VIEW POINT

DATA ECONOMY IN ELECTRIC POWER UTILITIES

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Executive Summary

Electric utilities industry has always played a key role in our society and economy. To be able to serve their stakeholders better, utilities have always adopted newer technologies focused on improving reliability of service delivery and bringing down the costs. An analysis of last two decades reveals three distinct waves of transformations seen in this industry.

The first wave of transformation established a solid foundation of data where utilities started collating large volumes of data, although, the data remained in silos within each utility until very recently. While the second wave added some new sources of data, a significant focus shifted to creating insights from data collected and using then for a wide range of applications ranging from improving the operational efficiency of the grid to improving energy efficiency through behavioral nudges. In the recent years, advancements in technology combined with global push towards a sustainable environment is ushering in a new wave of transformation that will displace the traditional role of utility as the sole electricity provider. In the new paradigm, a distributed energy system with characteristic highly variable energy resources and bi-directional energy flows is emerging, where large number of renewable energy producers, storage providers and prosumers (entities that will produce as well consume electricity) will co-exist with the traditional players of the utilities industry.

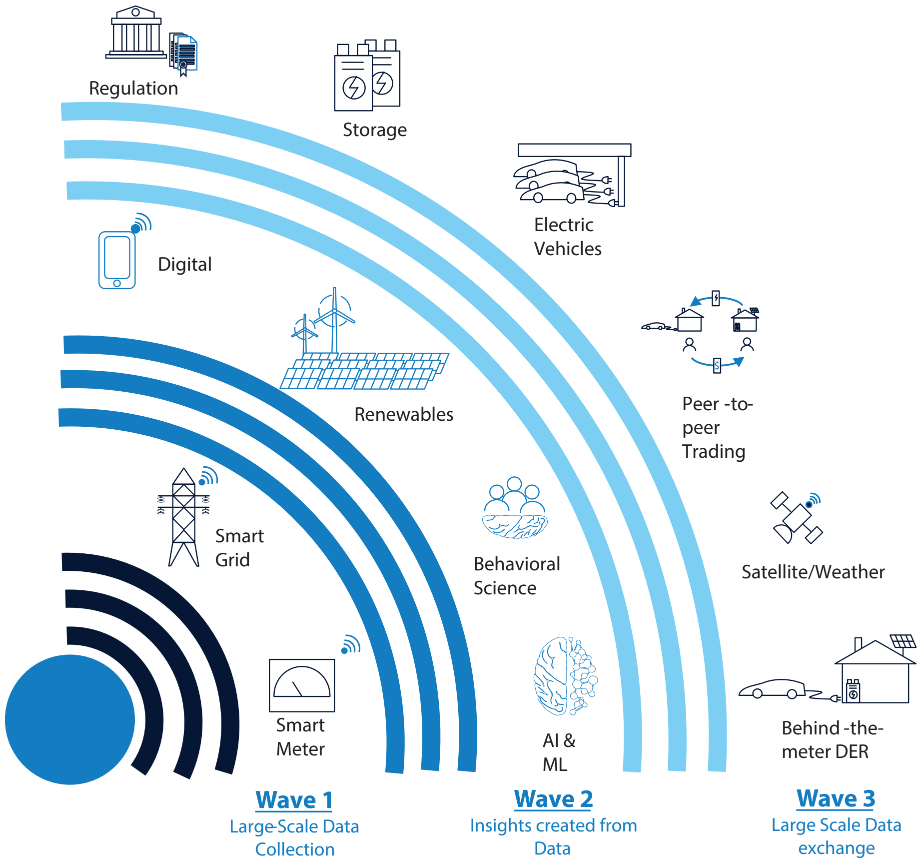

Fig 1: Evolution of Data Economy in Utilities

In this point of view, we will analyze the emerging economy where data plays a critical role in designing, implementing and operating the new distributed energy system that will operate across national and sub-national boundaries. We also provide our recommendations for building robust, scalable marketplaces that utilities will need to manage the exponential increase of trading in data, and complex real-time data flows across a large number of entities.

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Context: Transformation in Electric Utilities

Electric utilities have traditionally focused on improving reliability of operations and providing better customer experience. Now technology-led innovations in the supply and demand side of the industry is going to disrupt both the economics and the operating model of the industry as a whole. Apart from technology-led transformation, global awareness on sustainability is driving significant regulatory changes in the industry to drive higher adoption of renewable energy sources. Some organizations and government bodies[1] have set aggressive carbon-footprint reduction goals for themselves.

