Future Trends in Raw Materials and Energy Sources in Europe

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Jorma Ollila is Chairman of Royal Dutch Shell. A Finnish national, Jorma was appointed Chairman of Royal Dutch Shell as from June 1, 2006.

Previously he became Vice President of International Operations of Nokia in 1985. In 1986 he was appointed Vice President Finance of Nokia. Between 1990 and 1992 he served as President of Nokia Mobile Phones.

Between 1992 and 1999 he was President and Chief Executive Officer of Nokia and from 1999 to June 1, 2006 he was Chief Executive Officer of Nokia.

Prior to joining Nokia, he started his career in banking at Citibank in London and Helsinki.

He is Chairman of the Board of Nokia.

Jorma was born August 15, 1950.

During the first half of this century the demand for energy is expected to double. The industry will be hard-pressed to supply sufficient amounts of affordable energy to meet all customer needs. To make matters more difficult, the world also needs to reduce emissions of greenhouse gases. Clearly, there's a need for diverse energy sources, including renewable energy from wind, solar and biomass. And we need Carbon Capture and Storage, or CCS, to reduce emissions from fossil fuels. However, virtually every low-carbon energy technology uses more mineral resources than energy from oil or natural gas for every unit of energy that gets produced. While we've grown accustomed to thinking the era of easy oil is drawing to a close, it would be more accurate to say: the end of easy energy. In response, we have to make responsible use of *all* of the planet's precious resources, and that goes well beyond oil and gas.

Introduction

Thank you – it's a pleasure to be here.

I've been asked to speak about raw materials and energy sources in Europe.

That's a big topic. And I won't be able to tell you the complete story.

It is possible to highlight some of the world's resource constraints, and the challenges and opportunities this brings for Europe.

I propose to structure my speech as follows:

- First, I will sketch the global resources picture, with a focus on energy.
- Then I'll zoom in on the contribution that biomass could make as a low-carbon source of energy.
- And I will round off with a few remarks about what this all means for Europe.

Global resources

Humans have always lived in a vulnerable relationship with their environment.

In his book "Collapse", Jared Diamond analyses how some societies over-used the natural resources they depended on and perished completely – Easter Island is a famous example.

Another island, Japan, faced dramatic deforestation and soil erosion several centuries ago. Today, nearly 80% of this densely populated country is covered by forest, as a result of wise decisions taken by Shoguns in the past.

So it's possible for societies to increase their chances of survival by making the right choices.

Today, we extract raw materials from the planet on a huge scale. And these raw materials are finite. This is true for oil, natural gas, and coal. It's also true for copper, iron ore and nickel. And it's true for gold, platinum and alien-sounding metals like tantalum and coltan – which are used in mobile phones, laptops, video cameras and other electronic devices.

The world economy is growing. And a growing share of the world's population is starting to enjoy a "western" life style. As a result, demands on natural resources are greater than ever. The issue of resource scarcity has come back on the agenda with an intensity not seen since the 1972 "Limits to Growth" report by the Club of Rome.

We should not underestimate the scale of the energy, climate and resources challenge. During the first half of this century, the world population is expected to grow from around 6 billion to over 9 billion.

Energy use is expected to double during this period.

The energy industry will be hard-pressed to supply sufficient amounts of affordable energy. At the same time, we need to reduce emissions of greenhouse gases.

There's a need for new, renewable energy from wind, solar and biomass.

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And we need Carbon Capture and Storage, or CCS, to reduce emissions from fossil fuels.

Like it or not, virtually every low-carbon energy technology uses more mineral resources than energy from oil or natural gas. In terms of resource intensity per unit of energy produced, nothing beats an oil well.

Carbon Capture and Storage reduces greenhouse gas emissions from coal-fired power, but doubles the amount of steel used in a power plant – for capture installations, pipelines and injection wells.

Wind turbines consume double the amount of steel in producing the same amount of electricity as a natural gas-fired power plant.

Wind turbines also consume more nickel and chromium than conventional power stations for the same amount of electricity. And a lot of cement is needed for the concrete foundations of the turbines.

