A random walk through the energy transition

A number of oil and gas majors are now grappling with making a significant shift into renewables.
Aspen Technology's **Ron Beck** discusses the technologies that will help in what will be a difficult transition for them to make.

Several oil and gas majors have made clear their plans to shift strategic focus. Just recently BP, for example, in the face of a massive fall in oil prices, said it will invest tens of billions of dollars over the next decade to meet its target of becoming one of the world's largest renewable power generators and achieve net-zero in its operations by 2050.

But the energy transition will be complicated for these companies to navigate. There are many factors at play that make this more complex than it may appear. So how to rise above the crowd in these next few years? Technology is proving to be a valuable tool in navigating and thriving during the energy transition and will help companies be leaders.

Global energy demand will continue to rise, according to most predictions. There are two factors driving these forecasts: population and standards of living. The Energy Information Administration (EIA) forecasts global energy demand to grow by almost 50 per cent between 2020 and 2050. This will continue to drive the need for energy – the question is which energy sources? And therefore the "energy transition" required as the sustainability movement drives the globe towards "greener" energy sources.

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The challenge, of course, is the formidable reality of global energy mathematics. The numbers are so high, that no matter what the rate of adoption of renewable energy sources, hydrocarbons will remain a crucial element of the world energy picture for decades.

So how can technology help adapt hydrocarbon use to achieve better sustainability results? Let's look at a few levers the industry has and the key role technology will play.

Natural gas is emerging as an important future energy source, often seen as a 'bridge fuel" to reduce carbon. To make natural gas transportable, though, requires the energy-intensive and complicated liquefaction (LNG) process. Technology is playing a key role in improving the costs and reliability of natural gas supply. Digital twin models and advanced control have already proven to be crucial in the reduction of energy use during LNG processing.

Much more use of technology will be necessary here, as the producers, driven by both economic reality and sustainability needs, are embracing these proven approaches beyond the initial successful adopters of these tools. Each implementation of this technology further advances the 'green-ness' of natural gas.

Huge capital has been tied up in these projects, and so utilisation rates of these capital-intensive LNG plants is crucial. There, the prescriptive maintenance technology, which embeds machine learning and advanced AI analytics in solutions which alert operators to conditions that create risk of degradation of the high-capital compressors and cold boxes, are now beginning to have an important impact. The confidence of owners and developers in this technology will enable several large development projects to proceed quickly.

For highly complex and demanding assets, such as LNG plants, the self-optimising plant, a future vision for industry in which data and AI contribute to make these investments self-learning, self-adapting, and self-sustaining, will be important.

To achieve the aggressive targets of global players, who are pledging to reach "zero carbon" operations by dates ranging from 2030 to 2050, increasing the pace of developing renewable power assets is viewed as crucial. These technologies, though, are still relatively new in terms of the maturity curve. Utility scale wind and solar arrays are just now beginning to reach the operational phase where maintenance and uptime become concerns.

Again, as is being applied for LNG capital assets, wind farms have already begun successfully adopting prescriptive maintenance solutions, which provide asset health alerts to maximise the availability and utilisation of these large assets, which have not yet established a long-term reliability and maintainability record. This advanced digitalisation technology will be crucial in monitoring the health of equipment which is inherently installed remotely, under environmental stresses, and requires maximum uptime to be reliable in the energy mix.

An interesting analysis compiled by global political thinker Peter Zeihan, looks at the distribution of land across the globe that is suited for utility-scale renewable electricity production. Interestingly, Zeihan shows that roughly half of the world's population is located in Eastern and Southeastern Asia, which has low potential for solar and wind farms. Perhaps as a consequence of that, Southeast Asia has pursued a path of exploitation of palm oil plantations as a potential source of bio-energy and bio-chemicals. The balance of that ledger, however, is not clear, as clearing of rainforest in favour of palm oil farms, is arguably a net negative on the sustainability scale.

Bioenergy conversion approaches, including bioethanol, biodiesel, waste-to-energy pyrolysis, algae conversion, and biochemicals, have gained acceptance at least partially through the benefit of subsidies and government policy. Process modeling technology continues to be crucial, although not widely enough used, in improving the performance of these processes. These processes are hamstrung by the high energy consumption of currently accepted technology.

In order to contribute effectively to sustainability and energy transition, advanced modeling and optimisation is needed to achieve fundamental improvement. Dr. Eric Dunlop, a specialist in large-scale biochemical engineering projects and the algae business, has pioneered these approaches in some groundbreaking work on algae-to-fuels.

New startups continue to innovate with novel new technologies to improve bio-energy conversion, and the new generation of hybrid modeling, which combine AI analytics with rigorous process modeling (such as AspenTech's innovative AI model builder), will be playing a big role here in improving the technical pace of innovation and commercialisation opportunities.

Reducing energy use is another key area. Energy is consumed inefficiently in the conversion of hydrocarbons, synthesis of chemicals and the supply chain. Technology will play a key role in helping the industry navigate a drive towards carbon neutrality. In addition to improving energy efficiency, optimisation technologies can contribute to increasing the production efficiency of oil and chemical operations. Both digital twin monitoring systems and dynamic optimisation solutions can together save 5-15 per cent energy use, reducing carbon emissions a proportional amount.

Another great technology weapon is utility supply optimisation. As power plants looks to minimise carbon emissions, the choices between oil, gas, biofuels, and renewables can be made on a sophisticated basis. The choices can be made minute-by-minute, or at any longer interval. The technology can model the interplay between multiple plants, and multiple utility sources, for example choosing between a wind energy source, natural gas-based electricity, or diesel combustion at the plant, taking into account dollar cost, carbon costs, and reliability.

So what is the future path for oil and gas majors? Firstly, predicting peak oil demand is the forecaster's elusive gold star. Will it be 2025, 2030, 2040 or later?

This will depend on factors including global economic growth (only really forecasted to grow significantly in Asia), energy conservation (or "intensity") in different regions, a shift to electric power over combustion and others. The IEA in its most recent report has forecast peak oil demand will take place in the 2030s.

Corporations globally have acknowledged the onset of the energy transition. Some have chosen to reflect this through their investments and their actions. An IHS Markit analysis shows that Total, Shell, BP and Equinor have made at least 66 acquisitions in the past several years to diversify their energy portfolios. Others have chosen to focus on innovation in use of capital and on operational excellence to build a resilient market position.

As the industry navigates the energy transition, technology will be a key partner as organisations and their executives make strategic moves to improve their agility and competitive positions into the future. Those companies who adopt some or all of the technology opportunities mentioned will be bound to have an advantage.

Ron Beck is Marketing Strategy Director at Aspen Technology.