Good day ladies and gentlemen. My name is John Barry. I am the vice president for Unconventionals and Enhanced Oil Recovery at Shell International. And I'm here today to talk to you about carbon capture and storage.

While society will continue to push for aggressive development of renewable energy, will undoubtedly re-examine the merits of nuclear power and for sure should be pushing for further energy efficiency improvements in the decades ahead, there is one technology which looms large and will be an essential part of the mix. It is carbon dioxide capture and its geological storage. While it won't solve society's energy and environmental problems on its own, it will allow us to continue to make use of the abundant fossil fuels that are needed in the energy mix and provide a bridge to the eventual longer term lower carbon energy future.

We start our story as we do many of our energy and environmental stories these days, with what we call the three hard truths in Shell. The continuing growth in demand for energy and fossil fuels. The second hard truth which says that demand is increasing in difficult to supply from conventional sources of hydrocarbons. And the third hard truth that we must manage the carbon footprint of the production of energy in the future, particularly relevant perhaps for the more energy intensive forms of unconventional energy needed in response to hard truth number two.

We can actually quantify the effects of doing carbon capture and storage as a management approach to CO2 reduction. We use the Shell energy scenarios available on www.Shell.com. And in particular we look at the difference between a Scramble scenario of a late, knee-jerk type regulatory reaction around the world, compared to the more benevolent and attractive CO2 trajectory of the Blueprint scenario, where there is earlier, coordinated action by governments and society to manage CO2 and much lower CO2 emissions.

By interrogating the Blueprint scenario and saying: “What does Blueprint look like if we take out the CCS possibility?”, we can actually show the trajectory -here you see it on this slide- and we can say that something like 230 gigatons of carbon dioxide additional will be in the atmosphere in 2050 if we don't do CCS. That's several years of global CO2 emissions. We can also say that for every year we delay the widespread deployment of CCS, roughly 1 ppm of CO2 extra will be in the atmosphere at the end of the period.

CCS is only part of the solution. I mentioned earlier on: energy efficiency. And it is important for society, it is important for Shell. The top left-hand part of this schematic here; you see that managing CO2 emissions down, we start with energy efficiency. Get your house in order and operate properly. That's actually the cheapest way of reducing CO2 emissions. Very often pays for itself, in fact. But when we have done all of that, we may need to move in some of these more energy intensive sources down into the bottom left-hand corner, where we are capturing carbon dioxide and storing it underground, for example, in an aquifer, a saline aquifer. Or using it in enhanced oil recovery, again underground in an oil reservoir.
There is a tantalising possibility of being able to mineralise it in the long term future. That remains at the R&D stage at the moment. And of course further to the right on this picture we know that we are part of trading systems. There will be a need to manage residual CO2 by buying allowances in a number of environments, like in the European Union Trading Scheme. We can also bring in physical offsets, for example building in renewable energy to some of our operations. This is pretty much everything we could do about CO2, and you see that CCS forms part but it is an important part of that.

To the world as a whole there is of course a wide range of choices. And here we illustrate some of them. I think the key point to make is this is not on either/or story. Our scenario work shows we don't have the luxury of choosing to bet on one or two of these technologies. We live in an and/and world where we need to do all of it.

We are not the only people saying that. The intergovernmental panel on climate change that august body, convening scientists around the world, also concludes that CCS has a hugely important, potential role to play if we can get it successfully rolled out. In fact it is one of the most promising ways of managing the greenhouse gas problem.

Here I illustrate just a few of the technologies which -and these are my own words- we need to get better at doing. If I am honest -and I am a reservoir engineer by background- many of these technologies exist or we understand to some extent. The trick is we need to actually get better if we are going to see them more widely deployed. We know how to inject C02 underground; we know how to capture it from many types of CO_2 sources. We have a good idea of how it behaves underground from years of enhanced oil recovery operations, for example. But putting it all together, understanding the risks, bringing down the costs, convincing others it can be done safely; these are for the future. And there is a pretty active technology development and deployment effort ongoing in Shell and in many of our partners.

