COP-21 and the Grand Challenge of Decarbonisation

Manuel Baritaud
Senior Energy Analyst, IEA

Pathways to Decarbonisation: Potential Synergies Between Nuclear and Renewable Energy
Golden, Colorado - June 9, 2016

© OECD/IEA 2016

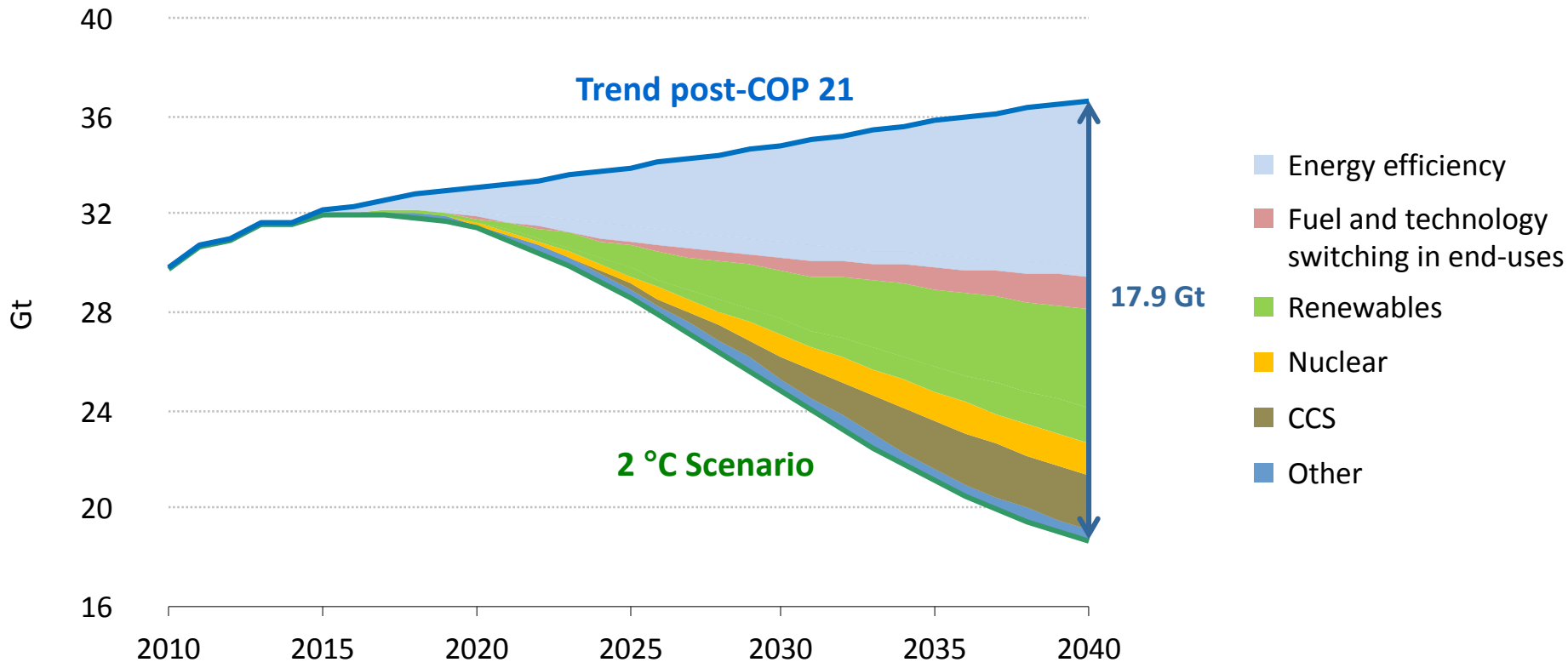
The vital role of nuclear and renewables in the Global Climate Agenda

- Maintaining momentum after Paris COP 21 Agreement
- Focus on implementation and tracking progress
- Renewables have made progress
- Nuclear at the cross road
- Outline:
  - Investment requirements
  - Regulated and competitive markets
  - The continued quest for optimal low-carbon generation mix

© OECD/IEA 2016

A 2°C pathway requires more technological innovation, investment and policy ambition

CO_2 emissions in a post COP 21 world



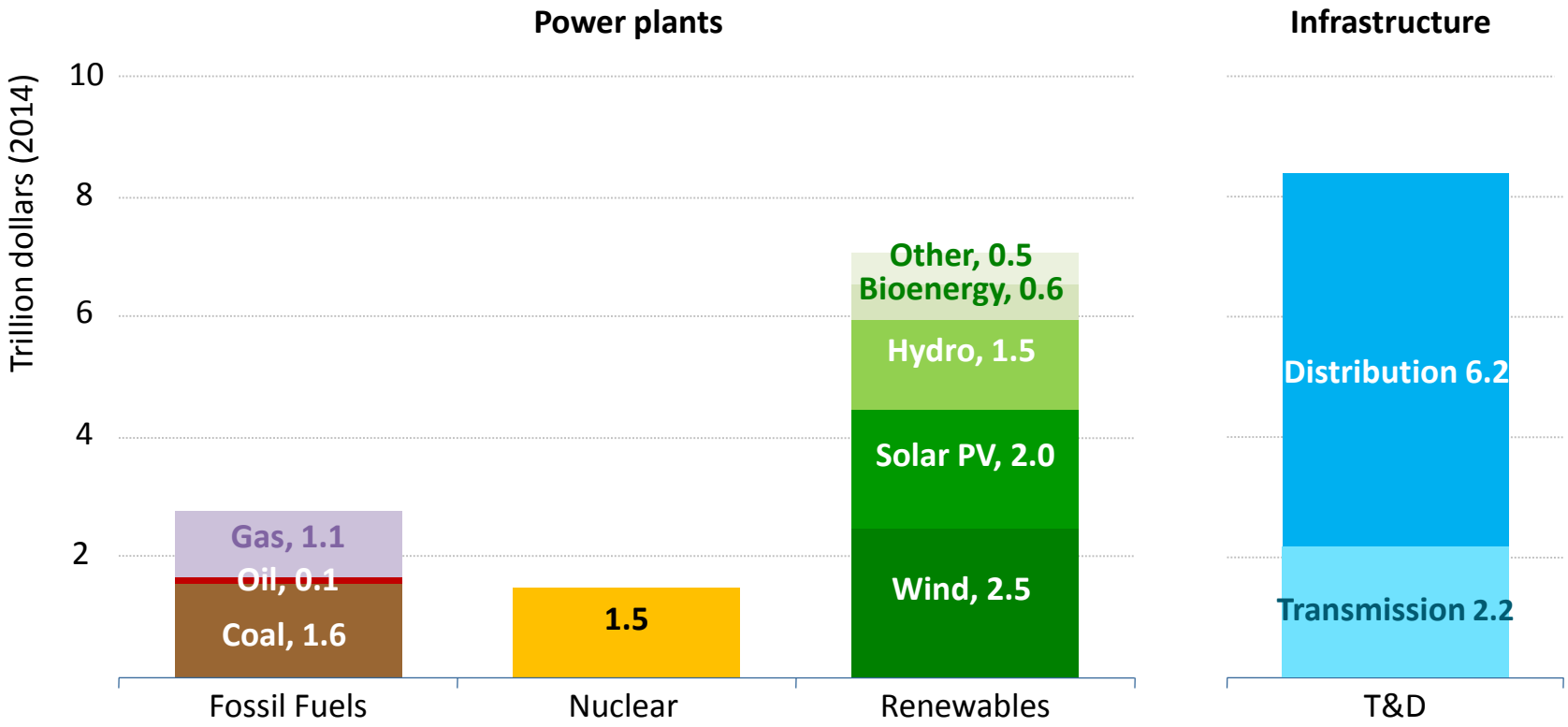
Massive additional investments in efficiency, renewables, nuclear power and other low-carbon technologies are required to reach a 2°C pathway

