



Driving towards more sustainable transport

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Session 2 Transcript

Meet the team

Dr. Selda Gonsel

Vice President of Fuels and B2B Technology

Selda Gonsel is Vice President of Fuels and B2B Technology in Shell's Projects & Technology business. She is responsible for a range of programmes across the Marine, Aviation, Commercial Fuels and Bitumen sectors. Selda has received numerous awards for her contribution to lubrication science.



Jose Bravo

Chief Scientist in Physical Separations

Jose is Shell's Chief Scientist in Physical Separations, leader of the global Physical Separations discipline and consults on separation matters to initiatives such as Novel Crude Upgrading, Unconventional Resources, Biofuels and CO₂.



Niel Golightly

Vice President, Downstream Communications

Niel joined Shell in July 2006, after a career at Ford where he looked at Sustainable Business Strategies among other duties. At Shell, his responsibilities include corporate communications, stakeholder engagement and issues management for our global Downstream business.



Andrew Harrison

Fuels Innovation Manager

Dr Andrew Harrison has global responsibility for Shells longer term fuels research and technology development. He has a background in combustion chemistry and has worked in diverse technical and managerial roles related to fuels and lubricants for over 25 years.



Nick Allen

Vice President, Downstream Management Consultancy and CO₂

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.



Introductory Questions

Q. Can electric cars really help reduce carbon emissions?

Jose Bravo

A. Electric vehicles offer the potential to reduce carbon emissions from road transport. However, as for all fuel and vehicle options, there are several key challenges to be overcome. Although electricity produces no CO₂e emissions at the point of use in a vehicle, its overall 'well to wheels' carbon intensity depends on how the electricity is generated. Therefore reducing the overall carbon impact of electric vehicles will require massive investment in low carbon electricity generation, such as renewable, nuclear or fossil fuels combined with carbon capture and storage (CCS). Due to the timescales required to deliver new electricity-generation capacity, making progress on decarbonising power generation represents an even more urgent challenge than delivering the electric vehicle technologies.

Dr. Selda Gonsel

Hello everyone. Welcome to today's webchat, "Driving towards more sustainable transport". I'm Dr Selda Gonsel, Shell's Vice President of Fuels and B2B Technology. I'm joined today by my co-host Jose Bravo, Shell's Chief Scientist in Physical Separations. Also on our team today are Niel Golightly, Vice President, Downstream Communications, Andrew Harrison, Fuels Innovation Manager, and Nick Allen, Vice President, Downstream Management Consultancy and CO₂. We're going to start answering your questions now, so please be patient!

Introductory Questions

Q. Could regulation speed up a move to more sustainable transport?

Dr. Selda Gonsel

A. First of all, I'd like to encourage you to send in your questions. Reducing carbon emissions from road transport requires concerted and collaborative action by not only governments, but also fuel suppliers, vehicle manufacturers and road transport users. Certainly, regulation can play a part. Governments can implement regulations to promote the wider use of existing low-carbon technologies and the development of new ones. They also have the means to construct new transport infrastructure and influence consumer behaviour. We support CO₂ regulations that will provide a predictable long-term policy framework and stimulate market-driven innovation to develop the most efficient solutions.

Introductory Questions

Q. How can we all help reduce vehicle emissions in emerging markets?

Nick Allen

A. Good question.

Firstly, there are some fundamentals to get on the table. The number of vehicles on the road could increase from 900 million to more than two billion by 2050.

Developing countries in particular are expected to experience sharp rises in vehicle numbers as their economic development continues.

So how to respond to this? When it comes to reducing these emissions there is no “silver bullet” option that will deliver sustainable mobility over the coming decades. Instead, we expect to see a more diverse range of fuel and vehicle options, with the preferred set of options varying by market. All options will be needed and all will have a place in addressing the challenge of sustainable mobility. For example, liquid fuels, including fossil fuels, will continue to play an important role, but we also expect to see an increase in the use of other options such as electricity and hydrogen.

Addressing this challenge globally will require cooperation, communication and collaboration. Governments, industry and consumers alike will all play a role.

Introductory Questions

Q. What can be done to ensure vehicles built today are still efficient in 2020 and beyond?

Andrew Harrison

A. Good question - to maintain efficiency they will need to high quality fuels and lubricants that keep the critical parts of the engines and drive train clean and free from wear.

Venkat

Q. Hello Team Shell, Thank you for your time!... I would like to know, what is shell's take on Biobutanol, as we all know that there's quiet some news in the market for sometime time projecting butanol as a potential biofuel - moreover companies like BP and DuPont etc have started their production facilities which is expected to flood the market post 2013

Jose Bravo

A. Venkat. Many biofuel options eh? Shell has focused on second generation ethanol, on algal oils, and on some thermochemical methods to process biomass. So we selected these. We needed to focus. Others have gone other ways. Fun.

