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Meeting the Challenge of Future Energy Supply from the Perspective of Royal Dutch Shell An interview with Matthias Bichsel¹

Peak Oil

The peak oil discussion is very present and causes a lot of discussion. Opposed to the peak-oil faction there are parties with less pessimistic views, for example as the article of Peter Burri in the Bulletin for Applied Geology (Vol. 13/1, 2008) implies.

How does Shell deal with the fact, that oil and gas resources are limited and sooner or later will be more or less depleted or can only be run on at inappropriately high cost? On the one hand, current shareholder interests have to be satisfied, on the other the company needs to be led into a viable and successful future. How does Shell position itself in this difficult situation?

Oil and gas are, and always have been, finite, non-renewable resources (at least in the non-geological time frame), and it is true that accessible, conventional supply cannot indefinitely keep up with growing demand. However, running out of oil or gas is not the primary issue we face right now, as there are large remaining hydrocarbon resources. The more relevant issue is that access to these resources is becoming increasingly more challenging as they are in more remote and difficult locations (e. g. very deep water and arctic regions) or in unconventional hydrocarbon forms such as oil sands and oil shale or trapped in difficult reservoirs such as tight gas.



The key issues for society and the energy companies in particular is how to overcome the increasing geopolitical, technological and economic challenges of finding, developing, extracting and bringing these additional resources to market.

For this reason, Shell is investing heavily in new technologies to enable the development of more technologically challenging fields such as those in deep water (e. g. Perdido project in the US Gulf of Mexico, which will be the deepest floating oil platform (SPAR) development in the world in about 2.5 km of water depth) and those with high pressure/high temperature. Another focus for us is on driving down technology costs for maximising recovery rates (i. e. the percentage of hydrocarbons extracted from

¹ Director of Projects & Technology, Royal Dutch Shell plc. The questions were put by Daniel Bollinger, editor of the Bulletin for Applied Geology, and Bernhard Gunzenhauser, vice-president of the Association of Swiss Petroleum Geologists and Engineers.

each field) and our ability to develop smaller or more remote fields which were previously economically unviable (e. g. through a floating production facility of liquefied natural gas, LNG). We are also looking to augment the world's supply of energy from «alternative energy sources», particularly 2nd generation biofuels.

Shell believes, that over time the energy mix will change to include more what is currently termed «alternative energies» such as biofuels, solar, wind power etc. However, even by 2050 some 70% of the world's energy supply is still likely based on fossil fuels. Ensuring this energy supply is delivered is a major challenge and we see our contribution coming from leveraging our technology strengths as a leading oil and gas company. This includes developing challenging resources; helping consumers use energy more efficiently; finding solutions for the CO₂ challenge; and increase the supply of sustainable biofuels.

On which figures does Shell base its assumptions when it comes to questions around existing reserves? At the CHGEOL – swiss geologists' venue on 19 March 2009 you gave the following rough figures: one trillion barrels used, one trillion barrels known, one trillion barrels still to be discovered. What did these figures look like in 1972 (Club of Rome – «Limits to Growth») and what in the meantime has changed when assessing reserves?

I am not fully familiar with the resource potential assessment by the Club of Rome nearly 40 years ago, but I would guess it was the limitation of imagination and technology available at that time that put a cap on what then was believed to be available. A good example would be the oil and gas deposits in water depths greater than 300 m, which then were simply not considered in the assessments. Some people could not believe that the industry would ever be able to develop oil and gas fields in 3000 m water depths – now it is a reality.

Another example is the success the industry has had with the development of shale gas. Its full potential is only now being recognised and many areas in the world remain unexplored for shale gas. People are now beginning to think seriously about the possibility of recovering gas hydrates from the cold depths of the world's oceans.

It is clear, therefore, that as technology marches forward so does our capability to assess the world's oil and gas resources.

Shell, like other energy companies continually calibrates its assessments with internationally recognised organisations like the US Geological Survey, to ensure they remain broadly aligned with the global consensus.

Environmental Responsibility

With tighter resources, pressure grows to explore and produce oil and gas in environmentally sensitive areas (e. g. arctic), which (also) pose highest demands in relation to technology and come close to what's doable in a responsible manner (deepwater). How far will Shell go to produce such resources? How much risk is the company willing to take (e. g. image and reputation issues with consumers who are alert to environmental matters)?

Shell is committed to develop resources in a safe and environmentally sound manner. We have a long track record in doing so and are proud of our achievements.

For instance, on Sakhalin Island we have demonstrated that we can operate safely and environmentally soundly in some of the most challenging environmental conditions in the world. Indeed, our venture has won environmental awards from the Russian Federal Government. As an example, the pipeline that runs along the spine of the island had to cross several rivers where salmon migrate upstream to spawn. Now that the project is finished no change in salmon migratory behaviour has been detected.

