

Energy for the Future ***Issues and Options for UK Energy***

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University of Hertfordshire, Hatfield

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SLIDE 1 – INTRO. SLIDE

Ladies and Gentlemen, good evening, I am delighted to be here tonight. Many thanks to Sir Bill Francis and the organizers for inviting me here tonight to discuss such an important subject. Let me be briefly summarize what I want to cover tonight:

SLIDE 2 - THE THREE-PART CHALLENGE

First, I want to look at a global, three-part energy challenge – global energy demand growth, climate change, and security of supply.

I'll say a bit about each of these. And I will suggest that by embarking on a global energy transition we can continue to meet our growing demand for energy, and that future energy supplies are sustainable.

The dominant feature of the energy business in the early 21st century is its increasing globalization, so I make no apology for talking about sustainable energy supply and consumption as a matter of global as well as local – UK - significance.

Second, I want to talk about the challenges facing the UK now that we are no longer self-sufficient in energy supply.

I'll explain what my company Shell and industry are doing to import gas. And I'll explain the central role of technology in meeting the longer-term challenges.

It follows that the third and final area I want to cover is my industry's need for great people with the technical and scientific know-how and expertise to develop the technology that will help us meet the challenges society faces. The energy business is a great business and we need great people to take it into the future.

Throughout my talk tonight I will refer to what we in Shell are doingnot because we have all the answers but because I am more familiar with our own operations. So please bear with me.

SLIDE 3 – WORLD ENERGY DEMAND -The three-part challenge

So let me explain the three-part challenge – first, demand. Lets' start with a broad human context.

The richest billion people on the planet consume over 50% of energy production. The poorest billion consume around 4%. Closing this gap is a challenge to the environment, to economic growth and ultimately to social justice.

The rapid development of emerging economies, particularly in India and China, and the impact on global energy needs — has come into sharp focus over the past two years.

The world consumed the equivalent of 8.1/2 mln b/d more last year compared to 2003. That's twice Britain's total energy consumption – and is the largest ever global increase in one year.

China accounted for over 40 per cent of this growth – almost all imported. Let's remember that energy fuels economic development and quality of life. There is not a lot we can do in modern life today without energy. The IEA forecasts that by 2030 demand for energy will be some 60% more than it is now.

Increasing demand can be satisfied. There's still a lot of oil and gas to find and, as I will explain, there are many other options for providing the energy we need. The challenge is to undertake the increasingly complex, costly and demanding projects.

As well as the skills of scientists and engineers, it will require massive investment – over \$16 trillion by 2030 to develop supplies and build energy infrastructure according to the IEA. About 60 per cent of this investment will be in developing and transition economies, much on basic power and infrastructure provision.

But as we know meeting expanding demand is only part of the challenge.

SLIDE 4 – CLIMATE CHANGE - The three-part challenge

The second element of the three-part challenge is climate change.

I think there is now broad agreement that climate change is happening; and in part is caused by carbon emissions from human activities and this requires urgent action.

If energy demand grows as rapidly as many expect, carbon dioxide emissions could increase by 70% over the first three decades of this century. That is in essence is the nub of the energy challenge.

If we are to eventually stabilise atmospheric carbon concentrations at 550 parts per million – twice the pre-industrial levels – we simply will need to

reverse this trend before 2050. That means big reductions in the developed economies.

The UK's goal of a 60% reduction by 2050 indicates the scale of the challenge. It also means that the developing countries need to find ways of growing in a more energy-efficient way than we did. We will need to help.

SLIDE 5 – SECURITY OF SUPPLY - The three-part challenge

The third element of the three-part challenge is security of supply. Conventional wisdom is that the high prices we've seen recently should stimulate supply and reduce demand.

Yet on the demand side we have so far seen surprising little change, with continued strong growth in energy demand in major emerging economies...just look at China.

On the supply side – despite increased activity – the response has been limited, particularly in non-OPEC supply. Overall upstream supply has struggled to match demand growth.

We need to raise our game, not only energy companies but also society, if we are to achieve the necessary transformation in how energy is supplied and used.

Much will depend on the decisions of political leaders, as well as on all our willingness to accept change. But, most of all, it will depend on our ability to foster and fund technological innovation in an atmosphere of uncertainty.

SLIDE 6 – GAS IS TRAVELLING

As to the availability of oil and gas. There are significant resources of oil being developed or still to be discovered.