Source: World Energy Outlook Special Briefing for COP21

© OECD/IEA 2016

The power sector requires the largest investment

Global power sector cumulative investment by type, 2015-2040



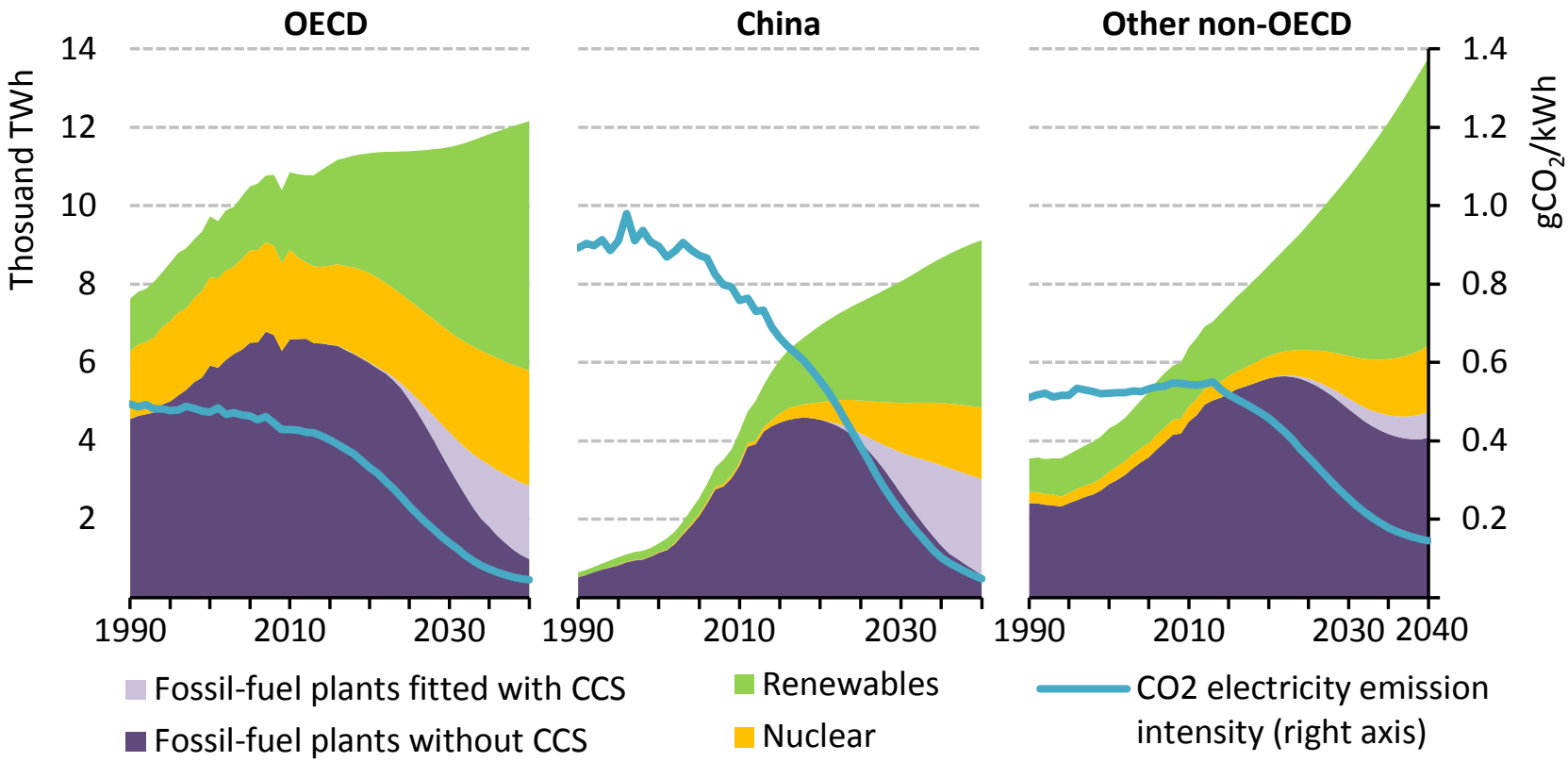
Power sector investment totals $19.7 trillion to 2040, over 40% of total energy supply investment, and 60 cents of every dollar in new power plants goes to renewables

