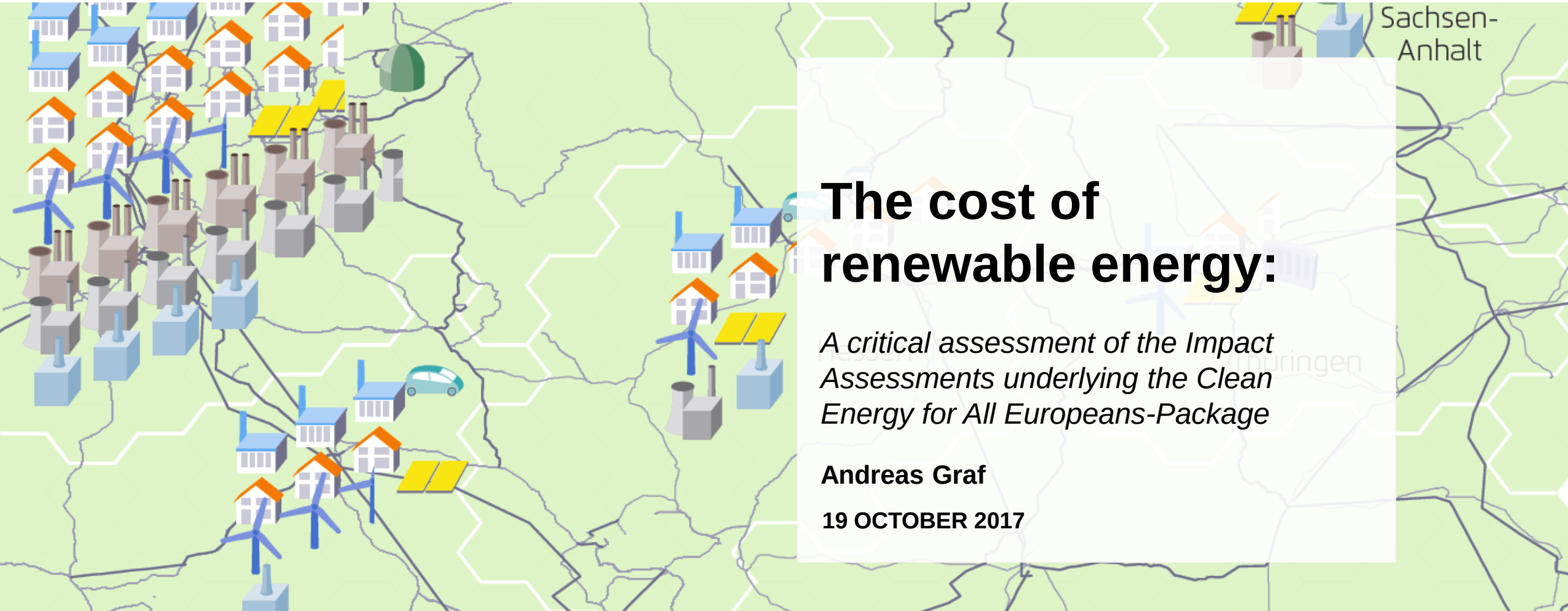


The cost of renewable energy:

A critical assessment of the Impact Assessments underlying the Clean Energy for All Europeans-Package

Andreas Graf

19 OCTOBER 2017

Agora Energiewende – Who are we

Independent think tank with more than 20 energy policy experts

Independent and non-partisan

Project duration 2012-2021

Financed by the Mercator Foundation and the European Climate Foundation

Mission: How do we make the energy transition in Germany and worldwide a success story?

