



The unconventional opportunity

Speaker: **Ahmed Hashmi**

Title: **head of upstream technology**

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A good morning everyone.

It is an honour to have the opportunity to speak to you.

It is always a pleasure to be in Oman and of course it is good to see so many familiar faces before me today.

The theme of this conference, the reason why we are here, is to look ahead at the challenges and opportunities in producing unconventional resources.

Let me start by sharing a few predictions from the past.

"The telephone has too many shortcomings to be seriously considered as a means of communication," Western Union memo 1876.

"Heavier than air flying machines are impossible." Lord Kelvin, Royal Society 1895.

How did some of us get to this event?

"Photographs will be telegraphed from any distance. If there is a battle in China a hundred years hence, snapshots of its most striking events will be published in the newspapers an hour later." John Watkins, an engineer, Ladies Home Journal 1900

"Physicians will be able to see and diagnose internal organs of a moving, living body by rays of invisible light." Ladies Home Journal 1900

I mention these predictions simply to illustrate how tricky it is to call out the future.

That has never stopped man from doing so, and I will do the same for unconventional resources today.

Global demand – our business exists to supply a world need

BP's Energy Outlook 2035 predicts that energy consumption will grow about 40 percent in the two decades to come.

While the [primary] energy supply mix will evolve, fossil fuels will continue to dominate, holding more than 80 percent of market share.

The demand for oil and other liquid fuels will be nearly 18 million barrels a day higher in 2035 than 2013. [Middle East 2013 production ~28 million b/d]

There is enough oil and gas in the ground to easily meet global demand through 2050, with some 45 trillion barrels of oil equivalent in-place according to BP's analysis.

About 1.7 trillion barrels of oil equivalent have been produced to-date.



Put another way, about 4 percent of the world's oil and gas resource in-place, has been produced to-date.

The most significant change to the resource opportunities over the past 10 years has been the advent of production from unconventional rock.

This has more than doubled total potentially exploitable oil and gas resources in-place.

In the Middle East, we estimate there is more than 300 billion barrels equivalent of recoverable unconventional oil and gas resource – including shale oil and gas and tight oil and gas.

Let's move on to the opportunities and challenges in producing unconventional resources

BP's Energy Outlook highlights the power of competition and market forces in unlocking technology and business innovation to meet the world's energy needs.

Nowhere is this truer than in the world of unconventional resources which require a confluence of several factors – fiscal policy, infrastructure, supply chains, alongside science, technology, experimentation, learning, and human capability to pull it all together.

Everyone in this room will appreciate that technology is a driving force in our industry.

Just take a look back 40 years when the oil and gas business got going in deepwater.

500 feet was regarded as [really] deep water.

Today, we routinely develop resources in more than 6000 feet of water and we are exploring at even greater depths.

The move by the industry into deeper water and complex geologies has resulted in major technological advances in seismic imaging, drilling rigs, surface and subsea facilities and instrumentation.

But...technology is not the only factor that must be considered when it comes to producing a resource.

Hydraulic fracturing was first used in 1947 by a BP heritage company in the Hugoton field in the United States.

For years, it was not economically viable to develop shale resources because commodity prices were just too low to justify the cost of extraction.

The increase in US natural gas prices toward the end of the last decade played a major role in unleashing a wave of business innovation that combined the known technologies of fracking and horizontal drilling.

Later, the attention turned to liquid production from the same source rock.

In 2003, there was no global shale oil production. In 2013 this was 2.7 million barrels per day.

During the same period the industry has gone from 1.4 billion cubic feet per day of natural shale gas to 27.5 billion cubic feet per day.



Now let's draw some parallels between conventional and unconventional resources to paint possibilities for the future

Over the past 30 to 50 years, in developing conventional giant fields, the industry has typically assumed a 30 percent field recovery factor upon project sanction.

BP's own experience from Alaska and Russia, where we have managed supergiant fields, is that through innovative practices and waves of new technology, the recovery factors can be higher than 60 percent.

By comparison, today's field recovery factors for shale gas are about 25 percent and for liquid rich shale plays they are only 5 percent.

Whereas the physics of unconventional rocks can be more challenging, we can expect meaningful strides in technology development.

At BP, we have a long track record and history of pioneering achievements in unconventional resources, starting from the first frac job in 1947.

In Oman, BP is applying its technology and expertise to develop one of the Middle East's largest tight gas resources.

The Khazzan project will provide a new gas supply to Oman on a significant scale.

The full field development was sanctioned in late 2013 and will involve drilling about 300 wells over 15 years.

We aim to have first gas in late 2017 with the ultimate production goal of approximately one billion cubic feet of gas per day. That is equivalent to an increase of about one third of Oman's total daily domestic gas supply.

Technology and technical know-how are crucial to this project.

Our 3D survey, conducted in 2008, was based on a game changing design called Distance Separated Simultaneous Sweeping or DS3.

This system allows the seismic team to acquire as much data in a single day as was previously gathered in a week.

The 1,080 square miles survey in Oman was completed in just five months.

The quantity and rate at which the seismic data was produced, over so large an area, was unprecedented but acquisition was just the first step.

Processing and properly digesting such a huge data volume requires extraordinary computing power. Our recently expanded Center for High Performance Computing in Houston is equipped with 3.8 petaflops of computing capacity and growing.

It allows us to extract insight from massive volumes of seismic data relatively quickly.

For the industry as a whole, the path to growing unconventional resources economically is to improve well cost and ultimate recovery per well. I think of these as Efficiency and Effectiveness.

Efficiency is about continuous cost and reliability improvement through technology enhancements such as drilling automation, low cost artificial lift, water treatment and re-use, to name a few.



Effectiveness means getting more production per well by targeting reservoir segments of good deliverability and designing highly productive completions. This requires integration of multiple sciences such as geology, geophysics, geomechanics, petrophysics and chemistry.

Integration of scientific models will create a clearer picture of the subsurface and its stress dynamics, enabling optimized completion designs as opposed to today's cookie cutter approaches.

Digital technologies are arguably the largest enabler for both efficiency and effectiveness.

As an industry, we will also need to reach beyond the oil and gas business to learn and put in place systems that can tell us what is really going on in the well-bore, near wellbore and the reservoir.

Sensors, signal and nano-technologies will provide this intelligence.

The supply chain is a critical enabler of efficiency improvement whereas the deep technical knowledge of scientists and engineers with access to advanced analytics and computational facilities will drive improvements in effectiveness.

All of this is fertile ground for leveraging and growing local infrastructure and building local capability

BP is fully committed to creating this future!

To summarize, the unconventional resource industry is still in the early stages and going back to the deepwater analogy, we can try to predict but cannot fully comprehend what will be possible 40 years from now.

In the world of today, where technological change is constant and rapid, it is safe to say that human beings will continue to experiment and innovate and that new and better ways will be found to extract and use energy.

We can also predict from experience that technology, economics, industry and governments will work together to bring about positive change.

In the words of Charles Kettering [inventor of the electric starter for automobiles] "My interest is in the future because I am going to spend the rest of my life there."

Thank You.