



# Hard Truths and Opportunities: Meeting the World's Energy Challenge

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Rob was born in Australia and graduated in Chemical Engineering from the Technical University of Eindhoven in The Netherlands, where he obtained a Ph.D. in Technical Sciences. He joined Shell in The Netherlands in 1976 and worked for Shell Canada from 1978 until 1999, finally as President Oil Products. He then led Shell Global Solutions – the Group's research and technical services group – before becoming CEO of the Equilon refining and marketing joint venture in the United States. Following the Group's acquisition of Texaco's interests, he became the CEO of Shell Oil Products US and President of Shell Oil Company.

He became a Group Managing Director, joining the Committee of Managing Directors in 2003, and became Executive Director Downstream in October 2004.

**Over the next half century, society's need for energy will double; conventional supplies of energy will struggle to meet demand; and the stress on the climate from CO<sub>2</sub> emissions will become more acute. In this speech, Rob Routs explains that the challenge for companies like Shell is to develop new and innovative sources of energy, from hard-to-reach oil and gas and 'unconventionals' like oil sands, to alternatives and renewables like biomass and wind. At the same time, we need to develop technologies and encourage policies that limit CO<sub>2</sub> emissions to manageable levels. Rob also outlines the important role we can play in improving energy efficiency – our own as well as our customers'. In short, for the next few decades our industry offers huge opportunities for scientists and engineers to tackle society's greatest challenges.**

I want to start by applauding this year's theme: "Sustainable Energy Systems" – and the recent launch of the Cornell Centre for a Sustainable Future

"Sustainability" is a word that gets used a lot these days – and it can mean different things to different people.

At Shell, "sustainability" is something very concrete, very personal, and very urgent. That's because our business – the energy business – is about sustaining the life blood of the world's economies...

...sustaining the ability of 6.7 billion people to warm themselves, feed their families, move about and make a living...

...sustaining our planet's fund of clean water, fresh air, biodiversity...

...and not least, sustaining the livelihood of our employees and confidence of our shareholders.

A lot of people don't think of oil companies as being on the front lines of sustainability. But a lot of people would be surprised at how many ardent environmentalists work for our company.

We all have future generations to answer to – indeed many of us have to answer to them across the dinner table every night! Our job is to meet the world's growing need for energy in a way that keeps the world safe, clean and liveable for our children... their children... and their children's children.

Meeting that challenge means acknowledging what we've come to call the "Three hard truths" about the energy.

The first hard truth is that the world's demand for energy is growing. Fast.

When I joined Shell 35 years ago, there were roughly four billion people in the world using 100 million barrels of oil daily. Today, there are 6.7 billion people using more than twice that amount daily – 225 million barrels.

By the middle of this century there could be over nine billion people using twice as much energy as we are today . . . or more.

It's obviously not just the number of people that's driving energy demand... it's their expectations. Billions in China and India want – and deserve – to adopt a first world standard of living... complete with cars, computers, washing machines, air conditioners, and high tech factories. Billions more around the world want – and deserve – simply to lift themselves out of poverty with access to clean, cheap energy to cook their food and light their nights.



Mexico City street scene

The author Jared Diamond recently observed that if all 6.5 billion of us on earth today were suddenly to have the standard of living enjoyed by each of us in this room, the earth would feel the equivalent of 79 billion people taxing its resources.

Truths don't come much harder than that.

The second hard truth is that conventional oil and gas – staples of our energy diet today – are becoming harder to find and produce.

Supplies of so-called conventional oil and natural gas will struggle to keep up with surging demand – as will all forms of energy, from nuclear power to renewable biofuels. There are still large amounts of hydrocarbons in the ground... but the stuff that's left tends to be concentrated under very deep oceans, very thick ice, or very difficult governments. It takes huge amounts of technology, energy, money and patience to get at it.

And that means the world is finding itself forced to tap less conventional sources of oil – like oil sands and oil shale – that require even more technology, energy, money and patience.

The third hard truth is that given today's technologies, more energy use means more CO<sub>2</sub> emissions – at a time when the climate can ill-afford it

To stabilize greenhouse gases in the atmosphere at anything like the concentration that scientists tell is the upper limit of what the world can plausibly tolerate, we need to cut the world's emissions in half.

So if the world needs twice as much energy and half as much CO<sub>2</sub>, then we need to figure out a way to cut the CO<sub>2</sub> content of every barrel by three quarters. The math is easy. The strategy is a lot harder.

Indeed, these challenges are enormous. They involve tough trade-offs. To put the hard truths another way, the world wants energy that is clean, cheap and always available – and none of these wants can be negotiated away.

But depending on where you sit, your priorities may look very different. An environmentalist may take one view... an energy minister another... a voter in Iowa yet another entirely.

Some people have the luxury of looking at the challenge through a single lens. And too many of them resort to scaremongering. "Fossil fuels are going to kill the planet"... "tree huggers are going to wreck our economy"... "competition for oil will lead to the next global war."