Source: World Energy Outlook 2015

© OECD/IEA 2016

Nuclear and renewables are growing in all regions

Electricity generation by technology and CO_2 intensity in the 450 Scenario

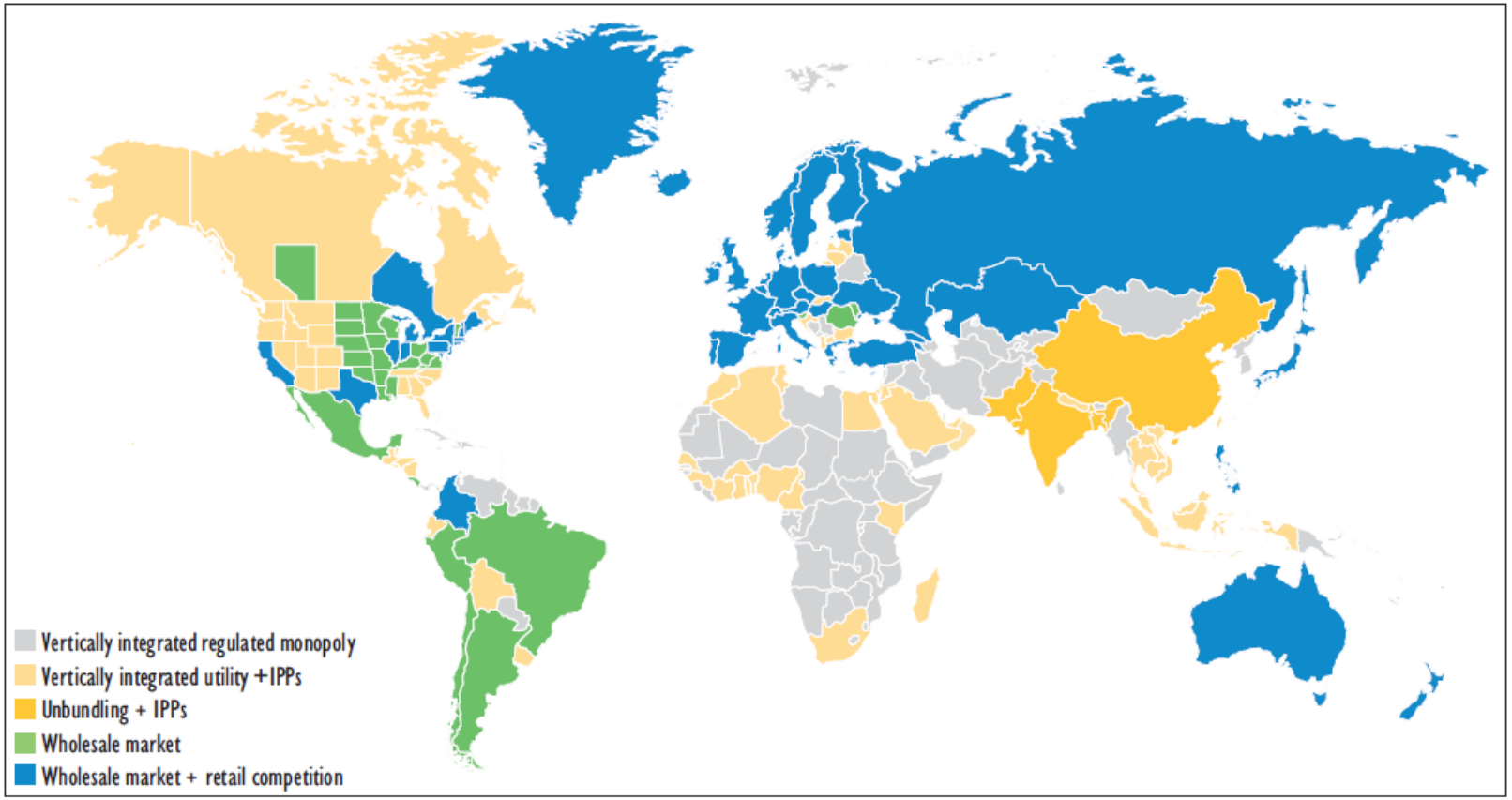


Low-carbon power generation needs to quadruple with respect to today, with renewables reaching half of the global power mix in 2040

Source: World Energy Outlook 2014

© OECD/IEA 2016

Electricity restructuring has changed market fundamentals



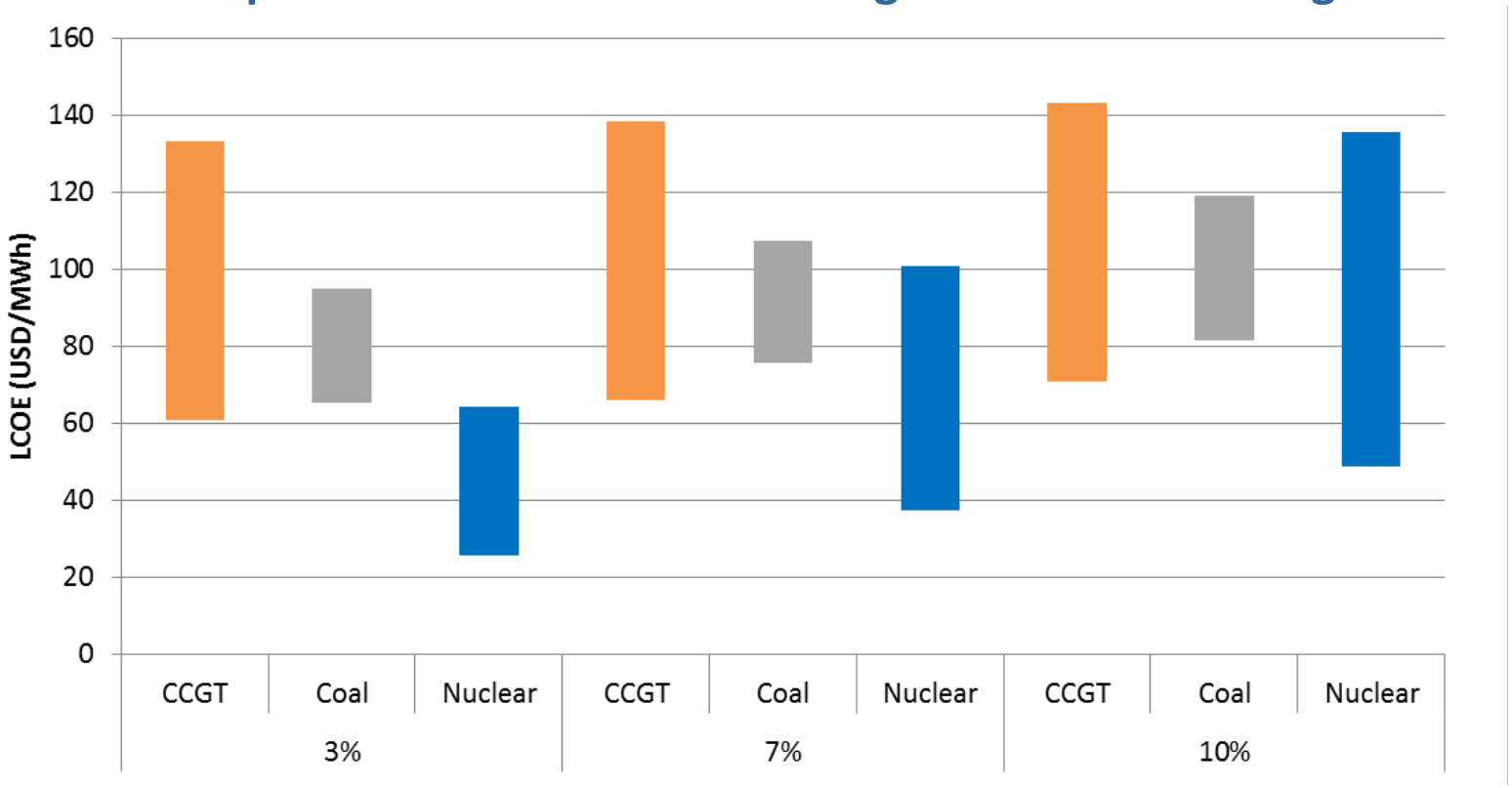
This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Competitive wholesale markets represent 47% of electricity consumption and all regions are confronted with the challenge of reducing CO_2 emissions.

