



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

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Session 2 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 Shell's webchat: "Big ideas for the future of energy: aspirations and reality". My name is Sergio Kapusta. I am Shell Chief Scientist, Materials, and I will be your host for today's webchat.

**Mike Harris**

- Q. If a small African enterprise wanted to apply for funding to get its energy solution on its feet, is there anywhere related to Shell that they could go for help?

**Simon Bishop**

- A. Mike - check out the Shell Foundation website. We have \$250m committed to small and medium-sized enterprises in Africa. Also try the site belonging to our partner, Grofin.

**Introductory Question**

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

**Sergio Kapusta**

- A. We need to be realistic about the time that it takes to bring new technologies to the market. It often takes more than 10 years for a research breakthrough to move from laboratory experiments to a demonstration plant, and another 10 years to build several large scale plants to deploy the new technology. I think that 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 similarly sized coal plants. I think that biofuels will play a big role in reducing emissions from the transportation sector. Wind energy is already a reality. Photovoltaics and other forms of renewables are still a few years away of making a major impact on the global energy supply.

**Rafael**

- Q. What is the end game on the energy challenge? What success look like?

**Martin Haigh**

- A. Rafael,  
I think we are a long way from the end game. Probably at least 100 years away, possibly significantly more. Technologies like CCS and nuclear fission, for instance, are likely to have a role for something like the 100 year time horizon. The greater challenge to my mind is the series of transitions that we shall need to go through before reaching that level. Success has to be around fostering successful human development in the context of a sustainable environment, doesn't it?  
Martin

**Introductory Question**

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

**Russ Conser**

- A. Good question, but quite broad. Corporations and governments are certainly driving, but so are you and I - with our everyday choices. In Shell, we aim to be a shaper not a watcher. We have some things in play (e.g. biofuels, CCS, wind), but look for where else we can play a shaping role. GameChanger is a part of our Emerging Technologies program in Shell with intent to take a long term view on new options.

### 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 is the sharp economic growth in China, India, Brazil, and other developing economies. I am very impressed by the high level of investment in new technologies in these countries, which ensures that they will play an increasingly important role in the future.

### jaberer

- Q. How do you see government interference influencing renewable energy developments?

### Martin Haigh

- A. Jaberer,  
I think I take a more positive view of the role of government. Renewables tend to be extensive in land use, and this means they require government help in terms of planning and land-use to get deployed. It's worth remembering that most new renewables today are getting deployed with the help of specific government policy interventions, like feed-in tariffs.  
Martin

### Percival

- Q. I am here to market our revolutionary technology how to enhance energy conversion efficiency by several folds. Who wants to hear it in details? I will win the Nobel Prize eventually. I am seeking for the person like Carl Bosch in BASF for commercializing of NH<sub>3</sub> synthesis.

### Russ Conser

- A. Percival, thanks for your question. I totally agree that inefficiency in energy conversion is a big problem needing novel solutions. You can learn more about GameChanger at [www.shell.com/gamechanger](http://www.shell.com/gamechanger) and if you think it's a fit, submit your idea for our consideration.

### jaberer

- Q. What do you foresee as the role of the BRIC countries in adopting the biofuels?

### Nick Allen

- A. Jaberer,

In terms of BRIC countries, clearly Brazil has a head start on bio given its early adoption and the benefits of sugar cane based ethanol vs. others such as corn. I think it is fair to say they will

continue to push in this area, and Shell have recently signed a memorandum of understanding with Cosan in Brazil.

Whilst I'd not claim to have a deep expertise in China's plans for biofuels, I think it is fair to say that they see the opportunity to build a technical expertise for at least their own use, as they look for a mosaic of options to meet their own energy needs.

#### **gdeluga**

- Q. how is crude oil changing and projected to change over the next 20 years? will it get heavier and require more hydrogen? how will the effect the fuel products available?

#### **Sergio Kapusta**

- A. Thank you for your question. We do anticipate a change in the characteristics of crude oil that will be available in the future, at least on a regional basis. There has been a trend to heavier crudes: the heavy crudes and oil sands of Canada are an example of this trend. The oil industry, and Shell in particular, have developed processes to handle these crudes and convert them to products. Perhaps equally interesting is the other side of your question, the shift in the type of fuels that consumers want. In Europe, for instance, there is an increasing trend to diesel power vehicles.

#### **JBesch**

- Q. I am reading an interesting book, "Power Hungry"....it talks about some of the realities of going to "Green Energy" and the practicality of it all. What do you think is the reality of "going green", especially in the US (where coal is cheap, etc.)

#### **Martin Haigh**

- A. JBesch,  
This is true, I agree, there are all sorts of realities to face up to to get a green energy system. In our Blueprints scenario, we had about 30% of the world's energy met by renewable sources by 2050. But achieving this will still be a lot of work. And as you say, cheap, abundant, local, good quality energy sources like American coal, will always be tempting. Especially as it would be likely to become even cheaper if the green energy was especially successful in competing against it.  
Martin

#### **GreenableBusiness.com**

- Q. There seems to be a disconnect between discoveries and their transition to the marketplace. It seems every day there is a new story about a potentially game-changing technology that may not mature for another few years, but due to lack of funding, proper oversight, or poor management it never becomes a commercial success. Is Shell doing anything to help innovators succeed to market and does Shell have a pipeline in place to help bring in-house innovations to market?

#### **Russ Conser**

- A. In GameChanger, we focus on part of this problem - namely the very fuzzy front end up to proof-of-concept. We have learnt a lot about how to (and not to) mature things after that and continue to work to apply these learnings. For in-house innovations, we send things on to either our core R&D, license ideas to other existing companies, or even sometimes start up new ones via our Shell Technology Ventures Fund run by Kenda Capital.

**Sali**

- Q. Hello, I was working on a project on CO2 emissions reduction, hydrogen, energy efficiency measures in the transport sector and would like to know your views on hydrogen and energy cells for the future?

**Sergio Kapusta**

- A. Hi Sali! I share your interest in hydrogen and fuel cells, I did some work on proton exchange membrane cells some years ago. I think that hydrogen might become an important energy vector, that is a way to transmit energy from the source to the user. Shell has several "hydrogen stations" around the world to demonstrate the feasibility of hydrogen. The development of hydrogen vehicles and of fuel cells in particular is still lagging, as is the development of the full hydrogen infrastructure. If you have ideas about how to make the fuel cells more efficient or economical, I would be interested in hearing them!

**Andrei**

- Q. What kind of interactions does the research laboratories in Shell make with Universities?

