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For sustainable energy.

Highlights of the 21st World Energy Congress, Montreal 2010

Addendum Edition to
World Energy Insight 2010
Official Publication of the
World Energy Council



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Montreal Congress round-up

By Pierre Gadonneix, Chairman, World Energy Council and Honorary Chairman, Electricité de France (EDF)

The Montreal Congress was a great success:

- 7,000 participants came from 141 countries (both developed and developing), among which there were over 60 ministers and as many CEOs of global companies.
- WEC demonstrated that it is the only inclusive forum for real dialogue among energy leaders of all energy sectors.
- Most importantly, very significant statements were made on what is, today, the current energy agenda, namely: the need for investments to secure energy supply, the role of conventional and unconventional fossil fuels, and the call for sound regulation.

Key 'take-aways' from the Congress

Investments: the narrow passage to energy security

- Massive investments in infrastructures are needed to secure energy supply by 2030. Most of the needed investments are still to be decided.
- These new infrastructures are needed for all energies, all technologies and in all countries.
- But the good news is that we can rise to these challenges.
- We have enough natural resources to meet demand.
- We have technologies to rise to the challenges.
- So, the challenge is to invest in the right, mature and affordable technologies, in a time of increasing uncertainties, among which the economic crisis, the intensity of the fight against climate change, and the unpredictable market disruptions, such as new fossil fuels and unconventional gas, for example.

Innovations can lead to market disruptions and change short-term opportunities but long-term objectives remain the same

- New conventional gas resources, along with the recent exploitation of shale gas, make gas appear to be a game-changer.
- Gas can indeed give a unique chance for some very fossil-fuels-dependant countries or industries to release the time pressure of the depletion of fossil fuels while developing new energy sources.
- But on the other hand, shale gas cannot be a radical game-changer. Its price will eventually go up under market pressure and the need to integrate the cost of security and of the environment (CCS), and it will re-couple with the oil trends. Most importantly, shale gas cannot be a radical game-changer because our end-goal remains decarbonising our energy systems.

The market alone cannot solve all our problems: we need smart regulatory frameworks to foster investments in the right sectors, while keeping costs in check and mitigating CO₂ emissions

Confronted with these uncertainties and challenges, to stay on the right track, we need a renewed governance at both national and worldwide levels:

- Stable national energy policies, giving investors long-term visibility, keeping the costs of transitioning to a low-carbon system to a minimum and ensuring that the transition can also be acceptable to all.
- More international cooperation, to make sure we keep the rise of the world's average temperature under +2°C by 2020; to promote shared standards for security for all technologies and to foster international trade and investment and job creation in all countries in clean technologies, while preserving global balances.

But we will never be able to rise to these challenges without cooperation. Cooperation, sharing of experiences and ideas is the way forward. And this is the core value of organisations such as WEC. □



21 Key Insights from the 21st World Energy Congress, Montreal 2010



1: The UN counts on the World Energy Council to create a sustainable energy future

During the opening ceremony, **Ban Ki-moon**, Secretary General of the UN, highlighted the importance of the Congress as notable: “My High-Level Advisory Group on Energy and Climate Change has recommended two bold targets – universal energy access and a 40% increase in energy efficiency by 2030. These targets can be achieved. To realise them, and all our energy goals, the UN counts on partners such as the World Energy Council. You, yourselves, are a mighty source of energy – [more than] 3,000 member organisations in [over] 90 countries. With your help, we can bring clean and affordable energy to billions of the world’s most needy people. With your help we can create a sustainable energy future.”



2: Energy is a central issue in all countries worldwide

Johannes Teysse, Chairman of E.ON, after the Congress, reported that “There is an overwhelming consensus that a broad and affordable availability of energy is a prerequisite for economic growth and prosperity.” For industrialised nations, however, the transformation of the energy system is the key issue and the main concern is to finance the transformation. For growth regions, especially BRICS, the large-scale construction of an energy system is the significant issue. The strong growth of their industries and the increasing income of their population lead to high growth rates in energy demand. And for poor regions their main interest is access to affordable modern energy.



3: Fossil fuels will continue to dominate world energy for decades to come

Khalid A. Al-Falih, President and CEO of Saudi Aramco, noted, “For the foreseeable future, the world will continue to rely primarily on the same conventional energy sources that have generated an unprecedented century of progress and prosperity. The contribution of alternatives will grow, but only gradually.” Fatih Birol, Chief Economist of the IEA, presented the preliminary findings of the World Energy Outlook 2010 study, launched in November. It also stresses that fossil fuels will continue to dominate the world energy supplies for decades to come. Renewables will significantly grow year after year, but their contribution will be modest by 2035 since they are starting from a low base.



4: Search for right energy mix includes on-going conventional sources as well as alternatives

Richard George, President and CEO of Suncor Energy, said, “The question is whether we can balance our continuing reliance on fossil fuels with the need to protect and promote a healthy environment. I’ve long believed the future is about expanding energy choice, not restricting it. First we need to get increasingly creative about finding and developing conventional energy sources, whether it is oil, gas, coal or nuclear – and do so in ways that are environmentally and socially responsible. Second, we should use these conventional sources to help drive research and development of alternative energy and new environmental technologies.”



5: The world’s fastest growing economies, such as China and India, are fuelled by coal

Gregory H. Boyce, CEO of Peabody Energy, underlined the increasing global use of coal in the electricity sector. He said that global coal use expanded nearly 50% in the past decade whilst in China electricity generation from coal has soared 475% since 1990. He noted, “What is most striking to me is that this acceleration in coal demand came even as attention to climate change was also on the increase and at a time when global warming was becoming a fixture on the global agenda.” He forecast that global coal use would rise 53% by 2030 and about 90% of the demand growth would come from emerging Asia. He added, “A major new build-out of coal generation is under way globally. Global coal-fuelled generation will nearly double by 2035.”



6: China's energy policies will determine the future of oil prices

According to **Fatih Birol**, Chief Economist of the International Energy Agency (IEA), China's robust economy has not felt the economic downturn as severely as other countries and its energy demand has grown from half of the US demand in 2000 to parity with US demand today. Its population still uses only one-third of the energy per capita of the OECD countries. China is a crucial factor. "China's energy policies will determine the future of oil prices," he said.



7: Shale gas is the biggest energy innovation since the beginning of the 21st century

Referring to the current shale gas revolution taking place in the US, Daniel Yergin, Chairman of IHS CERA, called it, "The biggest energy innovation since the beginning of the 21st century". **Peter Voser**, CEO of Royal Dutch Shell added, "The natural gas revolution is changing the energy landscape. Improvements in production technologies have made it economical to produce shale gas and tight gas resources that were previously considered too difficult to tap. Worldwide, there's now enough technically recoverable gas in the ground for 250 years at current production rates." A recent study by the WEC states that globally the reserves for conventional gas are estimated at 187 tcm, whereas shale gas is estimated with 456 tcm.



8: Nuclear Power: Renaissance or Demise?

