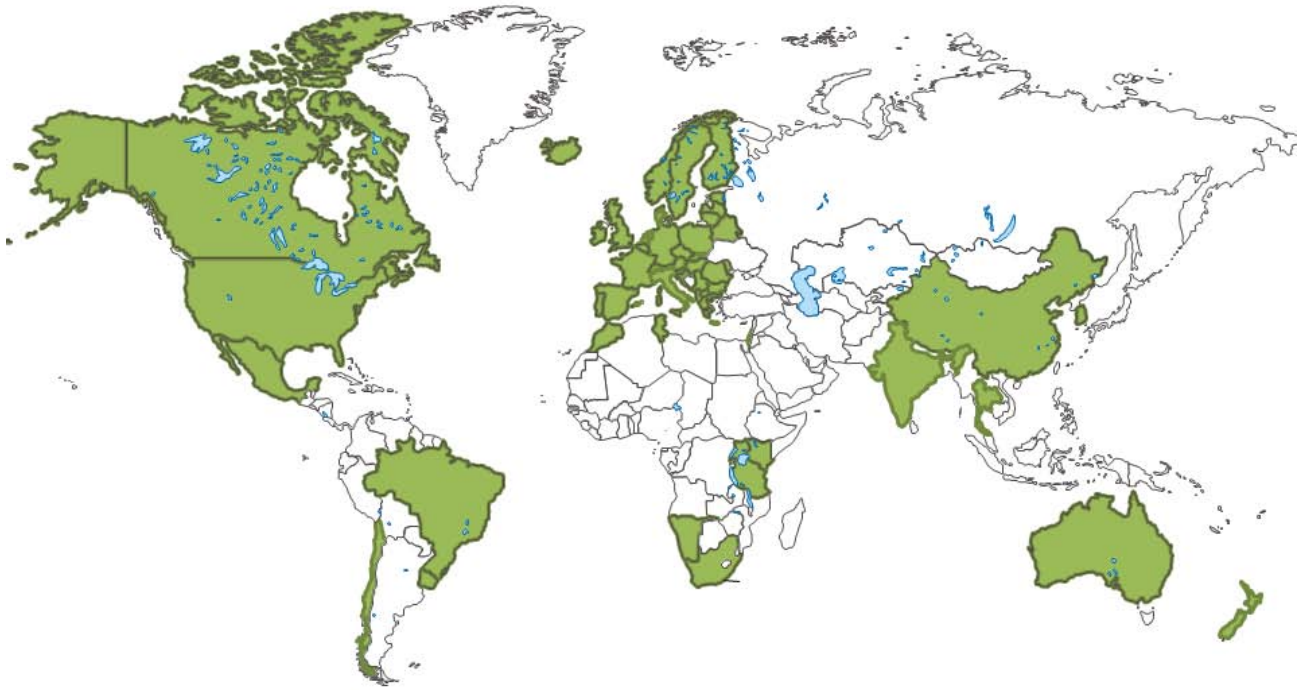
Global renewable electricity production, historical and projected



- **Renewable electricity projected to scale up by 45% from 2013 to 2020**

Role of renewable use in heat also increasing, but policy support still limited

Countries with targets and support policies for renewable heat

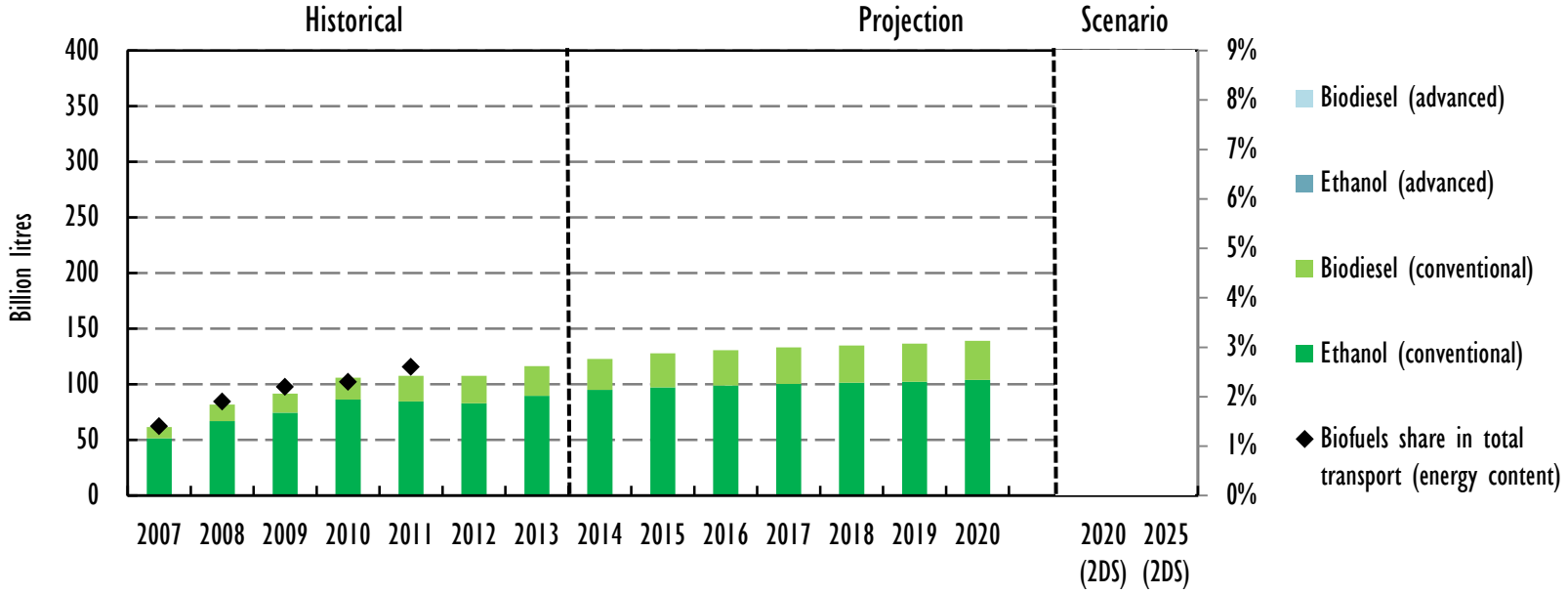


This map is without prejudice to the status of or sovereignty over any territory to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

- **Modern renewable heat continues to grow, providing 9% of world final energy use for heat in 2020**
  - **Broader adoption of support policies for renewable heat could reduce energy consumption and enhance energy security**

Transition to advanced biofuels for transport threatened by policy uncertainty

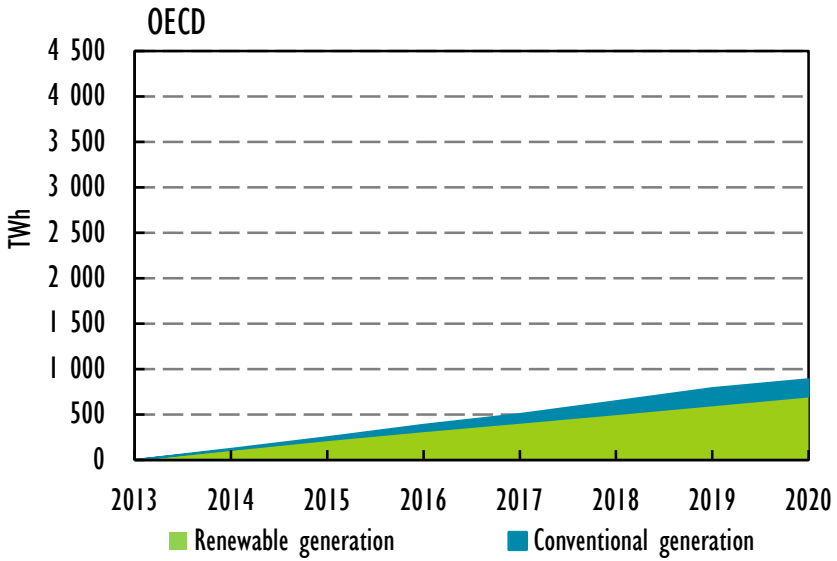
Projected biofuel production versus targets in IEA 2°C Scenario (2DS)

