Advanced Auction Design Elements

Navigant

November 20, 2019

Agenda

- Relevance of RE system-friendly procurement
- Global trends in RE system-friendly procurement
  - Time-based incentives and penalties
  - Aggregators (virtual hybrids)
  - Procurement of (physical) hybrid solutions
  - Locational signals

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System-friendly RE procurement minimizes both generation and system integration costs

Generation costs ≠ system integration costs

+	Investment and operational costs
+	Cost of capital (debt, equity)
=	**Electricity generation costs**
+	Grid expansion and upgrade costs
+	Balancing costs (including redispatch costs)
+	Provision of reserves
=	**System integration costs of RE generation**

System-friendly RE procurement considers both cost types in award decision, i.e.

- falling generation costs of RE, and
- the system costs and benefits of RE

System-friendly RE procurement is an opportunity to increase the uptake of RE

Based on situation & discussions in India

Matching demand curve

- Challenge: Changing demand patterns and trend toward higher evening peaks.
- Opportunity: Dispatchable RE (hybrids, storage) during peak time through higher tariffs/supply blocks following load patterns.

Mitigating grid integration/transmission costs

- Challenge: Grid constraints at the transmission level leading to congestion and curtailment or higher grid connection costs.
- Opportunity: Requirement for minimum capacity utilization factors (CUF), consideration of grid connection costs in bids

Reducing intermittency

- Challenge: Balancing of real-time generation shortages and surpluses.
- Opportunity: Procurement of more firm RE power, e.g. virtual or physical hybrids with higher CUFs (solar-wind + storage).

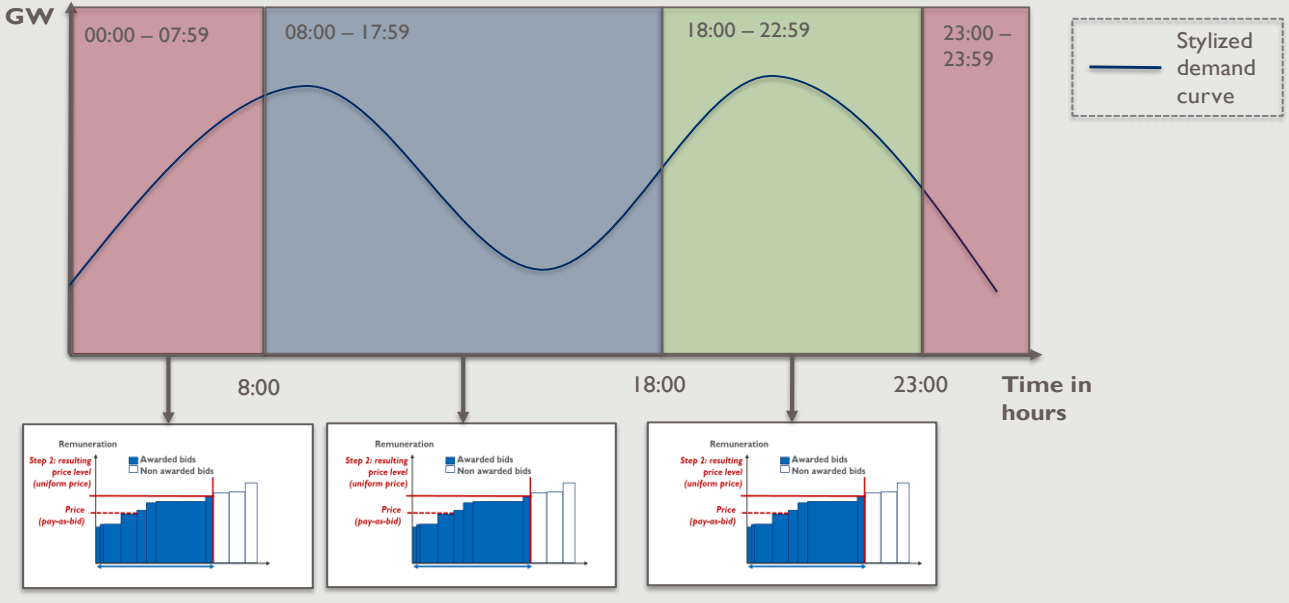
4 global trends in RE system-friendly procurement

