



**Big ideas for the future of energy:  
aspirations and realities**

July 22nd, 2010

07:00 GMT

Session 1 Transcript

## Meet your panel

### **Sergio Kapusta**

*Shell Chief Scientist Materials*

Sergio Kapusta has been employed with Shell for over 25 years. During this time, he has held positions of responsibility in Research, Engineering and Operations, across all major segments of the oil and gas business.



### **Martin Haigh**

*Energy advisor Business Environment*

Martin has worked in Shell's scenarios team for the last five years and has led the development of our World Energy Model, which underpinned much of the analysis behind the recent Shell Energy Scenarios to 2050.



### **Nick Allen**

*Vice President, Downstream Management Consultancy and CO<sub>2</sub>*

Nick is responsible for developing Shell's low carbon and energy-efficiency customer solutions and oversees all of our Downstream low carbon initiatives. In addition, he leads our Downstream Management Consultancy team and has relationships with a number of vehicle manufacturers.



### **Russ Conser**

*Shell GameChanger Program Manager*

Russ is leader of Shell's global GameChanger team, and is passionate about the role of technology and innovation in the future of energy. He spent his early years exploring for and producing oil and gas around the world, then later on such things as business planning, strategy, scenarios, and technology ventures.



### **Sally Gold**

*Head of UK Social Investment and sponsorship*

Sally's portfolio includes the management of Shell LiveWIRE, a programme for young entrepreneurs. She also oversees the Shell Education Service, which holds interactive science classes to 60,000 children a year and the Shell Springboard programme which provides cash awards to low carbon businesses.



### **Simon Bishop**

*The Shell Foundation*

Simon joined the Shell Foundation in 2006 and is responsible for its policy and communications. He also heads-up a social marketing campaign currently running in India as part of the Foundation's Breathing Space programme.



**Sergio Kapusta**

Hello everyone. Welcome to today's webchat, "Big ideas for the future of energy: aspirations and reality". I'm Sergio Kapusta, and I will be your host for today.

**Mark**

- Q. What scenario does Shell foresee in case solar or wind electricity becomes cheaper than electricity from coal or gas fired power plants?

**Martin Haigh**

- A. Mark, this does indeed happen in our energy scenarios in the longer-term. Clearly as the costs of renewables come down it will stimulate take-up. A lot of policy is directed to achieve this, to get the costs down the learning curve. In reality, any crossover will happen in different places at different times. And because of issues around intermittency, land-use, balancing demand, and rate of scale-up of industrial capacity to deploy wind and solar, the simple costs equation won't determine the whole story. Martin

**Introductory Question**

- Q. Which emerging economies are energy innovators?

**Sergio Kapusta**

- A. The global business environment is changing rapidly, thanks to a number of trends. One of these trends is the economic growth in China, India, Brazil, and other developing economies. These countries have shown great creativity in coming up with new solutions to their energy challenges. I am particularly impressed by the high level of investments in technology, which will ensure that these emerging economies will play a key role in the future of energy.

**Introductory Question**

- Q. How could changing consumption habits shape the future of energy?

**Nick Allen**

- A. An important question.

We all will need to adapt our behaviour to consume less energy by using it in a smarter way.

Taking personal mobility as one example, to shave large amounts off energy usage there are three types of things we can do to make a real difference - purchasing more efficient vehicles, be more efficient in how we drive, and switch some of our journeys from our cars to public transport.

Whilst this sounds simple, obviously it is not as our behaviour is often sub conscious and is driven by our goals. Increasingly, companies will need to work with governments, behavioural experts and civil society to identify the best solutions for helping each and every one of us to be more efficient, whilst not compromising what's important in our lives. Tough but doable.

## **PREM**

- Q. How much extra CO2 will be emitted in compressing the low pressure gaseous CO2 in to high pressure, liquid or super critical, CO2 for the sake sequestering the CO2? Aren't we producing more CO2 in the name of CCS?

## **Martin Haigh**

- A. PREM, Running CCS will increase the energy use within the energy sector. In our analyses we typically assume a 15% hit on the efficiency of power stations. There is a trade-off between the proportion of CO2 captured and the efficiency hit. A lot of R&D is focused on improving this, as well as getting the costs down. Martin

## **Introductory Question**

- Q. Who is driving innovation in the energy systems of the future?

## **Russ Conser**

- A. Great question, but very broad. Business, governments and consumers all have driving roles. At Shell, we're very strong in seeking a driving/shaping role. We aim to be part of the solution, not a spectator. For example, in the near term, we're very active in developing innovation in biofuels - e.g. our investments in logen, Codexis, Virent, Cellana. GameChanger is part of our Emerging Technology team, where we are more focussed on longer-term options, so we play a role, too.

## **Introductory Question**

- Q. Which energy technologies will progress most within ten years?

## **Sergio Kapusta**

- A. Thank you for your question. We have to be realistic regarding the time that it takes for new technologies to make a significant impact. It often takes more than 10 years to move a new scientific breakthrough from the lab to a demonstration plant, and another 10 years to build several commercial plants. Natural gas is the quickest and cheapest way to cut CO2 emissions from the global power sector. Gas plants emit between 50 and 70 % less CO2 than coal plants. Biofuels are also a way to reduce CO2 emissions from the transportation sector. The biofuel production is growing rapidly.

## **Introductory Question**

- Q. What are the challenges in commercializing new energy technologies?