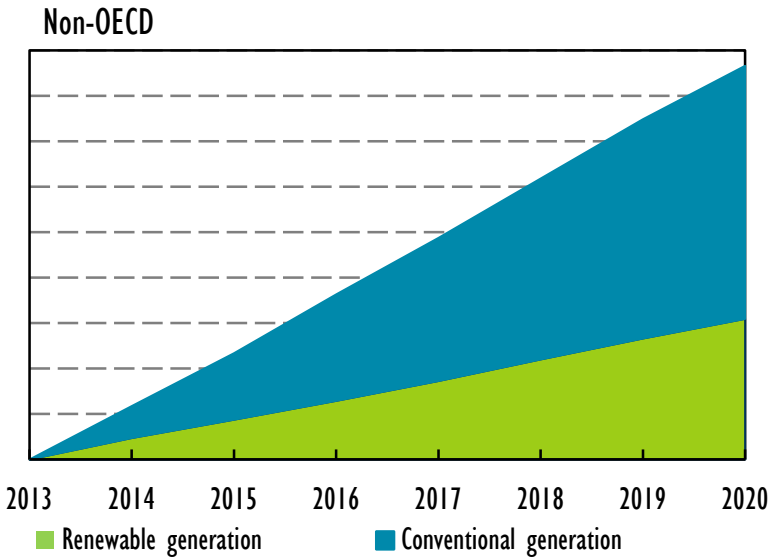


- **Conventional biofuel production continues to grow, and will provide 4% of road transport fuel demand in 2020**
- **First commercial-scale advanced biofuel plants coming on line**
  - **Without adoption of long-term policy framework, advanced biofuels sector faces grim future**

Renewables are major source of new generation

Cumulative change in gross power generation by source and region, 2013-20

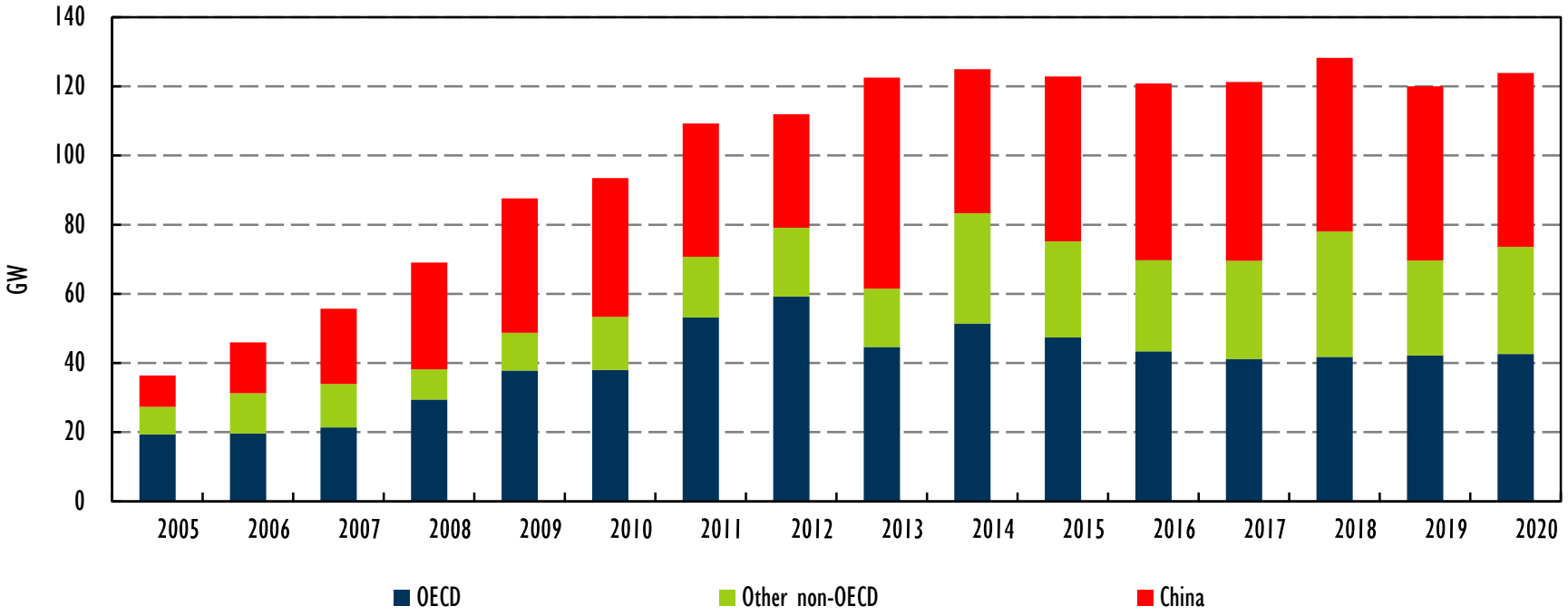




- **Renewables account for 80% of new generation in OECD**
  - **Limited upside in stable markets with slow demand and growing policy risks**
- **Renewables are largest new generation source in non-OECD, but meet only 35% of growth**
  - **Large upside for dynamic markets with fast-growing demand**

Increasing risks are expected to slow renewable growth

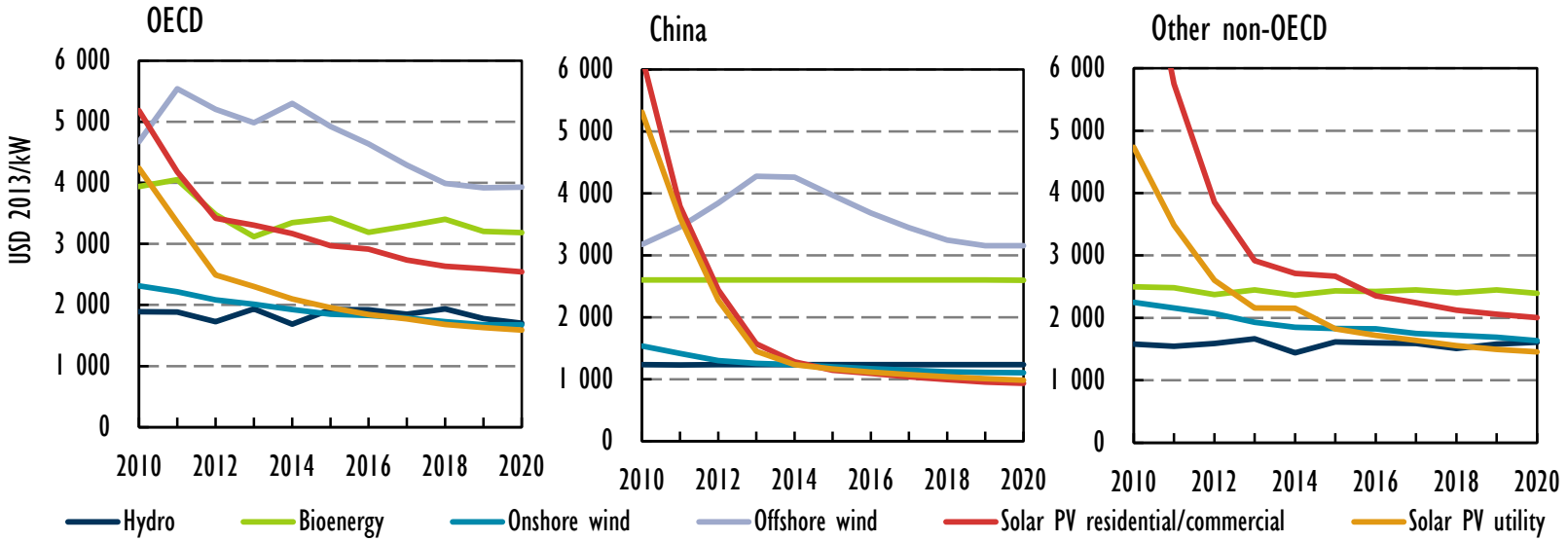
Renewable power annual net capacity additions, historical and projected



