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The Global Growth Agenda

OVERCOMING ENERGY SECTOR BOTTLENECKS TO GAIN SUPPLY STABILITY

Panel

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14:00–15:15, Pavilion 3, Amphitheatre

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Moderator:

Jeffrey R. Currie, Global Head of Commodities Research, Goldman Sachs International

Panellists:

Ashti Hawrami, Minister of Natural Resources of Kurdistan

Sergey Kirienko, General Director, State Atomic Energy Corporation ROSATOM

Alexander Novak, Minister of Energy of the Russian Federation

Jean-Pascal Tricoire, President, Chief Executive Officer, Schneider Electric SA

Dr. Daniel Yergin, Vice Chairman, IHS; Co-Founder, IHS CERA

Taner Yıldız, Minister of Energy and Natural Resources of the Republic of Turkey

Front row participants:

Mario Mehren, Member of the Board of Executive Directors, Wintershall Holding GmbH

Grigory Vygon, Director of Energy Centre, Moscow School of Management SKOLKOVO

J. Currie:

My name is Jeff Currie and our topic today is energy infrastructure. A topic that could not be more timely in the current economic climate. When we look at energy prices, we notice that the past decade was dominated by high and volatile commodity prices which has calmed down in the last two years; we have not seen such a stable pricing environment since the 1990s – with the emphasis on stable – which really underscores that energy markets are in a transition phase.

That stability we see in oil prices, however, really masks underlying developments. In the business that I do, we spend more time talking about the WTI-Brent spread than anything else. That reflects a lack of investment in infrastructure. At this point, we actually have too much of a good thing in many parts of the world. The development of infrastructure will be most important in being able to deliver this energy supply, whether it is oil or gas, to India's markets. Harnessing large-scale capital will be critical in obtaining that development and infrastructure. Our focus today will be on infrastructure that needs to be developed, how we will actually do it, and other interesting subjects within the oil and gas industry.

Mr. Alexander Novak, Minister of Energy Russia, I would like to address my first question to you. Thank you very much for participating in our panel today. It is a great honour to have you here with us today. Russia has vast resources of both conventional and unconventional oil. So far, development has focused on conventional resources, but as production starts declining in the more mature fields, companies are starting to pay more attention to an unconventional resource base. What is the government in Russia planning to do to create the necessary regulatory environment in order to support unconventional oil developments in Russia?

A. Novak:

Jeff, I want to thank you for inviting me to participate in this plenary session among such respected people. The topic under discussion today is extremely relevant for Russia, and for our oil and gas industry in particular. There is no

need to repeat that Russia ranks first or second in terms of natural gas extraction and first in terms of oil production, and that the oil and gas industry as a whole is a key sector of the economy of the Russian Federation. The primary objective of the Ministry of Energy is to create the appropriate conditions in order to allow this sector to occupy a leading position in both the world and Russia. You asked a question about our capabilities in ensuring supplies, developing infrastructure, and drilling in fields where the oil is difficult to extract. This is a very important and really urgent issue for us, because we are well aware that if we do not now incentivize the production of hard-to-reach oil and drill in low-permeability, unsaturated, and deep reservoirs, we will not be able to increase the current oil recovery factor, which is much lower than the coefficient achieved in other countries.

What are companies proposing, and what do we support? Did you know that on Monday the Government of the Russian Federation submitted a draft law to the State Duma to amend the taxation regime as it applies to the extraction of hard-to-reach oil? This legislation proposes a shift from revenue taxation to a taxation regime that encourages production efficiency. That is, the legislation proposes differential taxation that creates economic conditions for the profitable extraction of hard-to-reach oil. We are talking about tax incentives for the extraction of natural resources. In particular, an 8% tax credit is proposed for drilling into low-permeability reservoirs with permeability below two millidarcy and where the layer is less than 10 metres thick, and a 40% tax credit is offered for layers thicker than 10 metres. These tax benefits are planned to last for 15 years. A 100% tax credit will be offered to those drilling in the Bazhenov Formation, and a 20% credit will be offered for the Tyumen Formation. These incentives make it possible to ensure the profitability of extraction and allow for an additional two billion tonnes of oil to be produced. This is a significant increase that will provide a multiplier effect. In our view, this represents a significant change to the tax laws; it is essentially a tax revolution, which will both increase oil recovery from existing fields and act as a spur to the development of new ones.

And I would also like to state that we have an agreement with the Ministry of Finance that a separate accounting system will not be created for the extraction

of oil from fields with hard-to-reach reserves. We have agreed that we will implement an appropriate procedure for the accounting of oil (it is almost ready). The law does not create an additional recordkeeping system, since the expenditures required for such a system would actually neutralize the entire effect that could be achieved with an increase in profitability. I think this is a very good incentive, and it provides a signal to the market that allows our companies to start producing oil in large volumes and increase its recovery rate.

J. Currie:

Thank you, Mr. Novak. We have with us today Mr. Jean-Pascal Tricoire, President and CEO at Schneider Electric, a company offering a wide range of solutions in oil and gas. We are discussing various trends in the global energy markets today. From the perspective of a provider of services and solutions to the oil and gas industry, what trends in the global energy markets do you think are worth paying attention to? What are the issues and questions that need to be faced, and what technological solutions are available today?