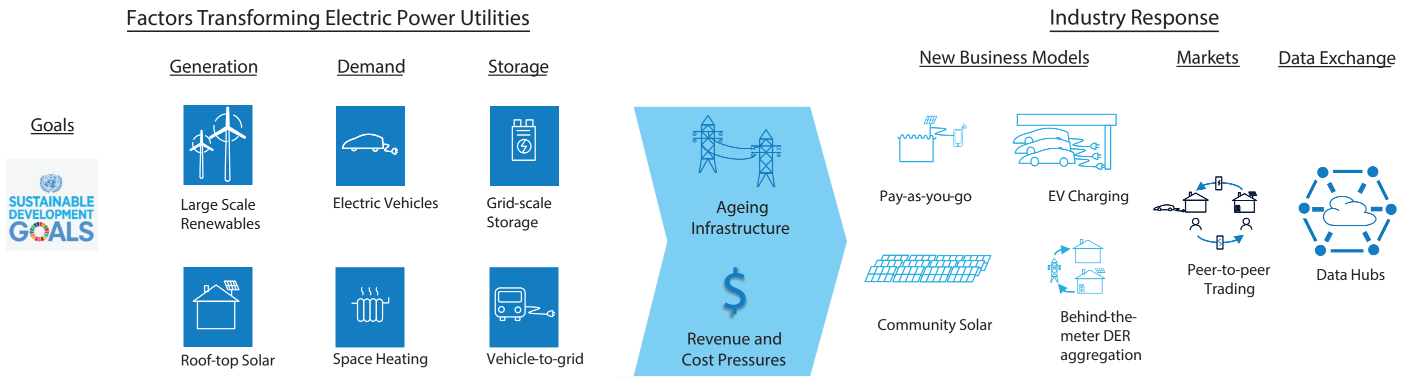

Fig 2: Transformation in Electric Power Utilities

Many new participants have emerged in the electric energy ecosystem due to the changes sweeping the industry. On the supply side, increasing number of generation alternatives are coming from large-scale renewable energy generators[2], roof-top-solar[3], grid-scale batteries[4] and vehicle-to-grid technologies[5]. On the demand side, while energy efficiency initiatives are driving down consumption from existing sources, new demand is growing from electric vehicles and increasing use of electricity for space heating.

New business models, like community solar initiatives[6], pay-as-you-go models[7], electric vehicle charging[8] and aggregated behind-the-meter storage[9], are emerging in the industry to extend the reach of new technologies to a larger population and maximize the usage of renewables and storage. To help small and mid-scale energy producers monetize their excess energy produced, innovative peer-to-peer trading platforms[10] are also coming up.

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Data and its growing relevance

With the rollout of a wide range of new technologies, both on the grid as well as behind the meter, we are now seeing a sudden emergence of a large variety of data sources and an exponential rise in the volume of data generated by them.

To ensure reliability of an electric power delivery system, it is very critical that any new technology introduced in the system is able to communicate seamlessly with the other parts of the system. To enable communication between different types of entities, system operators and regulators are looking at standardized data exchange formats. Regulators are leveraging industry standards for drawing interoperability recommendations for specific requirements like DER Aggregation[11] or Vehicle to Grid integration[12]. We find that some utilities have started piloting interoperability frameworks, covering multiple entities, with some encouraging results[13].

With the availability of wider range of data, new use cases are emerging in three broad areas: planning and siting new services, managing and optimizing operations and data monetization for 3rd party consumption.

