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The Economics of Energy

Audio interview with Christof Ruehl, Chief Economist of BP, PLC

Dr. Joe Hahn, Assistant Professor of Decision Sciences, Graziadio School of Business and Management

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Start

Joe Hahn: Good day this is Joe Hahn, Assistant Professor of Decision Sciences with Pepperdine University's Graziadio School of Business and Management. I'm pleased today to be able to speak with Christof Ruehl, Chief Economist of BP plc based in London. In his role at BP, Christof analyzes global economic and from a strategic input into BP's activities. He has a distinguished track record as an economist in academia as well as in economic development and policy advice. Prior to joining BP in 2005, Christof served as the World Bank's Chief Economist first in Russia from 2001 to 2004 and then in Brazil. From 1996 through 1998 he worked in the office of the Chief Economist at the European Bank for Reconstruction and Development in London. Earlier he spent time in academia, first as a researcher at German Universities and later as a Professor of Economics at UCLA. He has also been a visiting professor at academic institutions worldwide including the University of Western Ontario and the University of Chicago. His areas of specialization are macro economics and monetary economics and he is published widely in these fields. Thank you so much for agreeing to speak with us today, Christof.

Christof Ruehl: Good morning or good afternoon whatever the case may be.

Joe Hahn: Whichever the case is. Excellent. Energy costs and supply ability are important issues for businesses around the globe. And the impacts of the overall economy can be quite significant as we've often seen in the past. Of course we're all personally affected as well each time we fill up our cars, buy a plane ticket, pay our utility bill, et cetera. So there's lots of interest in these issues and we're looking forward to hearing some of your perspectives on the industry.

Christof Ruehl: All right, thanks for having me on now.

Joe Hahn: So let me begin by asking, if you can give our audience some background on BP's economics group and the function it serves for the company?

Christof Ruehl: Well, as you may know, BP is a global company so it's a-- and it's a global oil and gas company more than anything else. We also have alternative energy, renewables in particular; wind and solar and bio-fuels. But the bulk of our work is in oil and gas. The economics department we essentially do three different things. We provide through strategic input into company decisions. That goes all the way from briefings on how we see the current economic development panning out to assisting the planning assumptions and long term appraisal, assumptions on oil and gas prices around which the investment decisions are made. Another thing which we do is to play an increasing role in outside activities in talking to governments, talking to partners, talking to other companies, essentially on the same issues providing our view of global energy market developments and sharing that and collecting information. And then the third part, the third thing we do is research. That is-- the most visible sign of that is the *Statistical Review of World Energy*, which we publish every year but it includes more than that and tries essentially to make use of the data which we assembled throughout the year and through the statistical review and trying to push the functions of our knowledge about energy trends and energy markets a little bit.

Joe Hahn: You mentioned the *Annual Statistical Review* that BP does of world energy. This has become very widely cited reference both within the energy industry as well as direct external observers of the segment. Can you give us a little bit of history on how the review came about?

Christof Ruehl: That review has been around now I think 58 years this year. And it started funnily enough when the so called "Seven Sisters" the big oil companies were still active in the Middle East at a time when there was even less data available on oil markets in particular than today. And the reliability of that data was not very high. But there was a need for someone to do some research on that and provide reliable data just for business decisions or management decisions. That task was delegated to one of

these big companies at the time which was what became later BP, the Anglo-Persian Oil Company. Even after these companies had left the countries in the Middle East and then sort of went their own ways we just kept on producing that because the overall picture in energy markets as far as data and data reliability is concerned is not very good. And at some point in the past, I'm not quite sure when the decision was made to share that with the public that data, not only to use it as an internal decision tool. And the thinking behind that is very simple it's that we all benefit from a fact based discussion, a more rigorous discussion. Energy is a very emotional subject and a very politicized subject. So we aim to sort of provide rigorous data and rigorous analysis based on this data, which is fact based not guess work, which would be different from most other sources. And I think we are the only private supplier of all these energy data, so we're not an association or interest group like either the IEA or OPEC and I think that explains to some extent the trust which that data, the *Statistical Review*, has received.

Joe Hahn: Yeah indeed, it's something that you might expect the scope of the report and also the perspective, as you mentioned, as sort of an unbiased observer or as if it's something you would expect from the DOE or a governmental agency. But I suppose BP has the benefit of being a global company so that they can have the global perspective in mind when they're doing the report.

