The European Investment Bank reviews its Energy Sector Lending Policy
Call for public views

Alstom’s contribution

Introductory remarks

Alstom welcomes the EIB initiative and is pleased to contribute and share views on Energy Sectors, as an experienced and large player in this field through its activities in Power Generation and Power Transmission & Distribution.

Alstom Power - Thermal & Renewable:

As the supplier of 25% of the world’s installed power generation equipment and present in 70 countries with 47,000 employees, Alstom Power possess expertise in project management; engineering procurement and construction; and component design and manufacture. This allows offering a wide range of clean power solutions tailored to individual customers’ needs, including hydropower, nuclear, geothermal and wind as well as combustion plant (coal, gas, oil and biomass) and energy management systems.

Power generation technologies and solutions are key enabler for economic and societal developments. For development to be sustainable, delivery of power services needs to be secure and have low environmental impacts. Sustainable social and economic development requires assured and affordable access to power.

ALSTOM Power Offering is derived from a deep understanding of Power Markets and our Customer needs. It is organised around 3 Levers driving our Product & Portfolio Development strategy:

- **reducing Cost of Electricity** generation over the entire life-cycle by providing Competitive Assets to Customers
- **Lowering Environmental Footprint**, to make these assets increasingly Eco-friendly, contributing to mitigating climate change, reducing their impact on health & safety and allowing Clean Generation of electricity.
- **Increasing Flexibility & Reliability**, to ensure assets can adapt to fluctuating electricity & fuel markets conditions, and will ensure Dependable Operations to generate the required electrical load at all times.

Alstom Grid:

Present in 70 countries with 19,000 employees, Alstom Grid has a long lasting experience and knowledge supported by many projects successful execution, using the different technologies that have paved the Grid history.

To-day as technologies provider ALSTOM Grid is fully engaged in the development of innovative solutions, through a continuous improvement process, of SMART Grids and large transmission interconnection using UHV and HVDC technologies addressing the following electrical power applications:

- connecting of power plants to transmission Grid, whatever is the generation type (nuclear, fossil fuel or renewable),
- designing and building transmission network substations,
- Implementing electricity infrastructure for large consumers in industry like railway, mine & metal; oil & gas,
- designing control centers for energy management and distribution management system
- developing market management systems for whole sale, retail and market participants for electricity trading
General energy and economic context

Particularly in the current economic climate, is there a trade-off between promoting a competitive and secure energy supply and one which is environmentally sustainable? Where should the balance lie and what implications does this have for energy sector investments?

The important thing is to balance the objectives of access to power, environmental impact, diversity & reliability of supply through a balanced portfolio of energy and power technologies.

To do this, governments need to:
* set policy frameworks that enable markets to deliver; and
* plan strategically for the necessary national or regional infrastructure.

Governments must also bear in mind that policy intervention may create market distortion and unintended consequences. It is important for them to be sensitive to this and try to manage it with stable, long-term, transparent policy-making.

How does investment in the energy sector contribute to growth and employment? Are investments in all energy sub-sectors equally valuable? And how does investment in the energy sector rank relative to other investments in the economy which support growth and employment?

A number of eminent organizations have addressed this, for example the World Bank¹ and OECD². In addition, the annual B20 summit (alongside the G20) has focused on this issue in recent years and Alstom has been a regular and an active contributor. The key recommendations in this year’s report were:

- Promote free trade in green goods and services;
- Achieve robust pricing of carbon;
- End and redirect inefficient fossil fuel subsidies; and
- Accelerate low-carbon innovation.

Both developed and emerging economies are setting ambitious targets for GHG emission reductions (e.g. EU -20% to -30% from 1990 in 2020; Japan -25% from 1990|N éaëâ ; Brazil -36% to -39% from business as usual; China reduce carbon intensity from -40% to -45% by 2025 from 2005 baseline). Energy and green technologies also featured strongly in many of the stimulus packages introduced across the OECD to counter the recession, for example:

- US stimulus package saw an emphasis on investment in renewables and energy transmission
- Korean "Green New Deal" saw substantial investment in physical infrastructure (e.g. Four Rivers flood alleviation project).

The particular areas of focus for each country will vary depending on their historic industrial development, geology and geography and a range of other factors. In general, however, the attraction of inward investment in low carbon innovation and technology can have important technology transfer benefits for the host community. We attach a number of case studies describing our own experience that, while anecdotal, serve to illustrate the kinds of benefits in skills, jobs and supply chain development such investments can deliver. It also highlights the extent to which investment in the energy sector can act as a more general spur to growth and employment in science and engineering through related employment, skills, training and infrastructure development. See also our comments on RDI later in this paper.

