WORLD ENERGY COUNCIL

WORLD ENERGY FOCUS

Insights from and for the Council's global leadership community

Annual 2016

The only official Council publication marking the 23rd World Energy Congress - Istanbul, October 9-13, 2016

EMBRACING NEW FRONTIERS

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Jean-Bernard Lévy, CEO EDF

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World Energy Focus 2016
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WORLD ENERGY COUNCIL

The World Energy Council is the principal impartial network of energy leaders and practitioners promoting an affordable, stable and environmentally sensitive energy system for the greatest benefit of all. We are the UN-accredited global energy body, representing the entire energy spectrum, with member organisations in over 90 countries.
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The 23rd World Energy Congress: BUILDING THE FUTURE OF ENERGY

By Recep Tayyip Erdoğan
President of the Republic of Turkey

This past year, Turkey has successfully hosted exceptionally important summits and international events, and continues to do so.

We hosted the G20 Heads of Government/Heads of State Summit in Antalya on 14–15 November 2015, followed by the Islamic Cooperation Organization's 13th Islamic Summit Conference on 14-15 April 2016, and the United Nations' World Humanitarian Summit in İstanbul on 23-24 May, a first in its history. These summits, especially within a context of critical developments at the regional and global level, won critical acclaim for their themes, their organizational scale, their remarkably high-level participation and their outcomes.

The 23rd World Energy Congress, to take place on 9-13 October 2016 in İstanbul, will take these achievements to a higher level. The World Energy Congress, organized in a different city of the globe every three years, was first held in 1924, and has since been an influential platform that brings together energy market players, opinion leaders and decision makers. The Congress also plays a critical role in setting the global energy agenda. The Congress, under the theme "Embracing New Frontiers," will be the platform for crucial discussions on issues occupying the global agenda, such as the integration of low-cost, reliable, sustainable and modern energy sources to the global energy mix. It will offer an opportunity to identify changes in the energy field since the last congress in Seoul, and the emerging requirements. It will also assess the new steps to be taken in the field of energy and be a vehicle for a thematic debate on achieving sustainable energy in Africa in particular.

Increasing energy demand and the limited reserves of common energy sources bring an ever-present risk of conflict and tension on the global agenda

Energy is a field of cooperation that prompts different countries to converge on the basis of common interests, and makes significant contributions to global peace and stability. Nevertheless, energy can also be a trigger of destructive competition, conflict and regional instability. Increasing energy demand and the limited reserves of common energy sources bring an ever-present risk of conflict and tension on the global agenda. Situated at the centre of a region with 70% of the world's proven oil and gas reserves, Turkey's strategic geographical location charges it with a crucial role in strengthening global cooperation and trade. While this location offers our country geopolitical opportunities, it also imposes a great responsibility. Today, while energy consumers seek ways to ensure the security of energy supply, energy producers continue to explore the possibilities to reduce the risks involved in long-term and large scale investments. The cooperation between producer, transit and consumer countries is a key component of ensuring energy security.

As a country with limited energy sources that relies on imports for 75% of its energy demand, we have taken important steps especially over the last 14 years to strengthen our energy mix, to boost our energy efficiency, to diversify our supply sources and to make our country a crossroads in terms of energy transports. At the same time, we have made significant process in creating a conducive environment for competition and investments. Since 2001, we have revised and amended our rules and regulations to ensure compliance with EU member states.

Our main priority is the promotion of East-West and North-South energy corridors through the delivery of Caspian, Middle Eastern and Central Asian energy resources to European and world markets via Turkey. The Baku-Tbilisi-Ceyhan and Baku-Tbilisi-Erzurum pipeline projects, which were previously considered as "pipe dreams" by some circles, have been successfully realized. Since 2007, Turkey has played an intermediary role in delivering Azeri gas to Europe through an alternate route via the interconnector between Turkey and Greece. Kirkuk-Ceyhan, Iran-Turkey and Blue Stream are other pipeline projects that we have materialized. The Trans-Anatolian Natural Gas Pipeline Project (TANAP) that we are developing together with Azerbaijan will be the longest pipeline within the Turkish borders upon its completion. We are working on incorporating alternative sources to this pipeline very soon, with Turkmen gas being the top priority. Through these projects, Turkey will further buttress its role as the bridge between energy consuming countries to its West and energy-rich countries to its East.

In an era where 1.1 billion people around the globe are "energy poor," it is absolutely crucial to facilitate access to modern energy services and develop appropriate energy systems for different geographical regions. This is particularly important in ensuring energy equity. The missing link here is not scarcity of capital or imposed financial restrictions, but the will and determination to make this happen. If appropriate models are developed and investments are not delayed over short-term risks, access to modern energy can be achieved on a global scale. This important mission belongs not only with initiatives such as United Nations' Sustainable Energy for All Initiative, but also with banks, international finance institutions, energy companies, NGOs and governments. The upcoming process dictates the development of feasible programs as well as tangible steps to be taken to provide the "energy poor" with reliable and affordable access to energy.

> OUR MAIN PRIORITY IS THE PROMOTION OF EAST-WEST AND NORTH-SOUTH ENERGY CORRIDORS THROUGH THE DELIVERY OF CASPIAN, MIDDLE EASTERN AND CENTRAL ASIAN ENERGY RESOURCES TO EUROPEAN AND WORLD MARKETS VIA TURKEY

Within the context of the newly emerging needs and opportunities in the energy field, as well as historical events taking place in our immediate region, the 4-day World Energy Congress in Istanbul, along with its meetings, side events and discussions, will be a milestone in building dialogue and compromise. In addition to providing a unique opportunity for industry to address critical priorities, the Congress will also make a significant contribution to the global energy dynamics of today and tomorrow.

Renowned for its history, natural beauty and hospitality, Istanbul will welcome thousands of delegates to the World Energy Congress. We are honoured to be the hosts of this important meeting and we invite all stakeholders of the energy sector to visit our country. I wish every success to the Congress and hope that energy politics will be instrumental in achieving global peace and stability rather than precipitating war, conflict and losses. «

WELCOME TO THE ENERGY DEBATE

By Marie-José Nadeau

MARIE-JOSÉ NADEAU
Outgoing Chair
World Energy Council

Three years on from the last World Energy Congress held in South Korea, the world of energy has changed dramatically. Trends that were beginning to emerge in 2013 have continued at an ever-accelerating pace. The energy transition, once little more than an aspiration, is now a fast-moving reality challenging the business models of utilities and resource-holders alike.

As the latest edition of World Energy Scenarios (see p. 8-11) points out, we can no longer count on historical trends when looking into the future of energy. A range of disruptive technologies has emerged about which the past has little to teach us. These include better and cheaper solar technology, improved smart grids, advancements in energy storage systems, and the rapid pace of digitalization. Such technologies are increasingly invalidating existing business models, and potentially entire systems, in both power and transport.

THE RESPONSE OF GOVERNMENTS TO THESE CHALLENGES IS THE BIGGEST SINGLE UNCERTAINTY FACING US

As we look to the future of energy a number of key drivers are emerging as critical to the future of energy systems. These include not just how to respond to the increased complexity and uncertainty that arise from these disruptive technologies but also more traditional concerns such as growing demand for energy and global economic growth. Above all, the practical effect of policy changes following the COP21 climate change agreement adds to the uncertainty facing energy in the coming decades.

As the center of gravity of the global energy system is evening out with the focus moving away from mature markets in Europe and North America towards fast growing markets in Asia, the response of governments to these challenges is the biggest single uncertainty facing us. Will markets be given a free reign to find their own solutions or will governments seek to steer energy systems in a coherent fashion helped by consumers who are increasingly conscious of the price of energy paid for by themselves and the environment?

World Energy Scenarios map out possible contrasting scenarios. They make no value judgment of the merit of each scenario. However, these are discussions we can have here in Istanbul, during World Energy Congress. Debate is important: it is important to better understand what the future might look like and to explore possible future energy landscapes.
As Chair of World Energy Council, it is my pleasure to welcome you to Istanbul and to wish you a fruitful Congress at which the future of energy will be debated and, hopefully, shaped. «

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THE NEW ENERGY REALITIES

By Christoph Frei

CHRISTOPH FREI
Secretary General
World Energy Council

We are now beyond the tipping point of a global energy transition. In the energy sector, unprecedented speed of change poses a wide range of challenges for producers, utilities, policy makers and the energy finance sector.

At the last World Energy Congress in 2013, hosted by the Republic of Korea, we highlighted that the energy sector was at a tipping point. We corrected misconceptions and faced reality: the challenge of delivering secure, equitable and environmentally sustainable energy for the greatest good of all.

Now, the sector is preparing for this new reality. Since the last Congress the energy transition has accelerated. The cost of renewable energy technology has continued to fall. Utilities are restructuring their operations and creating new business models. Unconventional gas has reshaped global gas and LNG markets and investments in hydrocarbons have contracted on the back of falling prices. Investors are struggling to understand the future of energy over the 20 to 30-year timespan that underpins many investments - and many now look for more flexible and rapid payback solutions. The discussion of peak oil has moved to a discussion of peak demand and the fear of stranded private sector assets is shifting to a fear of stranded country-owned fossil resources.

The new reality for energy demand is slower growth coupled with faster underlying transformation. The global population is growing at a slower pace and its centre of gravity continues to shift eastwards. Electrification of is accelerating, digitalization is empowering consumers, and investors and civil society are becoming more active energy players. The number of people without access to any form of modern energy has decreased to 1.1 billion and new business models deliver innovative solutions to rural households.

Climate change has become an overarching issue impacting on the future of energy and acting as a major driver of the energy transition. The energy sector is a major contributor to greenhouse gas emissions and many countries have national climate plans with significant implications for the production and use of energy. Energy has become a crucial issue at national level, in a context of more complex geopolitics.

Meanwhile, direct climate change effects are already posing a major challenge. Extreme weather events have increased by a factor of four over the past thirty years and the food-energy-water nexus is becoming a more pressing issue. Resilience of energy systems is now a major issue. Apart from natural risks, cyber threats keep energy leaders in Europe and North America awake at night.

THE MESSAGE IS: INNOVATE OR DIE

As we meet for the 23rd World Energy Congress in Istanbul, the energy sector is facing continuously evolving frontiers. Changing market dynamics, constantly evolving innovation and technology options, new business models, shifting supply and demand centres, climate policy and resilience-preparedness all represent new frontiers to be embraced. It is clear from the research produced by the World Energy Council and the intense high-level dialogue taking place around the world that energy is undergoing a grand transition at unprecedented speed.

There is no such thing as business as usual. Companies that stand still fall back, countries that do not adapt to new realities put their prosperity at risk, and investors that take the wrong decisions will see their money disappear. The message is: innovate or die. More than anything in a world of great uncertainty, this World Energy Congress will offer global energy leaders a glimpse into the future, a deeper understanding of the new energy frontiers, and a stronger position for shaping the transition for the greatest good for the greatest number. «

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World Energy Scenarios show:

STRONG GOVERNMENT POLICIES NEEDED TO LIMIT CLIMATE CHANGE

By David Thorpe

A street in Mumbai
Photo Nicolas Vigler

The world will find it difficult to meet the 2°C target set in the Paris Agreement unless it goes down a path of strong enforcement by national governments of international agreements to curb greenhouse gas emissions. That's one of the key conclusions of the new World Energy Scenarios 2016 report from the World Energy Council, which looks at how global trends will shape the energy industry over the next 45 years.

"One of the big messages of the Scenarios is that if the commitment is there, the ambitions of COP21 can be achieved." This is how Ged Davis, the Executive Chair of the scenarios, sums up what is perhaps the most important message to come out of the flagship publication just published by the World Energy Council .

The World Energy Scenarios represents the fruit of three years' work by the World Energy Council with feedback from experts from all over the world and modelling by the Paul Scherrer Institute and Accenture. Rather than outlining for policymakers and senior energy leaders how to achieve specific policy goals, the Scenarios allow them to evaluate key factors and their consequences, to better shape tomorrow's energy world. The 2016 version, just published, offers three alternate pathways up to the year 2060, and is meant to be considered alongside other important World Energy Council reports on World Energy Issues, Resources and the Energy Trilemma.

The three different futures are dubbed Modern Jazz, Unfinished Symphony and Hard Rock. All three assume certain common factors such as population rise, slower labour force growth and the gradual shift of the balance of the world's economy to Asia, but from then on they diverge:

- **Modern Jazz** is a future where enterprises are able to innovate and compete, in open markets, and supply low-cost energy for all.
- **Unfinished Symphony** foresees a world where international agreements and national policies prevail and determine choices, but energy costs are high and there is still more work to be done.
- **Hard Rock** is what we might see if nations have slower growth and become more conservative and less outward looking as a result of conflict, environmental chaos and migration crises.

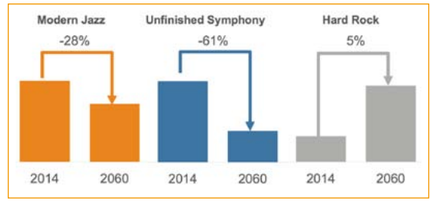


Figure 1. Carbon emissions in 2010 and 2060 ($GtCO_2$/yr). The greatest drop is in Unfinished Symphony – but even then it doesn't quite result in 2oC.

Only in the Unfinished Symphony scenario is total energy consumption – and energy intensity – reduced sufficiently to give us a chance of getting near the 2°C target. It does this by reducing carbon emissions at rate of -1.6% per year, and that is difficult. Hard Rock, on the other hand, gets us to about 4oC. Modern Jazz lands us in the middle.

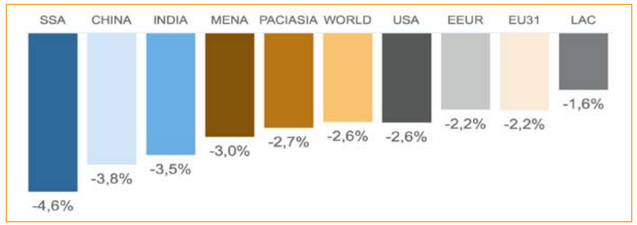


Figure 2: Global Energy Intensity reduction in Unfinished Symphony 2010 to 2060 (MJ per USD 2010 MER).

"In Modern Jazz, if you don't have strong carbon prices it slows down the migration to a low carbon economy," says Davis, "whereas in Unfinished Symphony governments enable relatively high carbon prices which accelerates decarbonisation."

But there is a price for living in a strongly regulated world, and that is the restriction on private enterprise to innovate and compete on its own terms. In the Modern Jazz scenario higher productivity rates lead to higher GDP per capita and lower prices, and thus a greater proportion of the world's people have access to clean water and electricity at affordable prices.

In the third, contrasting scenario – Hard Rock – the world's economic growth is weaker and the world is subject to various crises, countries retrench and progress is slow on decarbonisation and addressing wider issues besides jobs, conflict management and migration control. GDP is much lower and there is much greater use of fossil fuels because there is less funding available to invest in low carbon infrastructure.

GED DAVIS
Executive Chair
World Energy Scenarios 2016

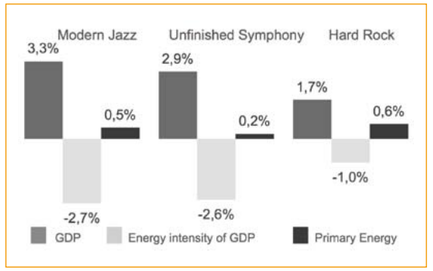


Figure 3: GDP, energy intensity and primary energy growth to 2060 in the three scenarios.

INTELLIGENT ECONOMIES

In the policy-led world of Unfinished Symphony, carbon pricing helps to dampen energy demand growth, to reach the lowest energy use per capita, and total primary energy supply is just 17% higher than in 2010. The share of fossil fuels falls to 48% and the rich-poor gap decreases because of greater emphasis on social, environmental and security issues.

Strong global governance leads to the design of intelligent and circular economies, resulting in a resilient, integrated global energy system. Yokohama Smart City is given as a good example of how integrated, smart planning can deliver a high standard of living more efficiently and with less pollution.

Nuclear power grows at 2.1% p.a. to 18%. Just 200-500 million people have no access to electricity. Electrification of mass transit happens in the world's largest cities, and by 2030, most developed countries have coal plants retrofitted with CC(U)S technology, as do natural gas plants after 2050.

> "UNLESS WE CAN FIND WAYS TO DOUBLE THE RATE OF DECLINE IN ENERGY INTENSITY WE HAVE A REAL PROBLEM"

SMARTLY CONNECTED

In enterprise-led Modern Jazz, the rich-poor gap widens but average GDP per capita is higher than in Unfinished Symphony, and there is the highest energy and electricity use per capita. Although most people have access to water, millions are forced to migrate.

Energy source	Modern Jazz	Unfinished Symphony	Hard Rock
Non Fossil Fuels	• Accelerated by technology innovation and supporting policies	• Accelerated by top down mandates • Nuclear and hydro more significant	• Driven by demand for domestic energy production • Nuclear and hydro more significant
Oil	• Demand peaks in 2035 at 99 mb/d • Diversification of transport fuels	• Demand peaks in 2030 at 91 mb/d • Lower demand and diversification of transport fuels	• Demand peaks in 2040 at 110 mb/d • Status quo technologies
Gas	• No. 2 fuel in 2040 • Growing share in transport and power • Cheapest emissions reduction	• No. 2 fuel by 2030 • CCS mandate by 2050 depresses demand	• Competes with coal • Unconventional gas driven by energy security
Coal	• Demand peaks in 2020 at 4,091 MTOE • Falls to no. 3 fuel in 2040	• Demand peaks in 2020 at 3,838 MTOE • Falls to no. 3 fuel in 2030	• Demand does not peak • Becomes no. 1 fuel in 2040

Table 1: How energy fares in the different futures:

Globalisation and technology transfer lead to more efficient industrial activity and a convergence of energy intensities across the world. Natural gas and electric vehicles power transport in heavy freight and shipping. All homes, offices and commercial spaces are smartly connected and more energy efficient, and energy systems are distributed. Natural gas is used widely as a chemical feedstock.