Another example is our sour gas operation in Canada where we have been working without incidents for years in the pristine Rocky Mountains and close to towns without creating disturbances or incidents. It is this long track record that we are building on when considering operations for instance in the Arctic. We believe we can operate there in a sustainable manner, creating conditions to work and live in unison with local peoples and in an environmentally responsible manner. We are fully aware of the valid concerns of people and we are engaging in an open and transparent manner to ensure all the issues raised are taken on board. We also take seriously our obligation to provide opportunities for local people to work and allow them to benefit directly from oil and gas activities.

Sustainable Development

The term «Sustainable Development» originated in the area of forestry. In that sector it means to not utilize more timber than a forest can reproduce through natural growth. Today the term «Sustainable Development» is used globally and spans more widely. The Brundtland-Commission (UN: World Commission on Environment and Development) defines the term as follows: «Development that meets the needs of the present without compromising the ability of future generations to meet their own needs». How does a global corporation like Shell, whose key activity and competence it is to utilize non-renewable sources of energy, define sustainable development?

Shell first made its commitment to contribute to sustainable development a decade ago, including it in our General Business Principles in 1997. Since then, its importance to us has grown further. For Shell, contributing to sustainable development means: *Helping meet the world's growing energy needs in economically, environmental-*

ly and socially responsible ways. In short, helping secure a responsible energy future.

We believe all the peoples of the world have the right to reliable supplies of clean, safe, affordable energy. Fossil fuels, while in themselves not renewable within human time scales, offer fuels for cooking, heating, transport etc in a way that makes growth and development of the human race possible. Fossil fuels today provide the greater part of the world's energy needs critical to enabling the development of next generation fuels that are renewable. As well as wanting to be part of the creation and supply of those alternative energies, Shell sees its role as helping provide the «energy bridge» (in volume of energy supplies and time) to enable the world's people to migrate to other forms of energy.

Meeting this commitment requires a particular mindset: one in which we consciously balance short- and long-term interests; integrate economic, environmental and social considerations into business decisions; and regularly engage with our many stakeholders.

In practice, this means *reducing impacts and delivering benefits* – both through our *portfolio and products* and through our *operations*. This includes a commitment to finding and delivering energy products that help meet the rapidly growing need for affordable, convenient and cleaner energy. This is also a commitment to responsible operations: building our projects, running our facilities and managing our supply chain safely and in ways that minimise environmental and social impacts while maximizing the social and economic benefits.

How does Shell live and breathe and implement sustainable development (keyword CO₂ as an indicator of global warming, which is attributed to the utilization of coal, oil and gas)?

Our role, at Shell, is to develop, extract and deliver energy from diverse sources. We are

committed to doing so profitably and in socially and environmentally responsible ways across a broad portfolio that includes conventional oil and gas, unconventional oil resources – such as oil sands and oil shale – contaminated gas, gas-to-liquids (GTL), and alternative energy.

«Responsible» for us is defined and embedded in our business principles and reflected in many ways in our activities. In the late 90s, acknowledging the threat of climate change, we set voluntary targets for reducing our own CO₂ emissions through 2010. We are expanding our natural gas business, enabling supply to emerging economies such as India and China. Improvements at our downstream facilities are already delivering CO₂ emissions reductions of about 1 million tons per annum (mtpa). Shell has adopted new investment benchmarks that will ensure that cost effective CO₂ management options are considered in all investments we make.

Nearly all of the energy Shell produces today is conventional oil and gas. About 5 percent comes from unconventional sources, a share likely to grow to 15 percent by 2015, as governments open up licenses for unconventional to secure energy supplies. Shell will seek to operate these resources at first-quartile environmental standards.

Expanding unconventional is a deliberate strategic decision. It means our CO₂ emissions from operations will increase as well. And that in turn underscores our ambition to develop a leading ability in managing CO₂ along six reduction pathways:

- First, increasing the efficiency of our operations, seeking to be first quartile.
- Second, establishing a substantial capability in Carbon dioxide Capture and Storage (CCS). The underlying technologies for CCS are proven and we're engaged in a number of projects to «learn by doing» as quickly as practicable.
- Third, continuing to research and develop technologies that increase efficiency and

reduce emissions in hydrocarbon production.

