

# WORLD ENERGY FOCUS

Insights from and for the WEC's global leadership community

ANNUAL 2014



WORLD ENERGY COUNCIL  
CONSEIL MONDIAL DE L'ÉNERGIE  
*For sustainable energy.*



## DISRUPTIONS IN THE ELECTRICITY INDUSTRY

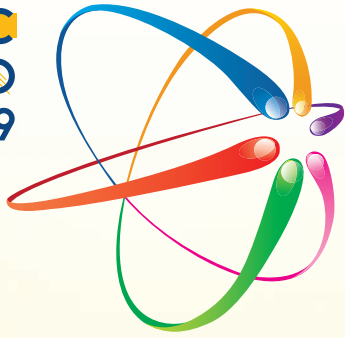
How to prosper in the green, clean energy world

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# WELCOME TO THE VERY GLOBAL BRAZILIAN ENERGY

All the components are in place for a flawless Energy World Congress in Rio de Janeiro in 2019. First, the cultural diversity and the hospitality of the Brazilian people, who will make you feel at home, wherever you come from. Then, there is the structure of a city that regularly and impeccably hosts major events, such as the 2014 World Cup and the 2016 Olympics. On top of all that, there is the breathtaking beauty of the Marvelous City, as Rio is known. It is the perfect environment for briefings on technology and countless commercial opportunities stemming from the vibrant Brazilian economy, coupled with priceless technical visits, regardless of your field in the energy business. Last but not least, there are outstanding options for leisure and tourism to recharge your own energy levels after such a productive congress. In 2019, bring your energy to Rio. And find out that you already are part of the very global Brazilian energy.

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By Marie-José Nadeau,  
Chair, World Energy Council

One year on from the hugely successful World Energy Congress in Daegu, South Korea, the energy sector has witnessed an increase in both complexity and uncertainty.

But let me start on a positive note. Over the last year, our understanding of the scale and sustainability of the North American unconventional revolution has vastly improved. Industry trends in North America have effectively destroyed the myth of peak oil. Not only does the world have plentiful supplies of hydrocarbons but global reserves are more evenly balanced, easing - but not ending - our energy dependence on regions subject to geopolitical shocks.

However, this new certainty does add another complexity, because, according to the latest climate science, on current trends if all the current proven reserves of hydrocarbons were used, the resultant rise in global greenhouse gases (GHGs) would lead to an unparalleled rise in global warming.

As we meet in Cartagena in the run-up to the climate summit in Lima, it is clear more than ever the energy sector needs to stand up and take centre stage in this debate. Without the active involvement of the energy sector, there cannot be a definitive agreement at COP21 in Paris next year. The reason is obvious: the energy sector is the single biggest contributor to GHGs and consequently, more than any other sector, holds the key to the solution.

There is urgency. According to the WEC's World Energy Scenarios, at best we will see a near doubling of GHG emissions by 2050. At worst emissions could increase by over four-fold. In the face of such a challenge, it is clear that energy ministers need a place at the top table.

In the meantime, the industry cannot and should not wait. There is an urgent need for continued investment in R,D&D. As WEC stressed in Daegu, we urgently need to realise the potential of breakthrough technologies such as electricity storage and CC(U)S (carbon capture, use and storage). WEC analysis shows that the 450 parts per million CO<sub>2</sub> goal cannot be achieved without CC(U)S.

Even as we, in the developed world, feel increasingly

comfortable about the long-term availability of energy supplies, we cannot forget the 1.2 billion people without access to modern forms of energy. Unless we take a different path, a population of up to 530 million could still be without access to electricity in 2050. How to address this energy poverty while also reducing greenhouse gas emissions and tackling climate change is a crucial global challenge.

This year we meet in a continent that has been one of the main engines of global growth over the last decade. Despite impressive economic and social advances, Latin America continues to face challenges in terms of competitiveness, productivity, job creation and energy security. Energy is a key element of the sustainable economic growth equation and, consequently, energy policies will play an important role in the future of this continent.

I have been impressed by the strides taken by the region in its development of its energy sector. For example, Brazil has managed to secure almost universal energy access and, by harnessing hydropower and developing biofuels, has become a model in terms of sustainable energy policies. However, Brazil's power sector is currently threatened by an unexpectedly severe draught, which could be linked to climate change, putting its entire energy sector under threat. Looking beyond Brazil's borders, we can expect global warming, changing regional weather patterns and an increase in extreme weather events to impact the energy sector. All this adds to the importance of giving equal weight to all three pillars of the Trilemma.

Our Executive Assembly and associated meetings provide an opportunity not just to discuss these important issues but also to influence and shape the debate. Among those in Cartagena discussing these key issues will be over 30 members of our Future Energy Leaders programme, young men and women who in time will take leading roles in this important sector that is energy. I take this opportunity to give them a special welcome.

Finally, I would like to thank the Presidency and the Government of Colombia for its support in hosting WEC members in Cartagena.

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# Latin America and the Caribbean: great potential for clean energy

By Hamilton Moss

Latin America is a region with sufficient energy resources to meet its present and future energy demand. However, their successful development will require important investment volumes, as well as strong institutions, regulation and adequate national and regional planning, writes Hamilton Moss, Energy Corporate Vice-President at CAF, the Development Bank of Latin America.

Latin America has 20% of the world's proven oil reserves, 4% of natural gas reserves and 2% of coal reserves. Venezuela, Mexico and Brazil are the leaders in oil production, Bolivia and Peru in gas and Colombia in coal. A high proportion of the region's electricity output – no less than 50% – comes from hydroelectric sources. Hydroelectric energy is dominant in most countries. What is more, its development potential is still high. It has been estimated that only 23% of overall potential has been developed.

The energy consumption of Latin America and the Caribbean (LAC) grew around 35% during the last decade. In 20 years, it is estimated that LAC will demand around 6 million barrels of oil per day, 700 million m<sup>3</sup> of gas per day and 1700 TWh/y of electricity. Due to the great energetic potential in natural resources the the region can rely mainly on its own resources, but a huge program of investments is necessary.

According to CAF's forecasts, based on national energy development plans and investment announcements from the private sector, the region requires yearly at least \$71 billion of investments in energy infrastructure. From this total the oil sector demands a yearly amount of around \$39 billion followed by \$26 billion for gas and \$6 billion for the electrical sector.

There is great resource diversity, both renewable and otherwise, across Latin America and the Caribbean. As resources are distributed in a heterogeneous manner, there is an enormous potential for cooperation and energy integration in the LAC region, which would benefit the optimal use of generation resources, diversifying the energy mix of countries and lowering prices. There are also, however, important obstacles and difficulties to overcome. Coordination of mutual political and economic agendas, flexibility in regulatory frames, models on how

to split revenues and agreements regarding tariffs are among them. There are important examples of regional integration but there's still a lot to be done.

## Clean energy

The region has one of the cleanest energy matrixes in the world, having, besides hydroelectric energy, a great potential for other renewable sources. Biomass and wind energy, which has recently seen tremendous growth, have a leading role. Solar energy has a great potential but still has little use. Cost reduction will increase its application, at first especially in remote and isolated communities and later also in large cities. Signs that the application of solar is improving can be seen in many countries nowadays. Geothermal energy has been used primarily in Central American countries and Mexico, but also shows potential in countries such as Bolivia and Chile. There is still substantial potential and opportunities for the development of clean energy sources and other sources that are in an earlier development stage like oceanic, hydrokinetic (for the rural sector) and hybrid vehicles. The region also has a huge potential for the development of plans and projects that save energy and money through energy efficiency measures.

In many LAC countries, CAF is the main financial source for the sector. In the last 15 years, CAF approved 135 energy projects, totaling \$ 11.6 billion. In CAF's current portfolio, energy projects account for almost \$5 billion, about 28% of CAF's total portfolio.

CAF is committed to promoting sustainable development, and its financing policies and activities reflect that commitment. Our energy financing and knowledge-based activities are essentially "green". CAF is also committed to promoting regional integration in LAC, which has the potential to contribute substantially to the so called "green growth".

# Time to move from the heart to the feet

By Christoph Frei

The world is faced with poverty and climate challenges in which energy plays a vital role. That is why policymakers and energy leaders across the world must cooperate to ensure that the challenges will be overcome, writes Christoph Frei, Secretary-General of the World Energy Council. The window of opportunity is closing. It is time to move from words to actions.

Energy Ministers of the G7 recently signed a joint statement in Rome on energy security. The fundamental principle they subscribed to was that energy security is a common responsibility. One country's energy security relies on energy security in neighbouring countries and on coordinated solutions. However, the foundation for a successful collaboration on energy security is a robust policy framework in every single country. To deliver long-term energy security each country has to provide a balanced policy framework that also includes energy affordability, energy access and environmental sustainability.

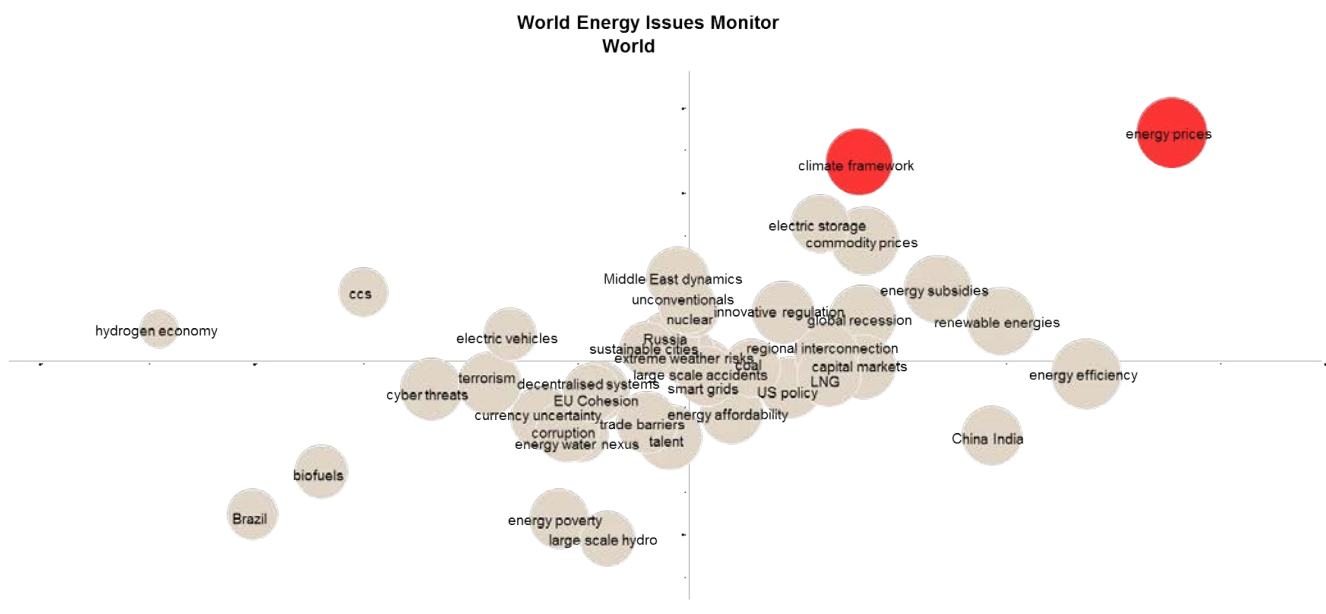
The World Energy Council (WEC) calls this balancing approach the "Energy Trilemma" and it is clear that much work remains to be done at national level when it comes to balancing the Energy Trilemma and delivering on the energy security goal.

The ongoing energy infrastructure expansion, renewal, modernisation and transition require every single country to mobilize large amounts of capital. Political and regulatory risk is the major factor that prevents the mobilisation

of the capital required. Balanced policy frameworks in terms of energy security, energy equity and environmental sustainability are the best guarantee to avoid sudden and dramatic policy changes and therefore a condition for the mobilisation of the required capital.

## What keeps energy leaders awake at night?

The political risk aspect can be illustrated by initial findings of the WEC's 2015 World Energy Issues Monitor, which shows that energy leaders from over 70 countries are prudently optimistic that we are getting out of the recessionary downside spiral, but remain most concerned about energy price volatility, climate framework uncertainty and also the fear from market distortions through stop & go energy subsidies. The quest to finance the transition to a cleaner energy system keeps energy leaders most busy at work and the acknowledgement that decentralized system and regional interconnection will be key parts of the solution is growing.



While the specific context requires that every country finds its individual solutions, it is clear that many energy challenges will have their most effective solutions in collaborations that go beyond borders. The three guiding questions that should drive international cooperation are: First, what are the fundamental energy related objectives that can only be achieved through international cooperation? Second, what creates energy insecurity that needs international fixing? And third, how to most effectively share uneven access to resources to the benefit of all involved.

## Building on shared values

With these issues in mind, the real challenges when it comes to international collaboration are agreeing on shared values and principles for our future in areas such as: climate framework, universal access, trade rules, subsidies, market design, burden sharing, coordinated RD&D in system critical components such as electric storage and carbon capture and storage (CCS).