1. Time-based incentives and penalties	Design options that incentivize RE generation to more closely match the demand curve (e.g. price adjustment factors, supply blocks).
2. Aggregators (virtual hybrids)	Several RE installations at different grid connection points are bundled and dispatched via virtual control systems. Virtual hybrids can thus feed in exactly as much electricity as has been purchased.
3. Procurement of (physical) hybrid solutions	Competitive procurement of RE electricity from installations combining technologies such as wind, solar, storage or dispatchable technologies with the aim of combining complementary generation profiles to offset technology-specific intermittencies and to reduce grid connection costs.
4. Locational signals	Locational signals aim to steer the location of projects to specific areas/grid connection points to avoid the concentration of projects in resource-rich but costly-to-connect areas.

Global trend 1: Time-based incentives & penalties

1. Time-based incentives and penalties

Design options that incentivize RE generation to more closely match the demand curve (e.g. price adjustment factors, supply blocks).



Global trend 1: Time-based incentives & penalties

Country experience: Intraday and seasonal supply blocks in Chile

This policy with time blocks enabled Chile to save on both its daytime and nighttime supply – and both times RE & storage were cheaper than thermal power.

Challenge	Allowing intermittent technologies to optimize their feed-in potential and guarantee supply to distribution companies.
Design Solution	• Supply blocks: Intra-day hourly (12am-8am + 11pm-12am; 8am-6pm; 6pm-11pm) + four 3-month blocks . • Supply block translates generation risk to RE producer → Production deviation are settled at spot-market prices.
Results	• In the technology-neutral auctions 2017, only RE projects won (2,200 GWh of electricity awarded). • Auction average price was 3.25 cents/kWh - lowest ever recorded in country. Lowest bids: 3.29 cents/kWh, for wind and 2.15 cents/kWh for solar • Non-RE alternatives more expensive: Thermal price 7.54 cents/kWh

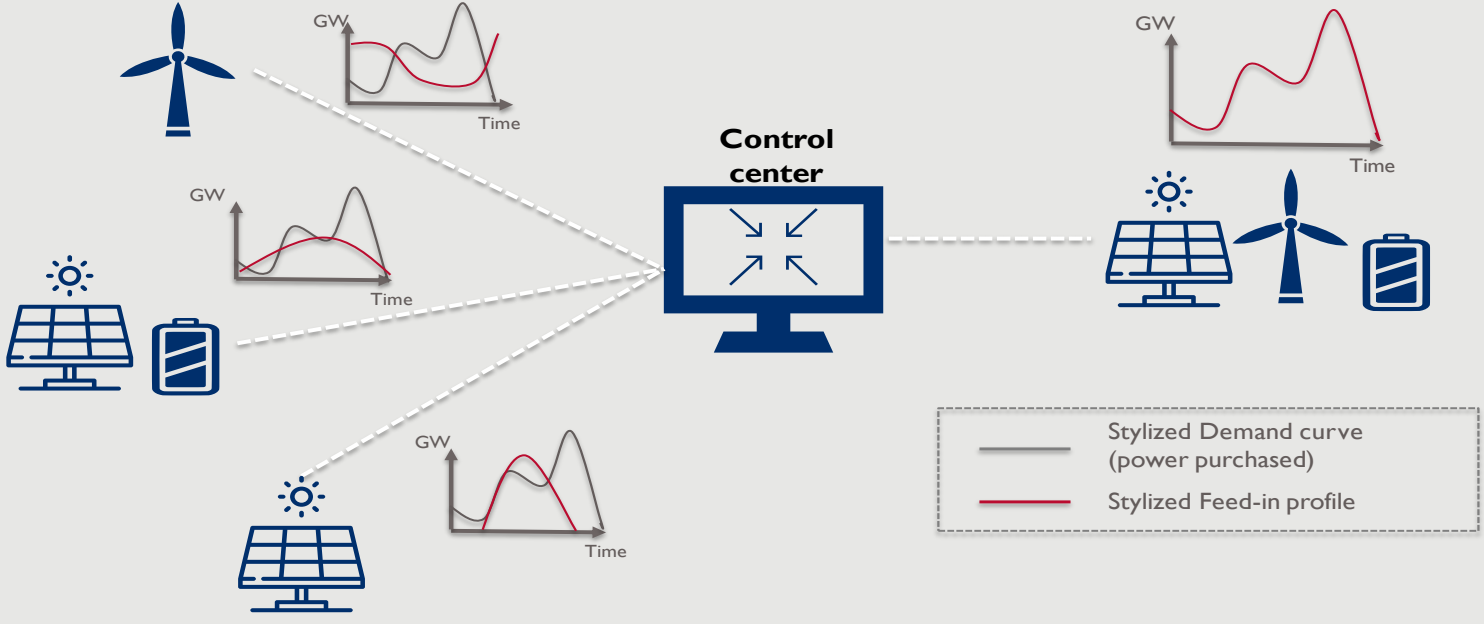
Global trend 1: Time-based incentives & penalties