Scary headlines provide no solutions... and no insights... and they put governments under tremendous pressure to "do something." And most of us know what happens when governments are forced simply to "do something." Generally we wish they hadn't.

Our industry does not have the luxury of looking at the challenge through a single lens. Our task is somehow to reconcile these competing priorities... to be the honest broker between groups with different perspectives.

To bring technical expertise, disciplined management, and sound policy advice to the problem.

As we say in our advertising at Shell, real energy solutions for the real world.

To help us pick the right road forward, every four or five years a team of Shell thinkers develops a set of global scenarios, offering views of various energy futures over the next thirty years or so. These scenarios help us – and others – pick the right strategies. They help us make the right investments in complex and expensive projects that can live for as much as half a century.

We recently completed the latest Shell scenarios. There are two of them, and they take the implications of the three hard truths head on. And they wouldn't live up to the art of scenario planning if we didn't give them names: one we call "Scramble." The other, "Blueprints."

These scenarios will be presented in greater detail to the European Commission and decision makers in Washington DC in the coming weeks.

In the "scramble" scenario, companies and nations rush to secure energy resources. Energy security is seen as a zero-sum game with winners and losers. A kind of "energy nationalism" breaks out, with nations pinning

their hopes on locally-produced coal and home-grown biofuels. Nobody has much time to think about tackling consumption until a supply shock finally kickstarts radical action.

Likewise, despite a lot of talk, nothing much gets done about greenhouse gas emissions until major climactic shocks trigger draconian political actions.

The result: energy price spikes, volatility, a turbulent and uncomfortable ride.

The “Blueprints” scenario is no less challenging, but the landing is a lot softer. In “Blueprints” the world anticipates the challenges of energy security, energy supply and the environment. Coalitions emerge across the private sector and at the local and national governments. Major cities develop links with industry to reduce local emissions, improve efficiency, and secure supplies.

National governments introduce efficiency standards and stable, long-term regulation of greenhouse gases. Policies converge across the globe, and we figure out how to reduce personal energy consumption and to capture and store CO<sub>2</sub>.

Expensive, yes. Technically and politically challenging, certainly. Difficult, yes. Impossible, no. And the end result is a good deal more benign for our grandchildren.

Normally we simply offer up our scenarios to the world without stating a preference. This time is different. It's clear that Blueprints offers options far safer and more manageable than Scramble's dog-eat-dog race for resources, and we are working with governments and other interested parties to move toward a Blueprints future.

In fact, Blueprints is already shaping our thinking across the business – from energy efficiency, to carbon management, to partnerships and government policy, to our product line-up, and our investments.

So what does a Blueprints future look like? We see at least six pathways.

The first is getting our own house in order – managing the emissions from our own operations. Improvements at our downstream facilities are delivering CO<sub>2</sub> emissions reductions of about one million tons per

annum. Our CO<sub>2</sub> emissions have declined by approximately 20 percent since 1990. We also have adopted new investment criteria that factor in CO<sub>2</sub> management options.

The second is capturing and storing carbon dioxide – for example stripping CO<sub>2</sub> out of our oil sands processing and pumping it into the ground. We have been using some Carbon Capture and Storage (or CCS) techniques for more than 20 years in oil fields. We're currently involved in carbon capture demonstration projects in Australia, Norway, and the Netherlands, and actively pursuing them elsewhere.

CCS is not cheap. And it is not easy. But it is likely to be a necessary part of the recipe for cutting CO<sub>2</sub> from our fossil fuels.

The third pathway is more R&D into ways to find and produce fossil fuels more efficiently... with fewer emissions.

Fourth is developing low- CO<sub>2</sub> sources of energy. You may not know that Shell is a material investor in wind energy. We're involved in solar power and the development of hydrogen options. Perhaps most importantly, we're a leader in developing next generation biofuels.

This is an area I'm particularly keen on, so let me dwell on it for a moment.



We've been working on biomass research since I joined the company 35 years ago. Today we distribute more ethanol than anyone else. In 2007 we sold more than 5 billion liters – mainly in order to meet government mandates.

But the world is starting to realize that first generation biofuels – ethanol and biodiesel made from food crops – aren't the environmental panacea they once seemed.

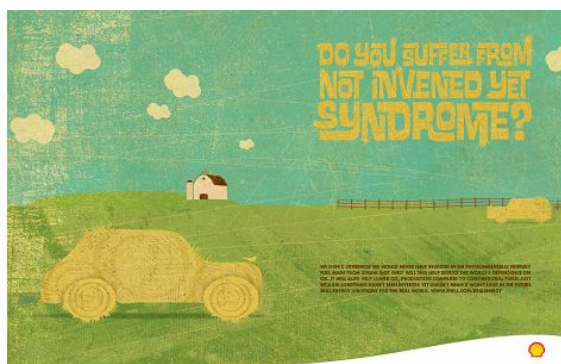
They often compete for land with food... consume vast amounts of water... affect the nitrogen balance of soils. Conventional ethanol delivers modest CO<sub>2</sub> benefits at best – compared to gasoline.