By 2030, there are over 185 million electric and hybrid vehicles on the roads, rising to 1.5 billion by 2060. The use of gasoline peaks in 2050 and diesel fuel peaks in 2040. But a decline in coal consumption in North America, Europe and China is offset by growth in India and Pacific Asia.

Natural gas does pretty well in both the enterprise-led future and the government-led one, although it starts to decline a decade earlier without a free market. Coal fades out even earlier. In the more dystopian Hard Rock future, coal remains king up to 2060 and demand for it never peaks as more and more coal-fired power stations are built to fuel growth.

Photo Adrian Mogenet

Variable	Modern Jazz	Unfinished Symphony	Hard Rock
Energy Consumption	-40%	-62%	-17%
Energy Intensity	-73%	-71%	-31%
GDP per Capita	236%	176%	61%
Population	47%	47%	47%
Emissions	-20%	-62%	36%

Table 2: The scenarios use a formula to derive final carbon emissions from the following variables: energy consumption, energy intensity, GDP/capita and population. This table shows the percentage change in these from 2010 to 2060 and their effect on emissions. Unfinished Symphony produces by far the greatest drop but Modern Jazz is more productive.

THE BIGGEST CHALLENGE

The process of creating the scenarios involved many participants from around the world: besides China, Europe, North America, workshops were held in Latin America, India and Africa. “We are working with partners Accenture Strategy and the Paul Scherer Institute, and have shared our work with the Energy Research Institute in China. The important issue, particularly for climate change, is what Indonesia, Australia, China, India will do. If you are in China and India – Africa even more – there is great potential to improve productivity through catch-up, the ability

Figure 4: The energy mix in 2060 under different scenarios.

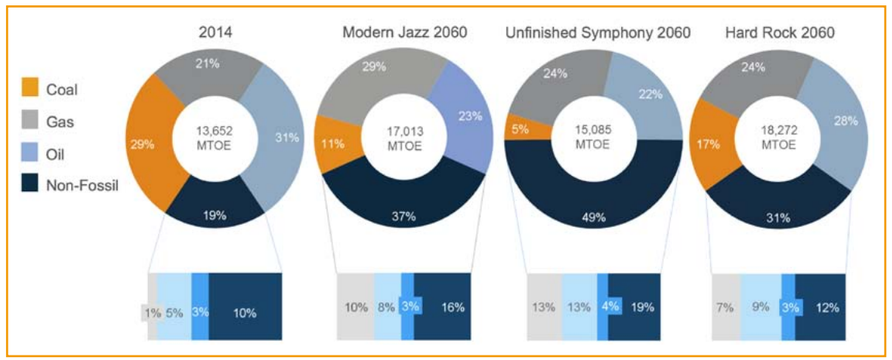


Photo Climate Alliance

to use best practices and technology from around the world. There is still much to do in Europe to improve productivity.”

The biggest challenge of the future in all scenarios is the potential slowdown in economic growth, Davis believes. “If we look back 45 years we’ve had exceptional economic growth of 3.5% per year, pretty much evenly split between productivity and labour force. In the next 45 years labour force growth will reduce to 0.7% or less. The slowdown in productivity means a re-emphasis on where growth is, and it will be challenging to address this.”

One finding is that the changing nature of work and technology will have a big effect. Davis: “The problem we have is that the more productive a nation is the less jobs needed, so there is a big need to continually retrain the workforce into new areas. The challenge in Hard Rock is about addressing this productivity paradox in a world in which the political and economic centre of gravity is shifting. This will present a potent cocktail in some places.”

BY 2030, THERE ARE OVER 185 MILLION ELECTRIC AND HYBRID VEHICLES ON THE ROADS, RISING TO 1.5 BILLION BY 2060

MAJOR SHIFTS

Other major shifts will have a powerful effect on our future, Davis notes. These are “a shift in the world’s economic centre of gravity to Asia, wider environmental concerns, population growth and climate change – which, when it hits, doesn’t treat everyone equally. So we have built into our scenarios the early results of the World Energy Council’s resilience analysis including the need for greater adaptation. Also deeper analysis on planetary boundaries. Furthermore, globalisation doesn’t work for everyone, so there is a lot of anger about the fairness of the economic system. We tried to understand the implications of this for energy security.”

In Modern Jazz and Unfinished Symphony radical improvements in energy efficiency and a shift towards a less energy-intensive economy play a big role. “Unless we can find ways to double the rate of decline in energy intensity we have a real problem.”

There’s another important shift, which we can see happening now, and it is a shift in values. The new generation of “millennials” may care more about wider social, environmental and political issues than the previous “baby boomer” generation. “These new values, if they persist, will reshape the nature of how we address large-scale economic and post-industrial development,” says Davis. “There are no easy solutions. We inherit the capital stock of the last 50 years and ideally we need new capital stock to reflect these new values. It is a question of the desire, and of capacity.”

“THERE ARE NO EASY SOLUTIONS”

Davis himself says that he would like to see Modern Jazz work, while admitting that stronger incentives will be needed to bring about the necessary changes. So does he believe the desire is there in the corporate world to make the required energy transition? “I come from 30 years of working in Shell. I know that energy companies spend a lot of time anticipating what their customers want up to 20 years ahead and investing to deliver that.”

But pressure still has to come from outside. “There are many ways to influence policy and activist groups are definitely important in that respect. Of course, there will always be some companies that are backward, just as some countries are. Some are progressive and some have much to learn.”

The Scenarios offer an opportunity for decision-makers to reconsider potential strategies and policies in an uncertain world. “The starting point for building our scenarios was to identify what is possible and feasible.” says Davis. “Our greatest challenge is how well we can work together to tackle problems relevant to all.” «

Interview Francesco Starace, CEO Enel

By Karel Beckman

“OUR COMPETITION IS NOT WITH OTHER UTILITIES BUT WITH FOSSIL FUEL ELECTRICITY”

“Our aim is to grow the use of electricity as energy vector”. This is how Francesco Starace, CEO of Enel, one of the world’s largest utilities and perhaps the biggest producer of renewable energy in the world, describes the strategic goal of his company. According to Starace, the utility of the future owns and manages a digitised grid that connects up decentralised green energy sources and is at the centre of a whole new system of energy products and services. But he is concerned that many utilities are still engaged in a futile effort to deny the future. “If we don’t make this transition together, now, we will lose the opportunity of growing the market.”

If there is one major utility company in the world that has fully embraced the low-carbon energy transition, it has to be Enel. The Italian company was probably the first in the world to replace all its conventional meters in its home country with smart meters. Through its subsidiary Enel Green Power, which owns over 10 GW of renewable energy capacity in 17 countries, Enel is also one of the world’s largest (if not the largest) renewable energy producers. About half of the company’s generation capacity is now carbon-free, and this number will only go up, says Francesco Starace, who became head of Enel in May 2014 after six years as CEO of Enel Green Power: “We have stopped investing in large-scale centralised power generation.”

In the period 2016-2019, Enel will invest for growth some €17 billion of which almost 90% will go to renewables and grids. This is where the utility of the future is headed, says Starace: “The key for us is to own and manage a digitised grid, which will connect as many decentralised units as possible. Who owns the generating capacity is less important.”

In a country like Italy, there are already some 670,000 small renewable energy plants, he notes, and this trend will continue. “As network operator you don’t only need to move electricity from high-voltage to low-voltage lines, but also increasingly across low-voltage and medium-voltage lines, and sometimes even in counterflow.” This kind of very fragmented and intermittent generation can be handled by the grid, says Starace. But only if that grid is digitised. Digitisation will, moreover, enable the development of new products and services that will make the energy system much more flexible and efficient.

MEGACITIES

“Over the next ten years grids are going to be extremely important,” says Starace. This is all the more so because of the worldwide trend towards urbanisation and “megacities”. Enel owns or operates grids in many cities in the world, also outside of its large domestic markets of Italy and Spain, e.g. in Bucharest (Romania), Santiago (Chili), Bogota (Colombia), Rio de Janeiro (Brazil), Buenos Aires (Argentina), Lima (Peru). “People are increasingly migrating from the countryside to these cities. We are committed to make them as livable as we can. As efficient and as modern as possible.”

Starace emphasises that the energy system cannot be modernised and adapted to the low-carbon energy transition if the grids are not digitised. “Digitised grids will enable a lot of features that are not there today. They will make electricity use much more efficient and will lead to many more new applications. Consumers will interact much more with their energy providers and become more conscious of their energy use.”

He views this trend as a great opportunity. Indeed, the Enel CEO is concerned that the world is moving only very slowly to digitisation. “In many countries there still is fear of digitisation. We still need to convince many regulators that this is not a cost, but an investment that pays out in 2-3 years. We really have to put this debate to rest, otherwise we won’t be able to grow.”

Europe and Japan are furthest ahead in digitisation, says Starace. In other parts of the world the trend is even slower. “We have to bring people up into 2016. We are carrying out pilots in many countries to show how it works and why it’s beneficial.”

> “OVER THE NEXT TEN YEARS GRIDS ARE GOING TO BE EXTREMELY IMPORTANT”

ELECTRIC CARS

Digitised grids are also key to enabling the transformation of the transport system. “It’s very clear today that electric cars can quickly become a viable alternative to the internal combustion engine,” says Starace. He believes that for the next twenty years the two systems will be moving together – then new cars will be all electric. “We want to push this

development as much as possible, because for us it's another use of clean electricity in a world of polluting inefficient fossil fuel use."

Electric cars are not only welcome new consumers of electricity, they can also be an important source of storage and flexibility for utility companies, notes Starace. "For us electric cars are batteries on wheels. We can pay car owners for connecting their batteries to the grid when they are sitting in their office and not using their car. For us it means we will be better able to manage the grid."

The growth of electric mobility will come at the expense of oil companies. Is Starace worried that they may try to move into the utility space? "Oil companies are eyeing the utility market, yes. For us it is a sign that we have value in our hands. But we are not particularly concerned about this. They tried it before, in the 1990s, and they all left again. The utility sector is a very special business, with relatively low margins. It's not an easy environment."

CORE BUSINESS

Then there are the Silicon Valley type of companies that are interested in the energy market. They are very different from the oil companies, Starace says. "They are not making the mistake of entering our core business. They look at the value they can add at the customer end. As utilities we have millions of customers. Thus, there is a lot of space for cooperation with these high-tech companies. I don't see this as a threat, but as a tool for value creation."

For innovative ideas, Enel looks outside the own company anyway. Starace has an outspoken vision on innovation. "There are several reasons why companies innovate. It can be because they are in a crisis. Or because it is built into their genes right from the start. Neither applies to us. We innovate because we want to grow. But how? Our industry tends to be risk-averse, because when you make a mistake in our business, this can have big consequences. But this is not an environment in which innovation thrives. That's why we decided to look for innovation outside the company. We stopped sitting around and trying to do it ourselves."

For growth to be sustainable, it needs to be inclusive, says Starace. "We need to grow with others. So we need to completely open up our processes, our minds. That is strange for a utility. We are now working with a great many start-ups. But we don't want to own or manage them exclusively. We want their ideas, adopt them fast, so we can create new revenue streams and do our job more efficiently."

BIG MISTAKE

In fat, Starace would like to see other utilities do the same. "We don't want to keep innovative ideas to ourselves. Our main aim is to grow the use of electricity as an energy vector. Our competition is not with other utilities, but with fossil fuel based electricity."

Italian Prime Minister Renzi inaugurates Enel wind power farm in Chile, 2015. Photo Enel

If the electricity market as a whole grows, Enel will grow with it, says Starace. "We are already very large. Growth for us is not a zero-sum game. We want people to use more electricity and less fossil fuels." One of his main worries is that other utility companies are not moving in the same direction. "There are still a lot of us who think they should own large centralised fossil fuel plants with some transmission and distribution and without much technology. That's a big mistake. It is futile to try to stop current technological trends. The opportunity is there, but if we as a sector don't jump on it, we will not be able to grow our market."

"There are still a lot of us who think they should own large centralised fossil fuel plants with some transmission and distribution and without much technology"

Starace notes that Enel's commitment to renewable energy and digitised grids is fundamentally changing the way the company operates. "We have always been a long-term industry. If you take a decision today, you see the result in five years. If you make an investment, you will start earning money on it five to ten years later. This was fine for a long time. But it's not fine anymore today. The world changes so fast that five years from now, you find yourself wondering why you ever made this investment."

For this reason Enel decided to stop investing in projects that take more than two or three years to be completed. "This is a big management challenge," Starace points out. "You have to invest in many more smaller things. This means you need more smart people. But what you gain is huge flexibility. We have €10.5 billion invested in growth and all of this investment will be completed around 2018. This means we will have cash again from 2018 to invest. This freedom is a great value for the company."

And as with innovation and digitisation, Starace would like to see other utilities take the same approach. "If we all do this, the sector as a whole will become more flexible." «

Interview Fatih Birol, Executive Director IEA

By Karel Beckman

"WE ARE ONCE AGAIN INCREASING OUR EXPECTATIONS FOR RENEWABLE ENERGY"

Photo Friends of Europe

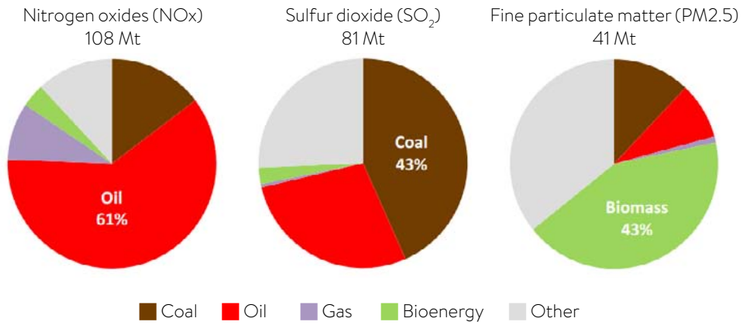
In its upcoming World Energy Outlook, the International Energy Agency (IEA) is "once again happily increasing our growth projections of renewable energy", says Executive Director Fatih Birol in an interview with World Energy Focus. But a world without fossil fuels is not yet in sight. "There are fossil fuels and fossil fuels. Coal and oil should be discouraged. Natural gas will continue to play an important role in even our most stringent scenarios."

Fatih Birol, the Turkish-born Executive Director of the Paris-based IEA, needs little introduction in the energy sector. As Chief Economist and guiding spirit of the IEA's annual World Energy Outlook (WEO), arguably the most influential publication in the global international energy world, he was for years "Mister IEA" behind a succession of politically appointed Executive Directors. Last year, the board of the IEA decided to break with tradition and appoint their Chief Economist as new Executive Director, an unusual move that nevertheless seemed quite logical to most outside observers.

In his new capacity, Birol continues to do what he has been doing for many years: warning about the threat of climate change and harping on the need for all people in the world to obtain access to electricity. A third, relatively new concern for Birol is the problem of air pollution from energy use and production, about which the IEA published a major new report in June. "Today, 6.5 million people die prematurely from energy-related energy pollution", says Birol. "It is the fourth major reason for premature deaths after heart diseases, smoking and high blood pressure."

The IEA's pollution report shows that coal and oil are the main causes of the major air pollutants (nitrogren oxides and sulfur dioxide), and as these two fossil fuels are also the main causes of energy-related greenhouse gas emissions, for Birol it is clear that governments should take measures to discourage their use. Indeed, more stringent measures than they are doing at the moment, for "developments in the energy sector are still not in line with the 2 degree warming target", notes Birol.

POLLUTANT EMISSIONS, 2015

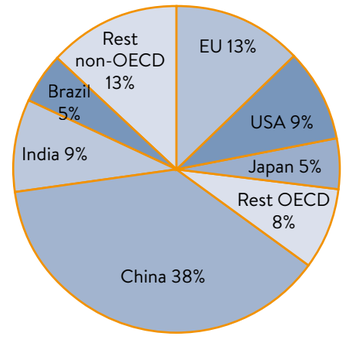


Energy is the single most important cause of emissions of all main pollutants. Source: IEA

POSITIVE RESULTS

The good news is that the projected share of renewables in the future energy mix keeps going up. The IEA's next World Energy Outlook, which will be published in November, wi e a special section on renewable energy. And it will show rather positive results, Birol reveals. "I can already say that we are – once again – happily increasing our expectations for renewable energy generation, especially in emerging countries."

Shares of net additional renewable capacity, 2014-20



Renewable electricity additions to 2020 will top 700 GW or almost two-thirds of net additions; Emerging economies make up two-thirds of the expansion. © IEA 2016 Source: IEA

The IEA has often been criticised by renewable energy advocates for underestimating the potential of solar and wind power in particular. But Birol says that this criticism is based on a misconception. "We base our projections on government policies. What we see now is that governments are increasing their support, so that's why our projections are going up. In addition, costs are also coming down sharply, which reinforces this positive trend."

