Power System Trends and the Cost and Quality of Power Plants

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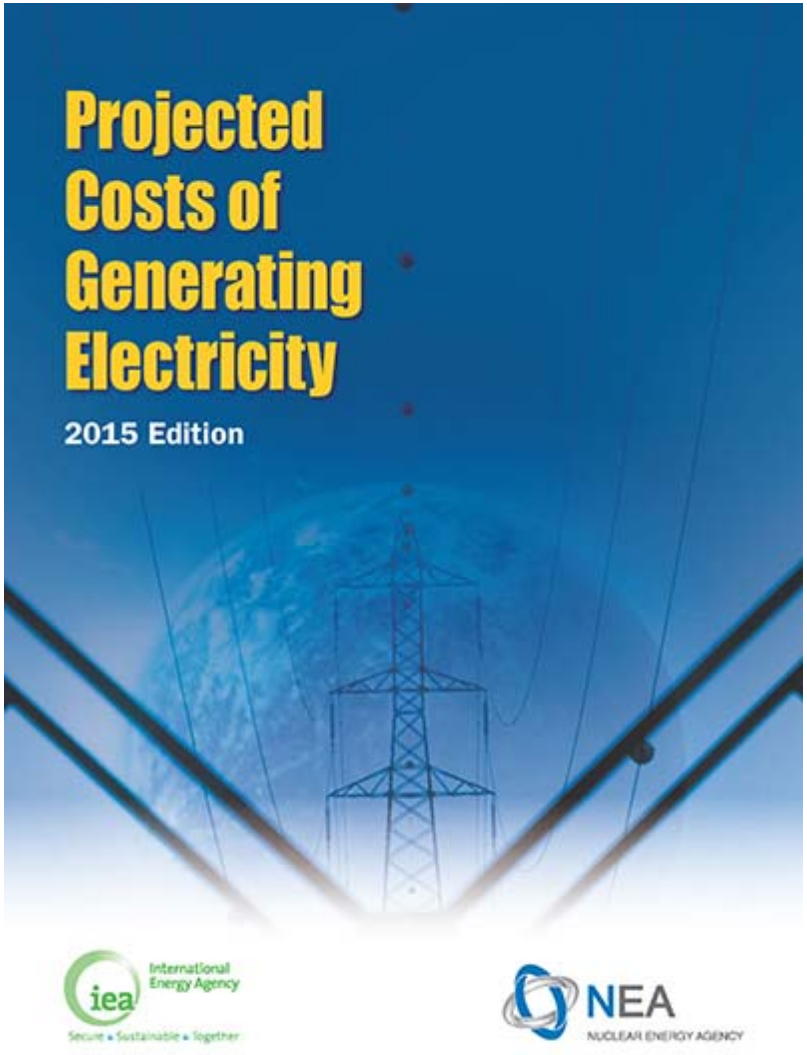
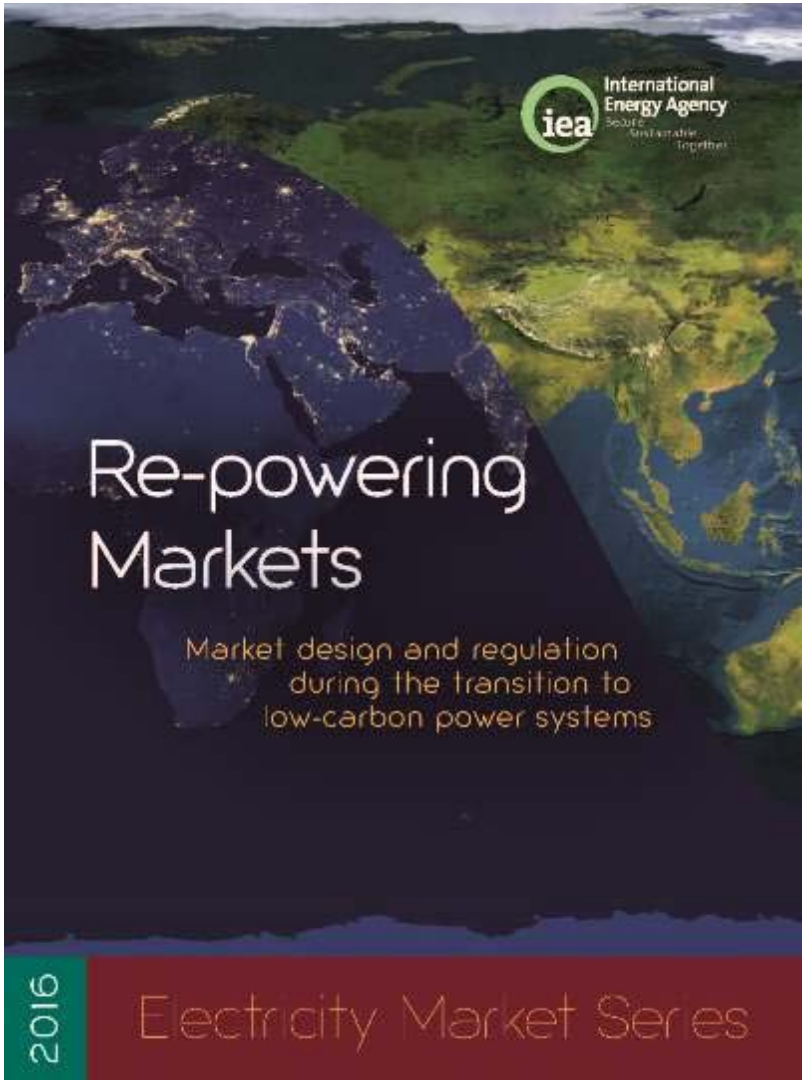
Overview of presentation

1. **The cost and quality of generation**
   - Levalised Cost of Electricity (LCOE)
   - Capturing cost and quality
   - Alternative or additional measures
2. **Power market trends**
   - Meeting climate change goals
   - Power market design
   - Integration versus decentralisation

