For Turkey, energy security is a global priority

“Mexicans face a choice”: Energy Secretary on reform

Indonesia’s lessons on subsidies

IEA focuses on Russia

CEO of GDF SUEZ calls for action
The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency’s aims include the following objectives:

- Secure member countries’ access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

- Australia
- Austria
- Belgium
- Canada
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Japan
- Korea (Republic of)
- Luxembourg
- Netherlands
- New Zealand
- Norway
- Poland
- Portugal
- Slovak Republic
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States
- The European Commission also participates in the work of the IEA.
Ours is an era of fundamental rebalancing of the global energy map. Consumption and production patterns are shifting, and new trading patterns and technological advances offer broader scope for market integration and reform at the international level — creating a common incentive for market stability and investment promotion. Meanwhile, the growing challenge of mitigating global climate change increases as decarbonisation of the global energy system stalls, and the cost of delay becomes even greater.

To meet these shared economic and environmental challenges, we need international energy co-operation at the highest level. The IEA is at the centre of international global energy policy, and we must maintain that position by reaching beyond our traditional membership. This issue of IEA Energy showcases Agency co-operation over the past two years with partner countries (Brazil, China, India, Indonesia, Mexico, Russia and South Africa), as well as global efforts to co-ordinate research and improve energy efficiency, plus the results of IEA work over the past two years to fulfil the goals set at the last Ministerial.

In that context, this issue of IEA Energy reaches readers as the 2013 Meeting of the IEA Governing Board at Ministerial Level brings together energy ministers and other top officials from member and partner countries, plus leaders of more than 30 major companies that form the IEA Energy Business Council. This meeting reflects the shared message of the importance of policies for energy security and sustainability, in both the near and longer term. Indeed, together representing over two-thirds of global energy production and more than three-quarters of global demand, the IEA member and partner countries that are gathering provide a landmark opportunity to address shared energy challenges.

“Global Synergy for Tomorrow’s Energy”

The World Energy Outlook 2013’s New Policies Scenario foresees substantial global energy demand growth through 2035, but almost all of the surge in consumption takes place outside of IEA member countries. Several traditional fossil-fuel producers, particularly in the Middle East, are at the forefront of that growth — which threatens to eat into their exports and present them with challenges usually associated with consumer countries. Indeed, the distinction between producers and consumers is blurring. Over the past decade, unconventional extraction techniques have set off a revolution first in natural gas, then in oil, originally in North America but spreading worldwide. Deep-water offshore drilling is also contributing to significant supply growth in consumer as well as producer countries. Finally, renewable energy technologies are not only growing “up” to new levels of penetration, but also “out” to emerging and developing economies.

These trends have significant implications for global energy security as well as for efforts to transition to a low-carbon future. Oil markets are coping with new levels of uncertainty as well as sustained high prices. The combination of high prices and increased import dependence means that expenditure on imports of oil and gas more than doubles by 2035. Despite efforts to increase efficiency and encourage the deployment of clean energy technologies, the IEA Energy Sector Carbon Intensity Index, which shows average CO₂ emissions per unit of energy produced, has barely budged since 1990, and absolute levels of greenhouse gas emissions have reached record highs, partly due to rapid growth in markets dependent on coal-fired generation — and also in oil-producing countries heavily reliant on their own product for power.

The theme of the 2013 Ministerial, “Global Synergy for Tomorrow’s Energy”, reflects what it will take to address the new threats and challenges posed by the changing global energy map. Only by working together, across the energy sector and across borders, will we find solutions. As the meeting kicks off the Agency’s 40th year, it affirms anew how the mission and work of the IEA are changing — and are ever more vital.
WARM UP

A large proportion of research into energy security is global.

The changes are not only national and to individual customers but also transparent and liberal, requiring a community of production.

Electricity alone is not enough.

For each period of ten whose Electricity State Act re-establishes the intermediate markets, with each country across the market, with more vehicles are running on natural gas.

Energy Minister Taner Yıldız of Turkey on how energy security is a global imperative.

How best can the IEA work with partner countries? Have your say and win a WEO.

Global changes in energy require global co-operation, at the IEA Ministerial and always.

The fuel’s many factors and facets make for a plethora of prices.

Coal: Colombia has big plans for production, but infrastructure is limiting growth.

Wind: Turbines are being engineered for top efficiency in faraway and brutal places.

CCS: This is a key decade for testing and determining that CCS can work.

Gas: Cars, trucks, trains, even ships: more vehicles are running on natural gas.

The “hidden” fuel is now the “first” fuel for IEA member countries.

Fossil fuels abound, but recovery is ever harder.

The intricate relationship between energy prices and national competitiveness.

Depicting 20 years of the changing global energy map, statistically and graphically.

CEO of GDF SUEZ urges policy makers to realise the benefits of the energy revolution.

Applause for a common-sense plan to limit emissions gives cause for new optimism.

IEA-facilitated networks help experts pursue cutting-edge technology.

Making “smart” machines truly smart about energy consumption.

This is a key decade for testing and determining that CCS can work.
2013 IEA MINISTERIAL
MEMBER OR NOT, ALL GET THEIR SAY

The IEA Ministerial brings together energy ministers and other top officials of member countries and nine other nations plus CEOs of some of the leading energy-producing and -consuming companies. They are gathering to address sustainability and security issues related to the changes to the global energy map since the IEA was founded four decades ago – issues that will affect everyone for decades to come.

The Journal of the International Energy Agency

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Printed in Luxembourg by Imprimerie Centrale.

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ISSN: 2225-6334

Cover photo: © GraphicObsession

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This year the International Energy Agency Ministerial meeting is being held at a time when major changes are taking place in the global energy picture. Leading players in the energy sector face new challenges as a result of dramatic changes in the energy landscape and geopolitics. This shift comes in the wake of the emergence of new energy resources, including renewable energy and the shale gas revolution, and the opportunities and challenges they present, together with current political and social developments in the greater Middle East. These developments place the concept of energy security high on the global agenda. Accordingly, Turkey will continue to engage both at regional and global scales to enhance worldwide energy security and the dialogue for sustainable and inclusive economic growth.

Energy-rich countries in the Middle East and Caspian regions have emerged as key players in international energy politics, becoming focal points for untapped oil and natural gas reserves. The shale gas revolution in the United States seems to have the potential to change the rules of the global energy game. The increasing production of unconventional gas in that country has made it self-sufficient in gas and reduced its dependency on imports across the board. This will as well have significant ramifications for energy prices. In addition to the United States, Canada and Australia are developing their unconventional gas resources while several countries in Asia, Latin America and Europe have firm intentions to do so.

With this trend, major gas suppliers will have to change their pricing strategies and their policies with respect to their new supply contracts. The increase in global gas production and the growing trade of liquefied natural gas (LNG) have eroded geographic barriers between regional gas markets, leading to a decoupling of gas from oil prices.

Diverse sources, routes and fuels enhance Turkey’s energy security

Uninterrupted availability of sufficient, clean and good-quality energy sources at an affordable price is defined as “energy security”. We view energy security as a critical aspect of the global energy outlook. Our multidimensional energy strategy is designed to strengthen our energy security through diversification of energy routes and sources.

Turkey, the 17th-largest economy and one of the fastest-growing energy markets in the world, acts as a natural bridge and one of the most important transit countries between producers and consumers. We, therefore, have focused on major projects, such as the Baku-Tbilisi-Ceyhan (BTC) oil pipeline as well as the Baku-Tbilisi-Erzurum (BTE) – also known as the South Caucasus – gas pipeline, which have been transporting oil and gas from the Caspian region to the world markets. These projects marked a turning point in shaping the political landscape of the region.

Turkey currently imports gas from the Russian Federation (Western Pipeline and Blue Stream), Azerbaijan (BTE) and Iran through pipelines as well as LNG from Algeria and Nigeria. Turkey’s import portfolio demonstrates that its gas sources are to a large extent diversified. We are seeking to further diversify our energy sources and routes. One such project designed by Turkey and Azerbaijan is the Trans Anatolian Pipeline (TANAP), which initially aims to supply to Turkey 6 billion cubic metres (bcm) of gas from Shah Deniz Phase 2 and transport a further 10 bcm to Europe. TANAP also constitutes the backbone of the Southern Gas Corridor.

Turkey places a priority on turning the Southern Gas Corridor into a reality to further strengthen the energy security of Europe as well as Turkey. We maintain that the most viable route for uninterrupted and reliable flows of such resources to Europe is via Turkey.

One of the major objectives of Turkey’s energy strategy is to have a sound and sustainable energy mix. Turkey has a 90% import-dependency in fossil fuels. In order to diversify as well as reduce the share of fossil fuels in our total energy demand, we have decided to include nuclear in the energy mix. Two nuclear power plant projects are under way, and 10% of our electricity
is to be generated by nuclear energy by 2023. Turkey also has a substantial renewable energy potential. We plan to increase the share of renewables in our total energy mix to up to 30% by 2023. Due attention will also be paid to fully utilise Turkey’s rich wind and solar energy resources. Another goal is to fully utilise our hydropower. We are as well aiming to explore the untapped potential for shale gas. In doing so, we hope we will be able to contribute to international efforts to deal effectively with climate change. Let me underline that Turkey is committed to work towards an effective, inclusive, comprehensive and legally binding climate change regime.

Turkey prioritises energy for the regional and global agenda

Energy sets the agenda of our co-operation with the European Union. Turkey has made significant reforms towards liberalisation of its energy market and wishes to further develop its co-operation in light of its accession process to the European Union. It is critical, however, that both sides maintain political will to enhance this co-operation. Opening negotiations on the energy chapter will surely provide mutual benefits.

I would also like to reiterate that Turkey will use its resources and relations with other countries and energy businesses to the utmost possible extent and will continue to contribute to regional and global dialogue programmes and projects based on mutual understanding and common interests.

I consider the IEA to be an extremely important organisation and an actor that provides a platform for productive dialogue and co-ordinated approaches in global energy affairs. The Agency’s guiding energy strategies, best practices, publications and events are indispensable not only for its members but also for the international community. In our view, the IEA has a special role in bringing around the same table IEA members, emerging economies and other key players, including the energy industry. The regular IEA Ministerial meetings are a testament to that.

Turkey’s first turn as chair of the IEA Ministerial

This year Turkey will chair the IEA Ministerial meeting for the first time in the organisation’s history. I will have the opportunity to moderate a close dialogue among ministers from IEA member and partner countries and leading figures from the private sector in the wake of the shifting landscape of the energy map. My delegation will bring to the discussion Turkey’s perspective on all these global challenges and developments.

We believe that more transparent, efficient and effective energy policies will be necessary for sustainable and inclusive growth. This is the perspective through which we will strive to succeed in the years to come and that we hope will enable Turkey to achieve all its ambitious growth and sustainable development targets. We believe that the IEA will continue to play a crucial role in this process.
WHAT DO YOU THINK?

Which area is most important for IEA co-operation with emerging economies: a. data; b. climate change; c. energy efficiency; d. energy security?

One respondent, selected at random, will win a free copy of the World Energy Outlook 2013.

From our last issue:

What must be done to achieve significant progress in energy efficiency?

Education and information.

BEN S. | Zrig, Tunisia

I’ve been in this arena for 25 years. Energy is not top-of-mind for most people or businesses. You need to make energy efficiency a simple way to achieve other, more attractive goals.

RAFAEL F. | San Francisco, United States

No change, no progress.

T. M. | Tokyo, Japan

The public must also be sensitised on the importance of conserving and protecting the environment. Developing countries such as my country, Tanzania, must invest in the use of clean energy to conserve the environment, meanwhile promoting sustainable development.

PETER H.L. | Dar es Salaam, Tanzania

Increase energy prices for all users by means of a slowly increasing CO₂ tax.

A. DE B. | Groningen, Netherlands

Pay incentives to consumers who buy efficient devices: the initial high cost of efficient devices is the principal barrier for consumers. When they have limited budgets, the efficiency attribute is not usually considered, although this irrational behaviour leads to much higher costs during the life cycle of the device.

ERNESTO E. | Montevideo, Uruguay

People must be aware of the externalities of energy.

AYTUG E. | Turkey

History shows us high prices of energy help the development of policies and measures on energy efficiency (remember the oil embargo)...

NORA L. M. | Mexico City, Mexico

Transport, industry and housing consume on average more than 70% of world total energy per year. Getting the right energy-efficient technologies in place in those sectors will definitely lead to tremendous progress. The obvious way of achieving this is to make research funding available to address technology gaps in energy efficiency.

AMOS A. | London, United Kingdom

Liberalisation of energy markets: it’s the most effective way to introduce cost rationale.

FRANCESC B. | Barcelona, Spain

The single most important thing that can be done to advance energy efficiency and distributed generation of all kinds is for governments to completely get out of the energy business. Only then will they be able to regulate these businesses genuinely in the public interest.

PAUL R. | Adelaide, Australia

There are technical solutions. The main question, however, is cultural and political. For this there is no easy recipe.

ALBERTO B. | Rome, Italy

Make all buildings and housing more energy-efficient ... because of the percentage of energy they consume for heating and cooling.

DANIEL F. | Bois d’Arcy, France

Pure education and awareness alone will not achieve the objectives — there has to be some sort of incentive.

A. R. R. | Bangalore, India

The winner of the previous raffle for a copy of the World Energy Outlook 2012 is Josko Bobanovic, Sofinnova Partners, Paris, France.
What is the price of coal? That is the first question that usually arises when talking about this fuel. But the only answer is another question: which price?

Unlike oil, coal is a domestic fuel: 85% of coal worldwide is consumed in the same country where it was mined. Domestic markets are more or less exposed to international prices, and prices can vary significantly because of quality, geographic, contractual and regulatory aspects. Plus different types of coal and purchase conditions, including time and point of delivery, make for as many different prices as you can imagine.

Coal in all its varieties

To begin with, coal is not a single product, but a family of many types of different rocks. There are many classifications, but the main split for prices is non-coking (steam or thermal coal and also lignite) and coking coal. Coking coal, which produces coke that is used for iron making, is of a higher quality, mainly in terms of caking properties and strength, than non-coking coal. Hence it commands a price premium, making it too expensive to be burned to produce electricity or heat. But things are not as simple as that.

Coking coal is not a homogenous product, as there are a variety of qualities, with hard coking coal representing the highest quality. Such other types as semi-soft or high-volatile coking coal are usually sold at a discount to hard-coking coal. In addition, some high-quality non-coking coals are used in metallurgy, as coal for pulverised coal injection (PCI) to reduce coke consumption in the blast furnace. Their prices are also related to coking coal, though still at a discount. Finally, there are some market niches. Whereas high-grade anthracite can also be used for PCI and follows those prices, ultra-high-grade anthracite can partially replace coke in the blast furnace, and hence, is related to coke price at a discount.