Anne Lauvergeon, CEO of AREVA, said, "At the WEC in Sydney nuclear energy was only being discussed among specialists. Now the picture has totally changed given the climate challenges we're facing, and energy security is in the forefront again." She mentioned that the first energy revolution occurred with the use of coal; the second with oil; and the third revolution had now begun. "There is not just one 'magic solution,' but many energy solutions," she said. She sees nuclear energy and renewables as complimentary and compatible. She further emphasised that nuclear energy must gain wide acceptance as a key element in the energy mix in the coming years.



9: Renewable Energy: Optimistic view is 50% of the global energy mix by 2050

There is a general consensus that the world will continue to rely on fossil fuels for decades to come and renewables will significantly grow year after year, but their contribution will be modest. However, **H el ene Pelosse**, Interim Director-General of IRENA, is optimistic that there will be a further increase in renewable sources. "While renewable energy accounts for 18% of total global consumption, there has been a four-fold increase in renewable energy investments in the last few years," she said "We expect renewable energy to account for 50% of the global mix by 2050." The largest contributor to the renewables is currently hydroelectric power, however, she expected, "Solar will see the most growth in the period to 2050."



10: 20-year demand will require real-time investments today

According to **Daniel Yergin**, Chairman of IHS CERA, the world demand for energy will increase by 32% to 40% within next 20 years. "This demand growth will require investment measured in many trillions of dollars," he said, "and it will pose dramatic challenges to all the energy industries." Effective contributions to global sustainable development will require large investments now to reap the benefits of new technology in the years to come. "We saw the impact in 2007 and 2008 of a 'demand shock' in term of US\$147 oil and the economic consequences that went with that," he said. "Timely deployment of investment is necessary in the years ahead to avoid future demand shocks that can cause crises and disruptions and damage the global economy."



11: Clear policies and efficient regulatory frameworks are required

The global crisis has proved that the market alone cannot solve our problems. Policies are needed and we must find a new balance between market and regulation. Leonhard Birnbaum, Chief Strategy Officer of RWE, said, "Clearly, the market should make decisions at the resource level, but they need target-setting by regulators." The arbiter must be the government setting policy targets and leaving execution to the markets. "Both are needed and both should be efficient." Fatih Birol, Chief Economist of the IEA, said, "What is needed is regulation with predictability, stability and transparency." He mentioned that the market would be best for meeting energy challenges but that market would need guidance from public policy. **Henri Proglio**, Chairman and CEO of EDF Group, said "National public policies will play a vital role in allowing us to achieve growth while tackling global warming. Without them, we will not be able to find a sustainable path. If policies are poorly designed, the result will be the same since public opinion will reject them."

21 Key Insights from the 21st World Energy Congress, Montreal 2010 *continued*



12: Oil Spill: Energy industry must manage risks through good safety standards

Amid concerns following the recent oil spill in the Gulf of Mexico, Khalid A. Al-Falih, President and CEO of Saudi Aramco, said, “The petroleum industry’s safety record is better than the images of the last several months would lead the public to believe and today it is more capable, the technological tools at its disposal are more sophisticated and the petroleum supply chain is more robust than at any point in the oil industry’s long history. But it would defy both logic and experience if any of us claimed that a similar incident could never happen again. For that reason, we need to understand how such incidents could be prevented and how their serious human, environmental and economic consequences could be better mitigated.” **Phillip Ellis**, Chairman, Global Energy of Willis Group pointed out that “there is a recalibration of risk in the industry after the oil spill and a mutual insurance model could point the way ahead to enhance industry collaboration in managing such risks”.



13: Each year more than 1.5 million people die due lack of energy access

Till now over 1.5 billion people do not have access to electricity. Adequate supplies of energy, particularly electricity, are essential for sustainable development, especially that of low income countries. Gregory H. Boyce, CEO of Peabody Energy said, “Study after study – and pure common sense – tells us that access to electricity helps people live longer and better. Yet each year, we lose more than 1.5 million people to the effects of energy poverty. We can no longer turn our heads from these brutal statistics. We must put people first. That is the first value.” **Donald Kaberuka**, President of AfDB, added, “The whole African continent has less energy capacity than the country of Spain.” However, he was optimistic. “Africa is still struggling with many challenges, but for the last 10 years, economic development is better than it has been in the last 50 years.”



14: Energy efficiency is the most effective way and energy subsidies need to be phased out

A reasonable use of energy by all parties is decisive: “Energy efficiency is the best permanent change,” said **John Drzik**, CEO of Oliver Wyman. Fatih Birol, Chief Economist of the IEA, said, “Energy efficiency is a concept everyone supports.” Strict and clear standards from government will assure efficient use of energy. In developing countries, strong subsidies may not be the long-term answer. These subsidies can encourage energy use. As a result, price signals are not making their way to consumers, eliminating a key throttle on demand growth.



15: Climate Change: We need to put the rhetoric aside and focus on implementation

The previous World Energy Congress in Rome in 2007 was largely dominated by the topic of climate change due to the expectations in advance of COP 15 in Copenhagen. In Montreal a sense of disillusion was obvious: Cancun and COP 16 were rarely mentioned. Nevertheless, climate change was on the agenda. **Yvo de Boer**, Special Global Advisor, Climate Change and Sustainability at KPMG said that the challenge of COP 16 in Cancun would be implementation of national commitments and action plans that were brought to COP 15 in Copenhagen. “While COP 15 had a strong emphasis on politics and targets, we do have national commitments that cover 80% of the world,” but “there’s still no binding treaty or roadmap.” The importance of CO₂-free generation was highlighted, but it is also noticeable that the interest in this topic was driven by industrialised countries. The WEC study Power Generation Performance delivered an interesting contribution to the climate debate. It says that a US\$80 billion investment to increase the performance leads to around 1 billion tonnes CO₂-abatement. This is a rather inexpensive and extremely effective way to contribute to climate protection.



16: World trade markets should remain open to the energy sector

Pascal Lamy, Director-General of the WTO, thanked the WEC’s Task Force on Trade and Investment Rules for Energy for making the point that the international community had yet to take a strategic approach to the rules of the Multilateral Trading System with respect to energy trade. He also mentioned that the Doha mandate asked WTO members to negotiate an agreement on the reduction or, as appropriate, elimination of tariff and non-tariff barriers to environmental goods and services. “The global economy requires concerted efforts to ensure that markets remain open to energy goods, services, investments, and movement of personnel”, he concluded.



17: CCS is advancing toward commercialisation

Gregory H. Boyce, Chairman of Peabody Energy, noted, “CCS is being advanced all over the world. As many as 80 large-scale integrated projects are at various stages of development. The IEA cites strong CCS momentum and calls for continued cooperation. As China leads the world in coal use, China is also leading a green coal revolution. The GreenGen power plant and carbon research facility will be one of the world’s largest coal-fuelled power projects that will be virtually emissions free.” He explained part of the ‘Peabody Plan’ would be to develop 100 CCS projects within 10 years, which complements the IEA’s goal of deploying more than 2,000 projects by mid-century.