Two relevant IEA publications

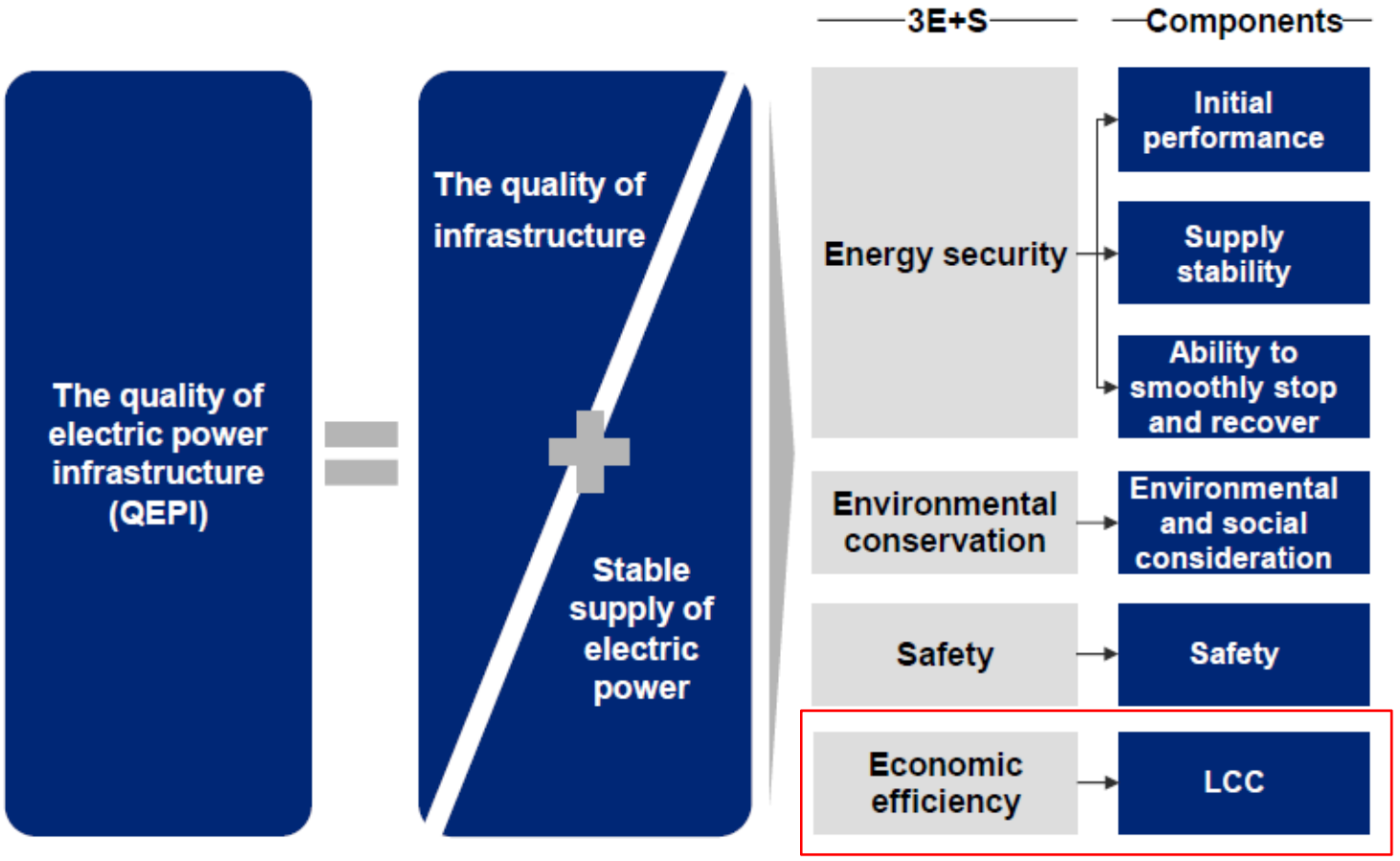




1. The Cost and Quality of Generation

Cost and quality, intertwined

Figure 1: Components of the QEPI



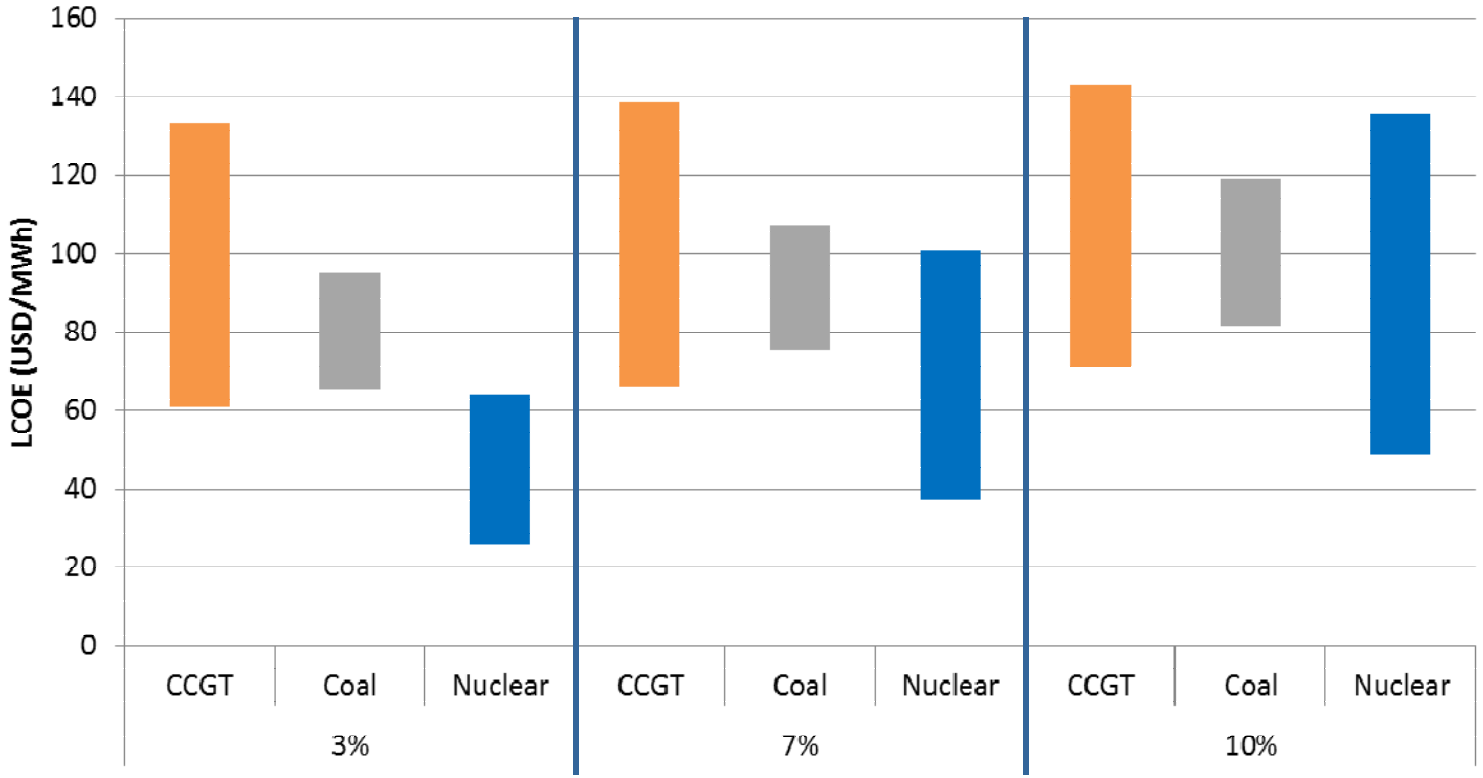
Source: APEC Guideline for Quality Electric Power Infrastructure (1st Draft)

What is levelised cost?

- Levelised Cost (LCOE) or Life Cycle Cost (LCC) is the per kilowatt-hour price that a plant has to earn in order to recover all of its costs over its lifetime
  - The break-even (i.e. no profit) electricity price
- Costs may include:
  - Construction
  - Financing
  - Environmental (pollution controls, CO_2)
  - Fixed and Variable Operations and Maintenance (O&M)
  - Fuel
  - Decommissioning
  - …

LCOE provides a simple metric for comparing (baseload) technologies

Comparison of LCOEs of different baseload technologies (2020)