## **Simon Bishop**

- A. This is a complex question. I can only answer it in relation to one specific new energy technology I work on through my job at the Shell Foundation. This technology is Improved Cook Stoves (ICS). Half the world's population still cook each day on open fires and traditional stoves; the toxic smoke kills 1.5m globally a year. 'The' internationally-recognised most effective solution is

ICS, which dramatically reduce emissions and fuel use - so are good for people's health and for the environment. But with 500million homes affected, we need to commercialise ICS as no organisation has the resources to give them away. But how do you convince an Indian householder with an income of \$1.5-a-day and whose family have cooked on an open fire (which costs nothing) for millenia to spend \$20-50 on an ICS? This is the challenge I grapple with every day.

#### **Andreas**

Q. Hello, in your oppinion - which "clean energy" technology will save the most CO2 in the next ten years?

#### **Sergio Kapusta**

A. Thank you for your question. I think that in the next few years natural gas is the quickest and cheapest way to cut CO2 emissions from the power sector. For transportation fuels, biofuels offer the potential to reduce CO2 emissions, depending on the source and technology that are used. I expect that both gas and biofuel use will increase in the next 10 to 20 years. Other clean energy technologies will also play an increasing role for specific applications and markets.

#### **Edouard de Guitaut @ energy-future.com**

Q. Although their use will grow significantly over the coming decades, renewables will probably not replace the use of fossil fuels in that timeline.  
How can we manage that expectation?

#### **Martin Haigh**

A. Edouard,  
This is a good question. Our analyses bear out what you say, although some other organisations are much more optimistic about rates of change in the energy system. Given the sheer scale up required and the long-lasting nature of energy infrastructure, by mid-century it is difficult to see fossil energy still not having a major place. As such, a major challenge will be to maintain the impetus of effort. And to recognise the need to take advantage of all the options we have available on the table.  
Martin

#### **Introductory Question**

Q. How can I get my new energy idea off the ground?

#### **Sally Gold**

A. Through our Shell Springboard programme we see a lot of people with some fantastic ideas. How they get them off the ground varies according to a number of factors, including the sector you are trying to launch into and the complexity and cost of the technology you are developing. In terms of seeking funding and support, there are a number of sources you can go to. In the UK market that I work in there are government organisations that give funding and incubation support as well as private sector investment. There are competitions like Shell Springboard which can also help you to raise your profile. In turn, this can help you access

larger funding sources. The key to accessing many of these sources is to show that your idea is innovative, that it could be financially viable (i.e. that you can scale it up) and that it could have a real impact on reducing CO2 emissions.

#### **Hans**

- Q. Can we expect any day soon from Shell something similar to GE's recently launched Ecomagination Challenge (a \$200 million call to action for businesses, entrepreneurs, innovators, and students to share their best ideas and come together to take on one of the world's toughest challenges – building the next-generation power grid to meet the needs of the 21st century). If not why not?

#### **Russ Conser**

- A. Another good question, Hans. Yes, I am familiar with the recent GE announcement. At GameChanger, we're already open for such opportunities and have been for a long time on a day-in, day-out basis. Yes, we are looking at ways to raise that game - especially those targeting the 'toughest challenges,' so stay tuned....

#### **G Goldbeck**

- Q. How do you see the future of mobile power applications, e.g. for transport. It seems that after strong investment in fuel cells, the emphasis is now shifting to batteries?

#### **Sergio Kapusta**

- A. Thank you for this excellent question. One of the main issues in mobile power applications is how to extend the range of the vehicles, that is how many miles or kilometres to achieve between charges. Fuel cells have the potential for large vehicle autonomy, but they require major changes in vehicle design and infrastructure to supply the hydrogen fuel. The evolution of the hybrid vehicles, that combine a battery with an internal combustion engine, has given more emphasis to battery development. I expect that in the future there will be room for both fuel cells and batteries, for instance for short and long distance vehicles.

#### **Erika**

- Q. Are any of the developing economies coming up with fresh ideas outside the known realm of energies?

#### **Simon Bishop**

- A. Erika - there are some new technologies being explored. For example, in India Shell Foundation works with an organisation - Husk Power Systems - that takes rice husks (the waste product from rice) and turns them into electricity - then supplies the electricity using localised grid systems. This means areas that currently don't have electricity because they are off the main national grid can be reached - and in a cost-effective manner. Beyond new technologies, the main focus in developing countries is on scaling-up existing technologies such as solar; either individual home-systems with a panel on the roof or smaller items such as solar lanterns. The Indian government, for example, has made solar one of its top priorities. For me, exploring new technologies is important - but scaling up existing technologies so millions (even billions) benefit is key.

### **Algasolution**

Q. What is your opinion on biofuel

### **Nick Allen**

A. Algasolution, thanks for the question.

Firstly, we believe biofuels available today are the most realistic commercial solution to take carbon out of the transport fuels sector over the next twenty years.

Then its about developing advanced biofuels - new feedstocks such as crop waste or inedible crops and new conversion processes. Shell was one of the first energy companies to invest in advanced biofuels and we have a dedicated bio team in our research centres in UK, US, Netherlands and India, and partnerships with biotechnology companies.