In non-coking coal used for heat and power generation (steam or thermal coal), calorific value is the main parameter for defining performance, but it is not actually that simple. A lower calorific value generally means a lower price, with the price falling faster than the energy value.

Different prices in different places

In general, different geographic markets are well integrated, as seaborne transport costs are much lower than, for example, those of LNG. Nevertheless, there are different prices in different importing and exporting regions.

For seaborne coal, freight still is a significant part of the price, and so, too, is insurance. Therefore, terms such as free-on-boarding (FOB), cost insurance freight (CIF) or cost freight (CFR) matter to the price. FOB is usually used for the port of origin and means that the buyer will pay for transportation to the destination port and assume the risks in transit. In delivery points, CIF prices are used. That means the buyer takes title in the destination port and the seller pays freight and insurance and assumes the risks in transit. CFR is similar to CIF, but the buyer pays the insurance.

UNLIKE OIL, COAL IS A DOMESTIC FUEL: 85% OF COAL WORLDWIDE IS CONSUMED IN THE SAME COUNTRY WHERE IT WAS MINED.

Spot or not also affects price

A further aspect when dealing with coal prices is whether the price refers to contracted coal or to spot purchase. For example, Japanese utilities often buy most of their thermal coal through one-year term contracts (and by one-quarter or one-month contracts for coking coal). But generally, coal is traded internationally on a spot basis, so most price markers and indexes refer to spot purchases.

And of course, as for any commodity, there are futures, forwards and swaps for different dates, different types of coal and different locations.

In short, you have to be pretty specific if you ask for the price of coal.
Colombia's oil future is promising, with state resources and fast-growing proven reserves. But to hold output above 1 million barrels per day (mb/d), let alone increase it significantly, as the government hopes, the country must overcome serious infrastructure challenges as well as security concerns.

Extensive exploration lifted the country's proven reserves in 2011 at the third-highest rate worldwide, behind only Iraq and Brazil—new resources that, if successfully exploited, would add to the ongoing shift to the Americas of non-OPEC production. The fourth-largest producer in Latin America—after Mexico, Venezuela, and Brazil—Colombia stands to benefit from its free-trade deal with the United States by drawing on the expertise of oil services companies experienced in North American unconventional production. Already, several US and Canadian companies are drilling, exploring or acquiring acreage for shale oil plays.

But marketing more oil requires more means to move it to markets. Colombia broke through the threshold of 1 mb/d this year, nearly double the production of ten years earlier, on slightly increased pipeline capacity. The current capacity of 1.29 mb/d, including what can be transported by truck, just suffices for that output.

Growth in two major pipelines is already easing a bit of the pressure. About 70% of Colombia's oil is produced in the Llanos Basin. The Llanos Orientales pipeline, completed in 2009, was expanded by 180,000 barrels per day (180 kb/d) in 2011 to a total of 340 kb/d, but some of the Llanos Basin crude still is shipped by truck at a cost of almost USD 50 per barrel. The Caño Limón–Coveñas pipeline, which carries Llanos oil all the way to the Caribbean port of Coveñas, was limited to around 220 kb/d but is expanding by 50 kb/d—though that added capacity is to take in incremental oil production from nearby fields, limiting new output.

The newest gain is coming from the first of the three planned phases of the 980-kilometre Bicentenario pipeline that is to deliver up to 450 kb/d to Coveñas, much of it from the Llanos Basin. Ecopetrol, the national oil firm, sees transit infrastructure expanding to a design capacity of just over 2 mb/d by 2016, with eventual plans to build a second pipeline to a Pacific port. But until more pipeline capacity is available, the high cost of trucking means that output much in excess of 1.1 mb/d may not be sustainable.

Associated potential problems, and security

A more distant concern for Colombia is the debate over the Keystone XL pipeline in North America. Colombia produces “heavy” crude that is popular with refiners in the US Gulf, especially in the absence of large Canadian volumes that Keystone XL might provide. Colombian crude also faces competition at US Gulf Coast refineries from heavy Mexican grades, though Mexican exports have declined in recent years.

Colombia's heavy crude also requires diluents, substances that make it easier to transport, and the existing infrastructure cannot accommodate all the diluents needed. This January, Colombia imported from the United States more than 30 kb/d of special naphthas—refined from oil—to facilitate transportation of its crude. Finally, any growth in Colombia's production or pipeline capacity depends on the country's security situation, mainly in terms of the Revolutionary Armed Forces of Colombia (FARC) and its nearly 50-year insurgency that has included kidnapping of oil workers as well as attacks on pipelines.

Wind already provides for about 2.6% of annual global electricity consumption—twice the share of 2008—as total capacity more than doubled since then on an average annual cumulative installed capacity growth rate of 24%. Investment has grown along with output, at USD 78.3 billion in 2012, up from USD 52 billion in 2008.

While the industry is still busy developing those sites that deliver the most power relative to investment, the technology is maturing, ushering in a new phase in which more complex sites' economic potential increases.

The general trend in turbine design has been to increase tower height, blade length and power capacity. On average, however, the height and rotor diameter of turbines have grown more rapidly than their power capacities. This decrease in specific power, or the ratio of capacity over swept area, has pushed up capacity factors considerably.

Reducing the energy cost has been the primary driver of this evolution. But by making it possible to install wind turbines in lower-wind-speed areas, which are often closer to consumption centres, the development also helps avoid installation in areas that are sensitive for environment and landscape integration, such as seashores and mountain ridges. More regular electric output also alleviates concerns about smooth integration into electricity networks. Finally, these advances allow reductions in the capacity of dedicated connecting lines, which can be costly, notably offshore.

And the next frontier is offshore. Among the largest clean-energy projects financed in 2012 were four wind sites in the North Sea. The IEA Technology Roadmap: Wind Power 2013 Update sees offshore wind capacity reaching 28 gigawatts (GW) by 2017, from 5.4 GW in 2012, delivering 76 terawatt hours of electricity globally, or close to double Hungary’s or New Zealand’s current annual electricity consumption.
Despite the North Sea and other projects, financing remains particularly challenging in the offshore sector. But given its earlier state of development compared with onshore wind, offshore is likely to see faster cost reductions. Foundations and grid connection comprise a larger share of total investment cost offshore, but foundations have substantial cost-reduction potential. One solution being tested is floating foundations, which require less material, simplify installation and decommissioning, and can be used in deep waters. Demonstrations off Norway and Portugal have shown good performance, and the European Union has agreed to finance construction by 2015 of five floating turbines off Portugal.

Offshore wind capacity is slated to quintuple by 2017.

Wind power from where it’s cold and icy

Offshore is not the only environment where new technology promises more wind power. An emerging market is cold climates, where turbines are exposed to temperatures or icing conditions, or both, outside standard turbines’ design limits. About 69 GW of installed capacity is estimated to be located in cold-climate areas in Scandinavia, North America, Europe and Asia, of which 19 GW is mostly characterised by temperatures below 20°C and the rest by icing risks. The roadmap sees up to 50 GW more in capacity installed in cold climates by 2018.

Turbines for cold zones need particular materials and components, including specialised measurement systems as well as heaters or pre-heaters for components and subsystems. Anti- or de-icing systems for blades often use electro-thermal heating elements. Permafrost at times requires special foundations.

While the new frontiers of icy and offshore locations pose technical challenges, they do largely spare the industry one concern: local groups’ opposition to turbines for reasons ranging from visual impacts to property values.

The principal benefit of carbon capture and storage (CCS) is that it addresses the issue of carbon emissions while preserving the value and supply advantages of fossil-fuel use and existing infrastructure. By trapping carbon and pumping it into secure reservoirs deep under the ground, CCS allows for significant CO₂ emission reductions from both the energy arena and industrial sectors such as cement, iron, steel, chemicals and refineries. In the industrial sectors, CCS is often the only available large-scale greenhouse gas emission reduction option.

Widespread deployment of CCS depends on many aspects, from government policy to technological development. Individual component technologies required for capture, transport and storage of CO₂ are generally well understood. But the track record for integrating these parts into large-scale projects is limited. A number of new projects have significantly advanced in recent years, but the pace of CCS deployment remains disappointing.

The IEA publication Technology Roadmap: Carbon Capture and Storage 2013 Edition reviews the state of CCS deployment and describes the actions by governments and industry necessary to lay the foundation for scaled-up deployment. The ultimate goal is to develop by 2050 a CCS industry at a scale comparable to today’s oil and gas production industries combined.

The next seven years are critical to accelerated development of CCS, which is necessary to achieve low-carbon stabilisation goals of limiting global temperature rise to no more than 2°C. The roadmap notes that governments need to show leadership in introducing financial support mechanisms, implementing relevant policies, and developing national laws and regulations. Industry must enhance pilot and demonstration efforts to prove capture on numerous processes and in various industries as well as increase research and development to reduce the cost of electricity from CCS-equipped power plants. Governments and industry both have to significantly increase their efforts to improve public and stakeholders’ understanding of CCS technology and the importance of its deployment.

Under the accelerated deployment, the largest potentials for CCS in the medium term exist in three regions: China, OECD Americas and OECD Europe. Overall deployment may vary significantly among different regions. For example, in North America, CCS will very likely be used primarily to reduce CO₂ emissions from coal and gas power generation, while in OECD Asia Oceania and in some non-OECD member countries (e.g. India), industrial applications of CCS will be more important than applications in power generation. The IEA report adds that countries may find it useful to co-operate to ensure that within the next seven years CCS is proven for all major applications where its deployment will be necessary at large scale in a not-very-distant future.
Much of the 15.6% growth in global demand for natural gas over 2012-18 will come from power plants and other predictable sources, but the IEA also sees a new and rising use of natural gas: to power cars and trucks. In the longer term, trains and ships could represent a significant demand centre as well.

Road transport represented just 1.4% of global gas demand in 2012, but that was already more than ten times the amount of natural gas it used in 2000. With China aiming to use cleaner fuels in the transport sector and the shale gas revolution triggering strong investor interest in natural gas as a transport fuel in the United States, the IEA expects this share to rise to 2.5% by 2018. That increase represents 9.4% of total additional gas demand – which means natural gas will have a greater impact than electric cars in slowing oil demand growth.

Natural gas vehicles (NGVs) are not unheard of, and four countries – Pakistan, Iran, Argentina and Brazil – already have a total of nearly 10 million on their roads, accounting for 61% of the world’s fleet. Next are the estimated 2.7 million NGVs in India and China, up from an insignificant 16 000 in the two countries in 2000. And China will dwarf developments in other regions as its consumption triples to 39 billion cubic metres of natural gas by 2018. That growth will be the result of attractive gas prices versus oil as well as the country’s need to develop cleaner transport vehicles and its wish to reduce oil dependency through alternative vehicles technologies.

Even so, NGVs are a negligible share in the total number of cars in India, at 3.5%, and China, where they are just 1.2%. But China added more than 500 000 NGVs in 2011 and 220 000-plus more over the first five months of 2012.

A shift towards OECD countries

In contrast, OECD countries have only 7% of all NGVs, with two-thirds of this share in Italy alone. Though the United States has the most vehicles in the world, Peru, to say nothing of China, has more NGVs.

But the price divergence between gas and oil as well as policy incentives and the recent abundance of natural gas in the United States are expanding use of gas in transport there, with the conversion of long-haul heavy trucks from diesel fuel an especially promising prospect. The premium to buy a natural gas-powered truck is currently estimated at USD 70 000 over the diesel equivalent, but that difference could be significantly reduced when more trucks are built. With future premiums estimated at USD 20 000 to USD 30 000, the investments could be recovered in only a few years in the current price environment.

Some North American gas producers have already started switching rigs that deliver water and other material to fracking sites, running them on natural gas instead of diesel, a retrofit that costs about USD 40 000. The producers then liquefy their gas at the production stage for use in the trucks.

Necessary conditions for NGV growth

NGV development requires political backing, sufficient gas supplies, and individual pricing and fiscal conditions. But most essential is the availability of fuelling stations and the vehicles themselves. Natural gas stations are appearing slowly, notably in China and the United States. At the Geneva Motor Show in March 2013, several NGVs were presented, such as the VW Golf TGI BlueMotion and the SEAT Mii. Audi recently presented its first NGV, an Audi 3. Additionally, many major heavy truck makers in the United States and Europe either have one LNG-powered model available or have announced plans to include such vehicles in their product lines.

Fleets are critical to adoption of NGVs, because natural gas in the transport sector faces the same chicken-and-egg problem confronting electric and hydrogen vehicles: filling stations need to be built so that cars and trucks can be refuelled, but these would need a sufficient number of vehicles to justify the investment. This challenge is easier to address with trucks or buses confined to determined areas or driving along specific highways, usually operated in fleets with dedicated places to refuel.

On the road, on rails, on the sea

Natural gas is not just for cars and trucks. Rail for regions such as North America and Asia, where locomotives use diesel, is one opportunity, and some – but by no means all – rail operators, such as BNSF in the United States, seem to be looking at the conversion with a favourable eye. GE Transportation and Caterpillar have both announced plans to work on new technology for railways, which could be available within months. Because trains move from one network to another, the technology will need to be mature before rail operators can switch.

In the maritime sector, very few ships now use gas (the Baltic Sea region being a notable exception), but new environmental rules on sulphur emissions mean that gas use in maritime transport could take off, too, albeit later than for road transport and at a slower rate. Technology is not an issue, but rather the need to develop infrastructure at ports, as well as the availability and price of natural gas.
YOU ARE THE ENERGY WE BELIEVE IN.

We are the most long-standing energy company in Italy and have been close to Italians forever. In 1883 we lit up the Teatro alla Scala in Milan for the first time and in December, for the fourth year in a row, we will be sponsors of the “Prima”. In all these years, we have never stopped and this is why we have joined the most important electric group in the world, to invest even more in the energy of Italians.
ECONOMICS OF ENERGY EFFICIENCY

“FIRST” FUEL’S VALUE

A new IEA market report seeks to change how people view efficiency by showing that it saves member nations more energy than they get from oil.

IEA member countries’ energy consumption was met by many energy sources in 2010. And the amount of energy saved that year thanks to energy efficiency measures implemented since 1974 was greater than the energy the countries derived by consuming any single supply-side fuel. This “avoided demand” due to energy efficiency was the largest energy resource for the IEA, transforming energy efficiency from the world’s “hidden” fuel into member countries’ “first” fuel.

And the savings keep on growing while energy efficiency draws ever greater investment. The IEA estimates that total global investment in 2011 in energy efficiency measures reached up to USD 300 billion, nearly equal to supply-side outlays for renewable energy and fossil-fuel power generation.