Clearly, all of these issues urgently need greater international cooperation and further progress than has been observed over the past two decades. We must keep ambitions high for the 21st Conference of the Parties (COP21) meeting next year in Paris. The UN's SE4All process has generated new dynamics in international understanding, correctly identifying that energy access is critical for the entire development agenda – yet, the issue must now move from the heart to the feet. On the trade side, regional trade platforms must pick up where the World Trade Organisation's (WTO) progress is slow and ensure that green goods and services are not prevented from reaching their markets due to high tariffs and other trade barriers. Low tariffs can unlock the use of new technologies at lowest possible prices which can facilitate and accelerate the needed energy transition.

It is important to highlight that the best foundation for collaboration in these areas, is strong and Trilemma-balanced national policies. This is specifically true for an international climate agreement: there can be no effective international climate framework in the absence of strong and balanced national energy policy frameworks. Well-functioning and balanced national energy policy

frameworks are the only viable enforcement mechanism for an international climate agreement.

Bismarck said that politics is the art of the possible. In Rome the G7 energy ministers defined some specific areas for intervention: diversification of energy fuels, sources and routes; encouragement of indigenous sources of energy supply; enhancing energy efficiency; promoting sustainable energy technologies and infrastructure modernisation. These are pragmatic steps that can support the Trilemma aspirations. However, the objectives agreed by the G7 energy ministers miss out on the more fundamental and difficult issues that we cannot afford to leave unsolved. Are we heading for a catastrophe?

Pragmatism is not always the best recipe to avoid catastrophes. The issues at hand are critical for global prosperity and require the full support of world leaders. UN Secretary General Ban Ki-moon has recognized energy is as the key to solving the poverty and climate challenges, but the window of opportunity is rapidly closing. We know the implications of non-action and understand what these may mean to our children. They will look back in a few decades and judge the leaders of this generation on actions taken or delayed now. The energy sector has a clear role to play in supporting this agenda, and while energy is not on the formal agenda in Australia at the G20 leaders have a unique opportunity to acknowledge the need for action, identify the areas for intervention and commit to supporting the existing institutions to achieve the objectives upon which our future prosperity depends.

Negotiations in Peru at COP 20 must have the objective of building a clear, unambiguous and equitable international climate agreement in Paris at COP 21 next year. Now countries need to accumulate substantial Intended National Determined Contributions (INDCs) that respect national circumstances and are deliver on the UNFCCC objectives. This is the opportunity for countries to make their Trilemma commitment tangible and strive for greater balance. A commitment of individual governments to review and improve their countries' Trilemma performance among these INDCs would not only be a positive signal to the COP process, it would also reassure investors that their concern about political risk is being heard and necessary action will be taken.

### About the author

Christoph Frei  
is Secretary-General  
of the World Energy Council



## INTERVIEW:

**Rajendra Pachauri**  
Chairman IPCC

# Energy sector must be prepared for large-scale changes in energy systems



Rajendra Pachauri

**T**o limit the damage caused by climate change, the energy sector needs to prepare for “large-scale changes in energy systems and land use by mid-Century”, warns Rajendra Pachauri, Chairman of the Intergovernmental Panel on Climate Change in an interview with the World Energy Council. Yet Pachauri is not desperate. He is “encouraged by the ingenuity and commitment of energy companies investing in renewable energy” and positive about the role natural gas could play in reducing greenhouse gas emissions.

***With the Synthesis Report of the Fifth Assessment Report coming up (on 31 October, editor), could you say what are the main implications for the global energy sector from your findings?***

The Synthesis Report has yet to be finalized so I can't say what its findings are yet, but I am happy to cite from the Working Group reports that have been published and from which the Synthesis Report will draw many of its findings.

We have high confidence that CO<sub>2</sub> emissions from fossil fuel combustion and industrial processes contributed about 78% of the total greenhouse gas (GHG) emissions increase from 1970 to 2010. Total GHG emissions from

human activity were the highest in human history from 2000 to 2010.

GHG emissions from human activity have increased by the equivalent of 10 gigatons of CO<sub>2</sub> equivalent in the period between 2000 and 2010. The energy sector has contributed nearly 50% of these emissions and is by far the largest single contributor to GHG emissions. If we want to limit the damage caused by climate change, we are going to have to implement substantial cuts in these emissions by mid-century through large-scale changes in energy systems and land use.

***While there seems to be general awareness among the established energy companies of the importance of climate policy and the need to reduce GHG emissions, are they sufficiently translating this awareness into concrete actions?***

More needs to be done across every sector that contributes to climate change. That said, I am encouraged by the ingenuity and commitment of those energy companies that are investing in renewable energy, not only because it is good for our environment but because it is clearly the future of the energy sector.

***The unconventional gas and oil revolution seems to be spreading from the US to the rest of the world. What do you think of this development?***

GHG emissions from energy supply can be reduced significantly by replacing current coal-fired power plants with modern, highly efficient natural gas combined-cycle power plants or combined heat and power plants, provided



that natural gas is available and the fugitive emissions associated with extraction and supply are low or mitigated.

***Renewable energy is quickly growing across the world, but do you believe it can grow quickly enough to replace fossil fuels in the power sector?***

Yes. Since the IPCC's Fourth Assessment Report in 2007, many renewable energy technologies have demonstrated substantial efficiency improvements and cost reductions, and a growing number of these technologies have achieved a level of maturity to enable deployment at significant scale. Regarding electricity generation alone, renewable energy accounted for just over half of the new electricity-generating capacity added globally in 2012, led by growth in wind, hydro and solar power.

However, many renewable energy technologies still need direct and/or indirect support, if their market shares are to be significantly increased; fortunately, renewable energy technology policies have been successful in driving their recent growth.

***Can the world largely get rid of fossil fuels round about 2050 while satisfying the energy needs of a growing global population?***

It's possible but not a requirement to meet the goal of limiting temperature change below 2°C relative to pre-industrial levels. Scenarios reaching atmospheric concentration levels of about 450 ppm CO<sub>2</sub> equivalent by 2100 (consistent with the 2°C target) include substantial cuts in anthropogenic GHG emissions by mid-century through large-scale changes in energy systems and land use. Scenarios reaching these concentrations by 2100 are characterized by lower global GHG emissions in 2050 than in 2010, 40% to 70% lower globally, and emissions levels near zero GtCO<sub>2</sub> equivalent or below in 2100.

In the majority of low-stabilization scenarios, the share of low-carbon electricity supply (comprising renewable energy, nuclear and carbon capture systems) increases from the current share of approximately 30% to more than 80% by 2050, and fossil fuel power generation without carbon capture is phased out almost entirely by 2100.

***What steps do you see governments taking and are you encouraged by those? What should they do what they are not doing now?***

I am very encouraged by growing awareness and action against climate change by regional and national governments. An increasing number of regions and countries are adopting cap-and-trade systems, which not only help reduce emissions but also show the way for other governmental bodies. Several local bodies have also implemented regulatory measures and other steps to promote energy efficiency and greater use of renewables.


***What are your expectations of the climate conference in Paris next year? What would be a satisfactory outcome to you?***

I would be delighted to see a binding agreement that ensures limiting our GHG emissions to levels that will ensure that we meet the goal of limiting temperature increase below 2°C relative to pre-industrial levels.

***Do you see there is a "global warming pause" and if so how significant is this for climate policy?***

There has been no pause. If you look at the entire climate system and not just one aspect of it, what you see is continued rapid warming. The atmosphere and oceans have warmed, the amount of snow and ice has diminished, sea level has risen, and concentrations of greenhouse gases have increased. The WMO recently confirmed that of the warmest years on record all occurred in the 21st Century; 2001-2010 was the warmest decade on record.

It's true that the rate of surface warming between 1998 and 2012 is smaller than the rate calculated since 1951. But such slowdowns have occurred in the past only to be followed by sharp increases in temperatures. You also have to consider that ocean warming accounted for more than 90% of the energy accumulated between 1971 and 2010, so it is misleading to consider only surface temperatures, which constitute a small minority of the total observed warming.



***"If you look at the entire climate system and not just one aspect of it, what you see is continued rapid warming"***

# Meeting the trilemma challenge: how to ensure investment will flow



By Joan MacNaughton

**T**remendous investment is needed if we are to meet the challenge of providing sustainable energy at an affordable price. However, with current policy approaches in most countries, this investment is unlikely to materialise, warns Joan MacNaughton. “Investors and policy-makers speak a different language.”

The profile of energy and climate issues has grown enormously over the last decade, but with it has come increasing politicisation. This manifests itself in some countries as populist gestures such as price freezes or controls, and in some as a lurch away from a balanced portfolio of technologies. Targets - which can be very useful if properly designed to send signals to the market - are being set more with an eye to popular appeal than to delivering the most cost effective outcomes. This poses systemic risks to the delivery of secure, sustainable and affordable energy services.

Of course it can be argued that it was ever thus - the tension between political expediency, particularly for short term electoral reasons, and a framework benign to long term infrastructure investment is nothing new. What is new however is the scale and urgency of the investment challenge. What is at stake in many regions is their prosperity and quality of life.

## New approaches

The energy sector needs to attract \$48 trillion of investment between now and 2035 if it is to meet the challenge of providing sustainable energy at an affordable price. This scale of investment represents at least a 25% uplift in the trend rate of annual investment. That is not at all impossible to envisage over a period of 20 plus years. But neither can it be taken for granted. The energy sector competes with others for capital and the financial world is notoriously unsentimental in reaching decisions - looking for the best risk adjusted returns and tending to operate in sectors, regions or countries where investors feel most confident.

We are also facing a period in which liquidity is constrained by the need to rebuild balance sheets - public and private sector. What needs to happen for the investment to flow, and to flow at a significantly faster rate than hitherto?

Over the last three years the trilemma team, encompassing WEC staff and staff from the global consulting firm Oliver Wyman, have with the help of Member Committees been looking at the intersection of business and policy decisions with a particular focus in 2014 on the financial community and on what drives investment decisions. This builds on our analysis in 2012 of what energy business leaders said they needed from policy makers (‘Time to get real - the case for sustainable energy policy’) and in 2013 what policymakers said that business needed to do to help them produce the right frameworks (‘Time to get real- the case for sustainable energy investment’).

Bringing together these two groups we drew up last year an agreed 'Agenda for Action' - highlighting the ten areas where as a priority business and policy leaders should focus their attention. Christiana Figueres, Executive Secretary of the Secretariat of the UNFCCC, has urged governments to look closely at the report and to act on its conclusions. Two of them, namely, first, the need to engage the financial community and, second, the need to ensure dynamic, transparent and flexible pricing frameworks, have underpinned discussions with finance leaders leading to several important recommendations in the 2014 Trilemma Report.

As might be expected, the views of the financial community echo several of the themes in the earlier reports about the kind of policy approaches which will tend to facilitate the bringing forward of projects; but some important new insights also emerge on what more needs to be done - and not just by policymakers, but also by energy business leaders.

Most striking perhaps is the need for a common understanding among the three groups. On a personal note, I was struck when I moved from senior government roles into the energy business at how different the language was in the private sector and at how difficult they sometimes found it to interpret government positions. Our work in 2012 and 2013 also underlined that those countries which took care to engage the whole range of stakeholders tended to have more durable policy approaches which in itself cuts costs and helps facilitate investment decisions on long lived energy projects.

## Quality of policymaking

Such engagement can often be tricky to handle. Just as commercial confidentiality must be respected, so too the scope for political fall-out needs to be minimised. But some countries, notably those who consistently top

the rankings in the Energy Sustainability Index, have shown the way through developing clear route maps for their overarching goals underpinned by discussions of the detailed steps needed to achieve them. While no one model provides a silver bullet - there does not for example seem to be any clear correlation between highly liberalised markets or per contra highly regulated ones and the achievement of the trilemma goals - problems clearly arise in countries where policy interventions do not allow cost-reflective pricing or where there is too much prescription on the detail of the technologies to be supported; both of these approaches turn out to be

costly in the end. In other words, even in regulated markets the market must be allowed to work, in the sense of taking decisions on the technologies to back - or to drop - and companies must see their way to making appropriate risk adjusted returns if they are to invest.

So what matters above all is the quality of policymaking. It is clear that the investment community is not convinced as yet that it can rely

on consistent government policies. They are not in many cases able to calibrate the policy and regulatory risk entailed in energy projects, particularly those in the less traditional areas. Not only does this uncertainty increase the cost of capital, it also makes it difficult for finance houses to get comfortable with certain subsectors and holds back the flow of funds. To overcome these issues, countries need a clear strategy - and a clear narrative about how it is to be delivered - clear that is, not just to the bureaucrats but also to the financial community. Achieving this implies building good processes of engagement, as well as an emphasis on trying to balance the competing trilemma goals - however difficult that might be in practice - in order to deliver sustainable policies. The Trilemma reports are there to help showcase what works and to provide a tool to support those grappling with these crucial but inherently difficult challenges.

***“I was struck when I moved from senior government roles into the energy business at how different the language was in the private sector”***

### About the author

Joan MacNaughton, who was Director-General Energy in the UK from 2002 to 2006 and Chair of the Governing Board of the International Energy Agency from 2004 to 2006, is Executive Chair of the World Energy Trilemma for the World Energy Council (WEC). She is now also Chair of the new International Advisory Board of the Energy Academy Europe in the Netherlands.



## INTERVIEW:

Maria van der Hoeven  
Executive Director, IEA

# The energy security challenge has become global



**N**ot so long ago “energy security was seen primarily as a concern of industrialised countries”, but today “the challenge has become global”, says Executive Director Maria van der Hoeven of the International Energy Agency (IEA) in this exclusive interview. She warns that with our greenhouse gas emissions, we are on the wrong path: “The ability of the energy sector to radically transform and decarbonise while maintaining energy security will be essential to addressing climate change.”