**Sally Gold**

- A. Hi Andrei

Our research centres link with Universities around the world in various ways. One way is through collaborative research on subjects that are core to our business, for example biofuels development. They also link in from a careers perspective - helping to give students an idea of the sorts of roles their studies could lead them into in an industry like ours and to encourage them to pursue the disciplines that we need. This is important as we recruit people from a range of disciplines. A third way is through academic and societal bodies. For example in the UK we support two schemes run by the Royal Academy of Engineering to provide funding assistance and also visiting teaching fellows to university engineering students. There is some info about this on our website which is country specific, so you can search depending on your country of interest.

Sally

**jaberer**

- Q. Would the recession (in your experience) impact the focus on the CO2 reduction targets or agendas for governments to crack down on the CO2 emissions? Do you foresee any notable trends in this area?

**Nick Allen**

A. Jaberer,

Clearly post September 2008 things changed, and we saw some of the effect of that played out in Copenhagen. However, what we are seeing is a clear focus from governments on energy efficiency for cost and energy security reasons.

In many cases this leads you to a lower CO2 outcome. The key challenge going forward though is the provision of sufficient investment and incentives to demonstrate and deploy the new technologies that will be critical to meet global aspirations on CO2.

We'll have to wait and see what happens, but in the interim it is important that businesses, like Shell, are focusing on applying their competencies and capabilities in the development of new technologies, like CCS and advanced bio.

**david.c**

Q. How do you view Mexico for possible new energy development investment?

**Simon Bishop**

A. David - works on one specific area that is relevant to your question: Improved Cookstoves (ICS), ones that significantly reduce emissions and fuel use. Tens of millions of Mexicans suffer from poor health linked to toxic fumes they inhale while cooking on open fires and traditional stoves. If we can convince people to adopt ICS then this problem could be significantly reduced. It is an area the Mexican government has begun to focus upon - and sales are increasing for ICS manufacturers but there is a long way to go. If you want to check out a good manufacturer try HELPS International.

**fieldilein**

Q. Does it make sense to capture Co2 at the power plant itself? (the energetic cost is gigantic, relative to both the biomass to with this captured CO2 can be converted as well as the (electric) energy that was generated to start off with)

**Sergio Kapusta**

A. You raise a good point. The cost of CO2 capture is indeed a concern. Shell is working on several technologies that could reduce this cost. Letting nature take its course, and capture the CO2 through plants (biomass) is ideal. Unfortunately, natural capture of CO2 cannot keep up with the pace of CO2 generation from burning fossil fuels. Carbon capture and storage is one solution to reduce overall CO2 emissions.

**Percival**

Q. Dear Bishop. is it possible for university professor at USA to apply for funds from ?

**Simon Bishop**

A. Percival - Can you tell me what the funds would be used for?

**plv**

- Q. What is your take on the outlook of some specific CO2 mitigation technologies for new power generation capacity. For example, post-combustion CO2 capture vs. oxyfuel combustion vs. IGCC technologies?

**Sergio Kapusta**

- A. PLV, thank you for your question. Shell is looking at several technologies for CO2 capture, including post-combustion, pre-combustion, and oxyfiring (which is a way to reduce the volume of flue gases from which CO2 needs to be extracted). I think that for CO2 mitigation there are "horses for courses". Very likely we will need a combination of various technologies which are best suited for a specific application or problem. For instance, for retro-fitting existing power plants, post-combustion seems to be the best approach. For new plants, IGCC or oxyfiring might be better.

**Percival**

- Q. Is hydrogen the ultimate transportation fuel as compared to batteries?

**Nick Allen**

- A. Percival,

This is a case of "AND" not "OR". Simply, there is no silver bullet when it comes to low carbon transportation in the long term. The reality is that the future world will be a mosaic of different solutions. In the long term we will probably see both hydrogen fuel cells and electric vehicles being part of the car parc, and they will likely complement each other, being relevant for different sized vehicles.

However, there are still a number of significant technological and infrastructure challenges for both. Shell is involved in a number of fuel cell activities in Europe and North America.

**Alison**

- Q. Do you have an example of where Shell has been innovative in sustainable energy?

**Russ Conser**

- A. Alison, Sure - how about one from our current biofuels program? We're making good progress working with our partner Virent to develop technology to convert sugars into gasoline, instead of fermenting them into ethanol (which has lower energy content). We've already started up a pilot plant on that and are now expanding that collaboration effort to work on making diesel.

**tad**

- Q. What do you see having a larger influence in our energy systems in the near (<10 years) and mid future (<50 years), climate change or peak oil?

**Martin Haigh**

A. Tad,

This is a great question. It depends what you mean by peak oil of course. But supply and climate are both key. One thing to bear in mind is that the scientists' advice on climate constraints on the energy system are much tighter than those determined by views of likely fossil energy supply. However, that said, expanding fossil energy supply in the way we have done before is likely to get harder. It is not a shortage of molecules in the ground, but access and difficulty mean that supply growth is unlikely to be able to continue historic trends for decades hence. Demand responses with new technologies are the other piece of the jigsaw too. In the short-term, the attitudes around climate will affect our energy systems in the longer-term, and affect how difficult the transition becomes.

Martin

**dr\_c\_rose**

Q. My question is around Shell's interest and current/anticipated investment in algal biofuels (micro- and macro-algae). What is Shell's thinking on the fuel to be generated (biodiesel, biobutanol etc), the scale of the operations required, global locations, and choice between micro or macro-algal cultivation and processing?

**Sergio Kapusta**

rose, Shell participates in a joint venture (Cellana) to look at various algae populations to produce biofuels, more specifically biodiesel. The joint venture operates a pilot plant in Hawaii. If you are interested in more detailed information, I can direct you to the website. Please check the webchat at the conclusion of today's session for the details of the website.

[http://www.shell.com/home/content/environment\\_society/alternative\\_energies\\_transport/biofuels/](http://www.shell.com/home/content/environment_society/alternative_energies_transport/biofuels/)

A.

**sahar.mirhadi**

Q. How can you educate society and business in ensuring that there is a clear investment in new technologies within the energy industries?

**Sally Gold**

A. Hi Sahar,

I think our scenarios work goes some way to showing that we have to invest in a range of solutions, both existing and new, to meet the energy challenge that we face. We are going to have 9 billion people on the planet by 2050 demanding double the energy of today, and we need to reduce carbon emissions. Achieving that will involve a mix of new, cleaner technologies, improvements in existing technologies and also changes in consumer behaviour. We are trying to contribute to this where we can.

Thanks for the question.

Sally

**Farnand**

Q. Shell has done strategic work historically using scenarios. Have you done any scenario work on the outlook for various transportation fuels (hydrogen, CNG, biofuels, electric etc.) that will be/is public? Thanks!