Based on IEA analysis of public spending, multilateral finance institution investment and some private investment where available, the range of USD 147 billion to USD 300 billion is conservative because it relies primarily on public-sector investment information and because even Agency data cannot isolate all the energy efficiency components within every infrastructure project. Of the total outlays, one-third was made in non-OECD countries, and about 90% of that share was in just the five BRICS countries of Brazil, Russia, India, China and South Africa.

A diverse market that is paying off

The market for energy efficiency is as diffuse as energy consumption patterns themselves. Analysis of demand-side investments and their returns in markets around the world is a focus of the new IEA publication Energy Efficiency Market Report 2013: Market Trends and Medium-Term Prospects. This is the first of an annual title complementing the IEA supply-side market reports that address all major energy resources.

The report looks at both supply and demand pressures on energy efficiency and what motivates successful investments in the “first” fuel.

The demand for improved energy efficiency is paying off as IEA countries in general are moving towards less energy use per capita and per unit of gross domestic product (GDP), the latter known as energy intensity. The improvement in both metrics is a welcome tendency even if neither necessarily indicates improving energy efficiency. IEA member countries’ aggregate energy intensity dropped by 1.7% per year on average from 2000 to 2012. In the years 2000 to 2010, member countries saw their GDP rise 16% even as they cut 10% from their total final energy consumption, a measure that excludes consumption related to refining and electricity generation.

Four factors push energy efficiency demand

Four factors drive demand for energy efficiency: price, policy, consumer preference, and multiple benefits associated with energy efficiency, such as improved environment and health. But the dominant drivers are energy prices and government policy. In transparent markets for energy, all consumers, from governments to households, can weigh the marginal cost of avoiding energy demand against the corresponding price of energy. For instance, high fuel costs have driven innovation in the airline industry and, in different regions, have resulted in profound changes in automobile fleets’ fuel efficiency.

But the trade-off is usually not that obvious: even in cases where the price of an efficiency measure is lower than competing energy-supply options, consumers often do not select the efficient choice because of market failures and barriers that block the full potential of energy efficiency improvements. When making vehicle purchases, for example, American consumers respond to fuel prices imperfectly, often undervaluing them. Plus, automobile manufacturers often increase the price of high-efficiency vehicles when fuel prices spike.

The relationship between price and efficiency is therefore not straightforward, in part because policy often affects end-user energy prices and because market failures can prevent energy price signals from reaching...
The particular role of government policy

A distinct feature of energy efficiency markets is government intervention, which aims to mitigate or remove the numerous market failures and barriers that hinder energy efficiency investments. These barriers include imperfect information, when the wide range of products and services for energy performance make it difficult to obtain easily (i.e. at little cost) accurate and sufficient information; principal-agent market failures such as the split in incentives for landlords and tenants; and negative externalities, e.g. excessive greenhouse gas emissions, that impose a cost on society but not directly on the energy consumer. Policies such as regulation, incentives and direct investment, as well as increasing information, often play a pivotal role in stimulating energy efficiency market activity by encouraging, facilitating or requiring investment in energy efficiency.

Governments also get involved because managing energy use and associated energy costs are important to them. Energy imports are rising on a volume basis worldwide for oil, coal and natural gas, so energy efficiency increases energy security by reducing the need for imports. Each barrel of oil, cubic metre of gas or tonne of coal not burned generates economic value not just for the individual investor or consumer but also for the country as a whole. Furthermore, and unlike fossil-fuel consumption, avoiding new demand for energy can generate additional public benefits for the economy and the environment.

What constitutes energy efficiency supply

The IEA considers the potential for energy savings, through cost-effective investment opportunities, to be the “supply” of energy efficiency – much the same way that the Agency views recoverable reserves of oil or gas. Like fossil-fuel reserves, these opportunities expand when the cost of improving energy efficiency diminishes or the price of other energy supply options increases. Market actors then find ways to bring these reserves into the market to meet the demand.

Government policy plays a fundamental role in generating the supply of energy efficiency, in much the same manner it fosters demand. Support for research and development in technologies that increase efficiency can lead to cost-effective solutions that reduce consumption in vehicles, appliances, buildings and industry. Policy incentives that increase demand for more efficient products also stimulate innovation and investment in the development and commercialisation of new and improved energy efficiency technologies and services.

Conversely, lower energy prices and policies that encourage or subsidise energy use reduce the supply of energy efficiency as well as demand.

But the outlook for further investment in energy efficiency is compelling. The Energy Efficiency Market Report 2013 notes that the World Energy Outlook’s Efficient World Scenario details how an investment in efficiency of USD 11.8 trillion to 2050 would easily generate USD 17.5 trillion of savings in fuel expenses, with an additional USD 5.9 trillion reduction in supply-side investments.

But to reap those returns, the Energy Efficiency Market Report 2013 highlights, government policies need to continue to enable consumers and market players to make these investments.

KOREA’S EFFICIENT APPLIANCES

Besides being well known for its significant appliance manufacturing capacity, the Republic of Korea has taken a leading role in advancing the energy efficiency of traditional as well as networked appliances, from white goods such as dryers to the latest tablet computers.

Korea’s development of a series of three standards and linked labelling programmes targeted at high-efficiency appliances has had a major impact on equipment and appliance markets, with particular success in driving efficiency improvements in refrigerators, air conditioners and washing machines.

The oldest of the programmes, the Energy Efficiency Label and Standard Program from 1992, requires an energy efficiency grade for products with high energy consumption. Products that fall below the fifth grade can no longer be made or sold, which effectively makes the programme a minimum energy performance standard.

In 1996, the High-efficiency Appliance Certification Program began guaranteeing high efficiency of products by certifying products that perform above certain standards.

The E-Standby Program of 1999 affixes the Energy Boy label to consumer electronic appliances and office equipment that satisfy the government’s standby power reduction standards.

In 2011, according to estimates by Korea Energy Management Corporation (KEMCO), the three programmes led to savings in appliance energy use nearly equivalent to total energy consumption by Cyprus or Tajikistan, avoiding more than USD 1 billion in spending in the process.

Appliance and equipment manufacturers face intense pressure from competitors and government regulations to produce more energy-efficient products. Standards are tightened on a regular basis, and as a result the proportion of products in each category is constantly changing: today’s first-grade (highest efficiency) product could be a second- or third-grade product next year and the current fifth-grade product could be phased out.

Still, when new standards are set, manufacturers fall behind in ramping up production volumes of the latest high-efficiency products. That helps explain why the proportion of first-grade products decreased from 35% in 2008 to 26% in 2012, even accounting for the recent technological progress in the energy efficiency field.
**IN DEPTH**

**MARKETS & SECURITY**

**HOW RESOURCES BECOME RESERVES**

**TAPPING INTO PLENTY**

Enough hydrocarbon resources exist for the foreseeable future and beyond, IEA analysis shows, but developing them gets ever harder technically.

There are sufficient fossil fuels to satisfy the global economy well into its transition to a low-carbon energy future: a new, in-depth IEA analysis of available fossil fuels, *Resources to Reserves 2013*, confirms the scale of resources available.

Worldwide proven reserves of conventional oil are estimated to be around 1.3 trillion barrels, with remaining recoverable resources representing about 2.7 trillion barrels. The global reserves-to-production ratio, based on current consumption levels, is in the range of 40 to 45 years but will grow as resources are successfully converted into reserves.

Proven reserves of coal are estimated at just over 1 000 gigatonnes (Gt) of both hard coal and lignite, with remaining recoverable resources of about 22 000 Gt. Coal production has seen a steep increase in the last decade, with projections pointing to a continued rise for the next 45 years but will grow as resources are successfully converted into reserves.

Estimates of proven reserves of conventional gas are around 220 trillion cubic metres (tcm) – or approximately 1.4 trillion barrels of oil-equivalent – with more than twice as much in recoverable resources. Based on current consumption levels, the global reserves-to-production ratio of conventional gas is in the range of 55 to 60 years. While proven reserves of unconventional gas are difficult to assess because of rock formations’ heterogeneity, present estimates suggest a minimum of 240 tcm.

**Technology enables shift in category**

Turning resources into reserves depends on technology and prices. Technology determines whether resources can be converted, while high fuel prices stimulate the development and testing of more sophisticated solutions, resulting in a growth of reserves.

Impressive technological advances made possible the increase in supply of recent years. Future supply will require even more demanding technological innovations to increase economic production in existing and new sources while responding appropriately to environmental challenges.

*Resources to Reserves 2013* updates and significantly expands on the first *Resources to Reserves* publication, in 2005, showing how oil resources have grown in part through investment in and deployment of improved and enhanced recovery techniques that extend production from conventional fields. At the end of its anticipated lifecycle, the average field still contains around two-thirds of the original oil in place.

Even a 1% increase in the average recovery factor would add more than 80 billion barrels, or 6%, to global proven oil reserves.

Over the last 20 years, the average recovery factor from the Norwegian Continental Shelf has shifted from 34% to around 46% today, largely driven by technology advances in horizontal/multilateral drilling, seismic acquisition, four-dimensional seismic techniques and subsea facilities. Were that increase successfully applied in all basins worldwide, current proven reserves would double.

**The challenges of frontier exploration**

Almost half of the 2.7 trillion barrels of remaining recoverable conventional oil is in offshore fields. Discoveries in deepwater fields, at depths greater than 400 metres, accounted for more than half of all discoveries from 2000 to 2009 so that now deepwater represents roughly one-quarter of all offshore oil production. New frontier locations for conventional hydrocarbons lie in ultra-deepwater, under more than 1 500 metres of sea, with active fields in the Gulf of Mexico and off West Africa and Brazil.

Successive new generations of technologies such as subsea processing and multilateral wells mean that more and more previously inaccessible fields can be developed.

**COAL THAT POURS INTO A TANK**

Most of the coal mined worldwide is used for power generation, but consistently high oil prices are generating growing interest in coal-to-liquids (CTL) technology that yields high-value products such as transport fuels. Depending on the location of the project, a CTL plant can produce profitable fuel when the price of oil is as low as USD 60 per barrel but usually needs a price not below USD 100.

China, in particular, has been active in planning large-scale CTL plants as it looks to the technology as a means of reducing dependence on imported oil and thereby increasing energy security. South Africa has operated commercial CTL plants for decades, and, besides China, projects are planned in Australia, Botswana, India, Mongolia, Russia and the United States.

Two different processes are used to convert coal into a liquid fuel: indirect liquefaction and direct liquefaction.

In indirect liquefaction, coal is gasified to produce synthetic gas, a mix of hydrogen (H₂) and carbon monoxide. Then, using an iron or cobalt catalyst, liquid fuel is produced. South Africa uses this two-step process to convert domestic coal into products equivalent to 150 000 barrels per day of oil-based fuel.

Direct liquefaction uses coal’s reaction to H₂ in the presence of a catalyst. China is one of a few countries pursuing this approach, and the country’s progress has been uneven.

CTL poses significant environmental challenges. While the fuels emit low amounts of pollutants including CO₂, conversion and refining at least double the fuel cycle’s CO₂ emissions over those of conventional petroleum-based fuels. Carbon capture and storage (CCS) offers a solution to plant-level CO₂, almost halving emissions. A Chinese CTL plant’s CCS demonstration project has been effective in offsetting 100 000 tonnes of CO₂ per year and is scaling up storage operations.
cost-effectively. In particular, ever more complex subsea infrastructure allows multiple smaller reservoirs to be connected to one floating production unit, such as a tension-leg platform or a floating production, storage and offloading vessel, or even directly to shore. Taking this concept a step further, drilling horizontally below the sea floor can access deposits in all directions for up to 15 kilometres, reducing the number of pipes on the seabed.

Such developments should help deepwater global production rise from about 5.7 million barrels per day (mb/d) in 2012 to 8.3 mb/d by 2017, accounting for about 40% of all offshore production. Total output from all offshore reserves, including deepwater, would then represent about 20% of global crude production. Despite technological advances, the remoteness of deepwater operations still poses major technical and engineering challenges and involves substantial costs. Among other critical precautions, the high pressures and near-freezing temperatures on the seabed require measures to prevent formation of methane hydrates (crystalline structures of gas and water; see sidebar “One Gas Remains Uncounted”) that block underwater pipes.

The Arctic is another new source of resources that are turning into reserves and are increasingly being tapped. There the imperative to do no harm to pristine and sensitive environments is particularly high. In especially remote Arctic locations, subsea operations are required to allow transfer by pipeline to distant facilities, and many of the technologies developed in Brazil and West Africa for deepwater exploration and production could eventually be used there. Additional challenges in the Arctic include protecting facilities from ice-related dangers and extending the drilling season.

Solutions to reach unconventional resources

Even though they have no universally agreed definition, unconventional gas and oil offer high global potential. Roughly speaking, unconventional refers to any source of hydrocarbons requiring significantly different production technologies from mainstream recovery in currently exploited reservoirs: thus unconventional oil is generally accepted as being complex to extract or having a high viscosity. Mining operations for shallow reserves increasingly use non-thermal production methods that are mostly based on creating miscibility between the oil and an injectant. Thermal technologies to reduce viscosity are being developed and applied to both shallow and deeper deposits.

Similarly, unconventional gas – tight gas, shale gas and coalbed methane – has seen substantial growth in the United States and Canada. Technology has been central to this growth, including driving vertical and horizontal wells, and creating hydraulically generated fractures to maximise and steer gas flow. But the financial viability of these developments remains very sensitive to the local gas price. Further cost reductions are possible through improved drilling and completion techniques, as well as enhanced understanding of the basic flow phenomena in stress-sensitive reservoirs.

There is one potential energy source that Resources to Reserves 2013 does not quantify as a medium-term resource, much less a reserve, is methane hydrates.

A form of unconventional gas deposit in very sensitive crystalline structures, methane hydrates are thought to be the most abundant source of natural gas on the planet, with estimates placing worldwide volumes at a factor several times higher than all other sources of natural gas combined. But those estimates range greatly, varying by one or two orders of magnitude. Producing methane hydrates safely and effectively could transform energy security for many countries, but the technology to achieve this remains some way off. Given that 1 cubic metre (m³) of hydrate releases 164 m³ of methane gas when it is warmed and depressurised, modest accumulations might yield vast volumes of gas. However, as even slight variations in temperature or pressure can break up the structure, irresponsible attempts at production could lead to massive releases and disastrous consequences. The global warming potential of methane is more than twice as high as that of CO₂.

To date there has been no direct commercial production of methane hydrates. The size of the prize, however, means interest in accessing deposits is strong. A test early this year led Japanese officials to propose that technologies for production might be established for practical use within the next five years. Others suggest that commercial exploitation might not be seen within the next two decades. Pilot projects such as those off Japan’s shores, in the Gulf of Mexico and in Canada’s Beaufort Sea are gradually unlocking this potential.