RON EDEMA

Greetings,
I'm happy to participate in the web chat today.

Doc

Q. Bio diesel and its impact

Jose Bravo

A. Tell me more

dcotov

Q. Dear Mr. Bravo, what do you think about Mikhail Prokhorov project to launch mass production of inexpensive electric cars (circa UER9000 a car) in Russia? Denis

Jose Bravo

A. An enterprising and bold idea. It may actually be advantageous to do so in Russia. The challenge will be in the market penetration of such vehicles. But I wish him the best. Also, the battery technology needed for inexpensive cars is a challenge

Aurélie

Q. What kind of research and new technology does Shell support to accelerate the move towards less CO2 emissions ?

Nick Allen

A. Aurélie, thanks for the question.

Overall, Shell's research and new technologies is focussed in a number of important areas - reducing CO₂ emissions in transportation through the development and supply of lower carbon fuels, new technologies in recovering natural gas, CO₂ capture and storage, and driving greater energy efficiency in our own operations and helping our customers do the same.

Doc

- Q. Will bio diesel be an important factor in the combination of factors needed to reduce emissions.

Jose Bravo

- A. Oh yes. It will become part of the mix. It has some nice features over other biofuels in heat content, and co-processing or blending with existing diesel. So biodiesel offers the inherent energy advantage of diesel with the renewable component and easy integration.

DanielCJones

- Q. What are the main things Shell is doing to contribute to more sustainable transport?

Niel Golightly

- A. Lots, actually. Sustainable transport means offering more efficient fuels (like our new FuelSave products), lower carbon fuels (like biofuels), working with customers on ways to use fuel more efficiently (like our FuelSave partner offer to fleet customers), working with governments on better sustainable fuels standards (we're doing this in most major markets), and developing technologies for the future (like next generation biofuels and hydrogen). In a world that can expect to see as many as a billion more cars on the road by 2050, we need to work hard and fast on all of these pathways.

Sol Shapiro

- Q. In the United States, with long distance travel and a "suburban" economy, the use of mass transit and short driving range electric vehicles will not come easy. I see the need for liquid fuels as the most likely approach - requiring invention possibly along the lines of Nate Lewis at Caltech artificial photosynthesis. But we also need a bridge to get there. Should this bridge include coal and natural gas to liquid?

Dr. Selda Gonsel

- A. Thank you Sol - very good question. Advanced liquid fuels will certainly play a significant role, as we see advanced internal combustion engines provide the greatest contribution towards improving energy efficiency and reducing CO₂ emissions within the next 20 years. We have been at the forefront of Gas to Liquids technology and we are in the process of expanding our global supply capability through our investments in Qatar. Coal will remain an important part of the global energy mix over the next half century. That's why we are pursuing a number of carbon capture and storage technology projects to help reduce emissions from coal-fired power. Over time advances in CCS technology will help to provide cleaner power for electric mobility as well.

Ken

- Q. Apart from the infrastructure changes that will be needed (fueling stations, etc), what are the other impediments to utilizing hydrogen technology? Is it really going to be a viable alternative?

Jose Bravo

- A. Well, I think that the ability to manufacture H₂ using a renewable resource as raw material as well as renewable energy will also be key. Right now, H₂ is largely manufactured by reforming methane and using fossil energy. The ideal world would have us manufacturing H₂ using water and a renewable energy resource. H₂ is an energy carrier and it needs to be "energized" with renewables.

"Every journey matters"

- Q. Hi, being in the transportation industry and seeing the amount of wasted capacity with our existing infrastructure and vehicles. Why can't we make a real-time impact with current technology to allow or more efficient capacity to be achieved?

Andrew Harrison

- A. I think you are absolutely right. Efficiency in usage of transportation - both freight and passenger have a lot of scope for improvement. The challenge for us as a society is to work out how to encourage these efficiency gains.

Waldi

- Q. We are all focused on Fuels, does that imply automatically that we are looking at future Lubricants as well?

Dr. Selda Gonsel

- A. Yes, absolutely! Developing low friction lubricants is one of our core research focus areas. There are significant energy losses that occur in internal combustion engines due to mechanical friction in lubricated engine parts, such as pistons, bearing and valve trains. The use of advanced energy efficient lubricants can play a significant role in reducing friction losses in these engine components.