² See the OECD website for a range of analytical documents on this as well as a suite of indicators to monitor progress
It is also important to remember that energy efficiency can support green growth through:

- **Direct jobs and growth that come from investments in the energy sector**: European Wind Energy Association has found that between 2007 and 2010, the number of jobs in the wind energy sector alone grew by nearly 30%, at a time when EU unemployment rose by 9.6%. The same study* projected that the number of jobs created in wind energy could rise by over 200% over the next 10 years.

- **Increased wealth-creating potential that comes from reducing the consumption of energy in households and businesses and the share of business expenditure that has to be committed to energy costs.**

- **Deployment of interconnected Grid that participates to enlargement of electricity market and securitization of energy supply.** Interconnection of EU grid with surrounding Mediterranean grids is an example which would widened the EU states energy market accessibility.

* European Wind Energy Association, Green Growth: The Impact of wind energy on jobs and the economy, April 2012

**What impact do you consider the current economic crisis will have on the energy sector (demand, policies, supply)?**

**Carbon Price:**

The economic crisis has led to an oversupply of allowance on the EU ETS, leading to a lower than anticipated carbon price. A robust and predictable carbon price is key to drive investment in low carbon products and services to accelerate and scale up the investment required to decarbonize on a global scale (estimated by IEA as being over $3 trillion by 2050). Firming 2030 targets for CHG emission reductions would strongly contribute for giving more visibility to investors. In such frame, we note that the price per ton of CO2 used in the EIB’s economic valuation process, far above the current price on the EU CO2 market, shows the EIB’s confidence in a strong ETS which should be pursued.

**Economic cycles of Power and Grid activities being complementary but not synchronous, we propose to differentiate for this question the two sectors:**

**Power Focus:**

Economic recession, slowing growth and debt crises in the EU and US have contributed to a general slowing of growth in power demand in many countries. Despite successful stimulus packages in 2009-10 (see comments above), the policy uncertainty created by many governments in their response to subsequent debt crises has also been reflected in hesitancy to move ahead rapidly with major public investment (e.g. in the EU’s CCS pilots) or to cut back on investment. Power market suffers from reduced liquidity available from the private banking sector especially caused by Basel 3 for EU. The ongoing euro-zone crisis and fiscal cliff concerns in the US also threatened climate-related spending. In 2011 Ernst & Young3 warned that developed nations were reducing climate-related spending as a result of austerity, for example in Germany by around $2.1bn; in the US by $2bn; in Japan by $2.5bn; and in Spain by $5.1bn. The IEA4 has echoed this, warning that governments need to invest more in energy-related public R&D which has fallen by two-thirds since 1980, and especially in offshore wind, solar CSP and CCS.

At the same time, we have seen the axis of global R&D activity shift towards emerging economies:

- China has set an R&D spending target of 2.2% of GDP by 2015 (from 1.75% now, which implies 12% real growth p.a. in R&D spend); Korea aims for 4%. China is already the second most popular location for R&D among the global 500 companies after the US;

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3 “Durban dynamics: navigating for progress on climate change”, Ernst & Young, 2011

4 IEA, Energy Technology Perspectives, 2012
• Korea’s Presidential Committee on Green Growth in 2009 published a list of 27 “core green technologies” that will take an increasing share of public R&D resources, including solar cells, nuclear power, fuel cells, green cars and intelligent infrastructure;

• The Climate Group’s Clean Revolution report forecasts an increase of over 700% in private investment in India over the next decade.

This has created a risk of underinvestment, especially in the developed world that may be manifested by a loss of competitiveness and of “first mover” status in relation to emerging economies. We cover this in more detail in the RDI section below.

Grid focus:

If we take the assumption that the current economic crisis is not going to last all over the period up to 2020, we can consider 2 phases for energy policy deployment:

- Phase1: 2012 to 2016 where the economic crisis will impact negatively the investment
- Phase2: 2016 to 2020 where one could expect recovery of the economies in most of the EU states and then return to some reasonable growth that will impact more favourably the investment in energy sector

During phase1, EIB should increase priority to Energy Efficiency projects by supporting more initiatives in that direction and preparing the regulatory framework for Smart Grid solutions deployment.

In the electrical sector, energy saving would come mostly from consumers and demand side optimization rather than from transmission infrastructure itself, where losses in the network are more or less controlled. So from grid perspective, any project linked to demand optimization should be supported by EIB that should contribute to this axis of development by:

- Assisting EU states to carry out comprehensive network assessment and planning at consumers side with Energy Efficiency and de-carbonization approach by providing a better incentive policy in:
- Contributing to the development of European regulation to leverage new consumer scheme with demand side management. Massive deployment of Smart meters programs have been planned considering more the “meter to cash”, rather than the real time capabilities to serve demand side management. The necessary functionalities need to be financed
- Supporting the elaboration of Energy Storage regulation in Europe sustaining the environmental friendly generation with clear incentive schemes for investors; energy storage policy at generation level but also at network level
- By increasing support to strengthen member states network allowing better conditions for their interconnections to EU Tran-European energy network that will play a central role. Flexible AC Transmission Systems (FACTS) and Static VAR Compensation (SVC) technology can contribute to energy efficiency, at this stage.

