Balancing Global Resources

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Malcolm Brinded is Executive Director of Exploration & Production and a Member of the Board of Royal Dutch Shell plc.

He was born in the UK in 1953 and joined Shell after graduating in Engineering from Cambridge University. He has worked for Shell companies in Brunei, the Netherlands, Oman and the UK. In 1998 he became Managing Director of Shell UK Exploration and Production - responsible for a fifth of the country's offshore oil and gas business - and from 1999 until 2002 he also was Shell Country Chairman in the United Kingdom. He became a Group Managing Director in 2002 and Executive Director of Exploration & Production in 2004. He is a Fellow of the Institutions of Civil and Mechanical Engineers and a Council member of the Royal Academy of Engineering. He was appointed CBE in 2002 for services to the UK oil and gas industry.

He is a member of the Nigerian President's Honorary International Investor Council, and a Trustee of The Prince of Wales International Business Leaders Forum and the Shell and Emirates Foundations.

In this speech, Malcolm Brinded discusses what oil and gas companies can do to promote a gradual transformation of the global energy system. The three hard truths of rising energy demand, dwindling supplies of easy-to-produce oil, and rising greenhouse gas emissions, make such a transformation necessary and inevitable. There are a number of areas in which the oil and gas industry can play a positive role. First, sustaining supplies of affordable and responsibly produced oil and gas, through better technology, cost reductions, more efficient operations and fresh thinking. Second, reducing the CO2-intensity of fossil energy by delivering more natural gas, the cleanest-burning fossil fuel, and by deploying CO2 Capture and Storage. And, third, helping the world to broaden the energy mix, with Shell involved in wind, solar and, in particular, biofuels.

Three Hard Thruths

What brings us together today is a fascination for the secrets planet earth hides below the surface.

Over the past century society has been able to unlock many of these secrets. We have of course learned to extract energy from the subsurface, to transform our civilisation.

Without this energy, there would be no heating, no lighting of the night and no convenient transport. As everyone in this hall knows, there is still plenty of oil and gas to be found and produced, but in increasingly difficult place, whether that's difficult geology, difficult environmental conditions, or difficult politics.

Indeed, supplies of easy-to-produce oil will by far not keep up with growing energy demand. That's because energy demand is likely to double over the first half of this century, and we simply cannot grow oil and gas production that fast.

Even if we produce energy from all possible sources, it will be difficult to meet the world's growing needs.

And of course, emissions of CO2 and other greenhouse gases are on an unsustainable pathway.

These are the three Hard Truths that make a transformation of the global energy system necessary and inevitable.

In Shell, we want to play a positive part in driving that transformation, and I'm sure that this goes for everyone in this Hall.

Energy technology deployment curves

But the transformation will have to be a gradual one.

We need balance between the three Es of Energy security, Economic development and Environment. Policies aimed at a too hasty displacement of fossil energy might well help mitigate the risk of climate shocks, but would at the same time condemn many of the world's citizens to energy poverty.

That's why the balance is so important to get right. Let me explain why:

Historically, it has taken 25 years for new energy sources and carriers to obtain a 1 percent share of the global market following commercial introduction.

And, before that, the transition from scientific breakthrough to commercial introduction itself may take decades. So Shell's latest Scenarios assume that wind, solar and biofuels, all grow much faster than previous energy sources, but even then it takes decades to get to materiality.

LNG, provides a good example. Following many years of research, the first LNG plant came on stream in 1964, in Algeria, actually using Shell technology. Since then, the growth of LNG has been spectacular. But, today, more than forty years after commercial introduction, the share of LNG in the global energy mix is still only about 2%. Even with massive LNG plants like our new one in Sakhalin shown here.

Shell's scenario experts believe that renewable sources could provide around 30% of the world's energy by the middle of this century, from around 3% today.

"Historically, it has taken 25 years for new energy sources and carriers to obtain a 1 percent share of the global market following commercial introduction."

That would be impressive growth, but it also means that it will take forty years to get there, and that fossil fuels and nuclear will supply the remaining 70% even then.

So if we wait for alternative energy to reach material scale, we will find it impossible to curb CO2 emissions in time.

To prevent severe climate shocks, we need to also focus on reducing the CO2-intensity of fossil fuels. And that should be one of our industry's key messages to stakeholders.