***Instability and conflict seem to be on the rise in the world at this moment. How do you see this affecting energy security?***

Recent geopolitical instability and conflict in major oil- and gas-producing regions are a cause for concern. The IEA has been closely monitoring developments in Eastern Europe and across the Middle East and North Africa to ascertain their impact on energy markets. Thus far, we have seen only relatively minor disruptions, which have been offset by well-supplied markets. And oil prices have actually weakened in the face of the tensions, indicating that markets feel comfortable about supply. But diplomacy has not yet resolved the underlying areas of contention, so we must remain vigilant. While a market response is always preferable, the IEA and its members stand ready to act if needed.

But collective action to release emergency oil stocks has always been a “last resort” strategy – though an effective one – and is short-term by nature. It is only one tool in the toolbox, but has proven an effective one when used. And interestingly, it is something of a relic from a time when the definition of energy security was rooted solely in oil. That definition has changed in the 40 years since the IEA was created. And just as our definition of energy security has changed, the ways in which we work to achieve it also are changing.

Perhaps the most striking change in how we approach energy security is that while each country must find its own solutions, the challenge is now global. Initially, energy security was seen primarily as a concern of industrialised countries, but this is no longer the case. This is why we are exploring ways to develop stronger multilateral cooperation. As energy security challenges do not stop at borders, we must work towards global solutions.

***Do you see a relation between the growth of renewable energy and energy security? Can the growth of renewables help to increase energy security for many nations?***

There is no question that renewables have the potential to enhance energy security by diversifying a portfolio of energy sources and by reducing import dependency. But countries must be careful about the way in which they deploy renewables, especially variable renewables (VREs) like wind or solar. Our recent work shows that a large share of wind and solar can be reliably and cost-effectively integrated into an energy system without putting security

at risk. This requires a move to more flexible power systems with more flexible generations, grid enhancements, more storage and demand-side response. Such a power system will be more diverse and resilient and therefore increase energy security in its own right.

***With regard to the climate, haven't we already given up on the 450 ppm scenario? Do you think it's still achievable?***

I must say that a 450 scenario is looking less and less likely with each passing day. We're on the wrong path. This is nothing new: the IEA has been saying this for years. The problem is that the longer we delay climate action, the more expensive it becomes. This is why the stakes are so high for UN climate talks in Paris next year.

***What can "Paris 2015" do and what are you hoping to see come out of this conference? How is the IEA involved in the run-up to the climate negotiations?***

The period leading up to COP21 in Paris is critical for determining the future global greenhouse gas emissions path. The ability of the energy sector to radically transform and decarbonise – while maintaining energy security – will be essential to addressing climate change.

With this said, as an observer organisation to the UNFCCC negotiations, the IEA does not participate directly in the negotiations. IEA's role is to provide expertise in energy topics of relevance to the negotiations. For example, the IEA provides statistics on emissions from energy use that underpin countries' national inventories. We also undertake analysis of options for energy sector decarbonisation, through publications such as the World Energy Outlook, Energy Technology Perspectives, and others.

Finally, the IEA and OECD jointly support negotiators via the Climate Change Expert Group (CCXG), which brings together negotiators from developed and developing countries twice a year to discuss technical issues relevant to formulating the 2015 agreement. This creates a valuable forum for information exchange outside that of the UNFCCC negotiations.



***"It's encouraging to see emerging economic giants like India and China develop their own emergency oil stocks"***

***Your latest report on Energy Efficiency forcefully describes this as the first fuel, and says awareness of this is growing. Yet at the same you write that there is not nearly enough awareness among – and action from – policymakers. Shouldn't we try to achieve a Global Energy Efficiency Accord (and perhaps a Global Renewable Energy Accord) rather than a Global Climate Accord?***

You raise some very interesting ideas, and I suppose I would only ask why an accord is necessary when these are things that make sense right now on a number of levels!

Let's just assume for the sake of argument that you are motivated purely by financial interests, and that climate concerns have no bearing on your decision-making. Even in this case, there would still be strong incentives for choosing renewables and energy efficiency. As costs continue to fall, renewables are cost-competitive with new fossil-fuel power generation in an increasing number of countries and regions. And as we showed

in the World Energy Outlook 2012, payback periods for energy efficiency improvements can be as little as two years. More recently, we showed that there are multiple benefits to energy efficiency – positive outcomes that have nothing to do with climate but are instead related to macroeconomic developments, public budgets and industrial productivity. The point here is that you can wait for an accord to

happen, or you can start making decisions about your energy production and consumption that make sense right now.

***Has the world made progress in energy security in recent years?***

I think that if you use the narrow definition of energy security – that is, all about oil – then we are doing well. IEA emergency stocks have proven to be a reliable tool for responding to acute supply disruptions. It's encouraging to see emerging economic giants like India and China develop their own emergency oil stocks, as this enhances overall oil security. But I do worry when we take a broader definition of energy security. We do not have such formal response mechanisms in place for gas or electricity security, although these are being discussed, especially in Europe. And furthermore, for hundreds of millions of people, energy security is a meaningless term because modern energy simply does not exist for them. Today, about a fifth of the world's populace has no access to electricity, and while this ratio is expected to fall somewhat over the next 15 years, we still expect it to be unacceptably and stubbornly high. It's time to focus on eradicating energy poverty as a moral imperative.

**Interview by** Karel Beckman

# Disruption in the electric industry: goodbye to traditional asset management

By Dean Oskvig

**A**cross the globe, electric utilities are working to manage the transformation of traditional elements of their businesses. This disruption, propelled by a confluence of market dynamics and shifting technologies, will eventually result in a leaner, more nimble electric utility industry that will better be able to deliver safe, reliable energy. However, as with any great period of transformation, this shift will not be accomplished without turbulence. Utilities should prepare themselves for a “fundamental shift from viewing asset health as the priority to a risk-based model that includes technology-readiness”, writes Dean Oskvig, President and CEO of Black & Veatch’s energy business.

One year ago, the Black & Veatch Strategic Directions in the U.S Electric Industry report reflected an industry in transition. Just 12 months later, we find an industry at a crossroads because of the accelerating impact of new technologies, regulation and external market forces. Year in and year out, electric utilities’ mandate to deliver “always there” service has kept reliability as the industry’s top concern. It remains so in 2014. Meeting this goal in the face of changes in environmental and economic regulation closely followed.

But this year we also saw significant shifts in concerns over cybersecurity and natural gas prices, two areas that are relatively recent entrants to the list. The former is likely due to extended coverage of high profile physical and cyber security-related incidents. The latter is driven by the expanded role of gas in the generation mix, which

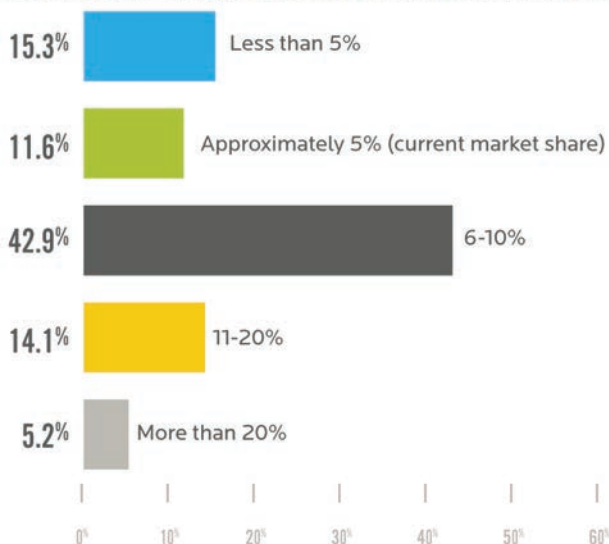
continues its rapid march. In fact, half of the report’s respondents stated their company is planning to replace retiring coal and nuclear power plants with gas generation. Further, more than 60 percent of utility leaders believe distributed generation will grow beyond its current 5 percent market share of U.S. power generation by 2020. Natural gas generation is frequently used as backup power for renewable generation.

As the U.S. power industry moves to embrace abundant domestic supplies of low-cost gas, utilities are also aligning their generation portfolio assets in response to greater industry regulation. Key events driving operational decisions now include the U.S. Supreme Court’s decision to uphold the Environmental Protection Agency’s (EPA) ability to regulate greenhouse gases emitted by stationary sources. This ruling has particular impacts for coal-fired power plants.

Likewise, the new EPA Clean Air Plan proposes to govern carbon emissions on a state-by-state basis with a national emission reduction target 30 percent below the 2005 base calculation year level. This will further challenge generators to examine the makeup of their portfolios. The market is already seeing the impact of these decisions through greater adoption of natural gas and renewables, while the available resources and economics of hydro and nuclear technology are weighed.

With the overall U.S. electricity market flat, the industry is also facing regional challenges to its residential model. Though coal retirements have little impact on much of the West Coast, the rapid adoption of rooftop solar is creating a bifurcated consumer market. Increasingly, those consumers with the resources to adopt rooftop solar are doing so, those without are not.

PERCENTAGE OF POWER GENERATION FROM DISTRIBUTED GENERATION



Source: Black & Veatch

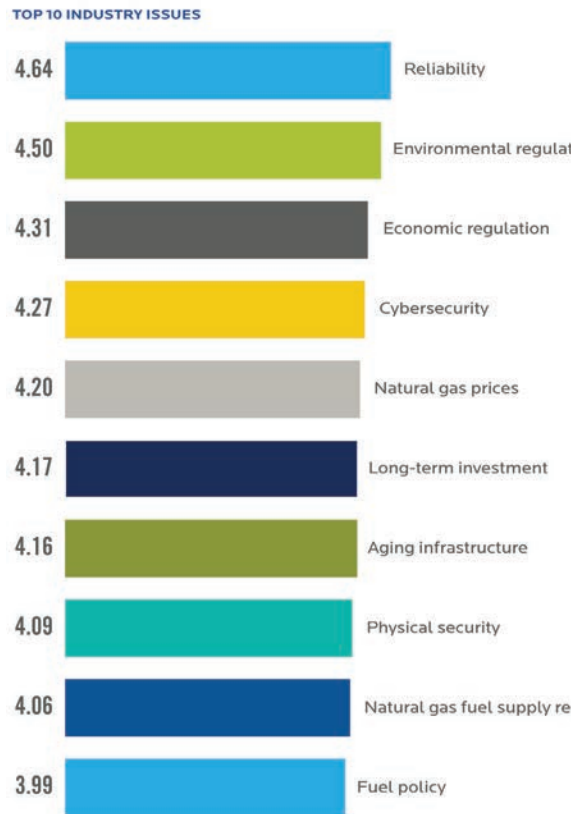
As storage technology improves and costs drop, many homes will conceivably go “off-grid.” Every kilowatt that is now being produced by a third party or a consumer is a kilowatt not being sold by the utility. At the same time, utilities still carry the burden of building, maintaining and operating the bulk of the power delivery system. Given the high cost of maintaining these assets, we expect to see more utilities making the case with regulators to adjust their business models.

## New sources of revenue

The best chance for utilities to grow lies in emerging technology and innovation. Storage and distributed generation should not only be viewed as threats, but as areas that may serve as potential new sources of revenue. The role of advanced metering infrastructure (AMI) and analytics will grow as technology affects the industry in other ways. For utilities managing environmental regulations, this could mean leveraging more advanced real-time air quality monitoring.

Others are working to provide consumers with resources to better manage energy consumption. Almost one-third of utility respondents stated their organization is offering Home Area Network solutions, such as smart thermostats, to support demand response programs. Critically, technology is enabling utilities to more fully embrace asset management programs. This requires a fundamental shift from viewing asset health as the priority to a risk-based model that includes technology readiness.

Risk-based calculations might also account for an increased pace of innovation and more rapid technology cycles. Formal risk-based planning, backed by data, also affords greater opportunity to support capital planning before regulators. With resiliency planning a growing area of concern, technology can help identify and remediate key areas of weakness. Nearly 60 percent of utilities are updating emergency response plans in order to improve resiliency to weather and unanticipated events. Understanding the full capabilities of new technology,



how to integrate the solutions into the utility enterprise and how to successfully transform business processes in order to improve operations will be a challenge.

It is difficult to address change without making a nod to cycles. The precursor to the current U.S. electric grid was Pearl Street Station in New York City. Established in the late 1800s, its model was replicated around the world until market forces came into play. Consolidation, regulation and competition followed. One cannot help but make comparisons to today’s environment: smaller, localized generation; collaboration and consolidation; regulation; and competition from non-utility actors. Preparedness will require agility, awareness and a willingness to learn the lesson from past cycles. With the benefit of technology, utilities are better able to understand their environment and act accordingly.

### About the author

Dean Oskvig is President and CEO of Black & Veatch’s energy business, a position he has held since 2006. Oskvig joined Black & Veatch in 1975 and has served on a variety of global energy and telecommunications projects and roles within the company. He was elected to his first term on the company’s Board of Directors in 2006 and is Chairman of the Electric Power Research Institute’s Advisory Council. Dean Oskvig also serves as Vice Chair North America for the World Energy Council, and is a Member of the board of the United States Energy Association.



