Energy system digitalisation

Today's power markets are designed for centralised power plants providing electricity in bulk to users with predictable and stable consumption patterns. However, the power markets of tomorrow, with high penetration of renewables, will need to cater for flexibility and broader distribution of both supply and demand. This trend has driven the emergence of supporting technologies, such as digital solutions, storage, demand side management, electric vehicles and hybrids.

So far, the focus has thus been on new hardware and making renewable energy feasible on a large scale. But as renewable energy has become as plentiful and cost-competitive with non-renewable sources, the energy systems of the future need to become more efficient, resilient, and digital to meet the world's growing energy demand.

This fundamental transformation entails that energy systems and power plant owners must improve forecasting accuracy for renewable production, optimise output from each individual generation asset and orchestrate a portfolio of resources across multiple sites and equipment types. By doing so in a cost-effective manner that ensures grid stability, renewable energy sources will continue to replace conventional, fossil-fuel generated power plants as the energy sector decarbonises in response to climate change.

Obviously, such a transformation includes a number of technology and policy challenges that need to be overcome, but also holds huge market potential. According to a white paper by Intel, the global market for smart grid technologies, which includes sensors, management and control systems, communication networks, and software, was already worth $80.6 billion in 2016 – an increase of 28.7 percent since 2011. Underlining the market potential, GTM Research/Wood Mackenzie expect the global smart grid market will cumulatively surpass $400 billion worldwide by 2020, with an average compound annual growth rate of more than 8 percent. Bloomberg New Energy Finance estimates that grid automation alone will be a $10 billion market by 2025

The challenges facing energy systems are primarily the outcome of how electricity is produced and the growing demand for electricity from the transportation and heating/cooling sectors. In terms of digitalisation of the energy system, advanced analytics have the potential to solve many of the challenges revolving around intermittency, ageing grids, decentralised generation, power flow, and distribution.

As the energy industry embraces digitalisation and digital solutions to solve some of these challenges, players across the energy industry also look to gain significant benefits from digitalisation, including:

- Lower operation and maintenance costs and increased uptime and/or energy production
- Improving product design with data-based simulation and reducing time to market
- More precise weather and production forecasting
- Orchestrating energy assets and hereby optimising the entire system
- Improving integration with energy grids
- Maximise lifetime yield & revenue
- Optimise spare parts pull, inventories, and dispatch of technicians through preventative and predictive maintenance
- Monitor critical KPIs

Digital technologies already permeate our everyday life and used widely across the energy system, for instance in the ever-growing number of sensors in energy assets. The transformation has, however, just started and as we improve our capabilities to collect, sort and analyse data, we also combine it with machine learning and artificial intelligence, which will increase efficiency even further through prescriptive analytics and automation.

Sources:

- Bloomberg New Energy Finance: Digitalization of Energy Systems – a white paper, November 2017
- GTM Research/Wood Mackenzie: Global Smart Grid Technologies and Growth Markets 2013-2020, July 2013
- Intel: Digitizing power utilities, 2015