In a renewable energy system, long-distance electricity transmission at high voltage would have to increase. This would, in turn, increase the need for copper.

A renewable energy system is also more high-tech, which changes the raw materials needs from oil, gas and coal to high-tech and often scarce raw materials.

Take lithium, a crucial component of the lithium-ion batteries that power electric cars. It can be easily produced in large quantities in only a few places on earth. And current production methods put pressure on the environment. Making a big shift to electric vehicles would require a formidable expansion of the world's capacity to mine lithium, even if we assume most car batteries will be recycled.

Another important metal is neodymium, which is needed for the strong magnets in wind turbines and car batteries. Neodymium is a rare earth metal. While abundant in the Earth's crust, bigger concentrations are rare and difficult to produce in an environmentally friendly way. Rare earth metal mines in the USA and elsewhere were closed some years ago for environmental and economic reasons. Today, more than 90% of the world's neodymium comes from China, which recently indicated it might tighten export controls.

What these examples show is that we have to make responsible use of *all* of the planet's precious resources, and that goes well beyond oil and gas.

While we've grown accustomed to thinking the era of easy oil is drawing to a close, it would be more accurate to say: the end of easy energy.

That's why the world's energy mix should be precisely that: a mix. This is especially true for a resource-poor region like Europe.

What needs to be done

Building a better energy system was never going to be a simple task. Against the backdrop of growing pressure on the world's mineral resources, the challenge looks even more daunting.

I am an optimist. And I think that human ingenuity and technology innovation can help us, provided there is proper and strong political management.

There are many things we can and should do.

First, we need a strong focus on energy and resource efficiency.

Even existing technologies can make a big impact in helping consumers to use less energy.

Installing smart grids and energy meters, better insulation of homes and offices, lighter and smaller vehicles with more efficient engines, more efficient fuels and lubricants – these types of measures are effective and deserve support from governments.

Shell as an energy company is actively looking for ways to help our customers to use less energy. For example, in the Netherlands, Shell last April introduced FuelSave, a new Euro 95 petrol that saves up to a litre per tank, based on a 50-litre fill-up. In the Netherlands, one litre per tank adds up to around 110 million litres of petrol saved each year. Which is equal to 2340 tanker trucks full of petrol.

The reception by Dutch customers was positive. Shell gained market share. FuelSave will be rolled out globally - and has already been introduced in Turkey, Malaysia, Singapore and Hong Kong.

"While we've grown accustomed to thinking the era of easy oil is drawing to a close, it would be more accurate to say: the end of easy energy."

The philosophy is that customers who save fuel and emit less CO_2 also spend less money. And happy customers tend to be loyal customers.

Energy and resource efficiency is not a panacea. The reason Japan still has so much forest is strong governance, not a more efficient use of trees.

Energy and resource conservation will only happen if there is strong political management.

A well-designed and internationally harmonised climate policy framework would be an important enabler of a responsible and gradual transition to a low-CO_2 energy system.

Shell favours cap-and-trade systems for setting the price of CO_2, and we have been a supporter of the European Union's Emissions Trading Scheme from the start.

The cap sets a certifiable environmental outcome, while the trade provides the commercial incentive for companies to look for the lowest-cost reduction measures.

Another important task is to produce more energy from diverse sources – and to do so responsibly and sustainably. In the oil and gas industry, much of the low-hanging fruit has been picked, so the challenge will be to produce more oil, gas and coal from more difficult resources.

For instance, new technologies allow companies to produce oil in ultra-deep waters in the Gulf of Mexico and off the coast of Brazil, and in ice-covered seas off the coast of Siberia and Alaska. And Shell is pioneering technologies that will allow it to produce and liquefy natural gas at full sea, rather than having first to pipe it to land over a long distance.

In the USA, new technologies recently helped to open up abundant resources of natural gas trapped in dense rock, changing the supply picture dramatically.

