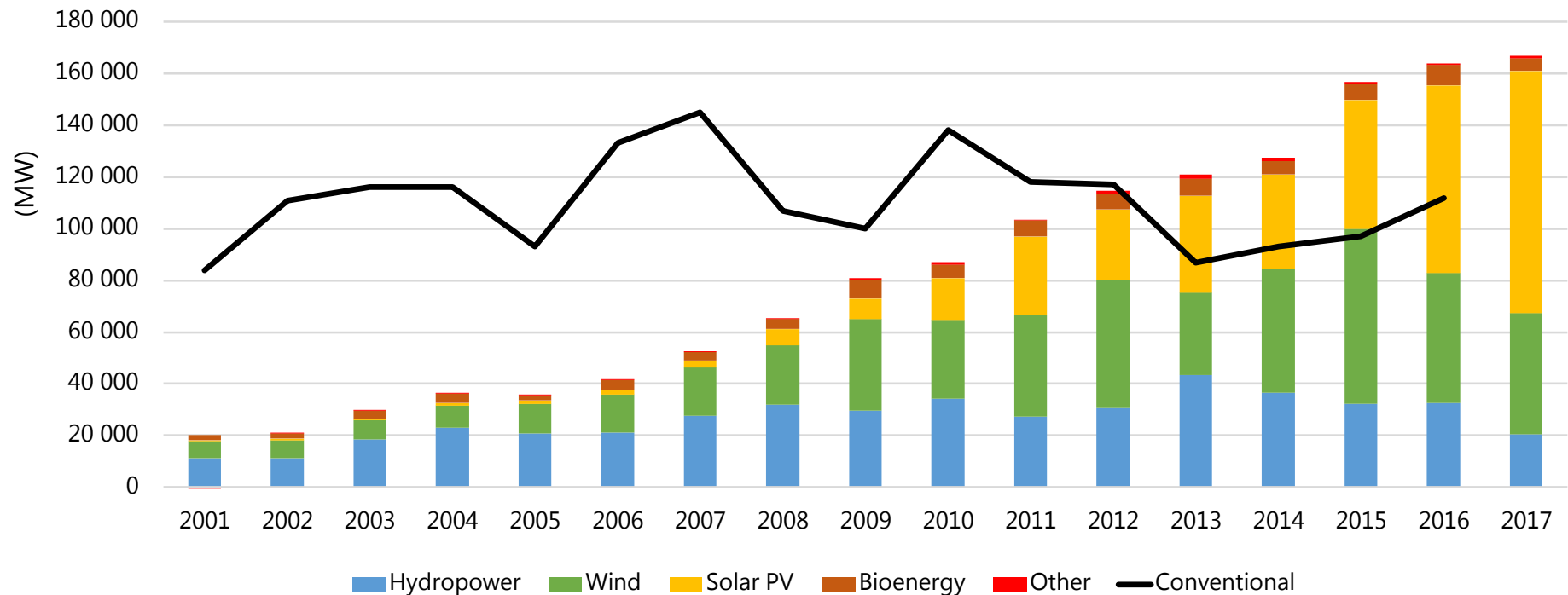


Cost Trends in Solar PV and Wind: A Real Paradigm Shift in the Competitiveness of Renewables

**Renewable Energy Auctions: A New Paradigm for Asia
ACEF, 8 June 2018**

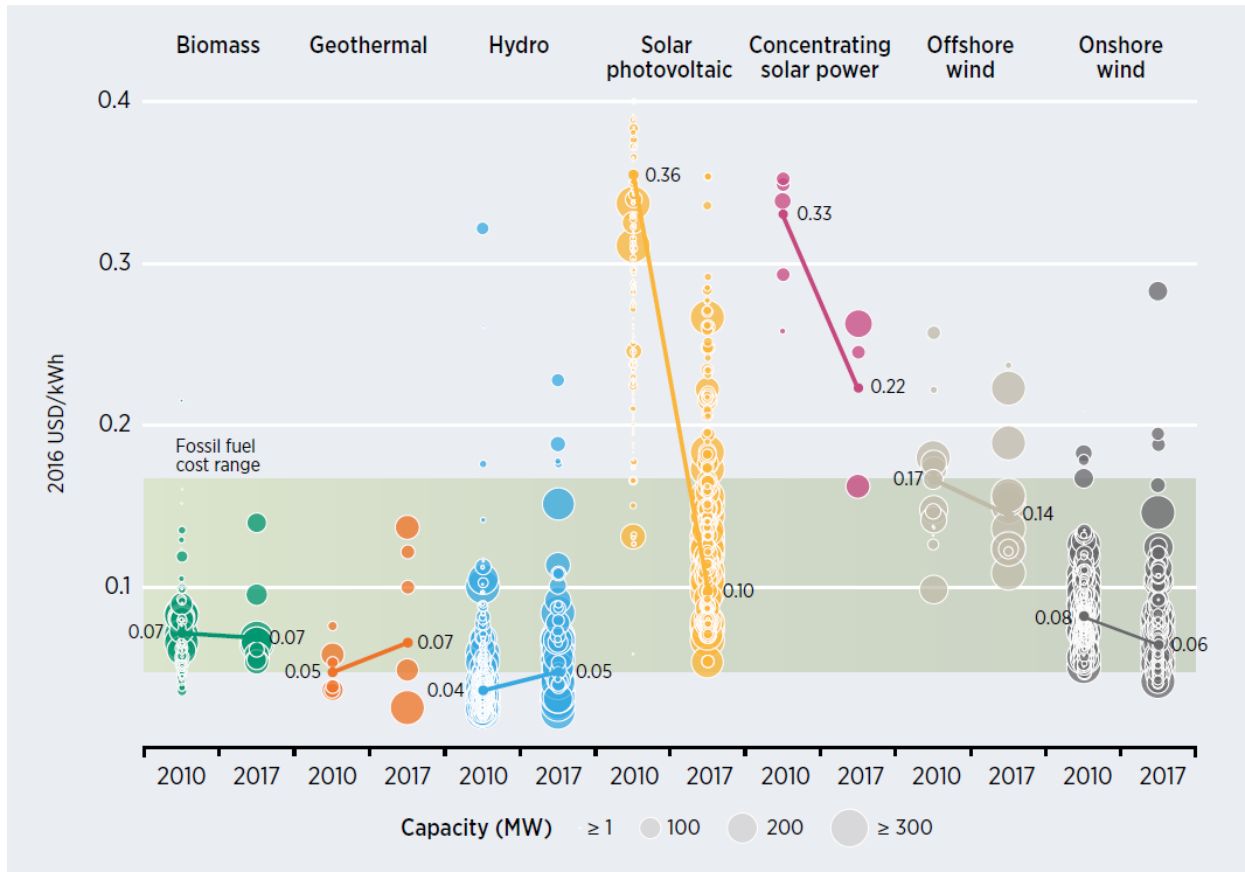
Annual additional capacity by technology, 2001-2017