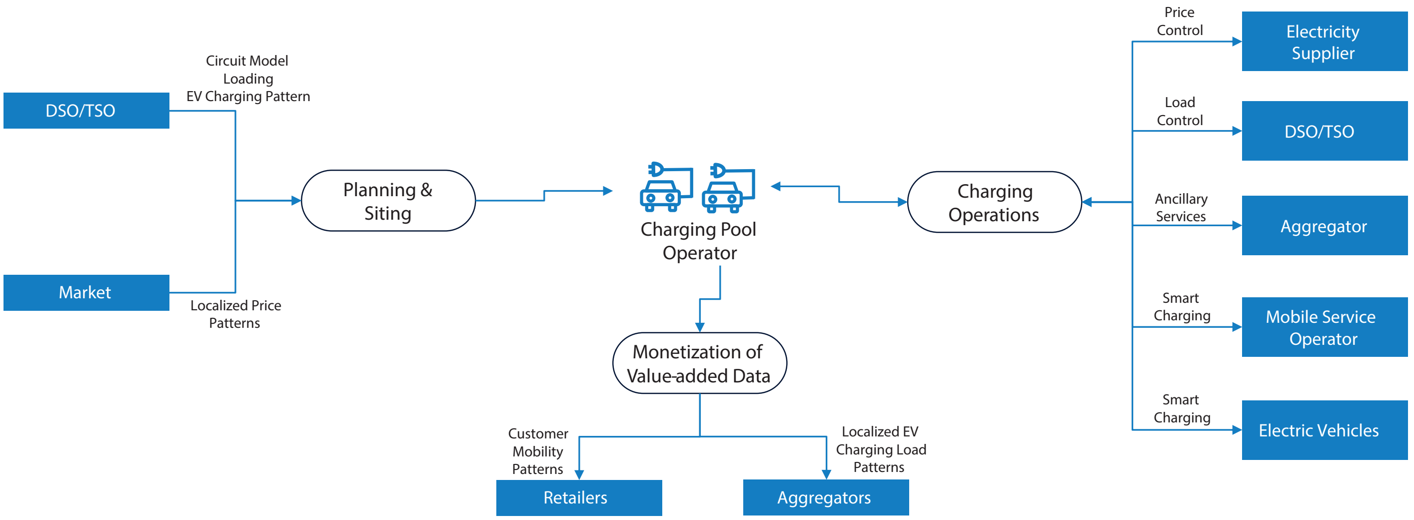

Fig 3: Sample Use Cases – EV Charging

For sharing information across entities, we find that two models are emerging in the industry. At the narrower end of information-sharing spectrum, Utilities are creating specific interfaces for disseminating a specific type of data, e.g. Smart Meter data[14] or Smart Grid data[15]. On the broader end of information-sharing spectrum, to manage the exchange of large volumes of data across different entities, we find that many Transmission System Operators (TSO), Distribution System Operators (DSO) and other central bodies are setting up data hubs[16].

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Need for a Marketplace

Currently, we can see that the electric power industry is going through two independent developments. On one hand, we find that new active participants are entering the energy markets. On the other hand, we find electricity data hubs are coming up at national and regional levels to enable seamless data exchange between different entities.

In the current scenario, we find that commercials trades are limited to electric power. Outside the utilities industry we already see commercial value attached to data typically consumed by utilities industry, like weather or satellite. With the increasing exchange of data within utilities industry, we expect that stakeholders in the utilities industry will realize the value of data generated by them and a market will evolve that will not only enable exchange of data but also help them monetize the data.

To manage these complex transactions the utilities industry will need a robust data marketplace that enables a data economy encompassing the current utilities data hubs and other commercial data sources outside the industry.