J-P. Tricoire:

What you mentioned is a very large subject. In the sector of energy, we work in two directions. The first one is to supply technology to the oil and gas industry in order to make the industry more efficient and help companies control their processes. On the other side of the equation, we develop technologies that augment energy efficiency and save energy everywhere. These are a convergence of IT technology and energy technology, connecting facilities to the frame of ‘smart’ grids for ‘smart’ cities, resulting in a better adequation, especially between energy production and energy consumption.

Probably the biggest transition that we experience in our sector today is what is called the ‘Internet of Things’. If you look at the past 20 years, the Internet was mostly about connecting people to people. Now, 2.5 to 3 billion people are connected to the Internet. However, over the next 15 years it will be about connecting machines – things – to the Internet, and interconnecting those machines and connecting people to their environment.

In this period, everything we do is connectable and connected, enabling you to connect the processes back to automation systems, and in a very transparent manner. We are, for instance, assisting in the automation of pipelines, making them more efficient, making the dissolution of energy more secure, but also enabling faster trading of energy, because then everything is connected.

Out in the field, in the downstream part of the equation, what we experience is that very often people consume all at the same time, giving rise to large peaks in demand. Very often this part of energy production is not optimized, in respect to its consumption. All the technologies that we are developing together with utilities, who are really the directors of this evolution, are to make sure there is improved adequation between production and consumption, for instance, that people consume more when electricity is cheaper and greener.

J. Currie:

Thank you. About shale oil: we have all heard about the revolution taking place in the United States right now; obviously infrastructure development there is the key factor. I would like to shift the discussion slightly and speak more directly about the impact it is having on the global energy markets in the current environment.

When we think about the impacts of shale oil, they are far-reaching; they go well beyond just oil or gas and also into the coal markets. First of all, I would like to give a little background on how the technology works to give you a better understanding of why it is turning the industry upside-down.

The process of extracting shale oil is done by basically by creating a fissure in a shale rock to ‘squeeze out’ molecules that were otherwise non-recoverable. The first thing that will come out will be the element with the smallest molecular density, such as methane gas. Next are propane and butane, and finally the crude oil. This is what is turning the industry upside-down: the clean-burning fuels are the ones that come out first. When we think about this, it is having a very large impact on light oils and cleaner-burning fuels, but it is also having a much larger impact on the energy generation markets.

When we look at the United States, many of you will be surprised to know that the United States is now about ready to overtake Russia as the third largest

exporter of coal because gas is displacing coal and pushing coal out onto the global markets. However, when we look at the impact it is having there, its impact is not only within gas and coal. It is also impacting the product markets. The United States is the third largest exporter of oil, and we are focusing on oil products at nearly three million barrels per day. The revolution and the impact it is having on global markets cannot be dismissed.

Before we kick off the discussion on shale, I would like to make a few points about why this happened in the United States. I have clients ask me whether their engineers are smarter, or whether their geology is different. The answer to both of those questions is: no, neither. The only reason the US is the home to the shale revolution is they simply outspent the rest of the world. Fifty percent of the global capital expenditure in the E&P sector is in the United States and Canada. Last year, the United States spent approximately USD 170 billion on E&P. Putting that in perspective, countries such as Saudi Arabia and Russia spend something in the range of USD 10 to 20 billion, Capital expenditure on E&P is significant in the United States.

The ability to spend that much is a function of two things. Firstly, the sheer scale of the industry. When you look at oil, gas and coal together, the United States, China and Russia are the largest energy producers in the world. They are the ones that have the scale to facilitate this investment. The second reason is due to the fiscal regime there. Low and stable tax regimes attracted a lot more capital to the sector, which created the investment behind the shale revolution.

The point here is that the shale revolution is having a global impact; it is not just isolated to the United States. As we go through this discussion of the global implications of the shale revolution, and the opportunities it provides going forward, I would like to address my next question to Dr. Daniel Yergin.

We have seen how development of technology has impacted the shale revolution in the United States and, as a result, we have seen a massive production response in the US. How do you think the scale of shale will develop further? It will be interesting to hear your views on whether or not we are going to see the unconventional development spreading across the world.

What do you think are the main bottlenecks that need to be addressed globally to make unconventional oil the new global supply driver of supply growth?

Dr. D. Yergin:

Thank you for that question. First, to identify what we are talking about, because we are also talking about logistics and supply. We see that the world's logistic system of pipelines and transportation needs to adjust to two things. One is the incredible growth in demand that we have seen over the last decade. The other is the new sources of supply, one example of which is represented here in the discussion about Kurdistan's new pipeline to Turkey.

The other area where logistics really has to catch up, as you suggested, Jeff, is in North America where we see such dramatic growth. Just to give two examples of what has happened, in terms of oil. Some of you will remember when we were here, in St. Petersburg, around 2008, they were saying the world was going to run out of oil and the United States was going to run out of oil. Since then, US oil production has increased by 46%.