Since 2012, RES capacity additions exceed non-RES additions. Wind and solar PV led the uptake of RES. Solar PV accounted for more than 56% of total RES additional installed capacity in 2017.

Falling cost of technology

Global levelised cost of electricity from utility-scale renewable power generation technologies, 2010-2017



Source: IRENA Renewable Cost Database.

Note: The diameter of the circle represents the size of the project, with its centre the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE value for plants commissioned in each year. Real weighted average cost of capital is 7.5% for OECD countries and China and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.

Between 2010 and 2017, the global weighted-average LCOE for:

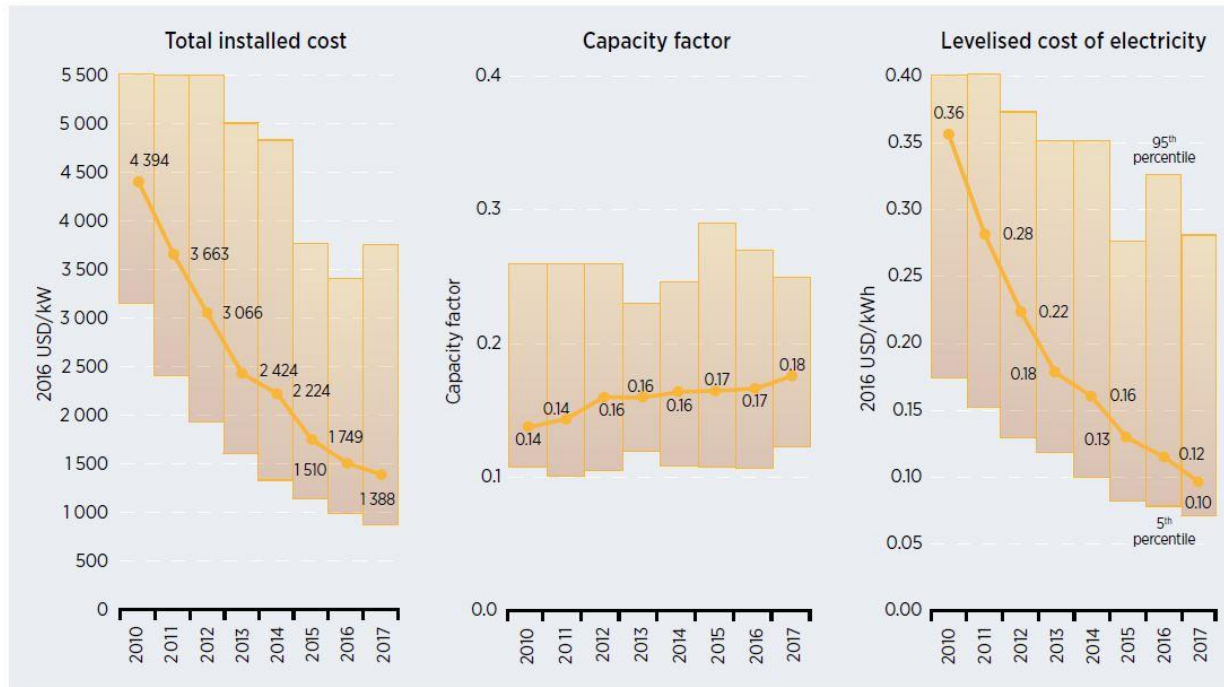
- **utility-scale PV fell by 73%** (81% reduction in module prices)
- **onshore wind fell by 23%** (improved technologies, higher hub heights and longer blades)
- **hydropower rose** from USD 0.036/kWh to USD 0.046/kWh (shift to more challenging projects with higher civil engineering and project development costs)
- LCOE for **biomass-fired power fell** slightly to just below USD 0.07/kWh
- **CSP fell by 33%** to USD 0.22/kWh and **offshore wind by 13%** to USD 0.14/kWh.

LCOE of geothermal power was USD 0.04/kWh - USD 0.13/kWh

Solar PV costs and performance

Trends in total installed costs, CF and utility-scale PV LCOE (2010 to 2017)

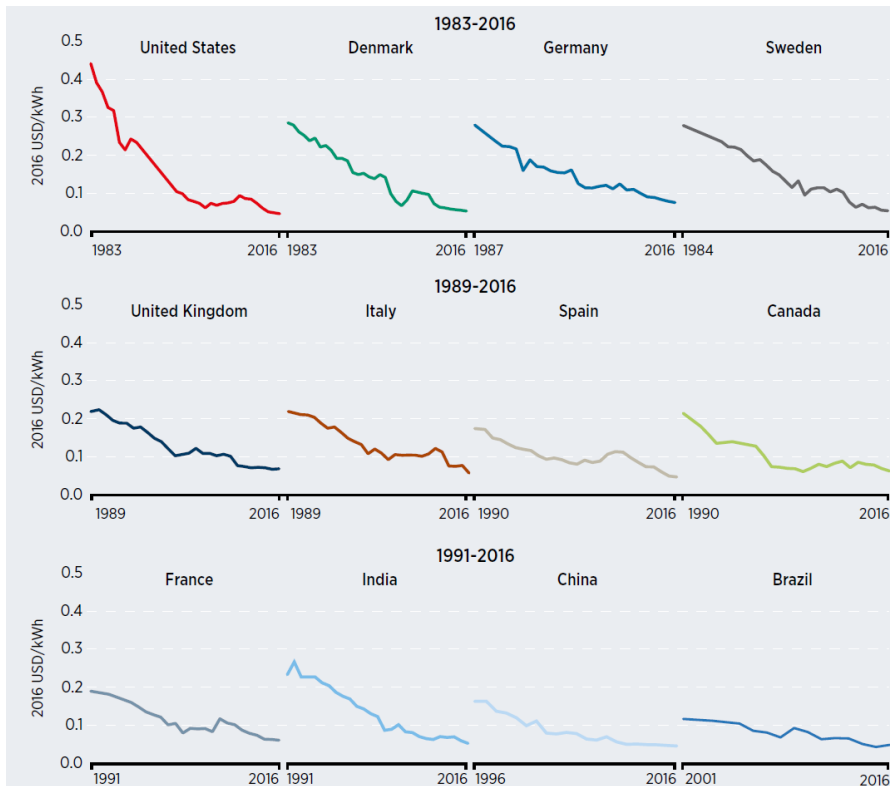
Global weighted average total installed costs, capacity factors and LCOE for solar PV, 2010-2017