## INTERVIEW:

**Colin Calder,  
CEO PassivSystems**

**“This is all  
about providing  
consumers better  
value for money”**



Colin Calder

“The energy industry has never understood consumers.” Colin Calder, founder and CEO of home energy management company PassivSystems and top-level advisor to the UK government, sees traditional energy companies struggling to understand “how companies like ours fit into their business model”. Even those who are active in demand response, show a “complete lack of understanding” of where the market is going, he says.

Colin Calder made a fortune by being ahead of the technological curve. He sold his four-year old software–internet–mobile phone company Paragon for £310 million in 2000. Living in Monaco, he is now targeting the energy market. His company PassivSystems provides home energy management services to consumers, helping them to reduce energy consumption, for example through apps that allow them to control the heating of their house with their mobile phone or by monitoring and managing their rooftop PV systems.

The technology he has developed can also help consumers avoid paying high-cost energy – if only, says Calder, the market structure would allow it, which is not the case right now. This is part of the reason why Calder is also politically active. He is a frequent speaker at big events of organisations like the World Energy Council and the United

Nations and sits on the new Energy Efficiency Advisory Forum of the Department of Energy and Climate Change (DECC) in the UK. “The traditional energy companies are still very influential in setting policy”, he says. “Naturally they are lobbying for their own interests. My position on the global stage is to talk about nothing but consumers. It’s all about providing better value for consumers.”

### There’s the rub

Calder’s company PassivSystems works mostly with what he calls “non-traditional energy companies”. The “traditional companies”, he says, “are struggling to understand how companies like us fit into their business model. Our purpose in life is to seek to reduce energy consumption and to seek lowest-cost energy. If you are a traditional generator, your business is to sell generation capacity. There is the rub.”

Calder is convinced that those who refuse to adjust to the energy transition are fighting a losing battle. “Worldwide there is 3.5 times more capital going to renewables than to fossil fuels at this moment, according to figures from the International Energy Agency. This is driven by climate protection policies, but also by steadily decreasing prices. In countries like Italy solar PV has already reached grid parity. In the UK that is expected in a few years. We are seeing a huge shift away from centralised to distributed energy. This is an unstoppable trend.”

Nevertheless, the transition can still become a failure if it is not properly guided by policymakers. “In the current setup, consumers are shut out of the market, so they



cannot reap the rewards from the energy transition. On the contrary, they are only confronted with higher costs. As a result, they start to protest and politicians in response start messing with the market, which only leads to more uncertainty and higher costs.”

To integrate renewables properly into the market and enable consumers to benefit, fundamental reforms are needed, says Calder. “The first reform we need is the introduction of half-hourly trading of energy for consumers. Today virtually no country in the world enables trading of residential energy. Consumers are typically aggregated into profiles. These are deemed to require a set amount of energy based on that profile and that gets traded on the wholesale market. But there is no correlation between the energy you are really using and what is happening on the half-hourly traded market. Unless and until that market change is introduced, consumers cannot participate in the energy market. They cannot unlock value from that market, they cannot provide flexibility to it or obtain low-cost energy. They will continue to be on the receiving end of ever-increasing energy costs.”

How would such consumer participation work in practice? On two levels, says Calder. “One, new companies will become active in the market that will sit between the wholesale market and consumers, providing them with differentiated low-cost energy based on their real consumption. Second, consumers will get connected to the ‘internet of things’. Most of the equipment in their homes will get connected to the internet in the coming years. Home energy management technologies will then make it possible to optimize consumption patterns. We have demonstrated that we can reduce heating bills by 23% and electricity bills by 38% with our technologies.”

## Internet of things

Calder notes that what these new technologies do is “aggregate demand in such a way that renewable energy consumption is favoured over fossil fuels. We

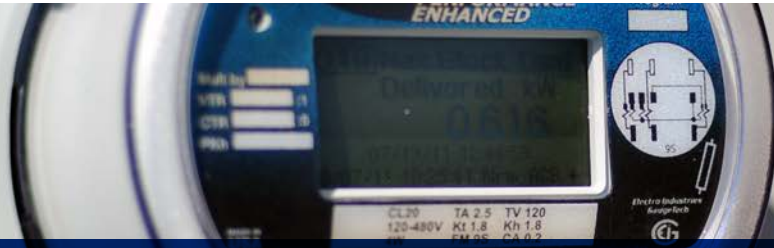
shift consumption to the times when there is plenty of wind and solar power available. Thus we shave off the peaks. This benefits consumers and also makes the whole energy system much more efficient. But it threatens the business model of the traditional energy companies who make the most money by providing peak power.”

Some sceptics argue that most consumers might not all be interested in managing the energy use of their household equipment. But Calder says people who argue that way represent the “patronizing attitude of an industry that has never understood consumers”.

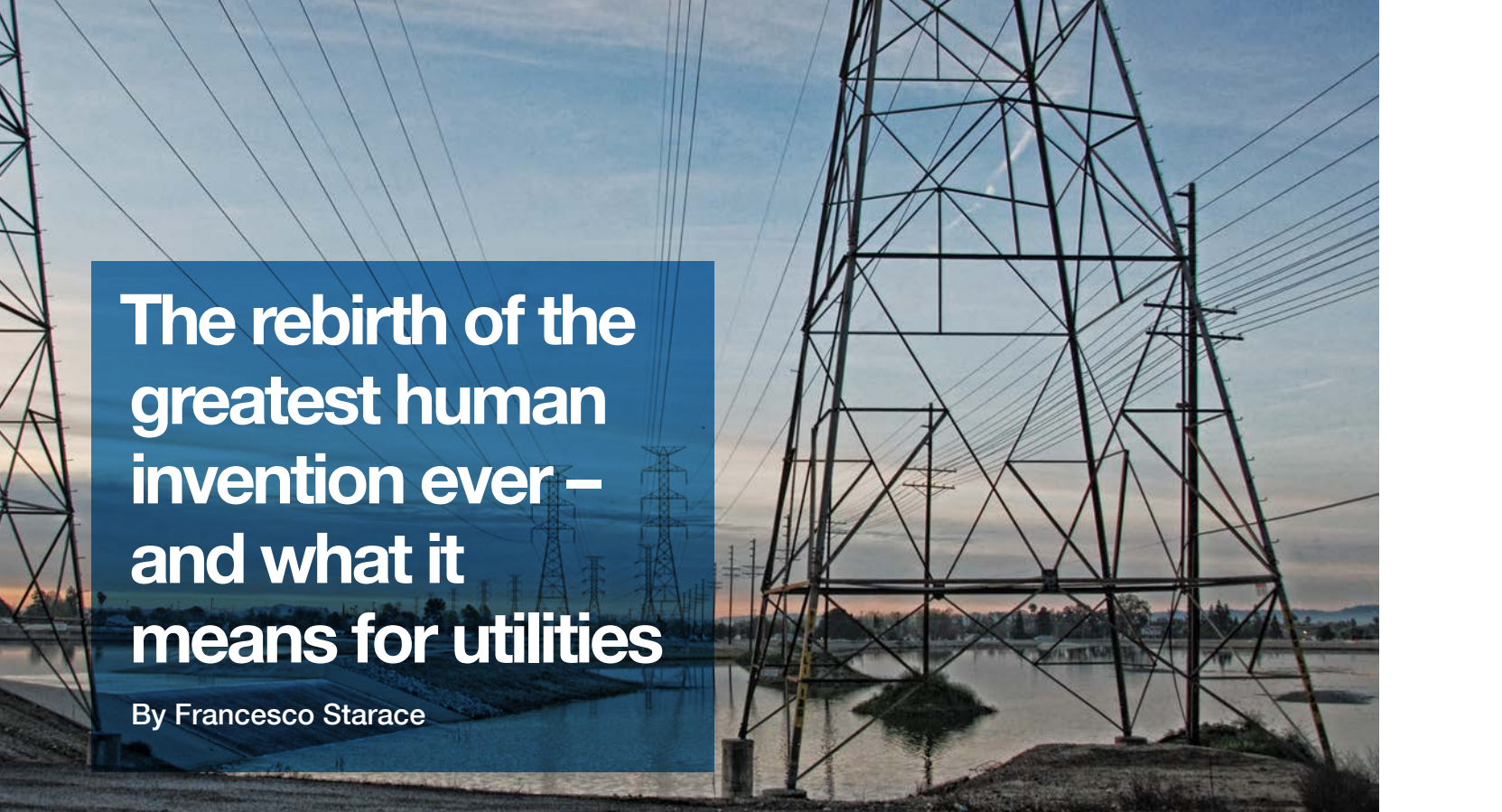
True, consumers “are not interested in micromanaging their energy use”, Calder says, “but that does not mean they don’t want to engage in the energy market. Technology has arrived in the form of Home Energy Management systems and the internet of things. Energy usage can now be harnessed through software that provides consumers with intuitive interfaces that allow them to make their own choices as to when they will use their equipment, at what cost, at what comfort level. The energy industry should be doing far more to encourage consumers to adopt these new technologies and therefore benefit from cheaper energy in return for providing grid flexibility.”

First, however, the market needs to be reformed to make real home energy management possible. Sadly, “these reforms are hardly on the political agenda as yet”, says Calder. Instead, policy is all about building new generation capacity and even worse, setting up capacity mechanisms “that will subsidize existing fossil fuel plants to act as backstop.

What policymakers also need to do, according to Calder, is to consider the emerging risk of there being no systems architect. “Right now capital markets are driving investment in renewables, but they get connected to the grid in a completely random manner. This puts extra stress on the grid. We need to create an efficient, resilient energy system that can deliver the greatest benefits to consumers.”



***“Consumers are not interested in micromanaging their energy use, but that does not mean they don’t want to engage in the energy market.”***



# The rebirth of the greatest human invention ever – and what it means for utilities

By Francesco Starace

**T**he electricity sector is faced with unprecedented changes. According to Francesco Starace, Chief Executive Officer and General Manager of Enel, utilities will be able to prosper in the new energy world that is emerging, if they recognize the trends and seize the opportunities.

Today we are witnessing the biggest changes in the power sector since the first electric grids were built across the industrialized world in the early 20th century. In what has rightly been described as the most significant invention in human history, we see two important developments tied to this great achievement, possibly of equal importance. First, the grid is expanding to reach all corners of the globe, providing energy access to all developing regions which will hopefully allow the enjoyment of modern life to all. Second, the existing grid in the developed world is seeing its first real transformation which is fundamentally changing the way we approach the production and consumption of energy. The evolution of technology at ever-accelerating speeds, the rising awareness for social and environmental sustainability, and the increasing role of international private capital, are together radically altering the landscape in which utilities operate.

It goes without saying that utilities must change with the times and adapt themselves to the shifting needs of their customers. While some project a gloomy future for utilities to meet these challenges, I firmly believe that the utilities

are well-placed to come out of this transition even more competitive than before, if they can recognize the changes and make the right choices. In very broad brushstrokes, I will describe some of these major changes and how I think the utilities should respond. Finally, I would like to touch upon the role government should play as a critical stakeholder in this industry.

## Change

The first and perhaps most breath-taking change we see is in technology. The recent advances in renewable energy technologies have been unprecedented in terms of the speed of innovation, breadth of deployment, and decline in costs, all of which continue to outperform initial forecasts. An equally impressive innovation is the digitization of the electric grid, which is allowing the marriage of information technology to the grid, rendering it “smart” and opening up opportunities for even more technologies to be deployed into the system.

These technological changes are also translating into fundamental shifts in the industry itself. For example, the smaller size and shorter time-to-market of renewables have allowed the market entry of small non-utility players. What used to be a market dominated by utilities in developing, constructing and operating assets in generation, transmission and distribution of electricity, has been transformed by the entry of these smaller players, some of whom come from different sectors such as the telecommunication and electronics sectors.

The shape of the industry is also changing in a different, perhaps more fundamental, way. Consumers, aided by the availability of distributed generation and energy

management technologies, such as rooftop solar panels, smart meters and residential heat-pumps, are quickly becoming more pro-active in their relationship with utilities, producing their own electricity or reducing consumption through energy efficiency. The customers are no longer at the passive end of the energy equation and increasingly becoming empowered, active users of the grid.

Another formative shift in the approach to energy has been the growing appreciation of social and environmental sustainability. Long gone are the days when utilities can build big-scale projects that leave a large footprint without considering the impact on local communities or the environment. More recently, the increasing concerns over climate change have galvanized public opinion and government policy in such a way that they now influence the investment decisions of utilities.

## Response of Utilities

So what are utilities to do? In a nutshell, they should embrace the trends and reorient their activities to remain relevant and competitive. A prime example is the modernization of the grid. Utilities should lead in completing the digitization of the grid and designing services for customers that further empower them to be the active participants they want to be. With the changing nature of the distribution grid, from a one-way conduit of electricity to a more dynamic bi-directional model that increasingly serves to provide balance to the system, the business model of the utility will have to change from one based on consumption to one based on services and capacity. Sustainability should also be fully incorporated into all stages of the business process, from project development and construction to operations. Utilities will need to be more attuned to the needs of their local communities and environmental impact of their activities. Ultimately, espousing sustainability will be a critical element in enhancing the security and durability of investments and even in expanding markets. For example, the efforts to expand energy access to remote villages, starting with initiatives to distribute light bulbs to homes that previously went dark at night, will lead to rising incomes and eventually create new customers for utilities.