Scientific assessments

Dialogue

Putting forward proposals

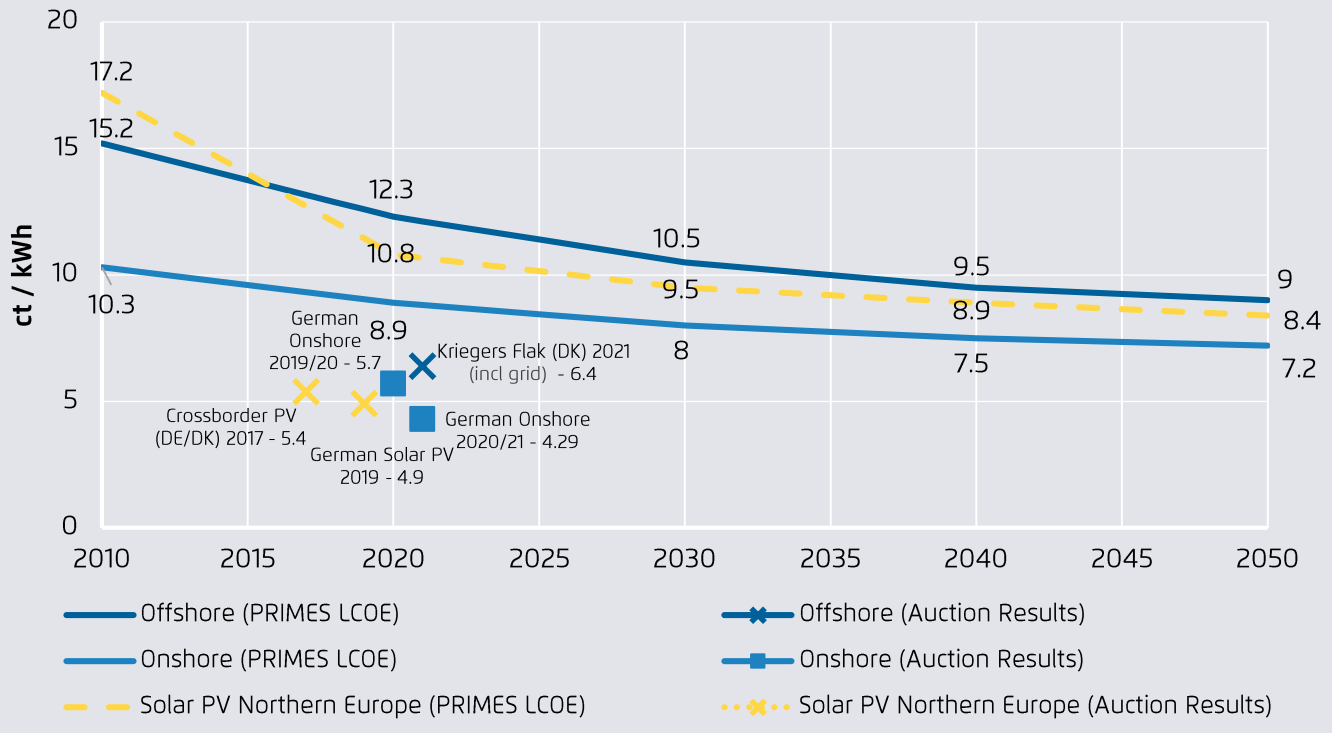
MEGATREND - Decrease in costs - Wind, solar and battery prices are falling

U.S. Department of Energy (2016)

- The price of power from wind turbines and PV installations has fallen drastically in recent years
- Already today, wind and solar are already cost competitive to all other newly built power plants
- Power system integration costs of wind and solar (5 to 20 EUR/MWh) do not change the picture, and a similar cost drop for batteries, LEDs and other enabling technologies has also occurred.
- Further cost reductions in these key technologies are foreseeable by 2030

Recent auctions in the real world resulted in significantly lower costs for renewable energy projects than suggested by Commission modelling.