RON EDEMA

I'm aware that sustainability refers to economic, environmental and social factors that enable understanding, progress and future trends in business. This measure is very important, in controlling problems that relates to environmental pollution.

edicicco

- Q. What do you think are the main drivers behind delaying progress made around more sustainable transport up to this point?

Niel Golightly

- A. Great question. It would be nice to think that we could transform the world's entire transport system to a more sustainable model overnight. But progress is going to be slower than that... mainly because of the scales involved. A billion cars and trucks, hundreds of thousands of filling stations, hundreds of refineries, and millions of miles of roads, and even the habits of all of us who drive cars have been built over the last hundred years. Changing all of those things -- and especially the habits -- will take time. For example, some studies show that it takes as much as 25 or 30 years for a new energy source -- say, biofuels or wind -- to capture just 1 percent of the market. Of course that should not keep us from doing everything we can as quickly as we can.

delliman

- Q. IN order to be a useful medium for transportation, batteries must meet certain benchmarks for performance. Can you please address what barriers remain for battery design, with particular attention to cycle life, charge time, amp-hour capacity, manufacturing cost, availability of materials, size and weight?

Andrew Harrison

- A. Batteries have made tremendous progress in terms of energy storage density and power density but I believe that they still need significant improvement in both these areas for battery electric vehicles to achieve their full potential.

Dave C

- Q. Do you foresee any future partnerships between energy companies such as Shell and electricity providers for the purposes of electric vehicle infrastructure/charging stations?

Nick Allen

- A. Dave, electric vehicles are getting a lot of airtime at the moment, and we definitely see them as a long term solution, along with fuel cell vehicles and advanced internal combustion engines.

As with other fuel and vehicle options, there are several challenges to be overcome with electric vehicles, including the supply of low carbon electricity, vehicle battery technology and customer acceptance.

Getting back to your question - cooperation, communication and collaboration are critical to cracking the challenge, and as with other fuel options, Shell is involved in a number of multi-stakeholder trials around electric vehicles and infrastructure.

Gary Kendall

- Q. As Jose Bravo points out in his opening remarks, well-to-wheels emissions are key. However, I would strongly challenge the view that this means electricity must be radically decarbonised BEFORE switching the transport fleet to electricity. The reason is the inherently high energy efficiency of EVs - they are typically 3-4 times more efficient than direct ICEV equivalents (take for example the Mitsubishi iMiEV). It means that for any given starting point - whether coal, oil, gas, or biomass - the electric pathway wins. This means that in terms of energy efficiency and CO2 emissions abatement, there can be no justification for CTL or GTL. Yet Shell pursues both. Does the economic argument always prevail?

Jose Bravo

- A. This is an excellent pair of questions: Decarbonizing electricity generation is good on its own merits and should happen. Because of the complexity of the consumer network, it may take longer to adopt EVs in significant numbers.

The GTL question is more complex but let me say that the sustainability consideration always prevails, and it includes the business case of course. So GTL makes sense in cases where feedstocks are available in an advantaged form or in some specific cases and markets. It is not a silver bullet.

By the way Shell works in Coal gasification as a clean coal alternative but at this point we are not looking at CTL integration projects

njackson

- Q. Thank you Shell for providing this opportunity. In your view, what is the single biggest opportunity for improving transport sustainability?

Niel Golightly

- A. The single biggest opportunity in the short term, in my view, is efficiency. We have to work on ways to meet transport needs with less energy right now... and that means not only more efficient fuels, vehicle designs, and road systems, but also thinking harder about the choices we make as consumers and the way we drive our vehicles.
- Longer term, of course, we're working on even more advanced fuels, lubricants and services that can help drive even more sustainable transport.

abhi0syal

Q. is shell undergoing research in engine design for transportation modes?

Dr. Selda Gonsel

A. Interesting question. Our focus is primarily on developing energy efficient fuels and lubricants. In this area we are working very closely with automakers to co-develop advanced fuels, lubricants and engine technology.

Del Stark

Q. Are you working on any research related to disruptive technology?

Andrew Harrison

A. Del - yes we do have a number of R&D programmes looking at disruptive technologies. As an example we are doing a lot of R&D on advanced biofuels from cellulosic biomass and other feedstock materials. These advanced biofuels will substitute fossil fuel demand. This substitution could be significant in the long term as one of several alternatives to oil based transport fuels.

dcotov

Q. Dear Mr. Bravo, thank you for your answer. Yes, he can produce them for the European market as well (as in case Micromorph thin film solar modules planned to be produced in Russia for the European market). May I ask you what is the progress towards the development of the less emitting air jet fuel? What is Royal Dutch Shell doing in that direction? Denis