- **Policy and market risks threaten to slow deployment momentum for renewables**

Renewable investment costs falling

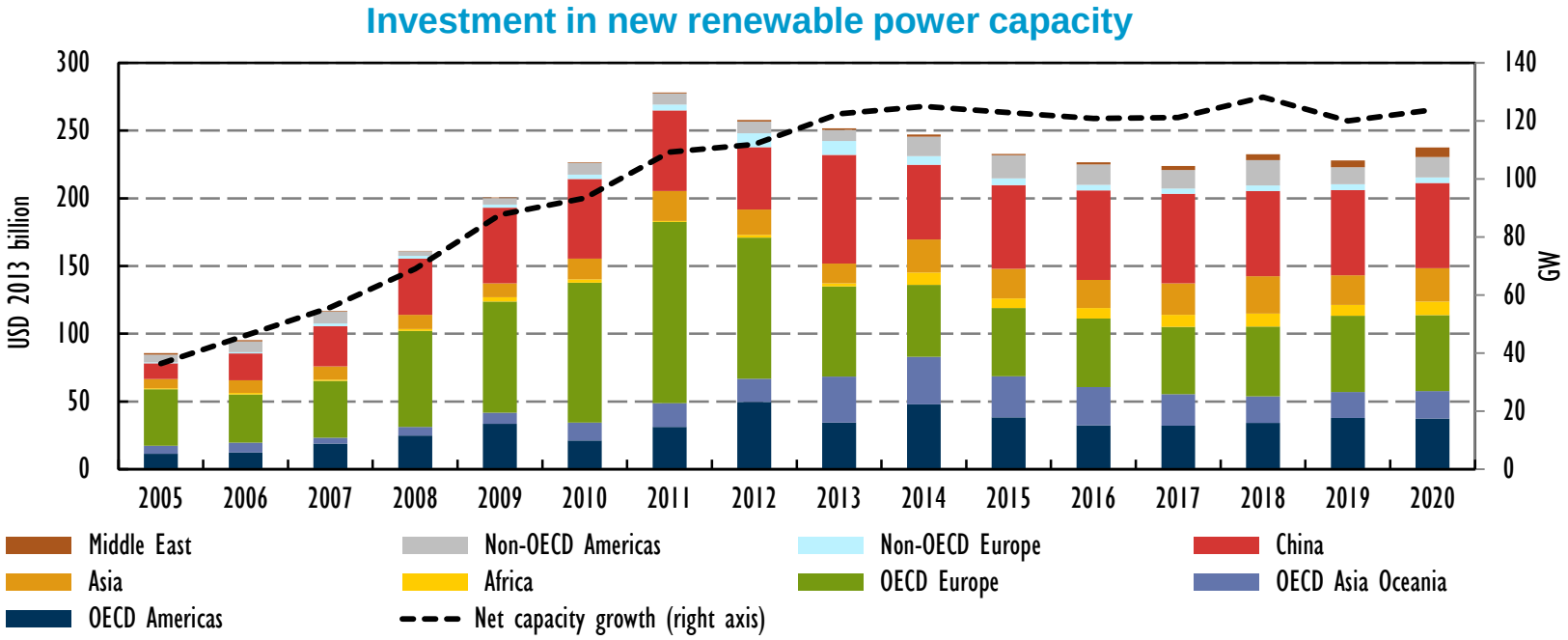
Weighted average annual renewable investment costs, historical and projected



Notes: Average unit investment costs are based on gross additions, which include capacity refurbishments that are typically lower cost than new capacity. Costs vary over time due to technology changes as well as where deployment occurs in a given year..

- **With scale up of deployment and learning, investment costs of most dynamic technologies (solar PV and onshore wind) continue to fall**

Renewable investment has risen to high levels



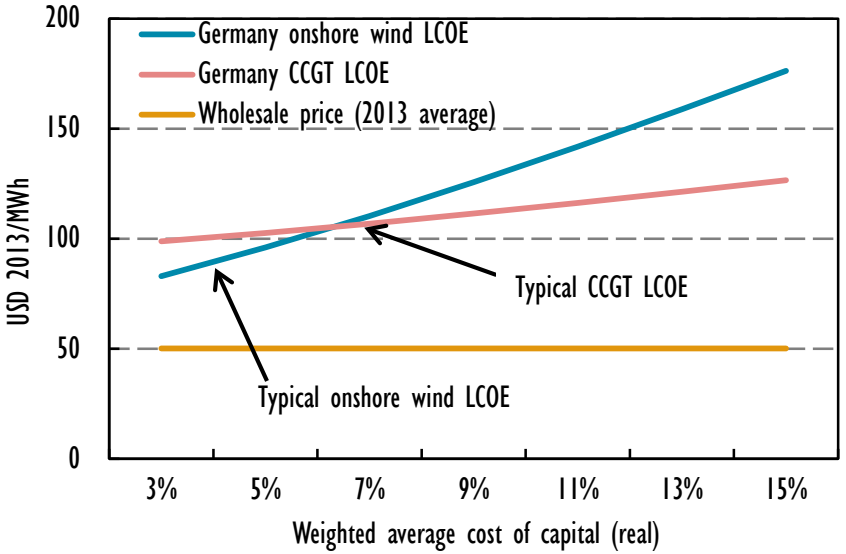
- Investment in 2013 relatively steady at USD 250 billion, but lower than peak in 2011
- Slowing capacity growth and falling technology costs limit investment in new renewable power capacity over medium term

Renewables becoming a cost-competitive generation option in more cases

- In some dynamic markets with country-specific conditions and market frameworks, new onshore wind is the economically preferred option versus new fossil fuel plants (e.g. Brazil, Chile and South Africa)
  - But fossil fuel subsidies can distort this picture

- In some stable markets, onshore wind with good financing cheaper than new CCGT plants
  - But market design based on wholesale pricing may not provide adequate remuneration

Germany LCOEs versus wholesale prices

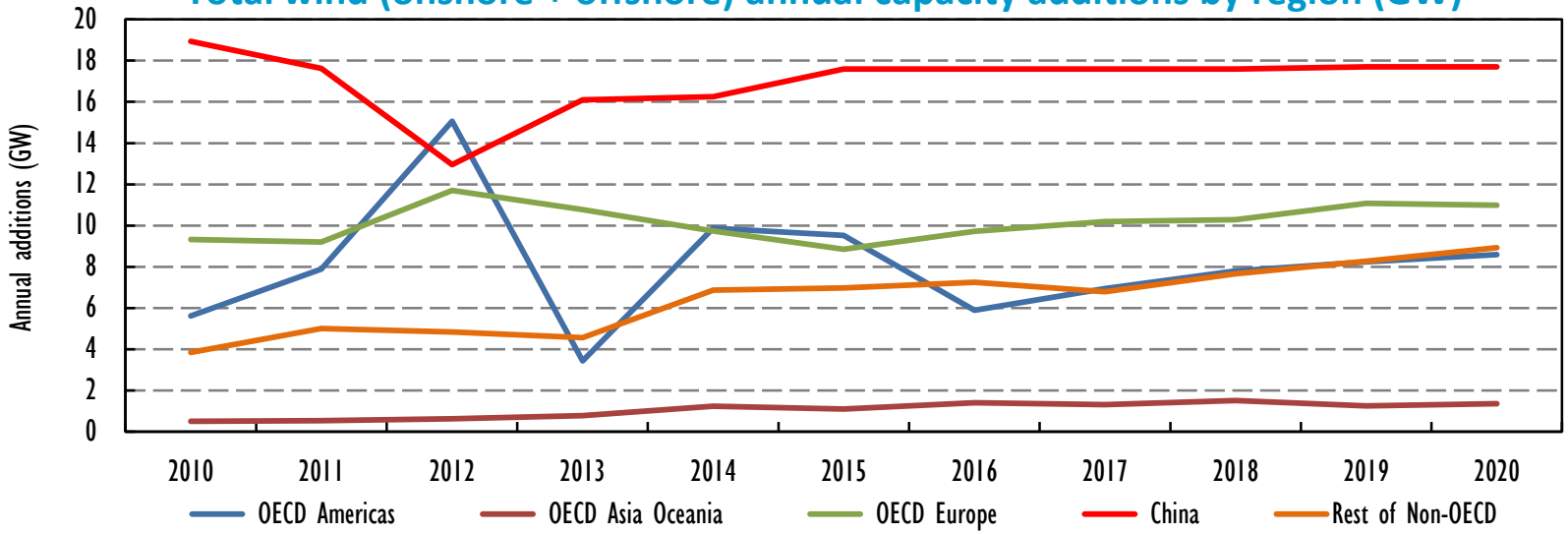


Notes: Onshore wind full load hours are assumed at 2000 and that for CCGT is 3500.
Source: IEA analysis with day-ahead average base-load wholesale prices for 2013 from Bloomberg LP.