So I see three key areas where our industry can play a positive role in promoting a gradual energy transformation:

- First, we need to supply sufficient amounts of affordable oil and gas to meet the world's growing energy needs. And, today, I will focus on that.
- Second, we need to reduce the CO2-intensity of fossil fuels.
- And, third, we can help the world to increase the share of non-fossil fuels.

Economic recession

The economic recession is temporarily masking the "hardness" of the hard truths. It suppresses energy demand and moderates CO2 emissions.

But the underlying trends will become visible again once the economy recovers.

In fact, the recession makes it harder to keep up investments in future supplies – paving the way for future price spikes and volatility.

In Shell we will keep our investment at $ 31-32 billion in 2009, of which over $ 3 billion is earmarked for exploration.

But the sector as a whole has great difficulty sustaining investment. Indeed the International Energy Agency estimates that upstream oil and gas investment will fall by over 20% compared to last year. And, spending on renewable energy projects is falling even more rapidly, and could drop by nearly 40%. But our industry's primary duty remains delivering hydrocarbons, affordably and responsibly.

To do that, we have to open up new resources and extend the life of ageing oil and gas fields. That requires new technology, lower costs, increased efficiency and fresh thinking.

Exploration technology

Finding more resources through better Seismic technology is where it all begins.

Let me give you an example.

In Shell we've invested over $100 million in high performance computing power since 2006.

This allows our in-house seismic processing experts to apply proprietary algorithms so that we can extract much more information from seismic data than in the past.

Combining this with technology like ocean bottom sensors, we can see features in the subsurface that simply are not visible on conventionally processed seismic data.

In particular we have been working on the problem of sub-salt imaging, in places like the Gulf of Mexico, the North Sea, and Brazil, using, for example, Ocean Bottom Seismometer (OBS) surveys by putting sensor nodes directly on the seabed.

The chart here shows the difference between streamer narrow-azimuth seismic (on the left) and the OBS wide-azimuth seismic on the right. This gives us much better data quality and much faster speed of migrating data.

The end result is that prospects become apparent where none had been visible before, allowing us to drill the right well in the right place.

Enhanced Oil Recovery

At a time of surging global demand for energy, squeezing extra barrels from ageing oilfields is another crucial way to sustain energy supply.

Today, the average global recovery rate is about a third of the original oil in place.

There are several proven techniques for Enhanced Oil Recovery (EOR): all aiming to reduce viscosity and improve oil mobility by either heating with steam, by flooding with miscible gas or by using chemicals.

The International Energy Agency (IEA) estimates that, by using these technologies, we could unlock an additional global resource of 300 billion barrels. That's more than fifteen times the total known oil reserves in the United States.

"If we wait for alternative energy to reach material scale, we will find it impossible to curb CO2 emissions in time."

Reviving Schoonebeek

Shell has a global portfolio of EOR projects with California and Oman on trail-blazers. But one of our most interesting is Schoonebeek, here in the Netherlands.

What is unique about Schoonebeek is that we are reopening a field that we had abandoned completely.

Some of you may remember seeing the nodding donkeys when driving through East Netherlands years ago.

With 1 billion barrels of oil in place, it was the largest onshore oil field in Western Europe when discovered in 1943.

But the oil in Schoonebeek is very viscous. Over 50 years, we managed to recover only around 18% through conventional techniques.

We launched various EOR projects to improve recovery, starting with hot water injection as early as 1957 and in the following decades, injecting steam. By 1996 it no longer made economic sense to extract the remaining oil. At that point, cumulative production was some 250 million barrels, a quarter of the total resource in place. The nodding donkeys and process plant were dismantled and returned to farmland. And if you go to Schoonebeek now, there is very little to remind you that it was once an important oil producing area.

However, after over a decade that's changing again. Advances in EOR technology have made re-opening of the field possible.

You won't see nodding donkeys, but we are busy drilling horizontal wells for steam-enhanced recovery. There will be 73 wells divided over 18 production units.

We expect to start producing next year, with planned peak production of around 20,000 barrels per day.

With production expected to last over 20 years, we will extract another 100 million barrels or more from Schoonebeek

And, recovery would go up to roughly 1/3 of the original oil in place. For such a heavy oil field, that would be a good result.