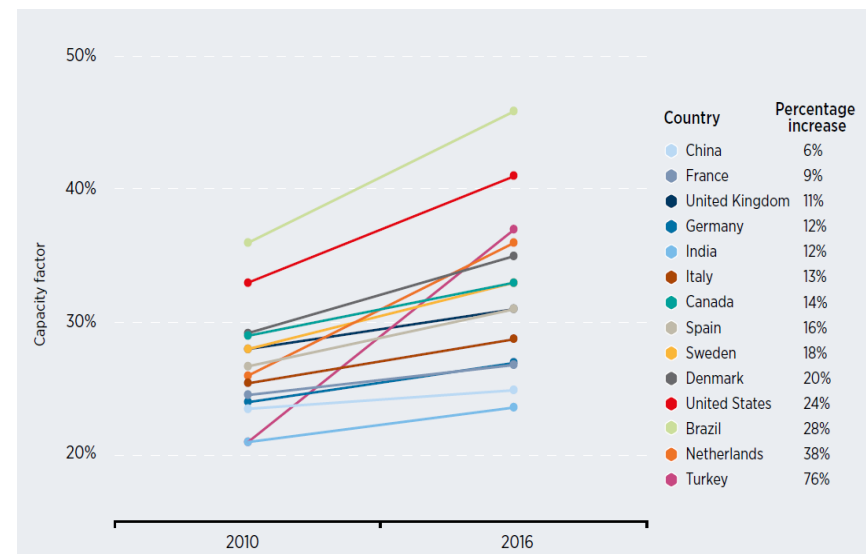
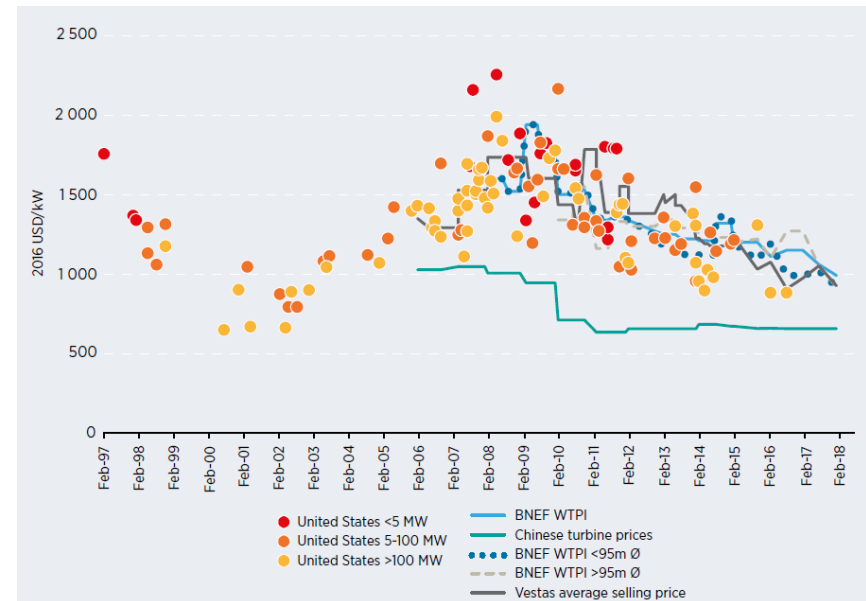
Source: IRENA Renewable Cost Database.

- 73% reduction in LCOE, from around USD 0.36 to USD 0.10/kWh
- Decline 2016 to 2017 -> 15%
- The range of costs has also narrowed

Wind cost and performance trends

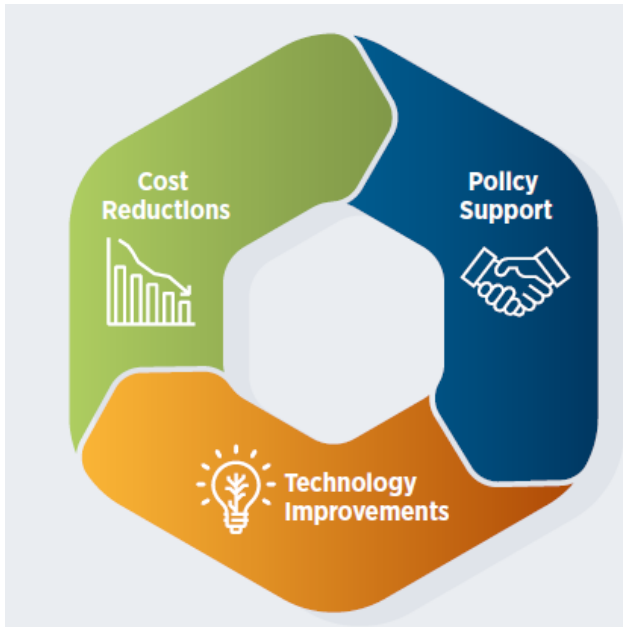


- LCOE of onshore wind has declined by 85% since 1983
- Globally, wind turbine costs have declined by 41-56%, on average, in 2017 in comparison to peaks observed between 2007 – 2009