© OECD/IEA 2016

Nuclear remains competitive with low financing costs and CO_2 price

Comparison of LCOEs of different generation technologies



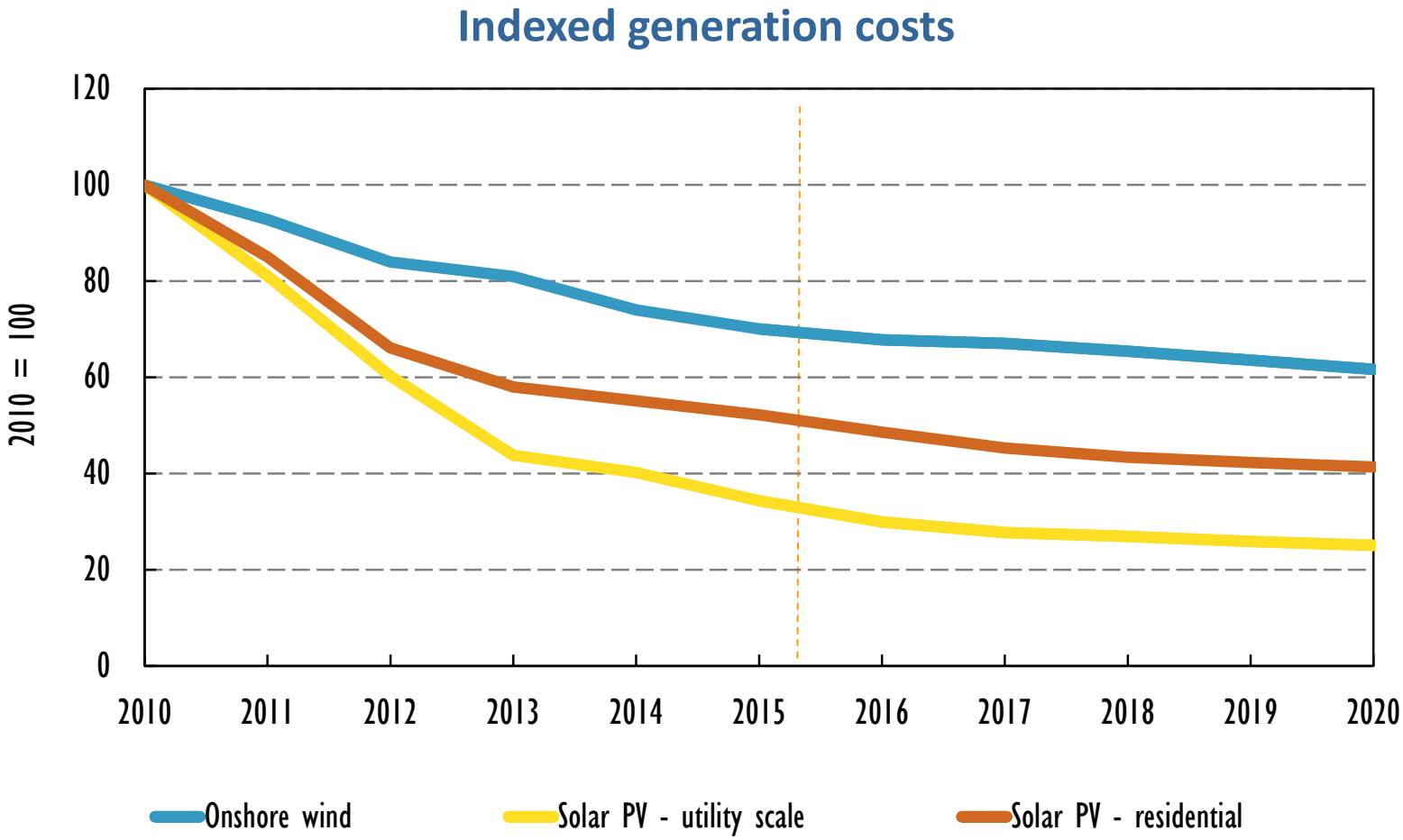
Note: Assumes region-specific fuel prices for US, Europe, Asia; 85% load factor; CO_2 price of 30 USD/tonne. (Source: Projected Costs of Generating Electricity 2015 Edition NEA&IEA)

Despite declining costs of renewables, the IEA NEA projected cost study found that nuclear can remain in the competitive range

