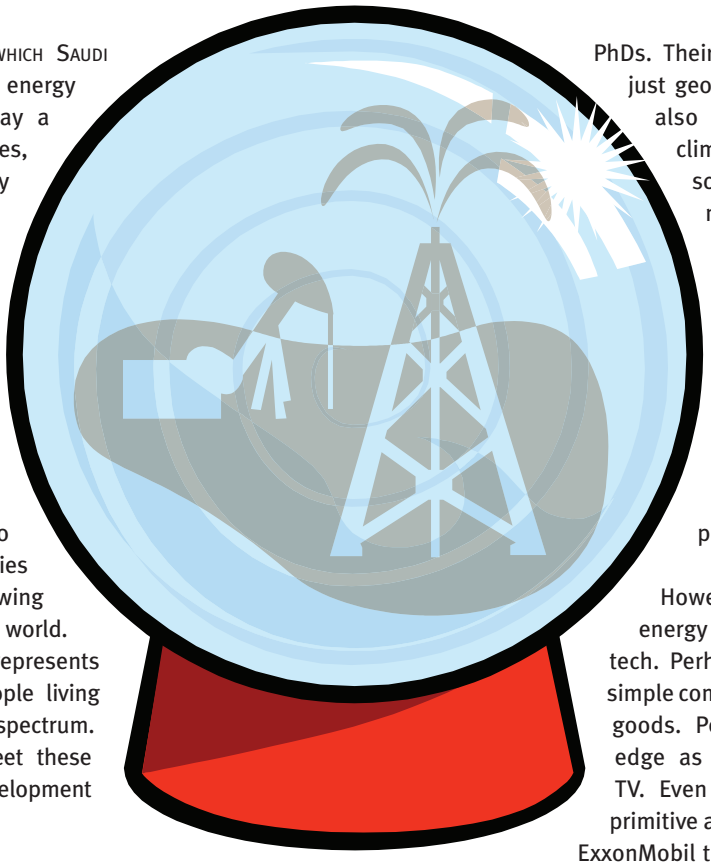
- The energy industry needs to meet growing demand, reduce environmental impact and improve security.
- With technology it can meet these demands through enhanced diversification and efficiency.
- Technology's vital role must be recognised and encouraged by governments.

Supplying energy to the future

Only technology will be able to solve the serious challenges faced by the energy industry today and in the future, says Rex W Tillerson at ExxonMobil.



The global energy system, in which Saudi Aramco, ExxonMobil and all energy producers and consumers play a part, is facing huge challenges, including growing energy demand, environmental expectations and concerns about supply security.

The industry must meet these challenges so that consumers can continue to access reliable, clean energy supplies at competitive prices far into the future. It is essential that the necessary energy is available to sustain the developed economies and support the rapidly growing economies of the developing world. Any failure to achieve this represents serious consequences for people living at both ends of the economic spectrum. One of the best ways to meet these challenges is through the development and application of technology.

The age of 'easy oil' is decades old and the industry is operating at the edge of technical possibility, developing and applying new technologies to make those possibilities a reality. The industry needs to develop and deploy new technologies that increase recovery, unlock new resources, reduce costs, promote energy efficiency, improve environmental performance and diversify supply options.

A high-tech industry

It is important to recognise the role technology plays in the energy industry and the contribution that this industry makes to technological development. ExxonMobil is aware of the technology-rich nature of its business, considering it to be the lifeblood of its success today and the platform for its success tomorrow. Its workforce reflects this view. It employs more than 14,000 scientists and engineers, 2,000 of whom hold PhDs. Their areas of expertise include not just geology, chemistry and physics, but also oceanography, palaeontology, climatology, microbiology, computer science, environmental science and medical science.

It is awarded nearly three patents a day for new technologies developed in its laboratories, research centres and operational facilities. It spends almost $2m every day on researching and developing new technology and nearly $50m each day on its projects around the world.

However, public perception of the energy industry considers it to be low-tech. Perhaps this is because fuel seems simple compared to high-tech manufactured goods. Petrol does not feel as cutting-edge as a mobile phone or flat-screen TV. Even the term 'fossil fuels' sounds primitive and low-tech. Despite the fact that ExxonMobil topped the Fortune 500 list of US companies and invested nearly $700m in research and development last year, the magazine does not categorise it as a technology company as it does many computer, medical device and aircraft manufacturers.

