

## Electricity Markets are Getting Ever So Complicated

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\* Ideas presented are personal ideas only. No institutional ideas/viewpoints/policies.. This document is for discussion only, no policy proposals are aimed

For sometime without thinking about “what is going wrong”, electricity markets are patched with one solution after another. I fear this will end up with a major upgrade to the underlying economic theory, physical flows, and -suprisingly enough- dethroning of AC(alternative current) by DC (direct current).

### **Rethinking Economic Theory**

The main problem is, what most people associate with liberalism- electricity market mechanism is the uniform marginal pricing with merit order system. Simply, it is a system, where all generators bid their production and the marginal price corresponding to the demand is set and given to generators uniformly.

The underlying assumption is, the bidder have the control over a certain MW of capacity -firmness- at a certain time to deliver if his bid is accepted. However if I do not have control over that capacity but merely assuming I may deliver such amount if sunshines and wind blows, the whole system gets disarray. Because I am more of a speculator – since I do not have control over that resource- than a rational agent.

There is a solution to that flaw. If I have an associated storage capacity, I may well satisfy the underlying assumption to have a firm control on the capacity I bid. This means, a renewable resource with a premium for storage can have the same qualifications to compete with in a merit system. Otherwise whole system will generate a price signal deficit of firmness premium. As system operators try to fix this problem with more capacity related mechanisms.

### **Price Models to be localized**

Most of the price forecast models are based on the merit order system. These models generally use a mathematical dispatch system to find the marginal price for every hour for a certain period. However, despite being close to market posted prices, these forecasts hardly encapsulate the full dynamics of ancillary service revenues.

It is always possible to correct the models with another ancillary service models. This means that you are actually trying to calculate constraints and in a way some sort of LMPs, locational marginal pricing. So the improved model that will give the less distorted price outcome should incorporate a calculation for LMP. LMP doesn't reflect the ancillary costs but signal the need of such services.

### **Myopic Forecast Horizon**

For a rapidly developing country like Turkey, when you built the model, you have a certain confidence in the installed capacity to be commissioned. Generally getting all the permits and building the power plant takes 4-7 years. It is safe to assume that 5 years is an acceptable period.

However, the problem starts with the solar capacities. There are less permits, it can be built close to demand centers and can be constructed in less than 2 years. If it is small scale, time scale is further

shortened. When someone sees the amount of solar capacity commissioned around the world, in 5 years there are at least 2.5 cycle for solar investments.

What this means is that, the mismatch the forecasts have in 10 years will happen earlier. Assuming how easily storage can be integrated to our systems and EV cars on the demand side, the good old school of long term forecasts are doomed for more failure.

## **Interconnections**

Since price models are distorted and forecasts are myopic, what happens next is the need for transmission lines get highly questionable. This is exactly what has partially happened in UK market. The rapid growth of distributed resources (DER) resulted with less utilized transmission capacities. This is contingent on the distance between supply and demand points.

The rationale behind interconnections is the centralized system with bulk power systems exchanging flows or electric fields. If high level flows are dampened by the distribution level flows, the distribution level interconnections become more important than transmission level interconnections.

## **How Transmission and Distribution will be differentiated?**

By voltage level of course. More people claim distribution system operators will work as a miniaturized transmission system operators, voltage level and services for that voltage level can be identical across high and low voltage networks. So the main differentiator will be the topology of the network as [Arriaga](#) claims.

Transmission is more meshed, distribution is more of a radial network. But will this topology survive the new reality? It is a question to be discussed

## **Solutions are more problematic**

There are lots of discussions going around regarding a new market design. The easiest patch, I found attractive is to split the market into two as “on demand”, “on available” market until economical storage systems arrive.

However recent literature on DER and their integration, gets the things much more complicated. There are lots of services and DER users should select among these services according to their needs. Partially it resembles mobile tariffs, like if you want SMS, or more data or minutes price change accordingly.

Or you can buy a packet of services for a fixed cost. This is understandable and much more economical for the final user. The problem is how to price all these services in the operational level. How many pricing systems DSO or TSO have to run to get a price per kWh, or fixed cost?

There are network level and energy level services in energy. If every service should be commoditized, the markets get more and more complicated, open to more gaming and misallocation. The efficient market becomes a burden by itself.

## **A Forecast to be Regretted**

From my point of view, electricity markets generate outcomes further away from the reality. What has to be the price of electricity if it was a very efficient, benevolent monopoly? Let's call this price with a silly name called natural price. What is the price markets are generating now? Published

price. As published price falls further away from natural price, current electricity market solutions generate new services, commoditize these services and tries to generate cash flow to get the published price plus other prices close to natural price. This is a very rough assumption, I admit.

With all these services, markets, pricing instruments, DC system makes sense more and more. It is easier to operate, more efficient for storage and solar as well as EV cars, easier to control and manage. AC may have a future for hundreds of years to come, but getting more transaction costs and requiring more transactions to sustain a system can make everything inefficient beyond our forecasts.

But for the rest of the problems, there are couple of solutions:

1. Calculate a firmness premium for renewables and run the merit order afterwards
2. Calculate LMP hourly and aim for 15 minute-LMPs and increase the resolution to distribution level
3. Predict variability instead of certainty
4. Interconnection planning should incorporate DER resources
5. Think beyond voltage levels
6. Accompany transaction costs in commoditizing electricity services