Comparison of PRIMES LCOE cost assumptions with the results of recent auctions by year of expected realization



Source: COM (2016) EU Reference Scenario 2016; BNetzA (2016, 2017); Danish Energy Agency (2016); ICIS (2017); Vattenfall (2016)

- Continued record-breaking auction results have been a frequent reminder of the declining costs of RES and the failure of the COM to reflect these in its modelling.
- Competitive auctions have led to an intense period of downward price discovery for wind and solar that has dramatically reduced the level of support needed for newbuild
- Since the beginning of 2016 alone, several auctions have resulted in support payment guarantees awarded to successful bidders reflecting levelized costs of producing electricity that are below those assumed under PRIMES modelling for the year 2050.

Overview of Key Shortcomings

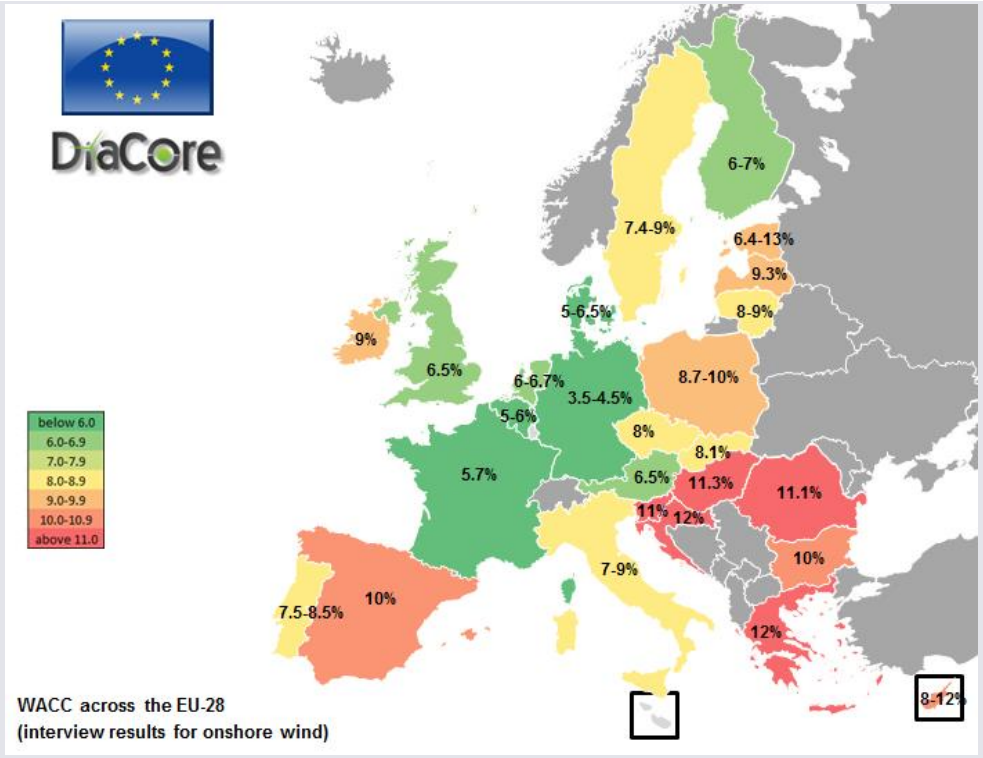
- Against this background, Agora Energiewende assessed the Commission Impact Assessment for the ‘Clean Energy for All Europeans’-Package and identified key shortcomings.

- The target scenarios of PRIMES in the 2016 modelling exercise:

1	Overestimate the costs of renewable energy
2	Overestimate the price of CO_2 and thereby exaggerate the role of markets in driving the development of renewable energies in Europe
3	Downplay the importance of robust sectoral policies and frameworks for developing Europe’s renewable energy resources at lowest possible cost

Cost of capital is a major determinant of the cost of renewable energy and varies substantially between EU Member State.