Utilities also have to stay at the cutting edge of innovation. They need to keep abreast of, and in some cases be actively involved in, the new technologies on the horizon. Given that the electricity sector is becoming infused with

technologies from the telecommunications and electronics sectors, partnership with players from these industries should be explored and exploited. Innovation is not limited to technology. It is equally important in terms of pursuing partnerships and changing business models and practices.

## Role of Government

Governments have an important role to play in guiding this transition. They must design a regulatory framework that not only protects the welfare of the consumer but also provides long-term certainty that will allow utilities to make the necessary investments that normally have long lead times in development and long payback periods. This means setting clear and transparent market rules, making sure that policy targets are long-term and irreversible, and incorporating mechanisms that help protect investments against arbitrary interventions.

Governments also have to keep an open mind about technological changes. History shows us that every time a new technology emerged there was a predisposed bias against it, sometimes even outright hostility. We need to ensure that the inherent inertia does not drag down the pace of technological advancement toward better solutions.

Finally, governments should cooperate across borders to encourage interconnections and the formation of bigger markets. The laws of physics and economics make clear the benefit of wide and integrated markets that justify investments that would not have been worthwhile if contained within a smaller national market.

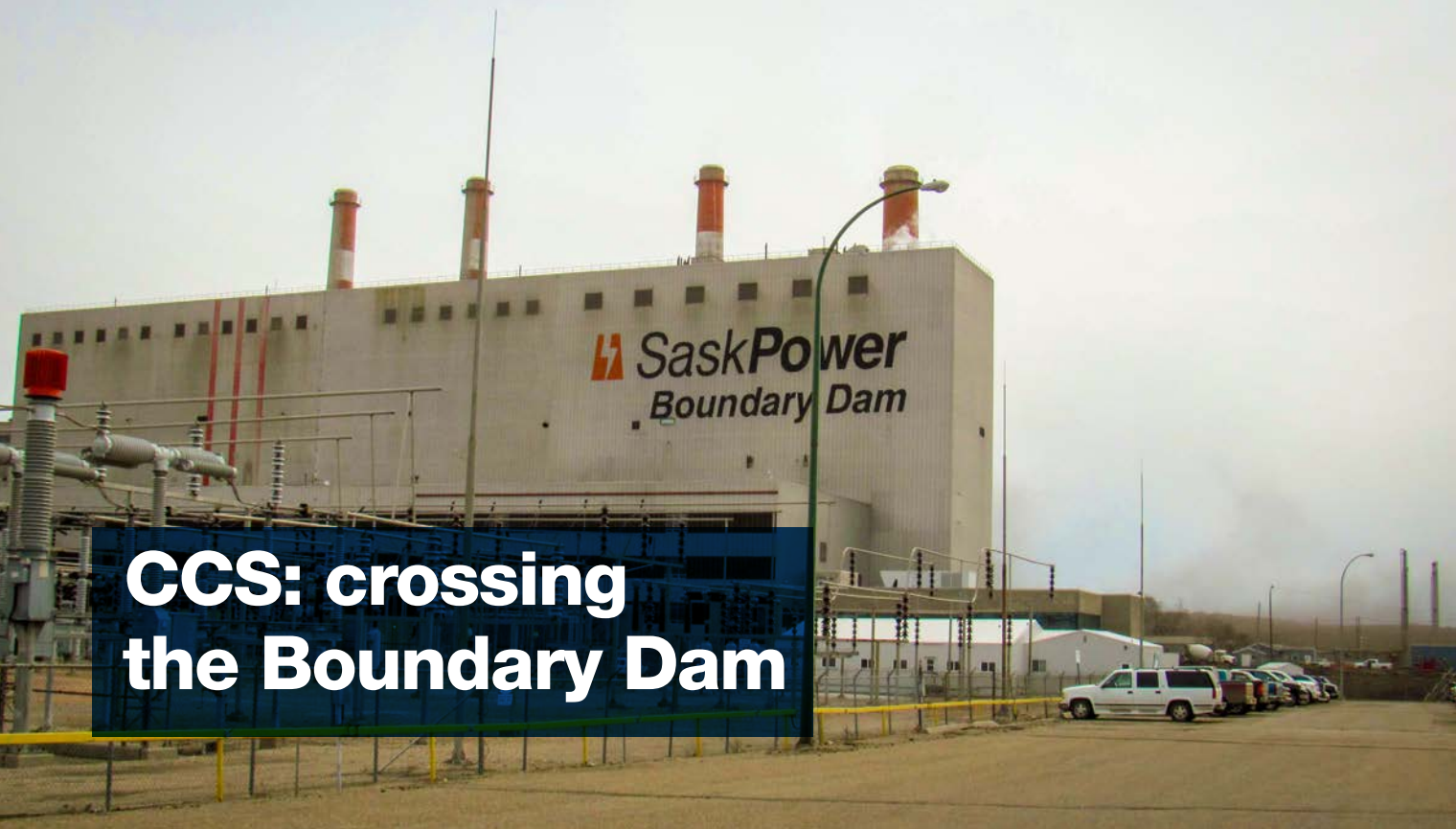
## Conclusion

Change always carries with it a sense of uncertainty and anxiety. And so it is also in the power sector, where technological advances, changing relationships with customers, and rising awareness of local and environmental issues, are making it necessary for utilities to adapt to the new environment if they are to remain relevant in the market. If they have the vision to recognize and respond to the trends that I described above, and with the help of the right government approach, I have no doubt that utilities, such as the one that I lead, can meet these challenges. The rebirth of the greatest human invention lies before us.

### About the author

Francesco Starace has been CEO and General Manager of Enel since May 2014. Before that he was CEO of Enel Green Power. Before he joined the Enel Group in 2000, he worked for General Electric, ABB and Alstom.





# CCS: crossing the Boundary Dam

By Brad Page

**P**rogress in carbon capture and storage (CCS) is much greater than generally realised. The Boundary Dam power facility, currently being commissioned by SaskPower in Canada, is paving the way for a new generation of CCS plants with sharply reduced costs. What the industry asks of policymakers is a technology-neutral approach in their support of low-carbon technologies so that CCS can compete on equal terms with renewables, writes Brad Page, CEO of the Global CCS Institute.

CCS technology deployment has doubled since the beginning of this decade, with 22 large-scale CCS power projects now in operation or construction. The world's first example of CCS at full scale on a power station will be in operation by the end of 2014 at SaskPower's Boundary Dam facility in Canada. Two more CCS projects in the power sector will come into operation in the near future in the US – at the Kemper County Energy Facility in Mississippi and at the NRG Energy WA Parish power station near Houston, Texas.

While there has been steady progress with CCS deployment, particularly in the US, Canada and China, there remain important gains that must be made in reducing costs. As with any technology, costs are expected to

be reduced significantly as second generation projects apply learning and expertise from existing projects. The Boundary Dam facility looks particularly promising in this context: being a first-of-a-kind project, the experience and lessons learned from its design, construction and operation can be applied to further reduce the cost of similar CCS projects at the same site or elsewhere. The operator, SaskPower, has stated that a capital cost reduction of up to 30% is readily achievable for its next CCS project.

## Numerous breakthroughs

From an engineering perspective, Boundary Dam has made numerous innovations and breakthroughs on the CO<sub>2</sub> capture design that could come to represent the new state-of-the-art for a post-combustion capture system at a coal fired station. The capture element of CCS often accounts for the majority of the cost in the CCS chain. In power generation, for example, more than 90 per cent of the overall cost of a large-scale CCS project can be driven by expenses related to the capture process. The current capital and ongoing operational costs associated with CO<sub>2</sub> capture in new applications, such as power generation, is a key target for improvement looking towards second generation projects and a stronger business case for CCS. The following achievements at Boundary Dam are particularly noteworthy:

- Shell Cansolv, a subsidiary of Shell Global Solutions which works on the emission control technologies within the project, reports that the heat requirement of the CO<sub>2</sub> capture unit is around ~2.5 GJ/t CO<sub>2</sub>. This means that the capture plant is expected to require only 21% of the power plant (power) output,

down from an industry average of around 30%. The project uses a single carbon capture system for SO<sub>2</sub> removal and CO<sub>2</sub> separation, which reduces costs by not requiring a flue gas desulphurisation (FGD) unit. Heat integration between the two processes minimises steam requirements.

- The amine columns are made of concrete with internal linings, achieving significant saving on raw materials (compared with stainless steel) while maintaining process performance and corrosion tolerance. A rectangular/square design instead of a circular design allows for easier and cheaper on-site construction
- Prefabrication and modular design saves project time and onsite costs.

Needless to say, the world's power industry is taking a close interest in how the Boundary Dam plant is developing.

But elsewhere advances are being made as well. Recent breakthroughs in other non-solvent technologies show promise in potential cost reductions, especially for natural gas processing applications. For example, membrane technology and adsorption technology have been applied to acid gas removal. Where applicable, membrane separation often incurs much smaller capital and operating costs, compared with typical solvent processes. It is recognised that for a membrane system, there is an intrinsic trade-off between the membrane area requirement and the energy consumption which is essentially a trade-off between capital and operating cost.

Several other concepts for capturing CO<sub>2</sub> in industrial processes and power plants are being developed around the world. Advancements are being pursued under effective collaborations among governments, academia and

industry. The Clean Coal Research Program supported by the US Department of Energy not only funds applied research but also establishes partnerships with industry and laboratories in making available its National Carbon Capture Center for bench-scale and pilot testing.

Neutral approach

The three CCS power projects in North America should highlight to policymakers around the world the potential of CCS. But too often there remains a gap in the policy treatment of CCS compared to renewables. Investors require longer term policy predictability if they are to invest in CCS. Strong, sustainable emission reduction policies that encourage CCS are urgently needed. In this regard, the United Kingdom is setting a good example with its 'Contracts For Difference' scheme. This market-based approach to low carbon technologies leaves the technology choice up to private developers to identify the commercial opportunity based on a single contract for difference price. This neutral approach allows investors to make rational economic choices at lower cost for the consumer.

***“The three CCS power projects in North America should highlight to policymakers around the world the potential of CCS”***

Industry has gained sufficient experience and confidence to build and operate large scale capture units. For the next generation of projects, significant cost savings can be realised by

optimising the first generation processes through 'learning by doing'; and by continuing R&D efforts on promising new concepts and pilot testing at facility sizes that could be scaled up with sufficient confidence to commercial projects.

It is vital that researchers work collaboratively and leverage each other's knowledge resources to achieve better, faster results to produce the future 'game changer' capture technologies that will help accelerate broad CCS deployment. But most of all, it's critical that CCS is acknowledged for its vital role in capturing carbon emissions.

**About the author**

Brad Page  
is CEO of the Global CCS Institute.



# Shale oil and gas exploitation in Argentina: a case study

By Jorge Ferioli

**S**hale oil and gas presents a tremendous opportunity in Argentina, but will also require tremendous investment. A study undertaken by the Argentinian Committee of the World Energy Council shows that developing the country's shale resources is worthwhile, but improving energy efficiency is at least as important for energy security.

**A**rgentina has been producing oil and gas for more than 100 years, achieving self-sufficiency only during short periods. YPF was established in 1922 as a vertically integrated national oil company. It was privatized in 1993 and bought by the Spanish firm Repsol in 1999; the resulting merger produced Repsol YPF. The renationalization of 51% of the firm was initiated in 2012 by the current government.

Argentina's energy matrix is highly biased towards gas and oil consumption (gas 55%, oil 30%). But the country is facing serious problems in this sector. Wrong and misleading public policies, including artificially low prices for oil and gas and energy subsidies, provoked, on the one hand, an increase in hydrocarbons consumption and, on the other hand, a discouragement to invest in oil and gas production and exploration activities along with an accelerated depletion of most of the major conventional oil and gas fields.

In 2008, the country started LNG imports which had a serious impact on its macroeconomic figures. These imports have been increasing and it is likely that oil imports will be needed as well in the near future.

Hence, Argentina has every reason to develop its domestic shale oil and gas resources, in particular since the U.S. Energy Information Administration (EIA) has estimated that the country has the 2nd largest shale gas resources and 4th largest shale oil resources in the world.

In order to evaluate the challenges and opportunities that our country would have to face, we set up a model that simulates what would happen if we were to reach 2030 without the need of LNG or oil imports through the exploitation of the potentially available shale gas and shale oil.

What makes this exercise interesting is that it makes clear the challenges and path that Argentina and any other country would have to go through if it decides to exploit this type of resources.

## Case study

Let's discuss the highlights of this case. These were our assumptions:

- 1** Well productivity: the average production curve of the 10 most productive fields in the Haynesville shale for gas, and the average production curve of the Eagle Ford shale for oil were adopted.
- 2** Cost of shale oil and gas wells: a gas well to the Vaca Muerta Shale was assumed as 3,000 meters in depth, with an additional 1,000 meters of horizontal drilling and 10 hydraulic fracs for completion totaling \$8.4 million/well, while an oil well was considered at 2,000 meters in depth, with similar horizontal stage and completion totaling \$7.8 million/well. Development phase costs were assumed in both cases.
- 3** Oil and gas demand: We assumed a 2.5% compound annual growth rate for Argentina's GDP in future years.
- 4** Conventional oil and gas production: we assumed a decline rate of 3% per year for conventional gas production and 2% per year for conventional oil. The discovery of an oil or gas field of such magnitude that it could significantly alter these decline rates was not considered, as its likelihood is very small.