Chirstof Ruehl: Yeah, I mean, maybe I think others could do it as well. We happen to be the first ones every year and we use our own network in the various countries. So that has been built, as I said, over more than 50 years and is now pretty reliable. That probably gives us an edge over others.

Joe Hahn: Indeed, yes it does seem to be working well. Well the scope of the annual statistical review is obviously beyond what say an average sized business might be able to carry out. But yet there certainly seems to be some common lessons and perhaps you could share on how to carry out data analysis to help manage a firm and the firm's strategy. Could you tell us a little bit about the process of compiling the *Annual Review* each year for example an overview of the timeline perhaps of some of the major tasks involved?

Christof Ruehl: So the basic legwork is done with a network of contacts in ministries. Whenever possible we use official data, that's the number one. We don't want to second guess people and over years that has led to a self-correction mechanism. People are very keen to look up the data for their own countries and to make sure that there's no mistakes so we get good information. And it's official information to the extent possible. In practice that means we send out a questionnaire once a year to the energy ministers of the various countries and ask them for that information. Now in some countries energy data is still a trade secret and so we don't get information. In those countries we compile of our own best estimate. We do that by relying on formal and informal contacts and also on the businesses which we have in those countries. We usually tend to have a good eye for what's going on there. Funny situations, for example in Russia the reserve data or the production data or the reserve data are a state

secret, but every company is forced to publish their own research so you just troll through the company reports. In other countries you have to make an informed guess. But that is the minority of countries. Some of the fuels, other than oil and gas we get from secondary, in particular coal, we get from secondary sources in this case there's a World Coal Association, I forgot what exactly it's called, which provides us those data every three years when it is published. And in some other cases we do our own best effort, for example, nuclear how many power stations are open and what the utilization degrees are and so on. We just try to research that from here. So it's a pretty big undertaking and the way we're just a limited group. So the way we do this is that we collaborate with academics at a university in Scotland, Heriot-Watts University. They manage the database and they help us throughout the year to update the database and to collect the data and so on. And we have sort of a hellish two month in April and May when I get together all of my team, which is scattered globally, in London and we go through the data which has come in by April and literally everything single data point try to make sure it doesn't look extraordinary, try to find out what happened if something looks extraordinary, go through the whole thing and then finally let the data speak. And that's then the second stage of the process, the statistical review, as you know <inaudible> is just a book of numbers, just a bunch of numbers. We then try to do is write a report or presentation which sums up what has happened in global energy markets over the last year and try to do that as rigorously as possible by analyzing the data and trying to compile so that the next chapter in this evolving global energy story.

Joe Hahn: Okay.

Christof Ruehl: What is important there also conceptually is that we stay away from <inaudible>, as I said, that includes you're not making any predictions. So we really try to sort of focus on what has happened last year based on an analysis of the data rather than predicting the oil price for next year say, which is stuff that you would only do internally.

Joe Hahn: Right. That's one of the things that I wanted to ask about also was, are you free to use internal data? I guess there's probably some things that BP uses proprietary from a data standpoint and some things that you are available to publish and work with in your report, is that the case?

Christof Ruehl: Yeah, I mean there's a range of sort of feedback loops between the statistical review and we can use it internally and how internal data feed in there. The big point is that this is done under the auspicious of the economics group. I'm responsible for it and it has been an old tradition at BP, which is still maintained and of which I think all of us are pretty aware and proud, which is that nobody interferes with the story we are telling. So I'm the economist that's responsible for collecting those numbers and reading them and whatever I and my group thinks would be said goes into the final presentation and speech. It starts with the CEO and so on, but there's never been an attempt of sort of the company policies to interfere with that. That's very important, this degree of independence. That also underlies the

credibility which we have because everybody in the energy world knows that this is a judgment of professionals and not some policy piece, as it is the case often with the, sort of, the more illustrious reports from other companies.

Joe Hahn: Right.

Christof Ruehl: Something that is which is shiny. Which is often the case of the more glossy reports of other companies.

Joe Hahn: Okay.

Christof Ruehl: All right. Now internally also the data is useful. It's not just a service which BP provides to society at large also, because we use this data for our own internal analysis. For example, if we make a 20-30 or 20-20 scenario of energy markets or fuel markets and how they may develop then we base that on the history which we have in this data, which we can track, which we can easily combine with things like GDP developments, labor market developments, growth for the developing world versus <inaudible> and things like that. And when we do analysis of particular regions of markets then the same applies. We can draw on that database in many ways which feeds into the internal world. As far as using other data I mean, we are free to use whatever is available in the public domain or whatever can be justified by-- on scientific grounds where there's no immediate restrictions.