Global RE capacity additions led by wind

- **Still, onshore outlook less optimistic than in *MRMR 2013***
  - **Policy uncertainties and grid integration challenges weigh upon outlook**
- **Offshore wind outlook also more pessimistic, with financing and integration challenges**

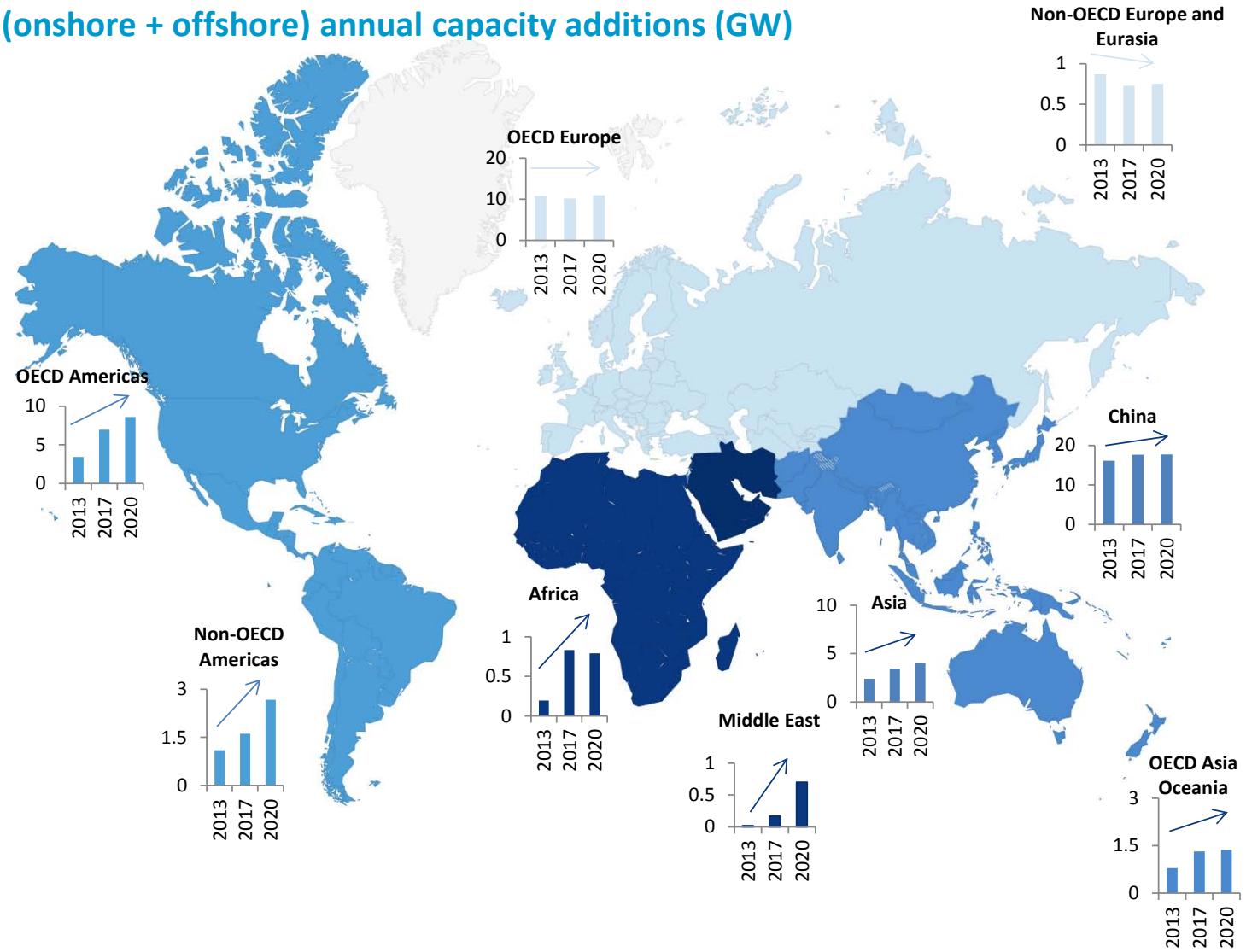
Total wind (onshore + offshore) annual capacity additions by region (GW)



GW	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
World Onshore	37.2	39.1	43.9	34.0	42.9	41.9	39.2	39.7	41.4	42.1	43.1
World Offshore	1.0	1.2	1.3	1.7	1.3	2.2	2.5	3.1	3.5	4.5	4.5

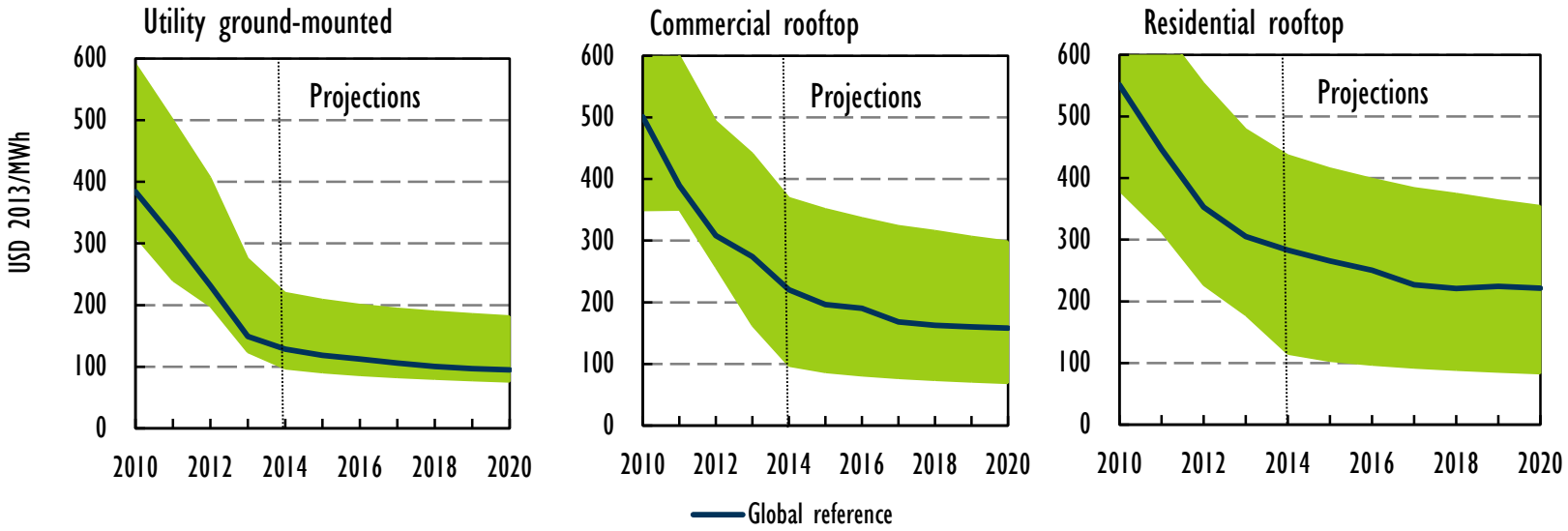
Wind growth continues to strengthen in emerging markets