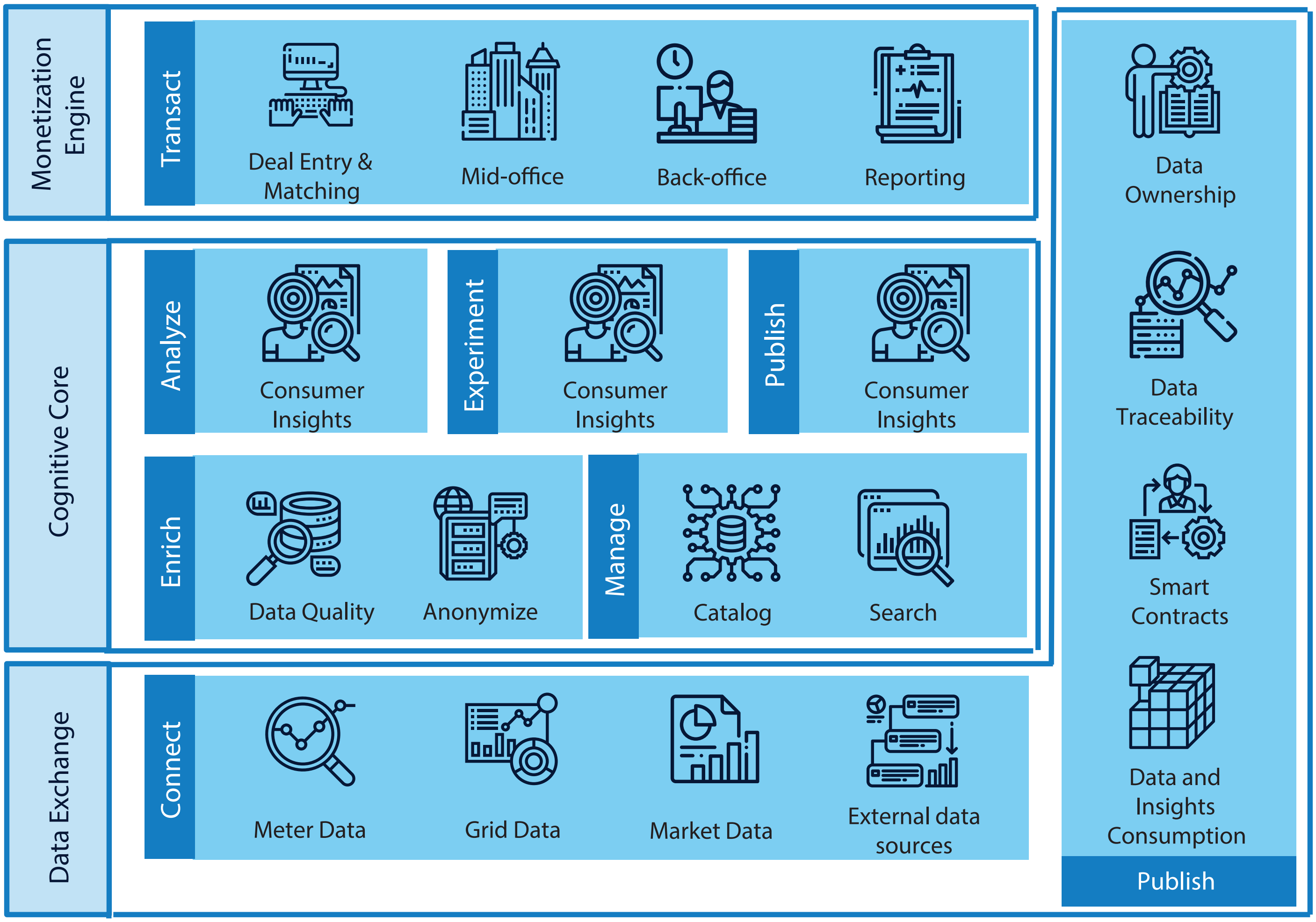

Fig 4: Architecture – Electric Utilities Data Marketplace

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Being a highly regulated industry, a utilities data marketplace will need to comply with specific regulatory and operational requirements. One of the key aspects we need to address pertains to ownership of data and the right of the owner to control the use of data. We can explore Blockchain technology[17] to establish the needed data ownership and ensure traceability of data for our marketplace solution.

Electric utilities deal with high volume of data and they take quick operational and market decisions based on data. Our utilities data marketplace should be able to deal with large volumes of streaming data and bring intelligent insights in real-time. A Kafka or Apache Beam based streaming analytics framework can provide a scalable solution for this requirement.

Currently we find that most entities in the Utilities industry have their own Data Science teams working in isolation on a limited set of data and platforms. The marketplace will create a Cognitive Core that will add value to the data collected by the platform. It will offer a breeding ground for innovative insights coming from Data Science teams across organizations by providing an experimentation workbench and an insights marketplace for their solution. We can explore Data Science Workbench solutions from cloud providers or custom-build workbench based on open source frameworks for providing this capability on the platform.

The Monetization component will help sellers of data and insights interact with the prospective consumers of their product. It will leverage the cognitive functions to help sellers to add value to their data products and buyers find the right data and insights for their needs.

At the end, the marketplace needs to provide secure, fast and reliable access to data and insights on the marketplace. We need to build a comprehensive consumption solution that meets the complex requirements of the industry while maintaining ease of use.

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Conclusion

Electric utilities need to implement intelligent and scalable marketplaces based on established functional models and technical frameworks that can integrate newer participants in future. Flexibility and reliability are the two foundational elements that will decide the adoption and success of the marketplace.

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Notes

[1] Many governments have set very high and accelerated goals for renewables. E.g. States of Hawaii and California are targeting 100% renewables over 20-25 years, More than 200 Mayors in the US signed up for 100% renewables by 2035.

[2] Solar and Wind power is already contributing to more than a quarter of total energy in countries like Germany, Spain, Portugal, Denmark and Uruguay. World's largest Power systems of China, India and US will also have more than 10% of their total electricity coming from Solar and Wind power in next 3-4 years.