Source: IEA NEA Projected Cost Study, 2015

© OECD/IEA 2016

Innovation and scale-up are driving down the costs of wind and solar PV

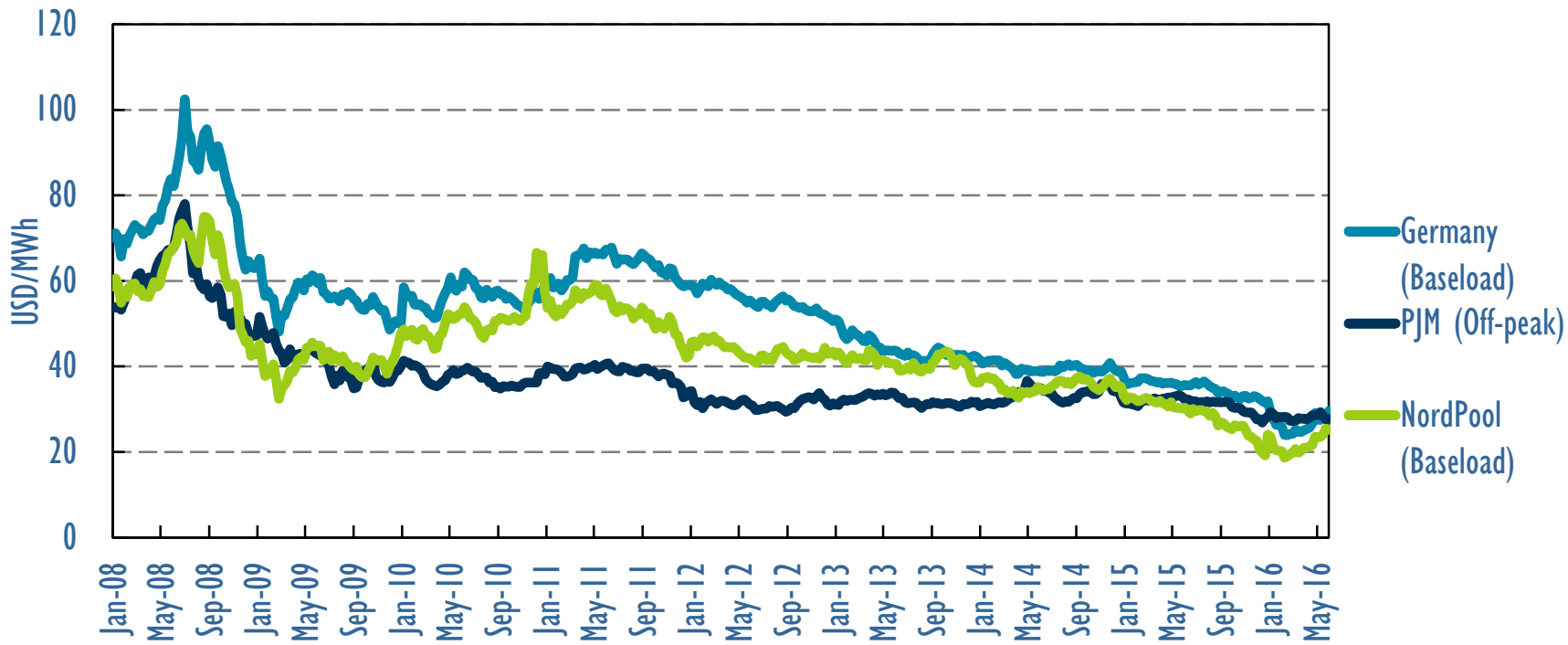


High levels of incentives are no longer necessary for solar PV and onshore wind, but investments still depends on regulatory framework and market design

© OECD/IEA 2016

Nuclear and renewable investments in competitive markets?

Year-ahead forward market prices USD/MWh, 2008-15



Source:Bloomberg

Under current market circumstance and without a carbon price, market-based nuclear investments are unlikely, and remain limited for renewables

© OECD/IEA 2016

New issue: keeping existing nuclear

- **Several nuclear reactors have been or will close:**
  - **Germany**
  - **Japan**
- **Risk of closure for economic reasons**
  - **14 reactors in the USA**
  - **Sweden**

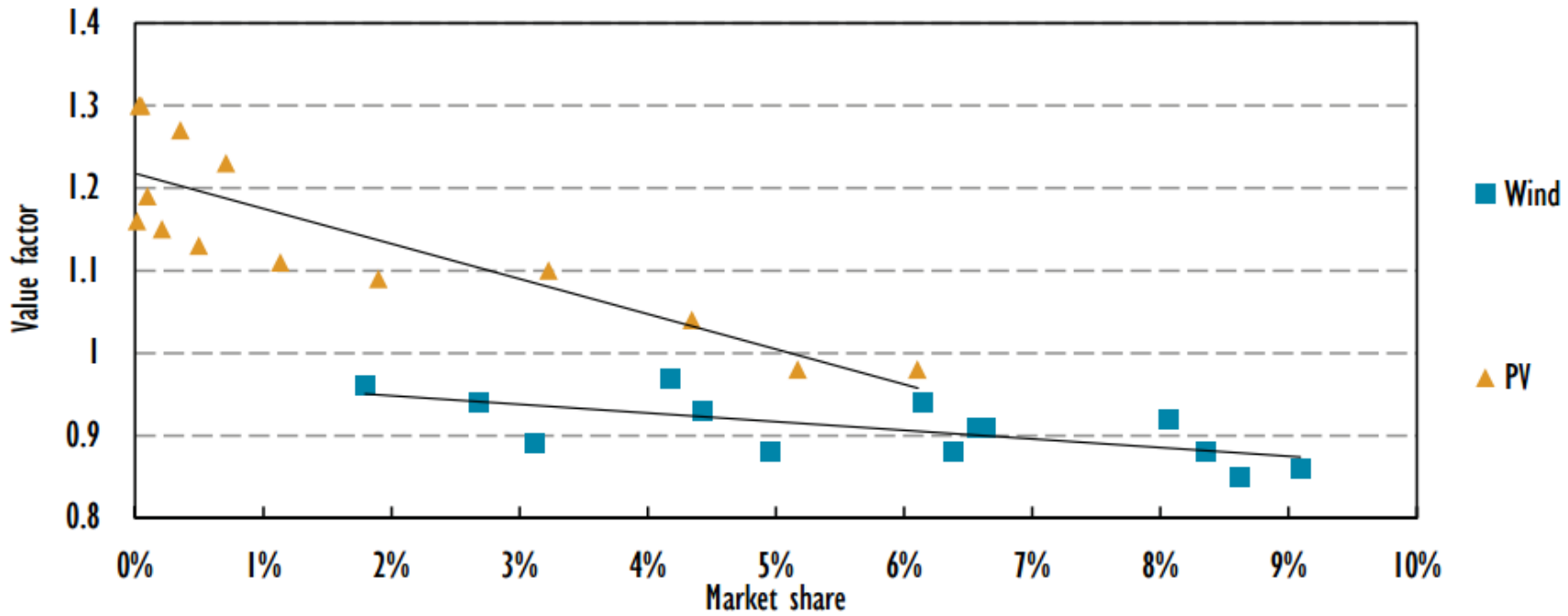
Pilgrim Nuclear Generating Station, Entergy Corporation