Advantages	Disadvantages
Time-based incentives help matching RE generation with the demand curve, thus avoiding an inefficient & costly capacity addition pathway for utilities. Price adjustment factors offer financial compensation to RE producers for optimizing a supply that meets the demand profile. Supply blocks limit supply timeframe to time/season-specific demand, increasing producer long-term revenue certainty and encouraging intermittent RE generation to provide reliable electricity.	Compared to the wholesale market, (fixed) time-based incentives increase the risk of overcompensating RE electricity that will be less valuable in a few years. Adapting supply blocks and volume regularly could mitigate the risk of future mismatch between generation and demand profiles.

Global trend 2: Aggregators (virtual hybrids)

2. Aggregators (virtual hybrids)

Several RE installations at different grid connection points are bundled and dispatched via virtual control systems. Virtual hybrids can thus feed in exactly as much electricity as has been purchased.



Global trend 2: Aggregators (virtual hybrids)

Country experience:
Virtual power plant (VPP) "NextKraftwerke" in Germany

This policy enables the German virtual power plant to provide reliable, dispatchable power for balancing just with RE.

Challenge	Integrating smaller intermittent RE to provide balancing energy products to the balancing market.
Design Solution	• Digitally aggregating multiple decentralized RE of different producers into a single centralized control system • Different generation technologies (PV, wind, hydro, biogas etc.) are bundled to offset intermittency risks. This allows them to be forecasted, optimized and traded as one single power plant.
Results	• 2016: Provision of 67 MW as primary reserve, 67 MW as secondary reserve, and 1160 MW as tertiary reserve • This reduces provision of these products by thermal generation

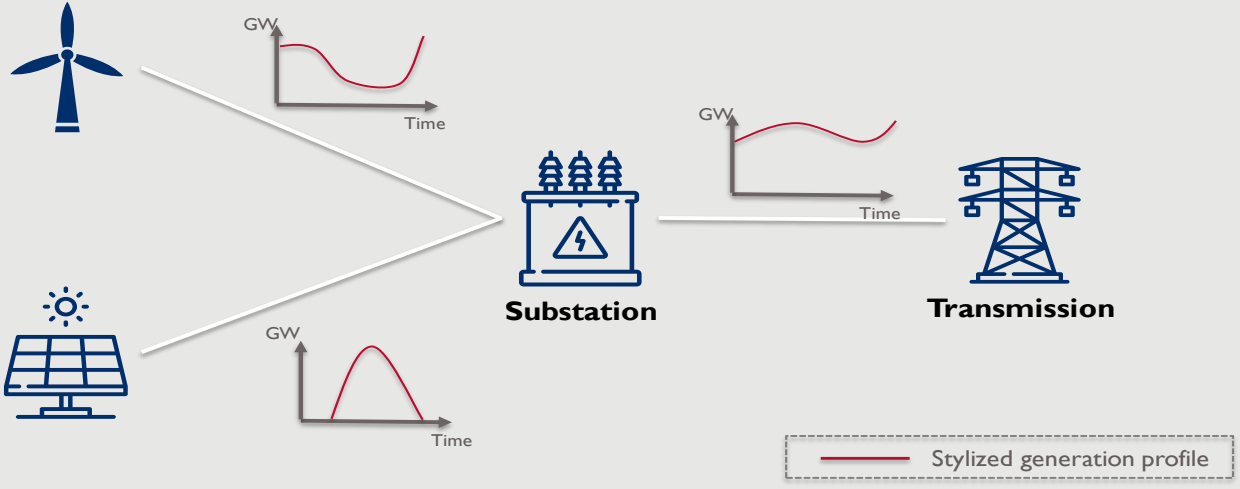
Global trend 2: Aggregators (virtual hybrids)