18: EV is seeing great strides in technology

Professor C.C. Chan, President of the World Electric Vehicle Association, said, “Interest in EVs has gone up and down as the price of oil has fallen or risen.” By 2020, EVs will make up about 7-12% of total volumes – from 3 million cars in 2016 to 6 million cars in 2020, he expects. Gil Forer, Global Cleantech Leader of Ernst & Young added that, “Market drivers vary regionally according to government strategy and support, enabling infrastructure, customer attitudes, and the EV value proposition.” Dr Donald Wu, Chairman of Pihsiang Energy Technology, said, “Batteries are the heart of the electric vehicle. The question is how much can batteries reduce charging times and expand the driving range.”



19: Mega-cities have major needs

The WEC has reported that the equivalent of seven cities with ten million people will be added every year in the next 20 years. As urban populations increase worldwide, so does the importance of providing a clean, efficient energy supply and improving standards of living. **Martin Chavez**, Executive Director, ICLEI, said, “The history of almost every nation is not the history of its frontiers, but the history of its cities.” In fact, 50% of the world’s population lives in cities; by 2030, that percentage will increase to 60%. “To understand energy for the future, we must understand the urban environment,” he emphasised.



20: Smart grids will add more intelligence, interactivity, flexibility and efficiency

Liu Zhenya, President of the State Grid Corporation in China, said, “Smart grid technology is being spotlighted and is thriving with each passing day. The smart grid is also a public service platform,” he noted. “The power grid is more integrated with the internet, television and communication sources to make better use of energy and information flow and boost the idea of a low carbon society.” Johannes Teyssen, Chairman of E.ON, after the Congress, added, “The smart grid will add more intelligence, interactivity and flexibility to the electricity system. It will also increase efficiency.”



21: Space technology will be able to help energy and environmental needs

Steve Maclean, Chairman of the Canadian Space Agency, offered the promise of help from satellites in serving energy and environmental needs. Research has shown that satellites monitoring soil depth, water content in clouds and other vital signs of the Earth can help Canadians increase crop yields by more than 30%. Similar technology can measure CO₂ emissions and follow their path through the upper atmosphere. Further, research can find more ways of using space technology to improve energy efficiency. In this opening speech, he noted that during his shuttle flight the oxygen atom fluence outside the spacecraft increased during the day and then dramatically decreased as they crossed the terminator into darkness. “I had the impression that the earth’s atmosphere was breathing and that each breath manifested its fragility.”



Sustainable energy: The key to achieving the Millennium Development Goals

By Ban Ki-Moon,
Secretary General of the United Nations

Energy has dramatically changed our world. In developed countries, everyday comforts such as electricity, light, motorised transport, running water and sanitation are taken for granted.

But such benefits have yet to reach billions of people in the developing world. In particular, most rural citizens are deprived of modern energy services and the health, education and job opportunities they provide. It will be almost impossible to keep the promise of the Millennium Development Goals unless we pay urgent attention to energy and related infrastructure needs in developing countries.

And we will not beat the climate challenge until clean and renewable energy and energy efficiency provide a firm

foundation for our energy needs. My High-Level Advisory Group on Energy and Climate Change has recommended two bold targets — universal energy access and a 40 per cent increase in energy efficiency by 2030.

These targets can be achieved. To realise them, and all our energy goals, the United Nations counts on partners such as the World Energy Council. We rely on your hands-on expertise, your capacity for research, advocacy and action.

You, yourselves, are a mighty source of energy — 3,000 member organisations in 90 countries. With your help, we can bring clean, affordable energy to billions of the world's most needy people. With your help we can create a sustainable energy future. □



Nuclear and renewables: The third global energy revolution

By Anne Lauvergeon
President and Chief Executive Officer of AREVA

The question before us is the following: what are the energy possible solutions that can meet all of our growing needs while preserving our natural resources and the climate, and remain competitive?

There are, in effect, two urgent issues which we must confront: of course, there is the issue of climate change, but also equal access to energy. This is a major challenge. Today nearly 2 billion people simply do not have access to a source of affordable and reliable energy. Living without electricity reduces life expectancy by a factor of two. This is the first issue that we must face!

Energy is inextricably linked to development. Too many countries have been bypassed by the first two energy revolutions, that of carbon and that of gas and electricity. The third energy revolution must be the time for us to

engage on a sustainable development path.

The truth is that there is no one unique solution, no magic bullet that alone would assure the transition to an economy without carbon that our planet needs.

The response lies in a balanced portfolio of solutions that begins with available energies, and it is absurd to pit one against another: fossil fuels, which we cannot do without; of course, renewables; and nuclear energy when the choice is appropriate. They all have their advantages and their disadvantages. Each energy source has its use. Nothing can be done without considerable efforts in the areas of energy efficiency and R&D.

Yes, Ladies and Gentlemen, I said nuclear AND renewables. These different technologies are not incompatible. On the contrary, they complement and reinforce each other!" □



Shaping the energy future: The role of WEC

By Pierre Gadonneix, Chairman, World Energy Council
and Honorary Chairman, Electricité de France (EDF)

We have made a significant step forward in identifying the following:

- First, the energy sector's new agenda;
- Second, the real constraints and opportunities we face in tackling our challenges;
- And third, the road ahead to adjusting our energy policies and fostering international cooperation.

Our end-goal has to be sustainable growth.

At a time when all countries are working to develop strategies to put the crisis behind them, growth is a legitimate and worthwhile goal. When accompanying growth, energy accessibility and availability contribute concretely to improving the living standards of people. However, the kind of growth we have experienced in the past leads us to address three issues:

The first issue is security of supply. Clearly, we must invest in new infrastructures to keep up with demand. However, the crisis has interfered with some investment plans. In addition, the recent surge in oil and commodity prices is curbing growth. We must bear in mind that many developing countries spend approximately 4% of their GDP on oil and gas imports, the same percentage as OECD countries did during the previous two oil shocks. In some developing countries today this figure can even reach 15% of GDP.

The second issue is environmental protection and climate change. The energy sector, which is responsible for 60% of global greenhouse gas emissions, is clearly on the front line regarding the debate on climate change. Finally, the issue of inequalities within and across countries is another major concern, as energy goes hand in hand with development. Inequality hinders development and depresses demand. Sustainability also means more social equity.

We will see no progress towards reaching the Millennium Development Goals if we persist in failing to efficiently tackle the 'energy poverty' that affects two billion people. This is why WEC will dedicate a special 'Energy Access' activity to this issue. To tell the truth; we no longer have a choice. The growth model we have experienced in the past, is no longer a sustainable one, simply because it is damaging our environment. Limiting growth is not an option either, as it would increase inequality.

More than ever, we must work all together to bring about a sound energy transition to 2030-2050, that is, to find a sustainable approach that reconciles economic growth, environmental protection and greater equality. We have what it takes to do this. The technologies we need are at hand.

On the demand side, solutions already exist and we must just go forward and invest on. On the supply side, there are also mature and competitive technologies available. Further out, we will need to invest to develop: Generation 4 nuclear, carbon capture and storage, more efficient photovoltaic technologies, electricity storage, and second-generation sustainable biofuels.