Of course, for methane hydrates, as for all forms of conventional and unconventional oil and gas, the emphasis is on bringing resources to market in a financially viable and environmentally sustainable manner.
ministerial meeting 19/20 november 2013

global synergy for tomorrow's energy

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THE AGENCY’S GENUINELY GLOBAL GATHERING

THE 2013 IEA MINISTERIAL

For their meeting to address the challenges and opportunities of security, sustainability and the changing global energy map, IEA energy ministers are welcoming their counterparts from partner countries as well as CEOs.

The 2013 IEA Ministerial meeting gathers not just energy ministers and other senior officials of member countries but also of nine other countries plus chief executives of some of the top energy-producing and -consuming companies. They are all meeting for two days in Paris this November to address the changing global energy map.

In the two years since the last Ministerial, a long-building shift has seen China overtake the United States as top oil importer while non-OECD oil demand exceeded that of OECD member countries, all amid a surge in new energy sources, from unconventional oil to increasingly competitive renewables.

A global partnership

Past Ministerials have included ever more non-members, with a record nine countries at the 2011 meeting after China, India and Russia attended the previous Ministerial. The nine countries from 2011 are again attending the current Ministerial. That means the represented nations account for more than three-quarters of global demand — and more than two-thirds of global energy output.

The main partner countries of the IEA — Brazil, China, India, Indonesia, Mexico, Russia and South Africa — will be joined by two countries that have applied for membership: Chile and Estonia. The theme, “Global Synergy for Tomorrow’s Energy”, emphasises how the Ministerial aims to build on the shared concerns and priorities of member, future member and partner countries not just for a secure energy supply but for a sustainable system built on global engagement and shared economic and environmental security.

WEO findings concentrate attention

This year, the IEA is hosting its Ministerial meeting just a week after the publication of its annual flagship report, the World Energy Outlook (WEO). The meeting’s first order of business is the presentation of the WEO 2013 findings. With the changes in the global energy map just since the last Ministerial, the 2013 edition sees ever more of a challenge to maintain a secure and sustainable energy future. Much of the discussion of how to build that stable future will be based on the WEO 2013 findings, especially its 4-for-2°C recommendations, which outline proven methods to reduce CO₂ emissions enough by 2020 to keep climate goals alive without harming economic growth.

From analysis to setting policy

With those findings still fresh in their ears, the ministers and other top government officials will join the CEOs of companies that belong to the IEA Energy Business Council to address three key themes: competitiveness; oil and gas; and climate change, the last focusing on the 4-for-2°C Scenario. Participants will discuss the issues as a group as well as in smaller circles. Later conversations will focus on the role of energy in development, with an emphasis on how to promote investment for economic growth as well as energy security and how to deploy energy efficiency as the most affordable fuel.

Discussion on the second day will include energy security and co-operation, including shifting supply and demand trends. With the global energy trade moving eastward but also traditional suppliers consuming a greater share of global output, the challenge is to adapt long-time IEA measures to ensure and expand energy security in the new paradigm. As the participants consider a move towards more formal global energy governance, they will discuss how energy security has moved beyond just maintaining oil stocks and addressing delivery security to become a global concern that goes well beyond borders. Participants will hear about and even experiment with new ways to ensure oil, gas and electricity supply in this era of evolving trade patterns and security risks.

The ministers and their guests will also consider the impact of the changing energy map on competitiveness, with participants examining IEA analysis of the shifting supply and demand trends’ implications for trade, security, the economy and geopolitics. The expertise of the top-level public- and private-sector participants will help examine how to improve competitiveness to foster energy development for sustainable economic growth. Subjects will include the decoupling of fossil-fuel demand from economic growth and the role of renewables and energy efficiency in fostering competitiveness. One facet will be a new emphasis on transparent, reliable energy data worldwide.

The Ministerial will conclude with a news conference where the chair will release his statement on the decisions reached. But the real work will have just begun, as the ministers’ concerns, enhanced by input from their non-member counterparts and corporate partners, will provide guidance for IEA work for the next two years and beyond.
FOLLOW-UP TO 2011 MINISTERIAL
A BUSY TWO YEARS

Since the ministers in 2011 set their priorities for its work, the IEA has focused on delivering results to present at the 2013 meeting.

When the energy ministers of IEA member countries last met, they agreed on Ministerial Conclusions that have guided the Agency’s work during the past two years. Since the 2011 Ministerial, the IEA has focused on tasks ranging from increasing energy security for both consumers and producers to promoting sustainability and strengthening co-operation with key partner countries.

The changing global energy map

The ministers charged the Agency with increasing co-ordination with non-IEA countries, a prescient move as the balance of energy tilts further to non-member countries. The Agency included such key partner countries as Brazil, China, India and Russia in diverse workshops and training initiatives, and it prepared analysis to highlight recent trends or means of strengthening energy security in those countries (see page 45).

But co-operation went beyond just suggestions, with the IEA including ever more non-members in its preparations for potential crises. About 30 delegates from non-IEA countries participated in the IEA Emergency Response Exercise (ERE) last year that looked at what would need to be done in the case of a disruption to the global energy supply. The IEA also performed a local ERE with India in May 2012. It held workshops on energy security in China and on energy stockholding with Southeast Asian countries, as well as supported an Asia Pacific Energy Research Centre forum on oil and gas security.

Also since the 2011 Ministerial, the World Energy Outlook (WEO) has involved non-member countries in the flagship publication’s special reports and other focuses. These analyses have assessed countries’ futures: Iraq in 2012 (the first IEA comprehensive review of a major OPEC member’s energy sector), and for the new 2013 edition, both Brazil and the countries of Southeast Asia.

Reinforcing energy security

The 2011 Ministerial convened shortly after the third-ever IEA Collective Action, when countries released oil from their strategic reserves to offset market disruption due to the Libyan civil war member until producers could increase output. The ministers asked for a thorough assessment of the lessons learned from the Collective Action as part of a general improvement of the emergency response systems that help the IEA ensure energy security.

So the Agency turned to the peer-appraisal process of its ongoing Emergency Response Review programme, which shares and develops best practice. The result was an exercise to examine IEA response tools for longer-running supply disruptions. The Agency also studied the costs and benefits of building and holding emergency oil stocks to maximise their value to member countries and the rest of the world.

But as it seeks to improve global security of energy supply, the IEA has looked at more than oil issues. The IEA analysed the secure delivery of energy sources, expanding its series of medium-term market reports to all of the key primary fuels. For electricity, the ministers asked the Agency to enhance security as well as increase diversity, so it promoted development of renewables through everything from formulating policies on investment and subsidies to helping create and popularise new statistics to monitor the production and consumption of low-carbon energy sources.

Electricity Security Action Plan

In a global decarbonisation process, the energy system is likely to be more reliant on electricity as an energy vector, posing new risks. So the development over the past two years of the IEA Electricity Security Action Plan was a significant step towards meeting the ministers’ goal.

Creating the plan required a comprehensive analysis of the investment, policy and market design aspects of maintaining supply security during the transition to a low-carbon electricity system. Each aspect was examined across four work streams: generation, networks, regional integration and demand response. As of the end of 2013, the IEA is expanding its EREs beyond oil and gas to incorporate electricity as part of the emergency preparedness programme. Ministers will discuss aspects of the plan at the 2013 meeting.

The IEA also deepened its analysis of the technical issues and costs associated with
grid integration of variable renewable sources into the electricity system, including assessment of electricity market design methods to maintain investment in power generation.

**Increasing diversity of supply**

As much as the global energy map has changed, so has the mix, with some countries turning away from nuclear power and many seeking to reduce carbon emissions even while increasing energy supply. The ministers charged the IEA with finding ways to improve the diversity and security of supply. So the Agency analysed the risks and opportunities of investment in different fuels, as well as the implications of the changing energy map on countries’ competitiveness. One related in-depth investigation was the policy aspects of developing a diversified, efficient liquefied natural gas trading hub in Asia, where policy changes post-Fukushima have seen increased imports. The IEA also produced roadmaps on bioenergy for heat and power, hydropower, geothermal energy, and solar heating and cooling.

Some of the most high-profile IEA work on changing supply were the *WEO* Special Reports on the “golden age of gas”. The first looked at the development of unconventional gas resources, while *Golden Rules for a Golden Age of Gas* examined environmental and social concerns and proposed policy for dealing with such serious hazards as the potential for air pollution and contamination of ground- and surface water. In March 2013, the IEA held the inaugural meeting of its Unconventional Gas Forum to discuss best practices for the sustainable development of global unconventional natural gas resources. Public- and private-sector participants came from most IEA member countries and many partner and other non-member countries.

**Improving efficiency to enhance security**

Because energy efficiency represents an important low-carbon “fuel”, the ministers tasked the IEA with fostering expanded and improved use both within member countries and around the world.

One major step in that direction was assisting China’s national energy efficiency improvement programme, which includes raising the thermal efficiency and environmental performance of the country’s existing coal-fired power plants. The IEA and the Chinese National Energy Administration are identifying how best to upgrade and retrofit older coal-fired power plants, with a final report already drafted.

Worldwide, the IEA published its first market report on energy efficiency in October, shining a light on the investment potential – present and future – for greater efficiency (see pages 14-15).

The IEA adopted a new role as part of the United Nations Sustainable Energy for All initiative, which not only seeks universal energy access but also calls for greater energy efficiency.

Besides the Executive Director’s joining the initiative’s Advisory Board, the IEA co-created a Global Tracking Framework that set the baseline and methodology for assessing progress towards the initiative’s three goals by 2030: universal access to modern energy services and doublings of the global rate of improvement in energy efficiency and of the share of renewable energy in the global energy mix.

Many of the tasks for the IEA were covered by analysis in publications such as the *WEO*, which besides outlining global scenarios through 2035 also examined closely energy poverty worldwide. *A WEO 2012 Special Report* focused on renewable energy, with projections for supply and demand for the full spectrum of technologies, underpinned by an assessment of their present and future economics. The report also offered guidance on the opportunities and risks associated with renewables in the context of the overall energy mix, including their impact on end-user services and doubling of the global rate of improvement in energy efficiency and of the share of renewable energy in the global energy mix.

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What’s next for the IEA?

The 2011 priorities list had many other entries, including work the IEA completed in market transparency and regulation; promotion of research, development and deployment; facilitating investment across all energy sectors; and much more. With the Electricity Security Action Plan and many other presentations at their 2013 meeting, the ministers are getting to see the results of the guidance they gave the IEA two years ago… and then they will most likely speak of new priorities that will keep the Agency busy until the ministers’ next meeting.

Guidebooks to a cleaner, safer future

The other long-view IEA title, *Energy Technology Perspectives (ETP)*, examines least-cost pathways to a decarbonised energy system. The 2012 edition’s core theme was “systems integration”, in which the IEA helps policy makers look at the energy system as a whole – considering impacts and opportunities across multiple sectors when new technology is deployed. One way *ETP* does this is through associated roadmaps and policy pathways that show the opportunities and best practices for a variety of subjects, from efficient urban transportation systems to the next generation of high-efficiency, low-emissions coal plants.
What is the status of Mexico’s energy sector?

The Mexican energy sector is at a pivotal point in its history. Mexicans face a choice between maintaining the status quo, which would endanger the country’s energy security, or opting for a comprehensive energy reform that would transform our industry into an engine for economic growth and development in Mexico.

Mexico is running out of “easy oil”. Although we have increased our investment in oil and gas exploration and extraction, oil production has declined from 3.4 million barrels per day (mb/d) in 2004, to 2.5 mb/d in 2013. In other words, in nine years, our daily oil production has fallen by almost 1 million barrels, while total oil and gas reserves fell by about 23% from 1999 to 2012.

Furthermore, the demand for natural gas in Mexico has risen steadily, while its production has been on the decline. As a result, from 1997 to 2013, the share of imported natural gas in total consumption has risen from 3% to 30%.

There is a growing gap between the production and consumption of gasoline in Mexico, which has resulted in increased imports. Whereas in 1997 the percentage of imported gasoline barely represented 25% of total consumption, in 2012 it rose to 49%. The same pattern has taken place in the petrochemical sector, in which imports rose from 41% of national consumption in 1997 to 65% in 2012. If this trend continues, Mexico will be facing an energy deficit in the coming years.

The electricity sector also faces a challenging road ahead. The average rate charged in Mexico is 25% higher than in the United States, despite our country’s subsidy, hampering our competitiveness. The expansion of our transmission grid will not be sufficient to meet the estimated growth of 4.1% in electricity demand, while distribution losses are nearly twice the average for OECD member countries. Furthermore, several barriers to entry have limited Mexico’s capacity to adopt renewable energies on a larger scale.

What are the main objectives of the reform and the key means of achieving them?

The energy reform initiative has the following goals:

- lower electricity and gas rates for families and small and medium-sized businesses, as well as the industrial sector;
- increase investments in the energy industry, creating around half a million jobs by 2018 and 2.5 million more by 2025;
- foster additional economic growth by approximately one percentage point of gross domestic product annually by 2018 and about two percentage points by 2025;
- increase the state’s oil and gas revenue in order to invest more in education, health, infrastructure and water services;
- raise oil output from the current 2.5 mb/d to 3 mb/d in 2018 and 3.5 mb/d by 2025;
- increase natural gas production from the current 5.7 billion cubic feet (bcf) per day to 8 bcf in 2018 and 10.4 bcf by 2025.

In order to reach these goals, the energy reform intends to amend the Mexican Constitution as well as secondary legislation.

The initiative proposes the establishment of the national transmission grid will be guaranteed. Lastly, the CFE will grow stronger through greater operative and organisational flexibility.

“THE INITIATIVE PROPOSES THE ESTABLISHMENT OF PROFIT-SHARING CONTRACTS.”

With this reform, the state’s guidance and its regulatory bodies will be strengthened, ensuring sound and prudent management of Mexico’s energy endowment. In this matter, transparency and accountability mechanisms will be reinforced to fight corruption in the energy industry.

How will the reform help Mexico in its goal of long-term cuts in carbon emissions?

Mexico’s Climate Change Act sets a target to reduce greenhouse gas (GHG) emissions by
30% by 2020 and 50% by 2050, compared with the baseline for the year 2000. The energy and fiscal reforms currently being discussed in Congress put forward three major changes focused on consolidating a low-carbon economy.

First, there will be an increase in the domestic supply of natural gas, which will allow for a quicker and more efficient substitution of fuel oil and diesel in electricity generation. This will not only reduce our GHG emissions but also represent significant savings, as natural gas-based electrical generation is between four and six times cheaper than generation from fuel oil and diesel.

Secondly, the energy reform sets up a legal framework that encourages the use of clean and renewable energy, including wind, solar and geothermal technologies. The reform will eliminate barriers to entry for renewable sources of energy by creating a competitive market for power generation, managed by an independent state operator under clear, transparent and fair rules. The reform also proposes new mechanisms for institutional and contractual planning, in order to facilitate the access of renewable energies to the national transmission grid.