Advantages	Disadvantages
Possibility to sign shorter contracts with DISCOMs/institutional buyers, resulting in prices better adapting to changing demand needs and RE market prices. Enabling compliance with time-specific generation requirements or balancing.	Business case (e.g. to provide balancing services) is weak: So far, no dedicated ancillary market for private players in India. If virtual hybrids portfolio is composed of mainly shorter contracts, cost-covering bids from virtual hybrids will likely not be successful. Compared to physical hybrids, virtual hybrids do not lead to lower grid connection costs per each RE asset.

Global trend 3: Procurement of (physical) hybrids

3. Procurement of (physical) hybrid solutions

Competitive procurement of RE electricity from installations combining technologies such as wind, solar, storage or dispatchable technologies with the aim of combining complementary generation profiles to offset technology-specific intermittencies and to reduce grid connection costs.



Global trend 3: Procurement of (physical) hybrids

Country experience:
Hybrid procurement for firm energy in Thailand

Policy enabled Thailand to purchase dispatchable RE w/ guaranteed evening generation.

Challenge	Ensure a continuous supply of electricity even during peak hours, reduce intermittency of RE generation
Design Solution	• Peak: 100% contracted capacity, ± 2% tolerance range (Mon.-Fri., 9:00am-11pm) • Off-peak: 65% of contracted capacity, ± 2% tolerance range (at all other times) • Penalty: 20% of fixed tariff (FIT_f) component ($FIT = FIT_f + FIT_v$)
Results	• Volume offered: 755 MW (of technically qualified bids) against 300 MW demanded • Average bid price: 7.39 cents/kWh against a ceiling price of 11.09 cents/kWh • Technology: predominantly biomass with 258.7 MW, biomass-solar with 29.31 MW, solar + storage with 12 MW

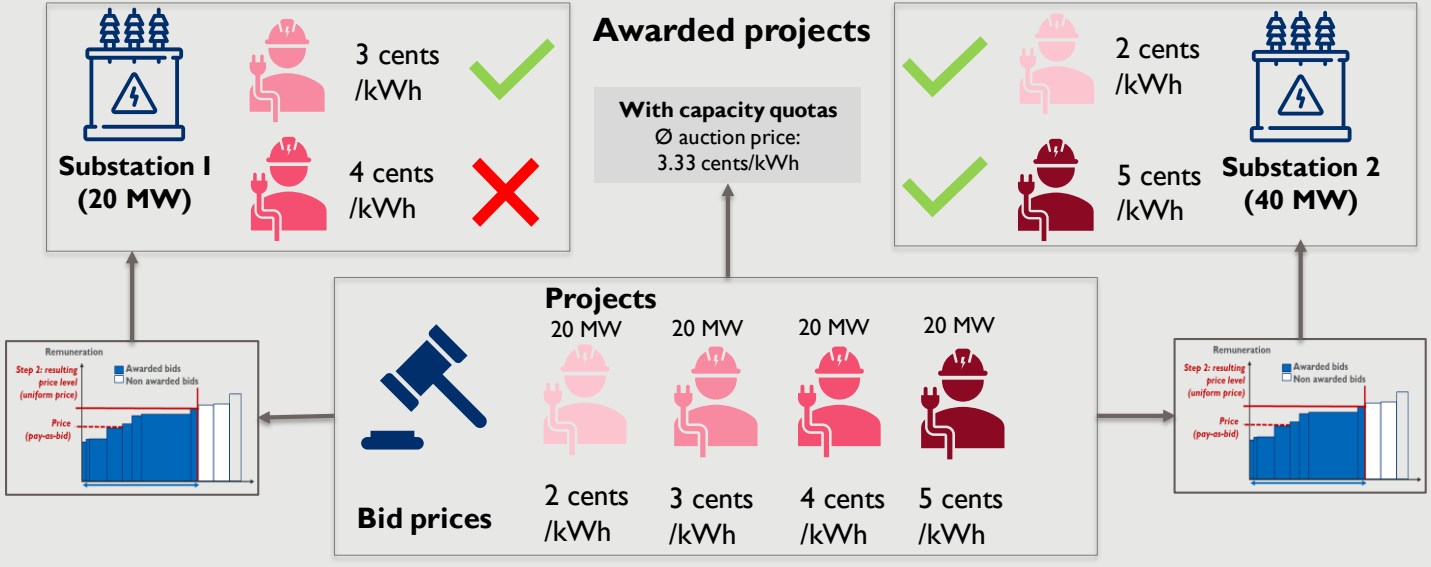
Global trend 3: Procurement of (physical) hybrids