And we don't have to worry about a shortage of gas...there is plenty of gas in the world. Latest figures show that the global gas reserve is 50% higher than

oil at some 60 years of current demand. And gas is far less explored than oil – so there's plenty more to be found.

The other thing to note is that gas is now being transported to markets over long distances. Just look at supplies positioning for the US Market. Gas is traveling.

SLIDE 7 – GAS FUEL OF 21 CENTURY

The UK Energy White Paper, in round terms, anticipates that by 2020 gas could supply around $\frac{3}{4}$ of UK electricity generation....which approximates to replacing today' oil and coal capacity by gas. That is a big change in 15 years! Indeed globally, Shell LT scenarios indicate that gas could overtake oil as main the fuel of choice around 2025-2030.

SLIDE 8 – ENERGY DEMAND TO DOUBLE – HALF STILL OIL AND GAS

In response to the three-part challenge I have described, societies around the world will need to embark on a transition from energy sources that are principally based on fossil fuels to energy sources that are renewable and sustainable for the long-term. The transition needs to happen if we are to have sufficient, affordable energy while ensuring that we do not do irreparable harm to the environment.

Although most medium-term forecasts show a rapid growth in renewable energy sources, it is likely that by mid-century, fossil fuels will continue to satisfy about $\frac{2}{3}$ rd of energy demand.

So, in thinking about the transition, we will need to make the best and cleanest use of hydrocarbons while we have them; we will need to identify bridging technologies that use existing infrastructures; and we will need to develop energy sources that are sustainable.

The pace and nature of this transition will be dictated by a combination of regulation, consumer preference and technology. We can not predict the

timing or path of the transition with great certainty. But we need to develop the options for ourselves so that we find which energy sources work best and deploy the solutions in good time.

SLIDE 9 – UK NET IMPORTER BY 2005/6

Now let me turn to the UK. You probably don't need me to tell you about the importance of gas in the UK's energy mix. We all want to maintain a security of gas supply for the UK. But I believe success will depend on a number of factors.

To begin with, it is vital that we maintain a long-term view amidst the many short-term pressures that challenge us. Energy provision is not a short-term business and requires stability and predictability in a positive investment climate. These are essential if we want to guarantee investment in adequate infrastructure for continuous and reliable supply of gas.

We must also strike the right balance – make the most of what remains in the North Sea - while we reduce or remove barriers to gas supply from elsewhere.

One of the primary areas of strategic importance must be liberalising European energy markets. That's why Shell supports the EU's adoption of the 2nd European Gas Directive.

SLIDE 10 – SHELL & UK SECURITY OF SUPPLY UK

After years of self-sufficiency gas is now being imported to the UK by Shell and others, largely thanks to value chain integration and cross-border efforts.

Over the last 10 years my company has invested well over £8 billion in the UKCS. And we will maintain our leading role, investing in the development of new infrastructure, to handle the changing volumes and sources of supply for the future.

Actually importing gas is nothing new for the UK. Shell already brings gas from Norway's Statfjord field into the UK via St Fergus in the NE of Scotland. And we are currently investing in many others sources of imported gas.

Consider the 235 km pipeline, Den Helder (NL) to Bacton (East Anglia), for example. This project will meet 10% of UK gas demand.

Clearly cooperation across national boundaries is particularly important. Let me remind you of the Anglo-Norwegian Framework Treaty, signed in 2003. It has recently helped the UK secure gas supply from the Norwegian Sea.

And this kind of cooperation is essential to the success of a vital project like Ormen Lange. This giant gas field could produce 20 billion cubic metres a year. It has the potential to supply 20% of UK gas needs for decades, through the 1200 km pipeline to Easington in the East of England.

Investment in Ormen Lange has been secured, thanks in major part to the progress of UK/Norwegian government moves to reduce barriers across the North Sea.

This project is on time within budget and about ½ way through construction and will be producing at the end of 2007. Shell will operate this project.

So from a strategic point of view, I believe there will be sufficient pipeline capacity for gas imports into the UK and that pipelines will be commercially competitive.

Although we are a global leader in LNG, we believe it's currently a better choice than bringing in LNG from distant sources.

We also recognize that others may see this differently and that has got to be good for UK plc.