### **keith mackrell**

Q. based on the blueprint scenario there will be a great increase in electric car transport.Long term does shell see itself as a supplier of oil and gas largely to power stations and industry.What does this mean to the organisation of the company

### **Martin Haigh**

A. Keith,

This is a challenging question. I would say it will depend. We know that the future of energy has to be very different to today. But a lot of the lead times are long - the world will not be giving up on oil and gas for some time. Shell has been involved in working on alternatives for some years and has real interests now in things like CCS development and low-CO2 biofuels. The key is to build these options up to scale - and make a viable business out of them. In the longer term, other possibilities may open themselves up such as hydrogen to complement the electricity and biofuels pathways for transport.

Martin

### **alex macgillivray**

Q. Good morning. Can the panel tell me whether it is feasible to convert oil and gas to hydrogen at the source and use carbon capture and storage to produce a carbon neutral liquid fuel? If it is, what sort of timescale for making it viable and who is leading on the approach worldwide?

### **Sergio Kapusta**

A. Alex, thank you for your question. There are indeed technologies that can convert oil and gas to hydrogen. In fact, most hydrogen is produced from oil and gas conversion. The technologies are more adapted to large scale plants, such as oil refineries, than to conversion at the source. There are some pilot studies to scale down the size of the conversion plants, for instance to make hydrogen at a local station. I expect that it will still take a few years until these technologies are proven and deployed at a significantly high rate.

#### **oceanresource**

- Q. Comment on Russ's response to introductory question. Many of the new concepts are being developed by SME's without access to significant innovation funding. In the past oil majors took a more significant part in filling a funding gap but this has more or less dissappeared. Are there any plans to tap into the SME innovative mind-set? David

#### **Sally Gold**

- A. Hi David,

We do fund research and innovation that relates directly to our businesses in Shell. It is really important to the future of our business. Last year we were the biggest investor in research of the oil majors, dedicating \$1.1 billion to this.

In terms of SMEs specifically, we recognise that they represent an incredible pool of innovation and ideas. We set up the Shell Springboard programme to help companies exactly like this who have ideas that don't necessarily relate to Shell's businesses. It is a competition for SMEs to compete for a financial prize of 40,000GBP as well as substantial PR support and endorsement. We are not tapping into their ideas through this competition for our direct benefit but to fill the funding gap you refer to. There are other sources of funding available but we recognise that, especially for SMEs, they are difficult to access.

Sally

#### **Fred Le Ballois**

- Q. Apart from gas gas and gas, are we looking at setting the pace in any new technology area or is it wait and invest when the tchnologies are more mature?

#### **Russ Conser**

- A. I like the way you word it, Fred... We think we are very much 'setting the pace' in some fields other than gas - e.g. 2nd and 3rd generation biofuels. But these are only a part of possible energy futures. It can be a struggle to get the timing right, especially as any given technology takes a long time to mature. I do believe there's an increasing awareness that waiting has its own dangers. We're working hard, but don't think we have the perfect answers yet.

#### **lok**

- Q. major car companies are moving for mast production of electric car, and that will slowly take up the car market share to replace the fosil fuel powered car. and we know the electric can be generated from solar or wind. that put electric cars can be power with energy coming 100% of renewable sources. that certainly that will impact Shell. what is the path forwards?

#### **Nick Allen**

- A. Thanks Lok.

We see electric vehicles as an important part of the energy mix long term, and definitely a solution for urban transportation. The road will be long on electric, as the world works to develop the necessary battery technology and the supply of clean electrons.

Thinking of pathways, we see the long term being more of a mosaic of solutions rather than the dominance by any single solution, with liquid fuels playing a key part of many modes of transportation.

#### **Arnold**

- Q. Sally: I read your answer regarding Shell Springboard. Can you please tell me more. I can be reached at [www.arnoldkeller.com](http://www.arnoldkeller.com) after this web chat will be OK. I have something that may fit your program. Thank you. Arnold

#### **Sally Gold**

- A. Hi Arnold,

There is stacks of information about the programme available at [www.shellspringboard.org](http://www.shellspringboard.org). The competition is open now and closes in early November. If you complete an entry form, your details will be assessed in confidence by a judging panel independent of Shell. We will then let you know if due course if you have made the short list. Good luck!

Sally

#### **Andreas**

- Q. Simon, I believe the Shell foundation works in several countries with rapidly growing economies, with people on the ground. How do you see the take up of cleaner energy technologies developing there? Which clean energy sources work for people that don't have a lot of money to spend - and which don't?

#### **Simon Bishop**

- A. Andreas - all good questions. You are right, the Shell Foundation works in a variety of rapidly growing developing world countries, such as India - and we do a huge amount of work trying to convince people to adopt cleaner energy technologies. The great thing about many of these technologies such as solar or improved cookstoves (ICS) - ones that dramatically reduce fuel use and emissions - is that they have the potential to be self-financing. For example, the \$20 price tag for an ICS can be paid for in six months through the fuel savings they deliver. However, that does not necessarily mean someone earning \$1-a-day can pay \$20 upfront. So there is real affordability issues linked to these technologies. Lack of awareness is also a major challenge; people just don't know these technologies exist. The Foundation tries to tackle both of these barriers - and more.

#### **oceanresource\_2**

- Q. Hello Sergio - Good point about China, India and Brazil - In the UK we see less investment in innovation these days. China installed an offshore wind farm in 2 years and has used PV

extensively in the Expo 2010 Shanghai. How does Shell approach innovation in these technologies? - you walked away from offshore wind power a few years ago. Thanks, Lewis

#### **Sergio Kapusta**

- A. Hello Lewis. As I mentioned in my previous answer, I am very impressed by the pace of technology development and deployment in some of the emerging economies. I should say that also in both Europe and the US, technology is seen as a key to our future. Shell is still involved in onshore wind power, especially in the US. We think that some renewable energies such as biofuels are more in line with our line of business, and have a strong potential for reducing the CO2 from the transportation sector.