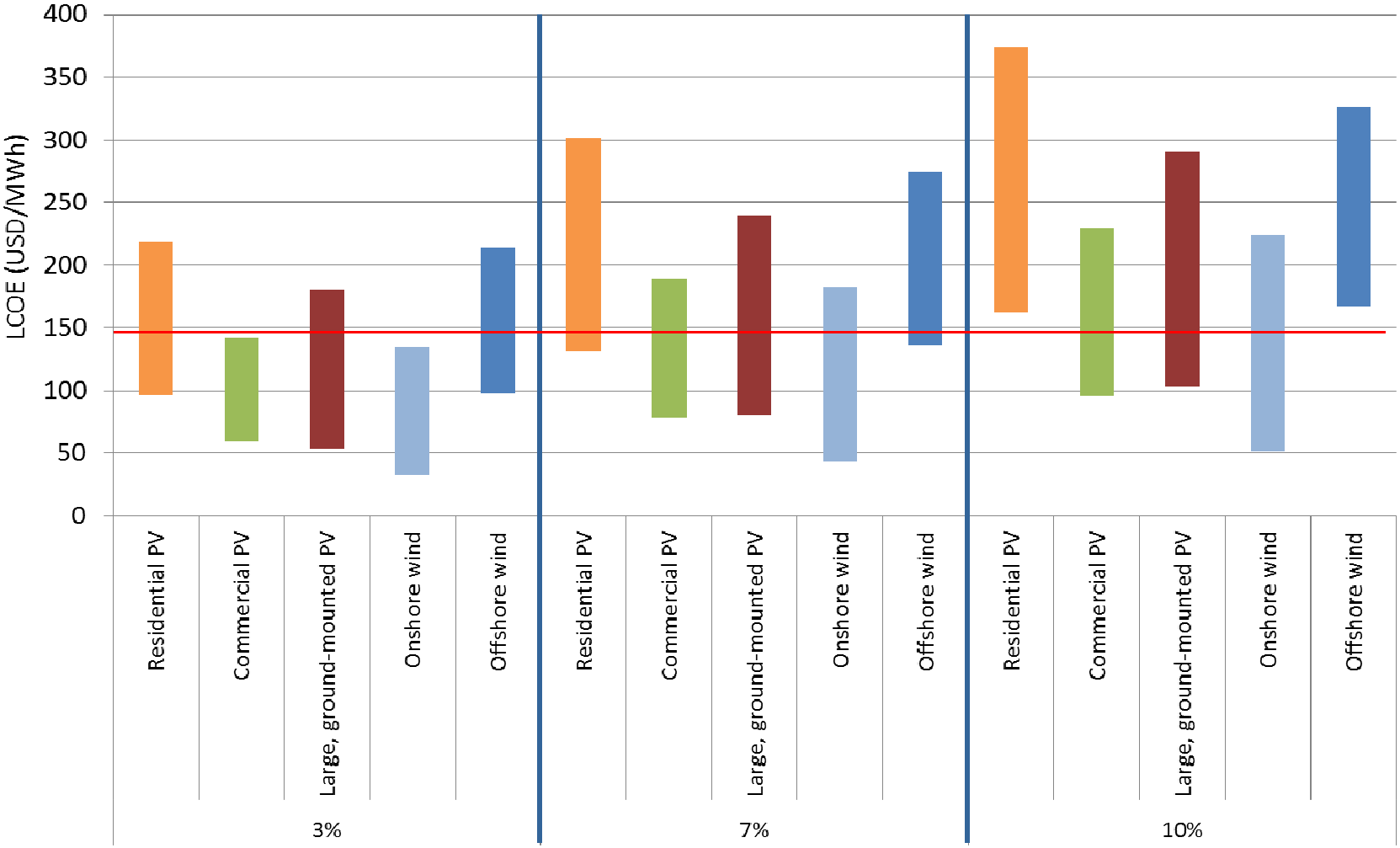


Note: Assumes region-specific fuel prices for US, Europe, Asia; 85% load factor; CO_2 price of 30 USD/tonne. (Source: Projected Costs of Generating Electricity 2015 Edition NEA&IEA)

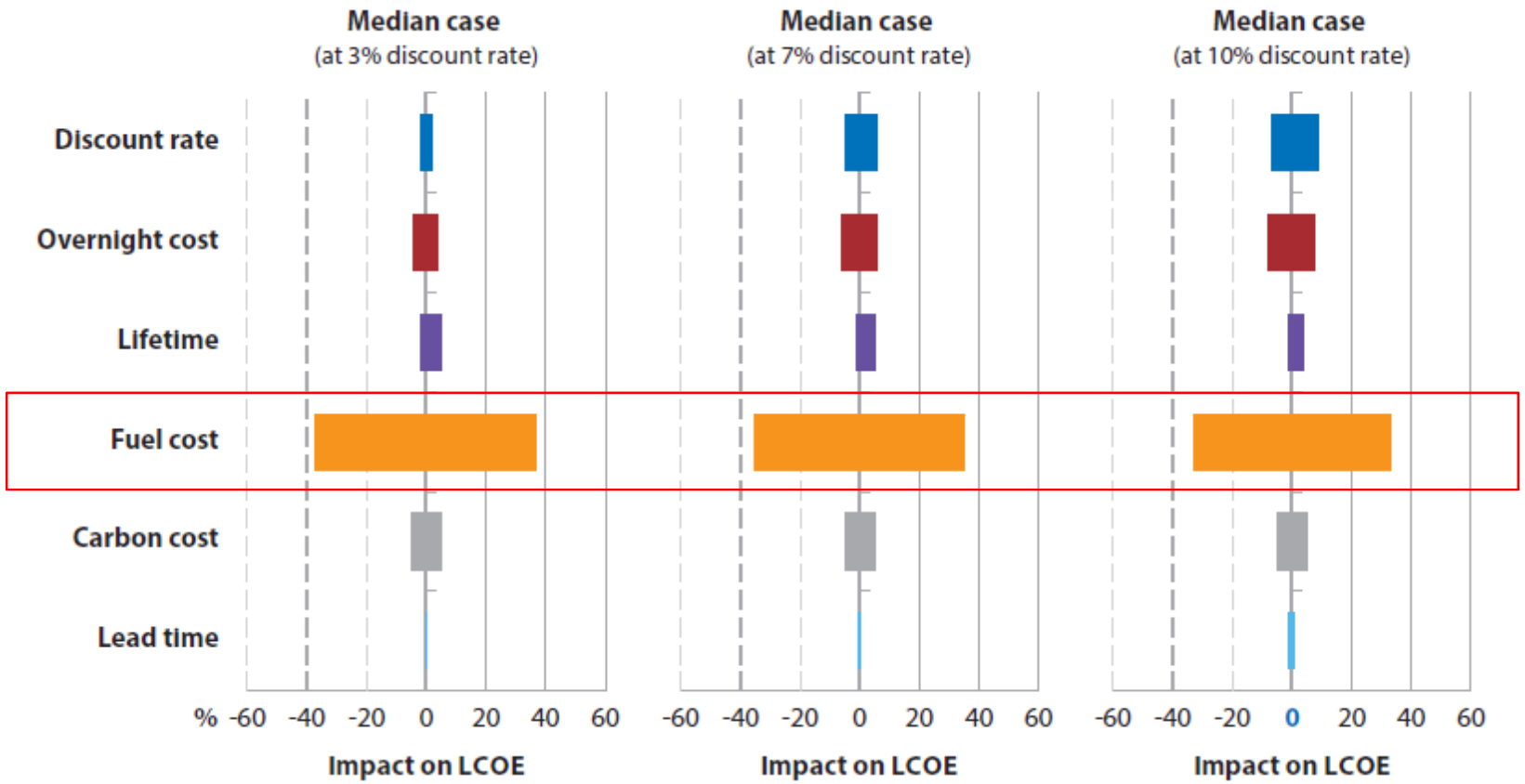
Source: IEA NEA Projected Cost Study, 2015

Renewables are no longer outliers, especially at low capital costs

Comparison of LCOEs of different renewable technologies (2020)

