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CASE STUDY
VIRTUAL POWER PLANTS
Delivering Flexible Renewable Energy to the Grid

The significant increase of renewable energy sources in the global energy mix, coupled with information technologies, is disrupting the energy value chain and bringing about investment opportunities in clean-tech start-ups and smart utility business models.

One such model is a Virtual Power Plant (VPP), which harnesses the power of information technology to virtually aggregate a diverse set of distributed renewable energy assets into a platform, operating them as a unified resource.

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Deployment of renewable energy is pivotal to achieving a 2°C compliant economy, with the global share of renewables expected to be over 60% by 2050.[1] A significant portion of energy will be generated and stored on-site by end consumers, through local installations such as rooftop solar or large-scale industrial installations, referred to as Distributed Energy Resources (DER).[2] Coupled with energy storage and IT solution systems, DERs are disrupting the energy value chain and challenging the traditional utility business models. Many start-ups focusing on solutions for optimising energy resources are emerging, creating investment opportunities for venture capital firms and traditional investors with exposure to energy, clean-tech and utility stocks.

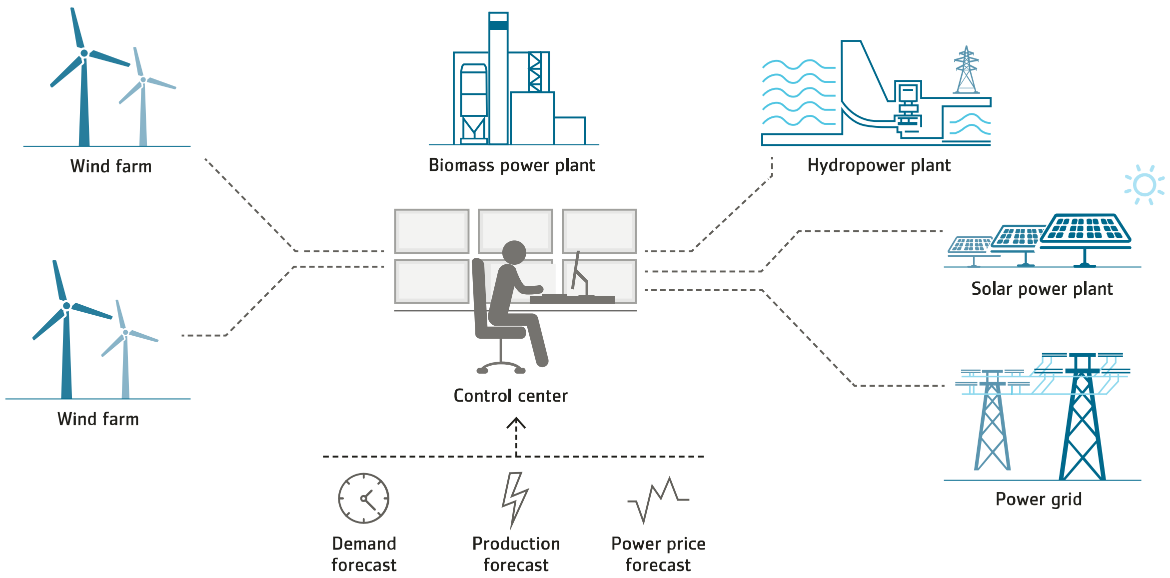
A challenge linked to renewable energy is that it is often less predictable and intermittent in supply due to dependency on weather conditions. This has raised concerns over the effects renewable energy has on the overall stability of the grid. In addition, managing distributed renewable energy generation, as opposed to traditional centrally planned power plants, requires significantly more coordination of information and energy flows. To address this, innovative business models such as Virtual Power Plants (VPP) have emerged, which harness the power of information technology to virtually aggregate a diverse set of distributed energy assets into a platform. By operating the energy assets as a unified resource, the VPP addresses some of the challenges mentioned.

A VPP can contain almost any power generating technology, including biogas, biomass, combined heat and power[3] (CHP), wind, solar or hydro. It also incorporates storage solutions as well as demand response programmes[4]. The centrepiece of a VPP platform is the control centre which digitally connects, operates and manages thousands of individual assets spread geographically, as if they were a single power plant (Figure 23). The assets are coordinated and optimised through algorithms that consider a variety of technical and market signals such as weather forecasts, price signals and technical requirements, allowing the operator to efficiently participate in the energy market.