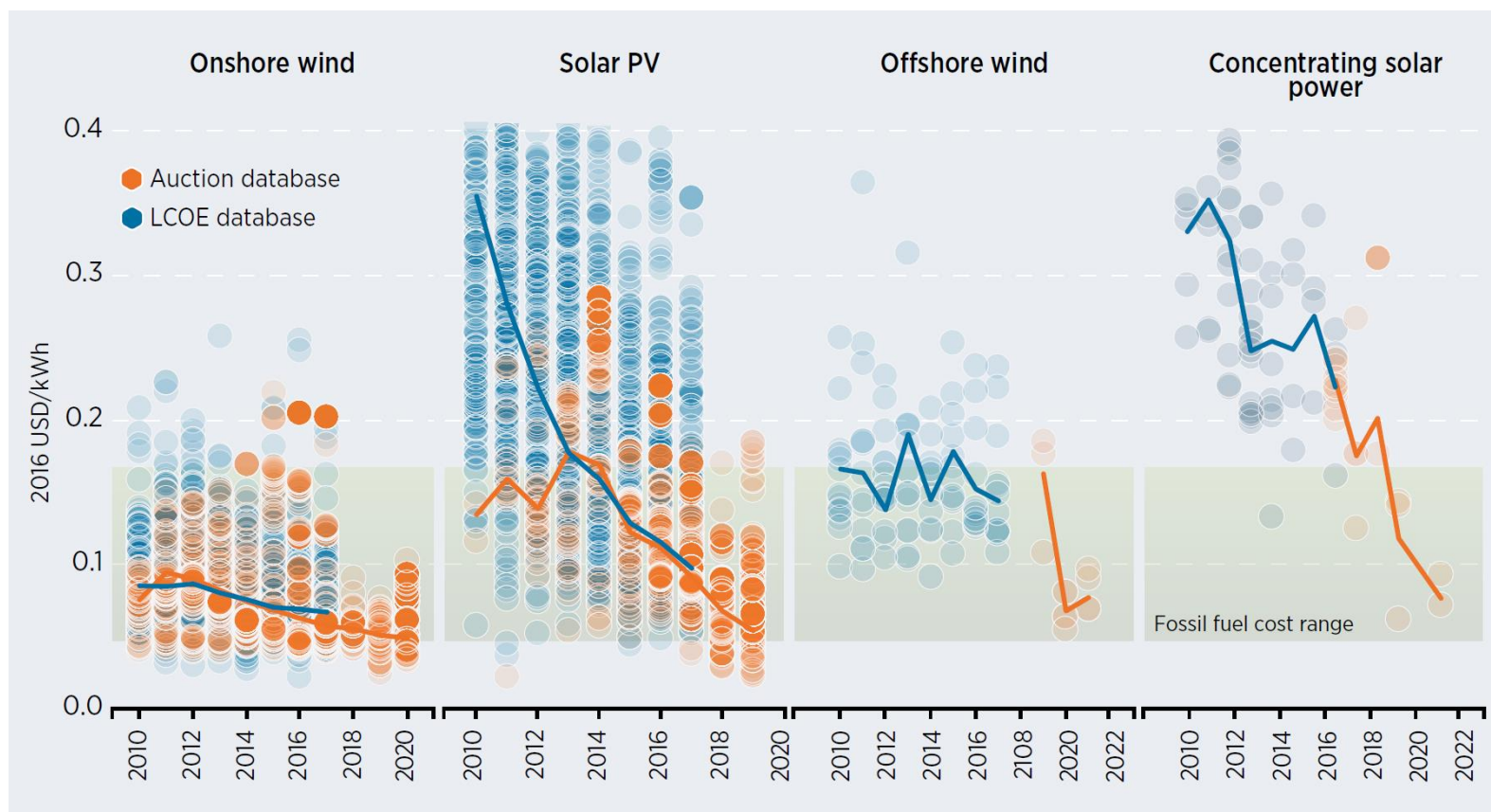
Drivers of cost reduction

Renewables are experiencing a virtuous cycle of technology improvement and cost reduction



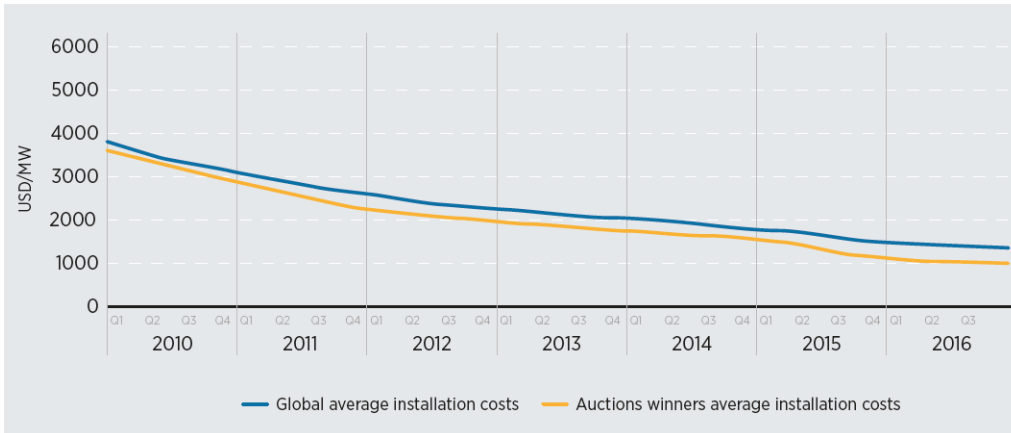
- Increasing **economies of scale** in manufacturing, **vertical integration** and **consolidation** among manufacturers
- Manufacturing **process improvements** that reduce material and labour needs, while optimising the utilisation of capital
- More **competitive, global supply chains** that are increasingly optimised to provide tailored products that best suit local markets and resource conditions
- **Technology improvements** that are raising capacity factors and/or reducing installed costs
- **Experienced project developers** that have standardised approaches to project development and who have minimized project development risks
- **Optimised O&M** practices and the use of real-time data to allow improved predictive maintenance, reducing O&M costs and generation loss from planned and unplanned outages.
- **Low barriers to entry** and a plethora of experienced medium- to large-scale developers competing to develop projects, worldwide.
- **Falling or low cost of capital**, driven by supportive policy frameworks, project derisking tools and the technological maturity of renewable power generation technologies.