By favouring Smart Grid approach in Energy efficiency and Reduction of GHG emission programs, the Bank will facilitate connection of renewable generation. The current level of the renewable intermittent energy has demonstrated to perform when the grid systems have the proper interconnection support and the proper policy implemented.

During phase2, low carbon energy technologies deployment will be key element to meet the 20/20/20 strategic plan. This is valid for grid related technologies that will need to be designed as to evolve towards Smart Grids. Smarter Grids will enable the integration and implementation of the following key grid evolutions:

- Regional interconnections based on HVDC or UHV technologies
- Modern Energy Management and Distribution Management Systems for domestic and regional energy trade, associated with a wide area telecommunication robust network
- Integration of large amounts of renewable sources with high penetration rates
- Mini or micro smart grid based on distributed renewable generation, able to operate as isolated power systems and to connect or disconnect from main infrastructure
EIB future policy is expected to address equally large development of renewable sources and grid infrastructure adaptation and development. This approach requests a coordinated and resourced network planning projects, for future transmission and distribution networks must be designed with the following essential objectives in mind:

- to serve the medium and long term electricity mix targets
- to meet modern reliability and robustness standards and resilience to large incident expansion
- to integrate the imperatives of GHG emissions reduction and energy efficiency targets from generation source, through the grid to the final end-user implementing a demand response optimized policy approach
- to take into account in the network planning the optimization of operation and maintenance costs with the adequate level of service of these future Smart Grids”

Renewable Energy

The Bank’s economic justification for supporting emerging renewable energy technologies, whose cost is significantly above that of conventional and mature renewable energy technologies, is that continued investments in these technologies will eventually lead to cost reductions and will ultimately be the least-cost approach to meeting the EU’s renewable energy targets. Do you agree with this approach?

Yes: the encouraging progress made by the wind energy and solar photovoltaic industries in reducing cost shows that public policies creating the right market conditions can trigger private R&D investment on the scale required, e.g. through:

- long-term, stable market frameworks supporting low carbon technology (especially carbon pricing and Feed-in Tariffs);
- removal of barriers to innovation by strengthening IPR regimes and enforcement;
- encouraging cooperation between public and private R&D;
- supporting the development and co-ordination of technology roadmaps; and
- Supporting international harmonization of technology standards

The financial risks involved in running the first full-scale projects of a new technology tend to be too high for the private sector to bear alone, especially where major infrastructure projects are involved. Targeted funding for a limited number of full-scale demonstrations, designed to leverage private sector finance can help to offset the greatest down-side risks. Offering these funds on a competitive tendering basis helps ensure that the most efficiently run projects benefit.

Is there an alternative approach to the economic justification of these technologies which you consider more appropriate? What evidence is there that the cost of emerging renewable technology is falling?

Many market analysts have published reports showing the relationship between higher deployment rates and cost reductions. See in particular: “The Past and Future Cost of Wind Energy” published by the US government and work by the IEA’s Cost of Wind Energy taskforce.


The relationship may not be straightforward, as the reports cited above find that:

- **levelized cost of energy (LCOE)** for onshore wind energy fell dramatically between 1980 and 2003 through reductions in capital cost and increases in performance;
- From 2003 to the end of the decade, capital costs increased with rising commodity prices, labour costs, and turbine upscaling;
- More recently, turbine prices have declined again and performance improvements have continued;
- Estimates of the future cost of onshore wind energy show a wide range of estimates, with a 0%–40% reduction in LCOE expected through 2030 depending on the scenario.

**What level of investment in RE do you expect in the short and medium term?**

Last November, Bloomberg New Energy Finance announced that investment in renewable energy had for the first time surpassed that in fossil fuels, attracting $187 billion compared with $157 billion for fossil fuels. Whether this remarkable progress is sustained will depend on a continued progress developing carbon pricing and support policy frameworks to inspire investment and reinforce profitability of low carbon technologies (see answers above).

**What are the barriers to investment in renewable energy outside Europe? How might these be overcome?**

In general, Policy uncertainty is a major barrier as well as a poor regulatory and investment climate in many countries, for example lacking adequate legal protections for investment including IPR. The absence of free markets can be also a barrier, hindering competition, slowing down deployment and cost reductions and preventing transparent and clear information exchange.

