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Capacity Market: possibilities for new generation entry and cost of CRMs

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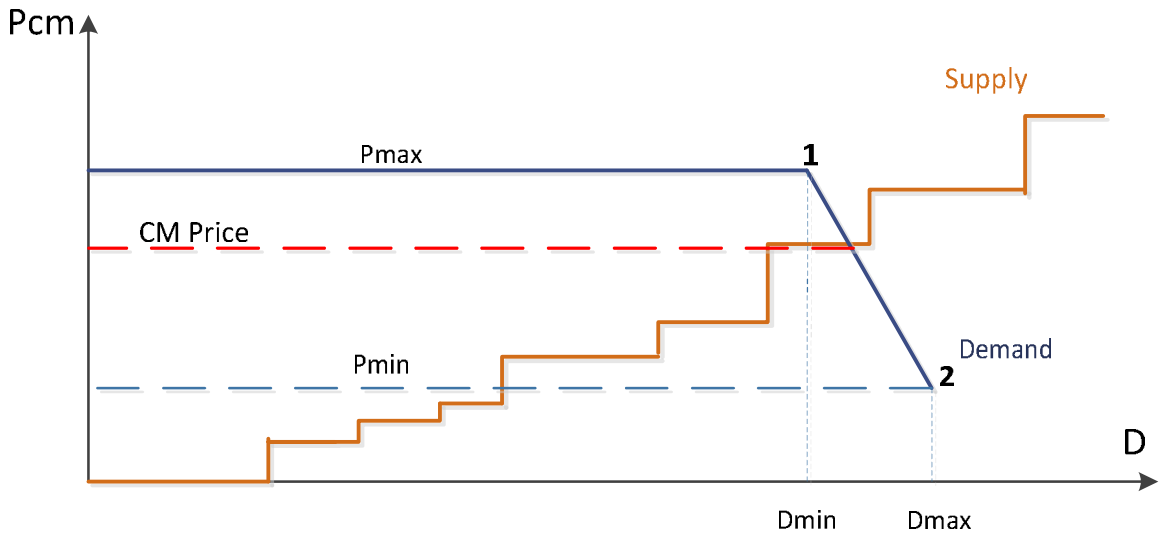
Capacity: Markets and Remuneration

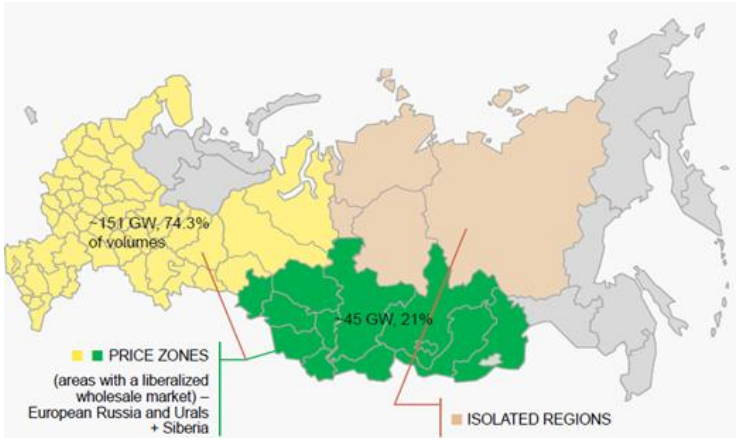
- The main objective of capacity markets or capacity remuneration mechanisms (CRMs) is to provide resource adequacy to the power generation system at reasonable cost
- Reasons: merit-order effect (developed countries) and incentive for investments (developing and transition countries)
- Focus on capacity auctions:

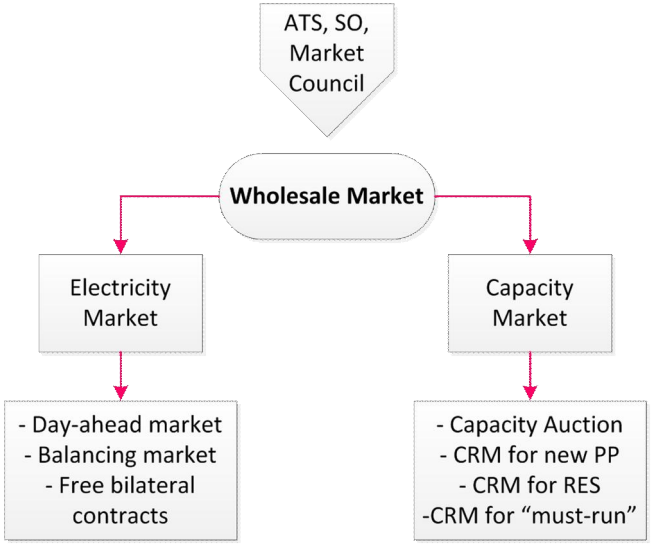


Capacity Auctions (UK, Russia)

Background on Russia's Capacity Market

- The power production industry of Russia was fully liberalized in 2011;
- Russia has two-commodity wholesale power markets: electricity and capacity (from 2008);
- Currently about 95% of the electricity produced is traded in the wholesale market, the rest is sold at the regulated tariffs (isolated zones);
- New power plants are constructed through Capacity Remuneration mechanisms (CRMs): Capacity Delivery Agreements (CDA) for 10 years;