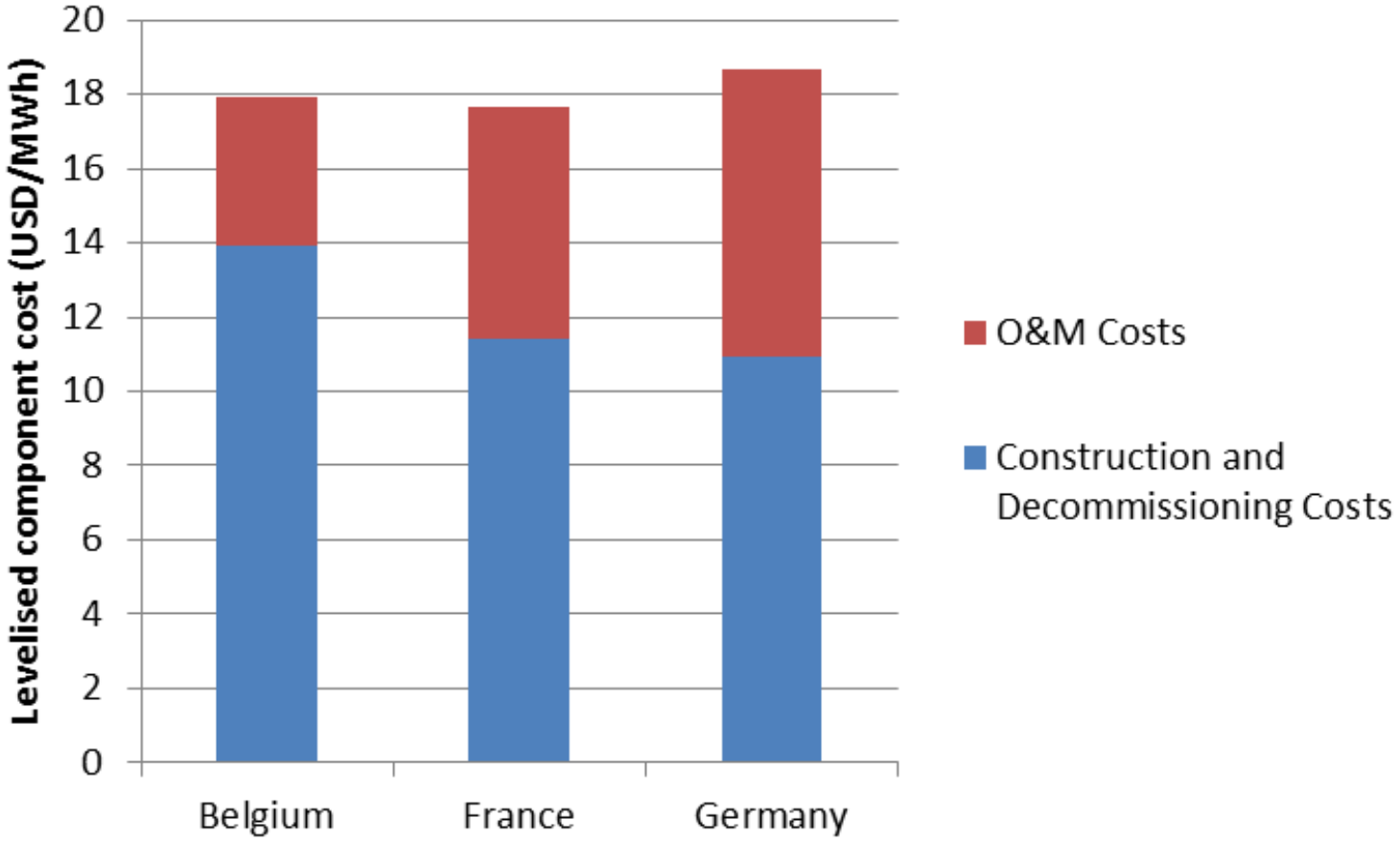


CCGTs: gas price divergence leads to different roles by region



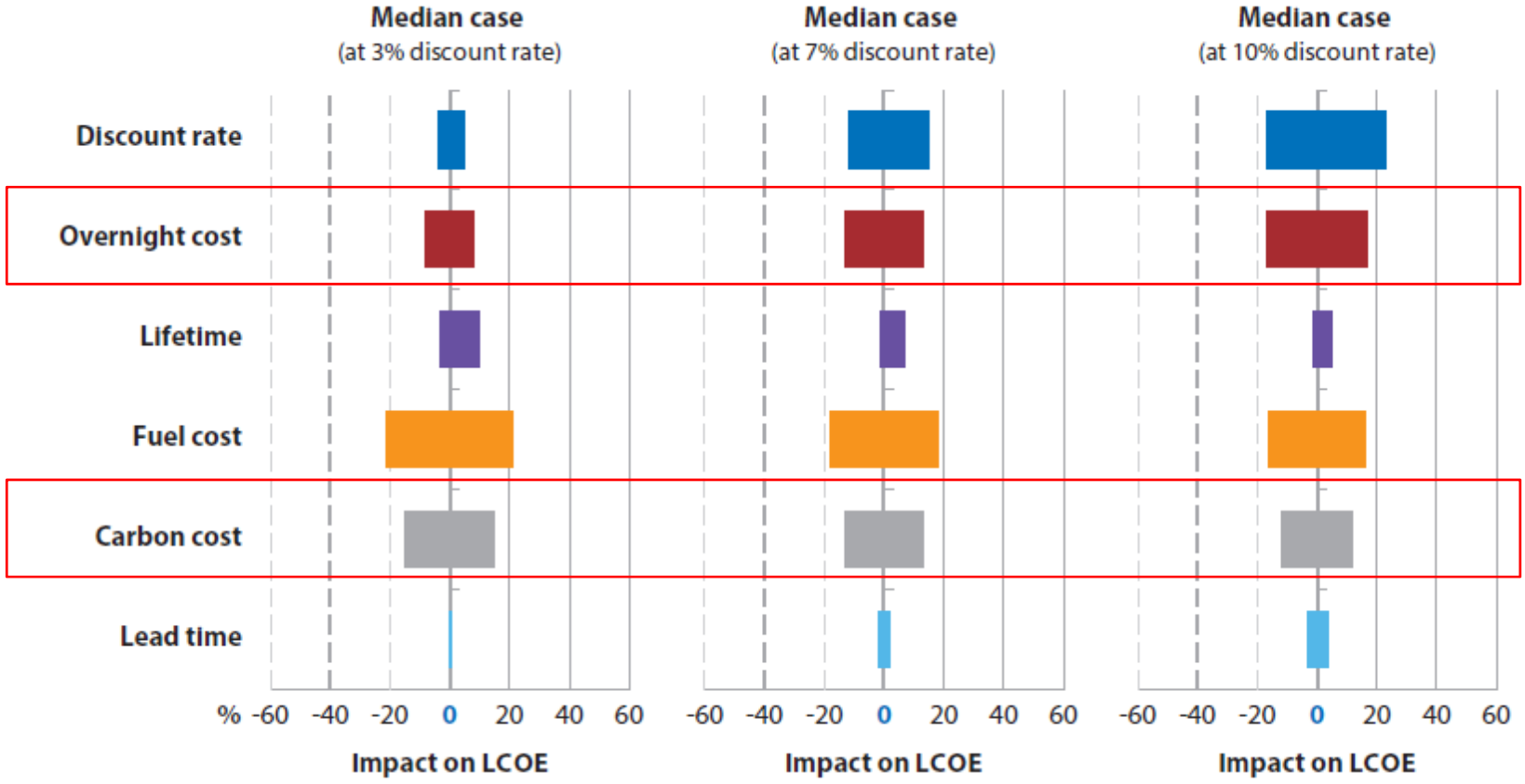
For some technologies, a single component can dominate the final cost.