We have, on earth, enough natural resources to meet demand. The real issue is not so much their overall level, but their uneven distribution across nations, and the fact that ensuring security of energy supply will necessarily lead to an increase in energy prices. Indeed, in terms of oil and gas, it is estimated that resources will last about two more centuries, factoring in unconventional gas and oil. Nevertheless, we will have to tap in to more and more remote, difficult-to-access resources. For this, more sophisticated and costly technologies will be required.

Meanwhile, we will have to ensure that these new technologies meet with the highest safety standards. The safety issue will be addressed as a priority in our future works. In terms of coal, there are enough resources to last for another several hundred years.

In terms of nuclear, with second and third generation technologies, today's uranium resources will last for about two hundred more years. With Generation 4 technology the length of time could be extended 50 times!

Lastly, potential in hydropower, wind and solar energy is highly significant worldwide. WEC's *Survey of Energy Resources and Technology* will regularly assess the state and costs of energy resources and technologies. But other types of resources are genuinely scarce or risk becoming so: The use of fossil fuels is under pressure because of Environmental and climate concerns. Water and land use become a huge challenge. By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity. The energy-water-food nexus is an important issue that will be addressed in WEC's future work.

When looking at the global picture, we realise that it will be not easy to successfully transition towards truly sustainable growth. It will not be easy because it will be costly, since clean technologies are more expensive than conventional ones. At the same time, we must work to keep the human and social cost which economic restructuring will entail, to a minimum. It will not be easy because the transition must also be acceptable to all. If not, we will fail. We must ensure that we do not leave the most deprived members of

society by the wayside of our path to sustainable growth. Taking action to specifically help the poorest has to be a key priority in forging new public policies. These are critical issues to consider and I am confident that the Congress has contributed to raise awareness on these issues.

In sum, innovation where policies, institutions and governance are concerned will be just as important as technological innovation. Here, I would like to address a fundamental challenge for building our future. I mean governance. There are indeed two all-important factors at different levels: at a national level: energy policy, and at a worldwide level: international cooperation.

The global crisis has proved that the market alone cannot solve our problems. As I said a few days ago – and the Congress has reinforced my belief even more – the invisible hand of the market cannot address alone all our issues. Policies are needed. That said, regulatory failures also exist and it is not an easy task to define what a “right” energy policy is. Therefore, we must find a new balance between market and regulation. And, at the same time, we will have to make sure that these public policies are coherent and compatible at an international level and enable us to address our challenges.

WEC’s *Assessment of Energy and Climate Public Policies* aims to identify fundamental principles to establish sound regulatory frameworks. One is that energy players require long-term horizons. Energy industry timeframes are long-term: investments are made over periods of 3-15 years, and plants are built to last for 30-60 years. In our sector, 2030-50 is a much more relevant horizon than 2020.

Long-term policies are possible only if we keep costs in check. This will require planning the roll-out of different technologies, starting with those that are mature, while preparing others for the market. We could in fact, already organise a massive roll-out of mature technologies over the next 20 years. And, for technologies that are not yet mature, whose cost of CO₂ avoided is usually 5 to 10 times higher, the first step should be to encourage and support R&D and experimentation. Behaviours and habits will also have to change. Norms and standards will play a vital role. At the same time, energy pricing must contribute to stimulating investment, guaranteeing security of supply and promoting energy savings.

WEC will make its efforts to promote sharing of experiences on how to ensure the benefits of growth are equitably shared. Some innovations like smart grids and smart homes can be


real catalysts in changing energy behaviours, making people more aware of the value of the resources and therefore more eager to be efficient and responsible. We must take up the urbanisation challenge and turn it into an opportunity. As shown in our study on *Energy and Urban Innovation*, 2 billion new urban dwellers are expected by 2030 – the equivalent of 7 Shanghais or Jakartas, or 10 Londons each year.

It should also be possible to complement efforts made at country level through international cooperation. Here again, I am convinced that we can surmount the obstacles in our way. Take the climate, for instance. While some were disappointed by the results of the Copenhagen Summit, we should not underestimate what was achieved. Most importantly, an agreement was reached through the unprecedented mobilisation of more than 140 heads of state and government, proof that we are, now, collectively aware of the issues at stake and willing to take action. From this standpoint, Copenhagen created real global impetus.

In my view, what we have to do now is build on this momentum. And we must not use the crisis as an excuse to fall back on protectionism and isolationism. There are two areas in which much remains to be achieved.

- First, we must design sound and effective public policies to deliver the mitigation objectives adopted by more than 70 countries in their commitments.
- Second, we must develop new tools to efficiently channel public and private funds and foster, among other things, technology transfer.

The WEC study on *Rules of Energy Trade and Investment* is our effort to contribute to these debates. Sustainable growth is no longer an option, it is a necessity. While the goal is clear, finding the best path to reach it will be a challenge for all. I believe that to rise to the challenge, we will have to rely more than ever on cooperation and dialogue between all stakeholders – governments, businesses, researchers and NGOs. WEC can be a driving force in this movement.

This Congress has indeed demonstrated its capacity to catalyse ideas and put forward new visions. Bringing together representatives from all energy sectors and all countries, WEC is a formidable think tank that bases its global work on local realities. Its technical programmes and regional plans enable immediate relevant action. Its flagship studies are designed to give political and business leaders the information and insight they need to shape the future while factoring in three criteria: equality, development and climate. 



Energy trade – keeping open markets in today’s global economy

By Pascal Lamy,
Director-General, World Trade Organisation

When I addressed the 20th World Energy Congress in Rome in 2007, my principal message to participants was that more predictable and transparent trade rules in the energy field could benefit both energy producing and consuming nations. Today, I would like to take that message further. To fine-tune it in light of the report that has been recently issued by the Task Force of the World Energy Council on *Trade and Investment Rules for Energy*.

I read the report with great interest, and certainly welcome the support it expresses for the Multilateral Trading System throughout its many pages. But I also see in the report a hope that the Trading System will be able to do more for the energy sector. I thank WEC’s Task Force for making the point that the international community has yet to take a strategic approach to the rules of the Multilateral Trading System with respect to energy trade. While several portions of the WTO ‘rule-book’ so-to-speak, are relevant to energy, they remain relatively scattered, with little over-arching global policy consensus or goal.

A stronger WTO rule-book could benefit the energy sector, because just as with any sector where trade is feasible, trade restrictions are feasible too. The WTO tackles these restrictions as its daily business. So, what could be the goal then? Well first, we must recognise that what we have before us is a complex web of trade-restrictive practices by state-trading enterprises; subsidies; export restrictions of various sorts; restrictions on transit; on investment; on the movement of energy service providers; and more. The WTO rule-book addresses some of these issues, sometimes deliberately, but other times only by default.

The World Energy Council has defined its goals around three As: “Accessibility,” “Availability” and “Acceptability” of energy sources. Another way to call these issues is “long-term energy security.” Were long-term energy security to also become the defining principle of energy trade rules, what would those rules look like?

The word “long-term” would suggest to me that social and environmental goals would need to be at the heart of those rules. Today, 2 billion people do not have access to commercial energy and 1 billion only have what is termed as “periodic” or “unreliable” supply.