The question is, though, how fast will renewable energy grow? There is a school of thought in the energy sector which argues that the world cannot move away from fossil fuels for a long time to come, in view of the relentless growth in energy demand expected in emerging economies. But Birol says "there are fossil fuels and fossil fuels. I would not lump them all in one basket. Natural gas will continue play an important role even in our most stringent climate scenarios. But the use of oil and especially coal can decline."

UNPRECEDENTED TRANSFORMATION

In sub-Saharan Africa, where the majority of the people do not have access to modern energy, Birol can see an unprecedented transformation taking place. "Previously in the US, Europe, Asia, economic development has always started with coal, after which other forms of energy were developed. In sub-Saharan Africa we may well see economic growth taking off on the basis of renewables, especially solar, wind and hydro, plus natural gas."

Nevertheless, in Asia, where most of demand growth is going to come from, gas is currently being squeezed between cheap coal and government-supported renewables, notes Birol. "Chinese coal consumption has declined two years in a row. This gives a downward pressure on coal prices, which will make coal more attractive than gas in Asia." Given the prominent role coal plays in both air pollution and climate change, this means that government must take action to curb its use, according to Birol. "If it is only left to economics, coal will continue to dominate in many countries."

Birol has not given up hope that the world will turn away from the unmitigated use of coal and oil in time to avoid climate catastrophe. And he wants the IEA to be at the heart of this transformation. His two strategic aims for the IEA are to turn it into a "hub" for renewable energy and energy efficiency, and to turn it from an OECD organisation into a global institution.

CLEAN ENERGY MINISTERIAL

Both these aims were given a boost in June when the IEA was chosen to become the host of the Clean Energy Ministerial (CEM). This is a high-level global forum, with 24 member countries (including Australia, Brazil, China, France, Germany, India, Indonesia, Japan, Korea, Mexico, Russia, Saudi Arabia, South Africa, the UK and the US), which are trying to accelerate the deployment of clean energy by sharing best practices. Its Secretariat has up to now been hosted by the US – it was an initiative of the Obama Administration – but will now be transferred to the IEA – to ensure its continuity in view of the political turbulence in the US. "A number of organisations applied to host the CEM Secretariat and we were unanimously chosen", says Birol.

The IEA has been trying for some time to expand beyond the limits prescribed by its OECD origins. The organisation was founded in 1974 to help the OECD countries coordinate a collective response to disruptions in the oil supply after the 1973/74 oil crisis. 42 years later, the world has changed radically. Today, most of the energy demand growth is coming from non-OECD countries. This means the IEA must expand its remit to include the "emerging" economies or become increasingly irrelevant.

In recent years, countries like Indonesia, China and Thailand have already become "associate members" of the IEA. Birol now wants his organisation to take a further leap and become a truly global institution. If he succeeeds, that would be an energy transformation in its own right. «

Electricity beyond the grid:

A GUIDE TO MAKING OFF-GRID SOLUTIONS WORK

Traditionally, national energy policies have been focused on large-scale generation and centralized grids. Now decentralized technologies such as standalone solar home systems and hybrid and renewables-powered mini-grids are bringing energy access to those beyond reach of the grid. A new report from PricewaterhouseCoopers (PwC), Electricity beyond the grid, identifies ways for policymakers to support this technological shift – and accelerate energy access for the 1.2 billion people in the world who live without electricity.

Most national energy policies are based on the assumption that large-scale generation and centralized grid systems are the principal means for developing access to electricity, resulting in an 'all or nothing' approach. People within reach of the grid get electricity. Those out of reach are relatively neglected, with the exception of the piecemeal development of local mini-grids.

The result is that 1.2 billion people in the world remain without electricity, 95% of them in sub-Saharan Africa and developing countries in Asia. On current trends, two-thirds of them will remain without electricity by 2030, the target year to achieve the newly agreed post-2015 UN Sustainable Development Goal of universal access to energy.

ENERGY LADDER

But the traditional 'all or nothing' policy approach is increasingly out of step with what is now possible in power technology. 'Entry level technologies', such as standalone solar systems, are now increasingly available. According to the International Renewable Energy Agency (IRENA), there are already more than six million solar home systems in operation worldwide, of which three million are in Bangladesh. These systems provide 'first rung of the energy ladder' access for many people in Africa and Asia. And growth is being driven by commercial business models that fit with household circumstances rather than the slower-moving progress of grid extensions.

In Kenya and Tanzania, for example, low income customers are now able to use mobile payment systems to obtain 'plug and play' solar technology for very basic home electrification, with the option to scale up as income and/or technological development allows. Suppliers in East Africa include companies such as Mobisol, M-Kopa, Helvetic Solar, EON and Enel Green Power. Mobisol reports that it has installed over 30,000 solar home systems for households in Tanzania and Rwanda since 2010. Nairobi-based M-Kopa reported in January 2016 that it had reached the milestone of connecting over 300,000 homes to solar power.

Price ranges per kWh depend on the type of system and the facilities it offers, as standalone pay-as-you-go solar home systems are about what a customer can do with the power (charge a phone, watch television, access to Internet services, refrigeration etc.) and not necessarily about the electricity it provides. The standalone system provides a very basic level of affordable electricity.

MINI-GRID DEVELOPMENT

Previously, the lowest rung of the energy ladder was usually some form of mini-grid system, typically based on diesel generation. But up-front capital costs, running costs and the necessity of project governance, maintenance and operation resulted in limited deployment.

Now the mini-grid rung is also becoming more accessible with lower-cost solar technologies enabling hybrid (diesel and renewables) or renewables-only mini-grids, bringing down running costs.

Mali is a leader in mini-grid development, with more than 200 mini-grids in operation. In Kenya, the Kenya Energy Regulatory Commission has licensed Powerhive East Africa, an operator of renewable energy microgrid pilot projects, with a utility concession to generate, distribute and sell electricity. In early 2016, Powerhive closed a US$20 million financing round to enable it to expand operations in Africa and Asia Pacific, and invest in continued growth in Kenya. In India, Husk Power Systems has installed 84 mini-power plants in 4 years, using biomass from waste rice husks, to provide electricity to over 200,000 people across 300 villages.

In addition, battery storage technology is evolving to play a significant role in smaller-scale off-grid solutions and is beginning to feature in utility scale solar storage. In Haiti, SolarCity is building a solar farm and storage that includes a 52MWh utility scale battery facility to distribute up to 13MW of solar power.

Photo Kirambo Health Center, Rwanda

POLICY SUPPORT

However, policy and regulatory obstacles remain. If these are addressed by policy makers, mini-grids have a logical role to play in providing electricity access. The time has come for national energy policies to embrace off-grid solutions with policies that can stimulate growth. By looking at the success factors as well as the difficulties that need to be overcome, it's possible to see the ways in which national energy policies in developing countries can be modified to accelerate electrification. The report Electricity beyond the grid makes five broad recommendations to policymakers to enable off-grid access.

> THE TRADITIONAL 'ALL OR NOTHING' POLICY APPROACH IS INCREASINGLY OUT OF STEP WITH WHAT IS NOW POSSIBLE IN POWER TECHNOLOGY

Firstly, a clear energy access map and development plan would help provide a framework for a top-down planned electrification 'push' and a more commercially-driven bottom-up electrification 'pull'. This would recognize to the role of off-grid solutions in national energy policies and enable companies to develop a viable business model and access finance. Secondly, policymakers should establish criteria for mini-grid development. This would help clarify what is currently an unclear business model and rationale. Investments in skills and training for clean off-grid system installation, repairs and maintenance are needed, as are mechanisms for the qualification and training of locals, enabling community participation. Thirdly, policy must promote the growth of mobile infrastructure, microloans and payment solutions. Dynamic and flourishing consumer payment mechanisms and customer loans can do a lot to help households to purchase basic electrification systems and enable companies to develop markets. In turn, this increases uptake, creates economies of scale and lowers costs.

A fourth recommendation is to establish national off-grid innovation and development funds. At the moment grant funding is available from multilateral institutions and from bilateral donors, but this can also result in fragmented funding and a scattergun approach to projects. A development and innovation fund, linked to the national energy access strategy, can provide a single focus for innovation finance, finance for pre-feasibility studies and support local entrepreneurs.

A final recommendation is to appoint a high-level energy access champion. A common challenge in many developing countries is translating plans into effective delivery on the ground. This makes the case for a high-level energy access champion who can cut across agencies and overcome obstacles and delays. Such an appointment might report direct to the president or prime minister, given the importance of energy access.

By keeping pace with technological development, these policy innovations could transform the off-grid market, turning it into a primary means of access to electricity – and key to providing universal access to modern energy services by 2030. «

More information about the PWC report Electricity Beyond the Grid can be found here: http://pwc.to/1OKPjbD

WORLD ENERGY COUNCIL | AUSTRIA Young Energy Professionals

Promotional Feature

INTRODUCING THE YOUNG ENERGY PROFESSIONALS PROGRAMME

Launched in November 2015, the Young Energy Professionals (YEP) Programme is the innovative junior staff network of the World Energy Council Austria. Aimed at young experts from enterprises, academia and governmental institutions, the programme provides a unique platform for project work and cooperation beyond day-to-day business. Recognising the growing demands of a globalised energy economy, the YEP Programme helps to prepare the young professionals of today for the challenges of tomorrow.

It is the Austrian equivalent of the World Energy Council's global Future Energy Leaders Programme and provides unique opportunities to its participants, such as interdisciplinary teams, contacts and cooperation with the global programme as well as the German counterpart.

The programme is supervised and supported by an advisory board which comprises Prof. Dr. Günther Brauner, Dr. Robert Kobau, Prof. Nebojsa Nakicenovic, Prof. Karl Rose, Dr. Jürgen Schneider and Dr. Stephan Unger. Other experts from our membership and organisations such as the Organization for Security and Co-operation in Europe regularly attend events of the YEP Programme to support the groups with their expertise. Niels Pollmann coordinates the programme on behalf of the World Energy Council Austria.

The YEP Programme of the World Energy Council Austria looks to the future of the Austrian energy sector. The YEP working groups focus on crucial sectors, such as fossil fuels, renewables, urbanisation, digitalisation and investment structures. By looking at pressing issues from a multitude of perspectives, the working groups presented here are able to comprehensively analyse the current state, to make reasonable assumptions for the future and to contribute to the development of the Austrian energy sector of tomorrow.

ENERGY TRANSITION AND ITS IMPACTS ON THE AUSTRIAN ENERGY ECONOMY

This working group is focused on the challenge of grid integration of renewables and an increased share of electricity in the energy mix. This necessitates higher storage capacities as well as higher distribution flexibility. Solutions identified include pumped hydro and gas storages, and flexible baseline power plants.

Furthermore, flexible energy distribution is increasingly important. Different energy sources must be integrated into one smart system in order to optimise synergies and reduce infrastructural overheads. However, this demands a high level of coordination, and significant investments – which, the working group concludes, can only be accomplished by transnational agencies.

Group members: Christoph Libisch, Birgit Lemmerer, Raphaela Reinfeld, Michael Fuchs, P eter Macher, Daniel Nauschnegg, Johannes Wall, Markus Pichler.

DIGITALISATION TASKFORCE

The objective of this working group is to investigate and understand the far-reaching and diversified potentials, opportunities, and impacts associated with the current trend of digitalisation. Research, including workshops with leading start-ups, structured interviews with senior energy managers and decision makers, and a survey of industry professionals, will feed into an impact assessment of this transformation in the DACH (Germany, Austria and Switzerland) region.

Of particular interest are repercussions on existing business models and strategies envisioned by companies and new market entrants. Consumer perspectives, regulatory consequences as well as issues such as cybersecurity and data privacy and security will also be addressed.

Group members: Sylvia Mayer, Johanna Ronay, Christian Fencz, Damir Trtanj, Nicolas Rathauscher, Tobias Rieder, Andreas Lassl, Philipp Irschik. For further information, please contact Mr. Philipp Irschik (philipp.irschik@e-control.at).

INVESTMENTS AND SUBSIDIES

The working group aims to assess the resilience of the contemporary European wholesale electricity market and better understand the ramifications of investments and subsidies in the power sector. At the moment, despite low fuel prices, all energy technologies struggle to cover their total generation costs due to persistently low energy prices. Capital intensiveness, long investment cycles, technical challenges and political obstacles all discourage investment despite current low interest rates. Although Europe's power system is still in a state of oversupply, this may change. Growing RES penetration and demand-side inflexibility to price fluctuations challenge the functioning of energy-only markets and drive the implementation of capacity remuneration schemes.

The group has commenced a comparative analysis of European energy policies. This work contextualizes competing intergovernmental priorities with regard to issues of energy security, which include: accessibility, affordability, availability, and social acceptability. Group members: Michael Weixelbraun, Fabian Stricker, Wolfgang Richter, Tobias Wurzer.

OIL DEMAND MONITOR

The working group is developing a national oil demand monitor. With changing consumption patterns of hydrocarbon fuels (due to e-mobility, dieselisation and de-dieselisation post VW scandal, improved engine efficiencies, better housing insulation, increased air travel) it is of utmost importance to monitor the current, "live" consumption of oil products in order to be able to anticipate future demand trends and to construct consumption scenarios. Monthly tracking by oil product grouping (gasoline, diesel, heating oil, petrochemicals, etc) will form a useful tool for a variety of stakeholders interested in this data including wholesalers, energy companies, and government.

INNOVATIVE APPROACHES TO STORING ENERGY

The working group is searching for completely new techniques and methods to store heat and electricity, which can be implemented in small to medium-sized cities. The group is using a scenario approach which envisions the construction of a completely new urban district. The group's work aims at presenting new and innovative ideas and concepts, stimulating new points of view. For example, why not add a reservoir on the top of each multi-storey building and use all of them as an upper reservoir for a pump power station in the town? The final paper will present each idea and its concepts as well as a detailed discussion and assessment of the potential for future use.

Group members: Thomas Beckel, Roman Gabl, Herbert Hemis, Lorenz Stangl, Thomas Weissensteiner.

Members of the Young Energy Professionals Programme

ENERGY IN AUSTRIA: STATE OF PLAY

Total primary energy supply (TPES) in Austria was 1.4 EJ in 2015, and has remained relatively stable in recent years, decreasing by a total of 2% since 2005. The energy mix is dominated by fossil fuels, which account for 66% of TPES. Oil is the largest source of energy at 36% of TPES, followed by natural gas at 20% and coal at 10%. Renewable energy and waste account for 31% of TPES.

The share of fossil fuels (oil, gas, and coal) has fallen from 77% of TPES in 2005. Energy supply from renewables and waste increased by 40%, with biofuels doubling since 2005 and the supply of wind and PV increasing by 4 times. Around 40% of Austria's energy needs are produced in-country.

Transport is the largest consumer of energy, accounting for 34% of total final consumption (TFC). The industry sector is the second highest at 29% of TFC, followed by residential energy use at 26%, and commercial and public services sector use at 11% of TFC.

Austria is a federal republic with nine states: governance is either at the federal level, or both federal and state level. The nine state governments have responsibility for policy making, setting subsidy levels, and implementing regulatory control of energy companies. The Federal Ministry of Science, Research and Economy is the main body responsible for energy matters on the federal level. Other relevant institutions are: Federal Ministry of Agriculture and Forestry, Environment and Water Management, Federal Ministry of Transport, Innovation and Technology, Federal Ministry of Finance, Austrian Energy Agency, E-Control and the Austrian Competition Authority.

Policy developments are in line with EU policy, including: an increase of the share of energy consumption produced from renewable resources to 34% by 2020; reducing greenhouse gas emissions by 16% from 2005 levels for sectors not included in the EU Emissions Trading Scheme (EU ETS) and 21% from 2005 levels for sectors included in EU-ETS; and a 20% improvement in energy efficiency to 2020.

Key challenges are security of supply, energy efficiency, sustainability and internal market dimensions; reduction of greenhouse gas emissions; and integrating these into energy and climate strategy.

Public visit Hanhikivi June 2016. Photo Fennovoima

FENNOVOIMA THE COLLECTIVE EFFORT BEHIND FINLAND'S NEW NUCLEAR POWER PLANT

By Eric Marx

Five years after announcing that it had chosen Pyhäjoki, in northern Finland, as the site for a new Russian-designed 1200 MW nuclear reactor, Finnish company Fennovoima is within sight of a 2018 construction start date. The power plant, to be called Hanhikivi 1, is expected to provide a major economic boost to Finland and deliver an important contribution to Europe's low-carbon power supply. Journalist Eric Marx travelled to Finland to find out why Fennovoima seems to be succeeding where other new nuclear projects in Europe are struggling.

The largest construction site in Finland juts out into the Bay of Bothnia, a rocky outcrop that is known as the Hanhikivi Peninsula. Busy with large earthmoving diggers, and replete with concrete batching plants and a steep embankment rising 4.6 meters above sea level, in ten years' time this open patch of land will be home to Finland's third nuclear power plant and sixth reactor.

Roughly 700,000 cubic tons of rock have been excavated, explains Jouni Sipiläinen, the construction director of Fennovoima, the company owned by a consortium of Finnish companies and municipalities that aims to build and operate the VVER-1200 reactor designed and supplied by Rosatom, the Russian nuclear energy company.