CCGTs: component cost can vary even between similar markets



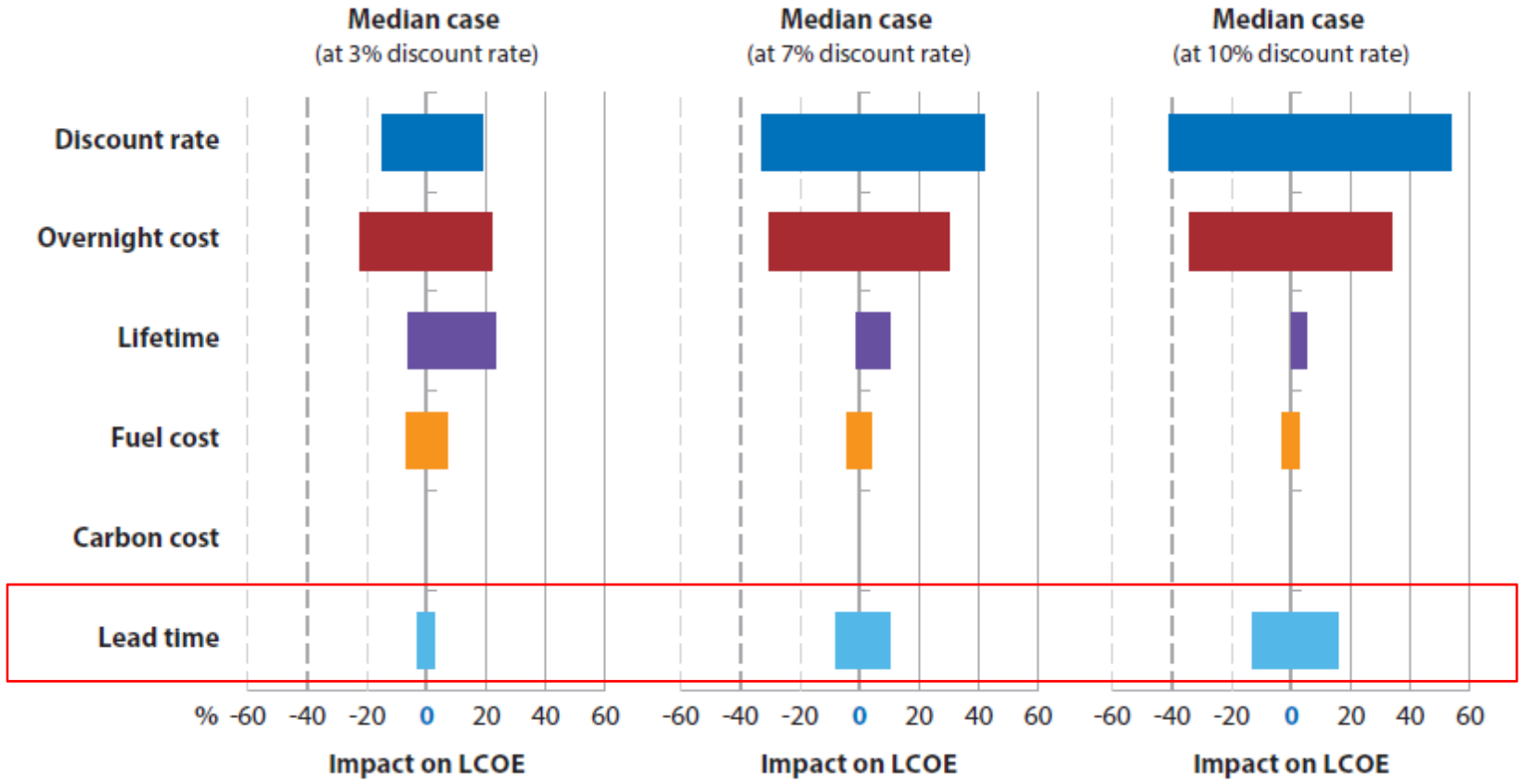
Divergence is often driven by local regulations (safety, labor, environment, etc) as well as local costs or variations in technology

Coal: LCOE can capture environmental considerations, if costs are measurable



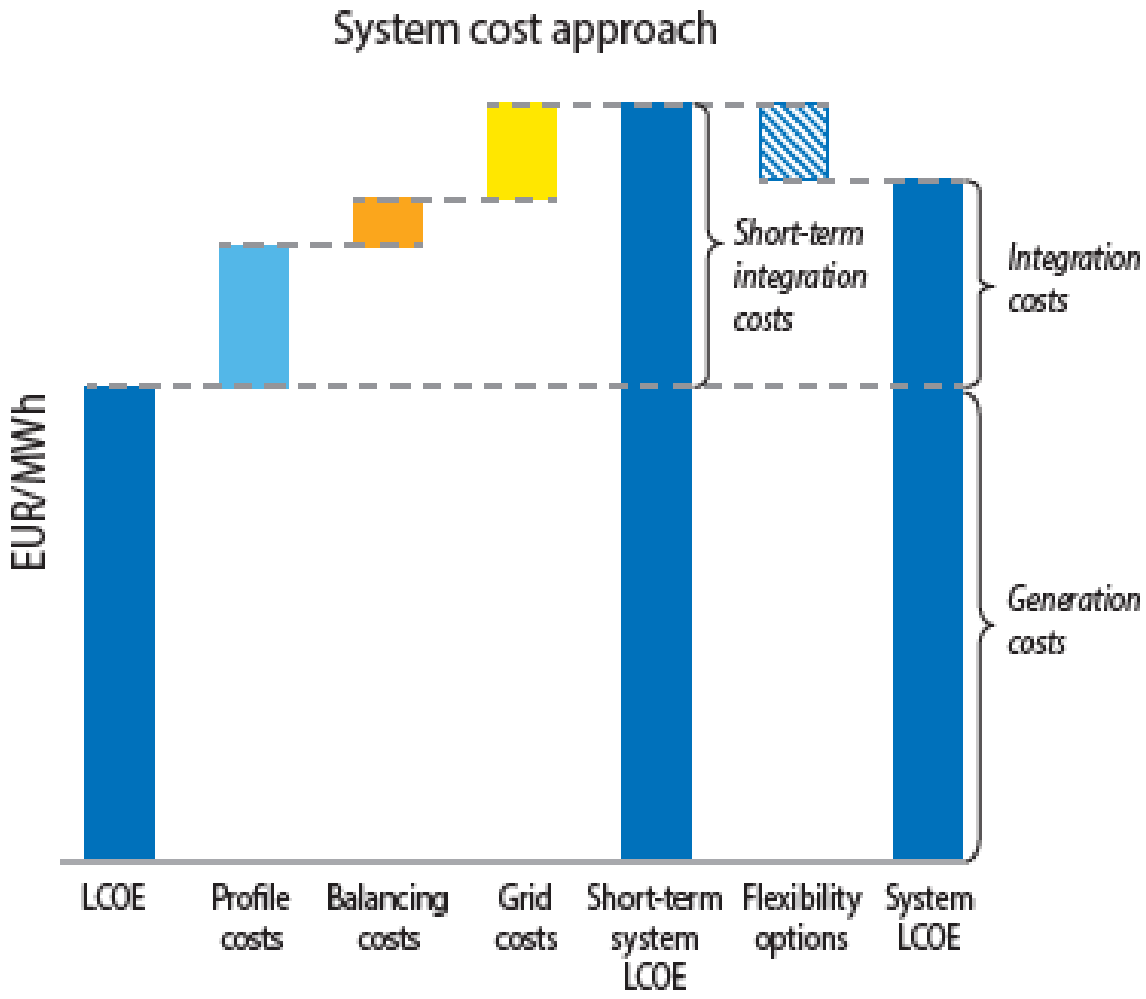
Environmental costs can be captured in the overnight cost (e.g. installation of environmental controls) or through priced externalities (e.g. carbon costs)

Nuclear: sensitive to capital costs, but also to "initial performance"



Construction delays can have a dramatic impact on nuclear LCOE, especially in high capital cost environments