Joe Hahn: Okay. Speaking of restrictions, you commented on the reported part of the review as well as the bit of inference that you add or interpretation of the numbers that you see in the report. Are you restricted on what you're able to infer outside of the company being that it is used for internal uses as well?

Christof Ruehl: No, I mean that's exactly the point here. What is used for internal purposes is based on the data and that's just the numbers, they don't lie. And it's our job to analyze them. The story which we make out of the numbers, so this summer we have to try to explain what happened in the year 2008 and beyond the first time of 2009, that story is our responsibility. So we try to the best of our ability to make the data speak and sing and do it as rigorously as possible. But there are no restrictions on what we say and there is no policy prerogative. So nobody comes and tells us you emphasize this or that because it's the company interest. The way the company benefits from having that database and then some of the internal analysis which we do we could-- we can do only because we have that data. That stays internally. But as far as the external story is concerned that is really an attempt to make sense out of the numbers and not to convey any messages.

Joe Hahn: From having read past reviews I can say that I think you do an exceptional job at walking that fine line.

Christof Ruehl: Thank you.

Joe Hahn: Can you comment on internally are you able to use the review to help setting, for instance, price forecast, commodity forecast and things like that for economics? Does it carry that weight with the company?

Christof Ruehl: Yeah, I mean, what we do internally is to some large extent based on this exceptional database which we have accumulated. So if you ask me whether cost follow prices or prices follow cost in the industry then I know where to go in order to look at past cycles to try to get an answer. Or if you ask me what will be the futures in 2030 between coal, oil, gas and renewables, then I would know where to go to see trends and also to combine new developments. For example, if you know that the share of the <inaudible> economies, the so called "developing world" and global GDP increases then we can try to use that data to estimate by how much that really reflected and for the demand growth for the different types of fuels from the <inaudible> economies, things like that. That would be examples of internal work based on this database.

Joe Hahn: Yeah, it seems it would be an extremely valuable piece of work across all segments and perhaps even in your trading organization as well.

Christof Ruehl: Yeah, the trading organizations generally appreciate it because there's a good division of labor here. They are very much into the short-term and interest in the short-term. And we cover them in medium and longer term perspective more looking at the fundamentals. And so there's good interaction between what the economics group does on the group level and what the analysts do at the trading desks, very complimentary.

Joe Hahn: BP obviously makes a very considerable investment compiling, you do have some help but BP is the lead player in compiling this review. And you did mention this earlier but could you comment a little further on the rational, perhaps looking back, but also looking forward on sharing the review with the external community?

Christof Ruehl: The prime rational is to provide unbiased data, just to provide the facts as they are. And it's kind of amazing when I entered the energy world as an economist and so I thought, "What could be easier than to measuring how many barrels of oil are pumped out of the ground?" But far from it, the

data situation is unstable. Data comes in a long lag and some countries don't-- some producers don't like to publish their data. So it's not like the car industry where you have at your fingertips all the necessary information. So that's the prime reason to publish it in order to have the public-- it's a public service in order to improve the quality of the public debate around energy and energy markets. And then the secondary reason is for it enables us to understand what's going on. This is a huge exercise for us and for the whole community to try to make sense out of developments and then the natural instinct if you do this kind of work is to go out and share it and get feedback and get other people's reading and other people's opinion and so on. So this then very quickly turns into a useful dialog, which is useful for everyone involved be a commercial company or in many cases also governments. So very often when I travel and present it, we are confronting essentially three completely different audiences. There is sort of the business world that is interested in what's going on and trying to get a-- come to grips with it whereas as the academic world which tries to understand on a deeper level most often more long term and more technically interested in more finer granularity and deep <inaudible>. And then there are governments both in producing countries and in consuming countries who are just very keen in trying to understand what is going on in order to see what policies should be applied and how past policies have turned out and how they performed compared to other countries and so on. So these are the prime audiences and they are really very different in what they demand. What they all share is the sort of desire to have some fact based analysis and that's what we try to provide. And of course it's useful for everyone involved including for BP because it opens doors, gives contact, it opens a dialog in an area which is not normally covered by a big oil company.

Joe Hahn: Right. Yeah I would imagine there's good will that accrues to BP as you mentioned from the general public your partners both in industry and government as well.