#### **Amos**

- Q. What role will growth in population exert on the trajectory of energy demand and supply in the future, and how can it be moderated to sustain global economy?

#### **Martin Haigh**

- A. Dear Amos,  
It is quite telling that a lot more people are asking questions about population now. In our analyses, we work with UN numbers and they project just over 2 billion more people on the planet by 2050, than today. Nearly all of these will be in the developing world. These people will clearly have an impact on energy demand - particularly for the longer-term, post 2050. Much of the research suggests that economic development and raising the education levels, both particularly for women in developing countries, will be critical in bringing birth rates down closer to the 2 births / woman average. I visited an NGO in Madagascar a couple of years ago who were doing some impressive work helping work with people in rural communities on family planning.  
Martin

#### **DavidElmes**

- Q. When you look at the projections for reducing energy use to curb emissions (e.g. IEA forecasts), about half of the emissions come from efficiency actions in both the generation and use of energy. Do you see companies like Shell being significant players in reducing energy use, as well as your current role in changing sources of supply (more gas, biofuels, GTL, etc)?

#### **Nick Allen**

- A. David,  
  
At Shell, along with many other companies, we are committed to improving the energy efficiency of our operations. We set ourselves an ambitious target to reduce our emissions by 5% compared to 1990 levels by 2010, and we are on track to beat this target. In addition, we are working to help our customers do the same.

#### **Wharmes**

- Q. what options are there for innovators in Australia to communicate new ideas to Shell, do you support innovation in Australia?

**Russ Conser**

- A. Wharmes, GameChanger supports ideas from anyone, anywhere, anytime... including Australia ;-). If you have an idea that you think Shell should be interested in, simply go to [www.shell.com/gamechanger](http://www.shell.com/gamechanger) to learn more about us and submit your idea.

**Arnold**

- Q. Sergio: Your comment on natural gas as the source for the immediate future to maintain low CO2 emissions. Has your team looked at Coal gasification to make SNG with CO2 sequestration. Where do you see the industry going. I am interested because the USA has extensive coal reserves, and limited gas reserves (besides tight gas). Any thoughts? Thanks Arnold Keller.

**Sergio Kapusta**

- A. Arnold, I am very happy that you mention coal gasification as this was one of the first technologies on which I worked when I joined Shell! We think that coal gasification combined with carbon capture and storage does indeed offer an interesting option to produce cleaner energy from a traditional source such as coal. The US has large amounts of coal. It also has large potential for natural gas from the tight gas formations. I think that natural gas is the cleanest burning fossil fuel. Coal gasification plus carbon capture and storage can help reduce the CO2 impact of coal from the power sector.

**wharmes**

- Q. Hello, is Shell actively looking for new opportunities in renewable fuel technologies? Or are you exclusively working within established relationships?

**Russ Conser**

- A. Wharmes, Simple answer this time - Yes (we are interested in new opportunities in renewable fuel technology).

**wharmes**

Russ, thank you for answering my question.

**Sudeep**

- Q. Would be interested in views on developing small stranded gas fields, not large enough for GTL or LNG, to produce Dimethyl Ether.

**Sergio Kapusta**

- A. Sudeep, you raise an interesting perspective. If you have some ideas of how to convert small gas volumes to valuable products such as dimethyl ether, perhaps you can contact our GameChanger group with these ideas?

### Waldi

- Q. Is nuclear still an option in generating energy in the mobile world or is it still too unstable to consider?

### Martin Haigh

- A. Dear Waldi,  
There is rising discussion about small scale nuclear. Development - particularly at scale - is likely to be some way off, though. The best option today for nuclear in transport is for large shipping. But the costs are still substantially higher than oil-based options. This is why we only see nuclear shipping today in very specialised situations, like polar ice-breakers and some military shipping.  
Martin

### monwafan

- Q. Which technologies and/or resources show the greatest potential for meeting the energy needs of sub-Saharan Africa in the most sustainable way. What policies can the governments of this area adopt to help realise these opportunities and help meet the ever increasing energy needs of this developing region and what role should the private sector play?

### Simon Bishop

- A. Monwafan - there are a variety of technologies that can potentially meet sub-Saharan Africa's energy needs, for example biogas, solar and improved cookstoves. At the Shell Foundation we believe these problems are so large - they impact 2-3 billion people - it is essential to get the private sector selling products, as opposed to them being given away or heavily subsidized. But government plays a crucial facilitating role in this process. Examples of what they can do include:
- Setting standards to make sure consumers get decent (not poorly designed) products
  - Implementing policies that promote these technologies. For example, removing tariffs or taxes
  - Use government networks - health workers and teachers - to educate their populations about energy issues and solutions.
- I hope that helps.

### Rob van der Stel

- Q. With regard to CCS and specifically post combustion capture. There's a constant debate on the cost of capture. What are the technological focus areas for Shell to reduce capture cost.

### Sergio Kapusta

- A. Rob, you are correct that the cost of CO<sub>2</sub> capture is an important issue. The conventional technology is CO<sub>2</sub> absorption using an amine solvent. This is proven technology that can be scaled up to the volumes needed for an effective carbon capture solution. We are also looking at other technologies which do not require absorption, for instance separation based on converting CO<sub>2</sub> to a liquid or a solid. I believe that we will have different capture technologies for different sources of CO<sub>2</sub>.