Jose Bravo

A. Very sharp of you. Jet fuels for the future have a different set of challenges because of the range and weight issues. Seems to me jet fuel will be a bastion for liquid fuels. So this means that clean and secure sources need to be available: GTL fuels can cover part of that, bio-oils can also be part of the mix. Some airplanes have flown with bio-jet fuel already. Finally, there is much to be gained in jet engine efficiency still

CJ

Q. Hi, Jose,
Agree with you on the EV and need for decarbonizing the power grid. Would like to hear your current view on H2 Fuel cell vehicles as an future option for sustainable mobility

Jose Bravo

A. They can be players but we need to get to producing H2 with renewable sources and energy input.

Michael

Q. Is Shell's involvement in motorsport, (e.g. Formula 1) helping to improve the efficiency of road vehicles?

Nick Allen

A. Michael, the simple answer is..yes.

Our long term technical partnership with Ferrari has led to a number of technical breakthroughs in fuel efficiencies, technologies we have transferred to our retail products for the benefit of our customers across the world.

The rationale for this approach is simple - as a testing ground, F1 is hard to beat given the extreme conditions the products have to operate under.

Gary Kendall

Q. China has 100 million electric bicycles, from nothing ten years ago. What assumptions are behind your projections that the automotive fleet will grow to 2 billion by 2050, and do you feel you pay adequate attention to alternative development pathways?

Niel Golightly

A. Great to hear from you Gary. I owe you lunch sometime soon.
And a great question, too. We tend to look at a range of projections -- or scenarios -- all the way from "business as usual" predictions based on today's assumptions, to "discontinuous shift" scenarios based on unexpected political, technical or economic factors. The 2 billion car projection is the best guess that a lot of people have based on what we know today. And partly it's based on the natural expectation that a lot of people who don't have cars today will want them tomorrow. But as you have already spotted, we may see shifts -- for example the explosive growth of electric bikes in China -- that may upend those assumptions.
We need to be prepared for that scenario as well.
Thanks,
Niel

Steve Cruickshank

- Q. Do you see natural gas as a viable transportation fuel in North America? If so, would it use traditional distribution (i.e. gas stations) or utilize residential refueling systems?

Dr. Selda Günsel

- A. Thanks Steve - very good question. Natural gas has a critical and growing role to play in our energy mix for the foreseeable future. In addition to use in power generation, natural gas can certainly serve as a transport fuel, and we need to continue to test and maximize the use of natural gas for transportation. Compressed natural gas for private vehicles, liquefied natural gas for vehicle fleets, and GTL (gas to liquid) fuels for transportation are all areas of research and development for Shell.

bollen

- Q. Do you agree with the assumption that all existing (and still to be found) oil will be used until the ultimate costs of its extraction will be higher than its potential exploitation (since it will be very difficult, if not impossible to deny countries the exploitation of their natural resources). And what are your views of the consequences of this assumption if true? Will we be able to use fossil oil without releasing the contained CO₂?

Jose Bravo

- A. Fundamental economics will dictate: Remember the Stone Age did not end because of a lack of stones. Now with this in mind the trick is going to be to manage CO₂ by efficiency, CCS, or carbon recycle schemes. I think it is possible and we are working at it.

ekinbirol

- Q. Are the lithium-ion batteries of electric vehicles really causing more CO₂ emission than an efficient car with an internal combustion engine because of the energy required to recycle them at the end of their life-cycles?

Andrew Harrison

- A. Good question. The overall CO₂ emissions associated with manufacturing and recycling a battery electric vehicle are typically greater than those of a conventional vehicle - mainly because of the CO₂ resulting from battery production. These emissions represent around 25 to 30% of the total CO₂ lifecycle emissions (i.e. including those resulting from use).

DSC

Q. I understand that Shell is developing more sugarcane fuels in Brazil. Is this part of the push for more second generation biofuels. and does Shell's definition of sustainable include concern for the lands that are cleared for this and the people who live there?

Doris Cellarius

Niel Golightly

A. Hi Doris,

You clearly know your stuff about biofuels. The answer is absolutely. The decision to move into biofuels in Brazil was very consciously based on the realization that sugarcane represents the lowest carbon feedstock available today. We've also done exhaustive due diligence to ensure that our role there would not have negative effects on land use, biodiversity, soil and water, CO₂ emissions, and the social fabric of the country. These are all critical to using biofuels as a sustainable, lower CO₂ alternative to fossil fuels.

Fitzgerald

Q. To what extent are China and India incorporating new energy-saving technology in their burgeoning car industries. How involved is Shell in working with these two huge car growth economies?