However, hidden from public view is the exceedingly complex and high-tech process for finding, developing, processing and delivering these seemingly simple products. If we are to create an environment that is supportive of the technological developments necessary to meet the world's energy challenges, it is essential to broaden understanding of the high-tech nature of this business.

Accessing more oil

Technological progress has created enormous benefits for the world's energy consumers. It has enabled the global commercially viable resource base to grow, despite so-called 'peak oil' predictions.

Improved seismic mapping methods, deeper onshore and offshore drilling and production techniques, reservoir simulators and other advances have increased the Earth's accessible oil. In 1950, it was estimated that the conventional, recoverable resource base was one trillion barrels. By 2000, that had tripled to three trillion barrels. Pushing forward with such innovation is critical to meeting the energy challenges of the future. By 2030, world energy demand is expected to increase by nearly 50 per cent.

Technology has diversified supply sources, allowing more energy to be accessed in more locations around the world. Ice-resistant and ice-breaking innovations have opened the rich reserves in arctic Russia. New state-of-the-art platforms and sub-sea drilling technologies unlock resources offshore across the globe.

The refining capacity has also been improved by technology. In the USA, capacity has increased consistently and adequately, in part through the application of advanced chemical catalysts. In fact, over the last ten years, ExxonMobil has increased its US refinery capacity faster than the growth demand, at a rate equivalent to building a new refinery every three years.

Extended reach drilling is another innovation that enables new supplies to be accessed. In the Sakhalin-1 project in Russia's far east, this technology has enabled ExxonMobil to drill a horizontal well from an onshore rig to an undersea reservoir.

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Reducing environmental impact

Technology has also contributed to reductions in environmental impact. Since the 1970s, emissions such as carbon monoxide, sulphur and particulates have been reduced so dramatically that today more than 30 cars in the USA would be needed to generate the same emissions as one car from the 1970s.

It is a testament to the industry's progress and ingenuity that it now takes 50 per cent less energy to create a dollar of gross domestic product in the USA than it did 30 years ago. And energy costs have not risen as fast as the cost of many other commodities over that period.

The environmental impact of drilling activities is also being minimised by technology. Using advanced developments in engineering and materials, ExxonMobil has elevated a pipeline in Alaska to protect the fragile permafrost and local biodiversity. Technology also helped ExxonMobil to prevent major offshore spills when hurricanes struck the Gulf of Mexico in 2005.

To reduce the environmental impact of energy consumption, ExxonMobil has partnered with Toyota and Caterpillar on separate programmes to design high-efficiency, low-emission fuel and engine systems. This has already produced groundbreaking research in combustion science, which is now being applied to homogeneous charge compression ignition and other powertrain systems. These efforts have the potential to achieve a fuel economy improvement of about 30 per cent.

Looking further into the future, new technologies will continue to play an important environmental role. To encourage this, ExxonMobil has initiated the Global Climate and Energy Project at Stanford University, which is researching ways to meet growing energy demand while reducing emissions. This project aims to identify and accelerate development of the most commercially-promising energy options, including carbon sequestration in underground aquifers, the use of genetically engineered bacteria to capture solar energy and produce hydrogen, flexible sheets of solar cells organised at the molecular level and new materials capable of storing hydrogen in carbon nanotubes.

Future energy security

Technology also plays a role strengthening energy security by enabling the development of more diverse energy sources. In the USA, for example, developing the full range of domestic oil and natural gas resources in an environmentally sound way would be a prudent element of any broad-based energy policy for the world's largest consuming nation. And so-called 'tight gas' and deepwater technologies enable this to be done.

Strengthening US energy security also requires the international sources of supply to be diversified. The world energy map is complex, with great distances separating energy exporting and energy importing nations. Technology enables these distances to be bridged.

The next generation of liquefied natural gas (LNG) tankers, for example, will carry up to 80 per cent more natural gas than conventional LNG ships, making it possible for the USA to gain access to distant energy supply at competitive prices.

Market forces drive innovation

Realising the full potential of these and other technologies requires public policies that encourage continued innovation. There are many contributing factors to the history of technological progress, and they all remain important today.

Government support is an important element. By investing in fundamental, pre-commercial research and development, governments have enabled breakthroughs such as nuclear energy and the internet.

Promoting science and maths education and prudent policymaking, focused on advancing basic science, are ways the government can support technological progress.