Beyond baseload – LCOE and integration costs

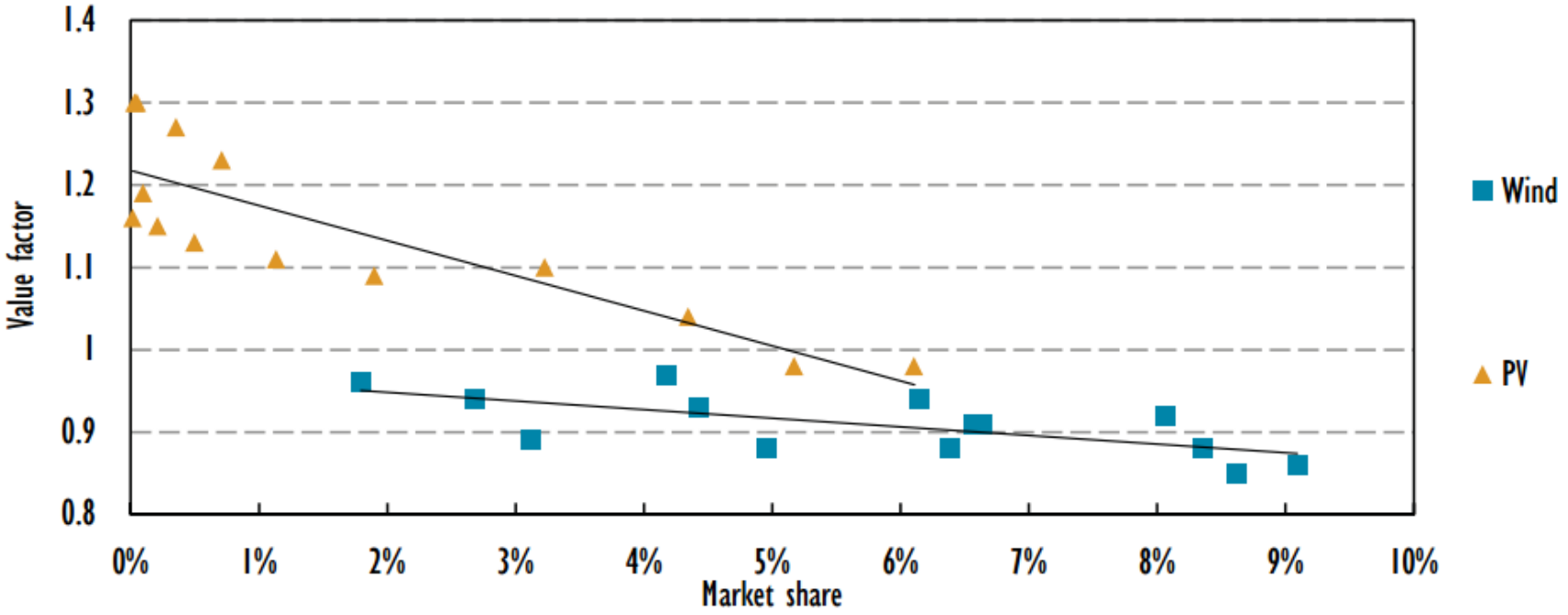


Alternative or additional cost metrics

1. **Capacity credit**
   - The extent to which a plant's capacity is actually available when needed, e.g. at the moment of peak demand
2. **Cost of New Entry (CoNE)**
   - Levelised cost of capacity (i.e. the fixed costs); the ability to provide just capacity at low cost, independent of variable costs, becomes a necessary complement to VRE production
3. **Flexibility metric**
   - Ability to change output or load at short notice (hard to value!)
4. **Value factor of renewables**
   - The market value of deploying VRE – who is being served?

Market value: changes as the generation mix changes

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



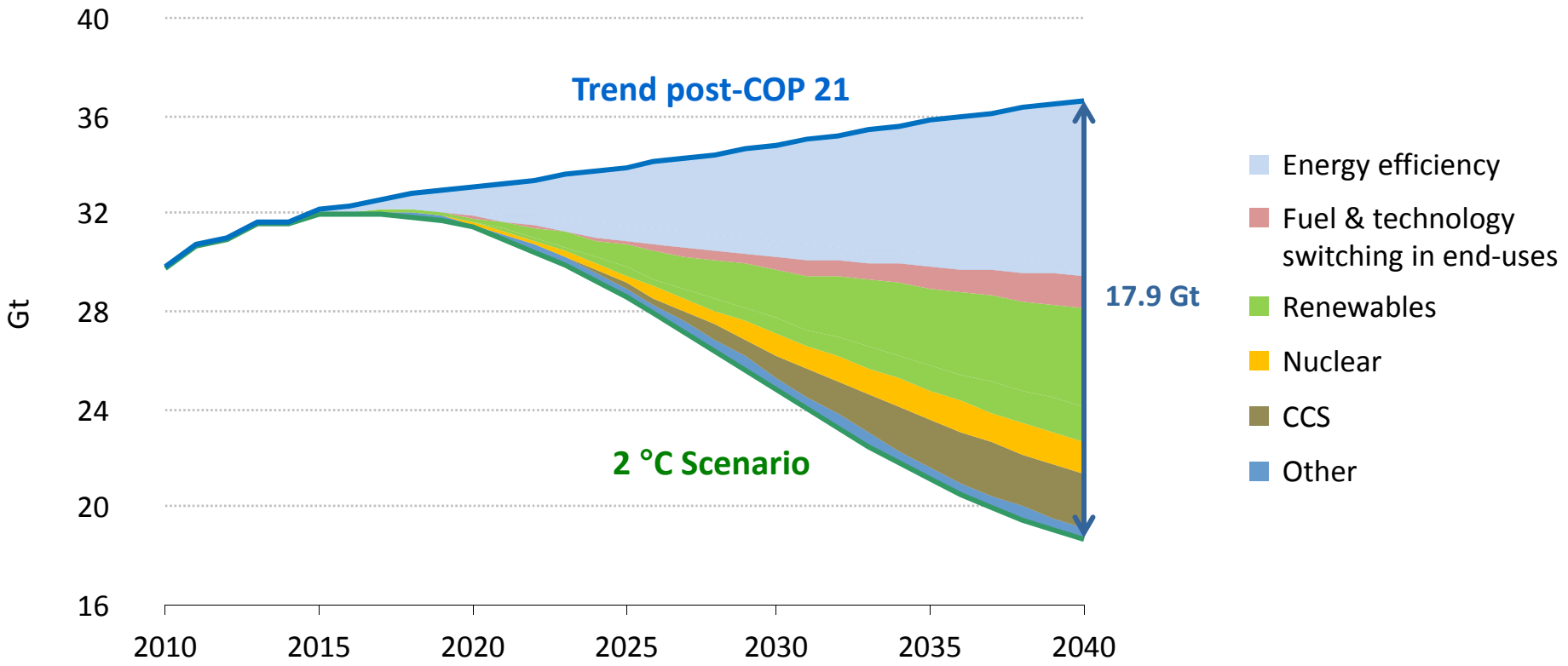
Source: Hirth (2015)

What is the optical generation mix? Investments are not only a matter of costs: the value of different technologies for the power system have to be factored-in