**Martin Haigh**

A. S Farnand,  
We did in our Shell Energy Scenarios 2008. Those had quite a feature on transport, with outlooks on hydrogen, electricity and biofuels. If we did them again now, we might look further at a larger role for natural gas in transport too.  
Martin

**Lou**

Q. Does Shell view algae as a viable source of renewable fuel?

**Nick Allen**

A. Lou,

There is rightly a lot of interest around the potential for algae. They grow rapidly, are rich in veg oil and can be cultivated in sea water ponds, thus minimising the use of fertile land and fresh water.

As you may know, we are a major shareholder in Cellana, a company set up to operate a small pilot plant in Hawaii to grow marine algae.

As with many advanced biofuels, it will take considerable time and investment to take this technology from a lab based process to demonstration stage, and then scale up, hence we'll not be seeing algae as a solution any time soon.

**jcondor**

Q. "Which emerging economies are energy innovators?" Definetely the BRICs are playing an important role outside of the OECD, however they are still very behind when comparing metrics. There are specific fields where the BRICs are being proactive. Examples are Brazil with biofuels, or China with wind and solar energy. In my understanding China overpass Germany in terms of peer-review papers in solar energy.

**Simon Bishop**

A. I'm afraid my knowledge doesn't extend to comparing the performance of different emerging economies as energy innovators. What I can say is that India is impressive in this area. They have made solar a major priority - and announced in Dec 09 that they would have a renewed focus on tackling Indoor Air Pollution - the toxic smoke from cooking on open fires and traditional stoves that impacts 150million Indian households. This suggests they are keen to deliver access to energy to their entire population - not just those within reach of grid electricity - or those that can afford to buy more expensive fuels. This is just one example of energy innovation in an emerging economy but I hope it helps.

plv

- Q. What is your take on the development of Marcellus Shale gas? Is this going to be a significant gas source for the U.S. or do you see the challenges (technical or otherwise) making this unrealistic?

**Russ Conser**

- A. plv, Well, we think the Marcellus shale gas indeed has a lot of potential, and it's only a part of a larger growing shale gas business in North America. We've recently announced our agreement to acquire a company called East Resources that is focused on the Marcellus. There will indeed be many challenges - both technical and otherwise - but our track record so far is that we will find solutions.

**tnp\_getesquared**

- Q. Hello Martin, Sally, Simon: Can I get in touch with one/all of you regarding potential a strategic partnership or social investment with Shell concerning a new social venture whose mission is to increase access to energy at the BoP? I have been unable to engage a member of or Social Investment team for an exploratory conversation. I am launching a new not-for-profit SV, e<sup>2</sup>: equitable energy, that aims to scale up access to energy resources/devices (solar lanterns, LED lights, clean cook stoves) for the 2.5 billion energy-poor consumers at the bottom of the pyramid, particularly across the off-grid parts of Africa and Asia. Like the Product (RED) campaign, the e<sup>2</sup> model utilizes a popular consumer-driven, cause-marketing platform to engage and empower OECD consumers to become a part of the (energy) poverty solution. Key to this are strategic partnerships with customer-facing energy corporations, like Shell. Strategic partnerships on all four sides of the e<sup>2</sup> model provide a timely opportunity to concomitantly: 1) empower first-world consumers to become part of the energy poverty solution by aggregating "micro-contributions" from point of sale; 2) reward them in return with a "donor dividend" in the form of a future affinity/loyalty discount/rebate; 3) build brand loyalty and engage a two-way dialogue between customers and corporations; 4) enhance the CSR/sustainability reputations of partnering firms; 5) mitigate carbon emissions, or black carbon, resulting from the combustion of "dirty energy" (i.e. firewood, animal dung, crop waste, kerosene (indoor air pollution claims more victims than malaria and TB each year -- two million lives, 80% of which are women and children); 6) consolidate the efforts and efficacy of UN MDGs; and 7) create a future customer base for IOMs to market modern energy products/services as those at the BoP move up the socio-economic ladder. Indeed, the multidisciplinary approach in the e<sup>2</sup>: equitable energy concept embodies what Bill Gates has aptly termed, "creative capitalism". Both the profit and philanthropic motives are internalized through public-private partnerships between energy Consumers, Corporations, and Conservation and Climate Change stakeholders, thus providing a "Square Energy Deal" for all. Access to energy, you will agree, is fundamental to removing the 'unfreedoms' of extreme poverty and an essential enabler to economic development, education, and entrepreneurial pursuits. Once operational and scaled up, the venture would become revenue positive and self-sustaining. I am endeavoring towards a high-profile launch announcement event of the venture at the 2010 World Energy Congress with the participation of a celebrity ambassador from the poverty advocacy space. I would appreciate having an opportunity to dialogue further. With many thanks, Paresh Patel

**Simon Bishop**

- A. Paresh - I like the sound of your initiative. Do you have a website where I can learn more? Simon

**Michael Jones**

- Q. We hear alot about the carbon foot print of gas based power generation. I also see information that suggests that the full life cycle carbon foot print is not different from coal when you include CO2 in shale gas, methane leakage, etc.

Please comment  
Mike J

**Sergio Kapusta**

- A. Mike, you raise an interesting point: we should look at the full cycle CO2 footprint of the various energy sources. This is not always done, as there is no consensus of how this full cycle CO2 should be accounted. Gas-powered plants can typically reduce CO2 emissions by around 50% to 70% when compared with similarly sized coal plants. Methane leakage is not a major concern during gas production. CO2 in the gas is an issue, and is considered as part of the overall CO2 footprint in our operations. One advantage of this CO2 is that it is in a concentrated form that is easier to capture and store.

**Sali**

- Q. Thanks Sergio. I have worked in the oil energy industry for many years for Saudi Aramco, BP and recently Tfl. The Energy Institute offers a great platform for learning and development. How do you think you can promote greater enthusiasm, interest and passion for more efficient resources in fuel energy at Shell?

**Sally Gold**

- A. Hi Sali,

We are trying! In the UK we launched a new fuel yesterday which is our new maingrade - Shell FuelSave. This saves our customers one litre of fuel for every tank full. But what we are also doing around the launch of this new product is to communicate to our customers that they can save more than the technology enables them to by making some simple changes in their driving behaviour. We did a recent experiment with some families from across the UK by giving them some training in how to save fuel (and save themselves some money at the same time!) and then tracked the results. We found they saved an average of 27% on their fuel bills. You can find out more about this here and take the FuelSave challenge yourself.

Sally

**david.c**

- Q. What technologies is Shell pursuing to help solve our fossil dependance on the short, medium and long term? If you had to put all your money in one technology, what would it be?