Electric and waste water lines have been laid and over a thousand workers have already passed the required training for project construction. The Russian company Titan-2, which is the main building contractor, has its offices in the area. A two-meter high security fence now rings the entire 555-hectare site, while over there, says Sipiläinen, pointing to two large craters filled with muddy water, is where the reactor and turbine halls will sit.
All that's needed now is a construction license.

> "THE PEOPLE OF FINLAND HAVE NOT LOST BELIEF IN NUCLEAR ITSELF AS WE HAVE FOUR GOOD REACTORS WHICH ARE ALL STILL RUNNING TODAY"

LOCAL SUPPORT

"Hanhikivi will be the most modern, the safest and best plant there is in the world," proclaims Matti Soronen. The mayor of Pyhäjoki, a municipality of 3,207 inhabitants, Soronen views nuclear power in terms of economic growth. He believes in the technology and is proud of the strong safety record of the country's four existing nuclear reactors.

If all goes according to plan, Hanhikivi 1 could start producing electricity from 2024. That is welcomed by the industry and energy companies as well as small municipalities across the country, like Pyhäjoki, which are susceptible to sharp increases in electricity prices as a result of costly imports. One of the chief benefits of the plant for Fennovoima's owners will be the opportunity to purchase dependable and competitively priced energy.

Pyhäjoki is one of 57 Finnish owners which comprise of municipalities, industrial companies and power companies that own a piece of the power plant as shareholders in Voimaosakeyhtiö SF, which owns 66% of Fennovoima. The shares don't equal dividends, but resemble a cooperative, or what's referred to in Finland as the "mankala" business model. The shareholders finance the project. In turn, they are entitled to tax-free power at producer prices, in proportion to their holdings.

The rest of the shares (34%) are owned by Rosatom through its Finnish subsidiary RAOS Voima. As several dozen municipal utilities are included among the Fennovoima shareholders, this has made for wide-ranging dialogue in town councils across Finland about their participation in the project. Notably, in 2014 the project's home municipality of Pyhäjoki voted 18 to 3 to host the project. In Finland, the support of the host municipality is indispensable for a nuclear power plant, because the local municipality has the right of veto.

"The problem in northern Finland is we have been losing inhabitants," says Soronen. The nuclear power plant will employ an estimated 450 to 500 people after it's built. Some 3,000 to 4,000 will be involved during construction.

In Raahe, a town some 20 kilometres up the coast, the leadership of the SSAB Ruukki steel plant also supports the plans. With 2,800 employees the plant is hungry for cheap electricity. Its iron and steel

production consumes one percent of all electricity in Finland. It relies partly upon wind power, but cannot at present expand without more predictable energy flows, especially in winter during peak usage periods.

Along with forestry and farming in the dairy and pork industries, the steel plant is one of Pyhäjoki's big employers. The Hanhikivi 1 project will change the landscape of the municipality. "We want to build residential buildings and provide new services," says the mayor. "It's only natural that we want growth." According to a poll held in December 2015, two-thirds of the residents of Pyhäjoki are in favour of the project.

FAVOURABLE AGREEMENT

The Fennovoima board compared several potential plant suppliers and chose Rosatom because of two deciding factors: familiarity with VVER technology and attractive commercial terms.
"The people of Finland have not lost belief in nuclear itself as we have four good reactors which are all still running today," says Jussi Lehto, head of Kerava Energy and also the CEO of Voimaosakeyhtiö SF. Of the four existing reactors in Finland, the two power plant units in Loviisa (to the east of Helsinki) are of the VVER-type. In operation since 1977 and 1980, the units have since been modernized, with their operating permits extended through to the end of the next decade. Currently some 18 VVER units from Russia operate safely in five EU countries.

Another deciding factor was the attractive turnkey agreement that Rosatom offered. This obliges the Russian supplier to take on the risk of any budgetary overruns or timetable delays. Rosatom also bought into the deal, becoming a 34 percent owner after German energy company Eon, one of the original shareholders in the project, decided to pull out of nuclear power in 2013.

> "HANHIKIVI WILL BE THE MOST MODERN, THE SAFEST AND BEST PLANT THERE IS IN THE WORLD"

According to Lehto, owners' equity will cover €1.7 billion of the estimated €6.5 billion to €7 billion cost of the reactor, with the rest coming from loans which Rosatom is responsible for securing. The ultimate cost of the electricity to be supplied by the new

Public visit Hanhikivi site
October 2015
Photo Fennovoima

plant will be around €50/MWh. That is much cheaper than, for example, the £97.50/MWh strike price (for 35 years, inflation-proof) guaranteed by the UK government to the owners of the proposed Hinkley Point C nuclear power plant, which is to be built by EDF of France.

According to Lehto, the project terms contributed to the wide buy-in from Finnish society at all levels.

In late 2014 the Parliament in Helsinki approved the deal by a wide 115-74 vote. The Parliament enacted the condition that owners from Finland or the European Economic Area must always hold a majority ownership of at least 60% in the project. As part of the plant supply contract, Rosatom is obliged to deliver nuclear fuel for at least the first ten years. After that the fuel can be freely tendered.

The deal also makes sense for Finland from a macro-viewpoint. The country imports about 20% of its electricity annually and the government and Finnish industry want to reduce that amount. In January this year, during a cold spell, "we were just lucky to cover peak [electricity] demand and avoid a catastrophe," says Lehto. Estimates are for Hanhikivi 1 to produce about 9 TWh of electricity annually, which is half the total amount of electricity Finland imported in 2014.

"All the companies that are shareholders are now 100 percent behind the project," says Lehto. "We will build this," he continues. "We will try to make a profit, but we also want to be responsible for Finland and the global environment."

GETTING A CONSTRUCTION LICENCE

Currently Fennovoima's main priority is the licensing process. There are roughly 8000 regulatory guidance protocols involving design specs for the plant's safety, construction and operation, as well as requirements for detailed management plans of

MINNA FORSSTRÖM
project director
Photo Fennovoima

Mock up Hanhikivi in
Bay of Bothnia
Photo Fennovoima

JOUNI SIPILÄINEN
construction director
Photo Fennovoima

the organizations of both Fennovoima and the plant supplier. It is a demanding process even for the most experienced technical oganisation, in keeping with the reputation of the Finnish regulator STUK as one of the strictest nuclear supervisory authorities in the world. Of course, safety is key and the company is committed to taking all the time and making all the efforts needed to fulfill all the required criteria.

Finland's regulatory process involves a single approval for the construction licence application, unlike the multiple steps found in some other jurisdictions. According to Fennovoima CEO Toni Hemminki, the licensing phase needs the full attention of the whole project organisation. Fennovoima is working on tackling all challenges and is confident to receive the construction license in 2018.

Before even a single design plan can be submitted, STUK requires that the design development and management are according to requirements and reviewed in detail. "In this respect the requirement level of STUK has increased," says Project Director Minna Forsström. It means the plant supplier Rosatom has to align these procedures into a management system and supply chain that already includes 300 companies.

The Fukushima disaster in Japan in 2011 has led to additional safeguards being implemented across the nuclear industry. "Greater efforts to ensure safety in the wake of Fukushima are an absolute priority", says Janne Nevalainen, the STUK manager of the Hanhikivi project.

As part of its standard procedures, STUK is currently reviewing the reactor's double containment silos, passive cooling systems and core catcher. The catcher is a special design feature of the VVER that traps and retains molten core material in case of a meltdown. Passive cooling works via a gravity wall tripwire that functions without the use of any electrical power. Concrete silos at Hanhikivi will be of a thickness ratio that prevents possible radiation leakage, but which will also be strong enough to withstand an outside force such as an airplane crash.

Nevalainen says one of the lessons learned from Olkiluoto 3 is that all aspects need to be verified down to the smallest supplier. Rosatom will "have to show who is doing what and when, and they have to show they have certified the quality assurance and quality control. When those are ready and good, Fennovoima then has to audit the supply chain. And when those audits are complete, and we can see that all work is being done according to instructions, then we will have assurance that things are being done in proper order."

USEFUL REFERENCE

In Russia at the Leningrad II nuclear plant site a VVER-1200 reactor is currently being built, which is scheduled to become operational in 2018, and serves as a useful reference for Hanhikivi 1. One of the strengths of Rosatom is its experience: it has produced more than 50 VVER family reactors. Fennovoima now employs about 300, and over half of them in Forsström's project department: she has eight teams of engineers and technicians, of which some have more than 35 years experience in working with VVER technology.

> "WE WILL TRY TO MAKE A PROFIT, BUT WE ALSO WANT TO BE RESPONSIBLE FOR FINLAND AND THE GLOBAL ENVIRONMENT"

"I'm really proud of our team," says Forsström. "Collectively, my supporting team has more than 200 years expertise working on large scale projects. I can really say nobody has ever before brought together that kind of team in Finland." «

Interview Spencer Dale, Chief Economist BP Group

"THE ENERGY TRANSITION COULD COME FASTER THAN WE THINK"

By Alex Forbes

The energy industry faces uncertainties of daunting magnitude on many levels, says Spencer Dale, BP's Group Chief Economist, in this exclusive interview: the pace of climate change policy, the growth of renewables, the apparent demise of coal, falling energy prices, the role of natural gas in the energy mix, and the likely impact of energy efficiency on demand growth. According to Dale, "it's possible that we will see forces leading to a faster transition."

Spencer Dale is a relatively new kid on the energy block, who has a fresh perspective to offer on the future of the global energy sector. In October 2014, he joined BP as Group Chief Economist after a career spanning a quarter of a century in the banking industry.

For six years, between 2008 and 2014 he was on the Bank of England's Monetary Policy Committee – "all the way during the financial crisis". He chose to move from banking to energy because energy "is critical for global economic growth; it's critical for thinking about the sustainability of our planet over the next 40 or 50 years; and the chance to be involved in some of those discussions and issues and debates was too good an opportunity to turn down."

He now leads the team of analysts that produces BP's annual long-term Energy Outlook and the famous annual BP Statistical Review of World Energy, widely regarded as the "industry bible" of energy statistics. This puts him in a great position to offer insights into energy trends. In this interview, he gives his views on climate policy, the ongoing transition to a lower-carbon global energy economy, major shifts in the energy mix, and likely price trends.

One of the successes of the COP 21 climate change negotiations in Paris last year was the target to limit global warming to "well below 2°C"? How optimistic are you that humankind will be able to achieve the level of co-operation needed to achieve that target?
The global energy industry – governments, regulators, resource owners, producers like BP – faces two massive challenges over the next 20-30 years. The first is to ensure that we use energy in a sustainable way consistent with the long-term health of the planet. At the same time, it's important to make sure there are plentiful energy supplies for the fast-growing economies of the world – so that many hundreds of millions of people can be lifted out of low incomes, out of fuel poverty. Paris was a significant step forward in addressing the first challenge. One of the messages from both our annual Energy Outlook and the BP Statistical Review of World Energy is the scale of the change that we will need to see to get close to achieving the goals set out in Paris – in terms of both energy efficiency and the fuel mix. That will require significant changes in policy, technology and consumer behaviour.

SPENCER DALE
BP Group
Chief Economist

Your projections show that we will still depend heavily on fossil fuels by 2040. How likely is it that we might see disruptive change that means the transition to a lower-carbon energy economy happens much faster than people currently foresee?
It's possible that we will see forces leading to a faster transition coming from a number of different fronts – and they may all operate together. One is policy. What was striking about Paris was not only the Intended Nationally Determined Contributions (INDCs) that governments pledged but also the commitment to come back and review those pledges, to find further policy support in the future. Another is technology, which is likely to change very dramatically, both on the supply side and the demand side.

But – history tells us that it takes an awful long time for new energies to gain market share. This year's Statistical Review showed a chart which looked at the evolution of different fuels from the point at which they achieved 1% of the world's energy supply. We then looked at how that share increased over the next 50 years. It took more than 40 years for oil's share to rise from 1% to 10%. Gas, even after 50 years, still didn't provide 10%. In our Energy Outlook, we have renewable energy – meaning wind, solar and biomass – growing more quickly than any fuel in history. It still struggles to reach 10% of the world's energy supply by 2035.

A big theme in the Statistical Review was the decline of energy prices, especially oil and gas. How do you see prices evolving?
Over the next five years we are likely to see a gradual firming in oil prices. There are three things I'm looking at closely to get a sense of what's going on. One is a very significant stock overhang of oil inventories which is likely to act as a dampener on the pace at which oil prices rise. Secondly, it is striking that we've seen, for a couple of months now, the US tight oil weekly rig count rise week after week. Thirdly, working in the opposite direction, is a very significant fall in investment spending. Capex spending in oil in gas this year is likely to be around a third lower than in 2014. That has been partially offset by falls in costs but even so real investment has shrunk and that is likely to squeeze supply growth.
Those three things together will have an important bearing on how prices evolve over the medium term. Beyond that, I don't know. It's unlikely that prices will jump back to the levels we saw in 2010-2014. If you look at that period, that was a function of quite specific factors, particularly the severity of supply disruptions in the Middle East and North Africa post the Arab Spring.

"I find it frustrating that so many people when talking about the Paris Agreement almost exclusively focus on the supply side"

For gas, there's a similar excess supply that needs to work through, in terms of very strong growth in US shale gas, compounded by weakness in Asian demand, and a growth spurt in global LNG supplies. Again, I expect the market to gradually absorb that supply so we'll see some firming in gas prices. But I am struck by the supply potential – particularly in US shale gas – which is likely to limit gas price rises in the medium to longer term.

The shale gas and shale oil revolution has transformed the energy landscape in North America. Do you expect to see this revolution replicated outside North America?
We expect North America to continue to dominate the growth of tight oil and shale gas over the next 20 years. There's a perfect set of factors in America which enables this to happen. If I look around the world, no other country comes close to meeting that perfect set of factors. However, in our Energy Outlook we do project gradually emerging growth in the rest of the world, such that towards the end of our outlook, in 10-20 years time, around half of the increase in production is coming from outside of North America.

Natural gas has become highly controversial, with some seeing it as key to mitigating climate change and others dismissing it as just another fossil fuel – and therefore part of the problem. What's your view? In particular, how important is methane leakage?
There's a danger of people lumping all fossil fuels together. Not all fossil fuels were made equal. Until there is an economically viable solution to large-scale storage of renewable power, we will need a balancing fuel to solve the intermittency problem. So, a gradual crowding out of coal and a switch to a combination of natural gas and renewable energy in the power sector is a key part of the transition that we need to see. Methane emissions are an important issue and the industry is very attuned to that. But the big picture is that natural gas is an awful lot cleaner than coal.

Generally, there seems to be a lot more emphasis on energy supply than on how we consume energy. How do you see world energy demand growth evolving? And how big a role will energy efficiency play in limiting growth?
I find it frustrating that so many people when talking about the Paris Agreement almost exclusively focus on the supply side. Energy efficiency needs to play at least as big a role, if not a bigger role, in responding to the challenges. In our Energy Outlook, we expect global GDP to more than double over the next 20 years, while energy demand increases by only 30%. The difference between those two things is improving energy efficiency or declining energy intensity. That is critical in underpinning the shift we expect to see in the rate of growth of carbon emissions. We think the energy intensity of GDP will decline much more rapidly than we've ever seen before. «

Hwan-Eik Cho, President & CEO of KEPCO

“WE HAVE A LEADERSHIP ROLE IN REDUCING GREENHOUSE GAS EMISSIONS”

“Since the World Energy Congress in Daegu, Korea, in 2013, the Korean people have developed a deep interest in reducing greenhouse gas emissions”, says Hwan-Eik Cho, President and CEO of KEPCO (Korea Electric Power Corp). “And KEPCO has been assigned a leadership role in realising this ambition.” In an exclusive interview with World Energy Focus, Cho explains how his company is living up to the climate challenge. “We are focusing on energy storage systems and energy efficiency and see great prospects for electric vehicles.” In its overseas activities, the Korean electricity giant, with $52 billion revenues in 2015 and a presence in 21 countries, wants to invest more in renewables and nuclear.

For KEPCO, a vertically integrated behemoth along the entire supply chain from generation and distribution to sales of electricity in Korea, the world is changing rapidly. The company, this year ranked by Forbes as the best utility in the world based on sales, profits, assets and market value, is faced with the challenge of leading the transition to a low-carbon economy in Korea, at the same time as it has to respond to calls for more competition. With Israel, Korea is the only OECD country in which the retail power market has not yet been liberalised.

For Hwan-Eik Cho, who has been President and Chief Executive Officer at KEPCO since December 17, 2012, the direction his company has to go is clear. “At the Paris Climate Conference last year, it was understood by all participants that global warming is the most serious threat faced by mankind. We are already seeing catastrophes happen around the world.”

In Korea itself the public has also become highly aware of the climate challenge and the role energy production and use plays in it. Cho says this was in part thanks to the World Energy Congress which Korea hosted in 2013. “Before then Korean people did not have a high understanding of the energy industry. Now they have become much more interested.”

So what activities is KEPCO pursuing to change the Korean energy economy? Currently, says Cho, of Korea’s total generation capacity of some 96 GW, 65% is derived from thermal energy, divided more or less equally between coal and gas fired power. In addition, 22% comes from nuclear power. Renewables still only make a small contribution. “We have a nationwide target to reduce greenhouse gas emissions by 37% in 2030. We aim to increase installed renewable energy capacity to 21% by 2029. So we will be reducing coal power and making significant investment into renewable energy.”