- Fourth, aggressively developing low-CO₂ sources of energy, including natural gas and low-CO₂ fuel options. We hold the largest equity share of liquefied natural gas (LNG) capacity among private energy companies and our innovative technologies and proven designs mean that our LNG plants have better unit CO₂ emissions than industry averages. We are also an investor in wind energy generating emission-free electricity that saves 1 million tons of CO₂ a year compared to energy from a coal-fired plant. We're one of the largest blenders and distributors of first-generation biofuels. We are investing in second-generation biofuels that offer significant CO₂ benefits and don't compete with food crops.
- Fifth, helping manage energy demand by growing the market for products and services – like fuel economy formulations for our petrol and high-efficiency lubricants – that help millions of retail and business to business customers use less energy and emit less CO₂.
- Sixth, by working with governments and advocating the need for more effective CO₂ regulation. It is clear that voluntary actions like setting emissions targets are not enough, especially as most low hanging fruit has been gathered.

We believe government regulation is required and will replace any voluntary targets. We will advocate CO₂ regulations that will subject the entire industry to the same standards, predictable long-term policies and market-based incentives on a level playing field so that competitive forces can drive the most cost-effective solutions.

Scenarios

In the 70s Shell introduced a way to develop alternative views of possible futures (scenarios). In «Sigma 1/2009», Swiss-Re Corporation even said this approach was a breakthrough method. What are the most current scenarios and what do they cover and say? Also, scenarios always base on assumptions. So which assumptions lie behind your scenarios and how reliable and plausible are they in relation to your current «Scramble» and «Blueprints» scenarios?

Shell's approach to strategy and investment decisions, for the last 30 years or so, has included the use of scenario development. Generally speaking, our scenarios paint pictures of how the world might respond to trends that have been identified and scrutinised by experts both within and outside the company. They are not forecasts or predictions. They are plausible potential futures based on detailed economic, political and technical analysis.

Shell has developed two scenarios for the energy system between now and 2050. Both very plausible and highly illustrative of the global challenge: The «Scramble» scenario, sees an uncoordinated, self-interested rush by individual countries to secure future energy supplies for themselves, with little attention given to the impact on others or the planet. Government responses to energy and climate problems are short-term and reactive. This scenario is characterized by greater economic volatility and wilder swings in energy prices.

The other scenario, «Blueprints», starts with a disorderly patchwork of local and national initiatives, but quickly settles down into a more orderly, co-operative transition. With «Blueprints», a global policy framework emerges for managing greenhouse gases within a decade. Technologies like carbon capture and storage, biofuels, wind and solar power are encouraged. And, after 2020, a mix of plug-in hybrid, fully electric and

hydrogen-powered vehicles come on stream faster.

Demand for energy grows more slowly in «Blueprints» than in «Scramble» – though it still nearly doubles by 2050. In either of these scenarios one of the biggest challenges is to build an energy system that produces more energy with less carbon dioxide. In «Blueprints» the cooperative policy framework and technology mix start to mitigate the carbon footprint.

Shell sees «Blueprints» as a better response than «Scramble». We are determined to help develop the critical technologies needed and advocate the policies required to move in a «Blueprints» rather than «Scramble» direction.

Strategies

During your presentation at the annual CH-GEOL – swiss geologists' meeting on 19 March 2009 you said, «poorer countries» or take off countries have a right to sufficient energy supply. You mentioned that energy demand may double until 2050 and at the same time made clear that conventional fossil fuels would not be able to cover that demand. What are Shell's strategies to respond to this dilemma? In which way can growth markets with enormous energy demand like China, India, Brasil be influenced to pursue a sustainable and ecologically appropriate development?

Energy is critical to enabling all the peoples of the world to live, to grow, to develop. I am therefore absolutely convinced that the right and proper thing to do is to seek to provide sufficient energy to meet the fundamental energy needs of everyone globally. The good news is that more and more people and companies worldwide are striving to minimise the amount of energy we use, and maximise the efficiency of the energy that we use. Much remains to be done at Govern-

mental and individual levels, but the desire is growing.

The job of energy companies like Shell is to seek to ensure the provision of sufficient energy in the most social and environmentally responsible way possible. This will necessarily require greatly increasing the production of all types of conventional and unconventional hydrocarbon energy, as well as alternative energy forms.

Shell's primary strategy is to focus on doing what it does best: find, develop and produce conventional and unconventional hydrocarbons as efficiently, safely and cleanly as it can. An example of this is the licensing of our world leading clean coal technology. Coal is playing an ever-growing part in global electric power generation, but this is putting more stress on the environment due to the release of CO₂ and other emissions. Shell has the technology to help reduce these negative impacts through use of its coal gasification and clean burning technology.

Shell is also spearheading efforts to facilitate the development of Carbon Capture and Storage (CCS) and wide-scale deployment on both a political and technical level. This includes working with research institutions, national geological services, and other companies and policy advocacy efforts worldwide.

We are also actively engaged in joint studies and research programmes with emerging economies, such as China and India, whose support is crucial to achieving rapid large-scale emissions reductions. As importantly we are involved in the development of large-scale CCS demonstration projects, joint industry initiatives and multiple research partnerships with leading academic institutes throughout the world.