New technologies will help us to reduce greenhouse gas emissions. CCS and renewable energy will each have an important role to play, despite the challenges I discussed earlier.

So will nuclear power, provided there's enough uranium to go round and environmentally acceptable solutions can be found for nuclear waste.

What's more, new technologies can also help us to address shortages in mineral resources. Alternatives exist or can be developed for virtually every raw material. For example: researchers are working on strong magnets that do not rely on rare-earth metals like neodymium. And if Lithium for car batteries one day became constrained, alternative batteries based on Zinc and Sodium-Sulphur could be alternatives.

Sometimes, new technologies completely change the game. The Club of Rome in its 1972 report already warned of a copper shortage. They calculated existing use of telephones in the developed world and the estimated future growth of telephone use in China and India.

But then optical fibre replaced copper. And mobile phones appeared on the market. Many customers in the developing world went straight from having no phone at all to a mobile phone.

Still, one issue remains: alternative technologies and mineral resources take time to develop and mature. This, in turn, inevitably slows down the deployment of new energy technologies.

And that's why we also need to redouble our efforts to develop a global recycling industry. There can be no sustainable growth in the high-tech and renewable energy sectors without a fully functioning recycling industry.

I mentioned the need for more cement in the wind power sector. Wind turbines, once installed, may provide clean electricity. But the cement industry is carbon-intensive. It is based on converting limestone at high temperatures. Across the industry globally, every tonne of cement that gets produced, results in around 800 kilogrammes of CO_2 emissions.

Fortunately, you don't always have to use cement to produce concrete. For instance, at Shell we are developing a sulphur-based binder, called Shell Thiocrete, which replaces conventional cement in concrete.

"Energy and resource conservation will only happen if there is strong political management."

Studies have shown that Shell Thiocrete could reduce the lifecycle CO_2 impact of concrete by 30-50%.

The reduction level depends on the specific nature of the application – think of sea walls, pavements, road barriers, and, yes, the concrete foundations for wind turbines.

The sulphur we use is a by-product of oil and gas production. So here we have a great example of how recycling can help. We turn a by-product into a valuable end-product that, in turn, helps to reduce CO_2 emissions.

We need to think of our energy system as a cycle, from production via consumption and recycling, back to production.

Unfortunately, we will never be able to recycle 100% of the energy and raw materials we produce.

Which brings me to another, potentially important resource for the world: biomass.

Biomass to energy

If the world manages the planet's resources well, and if further advances in agricultural productivity can be made, biomass will be a rich source of renewable energy.

An efficient use of biomass - from very low tech in the developing world to modern power stations in the Europe and elsewhere - is to burn the biomass. This produces heat, which can be used directly or converted into power. Burning biomass is simpler and cheaper than almost any other solution.

In Shell, we are studying the option of burning biomass directly in two of our projects.

These are projects where heat is required to improve the flow of heavy oil.

In both cases, the idea is to provide some of the required process heat by burning biomass, reducing natural gas consumption. CO_2 savings could be significant.

Given that the logistics are complicated and operability needs to be tested first, the initial target will be for biomass to contribute a relatively small percentage of the heat, with possible expansion later.

So the idea here is to use biomass to address some of Shell's own energy needs, but still with the aim of producing and selling fossil fuels - "greener" fossil fuels, if you like, with a lower well-to-wheel CO_2 footprint.

Instead of burning biomass directly, it can also be gasified. Shell possesses coal gasification technology which can also be used for gasifying biomass, including wood pellets. The NUON power plant in Buggenum in the Netherlands uses Shell technology and has run with up to 30% biomass.

We can expect the world to co-fire and co-gasify more and more biomass with coal as a way to produce greener power from otherwise "dirty" coal-fired power stations. In combination with carbon capture and storage, the use of biomass could potentially lead to zero-emission or even negative-emission power stations.

While the economic crisis and lower demand for paper has had a huge impact on the forestry industry globally, the demand for wood pellets for electricity has remained stable and is expected to grow in the coming years, as a result of subsidies for clean electricity and CO_2 pricing.