Estimated weighted average cost of capital for onshore wind in Europe in 2014



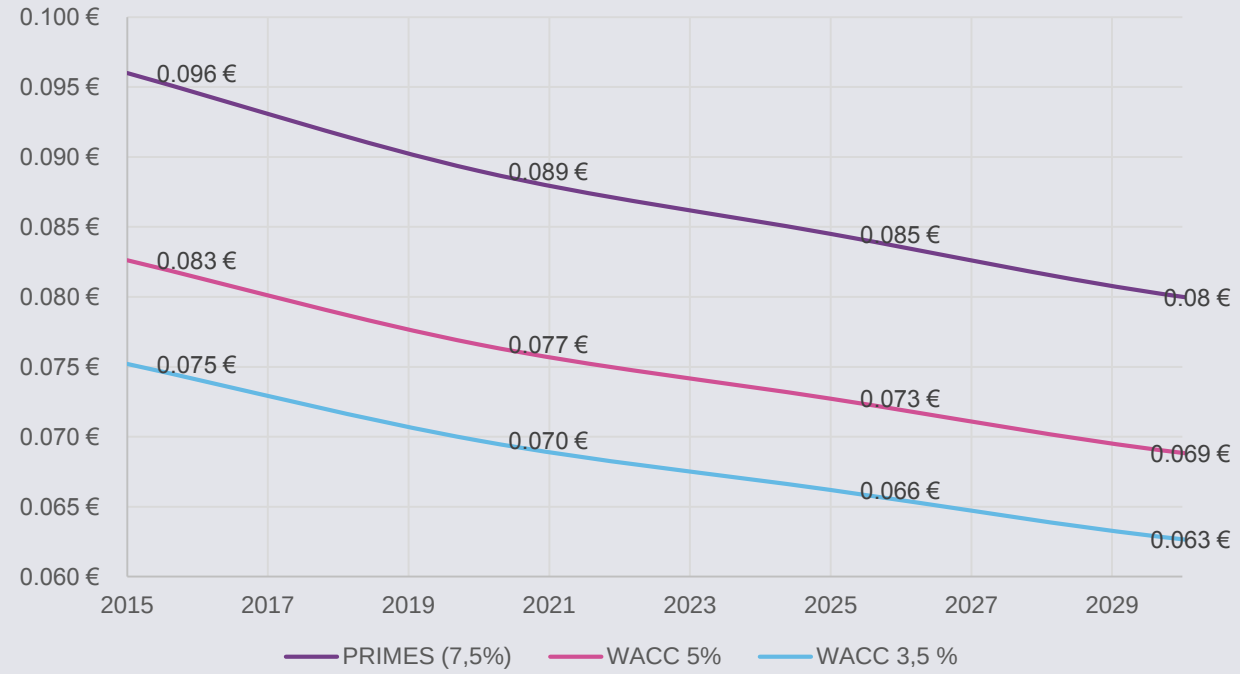
Source: DiaCore (2016), *The impact of risks in renewable energy investments and the role of smart policies*.

High fixed costs for renewables

Source: *Agora, based on IEA/NEA (2015)*

Shortcoming 1: Overestimating the costs of renewables due to simplified assumptions concerning cost of capital for renewable investment