Extending the operating lifetime of reactors and enabling them to operate safely is essential to maintaining low-carbon generation capacity

© OECD/IEA 2016

What is the optimal generation mix?

Market value factor of wind and solar PV as a function of their market share in Germany

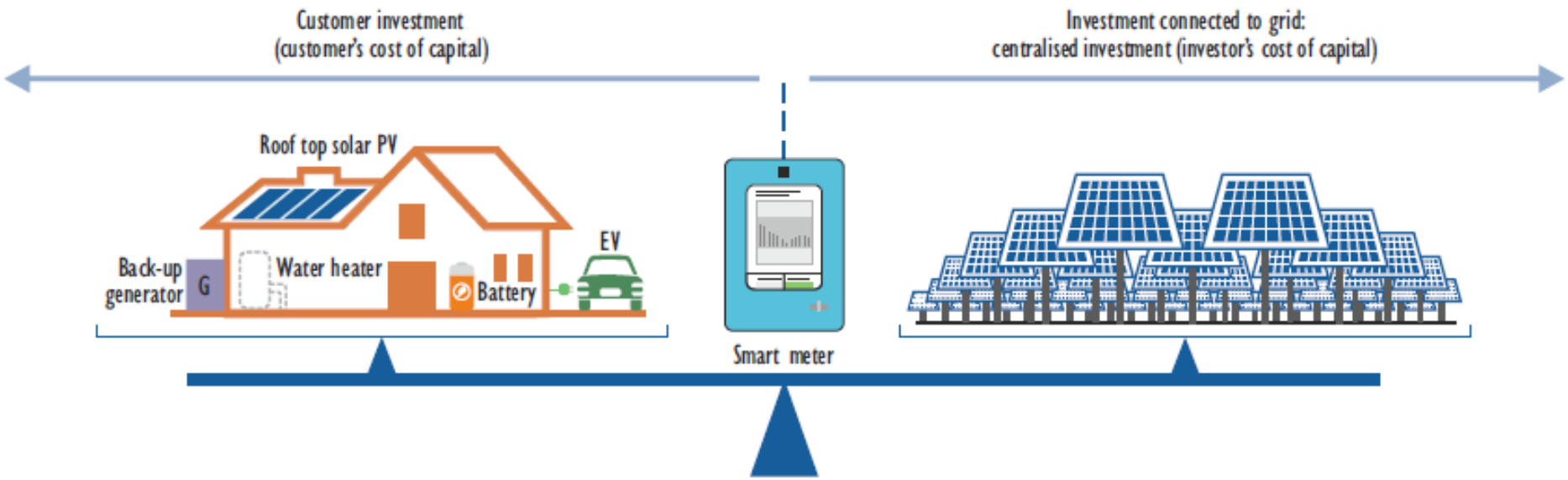


Source: Hirth (2015)

Investments are not only a matter of costs:
the value of different technologies for the power system has to be factored in

© OECD/IEA 2016

Centralised Vs. Distributed

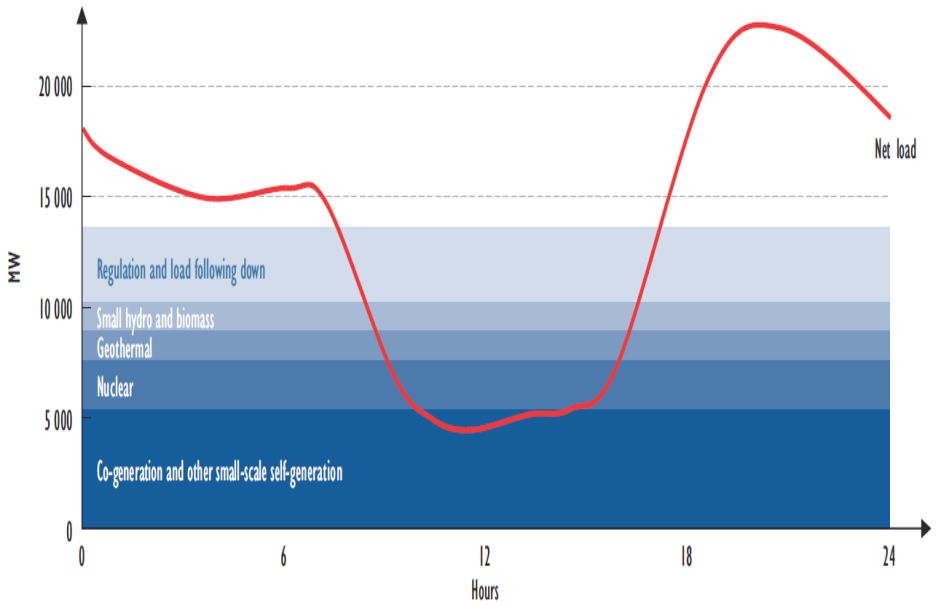


Getting the prices right is needed for both centralised and distributed resources in order to induce efficient investment