“Global warming is the most serious threat faced by mankind. We are already seeing catastrophes happen around the world”

HWAN-EIK CHO
President & CEO of KEPCO

Cho feels more investment will go into solar than into wind. An important reason is that solar can be combined with battery storage, which is a field in which Korea is very active. “We are highly advanced in energy storage systems, fortunately. Of the top-five companies in the world in this area, three are located in Korea.”

The concept of Energy Storage Systems (ESS) stands for intelligent storage technology that allows for more storage when the sun shines and dispatches more when there is less sunshine. “ESS enhances the stability of solar supplies. It is an important part of smart electricity management systems in homes, buildings and industries and eventually in smart cities. This is something we want to focus on.”

With regard to nuclear power, Cho believes “Paris” was a turning point. “After Fukushima, nuclear was regarded as something to be avoided. But against the backdrop of the threat of climate change, there is now more understanding of the necessity of nuclear generation. Many countries, including China, are further developing nuclear power. So the prospects for nuclear are not bleak. But the competition will be stiff. Incidentally, an interesting market will also emerge for the dismantling of old nuclear power stations.”

KEPCO is leading a consortium that is building four nuclear reactors in the United Arab Emirates (UAE) and is looking for more nuclear orders abroad. The company has a substantial overseas business accounting for 8% of overall revenues and is seeking to expand that. But it is changing its emphasis, says Cho. “We realise that there are limits to building new thermal power plants, especially coal-fired, both environmental and financial. We want to focus on what we do best: energy efficiency, smart grids, micro-grids. And we want to become more active in renewable energy overseas.”

Another area in which Cho sees strong growth prospects in Korea is electric vehicles (EVs). “We are lagging behind Europe and North America in numbers, but I believe the future is bright for EVs in Korea.” He notes that conditions for EVs in Korea are favourable. “We have an electricity supply with the same frequency on a national scale, so charging and recharging will be quite easy. We are very advanced in IT. And we also have world renowned battery manufacturers.”

KEPCO as a company will facilitate the development of EVs actively, says Cho. “We will expand charging infrastructure, beginning on Jeju Island, which will be a carbon-free island, and then nationally.” He adds that KEPCO sees “great potential” in vehicle-to-grid technology, in which EVs not only draw electricity from the grid, but also help to balance the electricity system. “We will make significant investments in this as well.”

Will all these activities be enough – and be timely enough – to save the world from climate disaster? Cho is moderately optimistic, but remains cautious.

“Now with the Paris Agreement we have a new climate change regime, which is very different from the regimes we had in the past, especially Kyoto. What is positive is that we see major companies, like that of Bill Gates, and major countries, like the US and China, actively participating. So in that sense I am hopeful. But the climate regime is voluntary, so it remains to be seen whether countries will live up to their commitments.”

> “THE CLIMATE REGIME IS VOLUNTARY, SO IT REMAINS TO BE SEEN WHETHER COUNTRIES WILL LIVE UP TO THEIR COMMITMENTS”

According to Cho, “we need to see whether it will be necessary to make the commitments binding after all.” He also notes that it still remains to be seen how international rules on carbon trading will work out. “There are a number of issues we need to pay close attention to.”

A KEPCO-led consortium is building the Barakah Nuclear Power Plant in Abu Dhabi

For Cho the tasks are clear. “As a publicly owned company, we carry a lot of responsibility. We have to make consistent efforts to develop new technologies, to improve our competitiveness, to respond adequately to the calls for market opening, and to make a contribution to the Korean and global economy. And we have to be a leader on climate change.” «

The 23rd World Energy Congress

ADDRESSING THE TRILEMMA AT A CRITICAL JUNCTURE

By Murat Mercan, Chair, World Energy Council – Turkish National Committee

The world is on the brink of a wholesale transformation in energy. As technology, geopolitics and the concerns and priorities in the field of energy continue to evolve, we will seek to explore, understand and steer these critical transformations at the 23rd World Energy Congress in Istanbul.

The World Energy Council, since its foundation in 1924, has pioneered in conceptualizing energy issues and advising on their future directions and prospects. I believe that the Energy Trilemma concept, as formulated by the Council, succinctly encapsulates the multiple challenges that humanity has come to face vis-à-vis a plethora of factors, including environmental hazards, demographic strains and political-economic dynamics. The Trilemma advises us to strive to balance the three major concerns in energy policy today: security, affordability and sustainability. This implies that as we seek reliable and affordable access to energy, we cannot afford to discount the ecological ramifications of each move we make.

> AS A SPECIES SHARING THIS PLANET, WE COLLECTIVELY FACE THE CONSEQUENCES OF ENERGY POLICIES OF INDIVIDUAL COUNTRIES

Let me elaborate on that point: Countries feel the burden of the security and affordability pillars of the Trilemma to a different extent, depending on their own circumstances. Energy-rich countries relying on the availability of vast energy resources, or energy-hungry ones with the economic means to import energy, have different concerns than, for instance, African countries which have abundant resources but lack the financial or infrastructural capacity to put them to good use. Countries that shy away from nuclear energy or transition to renewables face different issues than those that base their energy mix on fossil fuels. Some countries suffer, while some benefit from the commodity price storm. A change in the energy production technology or a discovery of new resources may shift a country from net importer to self-sufficient, or even net exporter status virtually overnight. Each of these changes are vital challenges to address for each country, considering the fact that energy is the foodstuff of our way of life today.

MURAT MERCAN
Chair World Energy Council – Turkish National Committee

Nevertheless, while the pillars of energy security and affordability appear in different disguises in different contexts, the challenge of the third pillar, i.e. environmental sustainability, will have the same manifestations for any member of humanity. As a species sharing this planet, we collectively face the consequences of energy policies of individual countries. This must remain a serious consideration in every policy decision to be made at both national and global levels. Energy is evidently indispensable at the level and in the form of our evolution, but so is the globe that we live on.

The 23rd World Energy Congress will be the first global event since COP21 in Paris that will address these issues comprehensively. With decision makers, opinion leaders and top businesspeople in the field of energy, we will take a new step in shaping the future of the world through the strategic choices we make. In Istanbul you will have your say in the direction that this global transformation will take. «

WHAT HAPPENS WHEN DEMAND FOR OIL PEAKS?

By Amy Myers Jaffe & Jeroen van der Veer

A gradual move away from oil will have many benefits for the global economy, write Amy Myers Jaffe, executive director of energy and sustainability at the UC Davis Institute of Transportation Studies, and Jeroen van der Veer, former CEO of Royal Dutch Shell. According to Myers Jaffe and Van der Veer, a diminished role for oil means markets will become more stable and costly price subsidies can be reduced. The authors, both members of the new Global Agenda Council on the Future of Oil & Gas, part of the World Economic Forum, urge oil and gas companies to explore how they can develop profitable alternative energies, noting that this will require "a change in the mindset of investors".

Since the First Industrial Revolution, oil and gas have played a pivotal role in economic transformation and mobility. But now, with the prospects that major economies like the United States, China and European nations will try to shift away from oil, producers are coming to realize that their oil reserves under the ground – sometimes referred to as "black gold" – could become less valuable in the future than they are today.

Of the four scenarios for the future of the industry outlined in a new set of white papers from the Global Agenda on the Future of Oil and Gas, three of them envisage this type of world. Factors such as technological advancements, the falling price of batteries that power electric vehicles, and a post-COP21 push for cleaner energy could even drive oil use below 80 million barrels a day by 2040 – 15% lower than today.

So what would a future of falling demand mean for the oil and gas industry?

WE'RE ALREADY FEELING THE EFFECT

Uncertainty about whether oil demand will continue to grow is already impacting the strategies of oil and gas firms. Through the 2000s and up until last year, the Organization of Petroleum Exporting Countries (OPEC), whose policies influence global oil supply and prices, took a revenues-oriented strategy, believing that scarce oil would be more valuable under the ground than out in the market, as global demand rose exponentially over time. Oil companies, too, responded to this world view by pursuing a business model that maximized adding as many reserves as possible to balance sheets and warehousing expensive assets.

Now, with new trends discussed in a new white paper, producers are coming to realize that oil under the ground might soon be less valuable than oil produced and sold in the coming years. This dramatic shift in expectations is changing the operating environment for the future of oil and gas.

A POST-OIL WORLD: NOT ALL DOOM AND GLOOM

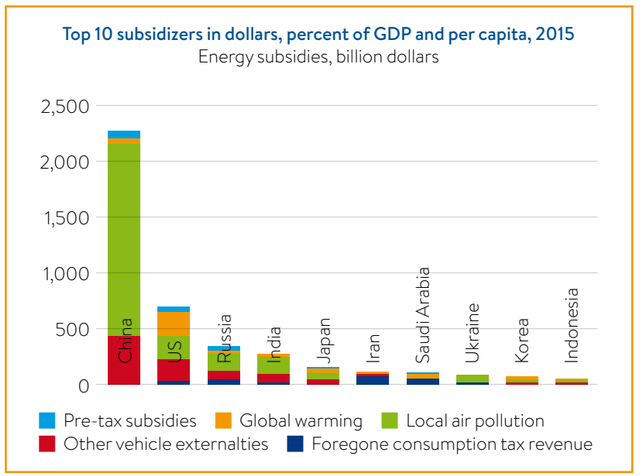
Countries with large, low-cost reserves, such as Saudi Arabia, are rethinking strategies and will have to think twice about delaying production or development of reserves

Countries with large, low-cost reserves, such as Saudi Arabia, are rethinking strategies and will have to think twice about delaying production or development of reserves, in case they are unable to monetize those reserves over the long run. Saudi Arabia, for example, has recently announced that it is creating a $2 trillion mega-sovereign wealth fund, funded by sales of current petroleum industry assets, to prepare itself for an age when oil no longer dominates the global economy.

Declining revenues that could be reaped from exploitation of remaining oil reserves would adversely affect national revenues in many countries that have relied on oil as a major economic mainstay. Those countries will face pressing requirements for economic reform, with the risk of sovereign financial defaults rising.

But for the majority of the world's population, structural transformations related to the future outlook for oil and gas offers an opportunity. If the global economy becomes less oil intensive, vulnerability to supply dislocations and price shocks that have plagued financial markets for decades will fade, with possible positive geopolitical implications. Moreover, many countries have reeled under the pressures of fuel subsidies to growing populations.

Image: IMF



According to the IMF [http://bit.ly/1CUnYDw], fuel subsidies cost $5.3 trillion in 2015 – around 6.5% of global GDP. Lower oil prices and larger range of alternative fuel choices would reverse this burden and lay the groundwork for shallower swings in prices for any one commodity.

STAYING COMPETITIVE IN AN INDUSTRY UNDER CHANGE

Eventually, players who remain competitive in the oil and gas industry will have to consider whether it can be more profitable to shareholders to develop profitable low-carbon sources of energy as supplement and ultimately replacements for oil and gas revenue sources, especially to maintain market share in the electricity sector.

This will require a change in the oil and gas industry investors' mindset. To develop this flexible, supplemental leg to traditional oil and gas activities, the oil and gas industry may find new opportunities by addressing the technological challenges associated with the different parts of the renewable energy space, as well as how one can develop efficient combinations of large-scale energy storage and transportation solutions in a world with a lot of variable renewable electricity.

Industry players can benefit from partnerships for flex-fuel technologies to ease infrastructure transitions and improve their resiliency to carbon pricing by achieving carbon efficiency for end-use energy through collaborations with vehicle manufacturers and mobility firms. Such responses will enhance the industry's attractiveness with customers and investors, and most importantly, will promote a smoother long-term energy transition. «

Amy Myers Jaffe is a leading expert on global energy policy, geopolitical risk, and energy and sustainability. She serves as executive director of energy and sustainability at the UC Davis Institute of Transportation Studies (ITS-Davis), and as lecturer in the Graduate School of Management. Jeroen van der Veer was the chief executive officer at Royal Dutch Shell from 2004-2009 and non-executive director until 2013. He is currently Chair of the supervisory boards of ING Bank and Royal Philips Electronics and member of the board of directors of Statoil.

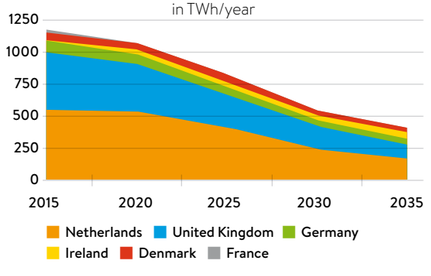
This article was written for The Global Agenda Council on the Future of Oil & Gas, a part of the World Economic Forum. The Global Agenda Council on the Future of Oil & Gas is developing a vision of what the oil and gas industry might look like in 30 to 40 years.

THE REAL STORY BEHIND NORD STREAM 2

By Karel Beckman

Nord Stream 2, the new gas pipeline that Gazprom is planning to build from Russia through the Baltic Sea to Germany, has been criticised for reducing Europe's energy security and even forming a geopolitical threat to Europe. Karel Beckman, editor-in-chief of independent website Energy Post, explains the economic rationale behind the project, and notes that the successful creation of a competitive, integrated EU gas market has made the geopolitical argument largely redundant.

The story behind Nord Stream 2 starts with an incontrovertible fact: domestic gas production in North West Europe is declining. The scale and speed of the decline can be seen in this chart:



Declining domestic gas production NW Europe

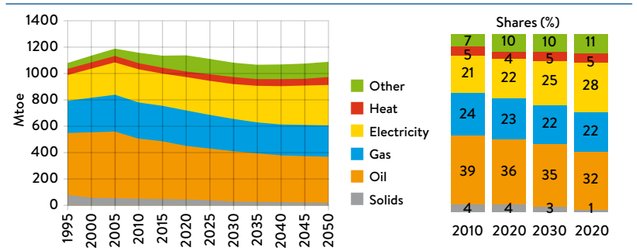
How can the countries respond to this development? They can do to three things: 1) develop their shale gas resources 2) cut back on consumption or 3) increase imports. Countries like Germany and France do have shale gas, but they don't allow fracking for environmental reasons. The UK government is trying to stimulate fracking but so far it has not been able to take off because of public opposition.

Cutting back on consumption seems a more feasible option. EU gas demand actually fell from a peak of some 530 bcm in 2010 to a low of 409 bcm in 2014, mostly as a result of the economic crisis. Last year, demand rebounded to 426 bcm, according to figures from trade association Eurogas.

Nevertheless, even though no one can predict how European gas demand will develop, most analysts believe that natural gas will continue to play a significant role in European energy demand. There are two reasons for this: first, reform of the EU's emission trading system (ETS) will lead to steadily rising CO_2-prices, which will drive coal-to-gas switching in the electricity sector. Second, renewable energies will show strong growth, but will still need to be complemented and backed up by gas.

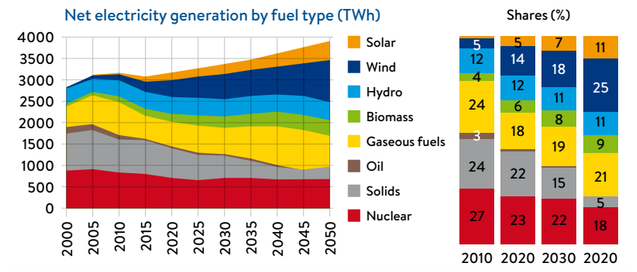
These are precisely the reasons why the European Commission's Reference Scenario, which is the main energy modelling tool Brussels relies on in all its energy policies, projects that the share of gas in final energy consumption will stay relatively stable up to 2050:

The operation of the Nord Stream Pipeline system is remotely monitored and controlled from the Control Centre in the Nord Stream headquarters in Zug, Switzerland.
Photo Nord Stream



Final energy consumption by fuel, EU-28. Source: EU Reference Scenario June 2016 http://bit.ly/29RHIjW

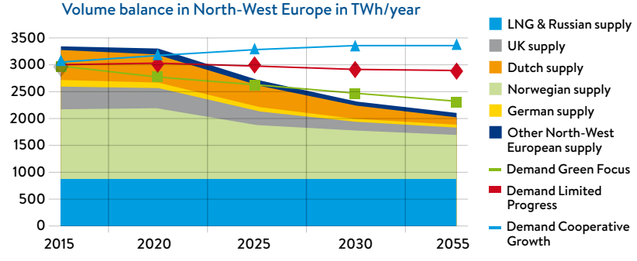
The share of gas in electricity generation is also expected to remain stable:



Final energy consumption by fuel, EU-28. Source: EU Reference Scenario June 2016 http://bit.ly/29RHIjW

This then leads Europe to the third option: to increase its gas imports.

Obviously as a result of the decline in domestic production, North West Europe is faced with a growing "import gap". The European Gas Atlas, published by Dutch gas infrastructure company Gasunie, illustrates this situation as follows:



Source: Gasunie, European Gas Atlas, shows three demand scenarios

This growing import gap is what the business case of Nord Stream 2 is built on. It is the gap that Gazprom is eager to fill with the new pipeline.

Currently the share of Russian gas in European consumption is less than 30 percent, with EU domestic production, imports from Norway and other countries accounting for more than three-quarters. If this figure goes up, European "dependence" on Russia will increase.

But Gazprom's "dependence" on Europe is actually greater than European dependence on Gazprom. The Russian company relies on Europe for almost two-thirds of its sales revenue and almost half of its sales volume (figures first half of 2016). And although Gazprom is expanding in Asia, Europe is and will remain by far the largest market for the Russians for a long time to come.