Impact of lower WACCs on PRIMES LCOE for Onshore Wind

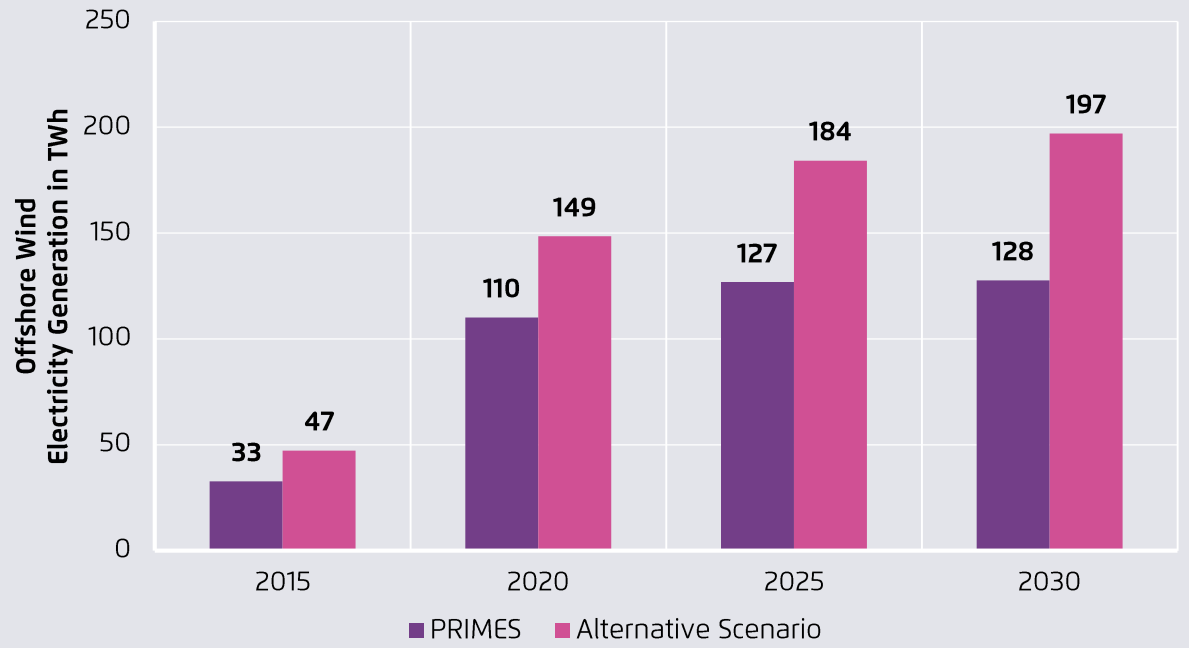


Source: COM (2016) EU Reference Scenario 2016 and own calculations based on PRIMES assumptions

- The Commission modelling for the central target scenarios EUCO27 and EUCO30 applies a flat-rate value for cost of capital of 7.5 percent across the whole of Europe.
- This is a rate significantly higher than capital costs for competitive technologies (e.g. wind onshore and solar PV) in mature markets (e.g., Germany, UK, Netherlands, France) where a majority of renewables investments in Europe is currently happening.
- In consequence, the Commission central scenarios set costs of renewable electricity projects in these primary markets considerably higher than plausible.

Shortcoming 1: Overestimating the costs of renewables due to outdated assumptions on capacity factors

Offshore Gross Electricity Generation (in TWh) for COM 2016 Reference Scenario vs. Alternative Scenario with Higher Capacity Factors