Finally, as part of the fiscal reform, the government has proposed the introduction of a carbon tax, set at USD 5.70 per tonne of carbon dioxide. Under the “polluter-pays principle”, the production and importation of fossil fuels will be taxed, generating an estimated annual revenue of about USD 1.5 billion. With these measures, Mexico will be at the global forefront of energy and environmental legislations.

**Does Mexico see unconventional gas as a critical element of its future energy supply?**

Mexico has a significant amount of unconventional oil and gas resources stored in the shale basins in the north of the country and along the coast of the Gulf of Mexico. According to the latest report from the United States Energy Information Administration, Mexico is ranked sixth and seventh in the world in terms of technically recoverable shale gas and oil resources, respectively.

Pemex’s estimates indicate that the prospective resources in these shale deposits amount to 60 billion barrels of oil equivalent, about 52% of Mexico’s total prospective resources. As of now, we have not capitalised on our shale potential. While the United States authorised the drilling of 9100 new shale oil and gas wells in 2012, Mexico only authorised 3 in the same period. This imbalance is due in large part to the Mexican legal framework, under which Pemex is required to undertake all of the oil industry’s activities by itself, and any region or deposit that Pemex is not able to develop – for technical or economic reasons – is also off-limits to other companies.

Taking advantage of our shale oil and gas resources represents an investment and technological challenge, since it is more costly and entails more risks than conventional production. While producing one barrel of oil in conventional onshore fields costs between USD 4 and USD 12, producing that same barrel from shale deposits costs between USD 25 and USD 35.

The profit-sharing contractual mechanism that the Mexican government has put forward aims to encourage more investment from more companies, so that the costs and risks associated with oil and gas development are more evenly distributed among industry participants. With this new contractual mechanism, we are looking to increase exploration and extraction in shale formations. Furthermore, the energy reform proposes concrete measures to strengthen the National Hydrocarbons Commission, the entity in charge of regulating the operational, environmental and social safety of shale projects.

**How will Mexico foster energy efficiency?**

Promoting energy efficiency will be key to reducing energy supply costs as well as the energy industry’s environmental impact. No litre of gasoline or megawatt hour of electricity is cheaper or cleaner than the litre or megawatt hour that is not consumed. Energy efficiency projects – from the replacement of light bulbs, discussed in depth the growing global energy demand, as well as the existing alternatives to make the future energy supply cleaner, more efficient and sustainable.

In the coming decades, it will be crucial that the co-operation between the IEA and emerging economies deepen. Together, solutions can be developed to foster clean, sustainable, low-carbon economic development, promote technological exchange, and help reduce energy poverty in the world. I believe these are the areas where more opportunities for collaboration can be found. Certainly, Mexico is ready to participate and contribute to these discussions in a proactive manner.

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*Energy Secretary Pedro Joaquín Coldwell has seen Mexico’s ties with the IEA grow closer and stronger.*
What is your diagnosis of the state of the Indonesian energy sector?

Indonesia’s energy situation is indicated by a steady growth of around 7% per annum; high dependence on fossil fuels, especially oil; energy elasticity still above 1, so that energy demand growth outpaces economic growth; and high subsidy spending for petroleum products and electricity. This situation needs to be improved.

We understand that the challenges are not easy. There are still some obstacles, such as overlapping regulations and lack of energy infrastructure. We are working to overcome these obstacles.

How does the IEA benefit Indonesia?

We thank the IEA for providing us with intensive training, especially on energy data and statistics, which have enabled us to improve the quality of our own energy data. Other activities include the IEA Energy Policy Review – Indonesia 2008 Review conducted in 2008, which is considered a good and complete reference concerning Indonesia’s energy situation and policy. We were also honoured that the IEA launched the World Energy Outlook in Jakarta in 2009, 2010 and 2011.

In the last two years, the co-operation has covered wider issues such as energy security, energy technology, energy efficiency and renewable energy.

We welcome the initiative of IEA to establish a strategic partnership with seven major energy-consuming countries, including Indonesia, as a forum to exchange views and experiences on energy-related matters.

How best can Indonesia reorient its policies towards renewable energy?

First, we will use of 10% biodiesel in the diesel fuel mix. Second, we will concentrate on large-scale renewable energy, especially geothermal and hydro, and gradually increase the capacity of other types of renewable energy. In this regard, we will establish a feed-in-tariff programme, continuously monitor the result and, if necessary, make adjustments. Third, we will streamline the licensing process and continue to provide fiscal incentives for investors. Fourth, we will use the state budget for developing less-commercial renewables and also promote a public-private partnership programme. Fifth, we will support local industry developing renewables.

How will you secure a long-term coal supply?

We will allocate production first to fulfill local demand, and the remainder may be for export. We also plan to set up a strategic coal reserve.

As a major gas and oil producer, how do you balance supply security and rising demand?

The national energy policy states the need to increase exploration of oil and gas resources in order to keep the rate of generation equal to or even above that of exploitation. The national energy policy sets a target to reduce the share of oil in our national energy mix to less than 20% in 2025 while increasing that of gas.

The discovery of potential unconventional gas sources such as coalbed methane and shale gas is very promising. To the largest possible extent, we will replace oil, including in transportation, with gas and other sources of energy.

We are also now preparing strategic petroleum reserves to provide a more secure supply of oil domestically.
Too many of the world’s children have no modern energy in their lives… no lights to read by, no computers for school work, no digital devices to bring their communities into the 21st Century.

Advanced coal is changing all of that. Coal has been the world’s fastest growing major fuel of the 21st Century. And coal is expected to pass oil as the world’s largest energy source in coming years. Coal-fueled electricity enables laptops for students, cell phones for villagers, safe lights for cities and modern appliances for families.

All over the world, advanced coal is creating electricity that is abundant, inexpensive and clean. Coal has driven the world’s best economies, raising hundreds of millions out of energy poverty in recent years.

But there is much more to be done. Some 3.6 billion people in the world have little or no access to electricity. Another 2 billion people will join the global population over the next two decades. Energy poverty is the number one issue facing the world today. Advanced coal is the best energy source to provide abundant, low-cost electricity at the scale needed to solve this challenge.

Let’s work together to bring energy access to all by 2050.

Find out more at PeabodyEnergy.com
LESSONS LEARNED

For the Ministerial, IEA members shared recent undertakings so others can learn best practices for bettering energy security and sustainability plus economic growth. Here are some examples, with more next issue.

RESPONSIBLE RESOURCE DEVELOPMENT IN CANADA

Natural resources account for 15% of Canada’s gross domestic product and 50% of its exports. More than 600 major economic projects representing CAD 650 billion in potential new investments are planned across Canada over the next ten years. To capitalise on these opportunities, the government of Canada has introduced its plan for Responsible Resource Development.

The plan has delivered several changes to strengthen accountability and ensure a more effective and efficient regulatory system. Responsibility for reviews was condensed from more than 40 agencies to 3. Review time lines were put in place to make government more accountable, including maximum beginning-to-end time lines for project reviews: 12 to 24 months, depending on the project. Resources are now more appropriately focused on major projects with the greatest potential for significant environmental effects, while smaller, more routine projects no longer require formal environmental assessments but remain subject to the requirements of all other applicable federal and provincial laws, standards and permits. Finally, the federal government is ensuring more consistent consultations with Aboriginal peoples and exploring new economic partnerships with Aboriginal groups.

UNITED STATES’ CLIMATE ACTION PLAN

On 25 June 2013, President Barack Obama presented the US Climate Action Plan for steady, responsible national and international action to cut the greenhouse gas (GHG) emissions that cause climate change and threaten public health. The plan has three pillars: cut carbon pollution in the United States; prepare the country for the impacts of climate change; and lead international efforts to combat global climate change and prepare for its impacts.

As the challenges are specific to individual actions and vary widely, the plan sets specific measures to address each of them. Examples of such challenges include: addressing the high costs of some types of technology development, such as carbon capture and storage; promoting widespread investment in appliance and equipment efficiency; and overcoming barriers to incentivising private-sector action (and wisely using government resources that avoid duplicating or crowding out private-sector investments). The United States looks forward to sharing with the international community the results of its efforts and will provide regular updates on progress through both domestic and international reports. One key metric (though one that will be measurable only over time) will be reductions in US GHG emissions; the plan is designed to help meet the US commitment to reduce emissions by 2020 in the range of 17% below 2005 levels, as agreed in the United Nations climate negotiations. President Obama has also set a goal to double renewable electricity generation by 2020.

JOINT SWEDISH-NORWEGIAN MARKET

Norway and Sweden have a combined goal of establishing 26.4 terawatt hours of new electricity production based on renewable energy by 2020. Each country requires energy producers to buy half of the total in tradeable electricity certificates through a common Norwegian-Swedish market for certificates that was established in 2012. For each megawatt hour of electricity they produce for a period of 15 years, electricity producers in Norway and Sweden whose output meets the requirements of the Norwegian Electricity Certificates Act and the Swedish Electricity Certificate Act receive one electricity certificate. Production related to each certificate is technology-neutral and can be located in either country, since the electricity certificates can be traded across the border to fulfil the national obligations. The larger market, with more actors and thus higher liquidity than national markets, is expected to improve market functioning, contribute to better competition and stabilise prices. A common market is also expected to contribute to more efficient resource exploitation.
KOREA HOLDS A DRILL TO SAVE ENERGY

Unusually hot weather led to a surge in power demand in the Republic of Korea in September 2011, just as many power plants went offline for seasonal maintenance. The Ministry of Trade, Industry and Energy (MOTIE) used rolling power cuts and price increases to temper demand, but it also pushed forward a plan for a 20-minute nationwide blackout drill.

So at 14:00 on 21 June 2012, Korea cut energy use as much as possible. The actions weren't totally new: non-urgent power supply is cut whenever power reserves fall to below 400 megawatts (MW) of the country's 79 000 MW maximum. But for the drill, MOTIE encouraged each sector to prepare a specific action plan. Large buildings turned off their central air-conditioning systems. Public institutions used power only for essential needs such as security and IT equipment. Community newsletters and electricity bills provided plans for households. Schools voluntarily extended the drill to a full hour, while “vulnerable” facilities such as hospitals, subways, and traffic systems practiced rescue and evacuation exercises.

The drill saved about 500 MW of electricity, or more power than Seoul uses in an average day, and a follow-up survey found strong support for the test.

WARM UP NEW ZEALAND: HEAT SMART

A large proportion of New Zealand’s homes are cold and damp, poorly insulated and relatively costly to heat. International and national research consistently shows that cold and damp homes are detrimental to people’s health and can lead to lower productivity. Households consume about one-third of New Zealand’s electricity. The Warm Up New Zealand: Heat Smart programme is increasing the number of warm, dry and energy-efficient buildings by insulating 230 000 homes.

Since 2009 the programme has offered grants of 33% – up to NZD 1 300 – of the cost of installing ceiling and/or under-floor insulation to all owners (including landlords) of houses built before 2000. A low-income owner or tenant can get a grant of up to 60% of the cost of insulation. The programme is on track to meet its final target of 230 000 retrofits within months. An independent evaluation estimated that the programme provides more than NZD 4 in energy, health and employment benefits to New Zealand per NZD 1 spent. The majority of benefits are from improved health, mainly from reduced elderly mortality but also from reduced hospitalisation and pharmaceutical costs, particularly in relation to asthma, respiratory and circulatory diseases.

POLAND’S GAS MARKET LIBERALISATION

Until now a closed market, with one dominant supplier, the Polish natural gas market is becoming open, competitive and ready for qualitative change.

Highlights of the liberalisation include new conditions that allow the introduction of a virtual point for gas trading: one without a physical location in the transmission system. This enables the sale and purchase of gas that is already in the transmission system, facilitating trade that consequently should lead to new entities’ entering the Polish gas market. The introduction of a virtual trading point was the cornerstone of the new Polish gas market model and will aid changes of supplier and increase the level of competition.

Also, natural gas began trading on the Polish Power Exchange in December 2012, with 179 071 megawatt hours (MWh) traded in the first half of this year via the gas exchange on the Day-Ahead Market for gas and 285 577 MWh of gas traded on the Commodity Forward Instruments Market. A recent amendment of the Polish Energy Law makes trade possible without the intermediation of brokerage houses and commodity brokerage houses.

The changes are of great importance to the country’s energy situation and to individual customers. Still to be achieved is real success: an open, transparent and liberalised gas market that would contribute to creating and maintaining a common energy market in the European Union.
NOW AVAILABLE

WORLD ENERGY OUTLOOK 2013

www.worldenergyoutlook.org
COMPETITIVENESS AND ENERGY PRICES

Recent strong divergence in energy prices across countries and regions has made energy a hot issue for economic competitiveness. Lower natural gas prices in the United States, supported by the shale-gas revolution, have boosted that country’s industrial and economic competitiveness, raising hopes of a sustained economic recovery on the back of a manufacturing renaissance. Conversely, higher energy prices in Europe and parts of Asia are setting alarm bells ringing, with politicians calling for urgent action to prevent the demise of their industrial heartlands. Are these hopes and fears justified?

The results of new IEA analysis just published in the 2013 edition of the World Energy Outlook (WEO) suggest that shifts in energy competitiveness could indeed have far-reaching effects on investment, production and trade patterns. In most sectors, in most countries, energy is a relatively small part of the calculation of competitiveness. But its cost can be crucial to energy-intensive industries, such as chemicals, oil refining, iron and steel, paper, cement, glass and aluminium. For those sectors, differences in prices across regions can lead to significant differences in operating margins and potential returns on investment, especially where the output is easily traded internationally. So these industries do tend to migrate to where energy costs are lowest, though other factors – such as labour, capital and raw-material costs – matter, too.

Certainly, regional differences in prices have widened markedly, particularly in the last five years. Gas prices have increased in Europe and Asia, but have fallen sharply in the United States. In 2012, European gas import prices were four times higher than in the United States; US prices have since rebounded, but are still a third of the level in Europe and less than a quarter of Japan’s. Industrial electricity-price differentials are big, too: prices in Japan, Europe and China remain roughly twice as high as in the United States. In the WEO central scenario, we project that gas-price differentials narrow in the coming years, though nonetheless remaining large, while electricity-price differentials persist in many cases.

Recent trends are already affecting international competitiveness of energy-intensive industries significantly. We estimate that cheaper gas and electricity, compared with Europe, saved US manufacturers USD 130 billion in 2012. There are signs that this is starting to affect investment in new capacity, especially in the petrochemicals sector, and we project that this continues over the coming two decades. In many emerging economies across Asia, strong growth in domestic demand for energy-intensive goods supports a swift rise in their production (accompanied by growth in exports). But among OECD member countries, export growth rates for energy-intensive products are generally highest in the United States, while the European Union sees a loss in export market share in all the main energy-intensive sectors, particularly in chemicals. Such shifts in industrial competitiveness have important knock-on effects for the rest of an economy: lower industrial costs mean lower input prices into other economic activities, increased productivity, an improvement in the terms of trade and higher income.