Christof Ruehl: By far the most downloaded document on all of BP's web site, more than any company report. So if you put a value on it or a reputation of value in the balance sheet it probably would take us away from building a cost center.

Joe Hahn: Right <inaudible> any time soon then?

Christof Ruehl: No, hopefully not. No plans.

Joe Hahn: Let me change focus here a bit and talk about what's in the report and some of the implications thereof. Within the past we've seen some really wide fluctuations in energy prices going from the high prices last summer to where we've been here in the past-- well early this year with some lower prices, quite a range there. And some have claimed that this has been due at times to market manipulation by traders rather than supply and demand fundamentals. So that's a claim not necessarily

mine. But many feel that such disconnect between fundamentals in prices diminish the value of trying to quantitatively model and conduct analysis on energy markets. How do you view this claim?

Christof Ruehl: With regard to that specific claim that it's speculators or financial investors driving prices, we have looked at that, CFTC has looked at that, the NASDAQ at looked at that, academics has looked at that and to my knowledge not one theory or study has come-- has found evidence that it was driven by speculation or financial investments. The indicators, I mean, half of these trades are over the counter trades, so you can't really see them. But from what we can see all the indicators are pointing to the opposite direction. So when, for example, speculation was said to have driven prices up there should have been an increase in inventory because at the end of the day these things need to be physically delivered hadn't taken place. If you look across the board at a time when oil prices and gas prices and heating oil prices all went up, the investment patterns are very different so there are long positions and <inaudible> positions, and heating oil and gas somewhere in between, yet the prices all moved in the same direction. So whichever way you play with the numbers I don't think this claim can be substantiated. No doubt they play a role in the sense that they play a role everywhere. It is said that financial is <inaudible> accelerating existing movements.

Joe Hahn: Right.

Christof Ruehl: So they can accelerate price up and price down swings but they do not determine the current earning points. So they jump from the train when they see it but they don't determine the direction. They're not stupid. They look at the same kind of fundamental data we look at and then they make their investments accordingly. So that then raises the question if it wasn't them what was it? And I think that the case is absolutely is compelling that it was really fundamental movements and particular it was OPEC and the OPEC cuts in 2007 which became effective and showed up in inventories in the summer of 2007 and then drove the prices up on this one way street until summer of 2008. And it was also OPEC in conjunction with the credit crisis which brought it back down again because if you recall what happened in early 2008, in May of 2008 when prices were about \$130 or so Saudi Arabia did something which was very rare. They made an announcement saying they would unilaterally increase oil production to cool markets down. And what happened the day they made this announcement all markets jumped up not down because either nobody believed them or nobody believed that they even could do it. Then in June, July they hastily convened a conference at Jeddah, essentially to repeat that claim, a platform where they had the 32 Finance Ministers and 34 CEOs of the biggest energy companies all coming together. It was another platform to say that they would increase production even further. And again nobody believed them and prices went up a little bit. And now with the benefit of hind sight with the data coming in we know that they have done exactly what they always do when they make these public announcement. They had to increase production already as far back as January and the rest is history as they say, right. By the summer and the fall of 2008 then A, the markets realized that this oil hit the

inventory so it's was actually yeah there was enough oil. Again it takes five, six months from such an announcement and changes at the well until they show up in inventories, be they cuts or increases. So it took until the summer until inventories held this additional oil. And at the same time the credit crisis broke loose and the <inaudible> fell off a cliff. And ever since OPEC is chasing demand and they have in this late fall and in the winter of 2008, they announced the biggest production cuts they've ever known. So far compliance is pretty good and it looks as if right now the cuts, the OPEC cuts, are catching up with demand and that's the reason why we see prices stabilizing. If you follow that kind of story line and you're underlay it with a price curve, I think the evidence is really compelling that it is this development which drove prices up and down and sometimes in real life the explanation is actually more simple than most people make it out to be. And that seems to be one of the examples here.

Joe Hahn: I'm glad you brought up OPEC because one of my questions in my notes to ask you is relates to the findings in last year that OPEC was successful in managing production via cuts going back in, I guess this would be back into 2007, and then in 2008 we saw the prices spike reportedly on fears of oil demand was rising so rapidly that the world could no longer necessarily count on OPEC to satisfy it. And that's the big question there, the elephant in the room, so to speak. What does your research tell you perhaps not now but at some point when production starts growing again is there a ceiling on OPEC's ability to meet crude oil demand as it continues to grow again?