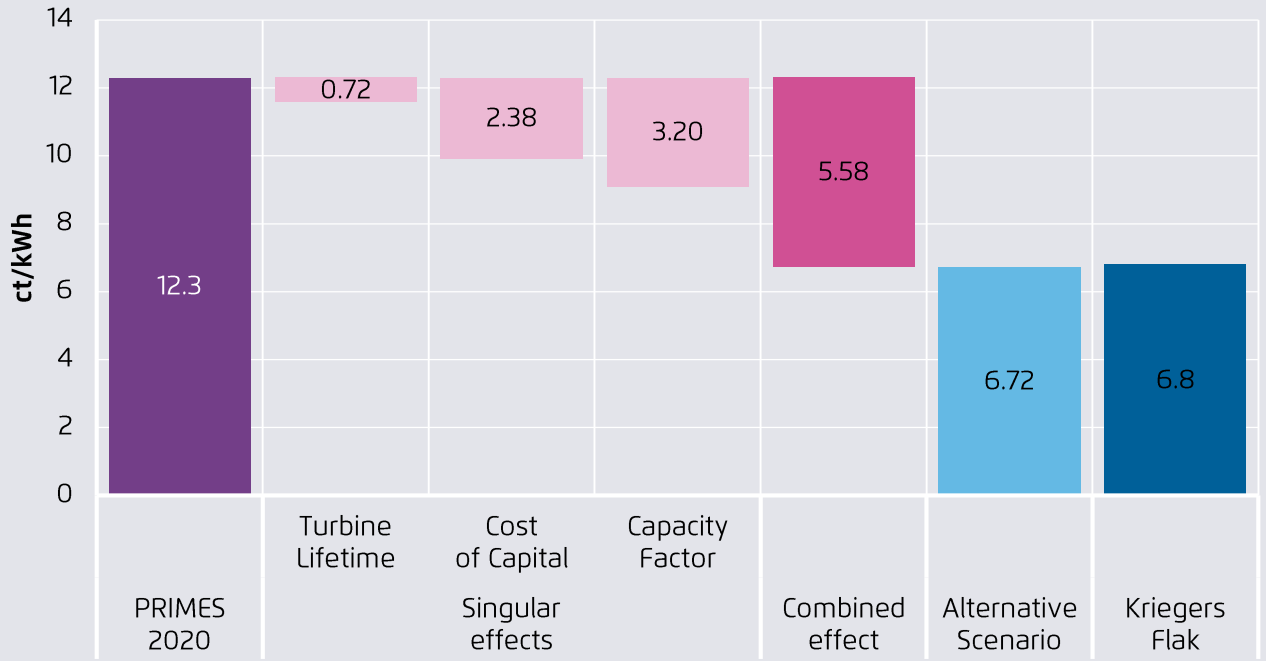


Source: COM (2016) EU Reference Scenario 2016 and own calculations based on PRIMES assumptions

- The PRIMES modelling for offshore wind installations results in significantly lower than plausible yearly full load hours (3.000-3.350 / capacity factor of 34-38%), compared to the averages reported by Danish Regulatory Agency (4.400 / 50%) for 2015.
- Applying such a higher capacity factor in the European Commission's 2016 Reference Scenario would increase the yearly electricity production by offshore wind farms from 128 TWh to roughly 197 TWh in 2030.
- Put differently, the same capacity of offshore wind resources would generate approximately 54 percent more electricity than projected in the Commission Reference Scenario.

Conclusion: A 27% RES share cannot be the cost-optimal contribution towards the 40% GHG target – RES share needs to be set significantly higher

PRIMES 2020 Offshore Wind LCOE vs. Alternative Scenario and Real World Auction Results



Source: EU Reference Scenario 2016 and own calculations;

- Taken together, our findings (lower WACC, higher capacity factors) imply that the central target scenarios in PRIMES are significantly overestimating the costs of investments in renewables and particularly the costs for developing Europe's offshore wind resources
- The contribution of renewables should be higher as renewable energies are relatively more competitive than other alternatives deployed by PRIMES (e.g., nuclear or carbon capture and storage).
- We conclude that a 27% RES share cannot be the cost-optimal contribution towards the 40% GHG target. In other words, the RES share needs to be set significantly higher.

The Commission's scenarios downplay the importance of robust renewables frameworks to reduce uncertainty and to bring down the cost of renewables

- The Commission concludes for the central target scenarios that under the right framework conditions only minimal support for renewable energy will be needed for certain renewable technologies (e.g. onshore wind, solar PV).
- A deeper look into the Commission Impact Assessments shows that the headline political message "mature renewables will be able to stand on their own feet after 2020" needs significant nuancing.
- **Shortcoming 2:** ETS prices are projected at significantly higher levels than by carbon analysts in the real market, thus overestimating the purely market-driven deployment of renewables (e.g. €42/ton of CO2 for EUCO27) – at least with the ETS reform as currently being discussed.
- **Shortcoming 3:** The Commission's scenarios downplay the importance of robust sectoral policies and frameworks for developing Europe's renewable energy resources at lowest possible cost, e.g. by using input parameters ("RES-Values") for electricity, H&C and transport that *implicitly* include renewable energy-specific policies and measures. The average RES value was set at 7 €/MWh for EUCO27 and at 58 €/MWh to reach a share of 30 percent renewables in the case of EUCO3030