**Richard**

- Q. Not sure it is a big idea, but is the launch of the Fuel save products a shift in marketing strategy, making what were previously premium price fuels as now our mainstream products

**Nick Allen**

- A. Richard,

Thanks for the question. In addressing the CO2 challenge, we listened to our customers and they were increasingly asking us for products that help them be more efficient, as well as addressing our own challenge.

To respond to this we have worked hard to develop a real breakthrough in regular fuels, out of which has come Shell FuelSave (now available in Europe and Asia), which offers customers the opportunity to save up to a litre of fuel per tank. FuelSave is a mainstream product, which sits alongside V-Power, our premium fuel, hence more of an evolution of our marketing strategy in response to our customers' needs.

**Kerry-Ann**

- Q. Kerry-Ann - Change is hard. Leveraging change is harder. Has Shell a co-ordinated approach across departments? There seems to be a number of really interesting groups and initiatives here but how much is this a silo approach to change?

**Russ Conser**

- A. Kerry-Ann, an insightful question - you must have experience in the challenges of change? In GameChanger, we have the luxury of being a well established innovation function that spans all of Shell, so we intentionally try to be a 'silo'-breaker. Although we have good success doing so, it's never easy.

**Richard**

- Q. Can biofuels realistically scale up to make a meaningful difference? What say, acreage would it take to make one percent difference? What's the maths? I have never seen it published

**Martin Haigh**

- A. Dear Richard,  
The estimates of the size of the biomass resource base are some of the most uncertain we work with. Depending typically on assumptions around yield improvements, development and other constraints such as water, one can see values anywhere between close-to-zero in the most pessimistic cases right up to 1000 EJ / year of primary biomass. (Today's world primary energy demand is around 500 EJ / year from all energy sources.) Median estimates tend to be around the 200 EJ / year. This does suggest that the biomass is a material option for the world's energy going forward.  
Martin

**Sven**

Q. Every major carmaker is working on hybrid cars and electric cars. Is there still room for hydrogen or gas?

**Nick Allen**

A. Sven,

As we look ahead, we see the future being a mosaic of transport energy solutions, including liquid fuels, hydrogen, electric and gas. In fact, there is increasing evidence that hydrogen and electric will complement each other rather than compete, as they are best suited to different classes of vehicle.

Specifically on hydrogen, you see many of the car makers committed to its development with a number of trials underway across Europe and North America, trials which Shell are involved in.

**Joan**

Q. I was looking at the "related material" to this chat and found the Shell foundation, if I see a promising development at a third party ( Ilford engines) could I ask for a development fee ?

**Simon Bishop**

A. Joan - we work almost exclusively in the developing world. On the assumption 'Ilford engines' are in the developed, it is unlikely we would consider them. We also focus on several particular issues we may or may not be relevant to their work. For more info check this website.

**wharmes**

Q. One more if you have time, I'm sure many people here rightly or wrongly will be concerned about confidentiality, are the Gamechanger and Springboard submissions in confidence? thanks again.

**Sally Gold**

A. Hi,

Thanks for the question, as it is important to clarify the difference between these two programmes. Information submitted to GameChanger via its website should be non-confidential. These are ideas that Shell can look at as a business opportunity.

Shell Springboard is different. This is a social investment programme for Shell, one that we run for non-commercial gain. All competition entrants for Shell Springboard are treated in confidence. Applications are examined by a company external to Shell called CAMCO Ventures. CAMCO look at each and every entry and shortlist them according to the Shell Springboard criteria. These shortlisted entries are then seen by two people in Shell and then our panel of external judges. Anyone who has access to these application forms signs a confidentiality agreement. Full information about the confidentiality of Shell Springboard is available at <http://www.shellspringboard.org/applications/submission-contract>

Sally

### **Natasha T G**

- Q. Any examples where biofuels is being used currently and the advantages/disadvantages it presents?

### **Sergio Kapusta**

- A. Natasha, biofuels are used all over the world. The largest markets are the US, Europe, and Brazil. Shell is currently the largest marketer of biofuels. We blend approximately 9 billion litres of biofuels into our gasoline and diesel fuels, as required by local regulations. The most common biofuel is ethanol which is typically mixed with gasoline up to 10 to 15 %. In some countries, such as Brazil, ethanol can be used at much higher percentages because car engines have been modified. The main advantage of biofuels is that they can be blended with the existing fuels, they require little modifications to the engines, and can reduce CO2 emissions depending on the source of the biofuels.

### **Richard**

- Q. If you really want to change behaviour you need to change the price. With Oil still relatively cheap, big consumers will only really want to drive more sensibly turn down the thermostat etc when the price signals force that change. What is our stance on taxation in the major resource consumers? Not an easy of palatable call to make.

### **Nick Allen**

- A. Richard, thanks.

We all know from our everyday lives, that tax plays a role in influencing our behaviour, however it is far from the silver bullet. I believe that the solution to changing our behaviour is a mix of regulation, taxation and incentives, and making available solutions that can help each and every one of us to change our behaviour. A good example is smart meters for energy consumption in the home, and being aware of how our consumption compares to our neighbours.