Addressing impacts of energy-price disparities on competitiveness

Yet relatively high energy prices do not have to mean high energy costs to end-users or the national economy: conservation and more efficient use of energy can mitigate the impact. In fact, high prices strengthen incentives to invest in more efficient energy technologies and deter waste. Subsidies that lower the price of energy to users have the opposite effect. Governments must take the lead by promoting diversification away from expensive sources of energy, establishing efficient and competitive energy markets, and pushing firms and households to invest in energy efficiency — not just to bolster energy competitiveness but also to enhance energy security and reduce harmful effects on the environment.
What can a proven track record do for you?

With 30+ years of experience in building wind power plants, 57 GW (49,000 wind turbines) of installed wind power across 73 countries, 62% more installed capacity than the closest competitor* and more than 24,000 wind turbines globally under 24/7 surveillance, our track record speaks for itself. Based on this vast experience and accumulated knowledge, we continuously support customers and policy makers throughout the world. As your trusted advisor, Vestas can help you make the most of your wind power potential.

* as of August 2013

Wind. It means the world to us."
IEA DATA ON PARADE

This On Statistics column has called before for better data, and indeed, the world needs more detailed and more reliable energy statistics for many countries. But there is no point in collecting a wealth of data if they are not presented and disseminated properly.

That is why the IEA introduced a new statistics section on its website this year, significantly improving access to its data while making it easier to understand. The new pages provide more information in a friendlier environment. Like before but better, the site features statistics on oil, natural gas, coal, electricity, renewables, energy-related CO2 emissions and more for over 140 countries and regions. But the old pages had data just for the most recent year; the new ones present data for the last 20. And all that information can be accessed in two or three clicks. The pages also offer maps, manuals, definitions and methodologies, plus links to selected data initiatives and organisations.

See the flow of change, year by year

The new site’s biggest innovation is that visitors can now view energy balances as a Sankey representation (see pages 48-49). Sankey diagrams depict energy transfers between processes: each component is represented by an arrow whose width is proportional to the flow quantity. For non-specialists, reading an energy balance table of a country can be cumbersome. But the balance becomes much more obvious when flows from production to consumption are represented graphically. This is what the new IEA statistics web pages offer when a user clicks on the “Energy balance flows” box. A menu guides newcomers through the numerous options: the list of many countries and regions; the choice between displaying the overall balance or focusing on final consumption; how to change colours, reposition flows, display shares for specific areas, plot time series; and much, much more.

Most interesting might be how the site depicts a country’s energy balance over years. Start in 1973 and ask the computer to animate the balance’s evolution to 2011. It will show flows growing or shrinking, stocks building or withdrawing: it’s an excellent tutorial to understand changes in supply mix or final consumption shares. For instance, go to Norway or China to see spectacular changes, highlighting the growing importance of natural gas for Norway or the growth in China’s energy output and use.

IEA efforts to disseminate its statistics better do not stop at the web site. In 2012, we launched a very interactive iPhone and iPad application of the annual Key World Energy Statistics booklet, the number one IEA download, available via the Key World Energy Statistics link on the new statistics web pages. The app’s success and requests for more have led to an Android version due soon.

Better informing the market is part of the mission of the IEA, and we take this role very seriously. But we cannot take all the credit: we would like to thank and commend the many energy statisticians from countries all around the world for the great work they do, sometimes under difficult circumstances.

By Jean-Yves Garnier

Jean-Yves Garnier joined the IEA in 1985 and heads the Energy Data Centre. Before coming to the IEA, his career spanned over five years in Indonesia, three years in Ivory Coast, two years in Djibouti, two years in Berkeley and the rest in Paris, where he was in charge of National Energy Plans and energy efficiency policy as well as building energy information systems.
The global energy sector is experiencing a radical change. I would describe the current situation as a three-speed world.

The first feature of this “brave new world” is clearly the momentum of the emerging economies, which are hungry for energy, with increasing needs for power generation capacity and amounts of gas, and oil products. Of all new energy requirements, 90% will be outside OECD member countries in the next 20 years. The Economist recently mentioned a “Great Deceleration” regarding the slowdown of the emerging world. This may be true at present, but over the long run, economic growth in emerging countries will be sustained and, on average, higher than in OECD member countries.

The second aspect is, undoubtedly, the non-conventional hydrocarbon revolution in the United States, which is triggering a reindustrialisation of the country as it becomes more competitive, and redefining the energy supply and demand patterns globally. The United States is on track to become self-sufficient, a net exporter of natural gas and the world’s leading oil producer.

Europe is the third part of this energy story. Not only has Europe failed to put in place an appropriate energy policy, but it is hesitant with respect to exploiting its own hydrocarbon resources.

As a global company with a European base, GDF SUEZ has to take action to promote an approach we believe is fundamental to any energy system. The objectives of a sustainable energy system concern key issues such as energy access (reliable and secure energy for all), economic growth (and this has to do with competitiveness), decarbonisation of the economy, and the ability to introduce technological innovation. This is true for Europe, for the United States and for the emerging countries.

The unconventional revolution’s implications

The intensive development of unconventional gas and oil has been a real revolution for the energy landscape and the world economy. Shale gas is already a game changer, starting in North America but directly impacting the global energy paradigms – in Europe and in Asia. Like all revolutions, this one has been pretty dramatic, and right now is a difficult time for investors. Nevertheless, it will certainly be a long-lasting evolution.

What does this revolution really mean?

Firstly, the existence of abundant, widespread shale gas resources in the Americas, Europe and Asia is good news in terms of security of supply and sustainability. There is of course a great deal of uncertainty about the production costs of these resources, as geological conditions, availability of land and environmental issues can be totally different from one region of the world to another. But globally, the extraction of unconventional gas will help having more energy at a lower cost. Recent conventional-gas discoveries by our Exploration & Production (E&P) affiliates in the United Kingdom (Cygnus), the Netherlands (Sierra) and Germany (Römerberg) have proven that Europe has a huge potential.

The significant impact of the development of shale gas in the United States on the global and Asian gas markets is especially visible if we look at liquefied natural gas (LNG) flows:

- We have seen a shift from LNG flows from the Atlantic to the Pacific basin. GDF SUEZ, as the world’s number three LNG player, participated in this.
- We also witnessed a redirection from Asia to Qatari projects initially aimed at supplying the United States.

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- We also witnessed a redirection from Asia to Qatari projects initially aimed at supplying the United States.
This has not really impacted Asian gas prices for the moment, in a context of rising gas demand in Asia (especially in Japan following the Fukushima Daiichi nuclear accident). Consequently, in the years to come, we will see the arrival of more LNG volumes in Asia.

Unconventional oil, though it still accounts for a limited share of global oil consumption (approximately 2%), is also remodelling the US energy landscape. It could for example make the United States the premier liquid hydrocarbon producer in 2020, ahead of Russia and Saudi Arabia, according to the US Energy Information Administration.

The uneven effects of the revolution
Shale gas will probably not change the European gas market. In the most favourable scenario for shale gas development, it would only represent 30% of EU consumption in 2035. As a negative side effect, coal consumption in power generation has increased in Europe to the detriment of gas-fired generation. This is due to lower coal prices resulting from gas displacing coal in the United States as the fuel of choice for power generation.

Concerning energy security, we are currently at a crossroad. On the one hand, new deposits and resources are discovered on a daily basis. The East African “new gas frontier” is just one example among many others. These additional energy flows will help satisfy increased overall demand and will help to supply energy-need ing areas. In Europe, for example, the renewal of current pipeline and LNG contracts is not sufficient to meet demand in 2030. New supply sources are required to fill the supply gap.

This revolution could also have geopolitical consequences. If we consider that the United States might be self-sufficient in energy around 2020, the US national security world map is likely to look different, too, by then. More generally, unconventional gas resources are spread in a more balanced way than conventional gas resources.

A call for EU governments to take action
We are facing sharp differences in energy prices that have a direct impact on competitiveness. In the United States, the non-conventional hydrocarbon revolution is driving down energy prices. The fall in prices since 2008 has been dramatic, from almost USD 10 per million British thermal units (USD/MBtu) to less than USD 4/MBtu today. A side effect of this move is a re-industrialisation of the country. In Asia, gas price equilibrium is under stress. In Europe, high energy prices may dampen economic recovery and weigh on the competitiveness of industry.

For the industrial consumer, the natural gas bill in the European Union is more than twice what it is in the United States. Regarding electricity, demand in the mature markets has decreased but new capacity is still being built thanks to the subsidies that incentivise renewable energy. Such an increase of capacity has pushed the wholesale electricity price down so much that we saw negative electricity prices in Germany last winter.

Here is the paradox: the electricity costs for final customers are not going down because the taxes that financed such subsidies are rising.

Given the current conundrum of the European energy sector, I decided in May this year to launch a major initiative calling on European governments to take action. Nine other CEOs of European utilities are now part of the initiative. We spoke before the European Council and before the European Parliament because we believed it was our responsibility to testify to the current crisis.

The major policy challenge in the coming years is to have a real European project for the energy sector that will deliver secure, competitive, affordable and sustainable energy. European citizens and industries must be able to pay a fair price for electricity. Our initiative encourages the integration of renewable generation in the electricity mix under a Europe-wide
The priorities in decarbonisation

With respect to transitioning to a low-carbon economy, a sustainable energy system is also about fighting climate change. The heads of the ten largest European energy companies are asking for measures to re-launch the carbon market in order to rebalance supply and demand and potentially to extend the carbon market’s scope of application to others sectors that emit CO₂: the transportation sector for example. We consider that energy prices for the end user should cover all incurred costs and fairly remunerate the invested capital. A CO₂ price should give a positive economic signal while establishing a fair energy price.

A Brazilian example of GDF SUEZ’s approach

Over the years, as Chairman and CEO of one of the leading utilities in the world, I have had the privilege to participate in the inauguration of the 1 087 megawatt (MW) Estreito hydropower plant, situated in Brazil, which is for me one of GDF SUEZ’s leading accomplishments and very emblematic of the type of projects we develop in Brazil.

Brazil is at the heart of our strategy in Latin America, and we are keen to participate in meeting the growing energy needs of the country through the development of projects that provide clean and renewable energy. As the leading private power producer in Brazil, we believe that our Brazilian portfolio provides an excellent base to achieve sustainable and profitable growth.

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The IEA and GDF SUEZ point out priorities

At present, a considerable amount of investment is needed to tackle the challenges posed by the energy transition coupled with technological innovation: investments for maintaining our operating assets, investments for a low-carbon economy and for an improved footprint of renewable energies, investments for electricity and gas networks which are becoming increasingly digitalised and which will be required to accommodate distributed generation and energy storage, investments for new E&P ventures. Adequate investment in energy infrastructure is one of the core challenges for industry, policy makers and society alike. It is a key to meeting increasing energy demand while at the same time safeguarding natural resources. The energy industry is one of the most capital-consuming and capital-intensive industries. As a result, the stability and clarity of market rules, regulations and fiscal conditions are critical elements of a positive environment that can attract investment.

Utilities such as GDF SUEZ and international organisations such as the IEA have a fundamental role to play in highlighting deeply needed priorities that must be tackled by policy makers. The regulatory frameworks, both on international and national bases, are essential to sending a clear signal and to setting a direction. I truly believe that this combined work is crucial in order to address the challenges lying ahead. GDF SUEZ and the IEA have collaborated for several years, and we see that in these days of profound and irreversible transformation of the energy world as we know it, it is important to be able to have a regular dialogue with the IEA.

Globally, the key priority for national energy policies is to ensure that, beyond their respective energy mix and position in the energy transition, countries will progressively converge towards common objectives: secure energy, reliable energy, low-carbon energy systems. This approach first requires functioning energy markets capable of correctly addressing national
objectives. Regional integration cannot properly work without this prerequisite.

However, there is no “one-size-fits-all” energy policy. National realities differ for several reasons, not just due to natural endowment of energy resources. This is the challenge for public authorities.

Adjusting to the new landscape

GDF SUEZ has implemented several strategic adjustments to address the new challenges of the global energy market. One of them is to increase our focus on natural gas, which appears as a lever of international growth. So as to introduce my point, let me emphasise three specifics:

- demand for energy should continue to grow globally and level out in Europe in the years to come;
- the growth in LNG trade is gradually transforming the former regionally based gas market into a globalised one;
- the North American shale gas boom is spreading.

A previous World Energy Outlook report coined the term “the Golden Age of Gas” for the period in front of us. Gas production has indeed increased rapidly over the past decade: by 35% globally between 2000 and 2011. It has been rising in the Middle East (Qatar, Iran), in Asia (Indonesia), in Russia, Africa and more recently in the United States. Natural gas is also the only fossil fuel whose share in the global energy mix is expected to grow.

Global uncertainties affecting the energy sector can be seen as opportunities for natural gas. Gas is in fact a particularly attractive fuel for regions such as China, India and the Middle East, which are urbanising and seeking to satisfy rapid growth in energy demand. These are the very regions that will largely determine the extent to which gas use expands over the next quarter century.

GDF SUEZ is active in shale gas. We just entered into an agreement with Dart Energy to acquire a 25% share in 13 UK onshore shale gas licenses. Dart Energy will retain a 75% interest and operation of the licenses. This acquisition represents GDF SUEZ’s first entry into licenses with shale gas potential and onshore exploration activities in the United Kingdom. We are very confident about the potential of British shale gas and its anticipated contributions to the country’s energy security. The prospective license areas cover 1 378 square kilometres. The initial work programme includes up to four exploration wells targeting shale gas potential in different areas of the Bowland basin and other wells targeting coaled methane.

A strategy based on much more than gas

Unlike many other utilities, GDF SUEZ is present in the whole value chain of gas and electricity, and in addition we are a leader in energy services. We not only offer energy to industrial, municipal, commercial and residential consumers, but we also provide tailor-made energy solutions, which include energy efficiency and energy management.

This double duality in our business – electricity and gas, energy and energy services – is of utmost importance considering the prospects of the energy sector, especially in Europe. I have described the European situation as the “4 Ds”: deregulation, decentralisation of production (rise in renewable energy), digitisation (advent of digital technologies in energy) and decline.

