The Role of Cloud in the Journey to Net Zero

Whitepaper

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1 Introduction

In February 2020, Bernard Looney announced BP's ambition to become a net zero company by 2050. Since then, a particularly virulent strain of coronavirus has changed the world in unexpected ways. Our use of oil and gas has plummeted and, along with it, global prices. HIS Markit predict that consumption in March and April 2020 might be down by as much as 55%. Oil giants like BP and Shell have cut forecasts and down-graded asset values. Bicycle sales have soared.

Have our habits changed for long term? If they have, that would be very good for BP's 2050 target, but not so great for the short-term profitability of oil and gas businesses in general.

Even before COVID-19 came along, all businesses were facing mounting pressure to address their impact on the climate. Demands came from consumers, employees, investors and governments to demonstrate the actions they were taking to do so. This was particularly true for businesses within the oil and gas sector, not only in regard to their own operations but also those of their customers.

Shell and BP, amongst others, have pledged to reduce the carbon footprint associated with their operations as well as with the use of the products they sell. The target is net zero by 2050, and a reduction in the greenhouse gases associated with each unit of energy they sell by 50% within 30 years. Even with the likely long-term changes driven by COVID-19, the world's population will continue to rely on fossil fuels, and hydrocarbon-based products, for decades to come.

This paper considers one important aspect of the operation of energy corporations such as BP and Shell that can have a positive impact on their carbon footprint: the management of their computing infrastructure. Get that right and it will be possible to cut direct energy use, support energy-saving initiatives such as remote working, reduce operational costs and, at the same time, substantially improve the carbon footprint.

Cloud computing provides oil and gas businesses with access to nearly unlimited computing power at the push of a button, enabling them to gain insights and make discoveries not previously possible. The resulting insights will radically improve the operation of the business and have a strongly beneficial environmental impact.

2 Energy Consumption and Carbon Emissions

According to a study commissioned by the US Department of Energy, in the United States alone, enterprise data centres will consume 73 billion kWh this year (2020). That's about 2% of all electricity consumed in the US. Globally, the energy consumption of data centres in 2015 was estimated to be 416.2 terawatt hours; significantly higher than the UK's total consumption of about 300 terawatt hours. This is expected to triple by 2026.

The scale of the associated carbon emissions differs based on the type of energy source, of course, and that difference can be dramatic. Using data compiled by Swedish state-owned energy giant Vattenfall, DigiPlex (which builds and operates centres in Scandinavia) claim that in Norway, where most of the energy comes from hydroelectricity, generating a kilowatt-hour of electricity emits only 3 grams of CO_2. By comparison, in France it is 100 grams, in California 300 grams, in Virginia almost 600 grams, and more than 800 grams in New Mexico. Suffice to say that the environmental impact of IT is, in most regions, significant.

Moving from many enterprise data centres to fewer large data centres presents the opportunity to reduce overall IT consumption of energy and related emissions. In 2018, Microsoft, in partnership with WSP, published a paper that illustrates the carbon benefits of moving to the cloud. The study assesses energy consumption and carbon emissions associated with four applications running in the Microsoft Cloud compared with their on-premises equivalents. The results show that the Microsoft Cloud is between 22 and 93 percent more energy efficient than traditional enterprise data centres, depending on the specific comparison being made. Taking into account their purchase of renewable energy, the Microsoft Cloud was estimated to be between 72 and 98 percent more carbon efficient.

451 Research has conducted similar research, on behalf of AWS, which concluded that the AWS infrastructure is 3.6 times more energy efficient than US enterprise data centres they surveyed, with an 88% lower carbon footprint.

The savings are attributable to three key features of the cloud:

- IT operational efficiency: commercial cloud services can operate with greater efficiency than smaller, on-premise deployments due to multi-tenancy and large-scale dynamic provisioning. A typical large-scale cloud provider achieves approximately 65% server utilization rates versus 15% on-premises, which means when companies move to the cloud, they typically provision fewer than ¼ of the servers than they would on-premises.