Clearly, the poor must see their access to energy increased. This will happen when their levels of poverty decline, so part of the answer lies in economic growth. But it will also happen if we can make energy cheaper, whilst

enhancing access, at the international level, to different energy providers.

Similarly, today the energy issue cannot be divorced from the climate crisis that our planet is facing. We need to reconcile the fact that the world will clearly need more energy, with the knowledge that our current patterns of energy use are harming our planet. The answer can only lie in greater energy efficiency, renewable sources, and improved lifestyles.

Energy security also implies that energy supply must be allowed to expand and to travel more readily from countries where there is surplus, to countries where there is demand (just as with any other natural resource). We all know, of course, that traditional sources of energy are heavily geographically concentrated. A clear element of energy security would reside in the predictability of energy supply.

A sense of certainty that supply will be sufficient and available, and will not simply be cut-off. This while striking a balance, of course, between the needs of energy exporting and energy importing countries.

A more sophisticated WTO rule-book could actually take us closer to these goals. Having said that, trade policy would still need to be couched in the midst of many other accompanying policies, in both the social and environmental spheres. For instance, it is not the rule-book of international trade that will decide “how” energy gets distributed within a country, or the ownership of natural resources. Nor is it that rule-book that will ensure that environmental regulations are put in place. The need for accompanying policies will remain.

The Doha Round of trade negotiations, behind which WEC’s Task Force has thrown its full support, could be considered a first stepping stone towards the emergence of a customised approach in the energy field. Towards greater energy trade security. It would build on existing disciplines, such as the non-discrimination principle, that forms the backbone of the WTO system as a whole.

And if successfully completed, it could open the door for a more holistic approach, possibly encompassing new issues such as competition policy. With the changing composition of the WTO’s membership, and with energy exporting countries, such as Russia and Algeria negotiating their accession, the imperatives could become stronger to address the energy sector more fully.

The Doha Round will reduce tariffs on various renewable fuels (such as ethanol and biodiesel) and the equipment involved in energy production and distribution; will improve WTO subsidy disciplines; will improve the rules for transit

under the Trade Facilitation chapter of its negotiation; will open energy services in areas such as drilling, engineering, technical testing, pipeline construction, and distribution; and will accelerate trade opening in energy-efficient and climate-friendly technologies.

The latter, as I have often said, is a low-hanging fruit. Today, the global value of the environmental goods and services industry is estimated to be around US\$800 billion, making it comparable in size to the aerospace and pharmaceutical industries. Solar panels, fuel cells, and climate consultancy services, are but a few examples of what is on the WTO negotiating table. Barriers to their trade of these technologies penalise the planet.

Through more open markets, greater competition, and the spread of clean technology, the Doha Round would help stabilise the international trade and investment landscape in the energy field. Having said that, the Doha Round will not provide an answer to issues such as export taxes. In addition, the many trade policies that are being contemplated in the climate sphere may require examination at a future date. I refer here to border measures that some countries may apply to manage carbon leakage, or offset competitive disadvantage arising from the carbon constraints imposed on production.

How permits are allocated within carbon markets, may also need to be explored. The Doha Round would only be the beginning of what the international community may need to do. Now, I would be remiss if I did not draw attention to this year's World Trade Report of the WTO, that has been devoted to natural resources. I would strongly recommend that the Congress examine the report, because of its clear relevance to energy. It is worth noting that the oil crisis of the 1970s had already placed the issue of export restrictions in the energy sector on the Tokyo Round negotiating table. But this, without success. Later, the Punta Del Este Declaration, that launched the Uruguay Round, initiated negotiations on Natural Resource-Based Products, leading to controversial and unresolved discussions on energy.

Let us remember that in the WTO, it would be neither the Secretariat, nor the Director-General, that could mandate negotiations, nor even make proposals for their initiation. This is the prerogative of WTO members, and they would need to forge the necessary consensus to set the negotiating machinery in motion. Coming back to the themes of your Congress. I note that to the three As, WEC has now also added a fourth, which stands for policy "accountability" in the

energy field. By placing international trade under that goal, the message is loud and clear. A global framework for trade in energy would bring accountability to a sector where various types of barriers remain "unaccounted" for. As the Task Force has put it: "the global economy requires concerted efforts to ensure that markets remain open to energy goods, services, investments, and movement of personnel".

A basic point that may enable WEC to convince the WTO to address energy more fully, would be to reassure its Members that in so doing, they would not be ceding sovereignty. Quite to the contrary, they would be sovereignly deciding to create a more reliable international system for trade in energy. Bringing greater law and order to this complex field could turn out to be one of the best sovereign decisions ever made. □





Accessibility and Acceptability: Striking the balance for an optimal energy future

By Khalid A. Al-Falih,
President and CEO, Saudi Aramco

The themes of this Congress go to the heart of many of the issues facing the energy sector, though I have elected to look in particular at two key challenges identified by the World Energy Council.

I would like first to look at the accessibility challenge, before turning my attention to issues of stakeholder acceptance. Then, I would like to look at the complex interplay of those two imperatives, and the ways in which we at Saudi Aramco seek to achieve a sustainable balance between them.

Allow me to begin by focusing on access to energy. It's worth remembering that today some two billion people have no access to modern forms of energy, while another two billion only enjoy limited access. Aside from the considerable human toll of energy poverty, there are also dire environmental impacts, particularly the deforestation and pollution resulting from the burning of crude forms of biomass.

Certainly none of us would begrudge the extension of greater prosperity to these disadvantaged individuals and families – and in fact hundreds of millions have in recent decades enjoyed prosperity that was once unimaginable, but which has been enabled by modern energy. However, these more affluent and more energy-intensive lifestyles mean global demand for energy will expand steadily, and when you consider that our planet's population is set to grow by roughly yet another two billion people by the middle of this century, it's clear that demographics will also contribute significantly to the expansion of renewables and nuclear power, although when it comes to nuclear, there are lingering concerns regarding plant safety and the safe disposal of spent fuel.

That means that even as we pursue promising new alternatives – as we should – we must continue to invest in efforts to both increase access to hydrocarbons and improve their performance, given their predominant role in the foreseeable future. This brings me to the issue of acceptability, and what I consider to be our industry's 'public permit' to operate as petroleum enterprises. Let me first look at environmental considerations. From my perspective, there are significant opportunities to make petroleum more environmentally friendly, including cleaner burning fuel formulations, carbon capture and sequestration, and a host of other advanced technologies that are still in their infancy – and I believe it is incumbent on our industry to do its utmost to realise those enhancements.

I would also stress that simply by concentrating on more efficient vehicles, equipment and plants, the world can reduce significantly its emissions of carbon as well as conventional pollutants. In addition, this approach offers a win-win solution,

as it not only reduces emissions but also cuts costs and conserves energy – or viewed another way, enhanced energy efficiency is yet another way of providing increased access to energy which is already being produced but otherwise would be wasted. But we should not single out the transportation sector as the only venue for substantial action on greenhouse gas emissions. In fact, a McKinsey study entitled *Pathways to a Low-Carbon Economy* analysed the significance and cost of various methods of abating greenhouse gas emissions, and concluded that the most substantive prospects exist in power, forestry, various industries, agriculture, buildings, and then transport, in that order.