2. Power market trends

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

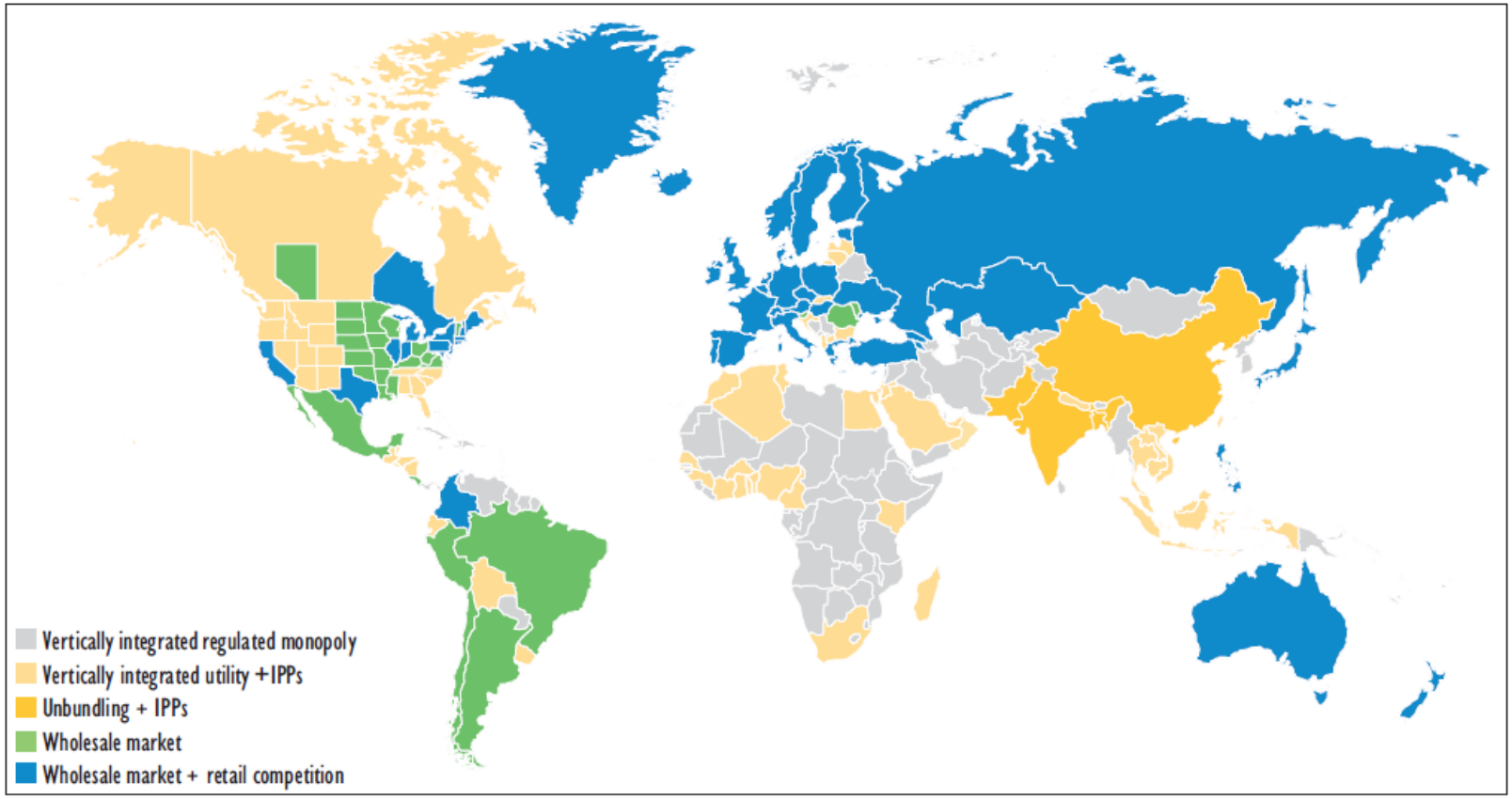
CO_2 emissions in a post COP 21 world



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

Electricity restructuring and decarbonisation – in conflict?

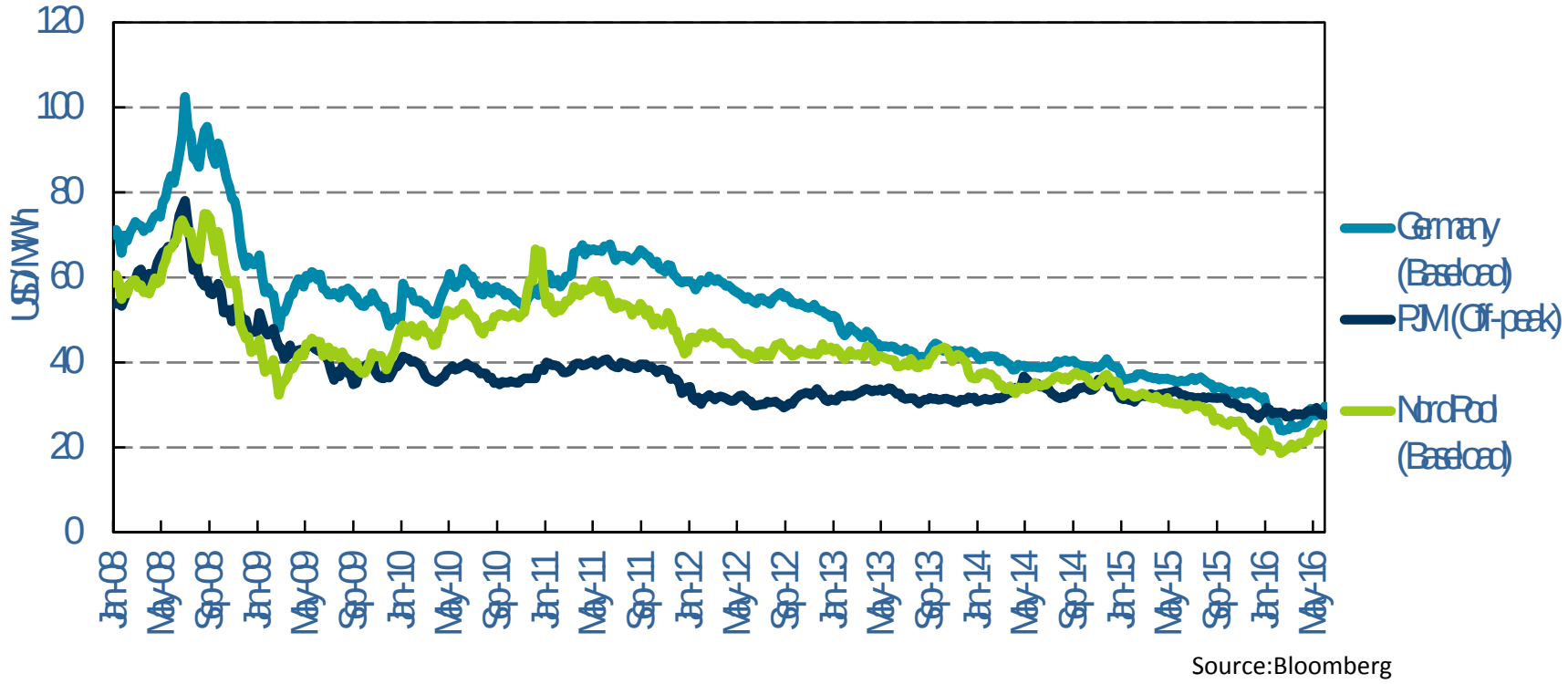


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Competitive wholesale markets represent 47% of electricity consumption and all regions are confronted with the challenge of reducing CO2 emissions.

