Three Questions on the Future of Electricity Markets

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Today, the world's energy system is moving more and more towards a massless energy system, namely an electrified energy system. In the past, a passenger used 4-10 kg of petrol to move his car 100 km. Now, with the advent of electric cars, we can move our electric cars without using any mass. As a thought experiment, we can imagine a 100% solar energy system powering the entire economy: No mass will be consumed, but cars, metros, motors will move masses, that is something interesting.

So it is important for us to rethink electricity or energy supply. It doesn't have to be about changing the weight and position of a mass. At a fundamental level, all energy systems are about 'the ability to change the existing order' and 'the space-time shifting of that order potential'. This may seem like advanced physics, but it is not.

Energy is not about creating action, a digital bit in a transistor can be turned on/off without any action. Space-time shifting basically means that transmission lines shift the ordering potential of resources to another geography or position. Time-shifting capability is about storage. In all energy resources, these three keywords are essential: Order-Space-Time.

This very confusing explanation is important for us to understand what is next for electricity and electricity markets. How do we value order, space and time shifting, how do we bundle these services? How do we generate, move and store energy?

In practical terms, it is more efficient to focus on 3 key questions about this future.

1.How to merit order generation from three identical solar panels?

We can call this the "three-panel problem". If there are three identical panels producing electricity at the same distance from the point of consumption, how should they be ranked?

Electricity markets and prices are "social constructs". When mass is consumed, it is preferable to rank mass to energy conversion efficiency to create a price construct. In a very ideal world, perhaps a price construct from bilateral trade surveys might be a better indicator. But in a thermal generation world, mass consumption efficiency is one of the choices for an answer.

In a practical operating schedule, the system operator knows how much generation he has and how much demand he will have with an estimated probability. As more energy is consumed in the form of electricity, the probabilistic nature of electricity markets will explode. Renewables will require more grid infrastructure, so the geographical distribution of lines will increase. They will be more vulnerable to weather events. There is no need to discuss the probabilities of solar and wind capacity factors. The whole system will be more dependent on the weather.

In an operating mode with more renewables, there is no merit order(zero marginal cost) as there is in thermal generation, but there may be a bid-based merit order. So prices will be more artificial than before. But there may be another solution.

In a three-panel problem, there is a solution if there is more or equal solar generation than demand. In one solution, panels should bid their curtailment costs. The lowest curtailment cost bid can be translated into "the right to join the next day's schedule". Any generation that is higher than the demand will not be in the system if its bid for the cost of curtailment is higher. If the cost of curtailment is really higher for this generator, it should invest in storage that justifies such high costs.

2. What will the electricity market be like if we had storage for one day's electricity production?

The original question was "Türkiye consumes 1 TWh of electricity per day, if we could store 1 TWh of electricity, how will the system look like".

In the electricity market, the system also tries to reflect the "real time premium" of electricity generation. Electricity, like "light", is more about electromagnetic waves than masses consumed. So the system is really a "light" or "radiation" market. Since you cannot store it, you create or transform different elements to provide the quality service.

When battery systems began to proliferate in the electricity system, one of the major developments was the creation of more "ancillary services" and then as battery systems increased they started to cannibalise revenues from "ancillary services". A technological solution to "real-time risks" will destroy most of the existing market solutions. It may be just like electric power trains destroying the gear systems in petrol cars.

But a practical energy system has a balance between space and time risks. The petrol supply chain is an example of such a system. There is storage in crude oil tanks, in refineries, in product storage, in petrol stations and in cars. There is a layer of "time shifting" tools or services to reduce "real time risks" in this system.

Therefore, a practical energy system must have layered (like an onion) space-time services. What this means for electricity is that storage has to be in all layers (transmission, distribution, demand), its size will depend on value and cost.

But the real question is how to get there and what kind of electricity market transformation needs to happen?

If we agree that the future electricity system will only abstractly resemble the petrol supply chain, progress in electricity markets will not be linear. Up to a peak there will be more services (better gears like cars), but after this peak even daily pricing will work. Therefore, more detailed and more frequent pricing may not be necessary.

3. What do consumers want?

This question is at the heart of electricity demand services. From a practical point of view, in electricity, consumers may not want more detailed tariffs that are envisaged by studies. The consumer is like the electron who does not want the hard work. An "iPhone" like smart device and a "Google" like search engine will work better than frameworks that present more options. This "abundance of options" can backfire and make the consumer more unhappy than before.

In the system explained earlier, if a consumer has a storage service at the point of consumption, he may not care about detailed tariffs. This brings us to the optimal framework for consumer welfare. This could be a subscription service for home storage. If this is a system that will become popular, the meter will no longer be a meter or a smart meter, it will be a meter bundled storage service.

The storage rental/subscription service will be shaped by customer preferences for "quality of service". Therefore, there may be no need for different pricing of kWh's or different tariffs for different quality needs. The consumer will buy energy and adjust the required quality with their storage subscription, with multi-dimensional tariffs. This will enable bulk tariffs just like mobile tariffs.

Conclusion

The future can never be known, it has to be invented. Invention requires more trial and error. The final destination is a moving target, especially in energy.

In the commentary, 3 questions with personal answers were discussed. The transition from a mass-based energy system to a massless energy system requires thinking on a different level. More "reforms" will not solve or advance a system in transition, because the path is not linear.

The best approach for future electricity markets is to deploy more storage to accelerate other developments. If storage progress lags behind, the system will become a patchwork of patchworks.

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