© OECD/IEA 2016

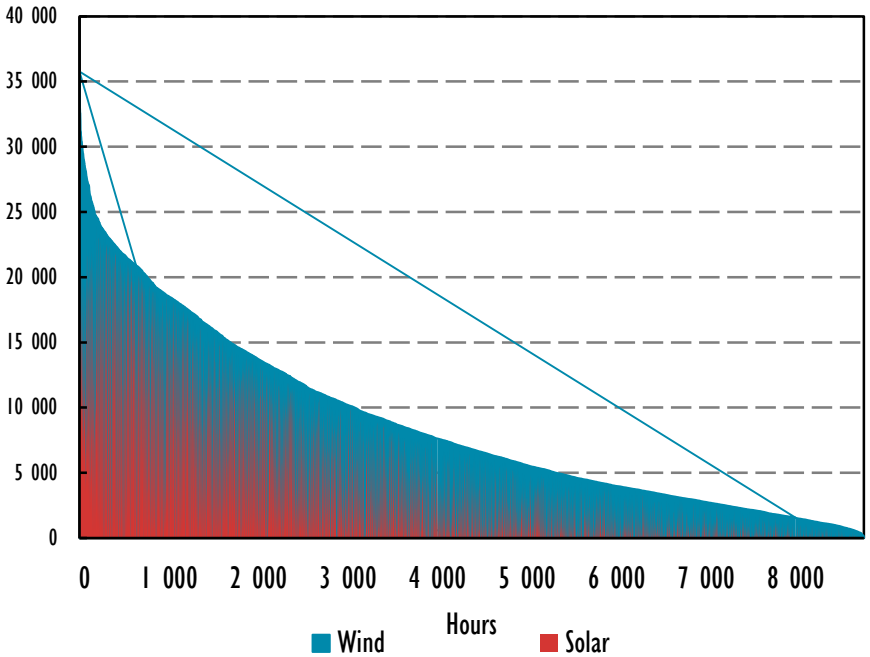
Overgeneration

Net load and inflexible generation
(California ISO simulation for 2024)



Source: CAISO

Load duration curve of wind and solar
(Germany, 2013)

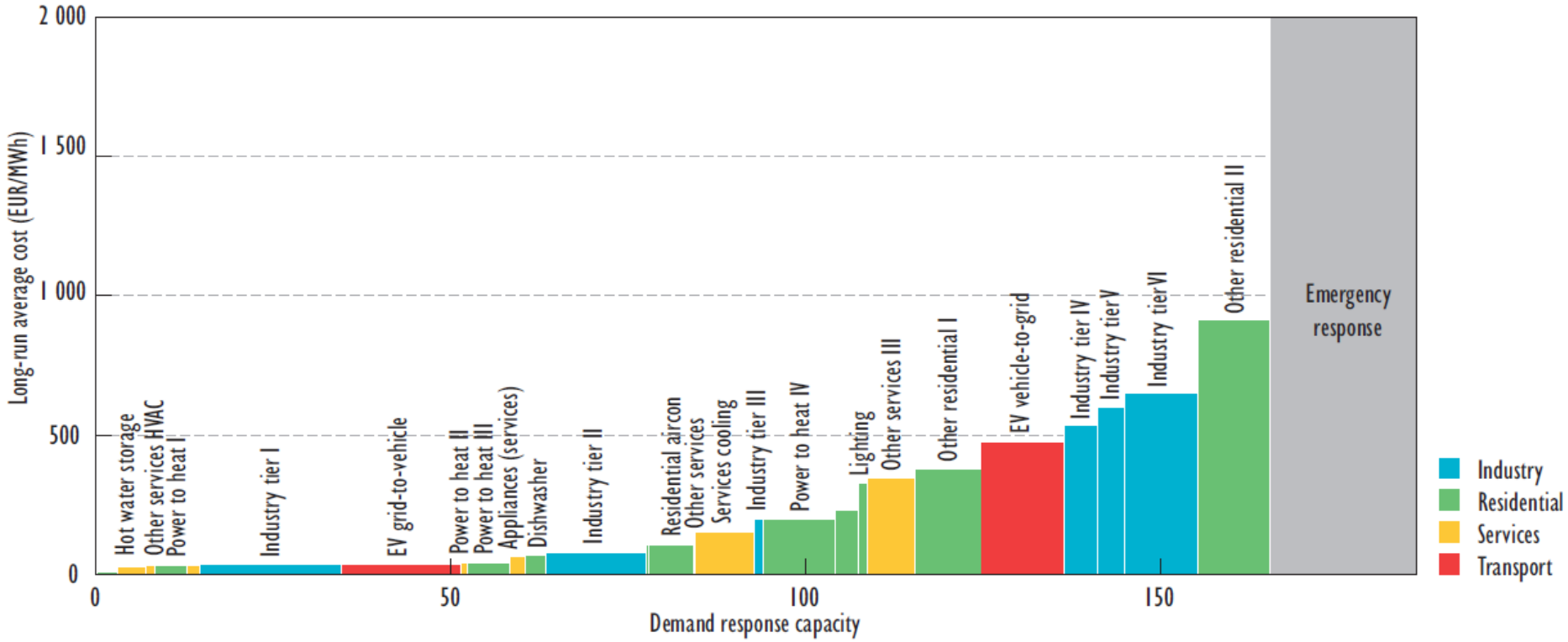


In the absence of sufficient technical or commercial flexibility, over-generation during hours of low consumption and high VRE output to curtail output