Canada is currently the world's leading exporter of wood pellets, shipping large amounts to coal-fired power stations in Europe and Japan.

On the face of it, this is a strange phenomenon. Why would Canada ship wood all the way to Europe?

Intervention by Mother Nature is one reason. An insect called the mountain pine beetle is literally killing millions of trees in Canada. Trees affected by the beetle cannot be used for supplying timber or paper. But they can still be used to produce energy.

Economics also play an important role. Europe and Japan are attractive destinations for Canadian wood, given that government subsidies and carbon pricing provide incentives to Utilities to burn wood instead of coal.

It's not certain that Canadian pellets will continue to reach Europe in the same quantities as they do today.

"If the world manages the planet's resources well, and if further advances in agricultural productivity can be made, biomass will be a rich source of renewable energy."

As Canada begins to think about ways to phase out old coal-fired power stations, it's likely that they will turn to domestic biomass as an alternative for coal.

Whether wood from Finland and other Nordic countries will fill the gap or part of it, will depend on the supply availability, the price of wood, on subsidies and CO_2 pricing, and the logistics. For instance, at Shell, we're interested in techniques for dehydrating and compressing wood, which would make transportation less of a barrier.

Another well-known use of biomass for energy is, of course, the conversion of biomass into bio*fuels*.

Biofuels are a welcome addition to the world's liquid fuels in an oil-constrained world. And they have great potential to reduce greenhouse gas emissions from transport.

More than 50 countries are developing or have renewable fuel mandates. The European Union, for example, insists that 10% of road vehicle fuel come from renewable sources by 2020.

The benefits of today's biofuels are tangible, but vary according to the feedstock and production processes used. For example, North American ethanol produced from corn typically reduces greenhouse gas emissions by 10%-30%, whereas an efficient variety of Brazilian ethanol derived from sugar cane can reduce emissions by up to 90%.

Shell, as the world's largest distributor of biofuels, has taken many measures to ensure our supply chains are environmentally sustainable. For instance, we include sustainability clauses in our contracts – and, to date, three quarters of our suppliers have signed up to them. Bear in mind that biofuel supply chains are long and involve thousands of individual farmers.

We are working together with the Roundtable on Sustainable Biofuels and many other international actors to develop an international certification scheme that would provide assurances on Greenhouse Gas footprints and other environmental and social aspects.

Looking further ahead, at Shell we're working hard to develop advanced biofuels that can also use non-food feedstocks like straw or even algae.

But it will take huge effort to overcome all the technical hurdles and produce them at competitive prices.

Is there a role for wood in producing liquid fuels? A question relevant to Finland.

As the demand for clean transport fuels grows, and the price of CO_2 increases, one would expect wood to become a source for biofuels.

For now, all wood-to-fuels options are in the experimental or demonstration phase, and it will take many years before any process could be commercial.

One option would be to convert wood into bio-diesel. You can gasify wood pellets into a diesel fuel through the Fischer-Tropsch synthesis process.

Another option would be to convert wood into ethanol by fermentation. In Canada, our partner Iogen Corporation specialises in converting straw into ethanol, using enzymes. Whether wood-to-ethanol is technically feasible and economically viable remains to be seen.

There is another important function of forests, which is this: they store CO_2.

Reducing emissions from deforestation and forest degradation, and by planting and replanting trees, as well as better forest management, together represent 30% of the world's total greenhouse gas abatement potential, according to McKinsey. And the cost of these forest-related measures is lower than either CCS or renewable energy.

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Europe

What does all this mean for Europe?

Well, the first thing to understand is that Europe will always be an importer of energy and mineral resources.

Today, the European Union plus Norway import around 70% of their combined oil needs, 40% of their natural gas and around half of their coal needs.

Shell's scenario team estimates that by 2020, the EU plus Norway will still import around 70% of their oil, 45% of their natural gas and a quarter of their coal.

Of course, if you leave Norway out of the picture, Europe by 2020 would have to import much more natural gas.