The increase in US production is equivalent to the entire output of Nigeria. Think of it like a new, non-OPEC country appearing in North Dakota or southern Texas. Those volumes are affecting the global energy balance. Then, as Jeff said, with natural gas, shale has gone from 2% of US output to about 44% of US output. It will be much higher; in fact, US gas output is up 26% over the last seven years, which is a very dramatic rise.

The question obviously is: how quickly will this go elsewhere in the world? We know if there is one industry that is global in terms of its technology, it is the oil and gas industry. There are major obstacles, however, that will slow development. The first is the discovery that all shales are not the same. The shales in North America were quite well-known, in the sense that there had been a lot of drilling through them over many years. This is not the case in other parts of the world. The first obstacle is simply ascertaining what kind of resource is there.

Second, the capabilities to develop it on a profitable scale. One country that we think, from our research, has larger potential than the United States is China.

Their viewpoint, however, is that it will take five to ten years to develop a substantial industry, because a very broad capability is needed to be able to build such an industry. It is a different kind of capability and a different kind of mentality. Other countries that have great potential are Mexico, Argentina, perhaps Saudi Arabia, various parts of Europe, and perhaps Russia. Yet, even if you want to go relatively fast, it will take a lot of work to achieve that.

Then there are all the questions of what happens aboveground, such as for example the nature of the regulations. You see very different attitudes towards development in Europe. You see misperceptions that stand in the way of development and questions about ownership. One key factor in the United States, in particular, was that individuals owned mineral rights, and that was a great incentive for development.

The answer to your question, Jeff, based on what we know today, is that this is going to spread. Work is already beginning in other parts of the world, but it will probably be five years or so before we start to see a major footprint in different parts of the world. A lot of that will depend on the fiscal regime, as we heard from the Minister of Energy, Mr. Novak. And a lot of the fiscal regime will depend on the attitude of governments, as well as public opinion. The difference that I can see, from even one year ago, is the recognition in the rest of the world that what is unfolding now is really very significant. That was not so clear a year ago. That in itself will be a motivating factor. Thank you.

J. Currie:

Thank you, Dr. Yergin. The development of new supply sources is clearly having an impact on the global supply-and-demand picture. The question then is, how does this impact the long-term price of oil?

Looking at the growth in supply from non-OPEC producers alone, they are able to cover the demand increases, keeping the market relatively balanced. That is part of the reason why oil prices have been so remarkably stable over the last several years. One of the drivers of that is the underlying cost of the industry, particularly to produce the shale oil. We estimated it somewhere in the range of USD 90 to USD 100 per barrel, which is one reason why Brent has been paying

somewhere around USD 100 to USD 105 per barrel over the course of the last several years.

In the context of this current price environment and the outlook going forward, how do you see the long-term price of oil?

Dr. D. Yergin:

Certainly, as you say, there is a floor under the price of oil, which is provided by these high-cost resources. Relatively speaking, whether you are talking about tight oil or oil sands, or similar unconventional sources of crude oil, below a certain level, the development of new supplies would certainly fall away. If you were looking at the build-up of supply and weak demand growth, then you would expect to see oil prices somewhat lower in the next year. However, oil prices are always also affected by political tensions and uncertainties. You can even see the increasing tension over Syria reflected in the oil price.

In the longer term, obviously the floor in the price of oil will be determined by the cost of substitution, the cost of higher-cost supplies, the pace of development, and also what happens with new efficiencies, as mentioned by Mr. Tricoire. We have peak demand in OECD countries, and there is some question about when we will have peak demand on a global basis. Rather than saying the oil price will be this or that, we have to ask what the factors are that will shape and reshape that price.

In the near-term, what we are looking at in Iraq, Kurdistan, the United States, Canada and other source countries, is a build-up of supply. A build-up of supply, in the absence of political tensions, conflicts and uncertainties about the Middle East, would tend to point at oil prices being somewhat lower in the next year or two than we have seen now. But politics always hangs over it.

J. Currie:

Thank you. Let us now broaden the subject of shale oil to frontier areas such as offshore and unconventional oil supplies. I would like to direct my next question to Mr. Yildiz, the Energy Minister of the Republic of Turkey. The Turkish government has already invested around USD 2.5 billion on exploration activities

in the Black Sea. Recently you have made another public statement, inviting global oil and gas majors to participate in Black Sea exploration. Based on your experience, can you share with us what, in your view, governments worldwide need to do to attract greater investments in explorations, particularly in the frontier regions?

T. Yıldız (translated):

We are working in Romania and Ukraine, and we believe that there are still oil reserves that have not been adequately explored. We are continuing to work in this area and to make appropriate investments. We believe that Turkey's main advantage is its stable policy framework, which creates a favourable situation for both energy producers and consumers. We know our capabilities, but not everyone is familiar with them. We have positive economic indicators: the size of the economy has tripled, and electricity consumption has doubled. Today we are the second-largest energy consumer in Europe. Our economic relations with other countries are developing in a positive way, and this gives us confidence in our plans. Of course, we have the advantage that we are located in both Europe and Asia, and we are prepared to develop relations with both Russia and Azerbaijan.