Ultimately, however, free market forces are the primary drivers of sustained technological progress. The need for energy companies to sustain a competitive future by meeting consumer demands and securing access to new resource opportunities in a dynamic marketplace motivates innovation.

Without the prospect of market rewards, no company would take the investment risks associated with research and development, which is essential to developing and supplying the huge amounts of energy the world will need in the future. At a time when energy prices are high and company earnings are setting records, this market dynamic is often lost. Earnings today enable energy companies to invest in developing tomorrow's technologies.

It is important to understand, however, that while technological development and new supply development are tied to market demand, neither is necessarily tied to the business cycle. New innovations take years to develop.

For example, ExxonMobil's breakthrough multi-zone stimulation technology for unlocking 'tight gas' took more than a decade of research and experimentation. During this period, the price for the natural gas ExxonMobil hoped to develop ranged from $1.60 to over $15 per one million BTU.

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Successfully bringing such technologies onstream requires a consistent commitment to R&D investment, regardless of the ebbs and flows of energy prices and earnings. Technological development is a long-term, evolutionary process. However, because of the enormous scale and global reach of the energy industry, such technologies, once developed and deployed, can have a revolutionary impact.

By enabling access and reducing risks and costs, technology creates value and transforms the uneconomic to the economic. To have this revolutionary impact, new technologies must be commercially viable. Because of their abundance and economic advantages, fossil fuels will remain the dominant sources of energy for many decades to come. It is therefore vitally important to continue improving their economic and environmental performance.

Rising to the challenge

The problems

- Demand is expected to rise by 50 per cent by 2030.
- The environmental impact of both drilling activities and energy consumption must be reduced.
- Global energy security must be secured now and in the future.

How technology can help

- **Access to oil.** Technology is making previously inaccessible reserves economically viable, both by getting more from existing wells and by opening up new regions of the world. It is also contributing to refining capabilities and transportation.
- **Environment.** Technology has helped cut emissions and improve efficiency. It is also reducing the negative impact of drilling activities. In addition, technology is developing the alternative energy sources of the future.
- **Security.** Technology makes it possible to diversify energy sources, helping to stabilise supply.

What the industry needs

- The role of technology in the energy supply industry needs to be recognised, as does its vital contribution to research and development.
- Support and promotion of scientific research is required at government level.
- An open market policy encourages and rewards innovation while securing global energy security.

Alternative technologies like wind, solar and biofuels will also play an important role in the future. But before they become a viable alternative, let alone replace oil, natural gas and coal, they must be commercially competitive on a large scale.

Government subsidies, mandates, tax incentives and other interventions distort the market in a way that discourages the development of more competitive technologies. A better approach is to promote a market-driven business environment in which developers of energy alternatives compete to innovate.

The marketplace is a great motivator for creativity and innovation. Markets are also the means to greater energy security. Free and open global markets, based on strong trading relationships between exporting and importing nations, will enable energy suppliers to diversify energy supplies.

Energy interdependence – not energy independence – is the surest means of securing our energy future. In this regard,

continued partnership between the USA and Saudi Arabia is vitally important. Given the scale of its resources and its continued commitment to technology, Saudi Arabia is destined to play an important role in the future for the USA and the world.

> Ultimately, free market forces are the primary drivers of sustained technological progress.

An endless frontier

The eminent American physicist Vannevar Bush once said: 'Science and technology is an endless frontier.' In the oil and gas industry, history has shown this to be true. For more than a century, we have blazed new trails of scientific discovery that have pushed the energy frontier forward, to the benefit of all consumers. In the future, the industry will continue to innovate and overcome the energy challenges it faces.

AUTHOR

Rex W Tillerson is the chairman and CEO of the Exxon Mobil Corporation. A native of Wichita Falls, Texas, Tillerson earned a BSc in civil engineering at the University of Texas at Austin before joining Exxon in 1975 as a production engineer.

He assumed his current position on 1 January 2006. Tillerson is a director and a member of the Executive Committee and Policy Committee of the American Petroleum Institute.

He is also a director of the USA-Russia Business Council and a trustee of the Center for Strategic and International Studies.

He is a member of the National Petroleum Council, the Business Roundtable and its Energy Task Force, an honorary trustee of the Business Council for International Understanding and a member of the Emergency Committee for American Trade.