At this stage, it is essential that we «learn by doing» in order to reduce CCS costs, accelerate technology deployment and ultimately make CCS commercially viable.

Technology

In context with the utilisation of tighter and tighter reserves technology becomes more and more important. Can you give concrete examples to demonstrate this?

As the largest technology investor among the international oil companies, Shell is at the leading edge of development and application. To give a few examples:

- Exploration: Technology is required to a] identify areas with exploration potential, b] pinpoint prospects (potential oil and gas fields) and c] increase the chance of success of actually finding oil and gas. Our focus is on the use of geophysics such as seismic in particular imaging underneath difficult geology such as salt, basalt, thrust belts. We invest both in acquisition technology particularly for desert areas, though mostly on making use of the full wave form rather than the wave front of a seismic signal. Electromagnetics and «passive seismic» are other areas of investment. A particular emphasis is also on identification of subtle traps, i. e. finding stratigraphic pinch outs of sand bodies that could contain hydrocarbons. Basin modelling from the generation of oil and gas to migration and intermediate trapping are an integral part of our research.
- Development: Emphasis is on finding lower cost solutions to enable us to push the frontiers. Focus is on deepwater but also other remote locations. Of late we have developed a low cost platform solution for the Southern North Sea to bring on stream small gas fields. Our solution is a mono-tower instead of a full platform, powered by wind and solar, unmanned and requiring maintenance only every two years. Without this solution, which we also licensed to another oil company, such small gas fields could not be economically developed.
- Maximising hydrocarbon recovery: Focus is on enhanced oil recovery using thermal,

miscible gas and chemical solutions. Currently we are working on «designer water» for our waterflood developments (changing the ionic composition helps to recover more oil in certain rock formations). We also have developed a technique called Smart Fields™, which allows us to optimise field operations and recover some 10-15% more oil than from conventionally operated fields.

- New frontiers: We have an active R&D programme for tight gas (nanodarcy permeability) including shale gas. We also work on novel technologies for extra heavy oil. Complementary is our R&D in heavy oil upgrading, both in the reservoir («refining the oil in situ») as well as on surface using catalysts.

Alternatives

To what extent are alternative and especially renewable resources part of Shell's strategic direction (short/medium and long-term)? More concrete: unconventional hydrocarbons, biofuels, solar energy, geothermal energy, wind and water. For which reasons do you not pursue the one or the other renewable energy? Which developments have to take place so that those could become of interest for Shell?

Some five years ago, our Alternative Energy strategy was to work on the full range of opportunities. Since then, for instance, we have invested in some 1 Gigawatt of wind power, we have made significant breakthroughs in thin film solar power. However, we have found that these technologies are not playing to our natural core strengths, nor would for instance wave energy. Hence, focus now is on biofuels and Carbon Capture and Sequestration (CCS). As mentioned earlier we are blending and trading 1st generation biofuels and we have a heavy R&D programme into 2nd generation biofuels, including cooperation and investment with 3rd par-

ties. In CCS we have an R&D programme focusing on capture as well as long-term storage in the subsurface. We are partnering in a number of active CCS schemes and we have a number of potential schemes in our sights. The investment level is already quite substantial and will likely increase. Just recently, we have, with our partners, approved the world's largest CCS scheme in Australia. This will sequester 4 times as much when it comes on stream in the middle of the next decade than the currently largest active CCS development.

Shell has great know-how in exploration and production technologies. To what extent could this knowledge be utilized as a resource – which is ultimately of vital importance, namely water (potable and general use supply)?

In the past we have looked into geothermal energy and have been involved in enhanced geothermal projects in France and Central America where we provided expertise in drilling, fracturing and surveillance. We decided to step out of these projects because of economic and commercial challenges. We have currently no firm plans in geothermal energy.

While we consider deep drilling a core strength, water well drilling for potable aquifers is not a drilling challenge per se. We have no plans to enter this field.

Water is produced as a by-product in oil and gas production. As oil fields mature the percentage of water produced to the surface tends to increase and might reach levels as high as 90 % of the total production. However this water tends to be saline. In most cases we dispose of this water through re-injection into deep formations or use it for improved oil recovery through water flooding. In some cases, for instance the Middle East, we treat wastewater and use it for irrigation.

Shell recognizes also that the energy indus-

try is becoming one of the largest-consuming industrial sectors of fresh water and must take steps to manage its water footprint in a responsible way.

Shell is reviewing its water management practices; technology applications, capabilities and processes so that we can develop a roadmap to reduce our footprint across our businesses, projects and value chain.

We are working in partnership with organizations such as the World Business Council for Sustainable Development, Water Footprint Network, International Water Association and UN CEO Water Mandate to develop and deploy solutions in a number of areas, including technology options and local pilot projects.