In my view, simply directing more natural gas supplies to the power generation sector could substantially reduce carbon emissions, given that gas emits less than half the carbon of an equivalent unit of power derived from coal. These conclusions make clear the need to examine the whole spectrum of energy use when it comes to environmental protection and preservation. However, I view the issue of acceptability as transcending environmental considerations, and encompassing the safety, dependability and affordability of energy supplies. All of these help to ensure reliability, which in turn helps to ensure responsibility – a connection made clear by this year's tragedy in the Gulf of Mexico and its lingering aftermath.

The petroleum industry's safety record is better than the images of the last several months would lead the public to believe, and today it is more capable, the technological tools at its disposal are more sophisticated, and the petroleum supply chain is more robust than at any point in the oil industry's long history. But it would defy both logic and experience if any of us claimed that a similar incident could never happen again. For that reason, we need to understand how such incidents could be prevented, and how their serious human, environmental and economic consequences could be better mitigated.

We may also need to look again at the possible impacts of other massively cataclysmic events that – like the incident in the Gulf – once seemed unimaginable. Other sectors – such as commercial aviation, space exploration, nuclear power, chemicals, and pharmaceuticals – have faced similar catastrophes, and emerged stronger and more capable as a result of absorbing the right lessons from such disasters. I believe our industry now has a similar opportunity for learning and growth. If nothing else, this incident reminds us of a few basic truths: first, we operate in an inherently risky business, and oil producers undertake a tremendous amount of liability as a result; second, ours is a technically demanding business that

requires a high degree of collaboration across a wide range of institutions and disciplines; and third, operational excellence, including the maintenance of health, safety and environmental standards on the job, is indispensable not only to corporate efficiency and productivity, but also to public acceptance.

Tragedies such as this also underscore the need for senior management to clearly set priorities, and to ensure that the drive for profitability and shareholder value does not undermine a strong culture of operational excellence, environmental stewardship, and safety. Just as it is irresponsible to tackle issues related to energy supply without assessing their potential safety risks or impact on the natural environment, we must also evaluate the viability and ultimate benefits of environmental protection measures in light of the increasing global need for energy.

Balancing access and acceptability is something we have taken to heart at Saudi Aramco. In terms of enhancing access to energy, our oil reserves of about 260 billion barrels represent roughly a fifth of the world's proven reserves, and at our current production rate, these reserves are enough for more than 80 years of production. Yet we expect that over time those reserves will grow by an additional 40 per cent, and are working to raise the rate of recovery from our major oil fields to 70 per cent, or twice the worldwide average.

On the gas side, our existing proven gas reserves of 276 trillion cubic feet are the 5th largest in the world, and growing. In fact, over the last five years we've added more than 45 trillion cubic feet of gas to our reserve base, even as our natural gas production increased. Furthermore, our future gas exploration programs target growing those reserves from deep offshore, sour gas, shale gas and tight gas reservoirs in addition to conventional onshore gas. All of those efforts ensure that we will continue to provide vital petroleum energy to the world for generations to come.

In terms of providing oil to the market today, and in keeping with the Kingdom's policy, we maintain large surplus production capacity at considerable cost to us. This surplus capacity, which currently approaches four million barrels per day, has helped assure market stability, providing additional supplies whenever unforeseen events such as natural disasters or man-made strife and conflicts have struck. Furthermore, we are making large investments in expanding our refining capacity, and are also integrating world-class petrochemical facilities with some of our major refineries.

At Saudi Aramco we are also heavily engaged in addressing acceptability issues, including environmental stewardship. To

that end, we have been steadily boosting our environmental investments, and capital funding for our Environmental Master Plan has risen to nearly five billion dollars today.

As part of this plan, we are concentrating on producing cleaner fuels from our refineries, and enhancing the protection of our land, air and water resources – aside from our research into cleaner fuels and advanced engines, the reinjection of well cuttings, and gas flare recovery. We're also devoting hundreds of millions of dollars to a CO₂-enhanced oil recovery demonstration project, which boosts oil production by injecting into the reservoir CO₂ that otherwise would have been emitted into the atmosphere.

Thus the technology not only protects the environment through carbon capture, but also boosts access to energy by enhancing ultimate recovery rates from oil reservoirs. These are the kind of win-win solutions we like to pursue, and which will enhance our industry's ability to supply energy to future generations, reliably and responsibly. In addition, we have placed operational excellence at the top of our corporate agenda, and although we are very proud of our safety record, we are determined to make Saudi Aramco the global leader in industrial safety.

That longstanding commitment to performance, coupled with our massive infrastructure and technology investments and our surplus production capacity, helps address issues of acceptability in the holistic framework I outlined earlier – including the stability of global petroleum markets and a range of concerns related to energy security perceptions.

In conclusion the best way to achieve a truly sustainable balance between accessibility and acceptability in all their complexity is to engage in a frank and constructive dialogue among all stakeholders. Only by working together can we better understand the complex issues in play; trace the alternative energy paths the world has available for the future; assess the real potential of these alternatives over time; concurrently examine both environmental and economic imperatives; and finally, recognize the various interests at stake in both the developing and developed worlds.

The World Energy Council plays a vital role in furthering that dialogue, and I applaud its continued efforts to bring energy issues to the forefront of the public agenda worldwide. At the end of the day, we must each act decisively in the short term while also considering the long-term implications of those actions, and do our level best to attain an optimal balance between access and acceptance which achieves the best possible results for the greatest number of people. □



Meeting energy demand: A global challenge requires global solutions

By Peter Voser,
Chief Executive Officer, Royal Dutch Shell plc

The natural gas revolution is changing the energy landscape. In a world of surging energy demand, we will need to mobilise the world's entire mix of energy sources unless we want to risk condemning billions of people to energy poverty.

In that mix, natural gas, as the cleanest burning fossil fuel, will play a prominent role in the decades to come. When it comes to natural gas supplies, a revolution is under way. This natural gas supply revolution has increased energy security for North America. And it has the potential to alter the energy landscape for the world as a whole. It depends just as much on the market forces and government policies that will shape the demand for natural gas. To see where the world is headed, let me take you through the following three themes: I'll talk about the supply boom itself because I think a lot of people still haven't grasped its full scale and impact, I'll discuss the main drivers for gas demand in China, the Middle East, Europe and North America, and I'll review the potential of natural gas as a source of clean, affordable electricity.

The supply revolution

The natural gas supply revolution itself rests on two innovation pillars: firstly, improvements in production technologies that have made it economical to produce shale gas and tight gas resources that were previously considered too difficult to tap. Worldwide, there's now enough technically recoverable gas in the ground for 250 years at current production rates. The other pillar is the diversification and globalisation of natural gas markets, driven by liquefied natural gas, or LNG, and to a lesser extent gas-to-liquids technology.

The facts speak for themselves: only a few years ago, the assumption was that North America's gas production would decline. Today, instead of declining, production has increased dramatically. So has the total resource base, which is now big enough to cover North America's current gas consumption for well over a century. The echo of this supply revolution is heard far beyond North American shores: it has freed up liquefied natural gas supplies for other markets. It has also inspired other nations to search for new gas resources.