Advantages	Disadvantages
More efficient use of land and grid infrastructure and higher CUF compared to single-technology plant. Savings on grid connection and transmission cost, since time-of-day generation patterns of wind and solar can be complimentary (Note: connection charges to Indian ISTS are high and waivers for RE expire in 2019). More balanced power mix for sale, given the lower peak-to-average power for the same hour throughout the year than for single-technology wind- or solar plants.	Correct parametrization of design elements for competitive procurement is more complex than in single-technology procurement (e.g. due to varying project development durations for solar & wind). Higher prices for hybrid procurement compared to single-technologies as grid cost savings in hybrids are not yet reflected in bids submitted by bidders.

Global trend 4: Locational signals

4. Locational signals

Locational signals aim to steer the location of projects to specific areas/grid connection points to avoid the concentration of projects in resource-rich but costly-to-connect areas.



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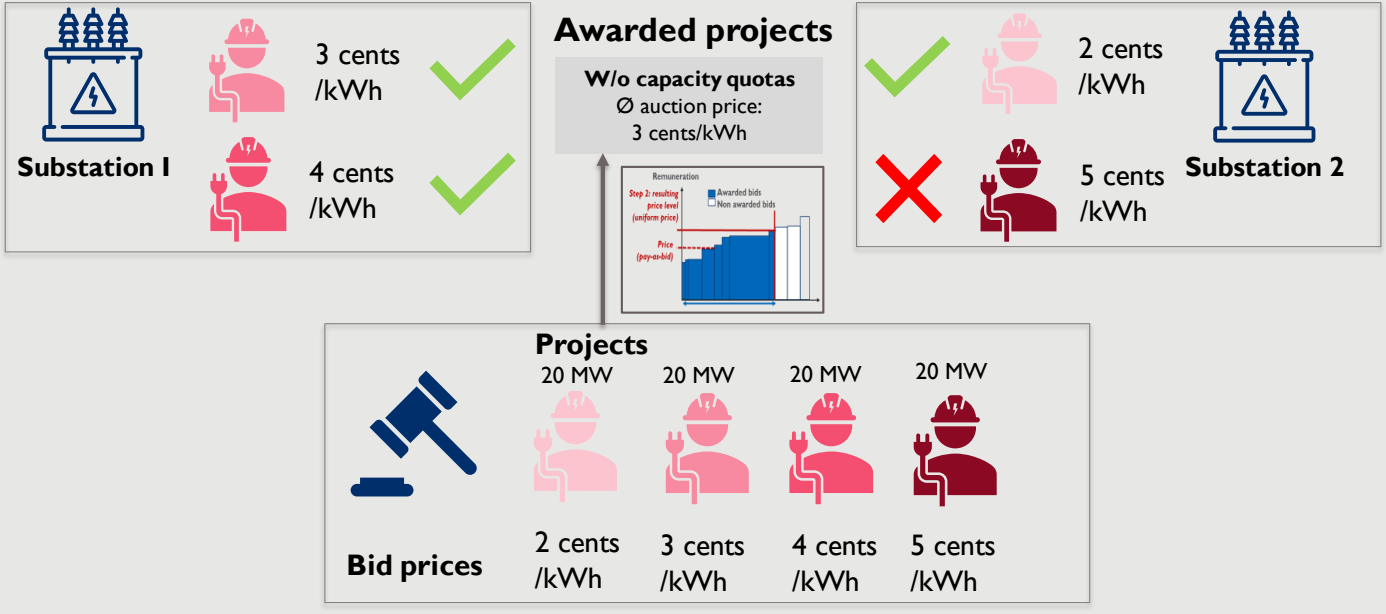
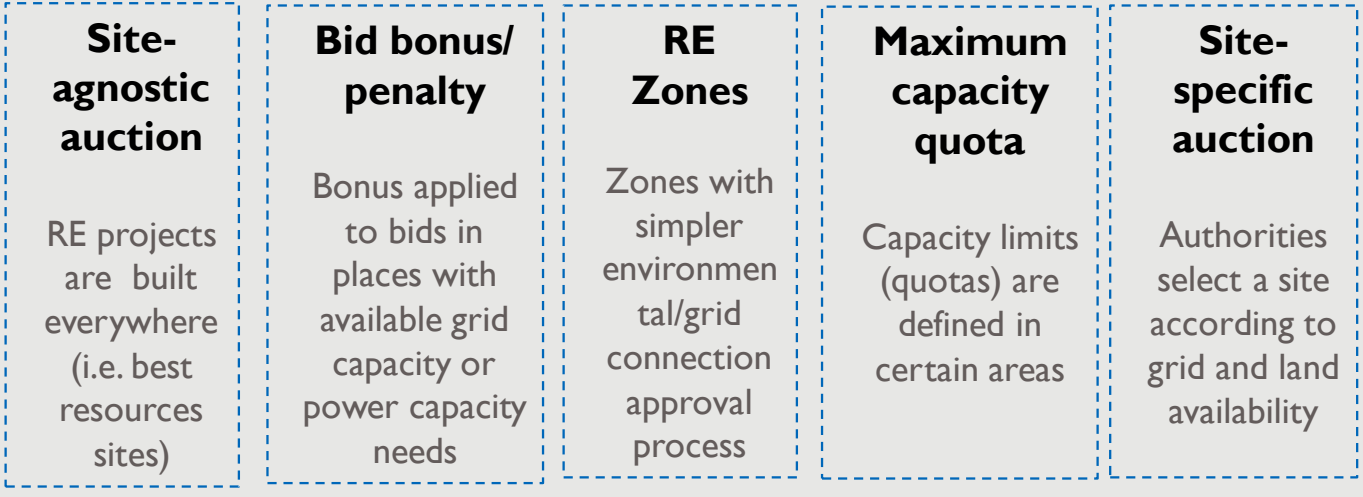


Global trend 4: Locational signals

Incorporating locational steering in procurement design



Global trend 4: Locational signals

Country experience: Capacity Quotas in Kazakhstan

This policy enables Kazakhstan to limit grid expansion needs to the minimum by using only already existing substations for its RE.

Challenge	Limiting new transmission costs from auctioned installations and ensure that the system can absorb additional generation capacity.
Design Solution	• Set capacity limits at mutiple nodes in the grid. Maximum capacity and number of possible grid connection points are communicated to bidders before the auction. • If bids for a node exceed the capacity limit, bids will be excluded in descending order of bid price until capacity limit is reached.
Results	• 857.9 MW of RE projects at nodes with sufficient grid capacities contracted. But: 7 rounds cancelled due to undersubscription. • Awarded technologies: wind (500.9 MW), solar (270 MW), hydro (82.1 MW), biogas (5 MW). Lowest awarded bids: hydro (3.5 cents/kWh), wind (4.7 cents/kWh), and solar (4.9/kWh).

Global trend 4: Locational signals

Advantages.	Disadvantages
Reduce total system costs by identifying an optimal trade-off between required grid extensions/ reinforcements and RE generation costs. Potential in allowing a faster deployment. Reduce the need for short-term grid extensions.	Procured prices might be higher when locational signals are applied. Effectiveness of location-specific and capacity quotas strongly depends on the capacity of state planning.

Thank you!

Comments or questions

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