As we look to the future, the next big challenge will be to move EOR from the onshore to the offshore, where wells and facilities are much more expensive.

Figure 1: Schoonebeek

Unconventional gas

Alongside enhancing recovery from existing assets, we clearly need to keep opening up new resources.

Having picked much of the low-hanging fruit, our industry is now focussed on more difficult resources, tight reservoirs, fractured carbonates, oil shales, oil sands, and ultra-heavy oil. Tight gas in North America has rapidly developed into a real game-changer.

Just a few years ago, it looked impossible for the United States to maintain domestic gas production, so that large-scale LNG imports would become essential.

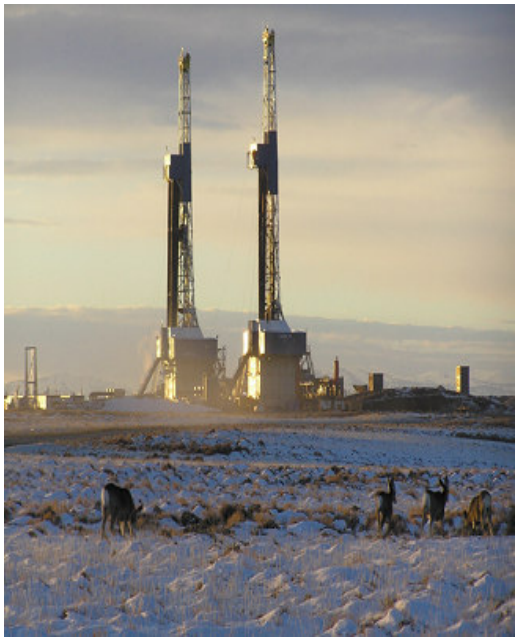

Figure 2: Pinedale

However, today, rather than declining, domestic gas production has stabilized and even increased.

That's because rising unconventional gas production is making up for declining conventional gas production. By 2020, over half of North American gas production is likely to come from tight gas plays.

The rise of unconventional gas has been made possible by new technology advances in seismic imaging, in hydraulic fracturing, in drilling and in well completion techniques, plus simply much more efficient, round-the-clock drilling and operations.

For example, since buying our tight gas field in Wyoming in 2002 we've used multiple new technologies including micro-seismic mapping and underbalanced drilling to treble production, while reducing well costs and delivery times by over 25%, despite the surge in industry costs.

Such advances industry-wide could open some 500 TCF of untapped unconventional gas resources in North America, possibly much more. That will supply current US consumption for at least two decades.

And best estimates of total technically recoverable tight gas volume worldwide are between 3,000 and 10,000 TCF, enough to keep the world supplied for decades.

North Sea: Boosting a mature basin

Let's stay with gas, but closer to Amsterdam. In the Southern North Sea, we are extending the life of another mature basin.

The challenge there is to recover natural gas cost-effectively from remaining much smaller accumulations.

Three elements give the answer:

- the first is: take a fresh look at existing data, with a different mindset, and new technologies and techniques;
- the second: reduce capital expenditure, in particular through lower drilling and development costs, and
- third: reduce operational expenditure, by rationalising the infrastructure and simplifying operational activities.

In the period 2005-2006, we re-acquired over 3500 km2 carpet seismic data in the Southern North Sea. After analysing all the available data, we replenished the portfolio with a large number of new exploration opportunities and high-graded the best.

The first wells have already been drilled and we've now quite some years drilling ahead of us.

Monotowers: Low Cost – High Efficiency

To meet the need for simpler, cheaper infrastructure, we developed Monotowers.

They are small, light-weight, unmanned, and powered by solar panels and wind turbines.

Maintenance visits are only required once every two years, which helps to increase safety and reduce operational costs.

In short, monotowers provide us exactly the kind of lean and cheap infrastructure that we need to keep up gas production in the Southern North Sea, despite accumulations getting smaller.

Figure 3: Monotower

Sakhalin II

The future of our industry also depends on opening up resources in frontier areas, like the deep water and the arctic and sub-arctic.

"Best estimates of total technically recoverable tight gas volume worldwide are between 3,000 and 10,000 TCF, enough to keep the world supplied for decades."

Sakhalin II in Russia is a case in point. It is one of the world's largest integrated oil and gas projects, as well as Russia's first offshore gas project and LNG plant.