Which brings me to the second pillar of the supply revolution: the technologies that have allowed us to grow and diversify the market for natural gas, in particular liquefied natural gas. As we have seen, North America will not have a structural need for LNG anytime soon; that doesn't leave out the possibility for cargoes of opportunity. But in other key markets, even the

most optimistic supply scenarios still leave considerable room for LNG to fill. Consider western Europe, where production of tight and shale gas and coalbed methane will not take off before 2020. Meanwhile, conventional gas production is in steady decline. To fill this gap, more gas imports will be necessary, much of which will take the form of LNG. LNG's unique flexibility allows it to follow demand as it shifts around the world. This enhances global energy security.

Traditional markets in Europe and Asia will be joined by China and a host of new countries like Thailand, Singapore and Pakistan. And who would have thought that one of the very first cargoes from Sakhalin II in eastern Russia would have gone to Kuwait last year? It's been more than 40 years since Shell technology helped start up the world's first liquefied natural gas exporting plant in Algeria.

The growth of LNG and the shale and tight gas boom are two mutually reinforcing developments; they both enhance long-term gas supply security. Both developments should give governments and investors greater confidence to support natural gas for the long term.

A brief word on gas-to-liquids, or GTL, not to be confused with liquefied natural gas. In Qatar, we are nearing completion of our massive Pearl gas-to-liquids plant. Gas-to-liquids technology enables us to convert natural gas into products you'd normally expect us to derive from oil. For instance, we're already preparing to sell a new GTL kerosene blend to the aviation industry for commercial aircraft. Pearl GTL will produce enough gas-to-liquids fuel to fill over 160,000 cars a day and enough base oils each year to make lubricants for more than 225 million cars.

GTL is one way for natural gas to play a role in the transport sector. Compressed natural gas, as a transport fuel for light passenger vehicles, is another. As for liquefied natural gas, it is possible to imagine a future in which it helps to power ships and heavy road transport. Another option is for natural gas to be a key source of electricity for the world's growing fleet of hybrid electric vehicles, such as the Chevrolet Volt that's about to be introduced in Detroit. And we could talk about natural gas as a feedstock for chemicals and hydrogen, but that would require another article. The key message is this: the supply picture has seen a spectacular improvement in recent years. There's plenty of gas in the ground. And we have learned to create value from natural gas in many different ways.

A key question is whether the world's appetite for natural gas will keep pace with supplies. At a global level the answer

is yes because of economic growth in emerging markets. Today's annual demand is 3.1 trillion cubic metres – or 110 trillion cubic feet. At Shell, our view is that global gas demand could rise by one-quarter by 2020, and by almost 50 per cent by 2030. That would represent double the growth of oil during the same period in the IEA's reference case. In the emerging economies, continued economic growth will push up gas demand across all sectors. In China, the government wants to more than double the share of natural gas in the country's energy mix to around the 8-10 per cent mark by 2020. Now that's a very powerful driver! As a result, in ten years' time, China's annual gas demand could reach a level comparable to half the current gas demand of the USA.

In the OECD markets, the growth of gas will depend primarily on the power sector. Which brings me to the third and final part of this article: how to make sure that natural gas can live up to its potential as the cheaper source of clean electricity. The supply will be there, provided there's a market. The environmental credentials are also strong: modern gas plants emit between 50-70 per cent less CO₂ than coal plants. New gas-fired power plants can be installed much more quickly and at much lower capital cost than it would take to build new capacity for coal, nuclear or onshore wind, not to mention offshore wind and solar.

As a result, for most countries natural gas offers the fastest, lowest-cost and easiest way to reduce carbon emissions in the coming years. The story can be even better. On both sides of the Atlantic, the average utilisation rate of existing gas-fired power plants has been at around 40 per cent. This means that we can push more gas into the power system and reduce emissions essentially by making better use of what we already have. A report by the USA's Congressional Research Service makes the case. In the USA, coal-fired power currently accounts for 80 per cent of CO₂ emissions from the power sector, and for around one third of the country's total emissions. If the USA would double the utilisation rate of its existing natural gas turbines to around 80 per cent, it would displace nearly one-fifth of the CO₂ emissions from coal-fired power plants – at little or no additional cost. Last year, the USA's power sector already saw significant coal-to-gas displacement. And it's expected to continue this year.

As for Europe, over the past few quarters, gas has seen more of an advantage over coal in the dispatch merit order, with coal even taking on the role of 'peaking' fuel on some occasions. In the coming years, many coal plants will have

to close down, in America and Europe, as well as in China. And these will have to be replaced by new plants. So there's more room for gas to grow. Once we have exploited the coal displacement potential, additional measures will be necessary to drive carbon emissions further down to the required level.


We will have to fit the newer, larger coal plants with carbon capture and storage technology, or CCS. Clearly, natural gas has many benefits that make it a highly competitive source of clean electricity. However, for natural gas to realise its full potential as the cheaper source of clean electricity, we need government policies that reflect these benefits.

Governments and regulators possess numerous policy instruments to help forge a clean electricity coalition between natural gas, renewables, nuclear and carbon capture and storage technology. The most important contribution would be to develop carbon markets that deliver robust carbon prices and stimulate investment in low carbon technologies. Within those markets, there are numerous ways to strengthen the price if necessary: you can reduce the number of emission allowances, or introduce a minimum price.

Separate and in parallel to the policy routes, governments could provide targeted support for new energy technologies while they are still in their demonstration phase. I'm thinking in particular of carbon capture and storage. That's because CCS projects of themselves don't bring in revenues. We need to advance CCS fast, to allow it to realise its full potential in tackling CO₂ emissions in the next decade. For that reason, governments need to maintain momentum and commit financial support to demonstration projects.

At Shell, we realise that our customers want a secure, affordable, and sustainable energy future. At Shell, our people embrace that future. And they work very hard to make it happen.

Some of the cleaner energy solutions will only be available tomorrow. Other solutions are available to us today. Natural gas is the most obvious one. We know how to produce, transport and use gas safely, responsibly and at affordable cost. In recent years, we have seen a spectacular improvement in the global gas supply outlook.

And in the power sector, natural gas provides the fastest, easiest and most affordable route to cleaner electricity. We should think of natural gas as a vital ally in the search for a sustainable energy future. If we create space for natural gas to grow, natural gas will change the world's energy landscape – and change it for the better 



What is the right energy mix for long-term stability?

By Gregory H. Boyce,
Chairman and CEO, Peabody Energy

I am honoured to be among members of this Congress who are creating solutions to advance the human condition. The face of energy poverty is stark and all too human. Today, I call on all of us to leave the comfort of our offices and living rooms and enter the villages of Sub-Saharan Africa, Asia and elsewhere where families seek electricity for the most basic needs: clean water, warmth, light.