### **oceanresource**

- Q. We know that there is a great quantity of oil and gas remaining in the ground. Has Shell any specific plans for developing new technologies applicable to the lower cost regimes required to develop stranded assets and sub economic reserves? The required philosophy appears to be outside the philosophy of the major offshore corporations.

### **Russ Conser**

- A. Yes, things like Shell's recently announced Floating LNG projects in Australia are explicitly targeted at creating a fundamental change to the economics of stranded gas. Floating LNG is an example of something that began its life in GameChanger with this very concept in mind.

### **G Goldbeck**

Q. What margins of energy efficiency improvements are still possible in areas such as exploration and refinement, for example with new materials and catalysts?

**Sergio Kapusta**

A. Thank you for your question. We are continuously looking at ways to improve the energy efficiency of our operations, and I believe that there are still improvements to be made. I like your reference to materials, because that is my main expertise. We look at alternative materials for construction, for instance lighter materials, more corrosion resistant, or cheaper materials. Similarly, catalysts are continuously evolving. It is hard to say how much more improvement is possible, but that is what makes the chase for energy improvement so interesting!

**Calum Hughes - YWE**

Q. Hello all.

Given the EU's, and particularly the UK's, commitment to CO2 reductions coupled with the associated requirement to compensate for the intermittency of wind generation, do you think there are any options other than continued reliance on fossil fuel based power generation with CCS?

**Martin Haigh**

A. Calum,

There is a lot of uncertainty around this for the long-term. There are four big options here it seems to me: fossil generation + CCS as you say, wide scale development of energy storage technologies (e.g. those batteries in electric cars, or the use of hydrogen), continental scale interconnection, and finally smart grids + demand management. A fifth option, I suppose, is to 'spill' the surplus electricity, but then things get expensive.

Martin

**Paul McLachlan**

Q. Dear Sally Gold, my question is - How does a company with a new technology ensure that the full potential is assessed by your team. Our technology is in the internal combustion engine design with a unique device for more efficient and more compact conversion of energy and in particular with gaseous fuels. The Pivotal engine will bring greater viability to natural gas and blends of bio-methane and hydrogen due to the extreme degree of thermal control and low parasitic energy waste. It is no small task to break into the engine industry with a novel and better design so it is important that major energy and fuel companies participate in ensuring that technologies that will enable changes in the type of fuels used get through to the commercial phase. It can be a very profitable path once the vision is grasped. Please let me know how we can explore this potential together. [www.pivotalengine.com](http://www.pivotalengine.com)

Thank you

Paul

**Sally Gold**

A. Hi Paul,

If you want to enter your technology for the Shell Springboard competition, the key is to put as much information as possible into your online entry form. This will be assessed by CAMCO Ventures against the three Shell Springboard criteria - innovation, carbon saving and commercial viability.

Our experience with past Shell Springboard winners who are trying to tap into the engine industry show that it is difficult as you say to get into this market, but not impossible. If you check out our website there are some past winners on there who have recently made some great strides, for example Oxy-Gen Combustion and Aeristech Ltd. There may be some learnings from companies like this who are making progress at getting through to the commercial phase.

Hope that helps a little.

Sally

#### **Ramona**

- Q. In the world there are still large quantities of fossil fuels, especially coal. If renewable energy will develop and be able to cover the energy demand will fossil fuels still be used?

#### **Martin Haigh**

- A. Dear Ramona,  
Most likely yes, I would say. It will depend on more than just the availability. Cost is a critical factor. And then issues like convenience will still affect choices for many applications.  
Martin

#### **LenaL**

- Q. How sustainable are biofuels at the moments?

#### **Nick Allen**

- A. Lena, appreciate the question. I'll answer from our perspective and how we are addressing the challenge.

We are working to ensure that the biofuels we purchase for blending are produced in a more sustainable way. We have systems, policies and resources in place to help us assess potential sustainability risks in our biofuels supply chain, to implement controls and to monitor and report progress.

Finally we are also working with other industries, such as food and cosmetics, governments and NGOs to raise standards and improve practices across the feedstock industry.

#### **Joan**

- Q. with reference to the answer on the on board fuel cells, could we return to the on board hydrogen production especially now it is easier to have on board methane ?

**Sergio Kapusta**

- A. Joan, There are some pilot studies to scale down the size of the units to convert methane to hydrogen. I am not sure if this approach is preferable to having hydrogen production in a central location where the process can be better controlled. What do you think? I would be interested in hearing your views.

**Joan**

- Q. I am here, what is next ?

Joan

**Sergio Kapusta**

- A. Hi Joan! I did not get your question. Please can you restate? Thanks!

**P.RAM**

- Q. Can we have a specific game changer web site for energy onl?  
P. RAM

**Russ Conser**

- A. P. Ram, Not sure what you mean by 'onl', but in principle, we aim to keep a single web portal and a single team. This allows us to flexibly consider all possibilities - e.g. whether there are opportunities to utilize technologies in principle aimed at the long-term, in our near to mid-term businesses. We are considering options to improve our web portal, but it will still be one site.

**Erika**

- Q. If we use cop waste or inedible crops for biofuel, won't we need to renew lands for large amounts of crop growth?

**Sergio Kapusta**

- A. Erika, you raise a very important point. The impact of large scale biofuel production on land utilization, which I believe is at the core of your question, is being studied. There are no simple answers, and the models that we have need to be improved to provide a better view of the issue.

**Ramona**

Dear Martin Haigh, Thanks for your answer.