The Commission's qualitative assessment is more explicit on the preconditions for a market-based financing of renewables

- 1) continued decrease in technology costs,
- 2) the availability of (reasonably cheap) capital,
- 3) social acceptance,
- 4) sufficiently high and stable fossil fuel prices,
- 5) addressing the current surplus of carbon allowances,
- 6) reducing the occurrence of low or negative market prices,
- 7) reducing balancing costs for renewables producers,
- 8) bringing additional revenues to RES producers in balancing and ancillary services markets,
- 9) ensuring a timely and sufficient deployment of all sources of flexibility in order to limit the renewables "cannibalization effect",
- 10) and electricity overcapacity effectively exiting the market

Source: RED Re-Cast IA

Efforts to remodel cost-effective potentials for renewable energy will still not serve as a crystal ball, solve all existing modelling flaws or help us to understand the impact of „black swans“, but they are still important.

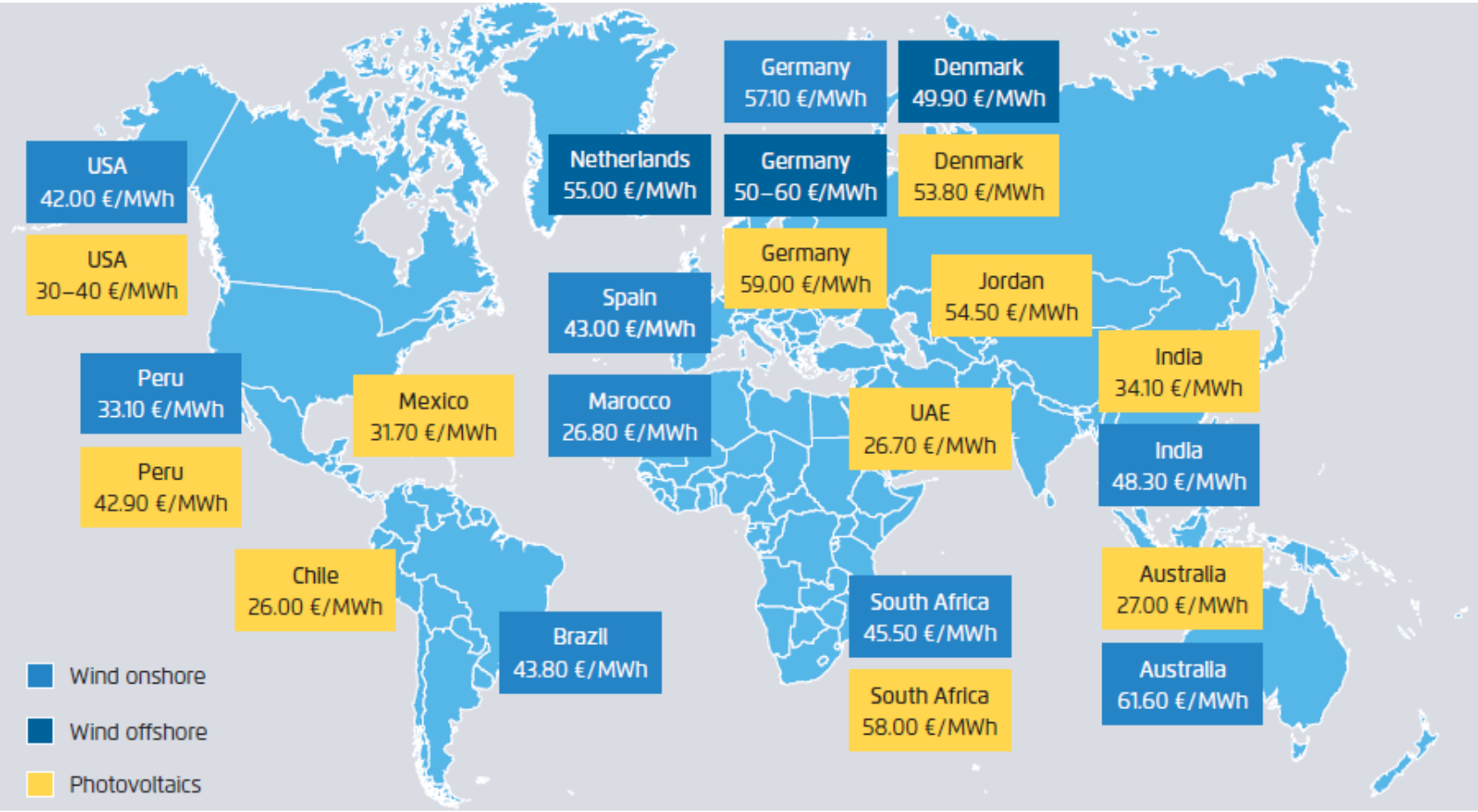
Comparison of investment and total system costs for the 2030 climate and energy framework - 2014 vs. 2016 Impact Assessments