**Martin Haigh**

- A. David,  
In the short-term, Shell have been developing wind in North America and there is active work ongoing now on biofuels and algae. For the mid to longer term, there is work going on with CCS projects. But developing alternative businesses further is something we are looking at as a company. I don't think we would want to put all the money on one bet for a long time yet, if ever!  
Martin

**David.C**

- Q. Shouldn't we look at the other side of the problem? Not at what alternative fuels should we use, but at what can we do to be more efficient in our use? We are wasting HUGE amounts of energy through electricity generation and engines. I think the most immediate answer is energy efficiency. Fuel Cells is a first step, but we need more.

**Nick Allen**

- A. David, I completely agree.

We need to grapple with the challenge of changing our own behaviour. As someone once said, the best barrel of oil is the one we don't use.

Energy efficiency is going to increasingly be an important immediate term focus, to reduce emissions now, whilst we wait for the long term technology solutions.

For me, the solution will be down for strong collaboration between companies (like Shell), governments and civil society, to put in place behaviour changing solutions.

**DavidSkrzypniak**

- Q. Given that natural gas is less expensive than in the past and governments including the United States are looking at the possibility of focusing on reducing emissions in the utilities sector, do you think CCS with coal will be overtaken by CCS with gas?

**Russ Conser**

- A. David, good question, but hard to answer without a crystal ball ;-). No question that gas and coal will compete for share in the utility sector. Even without CCS, gas has a significant CO2 advantage (at least 50%), so should stack out well with CCS as well. So gas overtaking coal is certainly possible, but who knows for sure?

**ravishsareen**

- Q. what role is algae bio fuels expected to play in meeting future oil demands?

**Martin Haigh**

- A. Ravishareen,  
This is a difficult question. It is still such an early stage technology. We are just developing the first pilot projects now. The ultimate potential will depend on all sorts of things - can it be done

out of confined reactors, can it be done in the open sea? But given the way to go, we are probably talking about less than 1% of the world's fuels supply for a few decades. But let's see!  
Martin

**Richard S**

Q. Hi, Do you think that the current 10% blending cap for ethanol in the US will limit the potential of ethanol as a biofuel. Cellulosic ethanol has yet to take off and the ethanol market already appears saturated with corn based ethanol.

**Sergio Kapusta**

A. Richard, the blending cap of 10 to 15 % ethanol in gasoline is to prevent damage to the engines. Some vehicles in the US and in Brazil are fitted with a flexifuel modification that allows them to use higher percentages of ethanol, up to 100 % in some cases. If more consumers choose this type of engines the limits on ethanol blending may be expanded.

**Oladotun**

Q. what is your view about the future of CCS and have you sponsored academic research in CCS areas

**Sergio Kapusta**

A. Oladotun, Shell firmly supports carbon capture and storage (CCS) as a way to reduce overall CO2 emissions from stationary sources such as power plants. We participate in several academic programs to look at this technology, and also in demonstration projects around the world. If you are interested in more details, please look at the Shell.com website and follow the trail to CCS. If you have trouble finding the link, I can help you at the end of this webchat.

**educador23013**

Q. Hello I'm William Vegazo from Lima Perú How can you see the future of the alternative energies in the short time?

**Martin Haigh**

A. William,  
In the last few years, the fastest deployment of renewable energy has been wind and hydro-electricity, and I'd expect these two to continue at the front of the pack for the next few years. Outside electricity, biofuels are also growing strongly. It's worth keeping a watch here on solar because that has been showing strong growth rates, around 40% pa or so, over the last few years.  
Martin

**Fatima**

Q. What kind of things do you think companies like Shell can do to better educate University students on the growing energy challenge?

### **Sally Gold**

A. Hi Fatima,

We try our best to speak with as many university groups as possible who are interested in hearing from us on the energy challenge, along with speakers from other organisations who may have similar or maybe different views. It would be difficult for us to get around everywhere though to speak with students face to face, but we do try to have some good stuff online. I hope people download and use along with resources from a number of other places. For example some of my colleagues developed a cartoon that shows some of the key points about the energy challenge and the Shell Scenarios which you can download here and a number of other resources on our energy challenge website.  
Is that the sort of thing you were after?

### **jaberer**

Q. Nick, how does Cellana see the importance of strain selection in the algae value chain?

### **Nick Allen**

A. Jaberer,

Clearly, as I suspect you will know from your interest in this area, selection is important and we have an academic research programme to screen natural microalgae species to determine which ones have the highest yields and the most veg oil.

### **Naveen**

Q. Simon,

Shell Foundation is doing excellent work, and I am keen to get involved in it's Indian initiatives. I am based at Scotford, Canada and originate from India, so have an appreciation and passion for fundamental socio-economic challenges facing India.

### **Simon Bishop**

A. Naveen - it is always nice to meet people who are passionate about socio-economic challenges facing India and I am very happy to hear you think we are doing "excellent work". Many people approach us offering help; this is tricky as we tend to work with a few focused in-country partners. What about a more radical suggestion: you go to India and launch a social enterprise of your own?! There is currently a wave (verging on tidal) of western-educated people who originate from India going there to do this.

### **Lin Tong Shen**

Q. To Mr Sergio, is it feasible to convert all of the oil rig on earth to produce hydrogen gas or having a fusion reactor on the rig itself to eliminate the energy crisis and to solve our long term energy issue?

### **Sergio Kapusta**

A. Ling Tong Shen, I don't think that it is feasible to have a nuclear fusion reactor at this time. There are still many technical challenges that need to be solved. Converting all oil to hydrogen might

be possible, but it will really serve no real purpose: hydrogen is an energy vector, a way to transmit energy from the source to the user, and not an independent source of energy.

**Andrei**

- Q. If the nuclear fission is likely to have a role for something in a 100 year time horizon, is Shell participating right now in such kind of research? or is waiting to be close to the time it is feasible to have it?

**Martin Haigh**

- A. Andrei,  
Shell did have some interest in the 1970s in nuclear, but not now. We don't see it as fitting into our core capabilities. Whilst nuclear is likely to have a key place in the energy mix, it is unlikely to dominate it, so Shell will probably continue to choose other areas to focus on.  
Martin

**Annie H**

- Q. Which particular out of industry technologies do you see having real application in the energy sector?

**Russ Conser**

- A. Annie, I'm not sure I fully understand your question, so please reask if I get it wrong... as to which energy technologies will have real application, I like to say "all of the above." Unlike the last  $\pm 100$  years where we've had a big global market in oil, I think it's likely we'll see different mixes and matches in different places.... biofuels in farm belts, solar in sunny places, wind in windy places, etc. Some people like to call this a "mosaic."

