Fuellers Lecture 12 September

"Certainties and surprises – the unfolding 21st century energy story"

Thank you very much, Master, distinguished guests, ladies and gentlemen.

I'm grateful for the invitation to share some thoughts with all of you in these great historic surroundings.

I understand that this Livery Hall was designed in its present form by Herbert Williams in the 1860s.

This makes it roughly the same age as the modern oil and gas industry, which started with an oil strike in a place called Titusville, Pennsylvania in North America in 1859.

And it's interesting to consider just how much has changed in our business since this great hall was designed.

The world's population has risen from just over one billion to over seven billion. The world's economy has grown at an

unprecedented rate and our industry has produced more than a trillion barrels of oil. In fact more oil has been produced since I began working than all the years before.

Some of these changes of demographics and economics have been reasonably predictable. Other changes – less predictable – have arisen from politics, legislation and technology. We've seen a shift from a world of empires to one of nation states and from a world divided between capitalism and communism to an integrated global economy connected by 24/7 communications.

The energy industry has evolved too.

Chapter One was dominated by International oil companies – or IOCs – based in countries such as The UK, US, France and the Netherlands. Chapter Two saw the nationalisations of the late 20th century and the rise of the National oil companies – or NOCs. And now we're seeing a Chapter Three in which IOCs and NOCs are increasingly working together globally.

So tonight I'd like to look back and also look ahead with an eye to both the certainties and the surprises.

What happened as expected? What surprised us? And what can we learn from these experiences for the future? I want to try to tease out a few principles that seem to drive positive outcomes.

Looking back

Looking back, it's interesting to see how some predictions were spot-on while others were way off.

For example, back in 1998 the International Energy Agency projected that the energy consumption of the OECD countries would grow by 12% between 1995 and 2010. In fact it grew by over 20%.

But what the forecasters really under-estimated was the growth in the non-OECD world. They predicted growth of more than 50% for these emerging economies – but the actual figure was an extraordinary 78%.

An even bigger surprise, however, has come on the supply side, in the shape of the shale revolution – which I noticed you recently covered in your journal, The Fueller.

In 2006 the US Energy Information Administration – or EIA – projected that US domestic gas production in 2011 would be 19 trillion cubic feet. In fact it was 23 trillion.

And US domestic oil production also came in much higher than expected. In fact until 2004 all the forecasts said it would decline.

And as we know, this renaissance in the US has led to a further series of unexpected consequences, which are still continuing.

US natural gas prices have fallen. Gas has displaced coal in power generation. And America has become less dependent on imports from the Middle East. In fact it is heading in the direction of self-sufficiency in energy.

In 2006 the EIA projected that the US would need to import around 5 billion barrels of oil in 2010. In fact, as a result of shale,

plus the state of the economy and improvements in energy efficiency, it only imported 3 billion.

These factors have also had a big environmental impact. Last year America's carbon dioxide emissions fell to their lowest level since 1994.

Energy has also helped get America back to work. Oil and natural gas companies now support over 9 million jobs – directly and indirectly – and the number is rising. That's more than the population of London or New York.

On a global scale, the increase in shale production, along with other unconventional forms of energy, such as heavy oil, has effectively removed the spectre of what was called peak oil. This was the fear that oil production would peak, decline and eventually disappear.

In fact there is plentiful supply out there. We now estimate there is over half a century's worth of both oil and gas, using today's

technologies, even if no more is discovered. It is the demand for oil and gas, not the supply, that is starting to peak.

In particular, oil demand in the US hit a peak in 2005, and demand for oil in the EU last year was at its lowest level since 1984.

However, in Europe the supply picture has been very different. And the surprises have not all been good ones.

Shale development has not yet taken off. Natural gas prices have remained relatively high. Coal, displaced from the US, has been exported to Europe. Coal consumption in the UK, for example, went up 24% in 2012. And carbon emissions also rose in Britain and Germany. I'll return to the implications of this later.

Globally, it's also interesting to look back on forecasts relating to renewable energy.