But let me be clear, I'm not saying imports or even gas are the long-term solutions. There is no panacea. They are a part of the transition that needs to happen. There are other challenges facing the UK to ensure a diversity of supply - and therefore our security of supply. I'll say something about five transition areas as I see them:

SLIDE 12 – 1. MORE EFFICIENT USE OF ENERGY

More efficient use of energy will help us manage the greater demand. Clearly industry and commerce have strong incentives to use energy efficiently and Shell is taking action in this area.

The constant drive to reduce costs means that lower energy bills are always going to be an attractive option. Putting a cost for carbon into the system creates an even better incentive.

SLIDE 13 – 2. MAKE THE MOST OF EXISTING SOURCES OF ENERGY

Making the most of existing sources of energy starts, at least for me, with oil and gas. We need to recover more from existing oil and gas fields. The industry average Recovery Factor for oil is just over 30%. Raising this to 45% would add over 500 billion barrels to world reserves, i.e. another 20 years of production at current rates.

SLIDE 14 – 2. MAKE THE MOST – IMPORTANCE OF TECHNOLOGY

Trying to squeeze more out of fields is nothing new. In the North Sea, the industry has been successful in prolonging the life of fields ...mainly through technology development and implementation.

SLIDE 15 – 3. REDUCE AND MANAGE EMISSIONS

As a third area of transition and technological progress, business must focus on its own activities to reduce and manage emissions of carbon dioxide from energy processes.

In Shell we met our target of reducing emissions from our own operations by 10% relative to 1990 levels. We then set a new target for 2010 that emissions should still be 5% below 1990 levels, even taking into account the growth in our business.

Emissions trading schemes are vital in driving down carbon emissions and in using market forces to find the most cost effective ways of doing so. We were the first to execute trades on both the UK and EU carbon emissions trading systems.

Given society's continuing and substantial need for fossil fuels the idea of 'carbon abatement technologies' is rightly attracting significant attention. The government's carbon abatement review, published earlier this year is well worth reading and creates an important basis for action.

There are solutions for capturing and dealing with CO₂ at various stages of production processes. And once CO₂ has been captured, it can be used to enhance oil recovery. Shell learned how to inject CO₂ into oilfields to enhance recovery 20 years ago in Texas.

SLIDE 16 – 3. REDUCE & MANAGE EMISSIONS - MILLER
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An example closer to home is a project being planned for the Miller field in the North Sea - where Shell is a partner. The project – to produce decarbonised fuel and use it for power generation.

The project would use the hydrogen gas as fuel for a 350MW power station near Peterhead, in the N E Scotland, while the carbon dioxide would be

exported through existing pipelines to be injected into the Miller field reservoir. This could increase oil recovery by 40 million barrels of oil, and potentially extend the life of the field by 15 to 20 years.

The different technologies are proven, but their proposed combination would be a world-first. If the project goes ahead, when fully operational it is expected to capture and store around 1.3 million tones of carbon dioxide each year – the equivalent of removing 300,000 cars from the roads and provide carbon free electricity to the equivalent of a quarter of a million homes.

We are also working on similar pilot projects in Germany and Poland whereby we inject CO₂ underground and into coal beds to extract gas.

At the same time we are looking at mineralization of CO₂ – where the resultant product can be used in construction materials.

Success with carbon sequestration could also be very important for coal. We know that the US, China and India have large coal resources that they are unlikely to ignore. The US for example has five times the energy in coal that Saudi Arabia has in oil.

At Shell, we initially pioneered our coal gasification process in the Netherlands. It has since achieved huge success in China where 12 different licenses have been sold, and more recently Shell was selected as the preferred provider for a proposed coal gasification power project in Australia. This is very exiting stuff.

SLIDE 17 – 4. NEW SOURCES INTO PRODUCTION

Technological progress is also bringing new energy resources into production – often in more difficult conditions and from unconventional resources.

These fuels will, of course, contribute to a diversity of supply and therefore our security of supply in the long-term.

SLIDE 18 – 4. NEW SOURCES INTO PRODUCTION - unconventionalals

There are the unconventional hydrocarbon resources such as heavy oil and bitumen, oil shale, shale gas, and coal bed methane – whose total global reserves are about three times the size of conventional oil and gas resources.

Interestingly, those resources are closer to major energy demand centres than the conventional resources focused in the Middle East. The challenge is to produce them in ways that are economically viable and environmentally responsible.