- IT equipment efficiency: the hardware is large-scale but can be tailored to the specific needs of cloud services and cloud service providers. Vendors like AWS and Microsoft have access to the latest server technologies and can both adopt and design new, energy-efficient, server platforms much faster that enterprise data centres. An example is the AWS work on highly efficient Arm-based Graviton processors.

- Data centre infrastructure efficiency: advanced technologies and operating improvements significantly reduce energy requirements for lighting and cooling. A typical on-premises data centre is 29% less efficient in its use of power compared to a typical large-scale cloud provider that uses world-class facility designs, cooling systems, and workload-optimized equipment.

As an aside, a seemingly off-the-wall example of projects to lower cooling costs is the small data centre installed by Microsoft in 2017 on the ocean floor just off the coast of the Orkney Islands. The idea of cooling data centres with cold water is, in fact, not new. IBM maintains a data centre outside of Zurich that heats a public swimming pool with its cooling water, and Green Mountain buried a massive data centre inside a Norwegian mountain where it can use near-freezing water from a fjord in the cooling system.

3 Green Power

Moving your IT to the cloud might reduce your individual footprint, but the digital footprint of these huge cloud operators – of which AWS, Azure and Google Cloud account for approximately two-thirds of the market – is potentially massive. So, the fourth key feature of the cloud which drives emissions reductions is the ability of these cloud operators to source green energy.

In 2017, Google, the smallest of the Big Three, announced it had achieved its goal of 100% renewable energy across all of its operations, and that data processed by Google Cloud had zero net carbon emissions. Google achieved this by a combination of in-house generated renewable electricity, such as the solar generation at its Mountain View headquarters, and Power Purchase Agreements to supply renewable energy. Under these agreements, Google buys power from renewable energy projects and sells this power back to the grid at the local wholesales price. The power actually used at the data centres is provided by the local utility and may use fossil fuels. While the renewable facility output is not being used directly to power a Google data centre, the PPA arrangement ensures that additional renewable generation sufficient to power the data centre comes on-line in the area. Google purchases an equal amount of renewable electricity as they use in their data centres.

Microsoft's data centres have been 100 percent renewable since 2014, although they also still use fossil fuels. The company offsets its fossil fuel use with Renewable Energy Certificates (RECs) in much the same way as described above. RECs are a tradable commodity that represent a claim to an amount of environmental benefits associated with renewable power generation. Without RECs, Microsoft's data centres run on 60 percent renewable electricity and they plan to boost this to 70 percent renewable energy by 2023. Microsoft has been investing in clean energy projects, including hydro, wind and solar, and by the end of 2019 had a renewable energy portfolio of around 1.9 gigawatts.

AWS is by far the largest cloud operator, with over one third of the market, and in 2019 announced its commitment to achieving net zero by 2040. It exceeded 50% renewable energy usage in 2018, though this included accounting for RECs. Amazon are engaged in a number of renewable energy projects: six solar farms and three wind farms are operating in the USA and the company announced a total of four new wind farms and one new solar farm across Ireland, Sweden and the USA. Once complete, the total portfolio will generate more than 2.9 GW.

4 Big Data and Operational Insights

As we've seen, moving to the cloud can have a significant impact on direct electricity use and carbon footprint. However, the big prize is the opportunity it affords to easily manage all of the organisation's data and apply leading-edge analytics to better understand, and improve, the business.

As an example, take commercial buildings. In the US alone, businesses spend about US$100bn on energy for their offices each year. Estimates suggest that smarter buildings could save US$20bn-25bn in annual energy costs. For these smart building solutions, cloud computing will deliver several benefits:

- Accessibility: At the core of the solution is the ability to analyse data from disparate sources. The cloud is ideally suited to providing a platform for managing building data together with information from other sources, such as weather monitoring and forecasting.

- Scalability: Buildings typically have thousands of sensors and controls, and therefore large volumes of data. A cloud-based architecture provides the scalability required to process massive volumes of data at an affordable cost.

- Ease of deployment: Cloud technology can provide a secure and uncomplicated connection between off-site servers and on-site equipment.