Nick Allen

A. Fitzgerald, important question.

Taking China as an example, they are definitely active in future vehicle development, both in hybrids and electric vehicles as we expect to see this accelerating as they look to build long term decarbonised transportation in their growing cities, whilst focussing on internal combustion engines for their public and heavy duty transportation.

As with India, the important thing to realise about these countries is that their rapid growth in energy demand through to 2050 will require all sources of energy.

In terms of Shell's approach, we are active in both countries across many of our businesses.

Stevejapu

- Q. If we are considering sustainable transport for land transportation, what are we doing for sea and air, as they also contribute to some level of environmental problems.

Dr. Selda Gonsel

- A. Very insightful question, thanks! The drive towards sustainable energy solutions and reduced emissions is spreading through all sectors of transportation including marine and aviation. For example, we see global legislation being proposed to reduce sulphur oxide, particulate emissions and nitrous oxides from the marine industry. Technologies developed for addressing emissions in road transport, such as Exhaust Gas Recirculation and Selective Catalytic Reduction, are also likely to be incorporated as potential solutions. In aviation, we are looking at options for cleaner fuels such as Gas to Liquid Jet fuels. We have shown the feasibility of such an approach recently in a passenger air flight from London to Doha.

Craig Morton

- Q. If we do move towards an electric powertrain in our vehicles over the next 20 to 40 years, how will Shell adapt to ensure they it stays competitive?

Jose Bravo

- A. Well, the electricity generation will need an energy source right? An evolving business model. We already lead the pack in gas, so we are in a position to start the journey

dcotov

- Q. Dear Mr. Golightly, as far as I know Royal Dutch Shell closed the hydrogen project? At least I was told so on the joint Shell/ACCA event in the Hague on March , 05 by Mr. Thomas Rupert?

Niel Golightly

- A. Not quite right. We continue to provide a number of stand-alone demonstration hydrogen filling stations in various markets, and they are giving us important insights into consumer behaviours, safety, cost and distribution of this future fuel. But we have decided to focus the bulk of our alternative fuel investment and energy in the near term on biofuels. We see more opportunity in biofuels to start reducing CO₂ content of fuels now.

DanielCJones

- Q. What about developing a significant alternative to bitumen in the construction of roads to make transport infrastructure more sustainable? Are there any R&D projects in place at Shell to do this?

Dr. Selda Gonsel

- A. Good question. Thanks. We are actively involved in developing new technologies for bitumen applications. One example is our Thiopave product based on a new sulphur technology.

Waldi

- Q. Does Nuclear play no role as replacement for the “well” or is it deemed to a high risk for consideration openly by anyone at this stage?

Jose Bravo

- A. More and more it becomes obvious that nuclear energy needs to be part of the mix....Consideration in various quarters is increasing

Gary Kendall

- Q. As recently as three years ago it would have been preposterous to imagine Shell hosting an online webchat about the prospects of automotive electrification. Given how far the technology and the regulatory landscape have moved in those three years - Shell in Japan even running it's own EV battery-swap initiative - how close are we to a tipping point in the automotive market?

Nick Allen

- A. Dr K, as ever, it depends who you ask and how you look at the opportunity.

What is important is to look at the well to wheels CO₂ intensity of the solution. There are some key challenges to be overcome - low carbon electricity supply, vehicle battery technology and customer acceptance.

We see the priority in the next few years to understand and address these challenges, to ensure that when we reach the tipping point, there is a real reduction in emissions from the vehicles.

DanielCJones

- Q. Promoting sustainable transport is all well-and-good, but at what point do efforts to be sustainable start balancing better with Shell's highly unsustainable extraction businesses? Does Shell have a long-term plan to shift focus to wholly clean technology?

Niel Golightly

- A. A fair question, but the hard answer is that the world will depend on fossil fuels for well over 70 percent of its energy needs for most of the next generation. Yes, we need to be working on alternatives... but we also need to work on more sustainable, cleaner ways to produce and use conventional fuels as well.

Mark

- Q. Can you address any pros and cons of a hydrogen? Also, what is the current status of advanced biofuels use for aviation fuels?

Jose Bravo

- A. H2 is clean at point of emission; it can hold a lot of energy. But, it is produced now from fossil sources and is more difficult to distribute and handle. See previous answers regarding renewable H2

AnthonyFoxtrott

- Q. i am a student in beijing from africa studying sustainable design - i would like to ask whether or not shell has considered investing into nuclear technology, given the risks of mass-scale oil 'gathering'?

Jose Bravo

- A. We feel Nuclear is better left to the experts

wimwield

- Q. One could argue that the degree of mobility in our industrialized society has meanwhile become unsustainable regardless of the type of technology used. Any visions on that?