As for natural gas, we have joint projects with Iraq. We have both direct trade agreements and a number of other agreements. We are working with many neighbouring countries to implement joint projects. We are paying great attention to natural gas and oil, and we follow the production chain for these resources. National economies as well as political systems are also globalizing.

There is a climate change problem, and it impacts the oil and gas industry. What influence does the Kyoto Protocol have on energy supply? We believe that such issues should be discussed jointly with the global community, and that global warming is a threat. We must respect the environment and conclude appropriate agreements. It is necessary for countries and regions to pursue a multilateral global policy in the energy sector. We are working together with the EEC countries to find joint solutions to ensure energy security and supply. We hope to contribute to the security of energy supply, and we believe that our country will

play an important role in this process. We are experiencing high energy consumption, and Turkey's needs will also obviously grow. This all needs to be taken into consideration. Once again, I want to take this opportunity to thank you for inviting me to participate in this conference.

J. Currie:

Thank you for that. Your comments about Iraq and partnerships there bring me to our next guest, Mr. Ashti Hawrami, the Energy Minister of Kurdistan. We are aware of the importance of the reserves in the Kurdistan region in Iraq. To meet Iraq's export targets, what needs to be done in order to create the infrastructure to be able to deliver those supplies to markets? Is there a possibility of meeting these targets, and what are the realistic targets?

A. Hawrami:

First of all, I appreciate being invited to this important panel. Thank you very much. Two or three things are required to meet the potential exports from Iraq. One is infrastructure and a clear investment law to allow investment to come into the country from the south to the north.

When we talk about infrastructure, obviously the expansion of the export facilities in Basra is important; Iraq has started doing that. There is talk of a new pipeline to Jordan. However, from our point of view, it is a must to have a strategic pipeline through Turkey maintained and expanded. We envisage three million barrels of oil going through the northern corridor to the international market. Some two million barrels of that oil will come out of the Kurdistan region; a further million from the south perhaps, from the other nearby provinces. We and our colleagues in Baghdad need to pay attention to get that infrastructure built very quickly.

When it comes to the Kurdistan region, we have already started that. We have already started building the pipeline infrastructure for the oil within the province. We believe that the initial phase of that pipeline will be completed by the end of this year, which will enable us to carry some 300,000 barrels initially. The pumping facilities added through the next year will take us to one million barrels

per day. A secondary pipeline needs to be completed by 2015/2016 to increase the potential of the region up to two million barrels per day.

These numbers are the statistics of the oil companies operating in Kurdistan. There are some 50 companies, or more now, that have together invested over USD 20 billion in testing for oil and gas in the region. The resources of the region are about 45 billion barrels per day, with three cubic metres to 60 cubic metres of gas. It is logical for us to start that infrastructure right now. We believe that we will be exporting by the end of this year, logistics permitting: certainly by early next year. The initial phase of production will gradually rise by the end of next year to perhaps half a million or more. Then will reach one million barrels per day by the end of 2015.

We have some 50 companies involved, so what is so attractive about Kurdistan? We have clear legislation and a clear legal framework to attract investment to the region. What we need, in the rest of the country, is a repetition of the same thing so that there is no question about legality, investment, rate of returns, or how the companies actually forecast their risk. We are engaged with our colleagues in Baghdad to address the constitutional issues, which present an obstacle at the moment, to fully monetize Iraq's potential to the international markets.

J. Currie:

Thank you, Mr. Hawrami. I would like to change gears slightly and focus more specifically on the gas market. Gas has always been the ecologically-preferred fuel. We are clearly seeing it start to dominate in terms of its ability to be produced on a global scale, particularly in the United States, where, as I mentioned before, it has already pushed coal to the margins in an effort to substitute gas for coal at an energy generation level. When you look at gas prices outside of the United States, they remain stubbornly high, particularly in Asia.

When we view the global gas market, we like to think about it in three different sectors. The US – an over-supplied market which is severely constrained in its capacity to deliver by its infrastructure; the European market, which is more balanced, but is driven by oil indexation; and Asia, which is an extraordinarily

tight market. Europe has high prices relative to the underlying cost structure of the industry. One of the reasons why Asia is extraordinarily tight right now is the incident in Fukushima. Taking the power generation supplied by nuclear power offline, you had Asia, and Japan, in particular, demanding substantially higher levels of LNG from the global market.

The other question about the global gas market is whether the higher prices that we see are sustainable over the longer term. Looking at the issue going forward, we think that the demand for US LNG, the area that is oversupplied, will not likely exceed 6 bcf per day. Fundamentals are changing. The cost basis of Asian gas is partially driven by a very weak US dollar. Looking four or five years down the road, we do think that some of these factors will begin to shift.

I would like to direct my next question to Mr. Sergey Kirienko, General Director ROSATOM, the State Atomic Energy Corporation. ROSATOM’s order backlog is said to have increased, even in light of the ‘post-Fukushima syndrome’. What is the reason for the increased interest towards atomic energy in spite of the wave of skepticism after Fukushima, as well as the rapid development of the gas industry, particularly in the United States?