Renewable energy used to generate electricity rose to over 750 terawatt hours by 2010, more than double what was forecast a

decade earlier, largely thanks to the support governments have provided.

That's a lot – roughly enough to power 150 million people's homes – half of the US – but renewable energy still only accounts for around 2% of all energy used in the world. Renewables are not generally cost competitive with fossil fuels at scale and governments can only go so far in subsidizing or mandating their use.

So what should we learn from these experiences? In my view they firstly show the importance of creating foundations for growth – for investment and for innovation.

In the US, the development of shale has been a classic case of markets at work – supported by favourable tax regimes, pipeline infrastructure and the fact that land owners also own the rights to minerals below their land.

However another part of that foundation for growth is a long-standing culture of public-private collaboration in innovation.

One of BP's heritage companies, Amoco, did a lot of ground-work on hydraulic fracturing back in the 1940s – but the technologies of directional drilling and fraccing were also advanced in a big way by support from the US National Energy Technology Laboratory in the 1980s.

In the UK, too, we have seen results when foundations for growth have been created. In particular, the government has listened and worked thoughtfully with the industry to create the conditions for growth in the North Sea.

In 2012, nine new fields began producing. This year Oil & Gas UK expect 15 more to come on stream, with reserves of 470 million barrels. BP and its partners are investing £10 billion over five years in North Sea developments. This will be welcome news for the UK.

Just yesterday at BP we announced that over £1 billion worth of contracts have now been awarded to UK-based companies for the redevelopment of the Schiehallion and Loyal fields west of Shetland.

Oil & Gas UK now forecast that, instead of declining, North Sea production could grow from around 1.4 million barrels a day to around 2 million barrels a day by 2017.

Energy plays a vital part in Britain's economy and its trade. The oil and gas industry is a flagship within British industry, supporting around half a million jobs, directly and indirectly, and generating about £40 billion a year.

Britain has been – and remains – a world leader in many areas. In sub-sea engineering, for example, it has almost half of the global market. So at least Britannia still rules *beneath* the waves.

But Britain also faces some challenges. It has been a net importer of energy for nearly a decade and it faces dilemmas in meeting its power needs as aging coal, nuclear and gas plants close.

Looking ahead

So let's now look to the future, again starting at the global level.

I would say the priorities are to understand the things that have surprised us in the past – and then plan from experience – so we can replicate successes and avoid unwelcome surprises.

As I've indicated, I think some of the key lessons from the past are to build platforms for growth, including open markets and public-private collaboration in innovation.

Looking at the demand for oil and gas worldwide, we certainly expect to be on an upward trajectory for several decades – following the continuing growth of the world's population and its economy.

Economic growth globally could falter – but we think the most likely outcome is that the world economy will roughly double in size between 2011 and 2030. Think about that for a moment – the world's economy doubling in only 19 years.

Our calculations show that this translates into a rise in global demand for energy of another 4 billion tonnes of oil equivalent or 36% from 2011 to 2030. And the growth is almost all coming from

the emerging countries of the non-OECD world – 93% of it, our economics team calculates.

There is good news and bad news here. The good news – which easily gets overlooked - is that this massive number – the 4 billion tonnes – represents a new chapter in human progress – millions of people moving out of poverty, into homes and jobs, enjoying heat, light and mobility to improve their lives.

It also reflects the increasing influence of China, India, Russia and Brazil in the energy world. The big talking points in the energy industry today are not only the US shale story and the events in the Middle East but the huge long-term deals being made between companies from Russia – the world's number one producer of oil and gas – and China – the number one consumer of energy.

Largely due to the influence of these emerging giants, particularly China, the world's car fleet will be evenly split between OECD and non OECD by 2030.

Also, a projected rise of 36% in energy demand up to 2030 is a lot. But it is a lot less that the 50% rise in demand in the 20 years between 1990 and 2010. That shows how energy efficiency has improved.

However, we also have to recognise that a 36% rise in energy use is likely to mean a 26% rise in carbon emissions.