Total wind (onshore + offshore) annual capacity additions (GW)



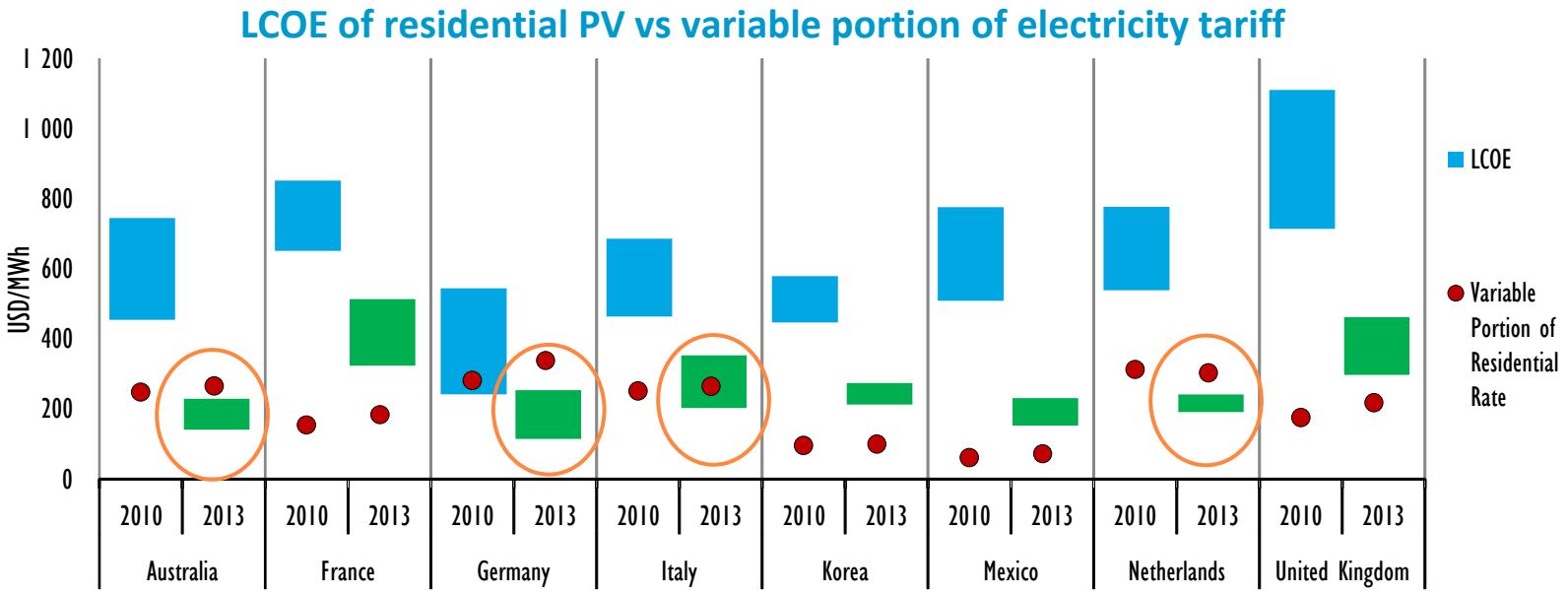
Generation costs for solar PV falling rapidly

Historical and projected LCOEs for typical solar PV systems, beginning year



- Growing economic competitiveness of utility-scale solar PV, with fewer incentives, versus other bulk power sources
- At present, the combination of low financing costs, low system prices and excellent resources remains exceptional
- Large ranges still exist between markets, i.e. China at low end, Japan at high end

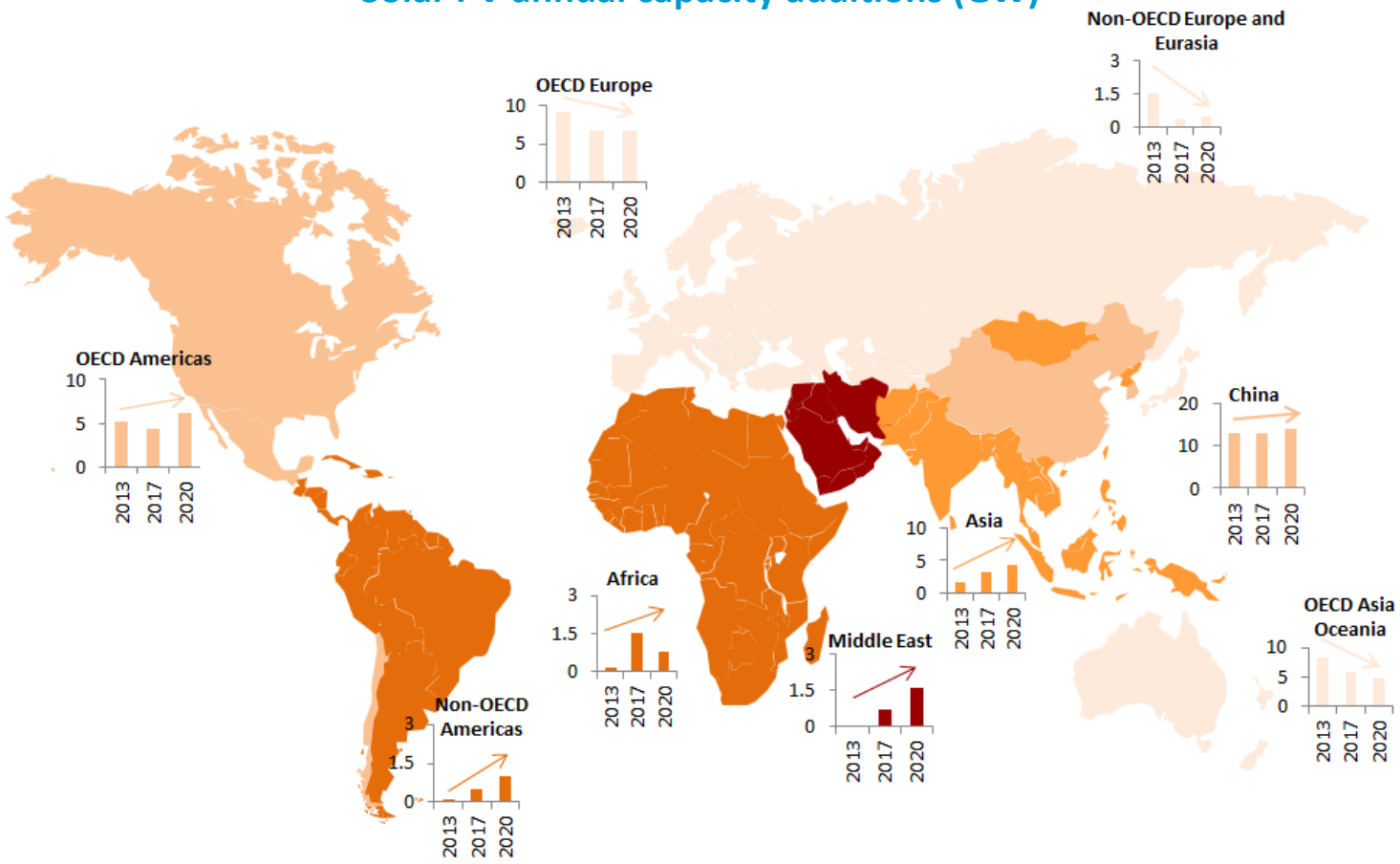
Socket parity emerging as potential deployment driver for distributed PV



- Economic attractiveness from offsetting electricity bill requires self-using most of the PV electricity
  - Currently limits potential, in particular for households
- Reaching socket parity is a driver for private actors
  - But PV may still have significant impact on total system costs, in particular depending on allocation of fixed network costs