I submit that the greatest crisis we confront in the 21st century is not an environmental crisis predicted by computer models but a human crisis fully within our power to solve. For too long, too many have been focused on the wrong end game. So I begin with this challenge: to carry with you the commitment that you will do all you can to endeavour to eliminate global energy poverty and energy inequality by 2050. For every person or agency who has voiced a 2050 greenhouse gas goal we need 10 people and policy bodies working toward the goal of broad energy access to reduce global poverty. Study after study – and pure common sense – tell us that access to electricity helps people live longer and better. Yet each year, we lose more than 1.5 million people to the effects of energy poverty. We can no longer turn our heads from these brutal statistics. So we as a world need to reset our priorities:

- Eliminating energy poverty **must** be job one.
- The goal: Electricity access for all by 2050.
- We also must advance all energy forms for long-term access. Coal is the only baseload fuel with the scale, abundance, reliability and cost profile to make this goal a reality.
- Using more coal, more cleanly, requires deployment of advanced coal technologies on a path to near-zero emissions.

There is no sustainability with energy poverty, with energy inequality or with lack of adequate energy access. So, as we debate the right energy mix for long-term stability, I will share with you The Peabody Plan to advance our shared energy, economic and environmental goals.

Eliminating energy poverty is the first priority

Simply put, we must put people first. This is the first value. World leaders noted this at the Copenhagen Summit last year. They reached the right conclusion agreeing that social and economic development and poverty eradication are the first and overriding priorities of developing countries. I would observe that social and economic development is also the task of leaders in so-called developed nations.

Global energy access

I am amazed by the number of goals that are carved out around

reducing carbon, but with no mention of universal energy access. The goal is clear: Global energy access by 2050. This is a greater priority with a far greater return for humanity.

Electricity enables people to live longer & better

There is a profound correlation between electrification and improvement in the UN Human Development Index. Every 10-fold increase in electricity is linked to a stunning 10-year increase in lifespans. Lifespans increase as electricity access grows, and economies increase as coal-fuelled power grows. This is the global economic miracle that is powered by coal – past, present and future. A rapid rise in the world's use of coal-fuelled electricity mirrors the global rise in GDP. From 1970 to 2010, coal use increased 353%.

When we talk about alleviating global energy poverty, there could be no greater example than China, which offers an unrivalled model for the enormous strength of coal to empower people and economies. China uses coal to power 80% of its electricity and has created energy access to hundreds of millions of citizens in recent decades. As coal-fuelled power has soared 475% since 1990 GDP has risen 375%. So electricity is life. Electricity is economic growth. And coal is electricity. Coal is the only sustainable fuel with the muscle to shoulder the primary energy needs of the world's rising populations and economies.

Global coal use expected to rise 53% by 2030

The world has trillions of tons of coal, which make up 60% of our global energy resources and we will use them all. Reserves are large and diverse, spanning nations on every major continent. About 90% of coal's 3 billion tonnes of demand growth by 2030 will come from emerging Asia. Coal-fuelled generation is expected to grow 2.5 times in China and 3.5 times in India by 2030.

Major new global build-out of coal generation under way

A major new build-out of coal generation is under way globally. Global coal-fuelled generation will nearly double by 2035. China, India, and the rest of Asia make up more than 85% of the major global build-out of new generation. If you project this growth out, you can see global demand growing by more than 1 billion tonnes every three years.

The world's strongest economies are fuelled by coal

And so, I close my thesis on why coal is needed, by pointing

out several statistics that show that coal powers the strongest economies. China uses coal to fuel approximately 80% of its electricity. Government forecasts suggest that China's GDP will climb 380% by 2030 for a projected US\$33 trillion GDP. And look at India: More than 70% of its electricity comes from coal. India's GDP growth is 290% as its economy reaches a forecast US\$11 trillion GDP.

Copenhagen: low-emission development is indispensable

We have reviewed the first priority: eliminating energy poverty and providing equal electricity access. The world also, rightly, wants continual environmental improvement. Here again, I bring your attention to the wisdom from Copenhagen, calling for a "low-emissions development strategy that is indispensable to sustainable development." I believe that technology deployment is essential to meet our environmental goals. This is the GreenGen low-carbon coal project in China.

Path to near-zero emissions

I believe there are several key benchmarks on the path to near-zero emissions. First, build advanced coal plants – super-critical and ultra-super-critical. Improved efficiencies drive CO₂ emissions that are 15 % below the average of existing plants and more than 40 % below the oldest plants being replaced. Second, demonstrate carbon capture and storage. We know the technology works: Statoil's Sleipner project in the North Sea, for example, has been storing 1 million tonnes of CO₂ annually for 15 years. After we demonstrate these technologies, we can deploy commercial-scale CCS. CCS is also essential for natural gas, which will require technology to meet any serious greenhouse gas goals. And finally: we can retrofit super-critical coal plants with CCS technologies to improve CO₂ further, just as we have done successfully for many other emissions.

Global super-critical programme would drive major re-industrialisation

There is enormous energy, environmental and economic upside to replacing older coal plants with today's advanced coal. The world has approximately 1,000 gigawatts of traditional coal-fuelled plants. Replacing these with super-critical plants would drive major global re-industrialisation and enormous reductions in carbon dioxide immediately without waiting for CCS. But all these plants would be CCS-ready when the technology is commercially deployable.

CCS is being advanced all over the world. A recent analysis by the International Energy Agency found that significant progress has been made since 2008 and that CCS is advancing toward commercialisation. As many as 80 large-scale integrated projects are at various stages of development around the world. IEA cites strong CCS momentum and calls for continued cooperation.

As China leads the world in coal use, China is also leading a green coal revolution. The GreenGen power plant and carbon research facility will be one of the world's largest coal-fuelled power projects that will be virtually emissions free. Peabody is the only non-Chinese equity partner in the project. I've visited the construction site a number of times, and can tell you that GreenGen is advancing rapidly. Phase 1 is expected on line as quickly as next summer. We need a global fleet of GreenGens as the world increases its use of coal as the green energy alternative.

Peabody is a global leader in clean coal solutions

So, to summarise the enormity of our task: the challenge is to alleviate energy poverty and inequality. The goal is electricity access for all by 2050. And the plan, which is predicated on the basic premise of unlocking the world's coal resources to advance energy security, generate economic stimulus and create environmental solutions – what we call the 'Three Es'.

The Peabody Plan calls for four action items. Number one: work to eliminate energy poverty and propel global economies by ensuring that at least half of new generation is fuelled by coal, the dominant global baseload source of power. Number two: replace the 1,000 GW of traditional coal plants with advanced coal technologies. Super-critical and ultra-super-critical plants are more efficient and the stimulus this would provide would add trillions of dollars of benefit, millions of jobs and significant emissions reductions.

Number three: develop at least 100 major CCS projects around the world that capture, store or use carbon dioxide from coal-based plants within the next ten years, which complements the IEA's goal of deploying more than 2,000 projects by mid-century. Number four: deploy significant coal-to-gas, coal-to-chemicals and coal-to-liquids projects around the world over the next 10 years. Such plants are in heavy development in China, and doing so elsewhere would reduce risky reliance on scarce oil and volatile natural gas. And finally, commercialise and deploy next generation clean coal technologies to achieve near-zero emissions. □

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