Solar & Wind: LCOE/Auction Price Evolution Overview



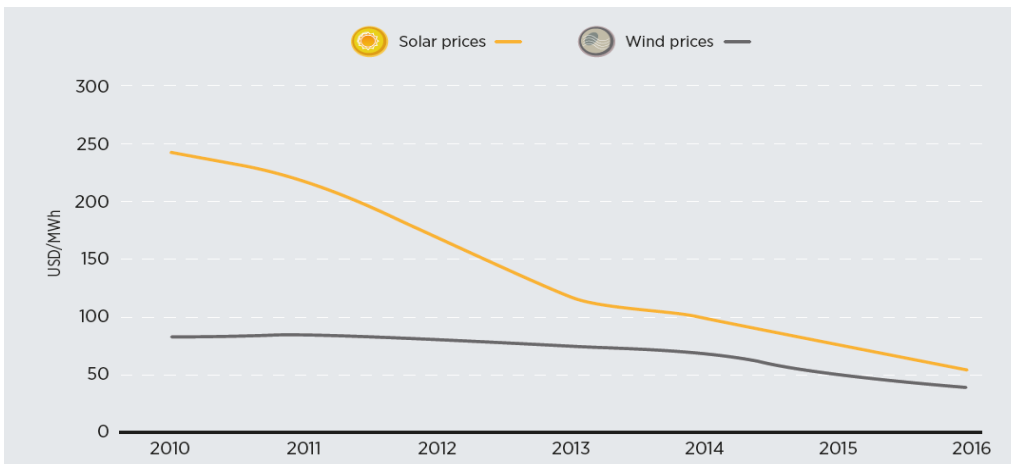
Auctions Strengths – Potential for real price discovery

Estimated installation costs of utility-scale PV projects: global versus auction winners, 2010-2016



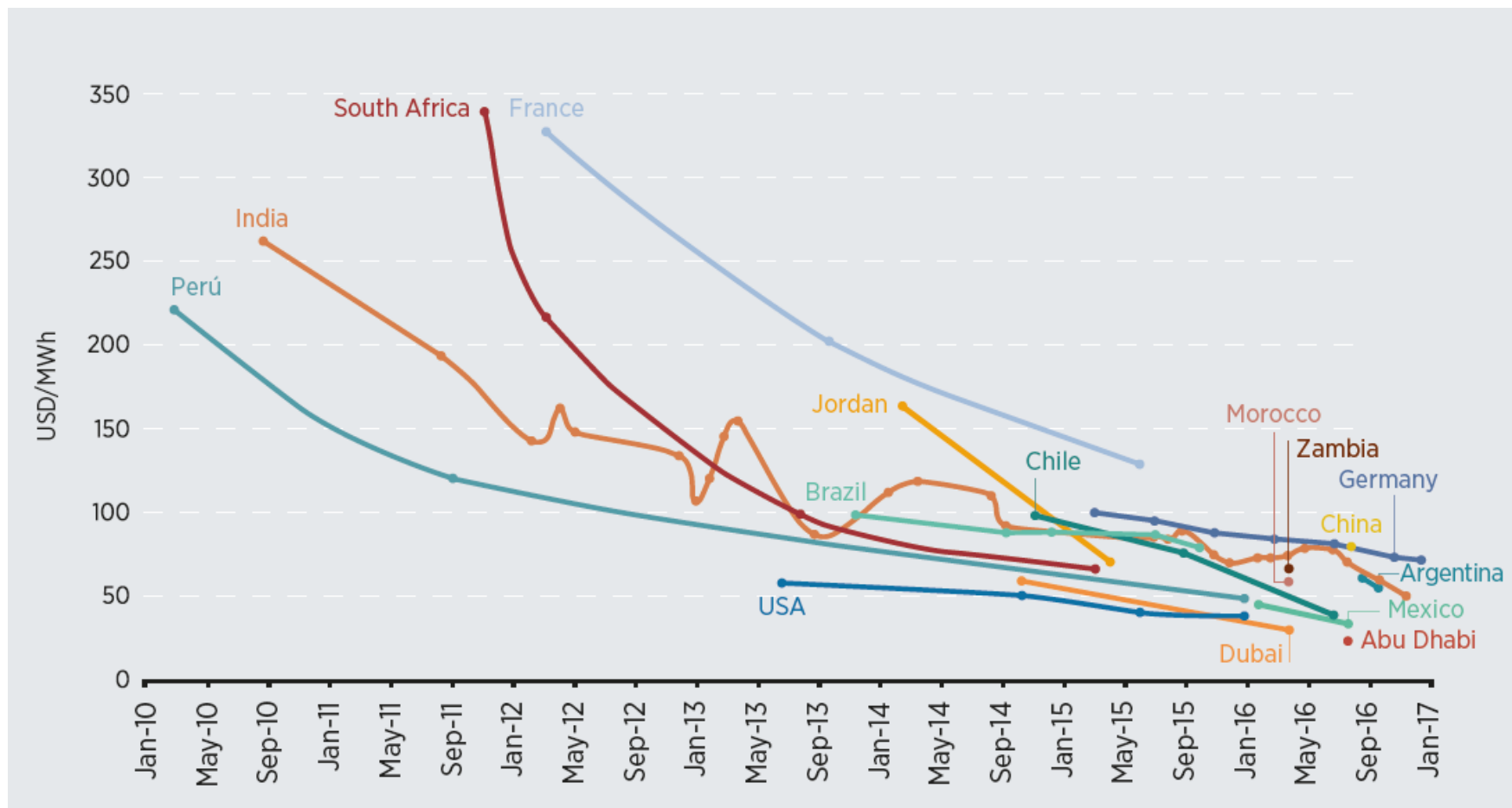
- The average installation costs of projects awarded from auctions are consistently lower than global average installation costs.