Stronger outlook for solar PV

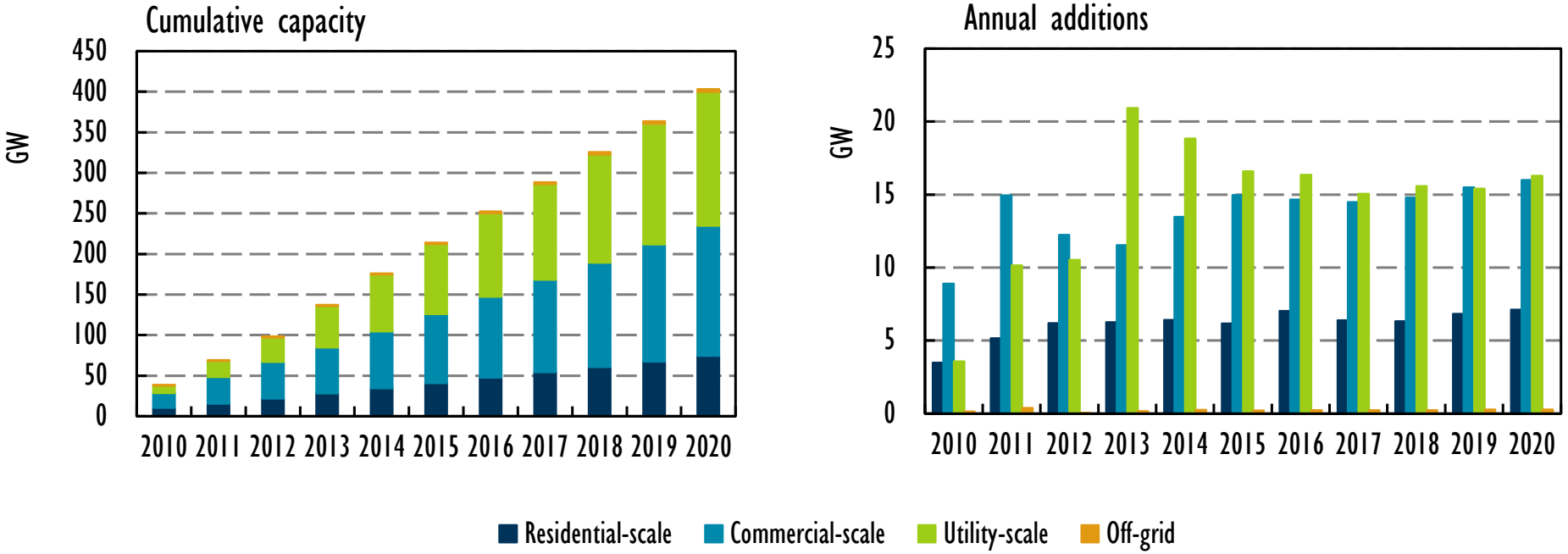
Solar PV annual capacity additions (GW)



- Strong growth in emerging markets and some OECD areas
- Policy debates over distributed PV a source of forecast uncertainty

Solar PV deployment segments vary by market

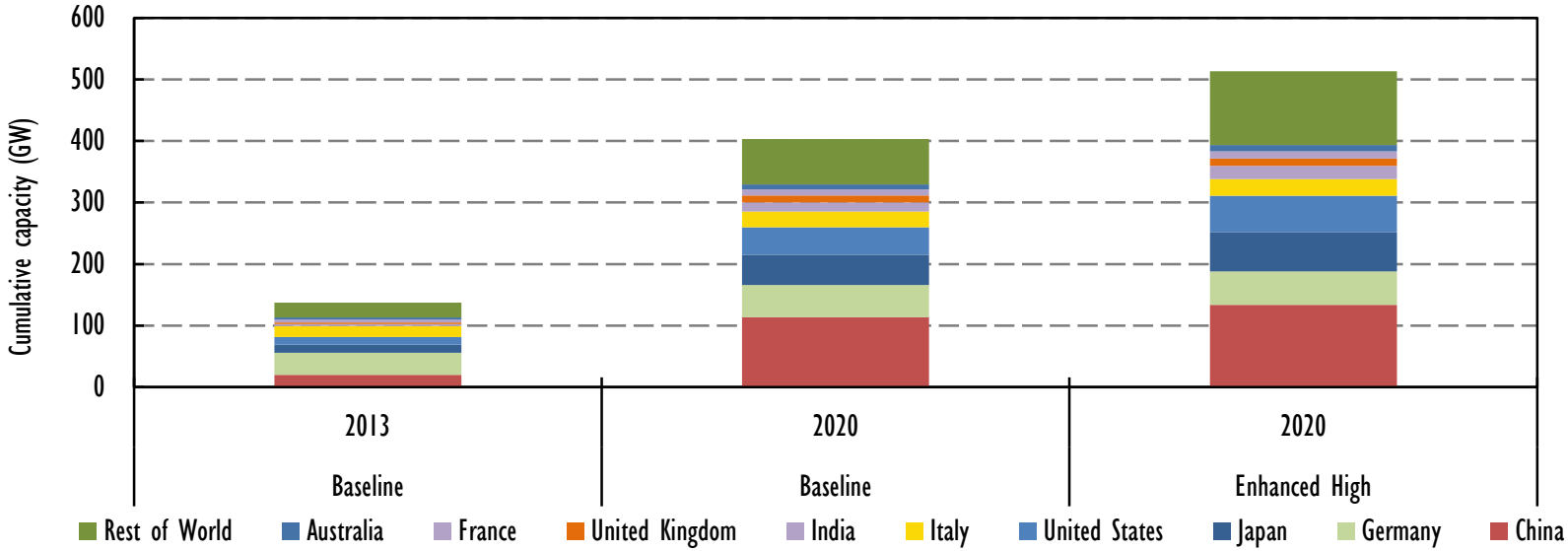
Global solar PV capacity and deployment by market segment



- **Utility-scale and commercial-scale systems should each account for roughly 40% of capacity growth, followed by residential (17%) and off-grid (1%)**
- **In Europe, development more in commercial/residential systems**
- **Utility-scale driven by markets with excellent resources, e.g. Western China, the US Southwest, India, the Middle East, Africa and the non-OECD Americas**
  - **Still, a significant amount of distributed growth should occur in some of these markets**

Higher solar PV under enhanced case

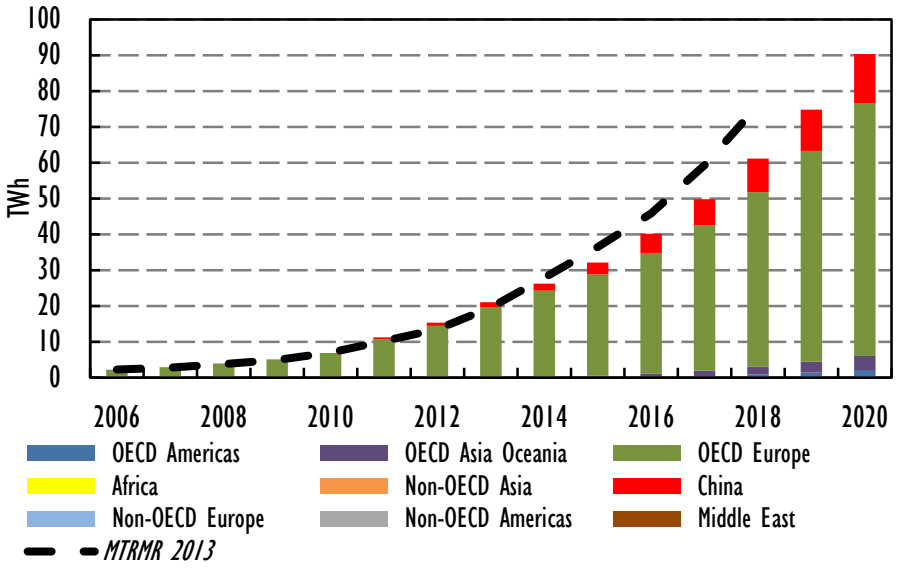
Solar PV cumulative capacity, baseline versus enhanced case