## Outcomes

If we examine in hindsight the results in late 2030, when self-sufficiency is achieved, we find the following results.

A total 14,500 unconventional new wells were drilled (7,500 gas wells & 7,000 oil wells) at an approximate cost of \$117 billion.

The total number of wells to be drilled in 2030 (including conventional and shale oil and gas) compared to the total number of wells drilled in 2013 (mostly conventional) represent a 240% increase approximately (1,300 to 3,100 wells/year). This means an investment in drilling of almost \$18 billion/year in 2030 compared to the current expenditure of \$3.2 billion/year in conventional drilling. It is worth noting that due to the high initial decline rate seen in shale wells, drilling activity can't be stopped or reduced if a certain amount of production is required.

The amount of drilling rigs increased 450% during this period at an approximate investment of \$8.4 billion.

The frac sets for completing these wells would have to increase from the current 350,000 HHP (hydraulic horsepower) to approximately 3,750,000 HHP in the Neuquen Basin where 70% of the estimated shale resources are located. This goal is achieved through the acquisition of an additional 1,700 trucks (2,000 HHP each) to the 175 trucks currently available.

With regards to the personnel needed to perform all the activities related to this effort, the analysis shows that 59,000 new direct jobs would be created for highly trained technicians, including 7,500 engineers and geologists. This represents an important challenge to Argentina's education resources and policies. Also, in similar environments, the multiplier estimated for indirect and induced jobs is around 5, hence an additional 300,000 new jobs would be created by this effort.

Considering the current taxation structure in Argentina, the government take (federal and provincial taxes) generated by this effort more than duplicates the earnings obtained by the oil and gas operating companies.

***“Our study makes clear the enormous impact that energy efficiency has in diminishing the dependency on non-renewable sources of energy”***

## Impact of energy efficiency

Taking into account the tremendous effort that developing these unconventional resources would require, a sensitivity analysis was performed to evaluate how an increased energy efficiency scenario, through a 15% reduction in oil and gas demand, would impact the results.

The new figures obtained through this analysis indicate that self-sustainability would be achieved in 2021, i.e., 9 years earlier.

The total amount of wells (conventional and unconventional) needed to achieve the same goal of self-sustainability drops from 38,000 to less than 13,500 and hence, the investment drops from \$177 billion (total investment in conventional and unconventional exploration and production) to \$37 billion. On an annual basis, 1,700 new wells would be needed in 2021 against the 3,100 needed in 2030 without demand reduction.

The number of new drilling rigs required would be reduced by half and the number of frac sets would be reduced to a fifth of the previous exercise.

The full investment needed (wells, rigs, frac sets, facilities both conventional and unconventional) to achieve oil and gas self-sustainability drops from \$198 billion to \$43 billion.

Clearly, developing shale resources implies a tremendous effort in technology acquisition, equipment, capital and human resources training. But, at the same time, the benefits are also significant. Through the value chain, the shale effort would create thousands of new jobs, incremental demand for goods and services, an important amount of income for both government and local economies, and of course, the substitution of energy imports.

Our study also makes clear the enormous impact that energy efficiency has in diminishing the dependency on non-renewable sources of energy. In Argentina's case, this is absolutely necessary to achieve self-sustainability.

### About the author

Jorge Ferioli  
is Chairman of the Academic Council of the  
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(CACME).



# Competition can deliver

**R**egulation and markets are often pitted against each other, but according to Leonhard Birnbaum, European Vice-Chair of the World Energy Council, what is needed is well-designed regulation that makes use of the economic benefits competition brings.

There is often a strong battle line drawn between regulatory enthusiasts and market believers. But both regulation and markets have advantages, so it is more useful to consider what a hybrid design should look like to deliver sensible results.

The advantage of regulatory solutions is a predictable framework (sometimes anyway), market solutions usually (not always) ensure more efficient allocation of investment. In Europe, after a period of deregulation of energy markets (implemented very unevenly across Europe), we are now seeing more and more regulation again. This is often defended on principled grounds. Deregulation, some argue, does not work in the energy space and regulation is to be preferred.

However, I believe this is misleading. No matter how much regulation there is in a system, there needs to be room for competitive elements. What is needed is a predictable regulatory framework in which competition can deliver efficient results.

## Renewables support

Support for renewable energies is a typical example of regulatory intervention. Support was needed in the beginning, but with renewables having achieved a substantial share in electricity production, several governments are now focusing on more economically sustainable support schemes. They are seeking to establish a regulatory framework with certain targets for renewable energy, but which use competitive elements, such as auctions, to achieve these targets at the lowest possible cost.

Such a solution ensures that energy stays affordable. It also avoids the necessity of having to intervene at a later stage to curb excess cost. Thus, the support scheme and thereby the whole energy system is made more resilient. Critics often argue that such schemes benefit only mature technologies and will not stimulate the search for new ways to produce renewable energy. But new technologies can be promoted by research and development funds, which could also deliver the needed progress on the learning curve.

Interesting examples of a more competitive approach to renewables support can be seen in Brazil, the US and the UK. The competitive elements are introduced via several mechanisms, e.g. auctions, contracts for differences or tax incentives. Typically all participants in these competitive mechanisms are willing to learn and to adapt the mechanisms in order to make them more efficient. This is in distinct contrast to less competitive mechanisms e.g. feed-in tariff systems, where defending the existing system seems to be the prime motivation of regulators.

## Nationalism and security of supply

Energy nationalism is another driver of regulatory interventions that tend to avoid competition, causing industrial and private energy customers to miss out on the benefits of more efficient markets. A recent study carried out by the Dutch and German World Energy Council member committees shows that the benefits of integration (induced by further market liberalisation) in electricity markets at the European level run into many billions of euros annually. One should keep in mind that through various mechanisms, e.g. market prices for oil, gas, coal or on international electricity exchanges, energy markets are already interlinked. National regulation ignores these connections and thus leads to distortions. One cannot respond effectively to global and regional trends with uncoordinated national regulation.

This leads to a third example, which is particularly prevalent in Europe at the moment: national strategies for security of supply. The increasing share of renewables in the system together with strong market price decreases for electricity and for emission allowances is causing hardship for conventional power plants. Though it is generally acknowledged that these power stations will be needed in the future as one important source of flexibility, and that it would make sense to share these flexibility sources internationally, discussions about capacity mechanisms are carried out predominantly at the national level. This ensures that the measures taken will forgo the benefits of regional competition.

Investors in the energy sector have experienced the effects of re-regulation and as a result they are reluctant to invest in a regulated environment in which economic sustainability is neglected. Regulators should therefore not only set long-term targets, but also decide on economically sustainable measures to enable market parties to meet these targets. With more and well-designed competitive elements, regulation will become a reliable long-term framework.



**By Dr. Leonhard Birnbaum**  
Vice Chair for Europe of the World Energy Council. He is also Member of the Board of Management of E.ON SE, one of Europe's leading electricity and gas companies.



# Towards a more globally optimized energy model

## INTERVIEW:

**Jean-Marie Dauger**  
GDF Suez



**F**orty years from now, we will have “a more globally optimized energy model”, says Jean-Marie Dauger, Executive Vice-President Global Gas & LNG at GDF Suez and Chair of WEC’s Communications and Outreach Committee. “Efficiency will gradually become the main word. New technologies will deeply impact the way we produce, supply and use energy.”

***The export of US LNG is much talked about in the global gas sector. Do you expect the US to become a serious exporter of LNG and if so, how would this impact the global gas market?***

Yes we do expect US LNG will be exported. Indeed a few projects have already been given FID - including the Cameron LNG project of which we are one promoter – and others will follow. There are many potential projects in the US for a total of about 308 mtpa (384 bcm/year). All will not come to fruition. The selection will be based on their respective competitive advantages. It can be expected that the US will export between 50 to 60 mtpa by 2025. Thanks to the US, but also to Australia, and probably also to Canada, Russia or East Africa, LNG will play an enhanced role, and will contribute to a well-balanced and dynamic worldwide gas market growth.

***Are we moving to a global gas market in the same way as we have a global oil market?***

Globalization of the gas market will increase in line with a growing number of exporting and importing countries or companies which will enlarge optionality. However natural gas and LNG trading still differ dramatically from oil – due to a difference in cost and financing structure as well as in logistics – so that regionalization of the LNG market

will continue to prevail as a basis at least in the midterm even if global trading also continues to develop. The LNG market will be dual, global and regional at the same time.

***There are persistent safety concerns about fracking. Do you think they can be addressed adequately in countries where there is a lot of public concern?***

Shale gas production raises legitimate questions in particular for water usage and land footprint which need to be properly documented and addressed. That being said, hydraulic fracturing has been used for a long time and can be considered a mature process. In addition, considerable progress has been made both on the technology side (such as reducing the water consumption and the footprint of projects) and on the environmental regulation side. There are issues that still require adequate investigation but, at this stage, no technological impossibility to mitigate identified risks has been identified. Nevertheless such technology may prove inadequate in some places or regions depending on specific local considerations as well as for social or political acceptability.

***Do you see the fracking revolution spread across the world and if so where would the first impacts be felt?***

Sooner or later, the production of unconventional gas will start out of North America and Australia, with, potentially, likewise meaningful impact on the gas panorama. Indeed, some of the current gas importers hold large unconventional gas resources. And some of them want to share the competitive advantage that a low-cost domestic shale gas production represents. Timing and extent for a generalized use of unconventional gas remain, however, uncertain. Resources are generally assessed with only a few data, and may not always translate into developed reserves.

***Is it realistic to expect a major contribution in future from “green gas”, such as biogas, but perhaps also power-to-gas?***

Biogas is a promising environment-friendly fuel. It also contributes to the agricultural sector and supports local employment. For France, we support an ambitious 2020 target: 20 TWh of biogas on networks (ie 5% of the total). By 2030, a target of 20% biogas on gas networks seems accessible.

***Can you describe how you see our global energy system 40 years from now?***

Access to energy is key to eradicate poverty and promote socio-economic development in developing as well as developed countries. Across the world, 1.2 billion people do not have access to electricity, and 2.7 billion use traditional biomass energy. Thanks to technology, a more globally optimized energy model will emerge, in which efficiency will gradually become the main word. New technologies will also deeply impact the way we produce, supply and use energy, as well as the way we can mitigate the impact on our environment in the future.

# Seven disciplines for sustaining electricity reforms in Nigeria

By Dr. Sam Amadi

**N**igeria's reform of its electricity sector has been partially successful, but more needs to be done, writes Dr Sam Amadi, Chairman & Chief Executive Officer of the Nigerian Electricity Regulatory Commission. Dr Amadi lists seven disciplines that are required to create a well-functioning sustainable electricity sector in Nigeria.

In 2000 Nigeria began a serious reform of its electricity industry. This reform, contained in the National Electric Power Policy (NEPP), seeks to create an efficient and financially viable electricity market driven by private sector investment based on full recovery of prudent costs. It started with the unbundling of the state-owned vertically integrated electricity monopoly and ended in November 2013 with the privatization of the successor companies of the state monopoly.

Underlying the Nigerian power sector reform is the philosophy that government ownership of electricity assets was the major cause of the collapse of the industry in the late 1980s. This assumption ties neatly into the structure of the dominant economic narrative in the 21st Century, which is, that private capital has the capacity to unleash creativity and productivity where public capital had bred stagnation and mediocrity.

Now after privatization, we are discovering that the journey towards efficiency and sustainability of the electricity market demands more than restructuring of ownership. Critical disciplines need to be entrenched to make the dream of adequate, reliable and affordable electricity available to Nigerians. I have identified 7 such disciplines that are necessary in a transitional electricity market.

## 1 The Discipline of Maintaining the Independence of the Regulator

The most important item missing in the Nigerian Electricity Supply Industry (NESI) in the past was an independent regulator. Previously, there was absence of corporate governance and no control of investment and performance in the sector. This is why both the reform policy document (NEPP) and the Electric Power Sector Reform (EPSR) 2005 Act established an independent sector regulator with full powers to regulate the entire value chain. The recent success in attracting foreign investment and privatizing state assets is attributed to the protection of the independence and effectiveness of the regulator. The political leaders

will learn to respect the requirement of independence and effectiveness of the regulator. They will need to strengthen the regulator and further reduce regulatory risks to make the market attractive.

## 2 The Discipline of Right Pricing

A key factor in the collapse of the electricity industry in Nigeria was the policy of the military government not allowing the then-government monopoly to charge cost-reflective tariffs to consumers. This was aggravated by the failure of bulk consumers like government institutions to pay their bills. At the same time government did not invest sufficiently in upgrade and maintenance. Since 2008 the regulator has issued a methodology for tariff setting that indexes electricity tariffs to macroeconomic indicators. The methodology is a law and gives confidence to investors that their investment will be recovered. It also incentivizes operators to undertake efficient and prudent investment. It is the regime of right pricing that makes for sustained private sector investment.

## 3 The Discipline of Transparent Procurement

More than ownership the success of the power sector reform depends on the quality of regulatory intervention and public sector management in the industry. We are aware that public utilities have fared well in countries where the regulatory framework and public sector management have been adequate. It is an important fact that if Nigeria is to recover from the collapse of its erstwhile electricity industry and enjoy the benefits of the reforms, it must submit to the discipline of transparent and prudent procurement. In Nigeria, the transmission services provider is still a public company. It raises additional risks of failure if the old undisciplined procurement practices continue.