Gazprom's heavy reliance on the West-European market is precisely why the company decided some years ago that it wanted to diversify its routes to Europe. Gazprom has more than once encountered major problems with its gas transit through Ukraine, which until recently was one of the two major routes to the North-West European market. On several occasions, especially in 2006 and 2009, gas transit through Ukraine was halted after payment disputes with Naftogaz, the Ukrainian operator.

To reduce its dependence on its Central European routes, Gazprom – with a number of Western European partners – built the (first) Nord Stream connection, consisting of two pipelines, which became operational in 2011 and 2012, running through the Baltic Sea straight from Russia to Gazprom's largest market, Germany, avoiding Ukraine. Gazprom at this time also launched a project, South Stream, to build a new connection to South-Eastern Europe (Italy is another major export market), but it cancelled this after the European Commission had indicated it did not fully conform with the requirements of EU energy legislation. The Russians are now in talks with the Turkish government to build a new connection from Russia to Turkey called Turkish Stream. Turkey is one of the largest consumers of Russian gas, with Germany and Italy, and could also function as transit route to south eastern Europe.

Right after the completion of Nord Stream, in 2011, Gazprom already started exploring the possibility of building another pipeline through the Baltic Sea. This resulted in the announcement, in September 2015, of a shareholders' agreement between Gazprom and Shell, Eon, OMV, Engie and BASF/Wintershall to construct a second Nord Stream alongside the first.

EUROPEAN COMMISON

Nord Stream 1's two pipelines have a combined capacity of 55 billion cubic metres (bcm). Nord Stream 2 will have the same capacity. To put this in perspective: a country like Germany uses roughly 80 bcm per year.

Many policymakers in the EU – particularly in Eastern Europe, but also in Brussels – greeted the

announcement of Nord Stream 2 with alarm. Eastern European leaders charged that the new pipeline would negatively impact energy security in their region, particularly in those countries that are heavily dependent on Gazprom for their gas supplies.

The European Commission took the same line. Maros Šefčovič, Vice-President of the European Commission in charge of the Energy Union, said that "Nord Stream 2 could alter the landscape of the EU's gas market while not giving access to a new source of supply or a new supplier, and further increasing excess capacity from Russia to the EU."

But the energy security argument seems forced. Even if Nord Stream 2 does not bring additional supplies (Gazprom says it will, opponents deny this), all it does is change the route by which Russian gas is transported to Europe. This does not reduce the number of routes or supplies, so how can it reduce competition or energy security?

True, some EU markets, in particular Germany, will see their options to source gas improve, while the existing transit countries will face additional competition if they want to source Russian gas. However, for the EU market as a whole, this should not be a problem. That is to say: if the EU market functions as an integrated whole.

GERMAN PRICES

Here is where we come to a key point in the Nord Stream 2 debate. Most analysts agree that the EU market today is totally different from what it was ten or even five years ago. The European Commission, with the help of far-reaching legislation, especially the Third Energy Package (from 2009), has managed to create an integrated, competitive gas market in the EU. There are rules requiring pipeline operators to allow third-party access. Destination clauses have been banned. Ownership unbundling has become mandatory. In addition, gas trading hubs have been created, new pipeline interconnections have been built and reverse flow capacity has expanded.

As a result, most independent analysts today would agree that gas that enters the EU market at any point can be easily transported to almost any other point.

Indeed, this is precisely what seems to have happened with the gas coming from Nord Stream 1, according to Andreas Goldthau, Professor of Public Policy at Central European University. "Particularly in Central Eastern European markets significant shifts happened in the aftermath of Nord Stream coming online", Goldthau has written. "Gas flows started to reverse. While traditional gas would travel from East (Russia) to West (transiting Ukraine/Belarus and feeding Slovakia/Poland), West-to-East trade picked up."

Goldthau points out that after Nord Stream 1 became operational, gas prices in Central and Eastern Europe (CEE) "started to align with German prices". He

Major gas pipeline routes in Europe. Source Gasunie, European Gas Atlas

believes that Nord Stream 2 may be expected to further reinforce this effect on the gas market: "Nord Stream 2 stands the chance of enhancing the liquidity of regional hubs in which the additional volumes will be primarily absorbed....Russian gas may end up competing with Russian gas."

Goldthau does add that this does not yet apply to the whole of Europe. Parts of South-Eastern Europe are still isolated from the overall EU market as a result of insufficient infrastructure.
In a report published in August 2016, "Completing Europe", the US-based Atlantic Council admonishes the EU to complete the Action Plan for Central and South Eastern Connectivity agreed in Dubrovnik in July 2015 to end the isolation of this region. The plan includes the construction of several interconnectors as well as an LNG terminal in Croatia. The Atlantic Council also argues that Europe should build a "robust North-South Interconnector to link the Polish LNG terminal at Swinousjscie with Croatia's planned LNG terminal at Omisalj in the Adriatic."

TRANSIT COST

It's safe to say that completion of the internal EU gas market would go a long way to solving the problem of overdependence on Russia that persist in some Eastern European countries.

Of course, it is still a bitter pill for existing transit countries, such as Poland, Slovakia and Ukraine, to see their gas transit income reduced. For Gazprom, however, the Nord Stream route simply makes economic sense. According to Paul Corcoran, Financial Director of Nord Stream 2 (who held the same job with Nord Stream 1), transit through Nord

Stream 1 is already cheaper than through Ukraine. "The transit cost of Nord Stream 1 is €1.86 per 1,000 cm per 100 km. For Ukraine it is €2.26 per 1,000 cm per 100 km. And as Gazprom is half owner of Nord Stream 1, half of the cost comes back to the company in the form of dividends. Not to mention that Ukraine have proposed to more than double their tariffs. But it is also in the interest of European consumers that gas is delivered via the most cost-efficient route."

Corcoran expects that transit costs for Nord Stream 2 will be similar to those of Nord Stream 1. He adds, "It angers me when I read statements that Nord Stream 2 is expensive and uneconomic. It's not. Looking to the future it's a very good investment."

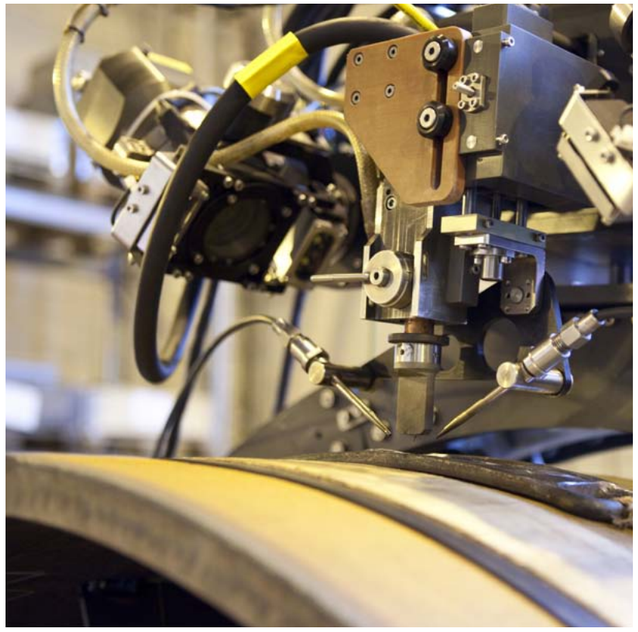
What about the geopolitical dimensions of Nord Stream 2? There is no denying that the political situation around Ukraine and the EU's relations with Russia have changed for the worse after the Russian invasion of the Crimea in 2014. But the question is whether that is an argument for the EU to try to stop Nord Stream 2. There are many economic relations between Russia and Europe going on (think of oil deliveries!) but no one advocates ending them because of geopolitical tensions.

Gazprom is routinely accused by critics of "using gas as a political weapon", but the question is whether that is true. Katja Yafimava, Senior Research Fellow at the Oxford Institute for Energy Studies, asserts in article for the Istituto Affari Internazionali (December 2015, http://bit.ly/2ceoFhz): "There is no evidence at present that Gazprom cut or reduced supplies in the past to those European countries that were paying for their gas imports in full and on time at a price specified in their contracts, which makes the assertion that Russia has used the gas weapon towards European countries problematic."

Likewise, Marco Siddi, Senior Research Fellow at the Finnish Institute of International Affairs (FIIA) has written that "the claim that Russia's pipeline politics constitutes a geopolitical threat for Europe is exaggerated." Tim Boersma, Fellow in Foreign Policy at the US-based Brookings Institution, has described "concerns about Russian gas" as "a relic from the past", given the changes in the European gas market.

> "RUSSIAN GAS MAY END UP COMPETING WITH RUSSIAN GAS"

The pipeline segments are welded together in several automated steps inside the underwater habitat. All welding operations are controlled from the dive support vessel, and assisted by technical divers. Photo Nord Stream



In any case, even if some policymakers in Brussels or some EU member states regard Nord Stream 2 as a geopolitical issue, this does not necessarily mean they have the legal means to stop the project. As Severin Fischer, Senior Researcher at the Center for Security Studies at ETH Zurich, has written: "in a community that is based on the rule of law, the rule of law should apply to all actors in the same way. In the end, this means, that economic activities in the range of the legally defined framework should be assessed under the existing regulatory criteria, but not under normative categories of good or bad".

WITHIN BUDGET

Paul Corcoran makes the same point. "Political processes should be disconnected from the legal framework", he says. "The legal framework for Nord Stream 2 is the same as that for Nord Stream 1. It is based on UNCLOS (the United Nations Convention on the Law of the Sea), which gives the right to lay cables and pipelines on the seabed in Continental Shelf areas. Nord Stream 2 will pass through the Continental Shelfs of five countries and the territorial waters of Russia, Germany and a small part of Denmark. If we obtain the required environmental permits, we will get permission from these countries to build the pipeline, just as we did with Nord Stream 1."

Nord Stream 2 will submit permit applications in early 2017. Corcoran is confident that they will be able to obtain the permits at the end of 2017. At the end of 2019, Nord Stream 2 should be operational, according to plan. "We built Nord Stream 1 on time and within budget. We will do the same with Nord Stream 2." «

Adnan Amin, Executive Director IRENA:

“CLIMATE NEGOTIATORS STILL HAVE MUCH TO LEARN ABOUT THE ENERGY TRANSFORMATION”

By Karel Beckman

Photo Asian Development Bank

“Eveything we have seen is pointing to transformational change in the energy sector”, says Adnan Z. Amin, Director-General of the International Renewable Energy Agency (IRENA). “We don’t need a miracle, it’s already happening.” In an interview with World Energy Focus, Amin, under whose leadership IRENA has become the world’s fastest-growing intergovernmental organisation with over 170 member countries, says that renewables are growing much faster than most people realise. “Many policymakers have a very rough understanding of the potential of decarbonisation. Even among climate negotiators there is suprisingly limited knowledge about what renewables can accomplish.”

ADNAN AMIN
Executive Director
IRENA.

Adnan Amin does not make the impression of a man who is in a desperate race to save the world from climate catastrophe. He appears suave and relaxed, in spite of his heavy travelling schedule. He has reason to be: thanks to quickly falling costs, renewable energy is on a global growth trajectory that, as Amin puts it, “no one could have foreseen five years ago”.

Indeed, according to Amin, “the power sector is no longer a problem” when it comes to decarbonisation. We must now turn our attention, he says, to “the end-use sectors” (transport and heating/cooling), questions of market design (“we have graduated from the feed-in-tariff”) and “the next generation of technologies”, for example in storage and infrastructure.

“We don’t think we are overly optimistic”

Amin is convinced that IRENA’s ambitious REMAP scenario (doubling of renewable energy to 36% in 2030) is perfectly realistic. He sees oil companies transforming themselves, believes there is “no more room for coal”, and is convinced the growth of off-grid technologies taking place in developing as well as developed countries is seriously underestimated. He is joined in the interview by Dolf Gielen, Director of the IRENA Innovation and Technology Centre in Bonn.

Bill Gates has said we need miracles to achieve a clean-energy breakthrough. What is your view?
Amin: The miracle is already happening. Everything that we have seen is pointing to transformational change in the energy sector. Costs of solar and wind are coming down rapidly. Last year we were blown away by solar PV prices as low as 5.4 cts/kWh in Dubai and 4.3 cts in Peru. Now we have had a record 2.99 cts in Dubai. Last year saw 8.3% growth in renewable energy capacity. Investment is up. Where Bill Gates has a point is that we now have to prepare ourselves for the next generation of techologies that will lead to us to an integrated energy system that’s sustainable. This means we need innovation and investment in infrastructure, storage, grids, and innovations in market design. We need to take advantage of the great opportunity low renewable energy prices is offering.

According to IRENA’s REMAP scenario (2016), the share of modern renewables in final energy consumption could and should double to 36% in 2030. But the report also notes that if all countries follow the national climate plans (NDCs) they have submitted to the UN, the renewables share will rise to just 21%. This means that growth has to increase six-fold. Is that realistic?
Amin: Yes. Costs of solar PV have gone down 80% in 5 years. Costs of wind and storage are also coming down. Five years ago no one could have anticipated this. And it is still continuing. We have also gained a lot of knowledge on what we need in terms of policy and regulations. Front-runner countries like Germany and Denmark are showing it is possible to integrate renewables into the energy system without major fixes. So we don’t think we are overly optimistic. We just came back from a visit to China. Researchers there think they can go much further than what is in the plans right now. In the US we have seen that Republicans and Democrats agreed to extend the renewable energy tax credit for 7 years. That will have a great impact, we will see a lot of growth in the US. And other countries are following the same path. We may even have been conservative in our outlook.

Dolf Gielen: This is a point that we made in the REMAP – we believe today’s policy plans underestimate what is going on in the market. Take solar. If you add up all the national projections, you get to 500-600 GW in 2030. Today we are 230 GW and adding 50 GW a year. So even at today’s growth rate you will hit 1000 GW in 2030. That’s not rocket science. If you assume some growth, you will get to 1500 GW. And it’s the same in other technologies. Battery storage for example. That’s being taken up by the market whether policymakers believe in it or not. All this is not fully reflected in the national plans. Nor has it been accommodated by the incumbent players.

Amin: Even among climate negotiators there is a lack of comprehension of the potential of renewable energy for decarbonisation. I just came back from a meeting in Paris and I was struck by the fact that even people who have been around for a long time still have a very rough understanding of the

economics of the energy transition today. They tend to look at their own country and not see the larger picture. They still believe renewable energies are too expensive, that they can't be handled by the grid, that there will be large system costs. They say they don't know how to do it. But in the energy community this is not the case at all.

Where do you see the cost of storage going?
Amin: Let me tell you one anecdote. We visited a technology company in China where we were shown a new storage device, comparable to the Tesla Powerwall. We were told this is going to deliver the same kind of storage capability at one-third of the cost. We will certainly see sharp decreases in cost, but it's difficult to predict which technologies will win out and how.

"I DO BELIEVE THAT PEOPLE ARE UNDERESTIMATING WHAT IS HAPPENING IN OFF-GRID"

Gielen: If you look at the price gap between stationary storage and car batteries, that's a factor 2 to 3. So that magnitude of cost reduction is still possible for today's lithium-ion batteries. What I see as a bigger problem is if we all start driving EVs, we will need an awful lot of lithium. At our latest conference there was a lot of buzz about ultracapacitators for cars. If something like that would work where you don't need that amount of materials that would be a real breakthrough.

In countries like the US there is a debate about centralised versus decentralised generation. What do you think is the wave of the future?
Amin: I don't think it's either-or. The trick is to achieve the optimal combination. I do believe that people are underestimating what is happening in off-grid. We have all been talking for many years about 1.3 billion people without access to modern energy services. Nobody ever questions this figure. But when we looked into this recently we discovered there is a lot of investment going into solar home systems, particularly in developing countries. You don't see this in the energy statistics, that's why we looked at the trade statistics. There are thousands of these home systems developed by entrepreneurs. They provide very low-cost basic power services for cell phone charging, refrigeration, and that sort of thing. So we see this picture changing dramatically, although we would still like to see it change more quickly. We need to improve the investment framework in developing countires. The aid model doesn't work. We need to incentivise entrepreneurs to start new businesses. That will lead to new revenues and new skills being developed.

Energy transition is often presented as win-win but surely there are also losers. Do you talk to the international oil companies or fossil fuel producers?
Amin: Yes, we talk to them. We see a huge change in attitude. Their scenarios are changing. They are investing in renewables. They more and more see themselves as energy rather than oil companies. Utilities like Enel are already developing towards a service-oriented model. Oil companies will follow. Oil producing countries also. Why do you think Abu Dhabi hosts IRENA? They are looking at a world beyond oil.

Do you think low oil prices will hinder the energy transition?
Amin: Low oil prices? In the renewable energy sector we are pushing the price down! But very few countries use oil for power generation, so there is no direct relation there. Renewables could form a virtuous combination with gas as balancing fuel. Nobody wants coal anymore. Even countries that are investing in oil are looking for an exit. Investors are beginning to realise that a lot of these assets will be stranded in 5, 6, 7 years.

"Investors are beginning to realise that a lot of these assets will be stranded in 5, 6, 7 years."

What are the most promising developments in market design?
Gielen: We see a clear trend away from feed-in-tariffs (FITs) towards auctions. Auctions have resulted in much better prices. Amazing prices. Although the devil is in the detail: you have to look carefully at how you organise your auction. On the whole in power market redesign there is still a lot of testing go on. We don't think there is a one-size-fits-all solution.