[3] Regulators are pushing for faster adoption of renewables. e.g. all California new homes will need a solar panel from Jan 1, 2020

[4] Multiple large grid-scale battery storage projects are coming up. Some examples: Hornsdale Power Reserve Battery Energy Storage System :World's largest lithium-ion 100 MW 129 MWh battery built by Tesla using Powerpacks. Stores excess energy from a Wind Farm. Provides supplies for commercial operations in Australia's National Energy Market and provides critical power system reliability service for the South Australia power system. FPL Manatee Energy Storage Center: The 409 MW/900 MWh energy storage will be coming online in 2021. It can power more than 300 K homes for more than 2 hours and will be the largest battery system.

[5] Nissan and Enel ran a pilot that uses Vehicle-to-grid (V2G) technologies to allowed EVs to draw power as well supply power to the grid. Consolidated Edison is conducting a V2G pilot with electric-powered school buses during summer months. Multiple other pilots are going on e.g. Nuvve (US), San Diego Gas & Electric (US), Parker Project (Denmark), ELBE (City of Hamburg, Germany)

[6] Community solar projects are picking up fast as an option for energy consumers with no provision to install solar panels. Some example projects are: SolarTogether(1490 MW, 20 Solar plants from FPL), Crow Lake Wind Project (162 MW), Prinses Alexia Wind Farm (112.3 MW, 88000 households)

[7] For people staying in remote locations where there is no access to grid, Pay-as-you-go model is a very attractive option to generate power and consume locally with no prior capital requirement. Some of the companies offering this model are Solaris Offgrid, BBOXX, Plug-the-sun RAYGO , Azuri Paygo Energy.

[8] Electric Vehicle Charging is a rapidly growing business across the world. This is evident with multiple Oil & Gas majors, like Shell (Greenlots) and BP (Chargemaster and Polar network), investing in this area. Similar investments are coming in from Utilities as well as vehicle manufacturers. Different business models are emerging like charging at home, charging at specific facilities (like supermarkets, community centers, large business centers) and charging at major transit points (like key arterial roads in cities or highways).

[9] Aggregating and managing supply from behind-the-meter storage has been a key initiative at many Utilities and can become a critical supply component on the distribution network. This model is now operational in some regions and many more are running similar pilots. Some examples are: Sonnen provides grid services to a German DSO by aggregating home storage systems across 30000 networked homes. CrowdNett, from Eneco Group in Netherlands, creates a Virtual power plant from BTM batteries. Green Mountain Power's Tesla Powerwall program will use BTM batteries installed at customer premises.

[10] Brooklyn Microgrid was the first such experiment with the first transaction done in April 2016 using LO3 Energy's TransActive Grid measurement technology and Exergy platform. Power Ledger has been running similar trials in Australia. Verv has tied up with Centrica to run community energy trials that will aim at reducing customer bills through peer-to-peer energy trading using blockchain.

[11] IEC 61850 and IEEE 1547 are the two key standards adopted for interoperability between Grid and DER resources.

[12] Communication for vehicle to grid integration typically involves multiple standards like IEEE 2030.5, ISO 15118, OpenADR 2.0b and OCPP 1.6. A recent recommendation paper from California Public Utilities Commission provides a detail analysis of the use cases supported by these protocols.

[13] With OpenFMB, Duke Energy has been able to integrate solution from 25 vendors spanning assets like solar system with smart inverters, carport with EV charging, load-banks, battery storage, automated distribution grid equipment, wireless devices, envision room smart breaker monitoring and control devices and operations room with commercial applications. Consolidated Edison's Secure Interoperable Open Smart Grid Demonstration Project (SGDP) has delivered similar positive results.

[14] Customers are able to access their own energy in some countries. Some of the regulatory initiatives enabling this are: Green Button initiative in the US, midata in UK and Powerfox in Germany.

[15] Many utilities are sharing smart grid data with their customers or new project developers to help them identify potential locations for siting new generation capacities. Hosting capacity maps from utilities in New York State is one such example.

[16] Typically, TSOs and DSOs are managing the datahubs in most markets, Scandinavian countries have adopted TSO based datahubs like Fingrid in Finland, Danish hub operated by TSO Energinet.dk, Norwegian Elhub and Swedish datahub operated by Svenska Kraftnät. In Belgium, five DSO have created a JV Atrias to setup the datahub. Electralink in UK operates the Energy market data hub. It is important for energy markets to develop similar data hubs across all geographies to ensure smooth exchange of data.

[17] Blockchain is proving itself as an essential technology for implementing Transactive energy solutions. LO3 Energy and WePower are leveraging Blockchain on their trading platform.

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