Christof Ruehl: You mean a ceiling in the sense of not being able to produce more or a ceiling in the sense that they would not be able to sustain the current production cuts?

Joe Hahn: Well there's always been the question that whenever there was a rise in prices that OPEC would open a spigot, if you will, to meet the demand because of the high price. There were some people who claimed last summer that it was wide open, that they didn't have anymore capacity to deliver to the markets.

Christof Ruehl: One of the rare coincidences between economic history and economic theory which says that cartels never lie. And OPEC sort of is an example for that. The first thing is, it's true what you said that people thought that last summer they couldn't produce anything more then I just try to say that when OPEC said they have still spare capacity, when push comes to shove, they could actually increase production considerably because they did have that spare capacity last summer. It was only about 2 million plus, but it was there. It was concentrated in one country, Saudi Arabia, which made the coordination problem for the cartel even easier, because since it's the main player one country can decide what to increase and to decrease. Now the situation is a bit different. After the cuts which have been implemented currently, we think there will be spare capacity about three times as high as it was a year ago. So it's somewhere between 5.5 and 6 million barrels per day. And if they continue with current compliance levels or with current discipline, by the end of that years end capacity in OPEC will reach six

million barrels per day. To give you an idea of what that means, if all demand tomorrow would be returning global oil demand, growth would return to the levels it had-- the average levels it had between 2000 and 2008, which were years of high growth. But then it would return to an average growth rate of 1.1 million. That means it would take three years just to make up for this increase in spare capacity which they have done, which they have introduced by cutting output in the last year. If that would be the case oil demand would grow at it's trend rate, which is unlikely because of the recession and if there would be no other source of supply, which is also unlikely, right. So that's the kind of buffer which we have right now.

Joe Hahn: Right.

Christof Ruehl: And the problem that raises over time is that, is the question, how long can OPEC maintain the discipline? Now they have 6 million barrels per day, 2 of which are outside of Saudi Arabia. And what has historically always happened in a situation such as this is that the success of cartel carries the seeds of it's own destruction. So a lot of spare capacity, prices higher than they would otherwise be and you see individual members starting selling oil through the backdoor. It will happen again and the key question is <inaudible> to me is when will this happen. We think that the-- if the history is any guide then it will not happen in 2009 they'll be quite capable of holding discipline through 2009. But assuming that the years 2010 and 2011 will be years of sluggish economic growth and therefore sluggish oil demand, at some point discipline will erode. And that's what happens to cartels. So OPEC is no exception. When you're successful you keep prices up, you create spare capacity and you-- the more successful you are the bigger the incentives you create for some members to violate the quota agreements and to start selling through the backdoor and that's the end of-- historically always has been the end of OPEC control. But these <inaudible> of OPEC control can last quite some time. So this is hard to-- almost impossible to predict when it will happen <inaudible>.

Joe Hahn: Interesting.

Christof Ruehl: The other point is that many people suspected last summer that actually there was no spare capacity left and that OPEC basically had turned up all the spigots and the world was running out of oil, so to speak, at least temporarily. Because of the big buffer in spare capacity and also because of the projects which are still under preparation in the Gulf and in particular in Saudi Arabia, I don't think that this is serious responsibility for the next three years. I mean, there's enough buffer here to deal with an economic recovery and with the increase of oil demand back to normal for some years to come.

Joe Hahn: Interesting. Following this price story line into this year, the first part of this year we saw prices come way down. I'm curious if that was supposedly based on real day end signals such as the

demand destruction that was observed, the demand numbers that were published by Government agencies and what not. Do you think the price was commensurate with those numbers or was there also on top of that a sort of fear premium or a bit of downside speculation that took prices all the way down to say \$35?