Amin: FITs were essential to bring costs down initially. But they are a long-term fiscal burden. We have graduated from FITs to more market-reflexive methods. You know, the power sector is really not a problem anymore. More important is how renewable energy can change end-use sectors such as mobility and heating.

What is the finish line for IRENA?
Amin: All of us who work in this field are very passionate about what we do. This is not just a job. We believe in what we are doing. Our real job is to support countries in the transition. That job is being made easier by the way technology and economics are working out. If we are successful in positioning the business case for renewables as both a driver for growth and employment as well as a critical plank of climate policy – if this becomes the operating model for the majority of countries – we will have succeeded. «

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Interview Jean-Bernard Lévy, Chairman & CEO EDF

"OUR FUTURE LIES IN A COMBINATION OF NUCLEAR AND RENEWABLE ENERGIES"

By Karel Beckman

EDF is building EPR plant at Flamanville, France. Photo EDF

EDF, one of the largest electricity producers in the world, has embarked on a "2030" strategy developing renewable energy and customer solutions in addition to its large nuclear business. In this exclusive interview, Jean-Bernard Lévy, CEO and Chairman, talks about how he sees global energy markets evolve and why nuclear power will be an indispensable part of the future. "It is my firm belief that EDF's future lies in a generation mix that combines nuclear and renewable energies."

Jean-Bernard Lévy, who became the Chief of Électricité de France (EFD), France's state-owned electricity company, in 2014, has had some turbulent years behind him. Electricity prices in the European market have plunged, and EDF has run into major delays and cost overruns with its new third-generation EPR nuclear reactors in Finland and France. Despite these troubles, Lévy remains upbeat. He believes in the future of the EPR: EDF, which acquired nuclear reactor producer Areva last year, is planning to launch a "New Model" EPR which Lévy says is cheaper and can be built more quickly. At the same time, the company is investing heavily into renewable energies and customer-oriented activities, as part of its CAP2030 Strategy. In the US, EDF is already a partner to firms such as Google, Microsoft and Procter & Gamble.

"I WOULD REMIND READERS THAT EIGHT OF THE WORLD'S STRONGEST ECONOMIES HAVE CHOSEN NUCLEAR AS PART OF THEIR GENERATION MIX"

How would you describe the strategy of EDF in the post-Paris energy landscape? You have something called the CAP2030 Strategy. Can you explain what this is about? What will EDF look like in 2030 and how does that differ from today?
COP21 showed that low-carbon electricity is one of the key solutions for combating global warming. With its generation mix combining nuclear and renewable energies, EDF is already demonstrating that it is possible to be a major global electricity generator yet emit very little CO_2. As part of the CAP 2030 strategy that I have launched, EDF will continue its development of low carbon emitting energy production whilst at the same time retaining a nuclear base and speeding up the development of renewable energies. Another priority for CAP 2030 is to support customers and communities in their energy transition. I am convinced that we will still have a centralised and secure system in the future but it will be supplemented by a more intermittent and local decentralised system, in which customers will take charge of their consumption. In readiness for this, we must press on with research into electricity storage and smart electricity systems, by capitalising, in particular, on digital technology.

How will EDF's energy mix evolve? How will it change from now? How big will renewable energy become?
It is my firm belief that EDF's future lies in a generation mix that combines nuclear and renewable energies. We are already the leading generator of renewable electricity in Europe and our goal by 2030 is to double our installed capacity worldwide, increasing from 28 to 50 GW. In recent years, we have been investing as much in renewables as in new nuclear projects. Nuclear offers us great flexibility and a very high level of availability, and renewable energies complement this perfectly as we are able to adjust our nuclear generation effectively in order to facilitate their development.

Companies like Eon and RWE have split up – they have one business focusing on renewables, grids and retail, and one business focusing on centralised thermal and nuclear generation. Do you see this as a model for EDF or for other utilities around the world?
Of course this trend is closely watched by the whole sector, in order to assess how these companies develop, to what extent shareholders could benefit and how it influences the market. As regards EDF, the group's strength offers us resilience in difficult market conditions and we intend to retain our integrated model by combining regulated activities with activities subject to market prices. We are in fact the only major energy supplier [in Europe, editor] to have consistently shown a profit over the past ten years.

EDF has traditionally been one of the world's leading nuclear energy companies. France has put a limit on nuclear expansion domestically. Does this make export of your technology crucial to future growth?
The aim of our reorganisation of the French nuclear subsidiary, with the takeover of Areva NP, is primarily to improve the effectiveness of our export offers. In the future, EDF will have full and sole responsibility for the design of reactors. Our responsibility over the long term is to be in possession of a competitive nuclear fleet and the very best skills, not only for the renewal of the French fleet but also to meet the needs of other interested countries. I would remind readers that eight of the world's strongest economies have chosen nuclear as part of their generation mix.

You are encountering a lot of problems with the EPR technology in Finland and France (Flamanville). Is the EPR the future of French nuclear technology? If it doesn't catch on, what will be the effect?
Without question, EPR is a technology of the future, combining performance, safety and predictability. We should not confuse the difficulties inherent in a large project such as Flamanville - due in large part to the fact that it is a pilot power plant - with the considerable benefits offered by EPR technology which is at the cutting edge of 3rd generation reactors. The EPR plant will be a key element in our strategy for renewal of the nuclear fleet in France by 2020 and beyond. On the strength of our experience in the construction of the first EPRs, we will be better placed to launch the "New Model" EPR. The NM EPR which we are working on with Areva will be a reactor offering the same characteristics as today's EPR but it will be cheaper to build with optimised construction times and costs.

JEAN-BERNARD LÉVY
CEO EDF

How do you see nuclear power evolve globally?
Positively. The nuclear industry is expanding rapidly throughout the world; 68 reactors are currently under construction (a third of them in China). In fact, nuclear energy offers many advantages: prices are stable and it is not impacted by market volatility, as in the fossil energies market for example. Nuclear also contributes to the energy independence of those countries that espouse it. Nuclear is an advantage for energy transition, as this energy does not emit CO_2 and it complements perfectly the development of intermittent renewable energies.

How important will the non-European market be to EDF in future? You have entered the Chinese wind energy market? What are your expectations there?
Our CAP 2030 strategy outside of Europe has been rolled out over the last two years at a very sustained pace. Our objective is to boost the international development of the Group, by delivering low-carbon offers and solutions: nuclear- and renewable-generated electricity, tailored and innovative energy services. Beyond our domestic markets (France, Great Britain, Italy and Belgium), we have accelerated our expansion into high-growth countries. You cite the example of wind power in China; we could also mention our projects in India. At the same time, we also want to support energy transition on the African continent, with low-carbon projects such as the Nachtigal Dam in Cameroon which we are developing with the Cameroon government and the World Bank. Furthermore, in the United States for example, we are already one of the sector's leading operators and partner to major American firms such as Google, Microsoft and P&G. So EDF's international development is well under way and I intend to continue this momentum in the coming months and years.

How is your business model developing in retail?
EDF has to adapt constantly to the major changes seen in the electricity sector: price volatility in the wholesale electricity market, institutional and regulatory changes, but also the new expectations of customers and communities in terms of energy. In order to retain its leading position, EDF places customers front and centre by delivering increasingly innovative offers that are consistent with new electricity uses, such as the Mon Soleil & Moi self-sufficiency programme. In this way, EDF is supporting businesses and local authorities by adapting to their needs, in particular in the areas of energy services and digital technology. For domestic customers, EDF is innovating by offering them digital solutions to help them optimise their consumption and make savings, like the e.quilibre digital dashboard for example.

"THE NEW MODEL EPR WILL BE A REACTOR OFFERING THE SAME CHARACTERISTICS AS TODAY'S EPR BUT IT WILL BE CHEAPER TO BUILD WITH OPTIMISED CONSTRUCTION TIMES AND COSTS"

With regard to energy policies, what are you expecting of policymakers? In Europe, with its high degree of variable renewables, the integration of renewable energy in the electricity system is an important issue. How can this best be done? Do we need capacity markets to serve as backup?
In Europe we need an incentivising, powerful and predictable economic signal, in the form of a CO_2 price corridor for example, as suggested by the French government. The aim is to move towards a fundamental shift in favour of the lowest carbon energies. At the same time, we have to take measures to secure the electricity supply of Member States, especially against the backdrop of a continuously rising share for renewables, which is in itself a highly positive development. Unfortunately, energy markets today are depressed and they provide no incentive to maintain or install generation capacity, or to invest in demand management. There is an urgent need for the effective operation of these markets to be restored by means of the capacity markets which have become indispensable in order to guarantee «

TOWARDS A FLEXIBLE AND GLOBAL LNG MARKET

By Seung Hoon Lee, CEO Korea Gas Corporation

Pyeongtaek LNG ship.
Photo Kogas

To ensure growth in gas demand in the post-Paris world, we need a globalized, competitive and flexible gas market, writes Seung Hoon Lee, CEO and President of Korea Gas Corporation. Asia should follow the example of Europe and create trading hubs and avoid outdated practices such as destination clauses.

At the COP 21 meeting in Paris last year, about 200 countries agreed to limit global warming to within a temperature rise of two degrees Celsius by reducing greenhouse gas emissions. As a consequence, demand for natural gas is expected to rise, since natural gas will substitute for fuels with higher emissions, such as coal and oil.

According to a business-as-usual forecast from consultancy Wood Mackenzie ("reference sceniaro"), the average annual growth rate for 2016-2030 is expected to be 1.4% for coal, 0.6% for oil, 1.9% for gas, and 3.5% for renewables. However, if they factor in the implications of the Paris Agreement, the demand for natural gas and renewables is set increase at 2.5% and 4.5%, respectively, in comparison with lower demand for coal at -1.9% and oil at -0.2%.

This does not mean everything will be smooth sailing for natural gas. In particular, gas will face competition from cheap coal and subsidized renewable energy. In order to cope, natural gas suppliers should improve on price competitiveness and many aspects of business flexibility.

Competitiveness and flexibility are particularly important for liquefied natural gas (LNG), which must go through an extra process of costly liquefaction and transportation. To achieve this, it is necessary that the currently segmented markets of LNG are consolidated into a global commodity market which is transparent, competitive, and flexible.

MORE COMPETITIVE

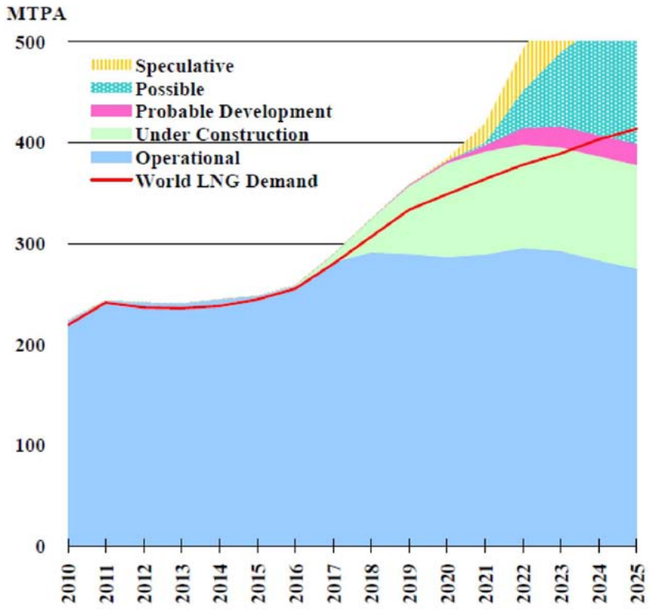
As yet, global LNG trade and liquidity levels are fairly weak with current LNG trading volume at only 10% of global gas consumption, compared with the seaborne oil trade which accounts for 40% in global oil consumption. The volume of global LNG trade will rise sharply in the next 5 years (2016-2020). In Australia, the US and other countries, about 30 new LNG trains will be put into operation, which will increase global LNG production capacity by about 50% (150 million tons) compared to that of 2015. Global traders such as Gunvor, Glencore, Noble Group, Trafigura, and Vitol have already entered the LNG trading market and are set to expand their activities.

SEUNG HOON LEE
CEO Korea
Gas Corporation

In addition, the number of buyers in the Asian LNG market will increase, from 33 at present, to 55 in 2020. Consequently, the global gas market will become more competitive and developed in the next 5 years with more buyers and sellers. Increasingly flexible LNG supply such as uncommitted LNG, portfolio LNG, and USA LNG will lead to the rapid development of flexibility and globalization of the LNG market over the next 5 years. LNG spot and short term trade will expand from about 68 million tons in 2015 to more than twice that volume in 2020. Thus segmented LNG markets will move towards a more liquid and unified global market.

INCREASED FLEXIBILITY

It is anticipated that the increase of large scale LNG supply facilities and the slowdown of gas demand in Asia will lead to substantial oversupply by the early 2020s. In addition, about 50 million tons of existing LNG contracts will expire within 5 years and about 30 million tons of uncommitted LNG is expected to show up in the market.



> EUROPE HAS MADE TREMENDOUS EFFORTS TO ESTABLISH A COMPETITIVE ENVIRONMENT FOR GAS TRADE. IN ASIA SIMILAR EFFORTS ARE NEEDED

Keen competition among LNG sellers for securing buyers will naturally push sellers to ease trading conditions, which will result in increased flexibility of LNG contracts. In consequence, various new pricing schemes and contract terms will be adopted when new LNG contracts are made, and this will further increase flexibility of the LNG market.

One of the key elements of LNG market flexibility is to allow resale and arbitrage trading by easing or exemption of the destination clause. The easiest way to meet buyers' increased requirements would be destination flexibility. Therefore, it is expected that substantial change in the destination clause will take place, probably in 5 years' time.

ABSURD DIVERGENCE

Presently, Asian gas prices are linked to oil prices, and a rise in oil prices could create absurd price divergence between Asian prices and those of other regions. This would perpetuate the so-called 'Asian premium', which could mean that the expansion and progress of the competitive LNG market could be stalled. For this reason, all regions of the world should have pricing schemes that are linked to the global gas market. One way to achieve this is to strengthen the LNG trading hub in Asia.

We can look to Europe as an example. Since the late 1990s, Europe has made tremendous efforts to establish a competitive environment for gas trade through negotiations with major gas suppliers and building gas trading hubs. In Asia, similar efforts are needed so that new LNG projects may avoid rigid and outdated practices and a more competitive Asian gas market can emerge. «

Interview Paddy Padmanathan, CEO ACWA Power

HOW A PRIVATE SAUDI COMPANY GREW INTO AN INTERNATIONAL ELECTRICITY PLAYER

By Alex Forbes

In just over a decade, Saudi Arabia's ACWA Power has grown into a company with assets worth more than USD 30 billion, representing electricity generation capacity of 22 GW and water desalination capacity of 2.5 million m3/day. Now an international player with assets in 12 countries across three continents, it has ambitious plans for further growth. In this exclusive interview CEO Paddy Padmanathan explains the company's strategy and its growth prospects in an increasingly carbon-constrained world.

PADDY PADMANATHAN
President & CEO
ACWA Power

Until 2004 the Saudi Arabian electricity market was much like many other places, tells Paddy Padmanathan, a professional civil engineer who has worked for ACWA Power since 2005. In those days if the Saudi government wanted electricity provided at a particular place, it would put out to tender a construction project. But the business of investing in the plant, and operation and maintenance remained in the hands of the government.

Then in 2004 the government decided to start bringing the private sector in to take responsibility for ownership and operation – the full value chain. ACWA Power was founded to take advantage of those opportunities. Today it is owned by a number of international and Saudi conglomerates along with Sanabil Direct Investment Company, owned by the Public Investment Fund, and the Saudi Public Pensions Agency. The business model, which nicely dovetailed with Saudi Arabia's programme, was to become a developer-owner-operator. "We don't want to operate assets owned by other people", says Padmanatah, "though we are happy to share ownership; and we don't want to invest in assets operated by other people."

The government also set up a regulator, the Electricity & Cogeneration Regulatory Authority (ECRA), which has been working at understanding how best to move forward to a completely liberalised market. In its economic transformation plan for 2020, Saudi Arabia says that by 2020 power generation should be entirely in the hands of the private sector.

Your company has grown impressively quickly since being founded. What plans do you have for future growth?
We don't want to grow for the sake of growing. But we think that there is a size at which we can be more efficient. So we need to get to a critical mass. Since we were founded in 2004 we have had three five-year plans. We've exceeded the first two, but the third is a bit more ambitious. By 2018 we want to have 40,000 MW of generation capacity and 5 million m^3/day of desalination capacity. The next phase would probably be moving towards 70,000-80,000 MW and 10 million m^3/day.

Installation of a parabolic trough at ACWA Power's 200 MW Noor II CSP project, Ouarzazate Solar Complex, Morocco

In 2015 you increased your power generation assets by 9 GW. Why was it such a remarkable year?
We focused our first five years in Saudi Arabia. We tendered five projects and won all of them. Very unusual – particularly as these are not little things.

The first was a $2.4 billion transaction, an integrated project: 900 MW of power and 880,000 m3/day of desalination. In 2009, we said: "OK, we've exceeded our expectations. It's time to grow beyond the kingdom." So we stepped out into the Gulf Co-operation Council (GCC) region, Turkey, Morocco and southern Africa.

Through the following five-year period we were typically working on three projects at a time. That trajectory suddenly morphed in 2015 to 10-12. Our win rate has gone down, from 100% to 75%, but that still means we're doing a lot. Typically, we are bidding for 12 projects and winning nine.