**achmura**

- Q. good morning, i am wondering if Shell is drawing the scenarios for hydrogen based mobility?  
  
1. what in Shell opinion will drive us in the future: battery electric vehicles or hydrogen propelled vehicles?

## 2. how do you think hydrogen will be produced in 2030 and 2050?

### **Martin Haigh**

A. Achmura,

We do maintain the prospect for hydrogen vehicles in some of our outlooks. Our Blueprints scenario describes this. Battery electric vehicles are starting to appear now, but a number of hydrogen fuel cell vehicles are close to launch as well on a more widely available basis. Rather than have a transport system dominated by one option as we've had up till now, with oil, a mixture of options for different situations is more likely I would say - particularly in the longer-term.

On the hydrogen production, gas and coal are the most energy-efficient pathways today. So if environmental issues are critical in its development then CCS will be key. Longer-term, 2050, we may start to get more of a mix of hydrogen from renewable (or nuclear) pathways as well as gas and coal.

Martin

### **MichaelP**

Q. The point of long lead-times for new energy technologies has been mentioned. In Cambridge we are developing materials technology that has potential to make CCS profitable - i.e. create a financial business to do it. Any suggestions on how to sustain investment at sufficient scale over long enough to complete the R,D&D in a real world where financial investors require returns from a market within two or three years and CCS as seen as being more than a decade from commercialisation?

### **Sally Gold**

A. Hi Michael,

Lots of the Shell Springboard past winners are in exactly this position. They need funding to complete a long R&D process, yet find it difficult to get investment until they can prove to investors that they have a viable, scalable product or service.

There are other sources of funding out there; the challenge is to find them. One approach might be to look at sources of funding other than a financial investor. The Carbon Trust for example runs an incubator programme. They provide both funding and business support to help you develop your product for a commercial market so that you can then attract investors when you are further down the line. Other opportunities may lie with programmes such as the Shell GameChanger initiative.

One other action I could suggest is for you to join some of the online networks of people who operate in this space. Through some of these SME / low carbon / technology networks you may get some ideas of how other companies in a similar situation are tackling this funding gap. We list some of these sources here.

Hope that helps.

Sally

### Algasolution

Q. Do you believe green algae has a future in Biofuel production

### Nick Allen

A. To put it simply, algae hold great promise because they grow very rapidly, are rich in veg oil and can be cultivated in ponds of seawater, minimising the use of fertile land and fresh water.

Since 2007 we've been a major investor in Cellan, a company set up to operate a pilot plant in Hawaii to grow marine algae and produce vegetable oil for conversion into biodiesel.

As with other advanced bio technologies, it will take considerable time and investment to take the technology from lab based process to demonstration and then to commercial sized plants, so algae will not be with us as a bio solution for many many years.

### P.RAM

Q. My name is P. Ramalingam. (P. RAM). I am from Bangalore.  
I am a Petrophysicist. I have nearly 25 years experience in this discipline.

My question:

We have technology /material to convert light into electricity. Do we have any material/Technology to convert the Gamma ray produced by shales in the subsurface in to electricity?

If such a material/technology is available why cannot we convert the abandoned oil wells into electricity producer using the Gamma from the shales?

If not will Shell strive to find suitable material/ Technology for the same? Can I propose this in the Gamechanger?

P. RAM  
STI-PP

### Russ Conser

A. P RAM, I am originally a petrophysicist as well :-). I am aware of others who have worked on solid state technology that aim to convert radioactivity into electricity. Sure, I think Gamechanger is a good place to take a look at your idea, so if you wish to develop it, please submit it.

### Mark

- Q. Thank you Martin, can you sketch a possible scenario in the specific case that sustainable electricity becomes cheaper across the board (central and decentral micro generation) (while fossil fuels still are the cheapest among fuels)?

**Martin Haigh**

- A. Mark,

Your conditions sound like a drive to renewable electricity, but fossil fuel dominated transport? How things pan out would depend on a lot of other conditions in reality. For instance, there will be system-wide issues (intermittency, demand management, land-use etc) that mean that other factors that things are unlikely to be as black-and-white as renewable electricity + fossil-fuel transport. However, the spirit of your question is a good one, in that we are likely to have more options to go for low-CO2 supply in electricity generation at large scale before we can do the same for transport.

Martin

**j-ramos**

- Q. Don't you think that biofuels can be the engine of development for many poor countries in the sunny tropics? Are there enough resources available for all the investments needed?

**Simon Bishop**

- A. J-Ramos,

I think biofuels have the potential to play some role in helping poor countries develop but I am not sure they can be 'the engine'. 2-3 billion people living in the developing world don't have access to basic energy such as electricity. Meeting this need is going to require a wide range of energy technologies.

**Erika**

- Q. I'll make this as succinct as possible. Shell has programs for children. What if very bright and creative children were raised by their parents in a somewhat isolated area(children from all parts of the world), and never told of the various energies available. Perhaps geothermal heating would be the only energy surrounding them. Given assignments at certain ages to come up fresh ideas for new energy, yet unknown to the world. They would have NO preconceived ideas given to them.

**Sally Gold**

- A. Hi Erika,

Good point. I know from spending time at our Shell Education Service science workshops how creative and intuitive young minds can be. I agree that children are a fantastic source of real out of the box thinking as they don't have the constraints we have imposed on us as adults. Our take on this, at least in the UK, is to use our science programme to get children excited about science and experimenting with it. We aim not to teach them the answers but how to ask the questions and find the answers for themselves. If they understand the principles of basic science like gravity, friction, motion etc, and are encouraged to study science to further

education, who knows what they will come up with...