Christof Ruehl: Again we found no evidence for speculation but it was a coincidence of two factors. One is demand falling off a cliff, as I said. Just as a little headline now remember September last year, U.S. oil demand fell by as much as the absolute oil consumption of India, right. That is still to the relationship between the big mature markets like the U.S. and these growing markets in developing countries. So it's the absolute sizes are still so they're dominated by the OECD countries and that's-- and in particular the U.S. oil demand fell off a cliff. And that coincided as I said, with OPEC, in particular Saudi Arabia, actually having increased production in the first half of 2008 in order-- why did they do it? Presumably because they look at the same numbers as we do and they didn't want to kill the goose which lays the golden egg. They saw that prices were going through the roof. They saw that the global economy was slowing down so they tried to cool it a little bit. But when their additional production hit inventories, that was about the same time the demand collapsed. So you have this coincidence of the double whammy, which caused them then to try to chase this falling demand by more and more cuts. I think that much of this demand destruction which we have seen, particularly in the U.S., was not structural as we call it, but was behavior. What do I mean by this? When you compare it to the situation in the eighties when demand collapsed actually to a larger extent than now you have a thing like new technology coming on for example. You have nuclear power crowding out oil from power production. That's a structural reason for demand destruction which is lasting and unlikely to disappear. You also have the affect of <inaudible> standards which have been changed in the seventies and improved efficiency particularly in the American transport sector. Again that's a structural thing which it comes one time and then stays. We have seen nothing like that so far. We have no new technology now which crowds out oil from anywhere. This may change but we haven't seen yet efficiency standards being raised and again seen any of this permanent or structural demand destruction. What you're seeing right now is all behavioral. Meaning it's really people that drive less and fly less. And in principle of course...

Joe Hahn: The discretionary consumption.

Christof Ruehl: ...in principle that could be transitory, right?

Joe Hahn: Right.

Christof Ruehl: And it's more sensitive to lower prices whereas the gas price when the pump price goes down some of it will be reversed. So the situation is different from the eighties in that in those two

respects the demand situation, a huge decline in demand, but all driven by people changing behavior and therefore not necessarily lasting.

Joe Hahn: On the supply side again maybe staying with the discretionary theme here, do you see any fundamental changes from where we were last summer in the high price environment obviously the recession and the pull back in prices may not have affected, say the development among the OPEC nations, but for companies like BP and Shell and Exxon and other global integrated companies, do you see them pulling back on their investment levels and do you think that's going to have an impact on the supply side?

Christof Ruehl: You know, when you read the papers a lot of noise is being made about investment being cut down and so I don't see that to be affected <inaudible>. We have not seen any substantial reductions in CAPEX expenditure. And then what happens in situations like that is that oil companies tend to cut down or to save or to slow down projects where the actual oil production is furthest away. And they tend to go through with projects which are close to first oil. And so I think that's a bit overstated. Also when you think of particular capital intensive projects such as big deep water oil rigs from the gulf of Mexico so once these projects produce oil companies correctly tend to fuel the investments at some cost and they keep them producing because it would be very expensive to mothball these projects. It's more likely that projects with operating costs that are suffering such as tar sands in Canada also which have become suddenly very expensive. But even there a second phenomenon takes place now, which is that always costs follow prices, right. A few weeks ago people would have said tar sands are profitable at \$80 a barrel now most people would say it's \$60 per barrel and the reason is that the costs of gas which you need to heat up that stuff has fallen. And so operating costs come down as prices come down but with a lag. And so from that perspective I'm not really worried about supply crunch coming anytime soon. There may be cutbacks and the oil companies are suffering right now and it may look funny to the outside of service but the same guys were celebrating \$45 oil three or four years ago are now complaining about it. But the reason is, of course, that in the meantime costs have escalated and it will just take some time until these costs are driven back down. But once that has happened you will see investment levels being at quite you know, returning.

Joe Hahn: Sure.

Christof Ruehl: So it's a cyclical industry. But the lags and the projects are so large and the time lags are so long that it's not reacting immediately, it's going to be stretched out over time, the cost adjustment.

Joe Hahn: Okay, makes sense. Okay for perhaps some of our readers and those involved in long term planning for businesses that consume significant amounts of energy in its various forms, what's your view

on how energy costs should be modeled given the current uncertainty that we've seen in the past year and the volatility that we've been dealing with?