Average prices resulting from auctions, 2010-2016

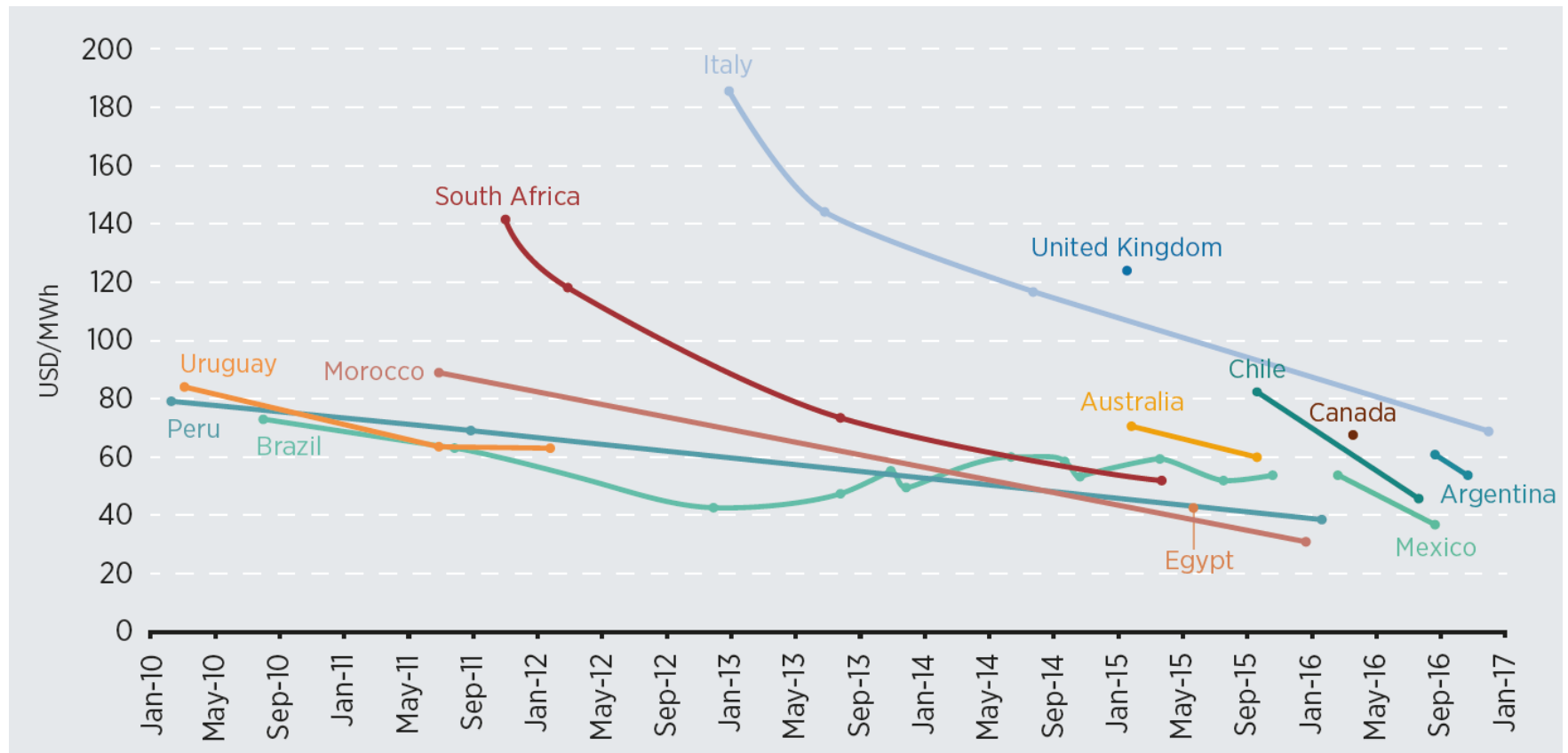


- Solar energy was contracted at a global average price of almost USD 250/MWh in 2010, compared with the average price of USD 50/MWh in 2016.
- Wind average prices have also fallen from USD 80/MWh in 2010 down to USD 40/MWh in 2016.