	2014–2030 Framework IA			
	Ref2014		**GHG40/EE**	**GHG40/EE/RES30**
Avg. annual total system costs (2011-2030) in bn €'10	2067	N/A	2089	2089
Avg. annual investment expenditure for generation & boilers (2011–30) in bn €'10	50 bn €	N/A	53 bn €	55 bn €
Share of RES-E 2030	42.70%	N/A	46.10%	53.10%
	2016 – Winter Package IA			
	Ref2016	**EUCO27**	**EUCO30**	**EUCO3030***
Avg. annual total system costs (2010-2030) in bn €'10*	1880 (-9.1%)	1889	1896 (-9.2%)	1899 (-9.1%)
Avg. annual investment expenditure for power generation (2021–2030) in bn €'10	33.5 (-32.9%)	42.6	42.5 (-19.9%)	N/A
Share of RES-E 2030	42.5% (-0.2%)	47.30%	48.7% (+2.6%)	54.2% (+1.1%)

Source: 2030 Framework IA (2014), RES Re-cast IA (2016)

- Changes in the modelling assumptions between 2014 and 2016, including technology costs, overall electricity consumption, fossil fuel prices and discount rates demonstrate that estimated costs have fallen dramatically since the EU’s 2030 framework discussion began.
- IRENA, COM and ECF efforts to remodel cost-effective RES potential with new cost data to be released in the future and could provide valuable input to debate, in particular by demonstrating to policy-makers that high ambition does not have to come at high cost.
- Considering the chronic underestimation of RES cost declines over the last years and the complexity of the Commission’s modelling design, policy-makers would be ill-advised to assume that their results will accurately capture the limits of cost effective RES.

The global race for the clean energy market has already begun



This figure shows the auctions result and power purchase agreements from 2016/2017. See Fortum (2016).
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- California, the sixth largest economy in the world, plans to have all its power from renewable energy by 2045
- China installed 64 gigawatts of renewable power in 2016 alone
- India has announced a plan to increase new renewable capacity four-fold by 2022, for a total of 175 gigawatts

Conclusions

1) **Renewables are significantly cheaper than modelled by the Commission. A significantly higher than 27 percent share of RES is cost-effective to reach the 40%GHG target. Real world RES costs would allow for a higher GHG target at the same cost.**
2) **Robust renewable energy frameworks are fundamental for unlocking Europe's renewable energy potential at lowest possible cost.**
3) **The limits to our current knowledge about future developments and our ability to model them must not become the limit to our climate and energy ambition.**
4) **The setting of a higher ambition level should also be informed by Europe's interest to be a home to a vibrant renewable energy industry that creates new economic and employment opportunities.**

More information and studies available at our website www.agora-energiewende.org – or subscribe to our newsletter!