Christof Ruehl: When you say energy, so there's not really a one size fits all. If you just look at fossil fuels, the first thing to recognize is that the oil market is dominated by a cartel, by OPEC. And for that reason alone it makes no sense to talk about marginal costs determining oil prices, any of this kind of notion. This is not a market which has a smooth supply curve so that you can always take the next expensive project under preparation, right. This is a market where you have access problems where you can't go for the cheapest oil first, where you have to take expensive oil and so on. So all these notions of <inaudible> cost determining prices to me are just misleading and nonsense, but it is a market which follows fundamentals in a very, I mean almost primitive way. I mean, you just look at the amount of supply and you have a very good proxy of how prices behave. But you need to take into account of the politics of what OPEC is doing in terms of increasing or decreasing supply because that's the short term decisive factor, just as much as you need to look at demand. And it's also interesting, the demand side here is shifting. We are used to-- we still have the biggest consuming countries obviously it's the U.S. and Europe and industrialization. But when you look at the incremental consumption, since the turn of the century 100 percent of the increment load is consumption over these eight years came from the developing world, came from the Middle East, from China, from India, from countries like that. And that demand is much more dependant on economic growth than it is on prices. So these kind of demand shifts need to be taken into account together on the demand side just as much as the cartel on the supply side. Now with gas and with coal it's different because the gas market is only one segment of it, which is the energy market developing liquid natural gas, liquefied natural gas, sorry, is developing into a globally integrated market. Otherwise the market for natural gas is still very regional. So American gas prices only gradually become affected by energy's supply and demand but are still dominated by local production and so is the European gas market whereas the Asian gas market is more or less just an energy market. So these are regionally segmented and need to be modeled regionally. With an increasing move for energy is connecting these regions. And then coal finally is just sort of bursting on the seam, so to speak, they're just trying to become a globally integrated market. There is still a lot of transport and other bottlenecks preventing that and there's a lot of subsidization and politics going on connected with utilities in the power sector which would have to be taken into account. So on a very, very big level I would say energy is just like any other commodity you do your demand and supply analysis and that is you go down into these markets and look at the nitty gritty there's a lot of politics, regionalization and specifics having to do with energy being a good, which needs to be consumed and people need it to survive which has to be taken into account. But if you do that, a good demand and supply analysis an ever greater granularity should apply.

Joe Hahn: So would you perhaps say that it's appropriate on the fossil fuel side to model things as say mean reverting so that there's some equilibrium level that, as you mentioned, would be set perhaps by OPEC primarily to plan around that level even though there maybe short term fluctuations up and down?

Christof Ruehl: Now that's a really good question. What the real question is, is there a long-term flat supply curve as people have said? It sounds absurd at first because everybody thinks of oil as something which is limited. But if you think of it as something which can be made out of almost everything including a bio-mass, if you wanted to, then you can look at it as a race between technologic improvements and productivity improvements and the ability of new oil and then people indeed. Some people would argue that there's a horizontal supply curve so that in the long term it will not-- the costs don't vary a great deal. It's sort of the opposite extreme position from peak oil guys.

Joe Hahn: Right.

Christof Ruehl: I don't know the answer to that but there's certainly is a degree of mean reversion and there certainly is historically great degree of cyclicity which is linked to the economic cycle, which is linked to global activity levels and which has a feedback mechanism. I mean we all know that the global economy and in particular the U.S. economy, for example, started to slow down as early as 2007 long before the credit crisis hit. And we also know that oil demand in the U.S. started to slow down late 2005, must have been a price affect nothing else, again long before the credit crisis hit. And it's up to future generations of students, of academics to look at this. But my bet is that the high energy prices did have something to do with that slow down.

Joe Hahn: Right.

Christof Ruehl: So there is always this feedback loop. Taking that into account I think yes there is cyclicity there is mean reversion and there's a very powerful and very little understood mechanism which goes from high energy prices to global economic performance and back.

Joe Hahn: Okay. What is...?

Christof Ruehl: That's one of the more interesting things and because it stretches all the way into this changing world. It's only over the last 15 years or so that the contribution of the developing world to global GDP has gone up over 50 percent. But they use about three times as much energy per unit of GDP than the developed world. So their contribution to and incremental demand for primary energy not just oil has gone up to about 90 percent. So it's changing from a world where global activity levels means more or less the U.S. and Europe to a world where it more and more means Asia and developing Asia and other developing parts of the globe. And the energy demands those segments are very different so that kind of feedback loop which I described between high energy prices and global economic development <inaudible> is changing, and the engine of economic growth is shifting away from the West.

Joe Hahn: Right. It might be interesting to make some comparisons between some other commodities, some non-fuel commodities to see if there's some parallels there will develop because it seems as if fuel and energy have always been commodities which act a little bit differently than the rest.

Christof Ruehl: Yeah, that's right and nobody really-- again, it's very difficult to understand what exactly makes the difference.

Joe Hahn: Right.

Christof Ruehl: But that actually is something which goes into the production of almost any other good or service. It's right at the-- it's one, what used to be called a basic good in classic economics because it goes into everything else. That makes it harder to track but more interesting to study.