**Percival**

- Q. I have submitted the game change idea. We have finished the proof-of-concept experiments and published them. Now we need commercialize it and remove the remaining obstacles. I hope that SHEll will do something like Carl Bosch in BASF for commercializing our key invention. This invention would be far more important than invention of air plane or TV.

**Russ Conser**

- A. Percival, Thanks. I'll look forward to seeing it.

**Robert**

- Q. What Carbon Capture technologies are emerging ahead of the others, in terms of effectiveness and economics? Amine scrubbing? Chilled Ammonia? Chemical Looping Combustion?

**Sergio Kapusta**

- A. Robert, Shell is involved in a number of research and demonstration projects to improve the efficiency and reduce the cost of carbon capture. At this time amine absorption is the most developed, since it has been used commercially for many years and can be scaled up to the sizes needed for large volume CO<sub>2</sub> removal. In addition to the other methods that you mention,

physical separation might also be attractive. I think that in the end we will have several technologies which are best suited for specific applications and for specific sources of CO2.

**tnp\_getesquared**

Q. Thank you kindly Simon for your reply. As we are currently pre-launch, we have only an introductory website at this time to present the concept. Please see urls- [www.equitableenergy.com](http://www.equitableenergy.com) or [www.getesquared.org](http://www.getesquared.org) I would be happy to provide any additional information or discuss off-line.

**Simon Bishop**

A. Thanks for replying. I will take a look at those sites after this session finishes. Why don't you send me your contact details as well and we can discuss things further offline?

Simon

**AmanahEnergy**

Q. Hi Bishop,

We are a U.S. based company in the early due diligence stage of a solar project in Africa. Can we apply to for assistance? The funds will be used for the feasibility study.

**Simon Bishop**

A. Your initiative looks interesting but I am afraid we are not planning any solar investments in Africa in the near future. I wish you the best of luck though getting it off the ground. Si

**Craig Morton**

Q. Dear Panel, In the past it has often been the case that energy/carbon efficiency gains have been negated by an offsetting increase in demand and consumption. Do you think it would be more appropriate to increase the price of energy resources to encourage a change in consumption behavior whilst also attempting to ensure private company's profitability? Other suggestions/ideas are welcome. Thank you.

**Nick Allen**

A. Craig,

My personal view is that the behaviour change challenge/opportunity will increasingly be part of the energy efficiency equation. Pricing will be one part of the solution, but it's not the silver bullet. We know this from the inelasticity of demand for energy.

What will be key will be a partnership between the behavioural psychologists who understand this a lot better than many, companies providing the right products and services, and governments implementing the necessary tax, regulation and incentives programmes to help trigger change.

It can be done - it will just be tough.

**rutvij**

Q. what role can new startups play in the forthcoming energy industry?

**Sally Gold**

A. Hi Rutvij, I think they can and will play an incredibly important role. In the UK startups and small to medium sized enterprises account for 99.9% of all enterprises and employ 13.7 million people. These small enterprises are a mine of interesting ideas and innovation. We have been running the Shell Springboard programme for 5 or 6 years now in the UK through which we invite people to enter their ideas into our competition. It is exciting to see some of the amazing ideas that these companies are developing into commercially viable businesses. The demand for energy by 2050 could be double what it is today. To deliver that, while reducing our emissions, is going to require a mix of ideas from a range of sources - of which startups are one.  
Sally

**Tom Acfield**

Q. What is your view on CSP, and is this something Shell is looking at?

**Russ Conser**

A. Tom, we are not presently active in CSP (solar thermal), but I do agree it has potential worth looking at. Has quite some advantages - especially where heat is what is sought, and also because compared to wind and PV, might be better adapted to day-night cycles.

**Marc**

Q. Realistically, what percentage of the world's energy is expected to come from renewable sources by 2030?

**Martin Haigh**

A. Marc,  
In 2000, the figure was around 14%, nearly all of which was traditional biomass and hydro-electricity. In Blueprints in 2030, we had this share growing to 19%, as part of what is a growing market. Thanks to the aggressive push for biofuels in Scramble, the share is even higher, in that scenario in 2030 at 22%.  
Martin

**tnp\_getesquared**

Q. Sally, to dovetail off of Fatima's question, would you be able to direct my query re panel speaking engagement invitation to the respective office/person at Shell Oil US/Houston? I am curating a I are curating a panel event for Houston World Affairs Council Young Professionals (co-hosted by Young Professionals in Energy-Houston and Petroleum Club YP). The working title is "Houston: Driving Towards the New Energy Capital of the World" and will focus on: The Changing Landscape of Energy in the Transportation Sector. Discussion will include the specifics of how Houston is leading this transformation, including its deployment of electric vehicles and infrastructure (with players including NRG/Reliant, CenterPoint Energy, the City of Houston, and

the Houston Advanced Research Center), as well as how the more traditional oil and gas energy companies - like Shell - are building their strategies in the changing environment. Naturally I thought of Shell, especially in light of the recent New Energy Future campaign; "The World Will Be On the Road to Sustainable Mobility" resonates quite nicely with the event topic -- and with what I hear in today's dialogue. And so, any thoughts or suggestions would be most appreciated!

**Sally Gold**

- A. Hi,  
Thanks for your invitation. I will certainly pass it on to my colleagues in the US and see if it is something they can contribute to. Sounds an interesting conference.  
Regards,  
Sally

**Richie**

- Q. Every report on energy recently has emphasised on energy efficiency is equally important as new energy resources. I still see little change in terms of how refineries/ plants continue to operate. Sure there is heightened awareness around EII in refineries/ plants but wouldn't it be worthwhile to incorporate two energy production methods for one final goal. Say a solar plant feeding electricity supply to a refinery? Refineries typically have buffer areas around their site. Also, ideas like providing heated air to boilers using solar energy helps reduce over all costs. What is shell and industry doing in this regard?

**Sergio Kapusta**

- A. Richie, you have a very good point. Shell is actively working on improving the energy efficiency of our operations. We set a target of reducing our energy consumption by 5 % over 1990 levels, and we are on track to beat that goal. We are looking at several options to do even better, and you mention a few of those options. One decision that we need to make is which of these options make the most sense from both a technical and economical perspective. Solar power might have a role if the costs, reliability and CO2 mitigation perspectives are favorable. If you have specific ideas that you would like to share, our Gamechanger group can help you progress those ideas.

**Kasia**

- Q. what role do you see information and communications technologies play on increasing energy efficiency?