S. Kirienko:

Thank you, Jeff. Indeed, after the tragedy at Fukushima, there were many predictions that the development of nuclear power would stop, and that all such programmes would either be phased out, like they have been in Germany, or suspended, as in Japan. But what difference two years make? What generalizations could we make on the basis of ROSATOM's portfolio of foreign projects? The number of our foreign projects has increased by 150% in just two years. Previously this portfolio was valued at somewhat more than USD 40 billion, but today it is worth USD 66.5 billion. The International Atomic Energy Agency (IAEA)'s forecast has almost returned to the pre-Fukushima state of affairs. Today the IAEA is predicting that 460 gigawatts of new atomic energy capacity will be brought online.

It is noteworthy that countries with their own hydrocarbon reserves are also participating in these programmes, as well as the countries without such

reserves. Of the 20 leading countries in the world with the largest reserves and production volumes of natural gas, 15 have announced serious programmes to develop atomic energy. The IAEA will be holding a conference right here in St. Petersburg next week which will establish an agenda for the development of atomic energy. It is telling that more than 600 delegates from 82 countries that have expressed great interest in nuclear energy development have already registered. Why is that the case?

In our view, there are several answers. The first reason (which you have already talked about, Jeff) is price stability. Of course, we can say that if there is cheap shale gas today, then atomic energy will not be able to compete with it. Of course, colleagues, if it is possible to extract shale gas somewhere at a price of USD 30–50 per cubic metre, then there is no need to build a nuclear power station at that location. It would not be competitive under those circumstances. But if natural gas costs USD 100, then a nuclear power station would be competitive, even now. And then the question arises: what happens after a while? A new nuclear power plant has to be built for a minimum operating life of 60 years, and it must be guaranteed safe for use for 60–80 years. What will the price fluctuations be over that period of time? I remember the late 1990s well, when oil prices fell below USD 9 and budgets were crumbling. Many experts said that there was no reason to believe that this price would rise above USD 20 in the coming years. But several years ago, right here at SPIEF, Dr. Daniel Yergin held a roundtable where many participants felt that the price of USD 150–200 per barrel had established itself, and there was no reason to expect any price reductions in the near future.

Nuclear power allows us to create an energy strategy for the long term and to be assured of how the cost per kilowatt-hour is calculated. Yes, there are big start-up costs, but at the same time, the cost of fuel has a minimal impact! The price of natural uranium affects the price of a kilowatt-hour by just 4%. Today large additional reserves of natural uranium have been discovered, and I would say that there would be no limitations on the access to natural uranium for about the next 150–200 years. We have a guaranteed opportunity to find sustainable supplies of sufficiently cheap uranium. Transport logistics are also important. The

ability to add an additional gigawatt of capacity to a reactor is only a plane flight away. Price and logistics make a strong case for nuclear power's long-term stability and predictability.

Furthermore, they contribute to capacity growth. It is no accident that those countries that need to quickly ramp up their basic facilities for the support and development of the economy are the ones that are most interested in atomic energy. Let us not forget the environmental contribution: today people are increasingly understanding the importance of CO_2 emissions, and nuclear power does not emit CO_2 even when used to produce large amounts of electricity.

And let us not forget one more factor that is often important to those making decisions on this issue. For every US dollar or rouble invested, nuclear power provides a far greater multiplier effect on GDP, jobs, and the development of private industry. This is well illustrated by the example of Turkey, where, in conjunction with Minister Yıldız, we are implementing a unique project to build the Akkuyu Nuclear Power Plant. This plant is not just a generating facility. It represents the creation of an entire industry, of a research cluster in science. It requires the training of specialists, the passage of relevant legislation, and support from technology. Such a facility is a major contribution to the future of the country, and many countries are prepared to institute similar projects using this method.

What does all of this mean for atomic energy? It means that the geography for the deployment of new nuclear power facilities will change somewhat. Of course, they will not be built near shale gas fields where energy resources can be cheaply extracted, just as previously they were not built near the edge of an opencast coal mine or at the dam site of a great river where hydroelectric power generation was possible. The geography is changing somewhat, but the overall pace of construction of these facilities has almost reached pre-Fukushima levels. It would be better to talk about the contribution of nuclear energy to the overall energy balance of the country. Our assessment of nuclear energy's optimal share of the energy mix is 25–30%. We believe that attaining more than this share is not practical. But given the current rate of growth of energy consumption in the world, this share represents a very large amount of capacity, especially in

view of changing consumption patterns and increases to the share of electricity used as fuel. These circumstances open additional possibilities for nuclear power. A prerequisite is, of course, the absolute priority of reliability. After the Fukushima disaster, accountability requirements, which apply to the reliability of the technologies used, have become stricter, which has helped us to rapidly increase our number of orders. Then there are the requirements for a comprehensive development programme. Building a nuclear power plant can never be an isolated construction project: it always represents an ambitious project to build an industry that requires special measures of responsibility from the supplier country. Responsibility is not just assumed for the safety of the proposed technology, but also for ensuring the entire process chain, from training experts, guaranteeing the supply of fuel for the duration of the existence of the nuclear power plant, and withdrawing it from service to assisting in the creation of national legislation that facilitates these processes. These kinds of projects are usually implemented under intergovernmental agreements due to the operational terms of 60–80 years, the substantial impact on the economy, and the investments made in the future, which are all subjects of public interest. Thank you.