© OECD/IEA 2016

Increasing demand-side flexibility

Modelled demand response and supply curve in the EU in 2050

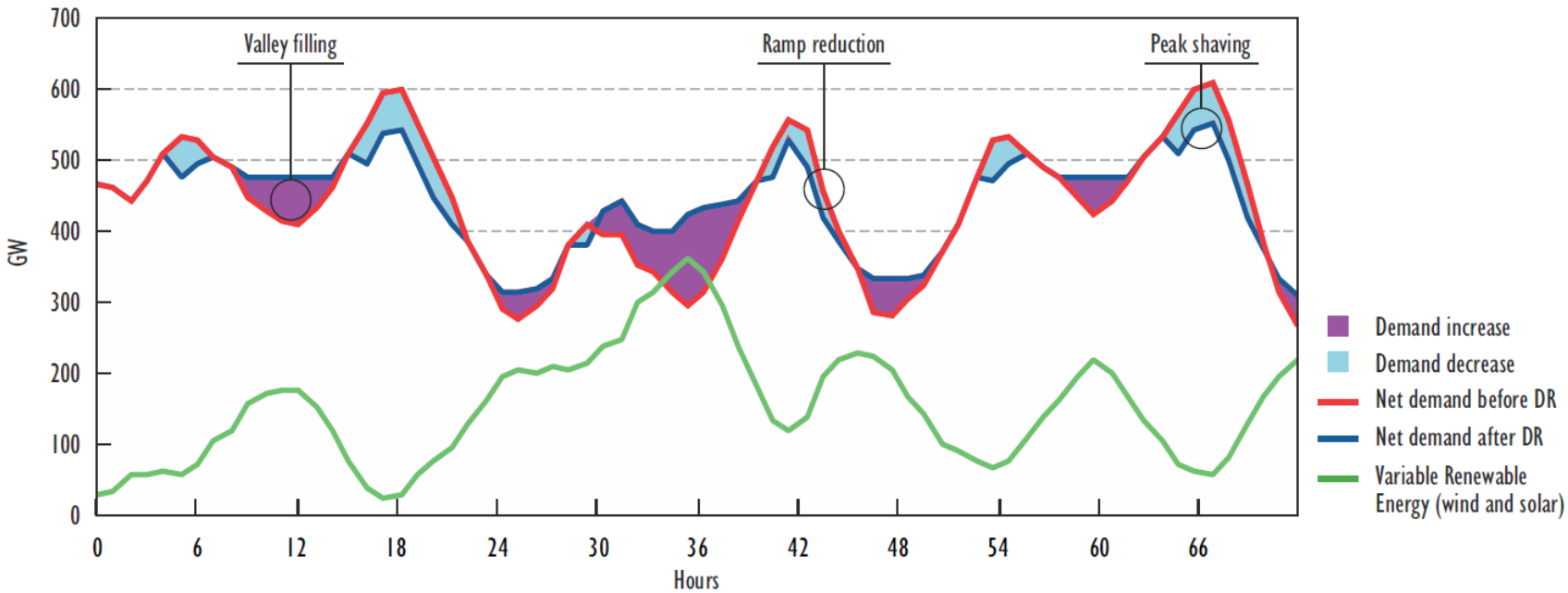


In the European Union, demand response potential could exceed 150 gigawatts (GW) by 2050.

© OECD/IEA 2016

Role of demand response and storage

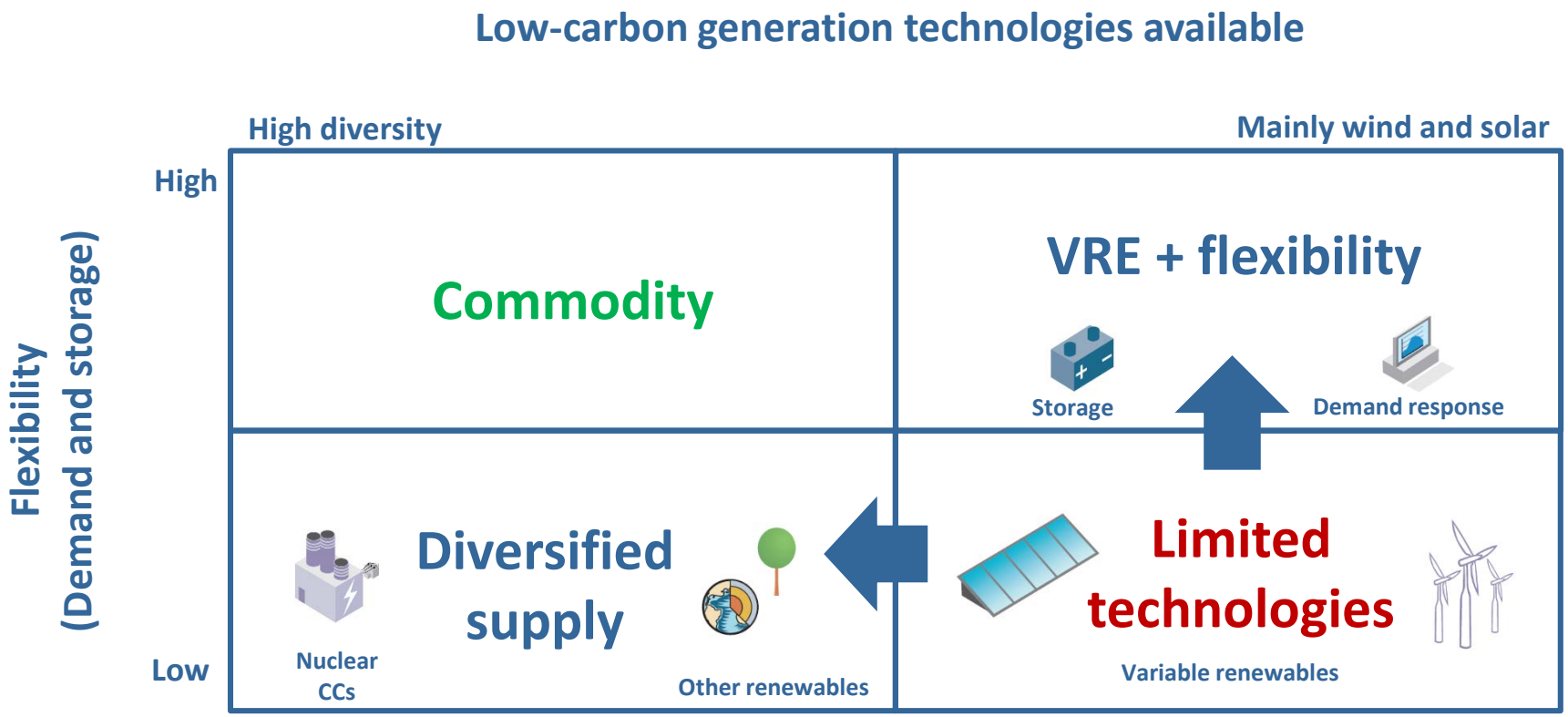
The different roles of demand response with high share of renewables (illustrative)



With new technologies, small consumers can contribute to flexibility and be able to react to wholesale electricity prices

© OECD/IEA 2016

Aligning market design and decarbonisation



For the long term, the design of electricity markets hinges on the portfolio of technologies available and improvements are likely to be evolutionary

© OECD/IEA 2016

Conclusion

- After the Paris Agreement, focus on implementation
- Tracking progress of the Paris agreement
- Nuclear and renewables:
  - are needed for decarbonisation
  - can provide generation flexibility
  - benefit from higher demand-side and storage flexibility

© OECD/IEA 2016

© OECD/IEA 2016