Niel Golightly

- A. Believe me, that is the subject of lots of late night conversations around here. So while we work on making today's transport system more sustainable, I think all of us -- companies, governments, NGOs, academics, city planners, consumers -- need to be thinking about ways we might change that system. More mass transport? More virtual working? Better city designs? Different ways of purchasing mobility? These are all likely to be part of the future mobility model.

RON EDEMA

- Q. The aviation industry, automobile industry, marine means of transport require life cycle transformation in the manufacturing, operations and global inclination to this changes.

Dr. Selda Gonsel

- A. Hi Ron. Yes, well put and we agree! It is very important to apply life cycle analyses or "well to wheels" CO₂ analysis to look at carbon intensity along the entire value chain. We are actively involved in developing methodologies for this type of approach, taking into account total CO₂ emissions from the production and distribution of the feedstock (well to tank) as well as the emissions from the fuel, and from the use of the fuel in the vehicle (tank to wheel).

CleanEnergy350

- Q. In its efforts to expand the market for biofuel produced by Cosan, will Shell look to increase utilization of biofuel for power generation within Brazil or to export markets for biofuel for use for transport?

Jose Bravo

- A. Interestingly, part of the utilization of biofuels in Brazil includes power integration with such things as baggasse. The export market for bioethanol from Brazil is a consideration we take seriously of course.

AnthonyFoxtrott

- Q. if shell were to come up with an efficient and profitable alternative to petroleum that only it knew about, would Shell be able to restructure it's business model over 10 years?

Niel Golightly

- A. Anthony,
Very intriguing question. Do you have such an efficient and profitable alternative in mind? One that can be introduced on a global scale? We're working on a number of them, but see a much longer timeframe than 10 years for scaling them up and making them profitable.

bego

Q. Good afternoon. I would like to know if you consider micro algae as a viable source for sustainable transportation. Thank you.

Andrew Harrison

A. Thanks bego - the short answer is yes but it is early days and it will take time and investment to overcome the technical challenges. We are a majority shareholder in Cellana a company set up to operate a small pilot facility in Hawaii.

dcotov

Q. Dear Mr. Allen, it seems to me that Shell changed a little bit its strategy in the renewable energy since Mr. Peter Voser became CEO? Is Royal Dutch Shell on the way back to the core business, the conventional oil and gas? Thank for you opinion.
Denis

Nick Allen

A. Dcotov, good question.

Yes we are primarily an oil, gas and chemicals company, but at a time when the challenge of climate change looms large, we owe it to our shareholders and customers to reduce the CO₂ impact of the energy we produce today whilst positioning ourselves as a leader in even lower CO₂ energy tomorrow.

It is for this reason that we put a major focus on new technologies around biofuels, CO₂ capture and storage, improved efficiency of our operations, and natural gas.

CJ

Q. Jose,
Producing H₂ either from fossil resources with CCS or from renewable resources like biomass is not a problem. Coupled with the high efficiency of fuel cells (2x ICEV), the well-to-wheel carbon footprint (gCO₂/mile) and fuel cost (\$/mile) are already better than or competitive with existing options.

Jose Bravo

A. They are possible technically, but their sustainability needs to be improved, and the technology is not ready for business use at this stage. We are working to make it so

Sol Shapiro

- Q. For Jose Bravo,
Your comment that coal to liquid is not good, I assume is based on its CO₂ emissions. And I agree that it would be better to have less emissions. But the world is not changing its energy base and we will need geoengineering to offset any major climate catastrophe. AND we need invention to get to the nirvana of a carbon free energy base. And so we need a bridge. I agree that gtl is a viable resource. But so is coal. So let's do it all.

Jose Bravo

- A. Good points Sol. It is about diversity. But maybe a more sustainable route includes clean coal to electricity by gasification/IGCC where the gtl is associated then with Gas.

Andre Costa

- Q. Dr. Gonsel I would like to make a question regarding regulatory framework aiming to support the mass roll-out of electric cars. What new trends do you see as a next step to congestion charge-like levies? Do you consider possible that highly populated countries come to an outright prohibition of internal combustion engine vehicles in major cities due to severe pollution levels?

Dr. Selda Gonsel

- A. Thank you Andre, good point. Electric cars are receiving a lot of interest from governments as well as media as they offer potential to significantly reduce green house gas emissions. But there are significant challenges related to implementation, so they are more likely to play a role in the long term. The internal combustion engine will remain the primary power source for many years to come, so improving its efficiency is critical to making significant improvements in CO₂ reduction in the near term. For this reason, discriminating against internal combustion engines would not have beneficial effects for society.