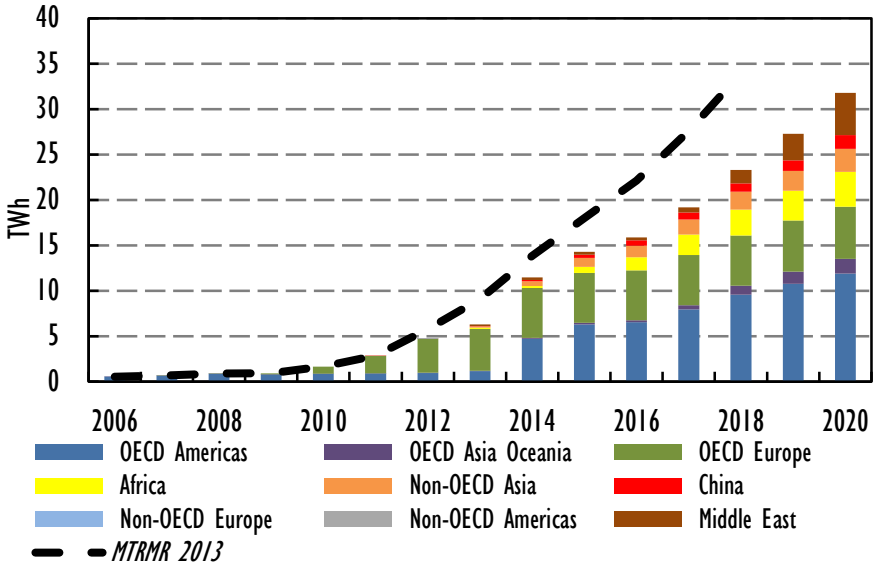
- Average annual market under baseline case = 38 GW (similar to 2013 growth)
- With certain market and policy enhancements -
  - Fair rules and appropriate electricity rate design for allocating the costs and benefits from fast-growing distributed solar PV
  - Greater implementation of ambitious policy aims (e.g. Middle East)
  - Faster-than-expected decreases in solar PV costs
- Solar PV could top 500 GW globally in 2020, with average market of 47-54 GW pa

Other technologies growing slowly

Offshore wind generation



Solar thermal electricity generation



- **Potential of offshore power remains high, but technical, financial and grid connection issues pose challenges**
- **Storage adds value to CSP, but deployment hampered by relatively high costs**

Progress tracked on different scales

Incremental TWh increase (2013-20)	
1. China	+ 880
2. Brazil	+ 207
3. United States	+ 180
4. India	+ 127
5. Japan	+ 72
6. Germany	+ 71
7. United Kingdom	+ 52
8. Turkey	+ 45
9. Canada	+ 41
10. Mexico	+ 38

Memo: EU-28	+ 251

Average annual growth (2013-20)	
1. Saudi Arabia	+ 117%
2. Jordan	+ 65%
3. UAE	+ 51%
4. Qatar	+ 37%
5. Israel*	+ 27%
6. South Africa	+ 25%
7. Cambodia	+ 22%
8. Ethiopia	+ 20%
9. Nigeria	+ 15%
10. Morocco	+ 15%

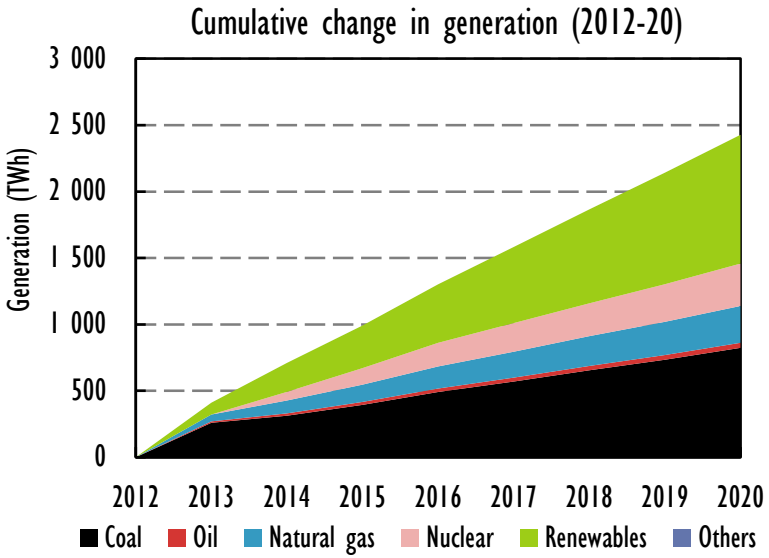
Note: countries with at least 1 GW of renewable capacity by 2020

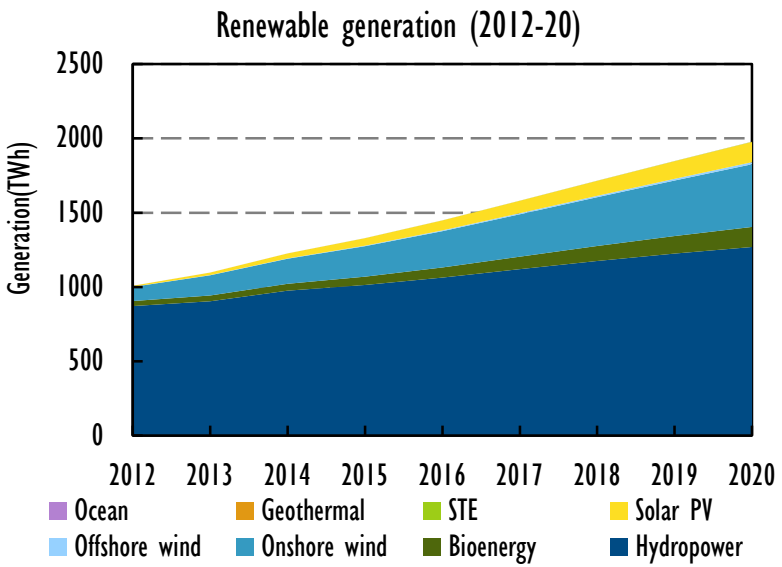
* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

China accounts for 40% of global growth

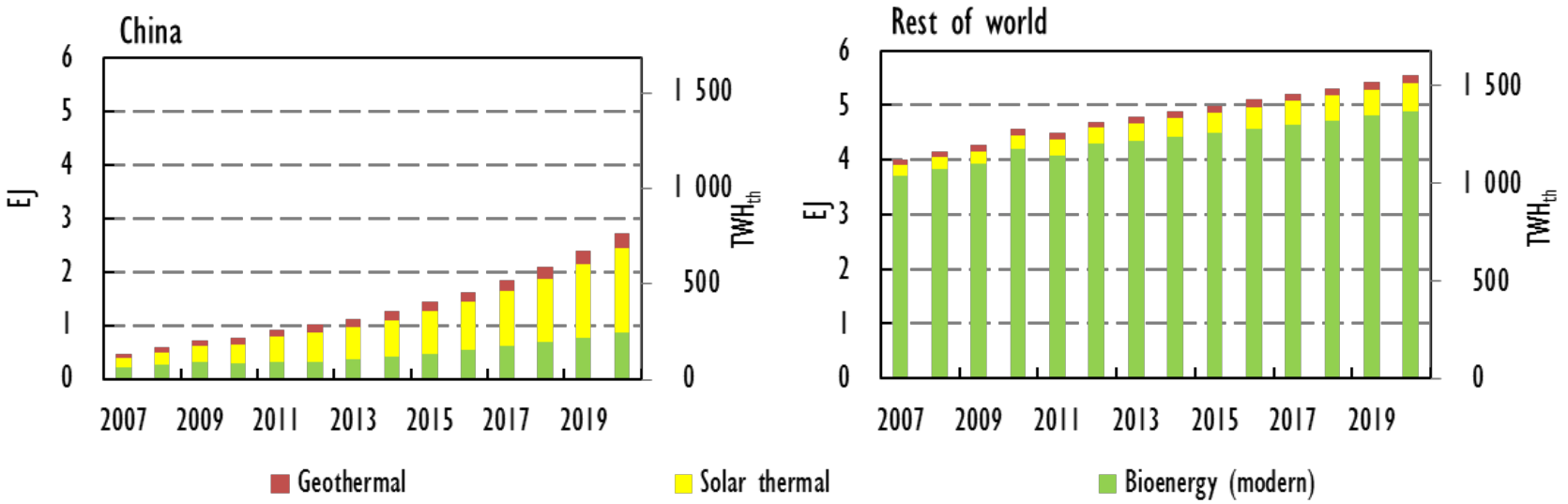
- **Strong generation needs, pollution reduction goals and policy environment with ambitious targets support China's deployment**
- **Renewables comprise 45% of new generation to 2020, ahead of coal**
- **Some emerging challenges –**
  - **Slower demand outlook than in *MTRMR 2013***
  - **Integration of large amounts of variable renewables**
  - **Uncertainties over favourable economics for distributed PV scale up**