Sally

#### **Woodven**

- Q. A recent report published by the US Department of Energy states that if CO<sub>2</sub> is stored in underground basalt formations then over a period of time basalt slowly converts the CO<sub>2</sub> into carbonates thereby eliminating any fear of leakage associated with CCS methods. How important it is for countries having widespread basalt plateaus like USA (Nevada plateau) and India (Deccan Plateau) to implement this idea.

#### **Sergio Kapusta**

- A. Woodven, thank you for this interesting question. There are several processes by which CO<sub>2</sub> injected in underground storage reservoirs can be converted to carbonates. Reaction between CO<sub>2</sub> and the rocks is one of these processes. At Shell we are looking at various types of rocks and storage formations, and we are also developing models to predict the long term effect of CO<sub>2</sub> in these reservoirs. There are many sites around the world where conditions seem to be best to ensure the long term stability of the stored CO<sub>2</sub>.

#### **deepa varma**

- Q. Is there a strategy be to team up with smaller players in the 'emerging countries' in the biofuels business to make use of their innovative technology that can have a better C footprint/ GHG savings?

#### **Nick Allen**

- A. Deepa,

simply, we have an active biofuels team, looking at new bio technologies across the world, in emerging and developed markets. One of our key bio research facilities in is India, and as you may be aware, we have signed a memorandum of understanding with Cosan of Brazil to establish a scaleable and profitable business in sustainable biofuels.

#### **Arnold**

- Q. Martin: The questioned on acerage to support a large biomass resources did not address the possibility of algae use which is the most prolific biosource. Some technologies attempt to convert algae to oil. Is it not better to use the more prolific algae in a Shell gasifier to make power? Then the CO<sub>2</sub> emitted could be captured to make more algae, etc. Any thoughts if this is eceonomic? Thanks [www.ArnoldKeller.com](http://www.ArnoldKeller.com)

#### **Martin Haigh**

- A. Dear Arnold,  
This an interesting idea. There is increasing interest in biomass+CCS now as the environmental challenge looks more and more challenging. Your option doesn't sound at all cheap to me -

there are probably rather cheaper ways of generating electricity. And transport is one of the most constrained sectors given the dependence on oil and difficulty scaling up alternatives quickly. However, it's a pathway we should keep in mind for the longer term.

Martin

#### **bulgaria**

Q. I'm working on a projects to develop new hybrid street lamp systems in Bulgaria. Is there any way to work with Shell? Does Shell invest in new ideas in small countries like Bulgaria?

#### **Russ Conser**

A. GameChanger does invest in ideas from anyone anywhere. However one of our criteria is 'Why Shell?' This is a question of mutual benefit - e.g. why are we the best partner to help you in comparison to other companies or organisation? If we take on ideas that we aren't pretty uniquely suited to help with, we find that in the end, neither party really wins. If you do submit the idea, you might think about your idea in this context.

#### **Natalia Zglobisz**

Q. What do you see as the best solution to tackle problems related to intermittency of renewables? Can you see hydrogen as part of the solution? What is Shell's current activity on fuel cells and hydrogen?

#### **Sergio Kapusta**

A. Natalia, there are several ways to tackle the problem of intermittency of renewables such as wind and solar, for instance energy storage or combination of renewables and fossil fuel power generation. Hydrogen is an "energy vector", that is a way to transmit energy and not an energy source. It can serve to store renewable energy, for instance by combining wind electricity with electrochemical hydrogen generation. Shell maintains an active programme in several countries (US, Japan, Europe) to demonstrate the delivery of hydrogen at "hydrogen stations".

#### **alex macgillivray**

Q. Thanks for the interesting responses. Can you help me summarize the Big Idea from Shell's perspective? Or is the real 'Big Idea' in fact the mosaic approach?

#### **Martin Haigh**

A. Alex,  
This is a good summary! Yes, we don't see one silver-bullet dominating the energy world of the future and a mosaic is likely to more and more prevalent.  
Martin

#### **kkeable**

Q. Changing personal mobility is one way of saving energy, but there are many more and this is the obvious way of saving CO2 emmissions.

**Nick Allen**

- A. Absolutely. At the risk of sounding like a psychologist (which I am not) its about how we can meet our goals and aspirations whilst being more efficient, throughout our daily lives - how we get around, how we behave at home etc. Tough but doable.

**Sergio Kapusta**

Thank you so much for joining us today! We hope you enjoyed the webchat and that we have provided answers to some of your questions. The team really enjoyed reading your thought-provoking contributions.

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Unfortunately we did not have time to answer all your questions during the live sessions. Please see below for responses to your questions that were addressed after the webchat:

**Sharon Tang**

- Q. What about petrochemicals? Do you see a sustainable growth for bio-based chemicals, supplementing the current petrochemicals and downstream plastic markets?

**Sergio Kapusta**

- A. Sharon, you raise an interesting point. A lot of our discussion has cantered around bio-fuels. Biomass and some of the intermediates in bio-fuel production can equally well be a source of bio-chemicals. We have some research activities around the production of chemicals from bio-mass. As someone noted elsewhere in this Webcast, one route from bio-mass to fuels or chemicals can be through gasification and Fischer-Tropsch chemistry. That route offers flexibility regarding both source and products.