Karsten Wilbrand

- Q. Electric vehicles are promoted as zero emission vehicles by legislators, automotive manufacturers, electric equipment companies and electric utilities. Additionally consultants and media are firing the E-Mobility hype.

How can Shell help to get the discussions more realistic without being blamed to talk negative about E-mobility in order to save the fossil fuel business?

Jose Bravo

- A. Hopefully with events like this where a frank discussion happens. The argument as to where does the energy ultimately come from needs to be active.

Jean-Paul Lange

Q. Dear Team,

What is the view of car industry on hybrid vehicles than run on power for short distance and on liquid/gas (bio)fuel for longer distance? do they expect the benefit in emission and range outweigh the increased complexity and weight of double propulsion?

Andrew Harrison

A. Hi Jean Paul - Hybrid vehicles, such as the Toyota Prius, which run on electric power for short distances are one of the key technologies that will help achieve efficiency gains in passenger car transport and I expect that they will continue to grow. Plug-in hybrids that also take power from the grid are the next logical step and despite the added complexity I expect that they will also be a major player in the long term.

Sol Shapiro

Q. Is Shell giving any serious thought to a gas to liquid plant in the United States? This country continues to talk about more domestic fuel for transportation but is laggard in anything but long range solutions. We desperately need a bridge using both gas and coal as feedstock for liquid fuel. And since these plants are really "refineries" it would seem that Shell could be a major supplier. As to the issue of CO₂, let's sequester as feasible, but since the world is likely to need geoengineering as a stop-gap, would it not make sense to build initial plants as capture ready - rather than hold them hostage to development of CCS?

Jose Bravo

A. GTL in the US with expanding gas supplies... You tell me. Geoengineering I do not know enough about to comment. Sequester when you can.. Of course

Craig Morton

Q. The technology side of this problem is very important and will assist us as a society to move towards a more sustainable transportation future. An area that has been perhaps somewhat overlooked is the role consumers will play in this transition. What do you believe to be the biggest consumer barriers to lower emission transportation (such as uptake of low emission vehicles) and how does Shell plan to approach this challenge?

Nick Allen

A. Craig, I agree with you that customer usage is very important. As with many products we all buy and use, the majority of emissions are related to the usage, rather than the production. We have a responsibility to help our customers to address this challenge. We have been active in this for many years, both in terms of education programmes and providing customers with tools, right across the world, and we continue this today.

I like to think in terms of opportunities rather than barriers - building awareness of what can be done, helping educate customers, and then providing them with tools to make a difference. It's going to be a long road as much of our behaviour is subconscious, but it's definitely one worth travelling.

evamohan

Q. Are you aware of any existing or proposed transport systems which use personal electric cars on unused railway tracks?

Jose Bravo

A. I am not, are you?

Sol Shapiro

Q. Jose,
You have deflected my discussion of the need for geoengineering to put climate change on hold to allow time for invention. Would you discuss this? And also that with geoengineering we can then use both ctl and gtl (note that from what I have seen ctl can be done for about \$65 per barrel)>

Jose Bravo

A. Sorry, I did deflect it. I really know so little about the topic I felt unqualified to discuss. Sorry, just a poor process engineer here

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Q. I saw that Lufthansa is soon starting a bigger trial with biocomponents in air jet fuel. Does Shell have respective cooperations with airlines?

Dr. Selda Gonsel

A. Good question. The aviation sector is facing pressure to cut CO₂ emissions as other sectors make substantial reductions. We work closely with airlines as well as aviation engine manufacturers to develop advanced fuel and lubricant technologies. An example is cleaner burning gas to liquids jet fuel. There is a need for a regulatory framework that will encourage market conditions that accelerate biofuel adaptation. Current technology and feedstock economics make bio-jet costly, however we are continuing our R&D efforts in this area to provide more options for the future.

vitorbomtempo

Q. The biofuel of the future: will ethanol lose ground to drop in biofuels?

Andrew Harrison

A. It's difficult to say - we can expect continued growth in the use of ethanol in the short to medium term. In the longer term we are likely to see a growth in advanced biofuels but I suspect that there will be room for both and it will be fossil fuels that are displaced.

RuneF

Q. Do you think it is possible to raise the photosynthetic conversion rate in plants (in most cases well beyond 2%) to a level where biomass can compete with solar panels (approaching 20% efficiency) in energy utilisation per unit? I guess as solar panels are improving on efficiency and falling in price at the same time a car batteries improve we will see a point where biofuels will be outcompeted?