Joe Hahn: Indeed. What if any, policy making actions do you believe need to be taken to stabilize prices and promote investment? And that's a two part question. First of all in terms of long term a conventional energy supply and second of all in terms of the so called next generation or alternative energy sources?

Christof Ruehl: Well it's a two part question but they are unfortunately linked because the more successful you are in establishing a stable regime for conventional fossil fuels, the harder it will become for renewables to make a breakthrough because they're still more expensive. Is that making the question, yeah?

Joe Hahn: That's true. Of course there's also the environmental and sustainability issues that people weave into this discussion as well.

Christof Ruehl: And let's take them one by one. I mean, the policy to stabilize for the fuel prices are very conventional run of the mill. You have to ensure equal access which of course isn't there. You have to ensure that companies would be capable of investing through the cycle, which never happens because when prices go high the government take increases, taxes increase, access becomes a problem and so on. And you have ensure competition in the sector, most importantly, which also is almost never the case because most countries, oil producing countries, monopolize it in one national company. But these in theory would be the ingredients for a stable and diversified supply and for relatively stable prices. In terms of energies, there is a basic problem because as I said, in almost all cases they're still more expensive than fossil fuels. So the straight forward answer is for fostering them, if one, for example, is afraid of climate changes so would be to put a price on the CO2 emissions created by fossil fuels, which would make fossil fuel use more expensive without distorting the case for investment in fossil fuels which

are still important, right. So a cap and trade system preferably or if necessary a tax system, which puts a positive price on carbon emissions would be the first important ingredient for making, research in investment and renewables more lucrative. Positive things are the kind of subsidies which we are seeing including the tariff barriers and so on, which are now, for example ethanol and bio-fuels in the U.S. to root to some extent, but which also then immediately has fossil fuel crisis coming down now, point at the limits of such a system because the subsidies go sky high and it becomes hard to maintain, especially in poorer countries so it would always be some kind of luxury at that price in rich countries. And the hope connected with these subsidies is of course that they would lead to investment, which in turn leads to cheaper ways to producing renewable energy so that one day they can compete with fossil fuels. The track record of these kind of things is very poor. Governments are notoriously bad at picking the fuels or the technologies which they think will make a breakthrough in the end. And the fact of the matter is that we don't know which kind of renewable energy will be the one where we see a technological breakthrough. So that makes me uneasy when I think about these subsidy schemes and strongly it would lead me to support things like a carbon tax or a price for carbon as a mechanism to change the relative prices between renewables and fossil fuels.

Joe Hahn: I know you've spent a little bit of time in Brazil and there's an interesting policy experiment there going back to their development of ethanol in that country where they've also continue to foster their conventional energy supply and explore for oil and gas offshore and I don't know if you could say that the result of government policies, but it seems that they've come to a fairly good place in terms of their energy supply in that country. Would you agree with me?

Christof Ruehl: Yeah, absolutely. It's actually a perfect example of what you need to do in terms of the investment climate. The perfect case study if you compare Brazil and Mexico, 30 years or 25 years ago both of them were countries which sort of had a nation oil company, had no way for foreigners to invest, they were closed off and the national oil company was hopelessly behind the curve when producing stuff. Brazil then opened up, and it's important they didn't do anything really revolutionary or, right, like privatizing petrol prices they didn't. All they did was to allow competition in. They allowed foreign companies to compete with petrol price, their state company. And in the process they created a national oil company which is world class in terms of deport operations and they literally owe the discover of these new giant fields there to the company which became such a world class company because it was forced to compete. And now you look at the other side of it, Mexico has never opened up it's still I think in the constitution that you can't invest as a foreign company there. And all around them people invested in the Gulf of Mexico and really deep water and they don't even get their toe into the water and they're onshore fields are declining and the energy situation is miserable. That's the effects of competition on efficiency. And then of course the other side, the alternative fuels, Brazil is just the best country because they have sugar cane. Sugar cane is cheaper and so they can produce ethanol without major subsidies at an oil price which is competitive at an oil price of about 40. That's very different from the corn based ethanol



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and the economically rational thing to do would be to scrap this U.S. tariff and then you would have sugar cane based ethanol in the U.S. But that of course is a political problem.

Joe Hahn: Well thanks again for your time Christof.

Christof Ruehl: No problem. Thanks for having me on.

Joe Hahn: We certainly appreciate your insights and again we'll look forward to continue to follow your teams work for the review this year and years to come as well.

End