One notable example is Microsoft's headquarters in Redmond. Now the size of a town, it began life on an 88-acre site originally intended to house a shopping centre. The company grew so fast that, initially, there were no defined construction standards and they had to work with a variety of contractors and construction schedules. As a consequence, the 125 buildings on the site were constructed in a variety of styles and configurations. By the time Microsoft instituted comprehensive building standards in the 1990s, a large portion of the campus was already built. Today the campus spans 500 acres and has 14.9 million square feet of office space and labs that now function as one interconnected system. In the intervening years, Microsoft has used the Redmond campus as a test bed for smart building software from three different vendors, built on its Azure cloud computing platform. The software receives data from thousands of building sensors that track heaters, air conditioners, fans, and lights: billions of data points per week. In addition, the system sources data from external services, such as weather forecasts. The system has provided deep insights, enabled better diagnostics, and has allowed for far more intelligent decision making. Microsoft has saved energy and millions of dollars in maintenance and utility costs. Faults can be identified in seconds where, previously, they might have been completely missed. As a small example, in one garage they discovered that exhaust fans had been mistakenly left on for a year, wasting $66,000 worth of energy.

Last year, Google announced a collaborative pilot project with the Stella McCartney fashion brand to provide cloud-based data collection and analysis of their global supply chains. The fashion industry produces 20 per cent of global wastewater and 10 per cent of global carbon emissions, more than all international flights and maritime shipping. Textile dyeing is the second largest polluter of water and it takes around 2,000 gallons of water to make just one pair of jeans. Much of this impact occurs at the raw materials stage in the production process, where brands have little to no visibility. The tools being developed by Google will use data analytics and machine learning on Google Cloud to give the brand a more comprehensive view into their supply chain, particularly at the level of raw material production.

As a final example, in 2014 a team at Google established a partnership with Oceana and SkyTruth, called Global Fishing Watch (GFW), to provide a transparent view of commercial fishing activities across the globe. The goal was to help protect critical marine habitats and provide tools for sustainable fisheries management. This has resulted in a free, public, interactive view of all the world's large industrial fishing vessels, of which there are roughly 60,000. It includes an online map that anyone can access.

These kinds of advances are directly applicable to the world of oil and gas. Not simply to the buildings required to house all of the engineers, scientists and accountants, but to every component of the infrastructure, and the supply chain, required in the production of hydrocarbons. Imagine what improvements to global production operations might be possible if the sensor data was readily accessible to all those who needed it and could be digested by advanced analytics tools.

5 The Cloud Worker

In 2018, Forrester Consulting studied how cloud computing has transformed employee technology needs and behaviours, and what enterprises are doing to meet those needs. The resulting paper reports that business environments have become more virtual and more connected, and that they thrive on real-time collaboration. They established that cloud computing has played a huge role in enabling this shift.

94% of the workforce respondents to the Forrester surveys reported that they use their laptop, smartphone, tablet, or wearable device for work while commuting, travelling, or at home. Typically, employees see this new normal as a good thing: 69% agree that their ability to access company resources from everywhere gives them a better work/life balance.

Increasingly, businesses see the future office as a flexible 'workspace' with fewer defined areas, and more 'turn up and work' environments. The concept of the internet of things powered by the cloud is key in enabling this universally connected state of being, with people able to control everything from their own devices.

For the oil and gas sector, like many others, the potential direct impact on the environment through reduced office commuting and business travel, is obvious. But the cloud, and associated IoT devices, also present the opportunity for much higher levels of remote operation and management of infrastructure, globally.

6 Conclusion

The 2050 targets that BP and Shell have set themselves are challenging and will need massive changes across the breadth of their operations. A revolution in IT infrastructure is just one part of the solution, but its impact in achieving these goals could be massive. It is not just a case of better managing one energy-hungry component of the business: making the move to the cloud has the potential to deliver improvements across the entire organisation.

Having said that, it is important to recognise that the huge data centres operated by the cloud computing providers potentially have a colossal carbon footprint. This means that the selection of a suitable provider should include an assessment of their "green credentials"; primarily, the efficiency of their operations and the source of the energy they consume.