J. Currie:

Thank you, Mr. Kirienko. My next question is to Mr. Mario Mehren, Member of the Board of Executive Directors at Wintershall AG. As one of the world's largest chemical companies, you are a consumer of natural gas. At the same time, Wintershall participates in various gas projects around the world.

What are your thoughts on the global gas market and how has it changed over the last decade? How do you think it will change in the future? Do you consider gas projects globally an attractive investment for Wintershall, or do you think profitability is now shifting from upstream to downstream in the gas business?

M. Mehren:

Thank you. Wintershall strongly believes in the profitability of gas projects. That is the reason why we are here. As you are aware, we are moving upstream. We

are investing in Russia, and we are investing in pipelines across Russia. We think this will be necessary for the future because, in Europe, we will need more gas. We can discuss growth rates for gas, but the fact remains that domestic production in Europe is decreasing, which will create a significant demand in imports from producer countries like Russia, Norway, and other parts of the world, in order to supply this demand coming from Europe.

What we need for that is the right infrastructure. In order to build that infrastructure, and to build up production, we need a reliable framework. That is the most urgent issue that needs to be discussed here in Europe. We need a reliable tax regime, as Mr. Novak said, to be implemented here in Russia. It is far from being only a Russian issue. It so happens that tax regimes are changing all over Europe. Therefore we very much appreciate the initiative by Mr. Novak.

Secondly, we need a system that also benefits investment in infrastructure. What we currently have, in terms of European legislation, is not really inviting investors to create new pipelines or to create new storage and earn money with that. Of course, that has an immediate impact on what energy supply security is like in Europe.

Lastly, what is also important, as Dr. Yergin mentioned, is that developments in the gas industry will be very interesting in Europe if we allow the technologies to develop. There might be shale potential all over Europe. The problem in my home country, in Germany, is that people do not even allow us to investigate whether we have suitable technologies, nor to really develop these technologies.

In a nutshell, it is an interesting business, but we also need to make sure that we have the right framework in place all over the value chain for it to remain an interesting business; that infrastructure investments will be made, and that we have a guaranteed supply of energy in Europe and in the rest of the world.

J. Currie:

Thank you. Talking about shale and extraction technologies in the United States, one of the biggest questions there right now is whether to export or not to export. My next question is to Mr. Alexander Novak. Russia is the world’s largest holder of gas resources and a major exporter of gas to Europe. However, it has a

relatively low market share in LNG. Does Russia want to expand its presence in the LNG market? How attractive is LNG for you, and what positions would you like to establish in the global LNG market?

A. Novak:

Thank you, Jeff. Did you know that Russia still has just one operating LNG plant, which is located on Sakhalin? This facility produces 9.6 million tonnes of LNG per year, which accounts for about 4–4.5% of global consumption.

The LNG trade first began almost 50 years ago in 1964: that was the date of the first tanker delivery of LNG from Algeria. But LNG has only been actively traded over the last ten years (since 2000). During this period, the average annual growth rate of the LNG trade was 7.6%, whereas for natural gas delivered by pipeline the figure was 2.6%. We see that the number of terminals for LNG and natural gas regasification has been growing in recent years, and that there is a major change in the market, insofar as more and more new countries are importing natural gas. Whereas before, just five years ago, the number of countries importing LNG was equal to the number of exporting countries (19 countries), in recent years the number has increased. Though it has not doubled, it has increased by 60–70%, and in the future each country may have to build a regasification terminal itself in order to receive gas.

This speaks to the fact that today there is high demand for natural gas. In 2012, the volume of the LNG trade reached 240 million tonnes, and that figure is expected to double in the next two to three decades. There is great demand, and it must be addressed while taking into account those changes that are occurring today on the global natural gas market. This, of course, is a very pertinent issue for Russia. Today we are faced with the task of ramping up the construction of LNG factories in Russia. The Ministry of Energy has put forward a proposal to liberalize the export of LNG. A decision on the proposal is still pending, but I think that if there are specific agreements, draft contracts with potential buyers, and financing projects for related plants, then such a solution would be desirable.

What are future prospects like? We see that during the period from approximately 2016 to 2018, this kind of solution could be implemented on the

world LNG market. This is the near-term outlook. Already today our gas companies are reviewing and making investment decisions about the construction of LNG plants in order to achieve this. In particular, Gazprom has announced the construction of a new LNG plant in Vladivostok. OAO Novatek, in partnership with Total, is implementing a project for the construction of an LNG plant on the Yamal Peninsula with a capacity of 16 million tonnes, and plans to complete phase one by 2016. Rosneft has plans to build an LNG plant on Sakhalin. We have set ourselves the following goal: by 2020 we will increase LNG supplies from Russia to 35–40 million tonnes, which will represent about 10% of the market. Of course, in order to achieve this, the Government of the Russian Federation and the Ministry of Energy will create all the necessary supporting conditions, insofar as we believe that the LNG market is really promising and has great potential. Thank you.