As an international utility, we go beyond an optimised supply energy mix, for electricity and gas, to allow for a comprehensive solution. That certainly includes the energy mix but incorporates energy efficiency, energy storage and the smart grid, which allows for management of supply and demand fluctuations in a world to achieve inter-regional balancing and through flexible conventional backup, demand-side management and electricity storage. Storage is pivotal for the electricity security of supply. Storage facility can hold excess electricity from renewables generated during periods of low demand (at night) and feed it back into the grid when demand rises (at noon). This would provide flexibility and buffering to the baseload fleet, and require fewer conventional power plants to be ramped down at night, lowering overall generation costs and overall CO₂ emissions.

Among these compensation mechanisms, energy efficiency programmes can help reduce energy use by a large margin, leading to lower costs. In the context of a challenging European market, in which energy must be safeguarded, energy efficiency is a major tool to manage demand and to improve GDF SUEZ competitiveness.

Through our affiliate Cofely, a European leader in energy services, we propose innovative and integrated energy efficiency solutions, such as energy management through smart equipment, high productivity technologies in utilities, in heating, ventilation and air-conditioning (HVAC) and in public lighting. For instance, Cofely and Sanofi signed an agreement last June to strengthen their collaboration by implementing projects in the field of energy at Sanofi industrial sites. The five-year contract includes energy production and distribution systems relying on, among other sources, renewable energy.

Globally, we are moving from a focus on centralised generation to models that rely on more customer interaction, commercial and energy services, and digitalisation management, especially if we consider the rise of distributed energy. All these evolutions result in a world with much more energy security of supply.
energy isn’t just what it is, energy is what it becomes. energy is transformed. energy is commitment to research, because research itself is energy. energy is what we offer to those communities that have none. it is support for culture. it is imagining a more sustainable future and working to make the dream come true. energy is what we do, the ideas we have. we who search for and produce energy worldwide. you who take care of energy with your daily actions. energy that becomes, new energy.

taking care of energy means creating new energy, together
Energy research under IEA Implementing Agreements (IAs) covers a wide range of subjects: advanced fuel cells to wind turbine systems; buildings to transport; electricity to industry; clean coal to fusion power.

IAs permit member country governments to engage with experts in the private sector and partner countries around the globe. Some 6,000 professionals participating in IAs carry out applied research, on-site testing, workshops and scientist exchanges as well as maintain experts’ networks and databases. These efforts not only result in academic studies but also generate practical information such as guidebooks, input to standards and even demonstration plants, all while reducing costs and the risk of duplicated work.

The IEA Governing Board established the mechanism for the first IA in 1975, making the family of activities one of the oldest programmes supported by IEA member countries. Since then, IAs have addressed more than 1,400 energy topics.

IAs have helped fulfil policy goals such as reducing environmental effects of oil platforms while improving safety. These networks also contribute to and carry out activities under the Clean Energy Ministerial and provide input to high-level mechanisms such as the United Nations Framework Convention on Climate Change (UNFCCC).

Scores of topics since last Ministerial

Since the IEA Ministerial meeting in 2011, IAs have examined nearly 200 topics ranging from the testing of thermal-electric properties of materials to financing clean technology projects in IEA partner countries. One notable outcome is the development and commercialisation of an instrument that measures black carbon emissions in diesel engines in on-road conditions. Also, results of experts’ workshops about carbon capture and storage (CCS) fed into key studies that led to approval of CCS as a Clean Development Mechanism at the 2012 Conference of the Parties (COP) meeting in Durban, South Africa.

During the same period, IAs contributed to many IEA publications, including the World Energy Outlook, Energy Technology Perspectives, Transition to Sustainable Buildings: Strategies and Opportunities to 2050 and 12 energy technology roadmaps.

IEA makes it easier for experts to work

The IEA relies on the vast networks of IAs to develop and improve energy technologies that may alleviate current global energy challenges. And so it provides a common legal and governance structure for IAs that protects and promotes the operational aspects for collaboration and the participants’ intellectual property.

Each new IA must have at least two member governments as participants. From then on, the IA may include non-IEA countries, other international organisations and the private sector. Together, these stakeholders investigate and test the latest solutions to the global issues the Agency deals with. IA participants share the financial contributions to the collaboration on a cost-shared or in-kind basis.

While member countries naturally have the largest presence in IAs, at 74% of participations, 22 non-IEA countries made up 12% of all governmental participation in 2012, with China alone represented in 16 IAs. One-tenth of participation was by non-government entities, all located in partner countries. The remaining 4% of participants were international organisations, including the Organization of the Petroleum Exporting Countries (OPEC).

The OECD recently completed two studies on multilateral co-operative mechanisms, including the IA programme. Both confirmed the relevance and uniqueness of IAs. The first study highlighted IAs’ flexible governance mechanism compared with seven other international initiatives, noting the flexible structure and participation of the private sector as well as partner countries. The other study highlighted how IAs have promoted co-invention, noting a positive correlation between the number of countries participating in an IA and the number in which patents of technology resulting from the IEA collaboration were registered.


Built for a test fusion reactor, this bulk tungsten assembly will feed data to an IEA-supported research network.
TRULY “SMART” APPLIANCES EFFICIENTLY ONLINE

High-technology devices are a surreptitious contributor to surging electricity demand. The IEA advises on how to stem that growth.

The appliances and equipment in buildings are by far the largest consumers of electricity worldwide. The IEA projects that the residential and service sectors will be responsible for 44% of total growth in electricity demand to 2035, so that those two sectors’ total consumption will then exceed 2008 electricity use by all sectors.

Helping drive that increase is stealthy power consumption by network-connected appliances such as computers and “smart” heating and cooling systems. While traditional equipment such as non-networked appliances and lighting systems still dominate in device energy consumption, online equipment is using an ever-larger share of world electricity – especially as equipment that has been offline, such as televisions, refrigerators and temperature controls, increasingly goes online.

By 2020, networked products’ consumption is projected to approach 4% of present global electricity generation. About 60% of total energy consumption by information communication technologies already powers end-use devices such as computers, printers and TVs as well as network devices such as routers and modems that put these products online. Making all these items power down to energy-saving modes when not in use could more than halve demand.

The global savings potential is estimated at about 550 terawatt hours (TWh), equivalent to Canada’s annual electricity output. North America has the largest projected growth in energy consumption of networked products, reaching almost 330 TWh as of 2020. The region’s savings potential by 2020 is around 213 TWh, equivalent to more than one-quarter of the net power produced by US nuclear power plants in 2010.

What worked before needs tweaking

Countries around the world have effectively combated growing electricity demand through the IEA-led 1-watt initiative for standby power, as IEA Energy reported earlier this year (Issue 4, page 9). But network connectivity poses a new challenge as it typically requires these products to be active and online all the time.

Strategies and technologies exist to make products power down and reduce energy demand while maintaining a network connection, and policy makers have a clear role in prioritising efficiency and fostering these solutions – from network design through product and component manufacturers to, of course, consumers.

Even as high technology increases the number of appliances that use the Internet and other networks, it is also at the core of new energy efficiency and clean energy solutions – through the use of those smart appliances as well as smart meters.

High-technology products usually are designed for maximum output with little regard to the cyclical work profile, be it by the hour or the year. But new-generation higher performance systems increasingly optimise energy efficiency across varying workloads. Examples include devices that limit heat output or products that allow – and instruct – users to modify power-saving options to match usage cycles.

Further opportunities lie in technology that monitors the surroundings and the presence of users and then adjusts functions and power levels. For instance, if there are no users in a room, the display of a networked TV does not need to be on and can be powered down automatically.

Beyond just components and products

Network standby shows that the largest opportunities for energy savings rest, as usual, in optimising whole systems rather than individual components. Broad improvement requires tackling the complexity and interdependency of multiple devices and products on a network. Once designers know how much power each element uses over the full range of traffic loads and profiles, they can improve the network for savings.

For instance, improvements to the software and middleware of television set-top boxes can reduce their energy use by as much as 5%, while changes to the devices’ silicon hardware can save twice as much. But if the designers and manufacturers at all stages of the creation of the machines work together, energy savings can top 50% of total consumption. The challenge for the IEA, governments and industry is to get all these stakeholder groups to work together.
In an earlier commentary, “4°C in Davos”, I shared my concern that some senior decision makers seemed to be content with discarding the 2 degrees Celsius (°C) climate goal in favour of something more easily attainable. Work on the World Energy Outlook (WEO) Special Report Redrawing the Energy-Climate Map has afforded me many further opportunities to gauge the global temperature on climate change. I am pleased to say that the reaction since the Special Report’s launch in June has given me some renewed cause for optimism.

The report highlighted that the energy sector accounts for around two-thirds of global greenhouse-gas emissions and is therefore critical in tackling climate change. It took an important additional step by showing that, if implemented promptly and widely, a package of four pragmatic energy measures has the potential to halt the growth in energy-related greenhouse-gas emissions by 2020 without harming economic growth. The four measures, which all rely only on existing technologies and proven policies, are:

- Adopting targeted measures to increase energy efficiency in the building, industry and transport sectors, which would reduce emissions while limiting energy bills for households and industry.
- Where coal-fired power is used, encouraging the construction and use of highly efficient coal power plants. This would also boost the take-up of renewables and natural gas while curbing local air pollution.
- Minimising methane emissions from upstream oil and gas production. In 2010, these methane releases were equivalent to twice the natural gas production of Nigeria.
- Accelerating action towards a partial phase-out of inefficient fossil-fuel consumption subsidies, while still providing targeted support for the poorest. Fossil-fuel subsidies amounted to USD 523 billion in 2011.

All of these actions bring important co-benefits, and all can be undertaken without the need to wait for an international climate change agreement. Taken together, they are GDP-neutral across the period to 2020 and have a positive impact on economic growth after 2020. Collectively, they could get the world 80% of the way towards a 2°C trajectory by the end of this decade.

New optimism as WEO recommendations receive attention

Analysis for its own sake is of little value, but a number of initiatives and announcements since the report’s publication suggest that decision makers are looking closely at these four policy areas.

Upon its launch, the report received support from the ministers of many countries, the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC), international banks and investment groups, utilities, academia, think tanks and many others. The report – somewhat serendipitously – received a ringing endorsement in the form of President Barack Obama’s climate action plan for the United States, which includes strong action across these policy areas. And I was encouraged by the positive feedback while presenting the report’s findings around the world – in particular, in China, where I was joined by the country’s chief climate negotiator, and at a meeting hosted by the World Energy Forum (the organisers of Davos) where business leaders welcomed it strongly. In this light, I am pleased that plans for Davos 2014 are highlighting climate change as one of the critical global issues that will be the centre of discussions.

Support for the key recommendations of the WEO Special Report by governments and business leaders would seize upon the positive momentum that has been generated, and provide an important signal that can resonate with a broad international audience. In the build-up towards COP21 in Paris in 2015, such support would also stand as a timely and important milestone on the journey from positive words to positive actions.
ESTONIA SHIFTS FOCUS
CLEANSING OIL SHALE

Estonia’s environmentally savvy oil shale technologies may trigger a fresh look at the vast global reserves of this otherwise polluting fossil fuel.

Significant reserves and nearly a century of experience in tapping this resource make Estonia’s oil shale industry the most developed in the world. Oil shale, however, tops the list of the most polluting fossil fuels. One benefit the country could reap from membership in the IEA is collaboration in pursuing wider use of oil shale in a cleaner, more sustainable manner.

Not to be confused with shale oil, oil shale is a sedimentary rock containing up to 50% organic matter rich in hydrogen, known as kerogen. The extracted rock can be used directly as a power plant resource or it can be processed to produce shale oil, which in turn can be refined into gasoline, diesel or jet fuels.

Estonia’s oil shale is energy-rich, but its direct combustion, or transformation into shale oil and then other fuels, emits more CO₂ than any other primary fuel.

Reducing mining without reducing energy
Despite the high emissions, 70% of Estonia’s total primary energy supply (TPES) in 2012 came from oil shale. Just over 85% of mined oil shale was used to produce electricity — the country’s top priority for energy security — and heat generation; the rest was turned into shale oil, retort gas and other valuable chemicals.

The new IEA publication Energy Policies of IEA Countries — Estonia 2013 describes how the country is trying to slow its mining of oil shale amid environmental concerns. Last year, Estonia mined 15.86 million tonnes of its more than 4 billion tonnes of estimated reserves, which represent just over 1.1% of global and 17% of European reserves. But the National Development Plan for Oil Shale Use for 2008-15 calls for reducing annual extraction while preserving the country’s strong energy security. Estonia is also working to halve energy sector-related CO₂ emissions in 2020 from the 15.7 million tonnes emitted in 2007.

How Estonia will do more with less
Estonia is relying on technological improvements to maximise oil shale yield to generate more electricity, heat and shale oil so as to maintain necessary levels of electricity and heat for the economy, which remains one of the OECD’s strongest performers.

In 2011, public research, development and demonstration (RD&D) expenditures exceeded EUR 9.4 million, with the oil shale sector accounting for one-third. That spending demonstrates how RD&D is an economic priority, with the national research and development and innovation system enjoying one of the highest growth rates in gross RD&D domestic expenditure among OECD member countries in recent years.

The aim is to improve technologies for greater efficiency throughout the oil shale cycle, from mining to consumption. The research concentrates on two aspects: maximising the production of liquid fuel and reducing the carbon intensity of oil shale-based power and heat generation.

The recently launched ENEFIT280 technology of the state-owned company Eesti Energia highlights Estonia’s achievements in reducing emissions and increasing efficiency for the oil shale industry. ENEFIT280-equipped plants utilise 100% of mined oil shale, producing shale oil, electricity and retort gas with higher efficiency and improved environmental performance than other models. This essentially water-free, carbon capture-ready technology also generates electricity from excess heat and retort gas, further offsetting CO₂ emissions. Another competitive advantage of ENEFIT280 is the absence of waste, with the only by-products being non-hazardous residue ash. The ash can replace clinker in cement production and is registered by the European Union as a raw material for different applications in the construction and materials industries.

Estonia produced the first barrel of ENEFIT280 shale oil in December 2012.

Renewable energy is another solution. Renewables, particularly biomass for heat, provided 14.6% of Estonia’s TPES in 2012, a share which would rank tenth among IEA members.

The European Union Renewable Energy Directive calls for sourcing one-quarter of Estonia’s gross final energy consumption from renewable sources. To increase and improve the sector, Estonia is not only spending heavily on RD&D for biomass-based energy, wind and solar power, but it is also pursuing cutting-edge solutions such as fuel cells and electrolyzers as
well as computer-based energy management technologies for buildings, power storage and grid development.

**Estonia exports its home-grown technologies**

Relatively little is known about many of the world’s deposits of oil shale.

The United States tops the list of the richest reserves, accounting for more than 60% globally, with the most concentrated deposits located in the Green River Formation that lies in western Colorado, eastern Utah and southern Wyoming.