How do you go about selecting countries to invest in? And what proportion of your business is outside Saudi Arabia?
Just under 50% of our business is outside Saudi today. Our desire is to maintain that kind of balance. It's going to be challenging because Saudi Arabia has such an ambitious privatisation programme.

When we stepped outside Saudi Arabia we said to ourselves: "We need to find places where we can grow a portfolio of around 5,000 MW fairly quickly, in 5-10 years, because that's a critical mass for us to be able to autonomously run it." So we need a market that is growing, with respect for law, welcoming to private investment, welcoming to foreigners. But beyond all this we were looking for places where we could capture that kind of volume.

We also needed to make sure that we could get plants built efficiently so that tariffs are sensible. So we are looking at places that have some industrial capacity, some ability for us to attract long-term money.

Another criterion is that we can't run plants with expatriates for 30 or 40 years. So I need to be able to find people in that country, not necessarily power plant experts, who are interested in learning, interested in my sector.

This complicated set of mapping brought us to Morocco, Turkey, South Africa, Botswana, Mozambique and Namibia. Now we have stepped into the Far East, Vietnam and possibly Indonesia.

Your chairman says that ACWA Power is "passionate" about the role it plays in the socioeconomic development in the countries in which it operates. How do you approach developing that role?

It's absolutely not about charity for us. It's absolutely not about feeling good. It's entirely about self preservation. We invest billions of dollars in power plants. Now, power plants end up getting built typically in the middle of nowhere. Typically, the people who live in the middle of nowhere tend to be the poorer people in those countries.

We have to be there for 40 years. No amount of fences, security cameras or guard dogs are going to keep us safe. Somehow we have to work with this community and bring them up alongside us. That sounds expensive but it's not. We're going to spend $2 billion there; why shouldn't a little bit of that money rub off. You're going to have 4,000 people building this plant. You're going to need eggs in the morning. Why do you need to truck eggs in? Start creating community enterprises. We support all sorts of things.

Your electricity generation assets utilise a range of technologies and fuels. How do you go about selecting energy sources for your investments? Which technologies currently make up the bulk of your asset portfolio? And how do you expect the balance to evolve?
From day one we set ourselves up to be a generator of electricity and producer of desalinated water. So by definition we are technology neutral and fuel agnostic. It's not my business to tell you what to do. If you want me to burn wood chips, I'll find a way.

Now, of course there are a couple of other parts to it. The first is that as we put more and more money into the economies we have invested in, it's in our interest that they grow and prosper. Key to economic growth and social stability is provision of adequate electricity at the lowest cost possible. So we do advocacy, and we participate in the World Energy Council, and we recognise the role that renewable energy will play as time goes on. Today our portfolio is about 60% natural gas, 30% oil, 3-4% coal, and 6% renewables. By 2030 I can see that we'll end up with as much as 40% renewables, 40% gas, 15% coal and 5% oil.

Following the agreement reached at the UN COP 21 talks in Paris at the end of 2015, what impacts do you expect climate change policies to have on your business?
We are already seeing significant change in the fuel mix and it will go at a faster pace than people expect. Renewable energy will become a very significant part of our portfolio very quickly.

How will moves towards greater energy efficiency impact your business?
Efficiency is already playing a big role in reducing consumption. In the markets that we serve, all that will mean is that the growth rates will come down. So in Saudi Arabia,11%/year will probably come down to 3-4%/year – still a lot.

Are you concerned that some of your fossil fuel assets may become stranded as the world moves towards an increasingly carbon-constrained energy system? Or do you see carbon capture and storage (CCS) becoming a mainstream technology?
Are we concerned about assets getting stranded; the one-word answer in our case is "no" – because ACWA Power is a bulk service provider delivering to credit-worthy off-takers on long-term contracts. I've moved that risk to the customer.

The reality is that in December last year 195 nations signed a commitment that by 2050 they would have decarbonised power generation to net zero. So, by definition, any fossil fuel plant that gets built today is a stranded asset – because if it has a technical life of 50 years, and 2050 is 34 years away, you've lost 14 years even before you start.

"YOU'RE GOING TO NEED EGGS IN THE MORNING. WHY DO YOU NEED TO TRUCK EGGS IN?"

But there are parts of the world where we don't have a choice – parts of Africa, parts of Asia, where coal is the economic solution at the moment. So we need to figure out how to handle coal efficiently. CCS thus, will have to play a part. Costs are very high but with serious deployment of half a dozen plants you can start to bring costs down. I place my faith on this subject on China. They are building renewables as fast as possible now. But they are stuck with an enormous portfolio of coal plants that they can't shut down. So I am confident they will invest in CCS and help to drive the cost down to an affordable level.

"It's not my business to tell you what to do. If you want me to burn wood chips, I'll find a way"

Initially, CCS will be for coal, but once we have cracked coal it will be easy to deal with gas. We've also got to figure out how to use that carbon, not just capturing it and putting it into the ground because that will always just be a cost.

In solar power, do you have a preference for concentrated solar power (CSP) or photovoltaic (PV) projects?
For PV, utility-scale batteries are not there yet. So PV is there for time-of-use, when the sun is shining. We have proven that we can deliver CSP at a cost that is coming down. It's dispatchable, we can move heat into the store and bring it back up in the night. CSP is very valuable as a dispatchable renewable energy technology.

We are going to continue to invest in both. But we are going to invest more attention and effort in CSP. We need to do a half dozen more projects to get the price down to single digits. «

Image above: Typhoon Haiyan hit the Philippines in 2013. Photo Asian Development Bank

Interview The Atlantic Council

By Alex Forbes

THE GRIM IMPLICATIONS OF FAILING TO GET TO GRIPS WITH CLIMATE CHANGE

The implications of climate change targets not being met are massive migration, the potential for resource wars and "a further disintegrating of the international order", according to Richard L. Morningstar, Founding Director and Chairman of the Global Energy Center and David Koranyi, Director of the Eurasian Energy Futures Initiative. Both institutes are part of the Atlantic Council, a Washington DC-based think tank for geopolitical debate and diplomacy. Morningstar and Koranyi see that the required energy transition is happening, but warn that "the time horizon is extremely short".

The geopolitical issues surrounding energy – compounded as they are by the urgent need to mitigate climate change and the "energy-water nexus" – have never been as complex and intractable as they are today. They are a major focus of the Atlantic Council – a non-governmental organisation set up during the era of US President John F. Kennedy to focus on trans-Atlantic relations, which over time has become global in reach. World Energy Focus spoke with two of the Council's leading figures on energy.

Richard L. Morningstar, Founding Director and Chairman of the Council's Global Energy Center, served as the US ambassador to the central Asian Republic of Azerbaijan from 2012 to 2014, and before that was the Secretary of State's Special Envoy for Eurasian Energy. Originally an attorney, he has held a number of other senior diplomatic posts that make him an expert on energy issues in the former Soviet Union, Central Asia and the European Union.

"OPEC'S INFLUENCE ON GLOBAL MARKETS AND PRICING HAS DIMINISHED AND WILL DIMINISH FURTHER"

His colleague David Koranyi is Director of the Council's Eurasian Energy Futures Initiative, a former Hungarian national security adviser and an expert on the geopolitics of energy and European and US foreign and energy policy.

What are the main geopolitical challenges facing the world today?
David Koranyi (DK): One is climate change-induced conflicts and ensuing migration. Syria is an example often put in the context of climate change-induced droughts, spiking food prices, ensuing riots and protests, and then the civil war. In many ways, the conflict and the huge migratory pressures in Europe are the indirect result of climate change already. I expect to see this more often in the future, especially if mitigation efforts fail. The second is the stability of energy-producing countries highly dependent on fossil fuel revenues. Some of the more optimistic forecasts show that the penetration of electric vehicles could be a lot higher by the mid 2020s or even the early 2020s than many expect. So there could be a huge difference between forecast and actual oil demand. We already see the enormous pressures on producers like Venezuela and Nigeria. What happens in the next decade if oil demand is more depressed, if low prices are the new normal for the foreseeable future? What does that do to regional and global stability?

Richard L. Morningstar (RLM): I would include Russia – because, again, what happens if Russia has to deal with $20 or $25/barrel oil prices in the future. I'm not saying that's going to happen – but there is the potential, given what could be a revolution in transportation technology. On climate change I would add that there is a direct relationship between climate change, geopolitics and global security.

From what you've both said, the implications of climate change targets not being met are probably massive migration and the potential for resource wars. How concerned should people be?
DK: A lot. To these two concerns, let me add a third. The international liberal world order established after the Second World War is already under attack from various actors and its two key anchors, the European Union and the United States, are struggling with internal pressures in the form of populism and resurgent nationalism. Donald Trump [the Republican presidential candidate in the forthcoming US election] is a manifestation of that challenge from within. If international climate mitigation efforts fail, it will have a further disintegrating effect on the international order – a world where countries are more introspective, where multilateral institutions are more dysfunctional, where international co-operation on protecting the global commons is more challenging, where countries and many actors will not trust each other.

RLM: Coordination is essential, and it will be particularly important for developed countries to provide assistance to lesser developed and least developed countries to meet goals. The project that Secretary Moniz has started, on Mission Innovation, is also very important – where countries come together, provide significant research funds, and coordinate on projects relating to new technologies, which ultimately will have the best chance of a game-changing effect.

You've painted a pretty grim picture here. How much reassurance can we take from the international agreement made in Paris last December?
DK: I am still optimistic that we can pull this off. But the time horizon is extremely short. If you look at the timescales for previous energy transitions, we have very little time. The transition will happen – but will it happen soon enough to prevent the catastrophic consequences of climate change? If you look at the timescales for previous energy transitions and the climate clock, we will have to go well beyond Paris.

OPEC's policy – led by Saudi Arabia – to fight for market share rather than defend price has seen oil prices collapse, with major impacts on producers and consumers – for example, Venezuela and Nigeria. Is OPEC still relevant in an era of supply abundance driven by the North America shale oil revolution?
DK: OPEC's influence on global markets and pricing has diminished and will diminish further. I don't see how internal unity will be restored within OPEC and in my mind Saudi Arabia's decision to stick to its production levels and defend market share was as much about protecting its market share based on

RICHARD MORNINGSTAR
Founding Director and Chairman of the Council's Global Energy Center

DAVID KORANYI
Director of the Council's Eurasian Energy Futures Initiative

previous bad experiences when cuts were agreed but nobody else held to them. And, of course, about Iran returning to the market.

The US is well on its way to becoming a major LNG exporter – and, importantly, more commercially flexible LNG supply. Will this lead to Europe becoming a gas battleground as LNG competes with Russian pipeline gas exports?
RLM: The key point is the availability of US LNG exports. Just the fact that LNG can be shipped to Europe and other parts of the world already has had a tremendous effect on competition. In Europe just the availability of LNG has resulted in Russia lowering its gas prices. There's the famous anecdote of when the Klaipėda LNG terminal opened in Lithuania, Russia came back and re-negotiated its price. From a consumer standpoint, an availability standpoint, and diversification it's very important.

DK: LNG is going to act as a price ceiling for Russian gas in Europe. It is already forcing the Russians to completely re-think their strategy – maybe moving from a price maximizing strategy more towards a volume strategy. It may also lead to changes domestically in Russia, in market liberalisation and maybe the lifting of the export monopoly for Gazprom, which eventually could lead to the demise of that company as we know it today. But there are some deficiencies in terms of infrastructure availability in Central and Eastern Europe. There's an important task ahead for the EU to complete interconnections to make sure that these markets are accessible for LNG.

Ambassador Morningstar, you have written recently on "the pluses and minuses of Nord Stream 2" – the new pipeline that would bring gas from Russia to Europe. With gas supplies looking so abundant that we face a glut until the early 2020s, and with Europe seen as a "market of last resort" for LNG, is now a good time for such an investment?
RLM: No, for many reasons. There is a serious question as to whether there is a commercial need for Nord Stream 2. Some of its advocates have said gas production is going to decrease in Europe, while demand is going to increase, so it's going to be important to have that source. I would argue that there are many sources that could solve any such need. There are other reasons why Nord Stream 2 would be a mistake. It would not help Europe in the diversification of suppliers, it would have an adverse effect on Ukraine, in possibly eliminating $2 billion a year in transit fees, and it could make gas going back to Central and Eastern Europe via reverse flow more expensive. Also, there is a geopolitical aspect to this. It would be a very bad signal to approve Nord Stream 2 while Russia is occupying Crimea and is active in eastern Ukraine. It would show weakness on the part of Europe.

What are the prospects for development of the Southern Corridor of gas supply to Europe – from Central Asia and perhaps Iran?
RLM: Today, the Southern Corridor is important but will not have a huge effect on Europe. The present Shah Deniz project would provide 6 Bcm to Turkey and 10 Bcm onto Europe. As we look into the future, what might be added to the Southern Corridor? I don't think it's likely in the foreseeable future that Turkmen gas will be part of the Southern Corridor. There are opportunities for more production in Azerbaijan that could contribute significantly going into the middle 2020s. Hopefully at some point gas from the KRG and the Eastern Mediterranean will become part of the Southern Corridor. With respect to Iran, it doesn't appear to be one of their highest priorities right now because they're looking to their own domestic needs for gas, regional needs, and the possibility of LNG exports.

How will the outcome of the US election affect developments in the energy world?
DK: Let me be blunt. As in so many other respects, the election of Donald Trump as US president would be catastrophic in the climate change and energy space. It would significantly jeopardise the moral leadership of the United States and its standing in the world. If Clinton is elected, that brings up a very interesting prospect, depending on how the political setup in Congress looks. That will determine to what extent she will be able to lead on a more robust US climate policy, and whether there will be support, perhaps even on a bipartisan basis, in Congress. The latter may sound crazy and far-fetched as of now, but there are some encouraging conversations under the surface going on inside and close to the GOP about a more forward leaning approach on climate. There is increasing recognition in business circles, close to the Republicans, that the current positions will not only be vulnerable from the scientific standpoint but also politically harmful given how US public opinion is shifting on climate change. «

"AS IN SO MANY OTHER RESPECTS, THE ELECTION OF DONALD TRUMP AS US PRESIDENT WOULD BE CATASTROPHIC IN THE CLIMATE CHANGE SPACE"

AFTERWORD

AN ENERGY REVOLUTION THAT WILL TRANSFORM THE WORLD

Younghoon David Kim, sets out his vision for the chairmanship 2016-2019.

YOUNGHOON DAVID KIM
Incoming Chair of the World Energy Council

The World Energy Council has long discussed the concept of the Energy Trilemma – the best way to deal with the sometimes conflicting goals of achieving energy security, delivering affordable energy and reducing carbon emissions.

But a much bigger trilemma is facing the global energy sector: how decisions on energy supply relate to water and food security, particularly in the developing world. The United Nations calls this the 'water, energy and food nexus', highlighting the interdependence of these main building blocks of society. Discussions about energy must now take into account the role energy can play in promoting food and water security.

So the goal that the global energy sector must now pursue is the creation of energy systems that harmonize with food and water sustainability goals, and building economies resilient to breakdown in the water-energy-food nexus – such as the threat of drastic climate change, for example.

One approach is to identify the most appropriate energy technologies that complement local food and water security needs. Low-tech energy solutions can be particularly effective in developing economies and can be as simple as providing clean cooking stoves fueled by eco-friendly briquettes. Micro-hydro projects, small gas-fired generators and solar panels are other proven technologies that work in this environment.

Of course, high-tech concepts also have a part to play. There are many frontier energy technologies that are being explored, promising increased energy efficiency and reduced carbon footprint. These technologies include high-altitude wind power, grid-connected tidal power machinery, power produced from nuclear waste, nanotechnology, and even microbial energy research.

One of the goals of the World Energy Council is to nurture the next generation of energy leaders. This means that we need to inspire younger generations with passion for, and devotion to, innovation in the energy sector. Electricity was one of the greatest inventions that transformed the world between 1870 and 1940 – probably the most revolutionary economic period in human history. Many of its pioneers were self-taught, including Michael Faraday, Nicolas Tesla and Thomas Edison. We can take inspiration from the history of our sector and break new ground by harnessing raw talent from all levels of society around the world.

I believe that the World Energy Council can play a vital role in forging connections between innovators and investors in the energy sector, and stimulate ingenious collaborations between the food, energy and water sectors.

The World Energy Council is uniquely placed in this regard. We are an international non-governmental organization that enjoys the support of the private sector, bridging the divide between the thinkers and the doers, those with the brightest minds and deepest pockets. Close encounters between inventors and investors will spark collaborative innovation and accelerate the global energy transition towards future-proofed energy systems.

The global energy sector must tackle many issues in the coming years, including decarbonising the energy supply mix, increasing energy access and affordability, and improving energy efficiency. All of this will contribute to a paradigm shift from a carbon-based economy based on combustion to one based on new sources of energy and new modes of power generation and distribution. The World Energy Council stands ready to address these issues and bring about an energy revolution that could surpass even the industrial revolution in transforming the world. «

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Nord Stream 2
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Natural gas is a sustainable solution to help the EU to meet its future energy needs and achieve its climate goals. As global competition grows and domestic gas production declines, Nord Stream 2 would enable the EU to benefit from access to reliable and competitive supplies of gas from the world's largest reserves in Russia, in order to meet the increasing demand for imported gas.

Nord Stream 2 is a natural gas pipeline to deliver energy security for the long term.

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