## 4 The Discipline of Smart Project Management

Another major obstacle to capacity development in the electricity market is the absence of smart project

management. The failure of the Nigerian Integrated Power Projects (NIPP) after half a decade with billions of naira spent, illustrates the need for smart project management. Presently, the Transmission Company of Nigeria (TCN) and the Niger Delta Power Holding Company (NDPHC) have obviously learnt lessons and are remedying the mistakes of the past. The regulatory body under my watch has deployed strict guidelines and rules for project management in the new NESI.

## 5 The Discipline of Accountable Public Sector Investment

Even as the private sector is now playing a leading role in our power sector, the government must continue to invest in the value chains of electricity. As a nation, we cannot rely on the stimulus that the market offers for providing such essential services as electricity. This is all the more so as we have little capacity in electricity generation. Comparative evidence shows that even with all the institutional reforms and incentives, independent power plants (IPP's) may not be built in sufficient quantity. I think it is not strategic to rely for adequate power supplies only on IPPs. No! Not with our ambitious project of wanting to be the 20th leading economy in the world by the end of this decade. My role as the sector regulator will be to guide the government in areas where it can make the best interventions.

## 6 The Discipline of Consistent and Intelligent Policymaking

In the past we failed because policies were not well thought out and easily reversed. These reversals meant that even if policies were good, we never cashed in on them because we never allowed them to mature. Failure to be consistent in policymaking leads to too many policy reversals. This is a recipe for underdevelopment. We should always remember that the perceptions of inconsistency in policymaking can trigger a contagion. Perception that a sector or the wider country is flip-flopping on critical decision-making

sends a panic to the market and can undermine whatever the government does right. Credibility of the process is important to attract private sector participation. Credibility is reinforced when there is clarity as to the roles of actors and the process of making decisions. In Nigeria, we have spent time delineating roles and rules for stakeholders in the new power structure and this is paying off as there is orderliness in sorting out legacy problems of gas, debts, etcetera.

## 7 The Discipline of Public Participation

The last discipline could well be the most important: will the reform receive popular support? The major mistake of reformers is usually to assume that reform is essentially technical and therefore not political. It often happens

that technically smart reformers are politically naïve. But the truth is that real and lasting change in the sector is only possible and durable if there is sufficient civic support. The main focus of the power sector reform should be to make many people see the point of it. This is important for the new cultures we need to sustain transformation. We need a critical mass to make that change and sustain it. This means that reformers should be as good with graphs and

concepts as they are with words and symbols. They need to be communicatively smart as well as technically adroit. We need to understand what we mean by public participation. It is not just consultation. A regulator must consult stakeholders before it makes decisions and orders. But beyond participation, the reform requires sustained and good faith participation of civil society groups and other stakeholders in electricity policymaking. This is what is generally referred to as 'democratic regulation'.

The journey to full reliability and adequacy of electricity supply in Nigeria will take a long time and much effort. But we are doing the right things. And if we continue on the path of these disciplines we can sustain the reform and ensure that we have a prospect of full access to reliable, adequate and affordable electricity for Nigerian businesses and homes.

*“The most important item missing in the Nigerian Electricity Supply Industry (NESI) in the past was an independent regulator.”*

### About the author

Dr Sam Amadi has been Chairman and CEO of the Nigerian Electricity Reform Commission (NERC) since December 2010. He is a lawyer and an established expert in the area of high-level regional and international strategic and policy initiatives in governmental and non-governmental institutions. He obtained a Ph. D and LL.M in 2004 and 2001 respectively from the Harvard Law School, Cambridge, Massachusetts.



# Ecuador: changing to a clean energy system

By Esteban Albornoz Vintimilla  
Minister of Electricity and Renewable Energy



**E**cador has embarked on a revolutionary program that will make the country's energy system clean, green and largely self-sufficient. It involves the building of eight new hydroelectric dams and the large-scale electrification of household cooking.

The Government of the "Ecuadorian Citizen Revolution" has drawn up an ambitious energy program that will deliver: energy sovereignty, energy efficiency, diversification of the energy matrix and regional integration.

In the context of this program, the Ministry of Electricity and Renewable Energy has started on several initiatives which have been presented in the Ecuadorian National Plan for Good Living. These involve an increase in renewable energy, a reduction of oil imports, measures to improve energy efficiency and to reduce distribution losses. The Plan also aims for energy sovereignty based on the development of domestic productive capacities that allow energy self-sufficiency, especially in the generation of electricity.

Concretely, the Government is currently developing several challenging projects of great social, economic and environmental impacts, including the simultaneous construction of eight high-capacity hydroelectric power plants that will allow double the amount of existence hydroelectric installed capacity. In addition, the government is planning to replace gas-based cooking in households by efficient induction-based cooker appliances. It also plan to construct a new oil refinery.

These projects are oriented not only to ensure the future energy availability (energy security), but also to reduce impact on the environment (environmental sustainability) while ensuring the access to good quality electricity

service and oil-derived products to all the Ecuadorians (energy equity). The graph shows the expected energy matrix evolution until 2017.

The building of eight hydroelectric power plants, expected to begin in 2016, will change the history of Ecuador, since Ecuadorian electricity source will be clean. The current thermoelectric generation, based on imported fossil fuels, will be replaced by hydroelectric energy.

The program also includes measures to reduce energy losses in distribution. This includes big investment in grids, the installation of new measurement devices, the actualization of the customer database, implementation of telemetry technology for high consumption clients, etc. Already distribution losses have been reduced from 22% in 2007 to 13.7% in 2013, and reaching 12% in 2014.

In the area of energy efficiency, several projects have been started, such as the replacement of 15 million of incandescent lamps by compact fluorescent lamps, a nationwide program to replace traditional obsolete freezers by more efficient equipment, and installation of induction cookers to replace the household use of LPG.

This last project constitutes the most challenging and revolutionary initiative as regards energy consumption that has ever been developed in Ecuador. It is a unique regional initiative that seeks to replace in approximately two years, three million stoves that use LPG by induction cookers, allowing annual savings for the country of around \$700 million currently used to finance the subsidy on LPG which is mostly imported.

This project is part of a public policy which aims at the use and exploitation of energy resources that actually belong to Ecuador. Ecuador is a country that has huge hydro resources that properly exploited, will allow achieving adequate levels of energy sovereignty, while taking care of the environment and ensuring universal access to energy.

***"This is a unique initiative that seeks to replace in approximately two years three million stoves that use LPG by electric induction cookers"***

# China's new Vision of Energy Security

By Qinhua Xu

**S**ocieties have evolved in different ways, including the ways in which they produce and consume energy. This has led to differences in energy culture. Thus, China has a different perspective on “energy security” than that which prevails in western countries. To promote energy cooperation and achieve a common understanding, we need to take into account and overcome differences in energy culture.

Differences in energy culture originate from differences in values, level of economic development, stages of development in the energy industry, preferences in energy consumption and level of technological research & development. Such differences lead to a different understanding of the core concepts of energy. As a result, each country has its own development strategy for energy, which may hinder energy cooperation with other economies.

For example, there are big differences in how westerners look at energy compared to the Chinese view. China has its own energy culture with Chinese characteristics based on its specific cultural views, its development stage, political system, ownership arrangements, constitution, the way people think and the language. To be able to cooperate with China in the international energy arena, it is important to gain some understanding of these Chinese characteristics.

Take energy security. The definition of energy security in the western world has changed over time. After the 1970s oil shocks, energy security related to the risk of oil supply from the Middle East. As countries diversified their sources of energy, the definition of energy security became broader in scope, although security of supply was still at the heart of it.

After the 1970s oil shortage, most developed nations have endeavored to reduce their national dependence on external supplies, through diversifying their sources of supply, energy conservation and promoting alternative fuels. With the degree of self-sufficiency increasing, the key aspect of energy security has moved away from securing supplies to achieving a balance of what are called the 3Es: energy security, economic growth and environmental protection

For the Chinese, however, the concept of energy security has also evolved. The Chinese government uses the concept of “energy safety” instead of “energy security”. “Energy safety” includes the concept of energy security. For example, Liu Qi, deputy director general of the National Energy Administration, has been quoted as saying “China is committed to the development of renewable energy in order to ensure the safety of national energy.”

After more than half a century of energy industry development, China has developed what it calls a New Vision of Energy Security. China's former president Hu Jintao summarized China's energy strategy at the G8 Summit in July 2006 in St. Petersburg as follows: “Give high priority to conservation, rely mainly on domestic supply, develop diverse energy resources, protect the environment, step up international cooperation of mutual benefit, and ensure the stable supply of economical and clean energies.”

Thus, China's New Vision of Energy Security subsumes three elements:

- Energy security, with energy intensity reduction as the primary means of overcoming energy related obstacles, which is considered of national strategic importance.
- Environmental protection, centered on eliminating inefficient and heavily polluting energy production, which is the cornerstone of China's approach to addressing environmental challenges.
- Long-term economic growth, which entails departing from a resource-intensive growth trajectory and promoting energy efficiency as a key long-term mainstay of economic growth.

The World Energy Council (WEC), of all international energy organizations the most comprehensive one, is able to take the responsibility of playing the leading role in eliminating the gaps in understanding energy culture all over the world. It can do so in three ways.

Firstly by organizing energy workshops in various member economies in which national committees exchange views with representatives from other countries. Secondly by designing energy training programs for talented professionals from across the world. Thirdly, by organizing a special Energy Forum on the theme of energy culture, which would include in-depth discussion and studies which could be published by the WEC.

Dr. Qinhua Xu is Professor of Strategy and Energy, School of International Studies; Director of the Centre for International Energy and Environment Strategy Studies (CIEESS),



# The benefits of cross-border cooperation in power grids

By Oleg Budargin

**C**ooperation in power grids and further integration of the energy sector is the only way to achieve future prosperity not only on a national level, but also internationally and, who knows, across entire continents, writes Oleg Budargin, CEO of number one Russian grid company Rosseti.

Over the past several decades globalization has been one of the dominant processes in the world economy, including in the energy sector. By now it is quite obvious that countries on the Eurasian continent are more or less dependent on each other whether we speak of either raw materials and fuel supply or equipment and components. This gives the Eurasian and global energy industry a tremendous opportunity to boost international ties and go on with the mutual integration of energy systems.

One way forward is to expand trans-border power grids as in many cases it's easier to transfer electricity than to deliver gas, oil or coal. Of course, in each case analysis is needed to find out what is cheaper, safer and more reliable. Nevertheless, overall there are some undeniable advantages to a possible united electricity system on the Eurasian continent, with speed of 'end-product' delivery one of the most essential.

No doubt at the moment infrastructure for safe power transportation from, let's say, the Russian Far East to consumers in Portugal does not exist. Building new, cost-effective lines to transfer electricity for thousands of miles is not on the table now. At the same time Rosseti Group has been involved in many successful cross-border electricity transmission projects – e.g. with Belarus, Kazakhstan, Finland, Lithuania, Latvia – and we believe further integration of national power systems will contribute to the faster development of a global power grid and will make it more innovative and reliable. We also believe uniting national grids and arranging cross-border electricity transportation will lead to lower costs, because there will be less need for backup systems.

Continental integration should, of course, be considered a long-term multistage strategy. Initially, the number of cross-border power bridges in different parts of Eurasia can be enlarged to allow different countries to create reciprocal cross-flows of electric energy to lower costs and to use in case of emergencies. The next step will be broadening of the territories and number of substations as well as lines involved.

## Force for progress

Not to sound divorced from reality, I must admit that

technical problems to unite the Eurasian power grid are not the only ones. Policies to achieve national energy safety are probably a bigger obstacle. This has to do with mutual trust. But I see it as a chance for the energy sector to become a force for progress in social and economic relations between the peoples of the World.

Rosseti is eager to broaden its international cooperation and the company is in advanced talks with the State Grid Corporation of China on a variety of projects, including investments into the modernization of the power grid in Siberia, the supply of equipment and the plan to build a power bridge between the two countries.

Rosseti welcomes international producers who want to build their factories in Russia. Hyundai Heavy Industries has launched a production line for gas-insulated switch-gears in the Russian Far East. Toshiba has set up a joint-venture with Russian company Silovye Mashiny to produce transformers and other electricity equipment near St. Petersburg. Our cooperation with EDF with its subsidiary ERDF-Vostok successfully managing Rosseti's daughter company Tomskaya is another good model of international cooperation.

For Rosseti there's no doubt that cooperation and energy sector integration is the only way to future prosperity not just nationally, but also internationally and, who knows, in future across whole continents.

### About the author

Oleg Budargin is CEO of Rosseti, the largest Russian electricity grid company which comprises 97 subsidiaries in Russia with 190,000 employees. He is also WEC's Vice-Chair Responsibility for Regional Development.



## INTERVIEW:

**Matteo Codazzi,  
CEO CESI**



# “The best has yet to come for the electricity sector”

**T**he electricity sector is confronted with radical changes, but Matteo Codazzi, CEO of the Italian company CESI, a global provider of technical and engineering services, refuses to become downbeat. He believes the incumbent utilities should seize the opportunities offered by new business models and technologies. “The best has yet to come.” World Energy Focus asked him four questions about the future of the electricity sector.