Motivation & Research Questions

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- Long-term Capacity Auction (4 year-ahead)
- Sloping demand curve (to get rid of old capacity and ”must-run”)
- New Capacity Market rules should provide market based incentive for investment
- Renewable support is also provided through CRM
- Consumer capacity cost:

$$C_t^{consumer} = \frac{C_t^{total}}{D_t}$$

$$C^{total}{}_t = \left(D_t - \sum \left(V_{CDA,t} + V_{MRG,t} \right) \right) \cdot P_{CM,t} + \sum V_{CDA,t} \cdot P_{CDA,t} + \sum V_{MRG,t} \cdot P_{MRG,t}$$

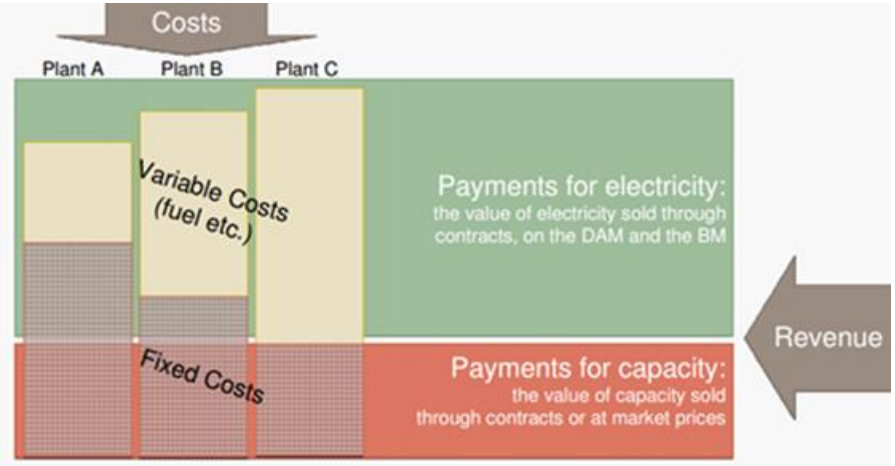
Research Questions

- Does market provide signals for efficient new generation entry?
- What would be final consumer capacity cost in future?
- How to ensure investments in new generating capacity?

Methodology

- Perfect competition is assumed in both electricity and capacity markets (two step cost-min model);
- Capacity market price is simulated for the 1st price zone of the wholesale market until 2027;
- Power producers bid their profitability gap in the capacity auction:

$$B_i = \begin{cases} \max(0; Fixed\ cost - Profit\ from\ electricity\ market)\ for\ existing\ generation \\ \max(0;\ Profitability\ gap\ in\ year\ t\ (NPV = 0\ when\ t = 30) \\ 0, if\ capacity\ under\ CDA\ or\ must-run\ generation \end{cases}$$

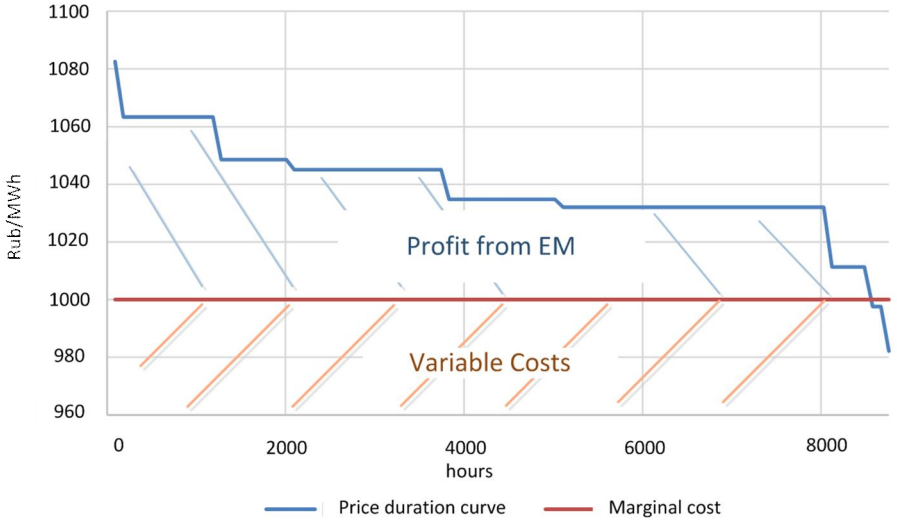


Electricity Market: profit

Price duration curve for the year is constructed to estimate profit from the electricity market for every power producer. Price is defined using linear programming for specific points of load duration curve (data 2015)

$$min \sum_f Q_{fT} C_f$$

S.t. $\sum_f Q_{fT} = D_T, \quad \forall T$



New power plant:

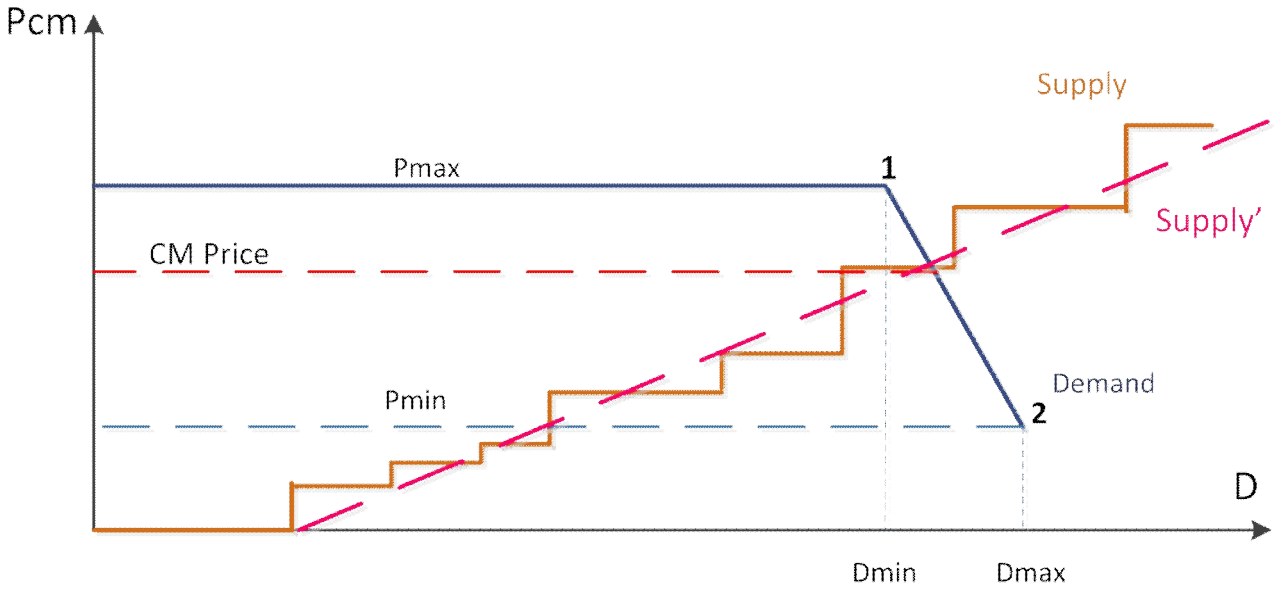
$$\pi_t^{NEW,gap} = \pi_t^{NEW} - \pi_{EMt}{}^{NEW} + C_{Fixed,t}^{NEW}$$

$$NPV^{NEW} = -C_{new} + \sum_{t=1}^{30} \frac{\pi_t^{NEW}}{(1+r)^t} = 0$$

Capacity Market

The capacity auction price can be defined using inverse demand function (F) and inverse supply function (S) based on the bids of power plants

$$S^{-1}{}_t(B_i) = a_{1t} + b_{1t}(B)$$
$$F^{-1}{}_t(D) = a_{2t} + b_{2t}(D)$$

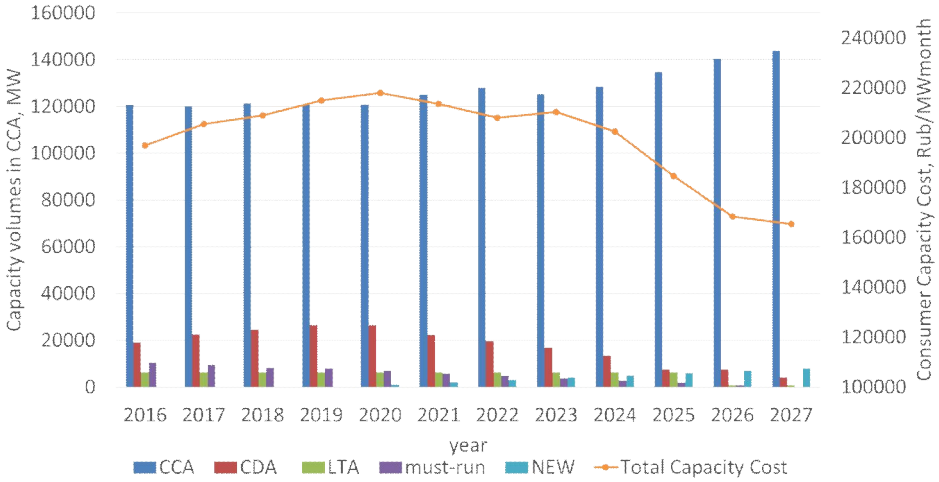


Assumption: Supply'=Supply

Results

Scenario 1: no CRMs for new power plants after 2020 – no investments in new power plants.

Scenario 2: CRMs only to replace must-run generation (MRG)



Conclusions

- Market does not provide signals for new capacity entry without CRMs due to oversupply of old capacity (including MRG and capacity under CRMs) and low price cap;
- Market does not provide signals for the old capacity decommissioning, high price floor allows power plants to cover their fixed costs;
- The capacity payment period for the most of CDA will end by 2027, resulting in consumer capacity cost decrease;
- Total capacity cost can be reduced significantly when the new capacity is constructed under CRM replacing MRG.

Thank You

Questions?