The application of VPPs can bring about many benefits. Firstly, intermittent power generation from renewables can be combined with more flexible generation capacities such as biomass or CHP to generate power with much greater predictability compared to renewables in a stand-alone scenario. VPPs can also participate in the balancing markets to provide short-term flexibility to the grid operator. This makes VPPs a powerful tool with the potential to transform variable renewable energy into a predictable and flexible energy resource.

Furthermore, integration of VPP platforms also brings value to utilities whose business model is being challenged by independent distributed energy producers. Utilities face shrinking profit margins as consumers shift from being traditional consumers to also producing energy for self-consumption. In fact, according to a survey done by Accenture in 2017, almost 60% of utility executives ranked distributed generation as the biggest disrupter to their busi-

Figure 23:
VIRTUAL POWER PLANTS



Source: ABB, 2014

ness.[5] Utilities are thus facing the need to reinvent themselves through digitalisation and shift their value from asset ownership to service-based business models. VPPs allow utilities to incorporate distributed energy resources in their value chain and expand their service offering to managing such assets and optimising resources. It is therefore not surprising that energy companies are making significant investments in digital transformation, with Bloomberg NEF estimating that USD 590 billion will be invested between 2017 and 2025.[6]

The VPP market is driven mainly by utilities, storage technology developers, energy service companies or municipalities aiming to capture some part of the value of the supply chain. Optimisation platforms are developed by technology companies such as Next-Kraftwerk, Virtual Power Solutions, AutoGrid or Enbala, who often operate their own VPPs or offer their products through SaaS[7] agreements. In Switzerland, Virtual Global Systems has developed an optimisation system with VPP capabilities. Many utilities or energy service companies apply these technologies to their portfolios. The Norwegian utility Statkraft operates a portfolio of 12GW in Germany and plans to add another 2 GW in the UK.[8] Japan also aims to aggregate 10,000 distributed energy assets into a VPP. Finally, Tesla launched a 50,000-home virtual power plant in Australia last year.[9]

Transitioning to a low-carbon economy requires a digital transformation of the energy sector so that it can accommodate a high share of distributed energy resources, storage facilities, electric vehicles and demand response programs, while maintaining security of supply. Advanced technologies like VPPs thus bring forth numerous opportunities for investors seeking innovation to deliver on sustainability-related goals. Venture capital firms and thematic funds have the opportunity to support clean-tech start-ups that are developing innovative platforms focused on digitalisation of energy systems. The Swiss investment firm SUSI Partners, for example, announced in late 2019 that it plans to invest $50 million in a residential solar-plus-battery storage VPP project in Australia. More traditional investors with exposure to energy and utility stocks can support this transformation through positive screening of utilities that have embraced such disrupting solutions in their business model.

1 Bloomberg NEF (n.d.). *New Energy Outlook 2019*. Available at: https://about.bnef.com/new-energy-outlook/

2 Ibid.

3 Combined heat and power (CHP) is a system in which steam produced in a power station as a by-product of electricity generation is used to heat nearby buildings.

4 Demand response programmes aim to reward end consumers for lowering their consumption at peak times.

5 ABB (2017). *White Paper Virtual Power Plants. Distributed generation is not a threat, it's an opportunity.* https://search.abb.com/library/Download.aspx?DocumentID=8VZZ000328T0000&LanguageCode=en&DocumentPartId=&Action=Launch

6 Bell Ventures (n.d.) *Power to the People. How digital is disrupting the energy industry – Top 4 Trends*. Available at: https://bell.ventures/insights/power-to-the-people-top-4-trends-disrupting-the-energy-industry

7 Software as a Service (SaaS)

8 Deign, Jason (21 March 2019). Statkraft Looks to Virtual Power Plants as Renewable Energy Demand Surges. *Greentech Media*. Available at: www.greentechmedia.com/articles/read/statkraft-looks-to-virtual-power-plants-as-renewable-energy-surges#gs.tp96n9

9 Smart Energy International (25 June 2019). *Japan developing world's largest behind-the-meter VPp*. Available at: www.smart-energy.com/industry-sectors/business-finance-regulation/japan-developing-worlds-largest-behind-the-meter-der-system/