We are pursuing the potential of other technologies – such as coal gasification - for accessing unconventional resources elsewhere.

SLIDE 19 – 4. NEW SOURCES INTO PRODUCTION – solar, wind, wave

The search for more sustainable long-term energy sources takes us to solar, wind and wave power. Fossil fuel companies have shown themselves willing to develop these businesses. For example, Shell companies have produced about 15% of the world's solar capacity. Improving the conversion efficiency remains a key challenge.

Equally, while solar can make some contribution in the UK, it is unlikely to be a major part of the long-term energy mix.

Wind energy is the most cost-effective renewable energy technology available. Shell is involved in developing two large offshore wind projects in the UK. One of these is the London Array. This project will require Shell and its partner to invest up to £1.5 billion. It is based on 270 wind turbines in the outer Thames estuary.

A planning application has been submitted recently and, if consent is given, it could generate up to 1,000 megawatts of electricity, enough to supply 750,000 homes. That's about a quarter of the homes in greater London.

There are a number challenges to respond to, but if it goes ahead this project would contribute about 10% of the government's 2010 renewables target.

Biofuels

Biofuels are already used in road transportation in the form of ethanol and biodiesel.

In fact Shell is the world's largest blender of biofuels and sells two billion litres a year – that's enough for nine million cars. We are supporting further development of these kinds of fuels from straw and other crop wastes. This then becomes a near zero carbon option.

Hydrogen

Hydrogen is tantalising, being emission free at the point of use. Nonetheless creating a hydrogen infrastructure and finding carbon free ways of producing hydrogen are not simple.

In Shell we are sufficiently interested in the prospects to be running pilots in North America, Iceland, Continental Europe and Japan. This is a technology where partnership among car makers, energy companies of various kinds and regulators is key.

Nuclear

Nuclear, well Dr Robert Hawley will give you a persuasive talk on the attractions of Nuclear as a carbon free source of energy.

One of the difficulties if nuclear does become a preferred option will be to create the right commercial environment in which the private sector will want

to invest. Front-end outlays are large, the decommissioning costs are high and the risks and uncertainties around dealing with waste pose a challenge.

SLIDE 20 – 5. DEVELOP MORE EFFICIENT WAYS OF PRODUCING

Shell is active in developing more efficient ways of producing energy and cleaner fuels.

Our gasification technology can be used to produce high-quality synthetic liquid transportation fuels and other products from gas, coal and biomass and we see such a potential role for all these three sources of carbon.

We have been pursuing the potential of gas to liquids for over 30 years – developing our technology, gaining operational experience and creating markets.

So there are many, many technological possibilities. What matters is our ability to develop and deploy them quickly enough.

SLIDE 21 – UNDERGRADUATES

And as I said at the outset, it follows that with so many challenges and exciting areas of technological progress – our largest challenge right now is attracting people – scientists, engineers and technologists. The importance of, and need for, top-class industrial capability and talent is greater than ever.

You know only some 5% of undergraduates entering British universities last year studied engineering, half the percentage in 1988. Compare this to 16% in Germany and France and 44% in China are in engineering – and there are 1.4 billion people in China.

We all have a responsibility – particularly those in positions of influence – to make clear that scientific and engineering skills are essential to meeting one

of the greatest global and societal challenges of our times, such as those concerning increasing energy demand, climate change and security of supply.

SLIDE 22 – PEOPLE

Ladies and Gentlemen. I hope I have succeeded in laying out the three-part energy challenge we all face, and explained how we can respond by embarking on a smooth transition to a high-demand, cleaner energy world.

The challenges are great but I believe the solutions are within our grasp. When all the talking is done, it is - and will be - about people.

I'll finish on a personal note. I joined Shell as a Petroleum Engineer 20 years ago. I was attracted to a great company in a great industry. I joined because it was exciting, it was pioneering, it involved big, capital-intensive projects in frontier areas with many engineering challenges. So as an engineer I was hooked.

I felt I was going to be part of something that was special and very different. In my 20 years there have been lots of opportunities for travel and for doing all sorts of jobs across the world. I have not been disappointed.

I hear talk today about the energy business being a sunset business. The energy business will never be a sunset business and I actually believe the offerings of the industry today are better than ever. I hope some of you agree. Thank You.

SLIDE 23 – PECTEN CLOSE