J. Currie:

Dr. Yergin?

Dr. D. Yergin:

Let me begin with what I might call ‘Yergin’s rule’, which is that everybody has a consensus and agrees where energy is going, and then every three or four years, the consensus changes because of some major new technical, economic or political development.

With that said, let me offer a few thoughts on that. I would add that one of the other huge developments over the last ten years has been, what we might call, the ‘globalization of demand’, meaning that demand is not concentrated in the OECD – in fact it will decrease – and what the impact of emerging economies, globalization, rising incomes, means for demand and the challenges of meeting that demand growth.

Thinking about the future, one of the other developments is the globalization of innovation, which will come from many more countries than it has in the past. Mr. Kirienko emphasized that, given the current uncertainty, we cannot confidently project on the future of diversity in terms of supply. That raises the question of

what is going to happen in the next wave of nuclear technologies; whether we will see small, modular nuclear plants become part of the mix.

I will make a prediction here today that by the end of the 2030s, natural gas will be the number-one source of energy in the world. It will have overtaken both coal and oil. It has been pointed out that the biggest innovation in energy so far, in this century – allocating solar technologies into the last century – what is happening is shale gas and tight oil. One of the big questions is whether it is going to go global. And if so, how fast will it go global? What will that do to the energy markets, particularly in a world that is using more natural gas?

The second big thing to watch, of course, is what happens with electricity storage, and the ability to store electricity, because of what that will do to the balance and role of renewables, which are now constrained by an inability to store that energy. The third thing is efficiency, something that Mr. Tricoire pointed out and which does not get much attention yet is huge. If you look at the US, Europe, and Japan, they are twice as energy efficient today as they were a few decades ago. As Mr. Tricoire described, there are tools and capabilities to manage energy efficiency which did not exist even ten years ago. One big surprise that we could see over the next 10 to 20 years is a much bigger role for efficiency in reshaping energy markets. I would say that, on the list of things to watch, that should be one of the things at the top.

J. Currie:

Thank you to all of the panelists. At this point, we have about ten minutes remaining. I would like to open it up to the audience to put their questions to each of the panelists.

From the audience:

Thank you for your very interesting panel discussion. I would like to note just one thing. You were all talking about conventional resources and sources of energy, but I have not heard a single word about probable new, future core energy sources in the industry. By that I mean innovative ways of extracting energy from new sources, such as we were talking about with new ways of using gas. Are

you thinking about some other ways, completely new ways, of extracting energy? One example, that comes to my mind, is probably the liquefaction of coal, because we still have large reserves of coal worldwide, but we do not use it in more secure ways. Thank you.

J. Currie:

Mr. Tricoire, since you are on the oil and gas service side, could you start with that question?

J-P. Tricoire:

I do not know if I can answer that question exactly. Are you asking about new means of energy? Dr. Yergin just went through the major ruptures that you can see. I would see a lot of possibilities in shale gas, of course, as a big revolution. The place we are working on the most is the optimization of the energy chain. The first, greenest, cheapest way of producing energy is not to consume it, but to be more efficient in everything we do.

Then, on the network, we installed, a mix of origins of energy. Some are renewable, some are more stable, some are coming from fossil fuels. At the same time, the consumption is becoming increasingly volatile. One of the issues that can be solved by what I am describing, is that this 'Internet of Things' will connect every stage of the chain, from power plant to plug. It will diminish, for instance, the need for storage. It will make it so that people will be consuming more when it makes more sense. We believe that between those savings and the means of optimizing the infrastructure, we have huge reserves of efficiency.

To answer your question, we are working on it and it represents a lot of change. The 2012 report by the International Energy Agency suggest for the efficiency equation to be pushed to the next level. That is one direction we are working on. A more precise answer to your question would therefore be that I do not, as yet, know what the new sources of energy are.

Dr. D. Yergin:

Certainly a lot of work has gone on over many years on the liquefaction of coal. There is always an interest in doing it when oil prices are high and the expectation is that they are going to go even higher. In recent years, however, the efforts to either liquefy coal or gasify coal – I know projects were undertaken in the United States a few years ago – all migrated to China, and that is therefore where the greatest centre of research on that subject is. It is obviously possible. The question is whether it is possible competitively on a large scale.

S. Kirienko:

I would like to add the following as it relates to atomic energy: fast-neutron reactors represent an area where today Russia is one of the clear world leaders. This is a new source of energy. Today all nuclear energy is generated using the isotope uranium-235, which represents only 0.7% of all natural uranium. If we can begin working with the isotope uranium-238, then we will be able to utilize the remaining 99%, which is currently being disposed as waste product. In other words, there is nothing else that needs to be added. We must simply take that waste product that is subject to recycling and convert it into fuel. We project that we will be able to use this waste product by the 2020s. The next step, in my opinion, is nuclear fusion. The community of countries participating in the international fusion reactor project is working on this problem right now. We are talking about access to limitless energy resources insofar as ordinary water is the source of raw material. Any type of water may be used, including seawater.

