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Jeroen Van der Veer outlines his vision for "Green Fossil Fuels"

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On top of concerns about high oil prices now comes the fear that we have reached "peak oil" and that global oil output will start to decline. Have we? If oil has peaked, do we face a future of growing energy shortages, rising prices and international conflict for supplies?

No one should underestimate the energy challenge. With continued economic growth, the world's energy needs could increase by half within 25 years. Unchecked, this will result in significantly higher carbon emissions. Many scientists agree that emissions from human activities are changing our climate and call for urgent action. The world's energy needs must be met while cutting carbon dioxide emissions.

But where are we going to find this energy? My view is that "easy" oil has probably passed its peak. But there are other reserves that are still a long way from their peak. In unconventional oil and gas – resources that are harder to tap – there are plenty of reserves. The oil industry has to explore new frontiers, develop new hydrocarbon energy sources and integrate "CO2 solutions".

The challenge is to develop technology that can fuel growth without environmental degradation. That means applying advances on the scale necessary to make real progress. It means integrating technologies because that is where the real benefits come in this complex business. It means applying those technologies in increasingly demanding projects, and accessing resources in challenging frontier environments such as the Arctic or in deep offshore waters.

The biggest impact technology could have is to increase significantly the amount of conventional oil we recover from existing reservoirs. This is little more than one-third on average at present across the industry. Smart technology enabling engineers to monitor and control reservoir processes remotely, along with techniques using heat, gas or chemicals to make oil flow more easily, could significantly boost recovery rates.

Integrating technology will also enable us to access previously inaccessible hydrocarbon resources. Much of the world's huge reserves of natural gas are still untapped. Cooling gas into liquid allows it to be transported as liquefied natural gas for power generation in other markets. Demand for LNG is set to double in the next decade but this, again, depends on technological advance. Technology is also being used to turn gas to liquids (GTL). This will enable the industry to unlock reserves and convert gas into fuels such as diesel, which will be ideal for reducing pollution in major cities.

Other new hydrocarbon energy frontiers include heavy oils and where oil is contained in sand and shales, contaminated and tight gas, and coal bed methane. There is lots of coal too, particularly in the US and China.

At Shell we are testing an environmentally sensitive way of unlocking the large potential of oil shale in Colorado using electric heaters to heat the rock formation and release light oil and gas. Coal gasification offers a way of using coal more efficiently, cleanly and flexibly. The resulting "syngas" can fuel efficient combined cycle power plants. It can also be used, with the same technology as gas to liquids, to produce high-quality liquid fuels. The world will need these resources. But they are more carbon-intensive and increase the urgency of finding ways of tackling carbon emissions.

So my vision is for "green fossil fuels" with much of their carbon dioxide captured and sequestered underground or in inert materials. In the medium term, this could be cheaper, more convenient and more flexible than alternative energies. A typical one gigawatt coal-fired power plant produces the same carbon emissions as 1.5m cars. China alone is building about 17 of these plants a year. This is why sequestration should be a priority for power plants.

One prerequisite to success is ensuring sufficient investment to access more difficult resources and undertake long-term technology development. The International Energy Agency estimates that meeting global energy needs will require investing more than \$17,000bn by 2030. Given the urgent investment needs, exacting windfall taxes is counterproductive, particularly in an industry with a history of volatile prices.

So, while the good news is that there is a wide variety of energy sources to deal with the energy challenge, our industry has its work cut out for it. It will have to mobilise its experience and talents but also rely on governments and consumers to recognise that we share common concerns and have to respond to changing circumstances.

The writer is chief executive of Royal Dutch Shell.