Nuclear and renewable investments often struggle in competitive markets

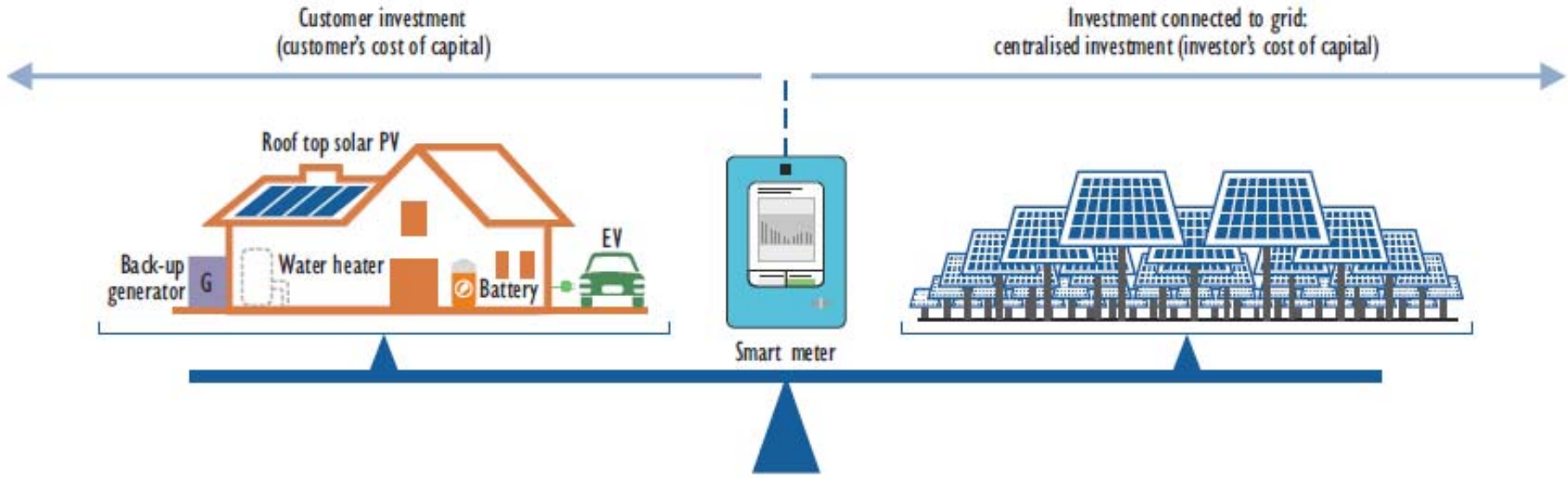
Year-ahead forward market prices (Real price 2015), 2008-15



Source:Bloomberg

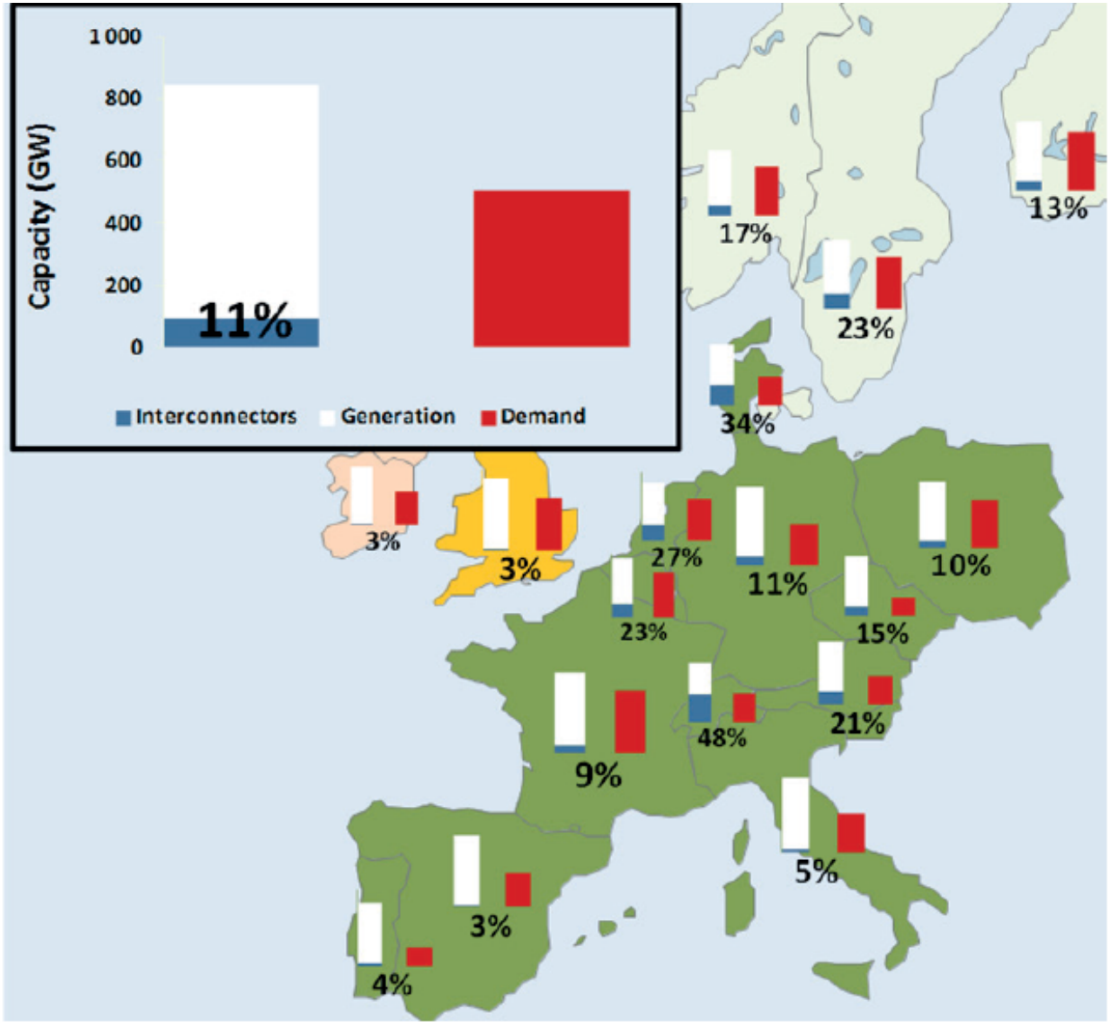
Under current market conditions, and without a carbon price, market-based investments in nuclear are unlikely, and remain limited for renewables

Centralised vs Distributed – which way is the right way?



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

Supporting security and renewables deployment through market integration



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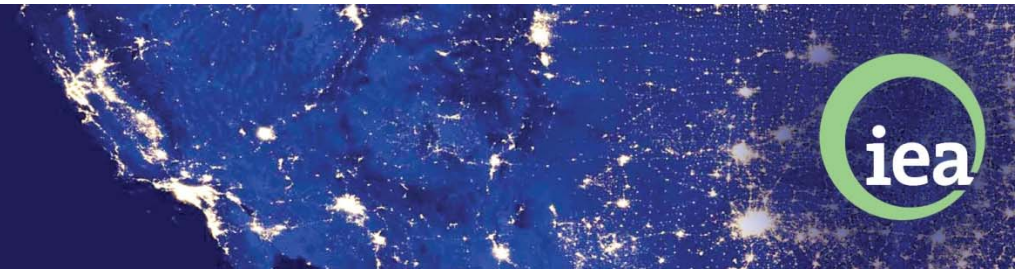
Source: IEA graph based on data from ENTSO-E, 2013

Relevant work by the IEA

- **Electricity Security Across Borders**
  - Case studies on how cross-border cooperation to ensure electricity security while decarbonising and meeting demand
  - Related: developing regional institutions to support power market integration in ASEAN
- **Integrating distributed resources into markets**
  - Series of workshops and whitepaper
- **Global Investment Report**
  - New annual report, to be launched in September

Conclusion



- Cost matters – but which costs are captured matters too
- Decarbonisation will be a primary driver of power sector development going forward
- As power systems evolve, the metrics we use to measure cost may need to evolve as well
- Power market design needs to think big (integration) and small (distributed power) at the same time
- No one size fits all solution – but many best practices and lessons learned are available already