From the point of view of further development, I would agree with what Dr. Yergin said about this being a separate area for research. This is not just a new source of energy; it is a quantum leap forward for the capabilities of small reactors, which are what we call atomic batteries. For example, we are making them today for space applications. In other words, we already have access to this kind of technology. The only issue is in dramatically reducing their cost. This is a reasonable expectation. When this happens, we will be able to provide a powerful source of energy in a small space, at a reasonable price, which only needs to be recharged once every 12 years. The next step will be to produce low-power atomic batteries that need to be recharged once every 25–30 years.

This would be a fundamental change for mobile and low-power applications, especially in isolated areas.

A. Novak:

I will add a few more words, if I may. In my opinion, if you take the natural gas industry, we are underestimating the possibilities of natural gas production from gas hydrates. This is probably the next revolutionary technological step forward, as there are larger reserves of gas hydrates than there are of natural gas and oil shale.

So what is the point? People are talking about shale gas, and they claim that it has sparked a revolution in recent years, though it started to be actively extracted in the early 2000s. But here in our country, we were engaged in hydraulic fracturing back in the 1970s, and we are continuing this practice even now. Extraction in the Bazhenov Formation, the field for which benefits have been discussed today, also began then. According to statistics, 10% of all scientific dissertations defended from the 1970s until now in the oil and gas field have been devoted to the development of the Bazhenov Formation. We are moving away from the old peak-oil theory, which, as everyone is well aware, has exhausted itself. There remains the issue of new technologies for the extraction, economic efficiency, and economic viability of extraction of new resources. In my opinion, gas hydrates are the future. I cannot know when it will happen, but the technology is already here, and to my knowledge the Japanese company JOGMEC tried to extract this resource on their offshore platform for the first time this year. The cost is high, but it will come down when new technologies are discovered.

T. Yıldız (translated):

There are various sources of energy. Renewable energy and new technologies are both very important, and we need to think first about the cost of this energy. And we must always ask the questions: which energy source is best suited to that particular country? And will that country's level of prosperity pay for energy production? It is necessary to strike a balance between price and the country's

capabilities while also considering the cheapest sources of energy. The state should ensure access to these cheap energy sources. It should be a priority for a particular country to choose the most profitable and attractive option. This decision-taking process, I repeat, is needed primarily due to price fluctuations for a particular energy resource. That is my opinion on this issue.

A. Hawrami:

Maybe I can offer some thoughts about two untapped sources of energy: ocean energy and soil energy, in abundance. In fact, they well exceed all the other sources of energy we know of. The degree of difficulty encountered in generating energy from those sources is improving. One problem is the mobility of that generated energy, from the point of generation to the point of need. We know that we can get ocean energy any way we want, but how do you transfer it to where it is required? Perhaps some innovation in the future may focus on the abundance of that energy source, and also solve the problem of how to generate it so it is truly available, transporting it to where it is needed? Perhaps that is something where eventually mankind will have to go when all other sources run out.

J. Currie:

Thank you. We have time for one last question.

M. Fedosovsky:

Good day, gentlemen. I am Mikhail Fedosovsky from the Department of Technological Safety at the St. Petersburg State University of Information Technologies, Mechanics and Optics. We have been talking about energy. Clearly, this is a very dangerous area of human activity that requires completely new solutions. The Fukushima disaster demonstrated this fact to the world, and Russia saw this much earlier: an event occurred that triggered the security mechanisms at both the technical system and construction documentation levels. Today, we have paid a good deal of attention to LNG and hydrocarbon-based energy sources, and discussed the economic efficiency of production and the

incentivization of extraction. I have a question for Mr. Yergin. Could you please comment on what is being done in Europe and the United States to ensure the safety of traditional and new sources of natural gas and shale oil? We all remember the accident in the Gulf of Mexico and the pipeline ruptures on the west coast of the USA that have claimed lives. At what stage of the scientific research process, in your opinion, will investments be made to ensure safety? Thank you.

Dr. D. Yergin:

Of course, the issue of safety is a critical issue in all energy production. In response to the Macondo accident in the Gulf of Mexico, the regulatory system in the United States has changed; a division was made between those who are in charge of promoting offshore development and those regulating its safety. Something similar was implemented after the North Sea accident and also in other circumstances.

The second thing, that has happened, is a focus on not only the regulation and safety of operations but also the ability to recover with a response system. A non-profit recovery company has been set up to have the technology to respond if there is any kind of accident.

Onshore, in terms of shale gas and tight oil, I was on the commission that President Obama set up to address the environmental aspects of shale gas production and to identify what needs to be done. These are local operations; this is not on the scale of an offshore drilling. What we have seen, then, is a question of the nature of the regulatory system, and the regulatory system for operations is very strict in the United States. It is largely managed at a state level rather than a federal level, but managing the safety of it, particularly in terms of waste water and how you manage water, is a big question.

With a pipeline system, obviously, as your pipelines get older, special consideration needs to be given to their condition and to managing their safety. This would be true anywhere in the world, in any country. In the United States, we have 180,000 miles of liquid pipelines and particularly managing the older systems is a very important focus of safety activities.

J. Currie:

Thank you. That is all we have time for. We are going to have to conclude this session. I would like to thank all of the panelists for contributing to a very interesting discussion.