Evolution of China's power generation mix, 2012-20





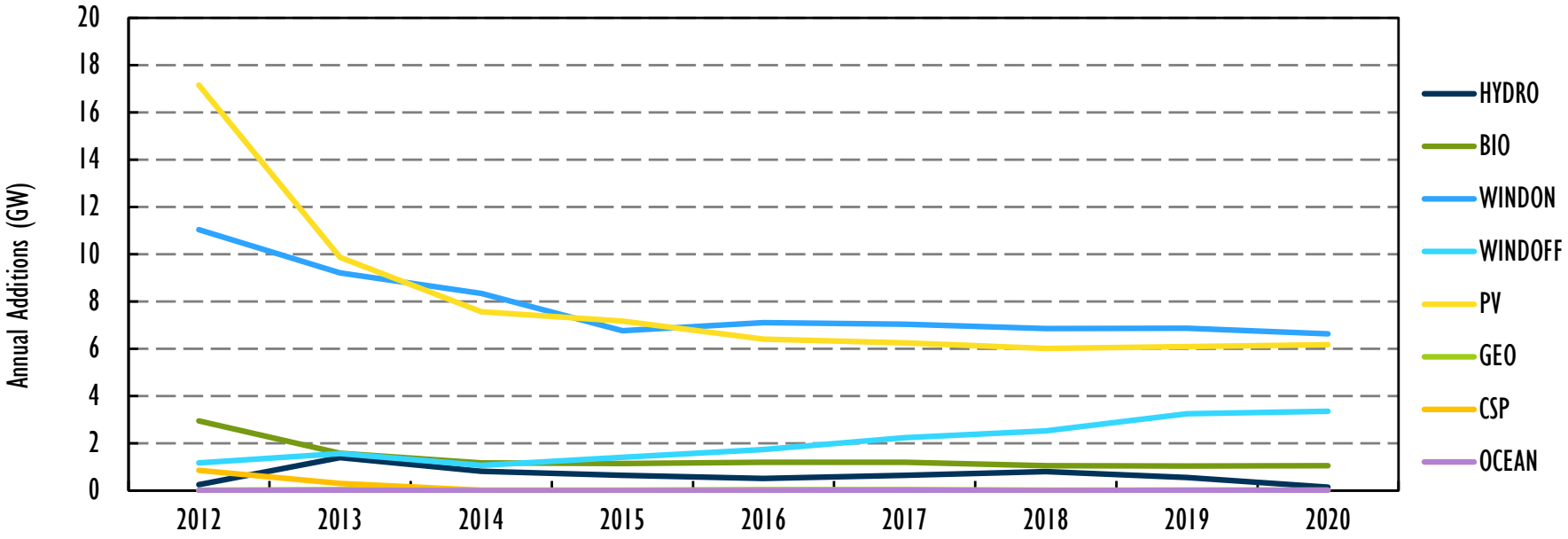
China accounts for 70% of growth in world modern renewable heat use in buildings 2013-20



- **Favorable combination of support policies and cost-competitiveness of renewable heat technologies supports growth of renewable heat**
- **Solar thermal (+15%/year) is fastest growing technology, driven by cost-competitiveness and targets under 12th Five-Year Plan**
- **Bioenergy use for heat set to triple (+13%/year, 2013-20) thanks to ambitious household biogas program**

Slowing capacity growth outlook in EU-28

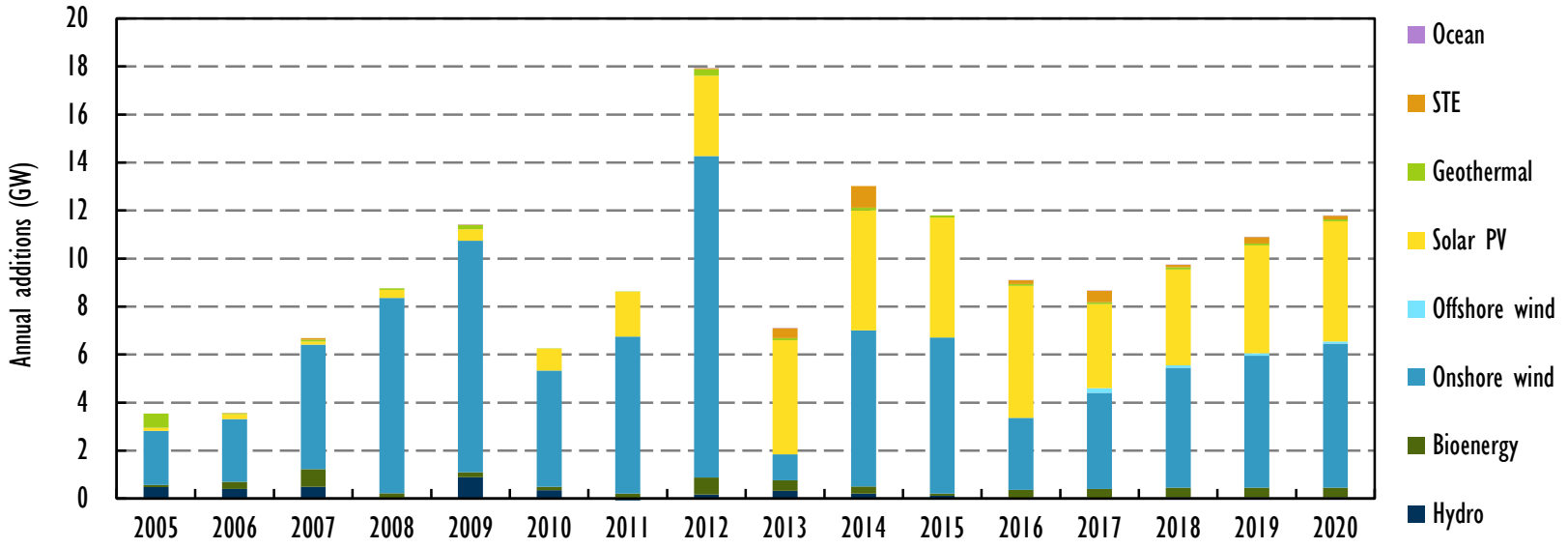
EU-28 renewable power annual net capacity additions, historical and projected



- Europe has been a leader in renewable development, but policy and regulatory uncertainty are rising
- Questions over post-2020 framework, particularly aspects of governance in the absence of binding national targets

Policy uncertainty in the US remains challenging to RE deployment

United States historical and projected renewable annual additions



- US renewable capacity additions have followed boom and bust cycles due to uncertainty over federal incentives.
- Another bust cycle is expected in 2016-2017 with PTC coming to an end and ITC to be reduced.

Main messages to policy makers

- Solutions to future development rest in policy makers' hands
  - Policy risk main barrier to investment
- Policies to focus on cost-efficiency
  - But policy changes must be predictable, and retroactive changes must be avoided
- Given capital-intensive nature, renewables require market context that assures reasonable and predictable returns
- Muddled signals may send the wrong messages about renewables at a time when newer markets have opportunity to leapfrog to more flexible and cleaner energy systems
- More focus on heat and transport needed

For further insights and analysis…

International Energy Agency

- **The Medium-Term Renewable Energy Market Report 2014 can be purchased online at:**

  www.iea.org

- **Thank you for your attention!**