Jose Bravo

A. Love the idea. Accelerated growth is one of the targets for example in algae projects. Much can be done there. Technology for biofuels will also evolve and I think they will fight a good competition

Facundo

Q. Hi Team, Thanks for the opportunity. Which are your thoughts around public transportation? Shouldn't we be talking about improving public transportation for the daily commute instead of putting more cars on the road (more efficient cars, but more in number)? Isn't it more efficient to have 1000 people riding an electric train instead of having 1000 people driving 1000 electric cars? Thanks

Nick Allen

A. Facundo, public transport is an important area of focus, and one where we are working closely with a number of governments and city authorities.

My experience is that it comes down to a combination of carrots and sticks. The carrot - how governments make it sufficiently convenient and attractive to switch customers. As for the stick, how much do they make car transportation less attractive?

The final point to remember is that all the options require big infrastructure investment and this takes time - so we will see these solutions coming through but they will take time.

Waldi

Q. Is Phytoplankton at all being studied - it is the most significant source of O2 whilst absorbing and acting as the most significant CO2 capture organism rather than pumping it underground ?

Jose Bravo

A. Many marine organisms under consideration precisely for those features

sam

Q. obviously my question was over your heads

Jose Bravo

A. You are right, Over my head just like an inexpensive wingless air vehicle

ekinbirol

- Q. Apart from the economic and technological aspects, is there any ongoing research to change peoples social behaviors to use more ecologically friendly ways of transportation?

Nick Allen

- A. Ekinbirol, nice question.

There is an increasing amount of activity on how each of us can change our behaviour on transportation, to make a difference, whilst allowing us to live our lives as we wish/desire.

We are involved in a number of these and it is an increasing part of our focus, as we work to help our customer use less energy and ultimately hence emit less CO₂.

abhi0syal

- Q. Other than electricity from fuel cells and biofuel, can renewable sources be used? How is shell positioned?

Dr. Selda Gonsel

- A. Shell is actively involved in exploring a range of alternative energies including wind, biofuels and hydrogen. We believe we are the world's largest distributor of first generation transport biofuels, which will be an essential part of the transport fuel mix. We are also investing in carbon capture and storage technologies.

wimwield

- Q. The take on battery technology seems to be that it should deliver all that HC-fuels do, and than some more. Do you think there is a chance that electric transport might become a preferred solution for a new type of mobility customer, that has different requirements?

Andrew Harrison

- A. Thanks wimwield- I think we will see a growth in electric transport. It is particularly suited for short urban trips. For longer distances I suspect that liquid fuels will remain dominant for some time. Cost of the vehicles is an issue currently and of course the CO₂ benefits are entirely dependent on how the electricity is produced.

Mark

- Q. Could Nick indicate the trajectory and investments that automobile makers may be taking to improve energy efficiency, transition to lower carbon fuels, and decrease non-stationary carbon footprints? Both in the States and abroad?

Nick Allen

- A. Mark,

Given the journey that automobile makers have gone through in the last 2 years, predicting their investment trajectory is a tough one.

However, what I can say is that they are investing heavily in new efficiency technologies and you are seeing these coming through in the new road vehicles today. In the next 15 years these engine technologies and bio fuels will have the biggest impact on lowering the CO₂ emissions of road transportation.

wimwield

- Q. Some developments in drivetrain technology, serial hybrids for instance, could lessen the requirement for premium fuels. One could say, at some point anything that burns will do. Is Shell anticipating this?

Andrew Harrison

- A. Yes - this is something that we have thought about - but I think that there will always be a market for higher quality fuels.

dcotov

Dear Dr. Gonsel, Mr. Bravo, Mr. Golightly, Mr. Harrison, Mr. Allen, thank you for your valuable time and thoughts. Shell is a great company providing great opportunities. Hope to see you and hear from you again. Denis Kotov

Niki

- Q. Given the fuel economy/emissions standards set by governments globally (for example binding EU target of new car fleet averaging 130 gCO₂/km and 95 gCO₂/km in 2020) what is your view on the level of EV/PHEV market penetration needed to achieve these standards in the next few years? Do you think this could be achieved by fuel efficiency/other technologies?

Dr. Selda Gonsel

- A. Electric Vehicles/Plug-in Hybrid Electric Vehicles will certainly be part of the longer term solution for sustainable mobility. However, market penetration will not be very quick over the next few years. In the US, hybrid vehicles have been around for over 10 years, and the current penetration is 0.6%...that is why we need to continue to focus on advanced internal combustion engine technologies for the foreseeable future. Energy efficient fuels and lubricants are a key part of this.

Dr. Selda Gonsel

Thank you for sending in so many interesting questions. We have tried to answer as many as possible, but there were a lot, so we are sorry if we didn't get to yours within the session. We're really pleased you could join us - thanks for taking part in today's webchat.