In absolute terms, both the demand for energy and the need for imports will decline – in line with an ageing population and an increasingly energy-efficient economy.

Coal imports may even drop relatively sharply. Europe's domestic coal production is expected to remain relatively steady. Meanwhile, natural gas, wind and biomass will increasingly displace coal – as a result of efforts to reduce CO_2 emissions from power generation.

The 2020 targets stipulate that 20% of Europe's energy must come from renewable sources.

For Finland this means growing the share of renewable energy up to 38%. Most of this will come from biomass-based energy. And most of the biomass, in turn, will be wood. Even for a country as rich in biomass as Finland this is proving to be a demanding target.

One of Finland's neighbours, Sweden, has been particularly successful at using its forests for heat and power in a sustainable way. Sweden introduced CO_2 pricing before other countries did, and this has paid off.

But even Sweden is likely to need fossil energy and energy imports for the foreseeable future. In that context it's not surprising that Sweden's potential to become a producer of natural gas is creating excitement.

Natural gas has an important role to play in Europe's future energy mix. A natural gas-fired power plant emits around half the greenhouse gas emissions of a coal-fired power station to produce the same amount of energy.

Concerns over the reliability of Europe's natural gas supplies are understandable. Natural gas supplies from Russia – coming into the EU through Ukraine – have become politicised in recent years. If we look at the facts, we see that the EU has continued to receive supplies reliably from Russia.

In addition, the EU will receive more Norwegian gas, and liquefied natural gas from countries like Qatar, Nigeria, Trinidad and Algeria.

Recent studies also indicate that Europe possesses very large unconventional natural gas resources. These are gas resources trapped in dense rock, coal seams, in layers of shale, or at shallow depths.

Unlocking unconventional gas resources will require many technology advances and favourable economics.

The United States has shown that there is real potential. There, new technology has opened up abundant gas resources contained in dense rock formations, increasing supplies dramatically. This reduces America's need for imports of Liquefied Natural Gas and frees up more LNG for Europe.

By 2050, Europe will still import much of its energy. Whether it's oil, coal or natural gas, solar, wind or biomass, Europe has fewer domestic resources and less available land mass than most other continents. And the same is true for the mineral resources underpinning renewable energy.

At the same time, Europe is one of the most energy-dependent regions in the world, due to its high degree of economic activity.

Europe will have to develop an intelligent mix of indigenous energy supplies and supplies that are imported by pipeline, ship or power cable. This mix should include all possible energy types – to ensure that risks are adequately spread.

To make sure that energy does flow to Europe, it's crucial that Europe invests in an Open Doors world, with low trade barriers.

That's why I'm happy that Commission President Barroso has indicated that he will put a lot of time and effort into third party energy dialogues.

In addition, if Europe is to compete on the world market with other customers, it will have to offer a highly flexible and efficient internal energy market.

"To make sure that energy does flow to Europe, it's crucial that Europe invests in an Open Doors world, with low trade barriers."

We will have to be a reliable, predictable customer.

And we will have to be a leader in energy innovation.

Conclusion

That last remark is more than just an afterthought. History has shown that innovation tends to thrive – not in times of abundance, but in times of relative scarcity.

If you look at today's list of Fortune 500 companies, half of these were created in times of recession. Microsoft was created after the second oil crisis; Nokia changed course in the midst of the 1992 recession; and Google began its rise after the dot.com bubble burst in 2000-2001.

Many of tomorrow's global champions are being created at this very moment. The question is: how will Europe contribute?

Europe will never enjoy energy and resources abundance. At first sight, this puts Europe at a disadvantage.

But perhaps we can turn resource scarcity into an advantage. It could provide impetus to the technologies that promote conservation, efficiency, and recycling.

Much will dependent on government policies.

Building a better energy system – capable of powering people's lives in sustainable ways – is arguably the most important challenge of our time.

It's our generation's responsibility to pass on to future generations even better energy and resource options than we enjoy today.
To make this possible, leadership will have to come from governments, companies and all of us as consumers.

Thank you

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