***Renewable energies are changing market dynamics and business models. Italy has been leading in this. What is the key take-away of this story?***

The dash for renewables has been mainly driven by generous incentives and has had several positive effects, among which are reducing CO<sub>2</sub> emissions and improving import independence. However, where volatile renewables are reaching significant penetration, they are also creating non-negligible technical and economic threats to the stability of existing power systems. In Italy, total installed capacity of wind and sun is close to 30 GW, greater than the peak load on some summer days. This situation creates distortions on the day-ahead market, very steep load gradients for conventional thermal plants, network congestions, inversion of power flows in primary substations, over-generation with inevitable curtailments and issues with voltage regulation. All the above must not be taken as a barrier and criticism to renewables, but it is something that has to be addressed properly if one wants to achieve an effective and efficient carbon-free scenario.

***What about the integration of renewables into the grid? Some are advocating government-led capacity mechanisms. Others say these are not needed if we implement smart grids and use balancing services available in the market.***

I don't think there is a single “silver bullet” to address the above problems. There are a plethora of useful tools, both technical and regulatory, available to solve or mitigate the issue of renewables integration. Some markets are addressing the issue of “rightsizing” an adequate reserve capacity. But other practical solutions exist. Smart grids can enhance flexibility of conventional units. Investments in reinforcements and upgrading of the transmission network can reduce bottlenecks and can enhance flexibility to accommodate more volatile power flows. Demand responsiveness through smart distribution grids can lead to electricity bill savings for load adjustment and reductions in the likelihood and consequences of forced outages. Energy storage solutions can be used both in small scale devices to smooth high frequency low amplitude intermittency and in large scale devices (e.g.: hydro pumping/large size batteries) to provide peak power or energy services.

***What benefits are possible through the implementation of smart grids and meters?***

The smart grid has intrigued energy experts for years and the technology to make this happen has been developed since more than 15 years. The momentum is building, but the course of smart grid adoption is yet far from clear. You can have several benefits from smart grid deployment in terms of energy efficiency, savings in a DSO's operational and maintenance costs, reduction of costly electricity losses, flexibility in dispatching generation, avoided investments in transmission and distribution, CO<sub>2</sub> reductions. In Italy, smart meters have become key assets at the edge of the distribution grid, capable of recording both historical and real-time consumption data, remotely manage customers' readings, thus lowering OPEX, reduce peak demand and eventually curtail consumption in order to reduce the scale of outages. Most importantly smart meters are now opening the “next door”, which is the era of big-data in the utilities sector.

***How will the final user be affected by smart grids?***

Smart grid means a flipping paradigm: from the client “at the end of the line” to the client “at the core of the system”. A client that will become “central” because she will be taking informed consumption decisions, will become energy efficient, will evolve into a distributed generator (who is storing locally overproduction and sometimes feeds electricity into the grid, based on real-time price signals). This “prosumer” will increasingly become a key part of the equation and can enable the entire system to achieve sustainable objectives. She will and create new market opportunities and new business models. This is the next challenge for existing utilities: they have to understand and anticipate this transformation, if they want to keep their edge. Smart grids can be intriguing and thrilling: they are the gravity centers for smart technologies, smart regulation, smart financial decisions and smart human behavior. I believe this is definitely a very exciting moment for being in the energy sector: the best has yet to come!

# Riding down the Asian Energy Super Highway

By Anthony Jude



**T**o solve their pressing energy needs and meet rising demand, Asian countries need to stimulate the integration of their energy markets, writes Anthony Jude of the Asian Development Bank (ADB). Many initiatives are underway, but more needs to be done to overcome the natural reluctance of nations to rely on their neighbours for their energy needs.

There are numerous examples of places where successful Asian energy market integration is already well underway. For instance, under the auspices of the Central Asia and South Asia Regional Energy Market (CASAREM) initiative, the Turkmenistan-Uzbekistan-Tajikistan-Afghanistan-Pakistan (TUTAP) project aims to link the energy resource-rich Central Asian countries of Tajikistan, Uzbekistan, and Turkmenistan with Afghanistan and Pakistan, both of which have low levels of energy access.

Another good example is the recent creation of a Regional Power Trade Coordination Committee for the Greater Mekong Sub-region (GMS), to co-ordinate and oversee the issues arising from the many planned and existing infrastructure projects for interconnection between the countries of that sub-region (both power generation and cross-border transmission).

Other flagship initiatives and market integration efforts include the creation of the SAARC Energy Ring and market for electricity in South Asia, the ASEAN Power Grid, Gobitec and the North-East Asian Super Grid, and the creation of a Central Asian Unified Energy System. Eventually, we may achieve the vision of greater Asian market integration in the form of an Asian Energy Highway, to borrow a term coined by UNESCAP.

## Uneven geographic distribution

Why do we need regional energy market integration in Asia? It is well-known that energy demand growth in Asia is very high, that many countries are dependent on energy imports and many people still have no basic access to modern forms of energy. To meet these challenges requires the best possible allocation of the region's energy supply resources to meet demand.

Ideally, efficient energy markets will allow entry and connection access for diversified supply sources and a wide distribution of demand centers, plus an energy trading regime that facilitates load matching and efficient pricing, all governed by strong institutional and regulatory regimes. However, the uneven geographic distribution of energy resources across Asia presents a variety of challenges to optimal market development. Restrictions to intra-regional trade can raise a number of barriers in terms of energy sector operating efficiency and overall security of supply.

Regional integration of energy markets can help overcome these barriers and yield significant dividends for individual countries. Evidence shows that regionalization of energy markets tends to improve efficiencies in power production and trade, reduce overall power prices, improve energy access and allow for increased penetration of cleaner but intermittent generation sources.

Given its deep and wide potential socioeconomic benefits, the Asian Development Bank (ADB) has been an active supporter of regional economic integration, and this extends to strong support for regional integration of energy markets. ADB's Energy Strategy (2009) is founded upon three pillars: namely, promoting energy efficiency and renewable energy; maximizing access to energy for all; and promoting energy sector reform, capacity building, and governance. Concerted support for regional energy market integration holds out the prospect of contributing to the achievement of all three of these goals simultaneously.



For energy surplus countries like Bhutan, Kyrgyz Republic, Lao PDR, Tajikistan, and Turkmenistan, regional energy trade can generate huge economic gains. For example, in recent years Bhutan's electricity exports have contributed around 25% of its GDP and 60% of government revenues. For energy-deficient countries like Afghanistan, Bangladesh, Cambodia, Indonesia, Pakistan, and Sri Lanka, importing electricity can enable sustained economic growth and ensure improved energy security, while decreasing the economic burden of direct reliance on imported fuels.

The benefits of increased energy market integration go beyond the energy sector. The overlapping roles of energy, water, and agriculture are increasingly well acknowledged. For example, agricultural production both uses and creates energy (through biomass); energy is important to water treatment processes, distribution (through pumping requirements) and waste water treatment; and water availability is a key factor in cooling in thermal power plants and for hydro-power generation. Viewed from the perspective of this energy-water-food nexus, regional energy market integration has flow-on potential benefits for food and water availability at a national level, where it leads to improved allocative efficiency and therefore better availability of food and water resources at the local level.

## Foster the will

It should be emphasized that market integration goes beyond the concept of simple cooperation between countries. It requires the building of well-governed institutions, aligned legal frameworks, and joint commitments to build hard infrastructure. As such, achieving the vision of greater Asian energy market integration and eventually an "Asian Energy Highway", will require a number of obstacles to be cleared. The first of these is the need to create a broader concept of national energy security, not based on total energy independence or national energy assets alone,

but in realization of the economies of scale that regional energy market integration can bring.

Regional institutions and mechanisms must overcome the natural reluctance of nations to integrate energy markets with their neighbors. They must be effectively governed, so that confidence is built even as some degree of sovereignty is delegated to them. This is complicated because there are uneven governance capacities between neighboring countries at differing income levels, and with different access to resources.

In relation to legal frameworks at the regional level, it has often been observed that Asia is relatively 'lightly institutionalized'. While many complex agreements are in place, most sub-regional institutions, frameworks and agreements (with some notable exceptions, such as ASEAN and the South Asian Association for Regional Cooperation or SAARC) are informal with no legal binding or enforcement capacity. Instead, they largely adopt advisory, regulatory, and financing modalities.

In addition, Asian countries face multiple challenges for infrastructure and energy sector development at both the national and regional levels: (a) insufficient market opening and capital account liberalization; (b) limited and varying degrees of price transparency; (c) differing levels of financial regulation and risk management of financial firms and markets; and (d) heterogeneous energy regulatory frameworks across countries. It is critical that regional efforts address the need to create a stronger and more consistent legal basis for energy market integration.

In building political dialogue and in communicating and demonstrating the benefits of energy market integration, ADB intends to support Asian nations on every step of this journey to prove that one plus one can be greater than two, and to help make the promised benefits of the "Asian Energy Highway" a reality.

***"There are numerous examples of places where successful Asian energy market integration is already well underway"***

### About the author

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# Turkey: reliable hub and transparent market in an uncertain energy world

By Hasan Murat Mercan

**T**urkish energy policy is aimed at improving its energy security by attracting diverse sources of supply, developing alternative fuels and position itself as a transparent, reliable hub in an increasingly uncertain energy world, writes Hon. Hasan Murat Mercan, Associate Professor at Bilkent University and Chair of the Organising Committee of the 2016 World Energy Congress.

**G**eopolitical developments are currently having a strong impact on the energy security of countries. The conflict between Russia and Ukraine, continuing turmoil in Iraq, Iranian sanctions, the territorial dispute around the South China Sea, growing political conflicts in Sub-Saharan Africa and ongoing political tensions in the Middle-East are all contemporary geopolitical risks that heavily affect energy security in the world. Clearly in such a political environment energy security becomes the main driver for the energy policies of countries.

Countries with insufficient energy resources are seeking new ways to meet their energy needs in a timely, economic, secure and efficient manner. They look for affordable supplies and safe routes and transportation systems to maintain their economies.

Development of new technologies also has a strong influence on energy markets and energy security of course. The gas market is a good example of this. The global gas market is becoming more competitive thanks to increasing supplies of LNG. This presents an opportunity for gas consumers like Turkey and the rest of Europe to diversify their energy supply. It could also change the position of supplier countries. The opening up of new resources with the help of new technologies will determine energy trade and energy transport routes for decades to come.

Overall we believe it is inevitable that fossil fuels will continue to be the major energy source in the upcoming decades. Renewable energy sources will play an increasingly important role as they will become more cost-effective. Climate change will be another significant factor shaping our energy future. It is a fact that decreasing greenhouse gas emissions is necessary to limit global warming to two degrees.

## Reliable transit

So what does this mean for Turkey? With a fast growing economy, Turkey has become one of the fastest growing energy markets in the world. Our country has experienced rapid demand growth in all parts of the energy sector for decades. Over the last decade, Turkey has seen the second largest increase in natural and electricity demand

in the world, second only to China!

At the same time, Turkey's domestic energy resources are limited. Dependency on energy imports, especially of oil and gas, is very high. So the priority of Turkey's energy policy is to reinforce its energy security. In that context Turkey's energy policy has four aims:

- 1 diversify its energy supply routes and sourcing countries
- 2 increase the share of renewables and include nuclear power in its energy mix
- 3 take significant steps to increase energy efficiency
- 4 make Turkey an important energy transit state and a significant energy hub

Turkey is geographically adjacent to more than 70% of the world's proven oil and gas reserves. Forming a natural energy bridge between exporting countries in the Middle East and the Caspian basin, and consumer markets in Europe, Turkey is a key country in ensuring energy security through diversification of supply sources and routes. These considerations have gained increased value in today's Europe.

Major pipeline projects, both realized and proposed, will contribute to Europe's energy supply security and enhance Turkey's role as a reliable transit country, not only on the East-West but also the North-South energy axis. Turkey aims to establish an uninterrupted and reliable flow of hydrocarbon resources from the Greater Caspian and the Middle East to its domestic market and to Europe. The latest Russia-Ukraine crisis has shown again that Turkey is a key transit state to transport gas from the Caspian and the Middle East to EU member states.

Finally, Turkish energy policy is aimed at becoming a totally open, transparent, and well-regulated competitive market. After the necessary physical infrastructure, such as new refineries, receiving terminals and storage units, has been established, Turkey is expected to become a commercial hub for suppliers and consumers. We are confident that we will succeed in this aim.



## CLEAN ENERGY TO REDUCE GREENHOUSE GAS EMISSIONS

By generating clean, renewable energy, Hydro-Québec acts as a key player in the fight against climate change. Our hydroelectric facilities emit negligible amounts of greenhouse gas: 40 times less CO<sub>2</sub> than natural-gas power stations and 100 times less than coal-fired generating stations.

As North America's largest producer of clean, renewable energy, Hydro-Québec places sustainable development at the heart of every project.



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food, science, filmmaking, sport.  
There's no field where Italy hasn't been outstanding.  
Now it's time to do even better. It's time to truly shine.

# LET'S LOOK FORWARD

Let's build, write, invent, produce. Let's do something new we can be proud of now. Not through nostalgia for our past glories. But through all the energy we now have inside us. Together with the energy of a leading, integrated player in electricity and gas. A group that started in Italy and today provides power to 60 million customers in Europe and Latin America.