**Nick Allen**

- A. Kasai,  
  
ICT, as the experts call it, will be a big enabler in providing the real time information to track our energy usage and the tools to help us change our behaviour. We are seeing this in road transport and in the home. At Shell, we've begun to explore this in work we are doing with the commercial road transport sector on in cabin telematics to help truck drivers be more efficient in their driving behaviour.

I believe we are only just beginning to understand the potential and business will need to work together to develop integrated solutions that help everyone consume less, whilst still meeting their needs and aspirations.

#### **Midhun**

Q. I have had a quick run through the Blueprint and Scramble scenarios from the Shell Energy Scenarios to 2050. How useful has the Scenario Planning process been for Shell - especially with the large variability and uncertainties prevalent on a day to day basis? And what would you advise managers adopting this approach in the energy industry - especially for emerging technologies?

#### **Martin Haigh**

A. Midhun,

Saying useful things about the future is hard! Shell has found over nearly 40 years that now the scenario planning approach to be helpful for its business planning as a way of trying to understand the uncertainties around the future. We tend to use scenarios for mid and longer term exercises rather than day to day issues. Indeed, it's important not to be buffeted around too much by day to day variability when taking energy decisions that last decades. Since I look after energy modelling in the scenarios team, I would advise any emerging technology company in the energy industry to take the quantitative side seriously to ensure that the outlooks are grounded in reality.

Martin

#### **AmanahEnergy**

Q. Mr. Bishop,

Does have any funding opportunities for biochemical development in Africa?

#### **Simon Bishop**

A. We do many things in Africa but they don't include biochemical development, sorry.

#### **John Nicholas**

Q. The Shell/Virent demonstration is currently working on cane sugars, I believe, but is intended to convert lignocellulosic sugars at oil industry scale in order to replace crude oil based fuels. Does it therefore follow that Shell sees large scale lignocellulosic sugar production as the key to future transport fuels? If so, when, and from what feedstocks and technologies?

#### **Sergio Kapusta**

A. Hi John! Shell is indeed pursuing several options to convert biomass to biofuels, including Virent. We see the advanced biofuels based on lignocellulosic conversion as one option for the future. We are also looking at Brazilian sugar cane, as an economic and sustainable source of sugars. The Shell joint venture with Logen has operated a lignocellulosic conversion pilot plant for

several years, feeding on plant residues. There are plans to expand this operation, but it might be premature to say to which scale.

**George771**

Q. I am greatly concerned about the safety of Battery Packs and Fuel Cells, proposed in the next generation automobiles, particularly in a crash, which is a common occurrence. I have read many articles in MIT Review, but the issue is not getting media attention. Am I wrong in believing these are real concerns?

**Martin Haigh**

A. George,  
Maybe you think I'm too cavalier, but I'm concerned that we don't be excessively risk-averse when it comes to new technologies. A gasoline tank may be more risky in some regards than a battery, fuel cell or hydrogen tank!  
Martin

**Brianfloyd**

Q. Russ,  
  
Would you describe one of the more obscure success stories from the Gamechanger Program pertaining to a non-engineer Shell employee?

Brian

**Russ Conser**

A. Brian, Obscure... OK... one of our Shell scientists got the idea one day whilst looking at a swelling foam dinosaur in the toy store, on how he could embody that idea to get more oil and less water out of older oil wells. You may not know it, but many oil wells water-out as they mature. In this case, the inventor conceived of a way to wrap water-swelling elastomers on the outside of well pipe, so that when water comes into the well, the foam swells and shuts it off. These have been very successful. This is now delivered from a company called SwellFix - a Shell spin-off company... recently rolled up into a larger company called Tendeka.

**Anne**

Q. @Martin, 100 years is too long a development period. The planet will be unlivable by then. It must be shortened.

**Martin Haigh**

A. Anne,  
I agree. I was trying to answer to say that the end-game, such as it is, is a long way off. Managing the transition with technologies that can cut CO2 for a century is critical. Focusing just on the end-game is not always helpful.  
Martin

**Lin Tong Shen**

Q. To Mr Conser, is there a deadline in submitting ideas to Shell GameChanger Program?

**Russ Conser**

A. Lin, thanks for the question on a key point. Simple answer - no. Unlike other programs that are event driven, we hear and act on ideas every day. You can submit at any time.

**Lin Tong Shen**

Thank you Mr Conser

**OI**

Q. What do you see as the most prominent technologies for deep water and for unconventional?

**Sergio Kapusta**

A. OI, this is a very wide question. Shell has been involved in deepwater oil and gas production for many years, with an excellent record of technical developments and safe operation. There are many technologies that come together to enable deepwater production. I would be happy to follow up with you if you want to know about some of these technologies. For unconventional I assume you mean unconventional oil, also known as oil sands or ultraheavy oil, or is it something else? Shell has been a major player in the oil sands in Canada. Again, there are many technologies that come together to enable unconventional oil production. Can you be more specific?

**Lin Tong Shen**

Q. In the next 20 to 30 years, what would be the trend on discovering new renewable energy?

**Martin Haigh**

A. Lin Tong Shen,  
I wouldn't want to bet on discovering a new form of renewable energy. Nearly all the energy options we are talking about today were known to the ancients. The exceptions were solar PV and nuclear, and those appeared as speculation in physics journals around a century ago! I think the challenge is to develop and improve the technologies we already know about.  
Martin

**Kees IJzerman**

A. In countries where gas is available for home heating (like The Netherlands), electricity is only 16% or so of our energy consumption. Aren't we focusing wrongly on sustainable sources that produce electricity, rather than on transportation and home/office heating energy consumption?

**Nick Allen**

A. Kees,

I'm with you on this - transportation is an important element in achieving a low CO2 world...and that's where much of our focus is. Sometimes we forget, Mobility has been a key enabler of prosperity across the developed world, and will be so in the developing world. We just need to find lower CO2 ways for everyone to experience these benefits.

#### **Oladotun**

Q. Do you sponsor Ph.D studies on the legal aspects of energy mitigation? if yes in which schools

#### **Sally Gold**

A. Hi Oladotun,

I'm not sure if we do sponsor PH.D studies in this specific area at the moment. There is a function through our recruitment website though whereby you can send in a proposal for sponsorship and each one will be looked at. This might be a good place to start to see if it is something we can work with you on. Here is the link you should look at -

<http://www.shell.com/home/content/careers/>

Hope that helps.

Sally

#### **Lin Tong Shen**

Q. To Mr Sergio, I am very keen on the hydrogen and fuel cell industry, is there any link that can help me answer my queries?