The capture part, where it all begins, I won't talk through these technologies in detail, but there are a number of different processes from which we will be driven to capture the CO_2 if we are going to really achieve the impact we want. For example capturing from the flu gasses, coming out of the power stations; that would be the top process here. We call it the post combustion capture. But as power generation gets more sophisticated, if we think of clean coal, using a gasification process to burn coal, possibilities of capturing the CO_2 prior to combustion and combusting a hydrogen rich stream start to emerge.
There are a number of techniques for taking CO_2 out of industrial processes, in refineries for example. Or taking it out of natural gas streams, which are contaminated with CO_2. They all require slightly different technologies, but those technologies are beginning to emerge. One of the key things is: today they are all relatively expensive. I talk tens of dollars per tonne captured, ranging up into the hundreds of dollars per tonne of CO_2 captured.

If we think about where the CO_2 should go once we have captured it, here is a schematic illustration, a cross section of the Earth, showing just a few of the kinds of reservoirs we might want to put that CO_2 in. It could go in depleted gas fields, it could go in depleted oil fields, to try and increase oil recovery. But we think that by far the largest destination for the CO_2 in the longer term will be saline aquifers, deep geological formations that today contain unusable, highly saline water. The reason we think that is because the statistics clearly show that the pour space available for storage around the world is dominated by such aquifers. So we are going to be driven to go towards them, aren't we?

Just a couple of examples of where CO2 is today being stored underground, or is being contemplated to be stored. Here is an illustration of the CO2 sink project in Germany, it is just outside Berlin. It is a small-scale project, focused on the subsurface behaviour of the CO2. And it is starting this year, already, to inject CO2, whose fate in the subsurface, in the reservoir, will be monitored by a consortium of the European Union institutions, of academia, of industry partners, including Shell.
At a larger scale but an earlier stage of development and not certain yet to go ahead is a feasibility study for what we call the Zerogen project in Australia, where Shell is providing a gasifier, Shell gasification technology, to a consortium planning to generate clean coal power and capture the CO2, store it in an underground aquifer, some distance away from the power generation site. Very exciting project if it goes ahead, because it will be a close to zero emissions, coal fired power generation value chain. We'd like to see lots of those in the future.

But for that to happen, costs will need to be brought down. This schematic cost curve -I emphasise it is not a detailed and realistic curve- illustrates that in the long term, by including CCS as a mechanism in trading schemes for example, giving carbon dioxide capture an economic incentive to go ahead because there is a price on the C02 if it is emitted and not stored, ought to be good enough when the price comes down to make CCS happen. But in today's situation, where the technologies have not yet been widely deployed, we don't know how most efficiently to do that. We may have even some new technologies we have to develop to fill a few gaps.
Prices are high; the costs of the projects are high. And there is a need for some short-term support to help us through the 'learning-by-doing' phase as I call it on the left hand side of this chart. Allow us to understand how to do CCS and drive the costs down. Shell will have a role to play in that, but so too will governments and industry consortia, to make that early phase happen.

To conclude then, I think a number of things need to happen on the policy front. The first of which would be the inclusion of carbon capture and storage in the long term inside trading schemes or whatever other frameworks are regulating CO2 and setting its price. Secondly, in the short term we have to bridge that gap and get through the learning-by-doing phase; that will need some special incentives. They may come from governments; they may come from other mechanisms. But they are needed if we are going to realise the potential of CCS in time. Thirdly, frameworks will have to be developed for the subsurface storage part. “What represents the right sort of reservoir, with well understood and acceptable risks for storage?” “How do we monitor the CO2 when it is in there, to make sure it doesn't come out?”

And fourthly there is some work that I put in the ‘boring but important’ bucket of administration. We will need legal frameworks which talk about ownership of the subsurface, which say how you can get a permit to dispose of the CO2, which talk about long-term liabilities and aspects like that. The most mature example of a set of frameworks like this today is the Draft Directive published in early 2008 by the European Union. Not yet enacted as a law, as it were, but I think contains many of the sorts of elements that would be needed to make this take off.

Ladies and gentlemen, thank you very much for your time and attention.

And best of luck with your CCS projects.