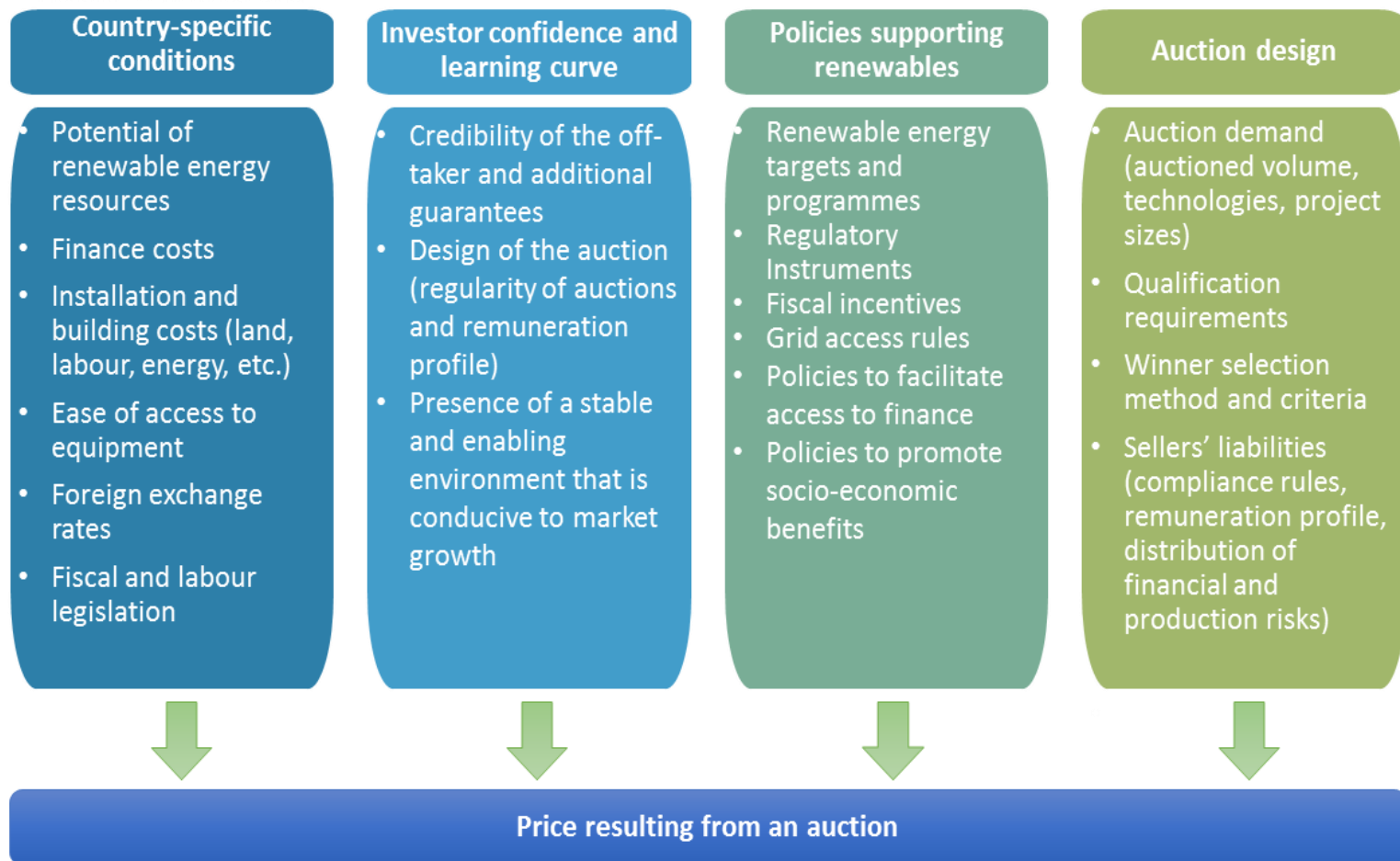
Price trends: solar PV auctions



Price trends: onshore wind auctions



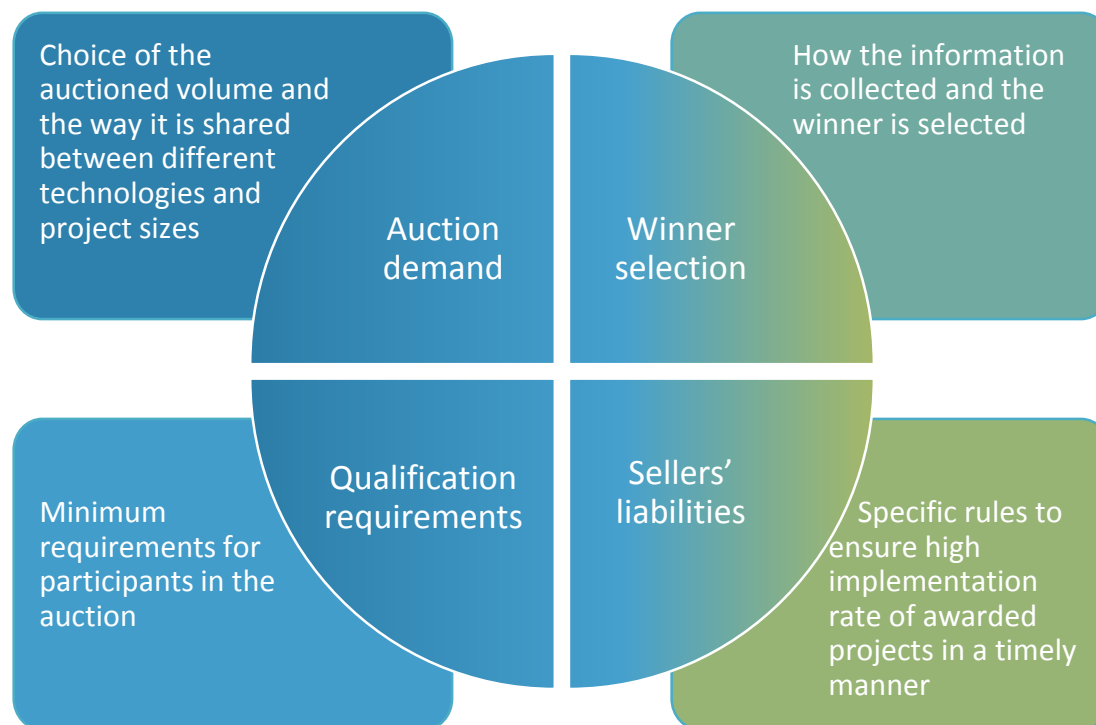
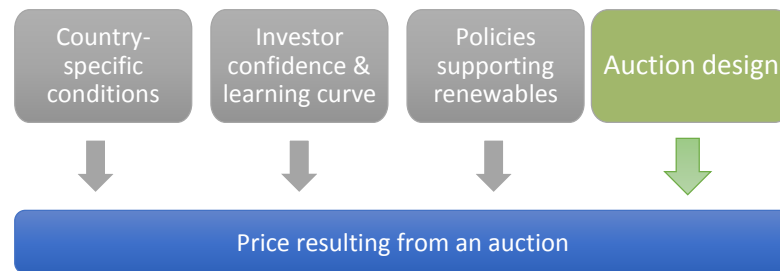
Factors that impact the price



Factors that impact the price

The design of the auction considering trade-offs:

- ◆ Ensuring project delivery and price
- ◆ Fulfilling development goals and price
- ◆ Encouraging small/new players and price