#### **Sergio Kapusta**

A. Lin Tong Shen,

Please look at this link

[http://www.shell.com/home/content/environment\\_society/alternative\\_energies\\_transport/hydrogen/](http://www.shell.com/home/content/environment_society/alternative_energies_transport/hydrogen/)

#### **goalgae!**

Q. Does shell foundation sponsor projects in latin america?

#### **Simon Bishop**

A. Our main focus areas are Africa and Southern Asia but we are involved in some Latin American based initiatives, particularly around sustainable transport. Check out our partner EMBARQ to learn more.

<http://www.embarq.org/en/about/about-embarq>

#### **jorgeramospeyrot**

Q. About biofuels, is Shell working with cutting edge research bioengineering companies as such Exxon, for example?

#### **Sergio Kapusta**

A. Jorge, thank you for bringing this up. I would be very interested to know what cutting edge bioengineering research are these other companies doing. Can you share?

**jaberer**

Q. How do you see the DERTEC initiative?

**Martin Haigh**

A. Jaberer,

The Desertec project is an exciting and visionary plan. It faces a lot of challenges, though, not least of which is the timescale and costs. But let's hope they are successful as a model for very long distance transport of renewable electricity. If it works, this may provide a way of helping handle some of the local problems around intermittency, and opening up much larger resource bases to effective use.

Martin

**Sol Shapiro**

Q. In the short term, what will be the role of gas to liquid for transportation fuel?

**Russ Conser**

A. Sol, thanks for the question. Fuel made from the GTL process is already in play as a transport fuel, and interest is rising. Shell is already blending GTL liquids from our Bintulu plant in Malaysia into diesel in certain locations to help improve local air quality. We should finish construction on the world's largest GTL plant called "Pearl" in Qatar by end of this year, which will greatly increase available output to do more of this in the short term (there are other products as well).

**whitney.kopf**

Q. In an earlier question, Martin spoke of big challenge in the energy crisis being the series of transitions that we shall need to go through before reaching success. Who right now is road-mapping what those needed transitions are?

**Martin Haigh**

A. Whitney,

Well we are one of the groups attempting to map out those sorts of transitions. In our work up until now, we have modelled energy futures to mid century. We are expanding our models to go out to 2100. The IEA are also well worth taking a look at with their work on 450 cases and what would be needed to achieve them.

Martin

**lindsay**

Q. Mr. Allen, you've been mentioning behavioral change in some of your responses. What do you think is the role for individuals in achieving the energy end game?

**Nick Allen**

A. Lindsay,

At the end of the day (when its dark), we each consume and if we are to change behaviour then it's down to each and every one of us. The challenge is that we need tools to help us as it's tough. Our behaviour is often sub conscious, driven by goals, and often conflicting goals. Its a bit like eating and exercise. How often does eating win out against exercise?

All that said, I am optimistic about the ability for governments, business and civil society (that's you me and everyone else) to crack this one.

### **Tom Acfield**

Q. Are there any must attend events to see first hand what the latest emerging technologies are?

### **Sally Gold**

A. Hi Tom,

I guess that depends where in the world you want to travel to! The UK technology and innovation growth forum could be a good place to start. Also (and I may be biased) I think we have some pretty good technologies on display at some of our Shell Springboard events - let me know if you would like to come along.

I had the privilege of attending TED in Oxford last week - some great ideas being talked about there, all of which is available to watch online at [www.ted.com](http://www.ted.com)

Sally

### **Derek@UVH**

Q. If the current increased demand for fossil fuels continues how long will fossil fuels really last? and what technology would Shell back today?

### **Sergio Kapusta**

A. Derek, you raise an interesting point. With the demand for energy anticipated to increase significantly over the next 40 years, the traditional sources of energy will have trouble keeping up with demand. We at Shell have been looking hard at this problem, and have been working with other partners in industry, government, and consumers to address this dilemma. It is clear that alternative sources of energy need to be developed, including biofuels, wind energy, nuclear, solar, and others. It is not so much a question of which of these sources will "win", but rather we need all of them.

### **Fatima**

Q. I have recently heard of a high-power laser technology to drill for gas and oil. Is this something that Shell sees itself implementing in the future? How advanced is this technology so far?

### **Russ Conser**

A. Fatima, thanks. I may be a bit out of date, but last I knew, the technology was still pretty immature.

### **Fitzgerald**

- Q. Maybe it's asking a turkey to vote for Christmas but might you not agree that the end game surely is to remove all national and commercial interests from energy production and make it common to mankind ..like the sea!

**Martin Haigh**

- A. Fitzgerald,  
I believe that companies will continue to have a valuable role providing energy efficiently to the economy. Removing all commercial interests may not work out for the best! Competition in energy provision can be a valuable source for innovation. That is not to say that there is not a valuable role for government, however.  
Martin

**Jorge**

- Q. Hello, what is Shell's perspective on this year's climate meeting COP16? Do you think that the Conference will reach the public expectations in terms of its outcomes and international agreements?

**Nick Allen**

- A. Jorge,

Clearly, after Copenhagen there's plenty of interest what will happen at COP16 in Cancun.

In common with many others, including governments, we do not see Cancun as being the place where a global climate agreement will be made. We do see it as a useful stepping stone towards a global agreement, which could be agreed at COP17 in South Africa. COP 16 has good potential to take forward a number of issues, e.g. on forestry and REDD, MRV (monitoring reporting and verification) and other issues. We'll need to wait and see.

**jaberer**

- Q. Russ, as you mentioned Biofuel is "in play" for shell. What prospects does it have in your view?

**Russ Conser**

- A. Jaberer, a lot potential, but still a lot to prove. I think the prospects will hinge on delivery of what we call 2nd and 3rd generation technology, which would greatly raise the practical upside for large scale economic volumes.

**Raph@Greenbang**

- Q. How has Shell's investment in green technologies developed during the economic downturn? Has investment decreased to support the oil sector? If not, then how much is investment from Shell in green technologies expected to grow in the crucial next 10 years?

**Sally Gold**

- A. Hi Raph,  
We see the need to maintain strong investment in research and development throughout the economic cycle. In 2009, our \$1.1billion spend on R&D was the largest of any international oil

and gas company. This includes research into emerging technologies, an area which several of our chief scientists are contributing to.

**jarundell**

Q. What is more important: a) new energy technologies; or b) more efficient use of energy?

**Nick Allen**

A. Jarundell,

Mmmm, I know you are looking for a winner here but the truth is that it's both.

**StephenR**

Q. For carbon capture and storage what are the prospects of capturing the CO2 for further use - through algae or for making minerals? What time scales would be involved?

**Sergio Kapusta**

A. Stephen, another participant (fieldilein) raised a similar question: can we use CO2 to feed biomass production, thereby capturing and storing the CO2 in a more useful form. Interestingly, we use some CO2 from our Pernis refinery in the Netherlands to "feed" tomato growth in greenhouses in the Netherlands. This is an important use of CO2, but it is on a small scale compared with the rate of CO2 production. It seems that plant growth is slow to take care of all CO2, but might have specific niche applications, as the greenhouse examples above.