Besides Estonia, countries with large oil shale reserves include Australia, Brazil, China and Russia. There are also significant reserves in Jordan, Morocco, Sweden, Syria and Turkey.

Countries with the know-how have used oil shale for different applications for decades, but Estonia’s latest technological breakthrough could catalyse a new approach to exploring the vast global reserves of this fossil fuel frequently perceived as a significant pollutant.

Estonia is keen to explore opportunities for the wider application of its latest technologies. Eesti Energia started its international oil shale activities in 2006, and has oil shale operations in Jordan and the United States.

Eesti Energia’s subsidiary Enefit is developing two parallel oil shale projects in Jordan, where it acquired the exclusive right to develop, design, finance, construct and operate a 500 megawatt oil shale-fuelled power station.

In the US state of Utah, Eesti Energia purchased Oil Shale Exploration Company in 2011. Properties owned or controlled by Enefit contain an estimated 2.6 billion barrels of recoverable oil that can be unlocked safely with conventional mining, mineral processing and refining methods.

**How the IEA helps oil shale RD&D**

Based on an agreement Estonia reached with the IEA on the sidelines of the 2011 IEA Ministerial meeting, the Agency took part in the International Oil Shale Symposium hosted by Estonia in June 2013. The Ministry of Economic Affairs and Communications and the IEA organised a joint plenary session on energy technologies, with the IEA presenting some of the latest advances in energy technology and policy for better use of oil shale.

Estonia is also expected to join a number of IEA-supported research networks related to the oil shale industry, including the Gas and Oil Technologies Implementing Agreement and the Implementing Agreement on Fluidized Bed Conversion, to further aid and benefit from international technological advances.

The symposium’s findings built in part on national basic research on oil shale conducted by the Tallinn University of Technology. But RD&D is led by the top oil shale users, including Eesti Energia, which expects its RD&D will result in two more ENEFIT280 plants by 2016 as well as shale oil-upgrading facilities for refining. Export of the technology may be aided by ENEFIT280’s modular design, which allows each processing unit a specific purpose, optimising maintenance, processes and adaptability to different oil shale deposits’ characteristics.

**AN ECONOMIC FUEL AS WELL**

Estonia first mined oil shale in 1918 for a narrow range of uses, such as heating houses and powering locomotives. Six years later, the first shale oil plant began producing low-quality gasoline and oil for heating and the Tallinn power station started using oil shale as its feedstock.

Oil shale output peaked in the early 1980s, at 30 million tonnes (Mt) per year, but the industry still employs about 1% of the labour force and accounts for 4% of gross domestic product. Shale oil sells for less in Europe than crude oil, but producing it from oil shale remains profitable. Eesti Energia, as the largest oil shale processing company in the world, uses about 15 Mt of trade oil shale per year for electricity and heat generation in Estonia.

Prices for crude oil and regional electricity tariffs have made it more profitable for companies to use oil shale to produce shale oil and other liquid fuels rather than to generate electricity. By 2018, Estonia expects only 70% of its electricity to come from shale oil, down from 85% in 2012.

In the process, Estonia plans to gradually replace its ageing power infrastructure with higher-efficiency plants, principally by units using the ENEFIT280 technology. These heavy investments, as well as outlays to mitigate CO₂, are affecting electricity prices, which are already higher since Estonia liberalised its electricity market at the start of 2013.

The increased use of oil shale to produce shale oil instead of electricity will not only reduce greenhouse gas emissions but also create approximately 8 000 jobs, with the development of the oil shale industry adding as much as EUR 455 million to the economy, including indirect benefits.

Eesti Energia’s first ENEFIT280-equipped plant uses virtually no water to produce shale oil waste-free.
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International Energy Agency
Russia is at a crucial stage in its decade-old electricity reform. An IEA report provides advice to support policy makers tackling the remaining challenges.

Russia is undertaking one of the most ambitious electricity reform programmes in history. The country has already made impressive progress by international standards, and the project offers the potential to transform the sector into a key driver of longer-term economic growth and prosperity.

Among other gains, Russia has realised an unbundling and privatisation of generation infrastructure; an investment obligation mechanism targeting new investment; a wholesale spot market for European Russia, the Urals and Siberia; and incentive-based economic regulation. It has also made progress on more cost-reflective retail pricing while creating or strengthening critical market and regulatory institutions.

But Russian electricity reform is entering a critical phase where IEA experience suggests that government commitment may be tested and the risk of undue compromises jeopardising successful implementation may increase. So the Agency just updated its 2005 study that advised Russian policy makers.

Russian Electricity Reform 2013 Update draws on the experience of IEA member countries and the views of key Russian stakeholders to examine the main challenges affecting the development of competitive wholesale and retail markets including market structure, market design, pricing, investment and related regulation.

The IEA has found that diversity of ownership is the best way to achieve a competitive wholesale market structure. Although Russia’s very successful 2008 privatisation brought several new entrants, the government still has considerable scope to diversify ownership and wholesale competition through further divestment as well as virtual power auctions or similar mechanisms to sell rights to the output of publicly owned generators. It can also strengthen market integration. The new report notes the crucial role of effective competition supervision, especially during the current initial phase of rationalisation.

Russia’s competitive wholesale spot market is one of the most successful components of the reform implemented to date. Russian Electricity Reform 2013 Update emphasises the importance of establishing transparent and competitive wholesale markets that create strong incentives for efficient and innovative investment responses, including renovation, refurbishment and retirements, while also removing undue legal and regulatory barriers.

IEA experience suggests that a well-functioning energy-only market will provide Russia with an effective electricity wholesale market model in the longer term. But that requires a competitive wholesale market structure; cost-reflective pricing and efficient price formation; a transparent and efficient financial market; and access to accurate and timely information, including medium-term demand projections.

Competitive retail markets are in an early phase of development in Russia, which is generally reflected in a highly fragmented and concentrated retail market structure. Russian policy makers have taken some positive steps towards establishing the market rules and regulations needed to develop competitive and innovative retail markets. But much depends on how effectively these rules and regulations are translated into commercial incentives and practical processes that support efficient, competitive and innovative market operation and development.

Russian Electricity Reform 2013 Update proposes an integrated approach, calling for effective market processes and practices for contracting, billing, switching and settlement; and building customer awareness and active engagement. It notes the need for close monitoring and supervision of retail markets to identify and eliminate barriers to new entry.

Price reform is essential for success

In the decade since it passed the main legislative backbone for electricity reform, Russia has also made considerable progress in rebalancing tariffs, but here too there is more to do, especially for regulated residential consumers.

Unwinding the remaining cross-subsidies and moving to cost-reflective pricing are needed to realise the full benefits of electricity reform.

The IEA proposes that on the demand side, price increases be linked to growth in user capacity to pay while direct government payments to regulated users replace user-funded subsidies. At the same time, the government needs to keep pursuing supply-side reforms to help reduce the level of cost-reflective prices, especially in relation to network services.
MEDIUM-TERM COAL MARKET REPORT 2013
Language: English; Release: available soon

Coal is the leading source fuelling non-OECD countries’ growth, and at the same time, it is the main source of power generation in OECD member countries. Yet current low prices add a new challenge to the sector, which faces uncertainty due to increasing environmental legislation and competition from other fuels. The Medium-Term Coal Market Report 2013 provides IEA forecasts on coal markets for the coming five years and provides in-depth analysis of global coal demand, supply and trade. It shows that while coal continues to be a growing source of primary energy worldwide, its future is increasingly tied to the mushrooming demand from non-OECD countries, led by China.

ENERGY EFFICIENCY MARKET REPORT 2013
Language: English; Release: available now

Energy efficiency has been referred to as a “hidden fuel”, one that extends energy supplies, increases energy security, lowers carbon emissions and generally supports sustainable economic growth. Yet it is hiding in plain sight: in 2011, investments in energy efficiency market globally were at a similar scale to those in renewable energy or fossil-fuel power generation. This first Energy Efficiency Market Report provides a practical basis for understanding energy efficiency market activities; a review of the methodological and practical challenges associated with measuring the market and its components; and statistical analysis of energy efficiency and its impact on energy demand.

WORLD ENERGY OUTLOOK 2013
Language: English; Release: available now

A new global energy landscape is emerging, resetting long-held expectations for our energy future. Incorporating these recent developments and world-class analysis, the World Energy Outlook 2013 presents a full update of energy projections through to 2035 and insights into what they mean for energy security, climate change, economic development and universal access to modern energy services. Oil, coal, natural gas, renewables and nuclear power are all covered, with more country-level detail than ever before. The 2013 edition also focuses on topical energy sector issues including energy in Brazil; a fresh look at the economics and decline rates of different types of oil production; and energy trends in Southeast Asia.

ENERGY POLICIES BEYOND IEA COUNTRIES: ESTONIA 2013
Language: English; Release: available now

In the last decade, Estonia has achieved one of the highest medium-term growth rates in the OECD, accompanied by rapid improvements in living standards. Estonia is unique among European Union member states in that its energy sector is dominated by one primary source of energy: oil shale. One of the largest producers of oil shale in the world, Estonia has a domestic energy sector heavily reliant on that unconventional source, from which the bulk of the country’s electricity is produced. Among other critical assessments, Energy Policies Beyond IEA Countries: Estonia 2013 examines the government’s policy priority to reduce the carbon intensity of the energy sector and the country’s clear aspiration for a more energy-efficient and sustainable economy.

Visit the online bookshop at www.iea.org or email: books@iea.org

CALENDAR

November
4-7 Carbon Sequestration Leadership Ministerial, Washington: www.csllforum.org
11-22 COP19, Warsaw: unfcct.int

December
2-3 ITER Conference, Monaco: www.iter.org
13-15 IFRI World Policy Conference, Monaco: www.ifri.org/ (in French)

January 2014
19-20 IEA Ministerial meeting, Paris: www.iea.org

February
21-22 MIT Energy Conference, Boston: mitenergyconference.com

March
10-11 Loeh Energy Forum, Austria

May
5-6 OECD Forum, Paris: www.oecd.org/forum
7-8 OECD Ministerial, Paris: www.oecd.org/mcm

June
9-11 Conference of Montreal: forum-americas.org/montreal
15-19 World Petroleum Congress, Moscow: www.21wpc.com
IEA ENERGY FEATURED RESEARCH

PRODUCTION COSTS OF ALTERNATIVE TRANSPORTATION FUELS: INFLUENCE OF CRUDE OIL PRICE AND TECHNOLOGY MATURITY

Author: Energy Technology Policy Division (Pierpaolo Cazzola, lead author)

Production costs of a range of transport fuels and energy carriers vary based on crude-oil price assumptions and technology market maturation levels. Production Costs of Alternative Transportation Fuels: Influence of Crude Oil Price and Technology Maturity uses data from a range of sources in a “bottom-up” approach to examine the effect of the input cost of oil and of various technological assumptions on the finished price of more than 20 transport fuels. This Featured Insight helps policy makers and practitioners understand how and why transport fuels are sensitive to changes in crude oil prices, and how the cost-competitiveness of different fuels may alter with changes in oil prices. It also should aid energy providers who seek to limit their exposure to future oil price volatility.

Production Costs of Alternative Transportation Fuels finds that depending on the scenario employed, few alternative fuels are likely to compete with oil below USD 90 per barrel, while many might compete when the price is at USD 100 per barrel. The Featured Insight warns policy makers not to assume that a future with higher oil prices will automatically make non-petroleum transportation fuels economically competitive: most production processes of alternative transportation fuels rely on petroleum as an input, so these alternatives will very likely face an increase in cost when oil prices rise. But alternative transportation fuels exhibit varying degrees of sensitivity towards oil price changes.

Lastly, refuelling infrastructure costs can have a significant impact on the introduction of a number of alternative fuels, especially in immature markets, where the ratio of infrastructure to the amount of fuel sold may be relatively high.

Read or download this publication at http://bit.ly/IEAcAltFuels

ENERGY INVESTMENT AND TECHNOLOGY TRANSFER ACROSS EMERGING ECONOMIES: THE CASE OF BRAZIL AND CHINA

Authors: Joerg Husar and Dennis Best

Global technology transfer and co-operation are changing profoundly. Emerging economies have stepped up their innovation efforts and increasingly invest in each other’s energy sectors, creating new, reciprocal opportunities through the deployment of new technologies and knowledge transfer.

The case of Brazil and China is particularly relevant. From 2005 to 2012, China invested USD 18.2 billion in the Brazilian energy sector. Sino-Brazilian trade and political relations have intensified over the past decade. Brazil’s abundant energy resources, China’s financial means and both countries’ expanded technological capabilities underline the significant opportunities for further investment and co-operation, with commercial interests in the areas of wind energy and power transmission already advancing this bilateral energy partnership.

The IEA Partner Country Series paper Energy Investment and Technology Transfer Across Emerging Economies: The Case of Brazil and China focuses on three main questions. What drives Chinese investment in Brazil’s energy sector? What potential exists for inter-firm technology transfer between the Chinese and Brazilian companies involved? Do government-sponsored activities and academic exchanges complement inter-firm technology transfer?

This publication’s analysis highlights the potential of energy technology co-operation between Brazil and China, but also shows that making use of areas of potential synergies is not straightforward. The paper also addresses the deployment of innovations in third countries and, more generally, the intensification of global co-operation in energy-related research and development.

Read or download this publication at http://bit.ly/IEAbzch

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HOW GLOBAL ENERGY CHANGED...

In these Sankey graphics, each line’s thickness is proportional to that element’s share of the balance. To see national or global Sankeys from 1973 on, and even an animation of annual changes, visit www.iea.org/Sankey.

1973 ENERGY BALANCE FOR OECD MEMBER COUNTRIES

1973 ENERGY BALANCE FOR NON-OECD COUNTRIES

Mtoe = million tonnes of oil-equivalent.
...OVER FOUR DECADES OF THE IEA

2011 ENERGY BALANCE FOR OECD MEMBER COUNTRIES

2011 ENERGY BALANCE FOR NON-OECD COUNTRIES
IEA IN ACTION

Oil & Money 2013 | IEA Head of Oil Industry & Markets Division Antoine Halff | London

Annual Meeting of the New Champions 2013 | IEA Chief Economist Fatih Birol | Dalian, China

The Executive Director and other IEA experts visiting the ASEAN Energy Award-winning Energy Complex | Thailand

Conference of Montreal | IEA Executive Director Maria van der Hoeven | Montreal

The IEA welcomes Deputy Executive Director Kenneth J. Fairfax

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Grupo R Founded in 1960, is the largest and most diversified conglomerate in the oil & gas industry in Mexico; engaged in the drilling industry since 1987, Grupo R has extensive expertise in different types of drilling contracts in Mexico, including: day-rate charters, turn-key wells, integrated service contracts and operation of gas fields (known as multi-service contracts).

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AREAS OF OPERATION
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