The feedstocks for first generation biodiesels – if they are not cultivated with care – can mean the destruction of rain forests, the disruption of indigenous cultures, and the violation of workers' rights.

To hear some tell it, biofuels are a disaster and should be written off as fundamentally unsustainable.

That irks me, because the fact is that not all biofuels are created equal. And sustainable, next-generation biofuels are already starting to show their promise. Biofuels that don't compete with food... that don't threaten rain forests... and that deliver CO<sub>2</sub> savings of as much as 90 percent compared to conventional gasolines and diesels are going to be vital part of the fuels mix in the future.

We're pursuing these next generation biofuels aggressively.



We partnered with the Canadian company Iogen to make ethanol from straw using enzymes – which in 2004 resulted in the world's first commercial cellulosic ethanol demonstration plant in Ottawa. That's led us to partner with other companies to improve enzyme efficiency – new territory for us.

We've also partnered with the German company, Choren, to develop a high performance synthetic fuel from wood residue – through gasification and the application of

the 100 year old Fischer-Tropsch process. The world's first commercial demonstration plant using this process will open in Freiburg later this year.

Just a few months ago we announced a partnership with HR Petroleum in Hawaii to explore the production of algae. I assure you the location did not influence our choice of that partner. But we were swayed by the prospect of a biofuel feedstock that does not use fresh water or arable land and grows at astonishing speeds.

I think biofuels could grow from a mere one percent of the world fuels mix today to as much as 7 or 10 percent over the next couple of decades. I want us to lead in that space; and to that end we've quadrupled our rate of investment in them.

But of course biofuels – even sustainable biofuels at 7 or 10 percent of the world's fuel mix – are not going to resolve those three hard truths I talked about.

Indeed, one of the best ways to address the energy challenge is, quite simply, to find ways to use less of it. And most intelligent observers are concluding that energy efficiency will be every bit as important as technology and policy and new sources of fuel in directing the concentration of CO<sub>2</sub> in the atmosphere towards the critical 550 ppm threshold, even though this is still above the 450 ppm level that the IPCC now recommends.

So our fifth pathway to a Blueprints world involves finding ways to manage energy demand by providing ways to help customers use our products more efficiently – to help millions of retail and B2B customers use less energy and emit less CO<sub>2</sub>... on the basis that small changes by all of us could make a big difference for all of us.

We've created gasoline specially formulated to increase fuel economy, as well as advanced lubricants that improve the energy efficiency of engines and moving parts. We're also working directly with automakers to optimize the combination of vehicle, fuel, and lubricant.

Our retail marketers surveyed 3,000 people in eleven countries and found that 60 percent of them had never tried to improve the fuel

economy of their cars. So we developed a range of “FuelStretch” Tips to educate consumers to drive in a more efficient way.

Using these types of techniques, a standard 1.6 litre 2006 Volkswagen broke the Guinness Round-the-World fuel economy challenge, covering 28,970 miles in using just twenty-four tanks of Shell fuel.

We also promote the goal of fuel efficiency through the annual Shell Eco-Marathons in California and Europe, where teams of university students compete fiercely to produce a vehicle with the best fuel mileage over a given distance on the track. Last year's winner clocked some 1900 miles per gallon.

As the number of cars in the world grows from a little less than a billion today to as much as 2 billion by 2030, it's vital that we find ways to increase their fuel economy – by developing better fuel formulas, by working closely with auto makers to help them develop more fuel efficient powertrains, and by educating consumers.

Which leads to the sixth pathway -- working with governments and advocating the need for more effective CO<sub>2</sub> regulation.

Most of the other five are very expensive, require long time-frames, widespread collaboration, and intense technological effort.

For all these reasons, governments have to play a role in facilitating these Blueprints pathways. Lawmakers have to provide clear and consistent rules. They must encourage investments in new technologies and energy conservation. They need to set a level playing field. And most of all we need them to set aggressive but predictable standards for CO<sub>2</sub> emissions.

I hope by now you understand why so many of us have a passion for this business... a deep commitment to meeting the challenge.

It's a hugely complex task requiring technical innovations, political cooperation, and the engagement of consumers worldwide.

And it's a task that matters – deeply – to society's future.

Ten years ago when I would speak at universities a handful of students might wander in, and some faculty might show up – mainly to be polite. Oil and gas was seen as anything but a sexy industry... unattractive to a generation caught up in the glamour of high tech and consumer electronics.

But these days I see rooms filled with students and academics keen to be at the crossroad of issues like alternative energy, economic growth, climate change, poverty alleviation, technical innovation, policy making and cause marketing. And that strengthens my confidence in our future.

Human ingenuity combined with business acumen and political will has helped us clean up rivers... scrub the smog out of cities like Los Angeles... and turn acid rain into an historic curiosity. Human ingenuity can also solve the energy challenge... and head off the climate crisis.

And in so many ways these solutions begin and end in engineering schools like this one. Because everyone needs to be involved in building a sustainable future: Scientists must make discoveries... politicians must make policies... consumers must make choices.

But we all know that at the end of the day, it's the engineers who make things work!

Thank you all.

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