**Sergio Kapusta**

Thank you very 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. Thank you again, and have a great day!

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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:

**Jaberer**

Q. Do you see the prediction of conventional oil running out by 2050 a reality, or a possibly misleading (like previous similar predictions)?

**Sergio Kapusta**

A. Jaberer, I think that conventional sources of energy, including oil and gas, will have difficulties keeping up with the expected raise in energy demand over the next 40 years. That is why we

need to develop alternative energy sources, including biofuels, solar and wind energy, nuclear, etc, regardless of whether we believe in the concept of "peak oil".

**Steve Cawley**

Q. Hi - what do you see as the key barriers to industrial scale CCS in the UK?

**Sergio Kapusta**

A. Hi Steve! Thank you for your question. I would like to make it a bit wider, since the same issues related to CCS might apply to locations outside of the UK. We think that CCS is technical feasible with current technologies. Large scale deployment of CCS requires several issues to be addressed and resolved: (1) a stable and realistic price for CO<sub>2</sub>;

**enyer**

Q. Can we really make any progress on renewable fuels without gasoline costing >\$4/gal.

**Sergio Kapusta**

A. Enyer, the answer is YES, we can and we are making progress towards developing truly sustainable biofuels. As the example of Brazil sugar-based ethanol shows, biofuels can be cost-competitive at current market prices. Cost is undeniably a challenge, as is ensuring sustainability of biofuel production. Shell is working to reduce the production costs of bio-fuels. Shell is involved in several projects, including production of ethanol from straw using enzymes (Iogen), the development of 'super-enzymes' for biofuel production (Codexis), a pilot research facility to grow marine algae for conversion into biofuel (Cellana) and a development effort to convert plant sugars directly into gasoline and gasoline blend components (Virent). We have recently announced a Memorandum of Understanding with Cosan to produce ethanol and power from Brazilian sugarcane. We expect that all this work will lead to better routes to biofuels.

**Doug**

Q. It seems like every day we hear something new about algae as a biofuel. Is there a future of algae? How will the biomass be separated from the water?

**Sergio Kapusta**

A. Doug, algae are indeed an attractive source of biofuels, for a number of reasons: fast growth rate, high lipids content, non-competitive with food resources. They also present challenges, including the recovery of lipids from a dilute mixture. Shell is working with Cellana on a pilot research facility to grow marine algae for conversion into biofuels. The separation of bio-mass from water occurs in several steps, including settling, skimming, and drying. Equally important is the separation of lipids released from the algae from the remaining biomass.

**Rafael Bianchini**

Q. Thank you for the opportunity of debating new energy solutions with Shell experts. I work at a consultancy company from Brazil related to bioenergy solutions. We are betting on small scale biomass gasification and Fischer Tropsch as a feasible solution for Brazil. What are your view on this?

### **Sergio Kapusta**

- A. Rafael, thank you for participating in the Webchat. Shell is involved in several projects to convert biomass to biofuels. These include ethanol production from straw using enzymes (logen), the development of 'super-enzymes' for biofuel production (Codexis), a pilot research facility to grow marine algae for conversion into biofuel (Cellana) and a development effort to convert plant sugars directly into gasoline and gasoline blend components (Virent). We also signed a Memorandum of Understanding with Cosan to produce ethanol from Brazilian sugarcane. I am interested in learning more about your small scale Fischer Tropsch biomass conversion. There might be several advantages to flexibility of small scale that need to be considered against the cost savings of larger scale plants. Please contact me to discuss further.

### **StephenR**

- Q. Many technical developments depend on use of suitable materials e.g. nickel in ultra super critical boilers. Any there any particular material constraints do you foresee that would constrain developments in energy industries?

### **Sergio Kapusta**

- A. Stephen, thank you for this valuable question. You raise an excellent point, and one in which I am personally interested. The availability and high cost of some materials may indeed limit the rate of development and growth of some of the new energy technologies, for instance Lithium for large scale electric vehicle deployment, Platinum for fuel cells, and even nickel for high strength corrosion resistance alloys. I am confident that technology developments will help us resolve these constraints, for instance finding alternative materials, reducing the amount of materials needed, or improving the recovery efficiency. Materials constraints is one of the elements that we consider as we develop new energy technologies.

### **Kasia**

- Q. What do you think the effects of a carbon price, such as a cap-and-trade system or carbon taxes will have on the growth of clean technologies and renewable sources of energy. Do you think it will lead to more innovative technologies and cost reductions in these new technologies?

### **Russ Conser**

- A. Kasia, Unquestionably any carbon pricing scheme would have a stimulating effect that helps kick start and grow cleantech and renewables. So yes, I think it would stimulate even more new ideas, and drive technologies already in play further down their cost reduction curves. If done well, such schemes would be best at doing so carefully designed to be technology agnostic - driven by results, not particular way of solving the problem. Measuring or certifying results could be a critical element of implementation process, and can be harder than some might think.

### **USAMIK**

- Q. Are fuels such as e85 a sustainable solution for the U.S. How is the growth of corn and other crops changing/need to change to meet these needs?

**Sergio Kapusta**

- A. At present, most car engines can use E15 without major modifications. In a few markets, such as US and Brazil, flexi-fuel vehicles are capable of handling higher percentages of ethanol, including E85. The number of these vehicles is still limited, therefore the main limitation to expanding the ethanol % is demand for E85. As more consumers choose vehicles with flexi-fuel capabilities, the market for E85 will expand and might lead to a larger demand for ethanol.

**CleanEnergy350**

- Q. What do you think the effects of a carbon price, such as a cap-and-trade system or carbon taxes will have on the growth of clean technologies and renewable sources of energy. Do you think it will lead to more innovative technologies and cost reductions in these new technologies?

**Russ Conser**

- A. CleanEnergy350, Very insightful question. I agree with your implication - that natural gas as a transport fuel becomes even more attractive in e.g. serial hybrids as storage requirements are greatly reduced. Hard to say at what point in penetration that might happen.

**Scalbers**

- Q. How much influence does molecule specific mandates coming from the American government have on research in biofuels at Shell and what is your opinion of these types of mandates placed on an emerging industry like the biofuel industry?

**Russ Conser**

- A. Scalbers, Thanks. I would say that mandates from American and other governments are indeed an important part of our thinking on what we work on. Molecule specific dimensions are probably more important in short term than long, as I think there's more time to shape policies to align with what's possible over the long term.