It's been a huge undertaking. At the peak of construction, we had 25,000 construction workers. They built two offshore platforms, an onshore processing plant, the LNG plant and the oil export terminal, and laid two pipelines of 800 kilometres each.

Conditions in Sakhalin are extreme: temperatures fluctuate between minus 40°C in the winter – so cold that the sea freezes – and 30°C in the summer.

There's also a high risk of earthquakes. To make sure the offshore platforms could withstand earthquakes of 7.0 or higher on the Richter scale, they were fitted with huge bearings, three metres across, and 30 tonnes each. These are "Friction Pendulum Bearings" - as used in bridges and buildings such as San Francisco International Airport. The platform topsides they carry are larger than ever previously attempted. For example Piltun-Astokhskoye-B, weighs some 28,000 tonnes.

By the way, Sakhalin production is today rapidly approaching 300,000 barrels of oil equivalent per day and has so far delivered twice as many LNG cargoes this year as we planned.

Figure 4: Friction Pendulum Bearings

CCS

Now, let me comment on the two other areas where Oil and Gas majors need to make a major positive contribution.

Reducing the CO2 intensity of fossil fuels on a well-to-wheel basis is one area.

There are several ways to do this. As a start, we must increase energy efficiency in our own operations and installations, for example, through cogeneration of heat, power and steam, and the use of renewables, as with the monotowers.

We should also increase our efforts to capture CO2 and sequester it underground: CCS, as it's called.

According to the Intergovernmental Panel on Climate Change (IPCC), CCS could provide over half of the global CO2 emissions mitigation effort until 2100.

Given the long timelines involved in delivering new energy sources, that I showed earlier, CCS is a transition technology the world simply cannot do without.

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CO2 Emissions

Let's focus on why…

The IEA believes that in the period to 2030 the growth in CO2 emissions from coal fired power generation in just three countries - China, India and the US - will be double the growth in emissions from all the transport worldwide.

So the first priority should be to deploy CCS in the power sector, especially coal-fired power.

In the transport sector, we can't capture CO2 from billions of exhaust pipes. Rather, the challenge is to reduce the CO2-intensity of transport on a wells-to-wheels basis.

As regards liquid fuels, we can make big gains by mixing in sustainable biofuels, building lighter-weight vehicles, and developing more efficient engines. And in the longer term, we can add CCS to hydrocarbon fuel production to bring down well-to-wheel emissions even further.

Cumulatively, these measures will allow liquid transportation fuels to compete with vehicle electrification for a long time to come, especially since electric mobility will depend for many years on coal and other non-renewable resources.

That is not at all to suggest that we oppose electric mobility. The world's vehicle fleet will more than double between now and 2050. With a billion new vehicles on the world's roads there will be room and need for diverse energy sources for transportation.

What's more, our industry must play an important role in delivering more sustainable electricity, including through natural gas, the cleanest burning fossil fuel, and through CCS,

Advancing biofuels

This leads me to the third area of responsibility: broadening the world's energy mix.

Most oil and gas companies are also developing new areas of expertise outside of hydrocarbons.

Shell has serious involvement in wind, has proprietary thin-film solar technology, and is a leading player in biofuels. Indeed for the next few years, it's in biofuels where we will concentrate our additional efforts. Biofuels are a natural fit with our downstream capabilities in transport fuel. And, provided they are sustainably sourced, they can make a huge impact in reducing CO2 emissions from transport.

Conclusion

The transformation of the global energy system will take decades.

To contribute to this transformation, companies like Shell have to make use of their core competencies and at the same time try new things.

Perhaps you have seen we have a new Chief Executive, Peter Voser. He has asked Shell staff to think of our company as an energy company, in a world moving slowly but surely towards a new energy future.

We cannot travel that road in isolation from society.

All of us are explorers here. But we must uncover and understand, not just the below-the-surface secrets, but the above-the-ground secrets – the needs of different nations and cultures, and how they see the future and work with them to realise their ambitions.

In doing so, Shell is fortunate to have one of the most diverse workforces in the world, united by an intense desire to deal with the three hard truths in an integrated way.

And we need partners and allies, especially among explorers and scientists like you.

Thank you.

"Shell is fortunate to have one of the most diverse workforces in the world, united by an intense desire to deal with the three hard truths in an integrated way."

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