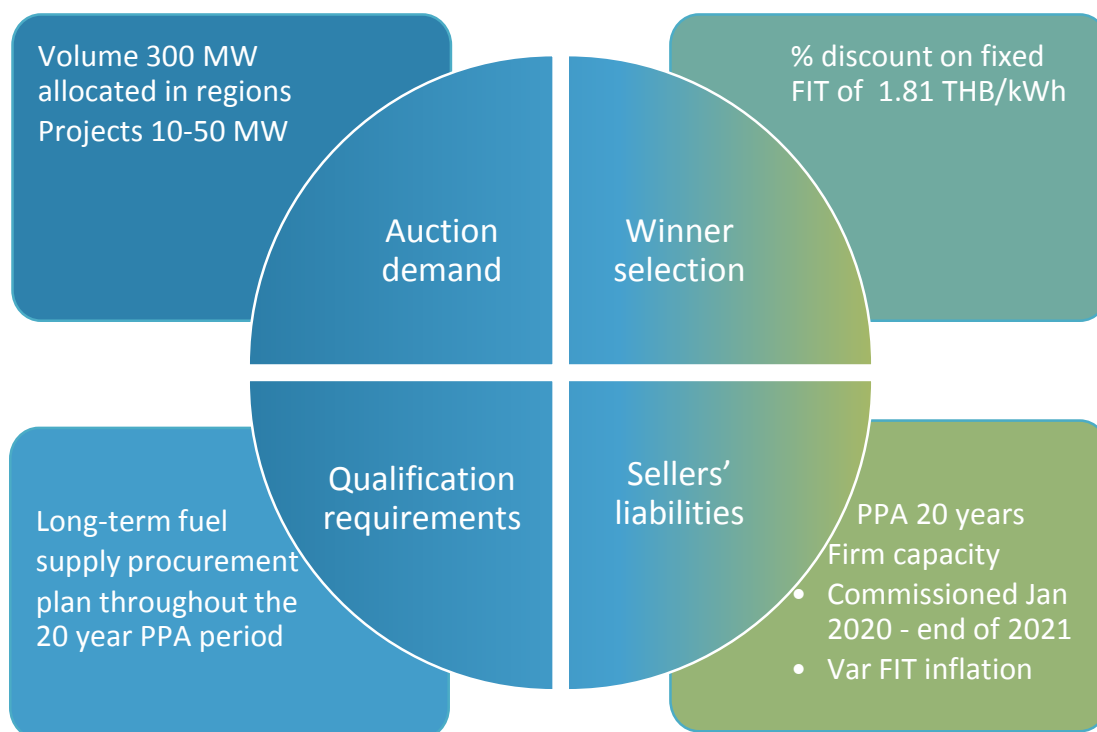


Hybrid auctions – the case of Thailand

Objectives:

- ◆ Promote storage
- ◆ Specific to Small Power Producers
- ◆ Match renewable output with grid demand

- PPA requires delivery of 98% - 102% of PPA capacity during peak periods (9 am to 10pm on weekdays).
- The PPA limits power output at other times to 66.3% of the PPA capacity

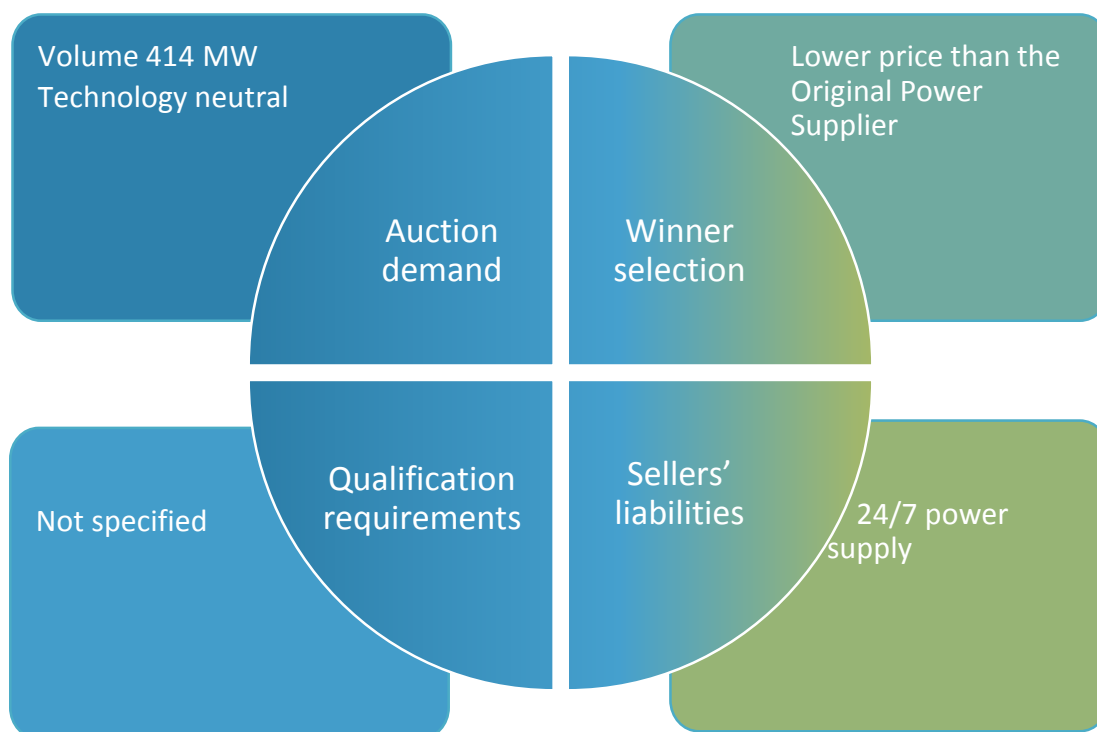


Hybrid auctions – the case of the Philippines

Objectives:

- ◆ 24/7 power supply
- ◆ Lower electricity tariffs

- The solar producer's offer came after Meralco's failed auction, with requirement that "the fuel for the generation of the Price Challenger must be the same as the Original Power Supplier, which is natural gas. No company was qualified to challenge the proposal
- Offered bid at P 2.99/kWh would allow consumers to save over 30% or an estimated P 75 billion per annum (compared to average of 3 months generation rate at P 4.74/kWh)



The way forward in planning and designing auctions

- ◆ Understanding the reasons behind the low prices is important to make informed policy choices.
- ◆ The value of renewable energy goes well beyond the energy services it provides. Therefore, trade-offs between cost competitiveness and other development objectives (such as jobs, industry development) should be carefully examined.
- ◆ Auctions may underestimate the true costs of renewable energy (e.g. balancing costs) or lead to overly aggressive bidding.
- ◆ Risks of underbuilding and delays can be reduced with solid contracts and penalties. Stringent compliance rules may deter the participation of small and new players.
- ◆ The extent to which the results are affected depends on choices regarding the design elements and how well adapted they are to the country's specific context (economic situation, maturity of the power market and level of deployment).
- ◆ The complex and dynamic environment of renewable energy auctions motivates constant innovation in the mechanisms' design.



Thank you!