So the challenge is to enjoy all the benefits of energy while using it even more efficiently and also trying to shift the energy we do use towards the lower carbon end of the spectrum.

We need to be practical about this. We have to face the fact that nature has created some immensely efficient sources of energy in the shape of hydrocarbons. This is because the energy is so densely packed in them. It's much easier and more efficient to produce and transport coal, oil or gas than energy from sunshine, wind or waves.

And when it comes to reducing emissions, there are many opportunities to save energy through using it more efficiently, or

switching from coal to gas. Both of these are generally more cost-effective than switching out of fossil fuels into renewables.

One of our academic partners at Cambridge has figures indicating that only just over a tenth of all the energy extracted at source actually ends up as useful heat, light and motion. So there is massive scope for improvement.

In the US, market forces have acted to bring down emissions, via energy efficiency and the substitution of natural gas for coal. But that won't necessarily happen everywhere without additional action. So we continue to support cap and trade systems that put a price on carbon and bring the power of the market to the effort to limit greenhouse gas emissions.

Beyond a carbon price – drawing on experience – we think that support for lower-carbon technologies should be tailored to their maturity.

Market-ready technologies – like housing insulation for example – can be supported by setting relevant standards and requiring people to use them.

Proven technologies that need scaling up – like onshore wind and some types of biofuels – can be supported by temporary incentives and mandates.

But promising technologies that are a long way from commercialization, like advanced batteries, really need R&D investment more than anything else.

We've seen the power of setting standards and deploying technology in the auto industry where car makers have responded to government legislation by creating downsized engines and lighter vehicles around the world.

Fuel economy is improving rapidly and that means demand for oil is expected to grow at under 1% a year in the coming decades. But with oil being the fuel of choice for transport, that demand is pretty solid and it still translates into 16 million more barrels every

day by 2030. That is a like adding at least another Saudi Arabia and another Kuwait to world production.

That means that the exploration and production industry is continuing to work at new frontiers – greater depths and pressures offshore, heavy oil formations onshore, shale and tight oil and gas fields and most recently the Arctic.

In BP we are acutely aware of the risks this entails, having experienced the Deepwater Horizon accident in 2010. And we have asked ourselves this very fundamental question.

How can we operate in increasingly high risk surroundings, while maintaining safety and delivering value to our customers and shareholders into the long-term?

We've approached this from several directions. We have created a powerful new safety and operational risk team. We've introduced new global practices. We have hired people and learned from other high hazard industries such as aviation and the military.

More broadly, we have reshaped the company, divesting non-strategic assets and investing in strategic ones. This has had the effect of driving down risk and driving up quality. Our $38 billion divestment programme, for example, removed around half our upstream installations and pipelines, but only around a tenth of our reserves.

We've made a lot of choices at BP that enable us to play to our major strengths.

For example, in the US, we have divested two refineries and we are investing in the others.

In the upstream we are focused on a limited set of provinces, the top four production locations for us being – North Sea, Angola, the Gulf of Mexico and Azerbaijan.

Exploration is a major strength and so we have doubled investment, increased the number of wells and built the world's biggest supercomputer for commercial research in Houston to process our seismic data. We want to build on the capability that

enabled us to pioneer the exploration of the deep-water and discover some of the world's top sub-salt fields.

In just the last few months we have had discoveries in Brazil, Egypt and India – in fact, we've had two in India.

In lubricants and fuels, we concentrate on premium performance brands – Castrol Edge and Castrol GTX for example, and BP Ultimate fuels. In petrochemicals we focus on just three chemicals – in which we have the world's leading process and technology.

These are PTA (Purified Terephthalic Acid), paraxylene and acetic acid. These are not the most catchy names but they are substances that end up in thousands of everyday items - including clothing and plastics of all descriptions.

Across BP, we are now seeing improvements in production, plant efficiency and refining availability, with fewer incidents, leaks and spills. We still have a long way to go – but we can see the direction of travel.

Looking to the future of our industry more widely, there is clearly a lot of food for thought in the US shale revolution, particularly for Europe and the UK.

In the US the ripples from shale have spread well beyond the energy world. As I indicated, not only has America increased its production. It has created jobs, increased its competitiveness, reduced dependence on imports from the Middle East and slashed its greenhouse gas emissions.

China and Russia are both exploring the potential of shale, and there is a risk Europe could get left behind. I think it's important that the debate in Europe is a really balanced one – and in particular, the potential environmental prize should not be overlooked.

I wonder how many of the well-intentioned demonstrators that we see on television know they are protesting against a technology that has helped to cut America's carbon emissions to a 20-year low?

Another way Europe can gain access to more affordable gas as an alternative to coal is by expanding its sources of gas imports. One new source will be opened up through what's known as the southern gas corridor. This will pipe gas into southern Europe from a giant field that we'll operate called Shah Deniz in the Caspian Sea. The project is due to provide about 16 billion cubic metres of gas each year. That's roughly four times the total used in Greece or about a quarter of what Italy uses.

As well as undertaking such large projects, we also need to make advances in the technologies used to find, produce and process fossil fuels. And here I think one big question for the UK is how it can build an even stronger culture of public-private collaboration in innovation.

In BP we have benefitted from this in lots of ways. For example, we worked with Imperial College, London to design a new type of wireless corrosion monitor – known as Permasense. Thousands of these monitors are now installed in refineries worldwide to detect early signs of corrosion.

Last year we launched a new International Centre for Advanced Materials, or ICAM, the 'hub' of which is based at the University of Manchester. This is a 10 year, $100 million programme that brings together some of the world's best materials researchers – not only from Manchester but also Cambridge, Imperial College and the University of Illinois.

All of this needs to be co-ordinated and there is good work going on in government and elsewhere to shape Britain's energy future. One initiative that we're involved with is the Energy Technology Institute – or ETI – based at Loughborough University, designed to identify and accelerate the most promising areas for development.

At the heart of the ETI is a model of the entire energy system, including interactions between power, heat, transport and infrastructure. It factors in performance, costs and rates of installation for each new technology with options for each geographic area. We think this is probably unique in taking such a holistic approach. I suggest you take a look at the ETI.

Finally I must add that while smart technology matters, smart people matter more.

One absolute certainty is that the baby-boomer generation is now retiring and the growing industry will face a shortage of highly skilled engineers, technologists, geologists and other professionals.

So we urgently need to show young people – around the world – that this is an industry with a great future as well as a great past.

We have to demonstrate that this is a high tech, high value industry which is bringing real benefits to people around the world. And we must show young people how exciting and fulfilling a career in energy can be.

That is why for example in the UK we have supplemented our 40 year old Link Programme with new projects such as Enterprising Science which we are running with the Science Museum and King's College, London. The goal is to develop new tools and techniques

that teachers and museums can use to inspire young people into following a career in science, technology and engineering.

Last but not least, we know students want to join a firm that has clear values and applies them. In BP we do have clear values – they are safety, respect, excellence, courage and one team – and we stand up for what we think is right.

That for example is why we have paid $11 billion worth of legitimate claims to people affected by the 2010 spill in the Gulf of Mexico – indeed no company has done more to respond to an industrial accident – but why we are resisting paying claims to people for inflated or non-existent losses.

Conclusions

So to sum up, we operate in a sector where some things are predictable but others are not.

However, we should be able to plan from experience to minimise surprises and replicate successes.

That should lead us to do several things – to prioritise safety and systematic operations in the industry – to create strong collaboration in innovation between private and public sectors – and to build foundations for investment such as those which have driven the transformation of America's energy and its economy.

Finally my last and crucial point – we all have an obligation to explain to young people – and indeed everyone – that the work we do is critical, exciting and innovative. I believe it is a real force for good in the world. The energy, heat and light we generate are critical in the economic development of the world and to providing a better standard of living for its growing population.

I hope you agree – at least with that last point – and I very much appreciate the opportunity to speak with you tonight. Thank you.