For the developing countries, in our opinion, the main barriers are:

- Absence of legal frameworks for PPPs & PPAs, lack of FIT, and low level of access to finance.
- Lack of skilled technicians and supply chain capacity
- Lack of absorptive capacity throughout the whole value chain as well as a lack of understanding of what technologies is needed to address specific local climate mitigation and adaptation issues. (See also comments under External and Cotonou Mandates).

For the developed countries, such as USA or Australia, we could point out that the most important issue overall is the lack of a clear and robust carbon price signal.

**Do you agree that there is significant scope for investment in renewable heating and cooling? What are the barriers to investments in this sector and how might these be overcome?**

No comment.
Energy Efficiency

What do you think are the main barriers to energy efficiency investments? What might be done to overcome these?

There is huge global potential to deliver power more efficiently through retrofits and upgrades to hydropower, nuclear, coal and gas-fired plants. For fossil-fuel plant, efficiency improvements carry the additional advantage of reducing CO2 emissions. According to the IEA each one percentage point increase in efficiency can deliver a 2-2.5 percentage point reduction in CO2 emissions. Between 2002 and 2010 our power equipment customers have reduced their emissions by around 189 million tons of CO2 per year compared to Business-as-Usual. The majority of these savings – 64% - were achieved through improvement of the efficiency for new and existing thermal power plants.

Governments can do more to incentivize supply-side energy efficiency improvements by:

- adopting policies to price CO2 (either through emission cap and trade systems or through carbon taxes) at a level sufficient to incentivize the achievement of such efficiency savings by generators;
- setting binding efficiency targets, product standards and benchmarks;
- considering additional regulatory or fiscal/financial incentives to encourage efficiency improvements for power plant and grid technologies.

In addition we consider that Governments have to improve:

- Regulatory framework in real time pricing of KWH and consumers’ information for driving new habits of consumption.
- Education’s program on energy efficiency behavior.

What role can Energy Service Companies (ESCOs) play in developing energy efficiency investments?

Smart grids and related energy management technologies offer significant efficiency benefits and can help to open up new commercial models for the provision of services, managing demand and optimizing use of generation assets in response to real-time demand.

Alstom is involved in the Pacific Northwest Smart Grid Demonstration project covering 5 US states and 60,000 consumers (Washington, Idaho, Montana, Wyoming, Oregon) from 2010-2015 to test the costs and benefits of smart grid technology. The project will:

- validate new smart grid technologies and business models;
- provide two way communication between distributed generation, storage, and demand assets and the existing grid infrastructure;
- quantify smart grid costs and benefits; and
- advance standards for interoperability (smooth integration of all elements of the electric system) and cyber security approaches.

Alstom is providing the control room system which will allow intelligent devices to negotiate with one another, their users and the energy supplier to increase efficiency and reduce overall costs. As technologies like these are brought to market they will create new commercial opportunities not only for for energy services but in a much broader range of services and logistics support, especially in major urban areas. But support, both in policy (support mechanisms for deployment of smart grids technologies, to enhance the ability to optimize power flows and reduce transmission and distribution losses), planning and finance, from public authorities will be crucial to realizing these opportunities.

In addition, Alstom believes that ESCOs have a strong role to play for retrofitting and up-grading of existing assets through OEM’s contract management, which fit with the target of developing Energy Efficiency of existing investments.
What is the potential for energy efficiency outside Europe?

There is significant potential in the US but also in the emerging economies – especially China, India, Russia and South Africa.

Faster growth in China will require faster gains in energy efficiency to meet its total energy consumption target\(^7\). There is a growing retrofit market for boiler (low NOx) and steam turbines in China – even though the fleet is relatively young. This has been driven by government requirements tightening environmental regulations on thermal power plant.

In South Africa and India, growing demand for power seems likely to continue to be met with fossil fuel plant, both new and existing. In 2006, Alstom undertook the upgrade of the six units of Arnot Power Station, a coal-fired plant owned by Eskom, increasing power output from 350 MWe to 400 MWe per unit, while at the same time improving efficiency and extending the plant’s lifetime by 20 years. This helped bring more electricity to the grid quickly, in a country where demand, driven by economic and demographic growth, had far outstripped supply.

There is also significant potential in emerging economies to deliver faster, more efficient and lower carbon growth by minimizing the loss of power through transmission and distribution systems. This will also improve the affordability of power to final consumers; enhance availability and reliability; and support flexibility and storage.

In some emerging countries, addressing the issue of technical losses in the electrical system and having a proper control of non-technical losses is a lever for energy efficiency.

Supporting investment going that direction should be given more consideration. The issue of non-technical losses has been improved a lot in most of the Latin American countries during the last 20 years. This benchmark should be replicated in some countries in Africa and other emerging economies, by similar policies and similar technologies deployment. Modern metering technologies helping solutions, already exists.

Do you consider the criteria used by the Bank to categorise projects as Energy Efficiency projects appropriate (see Annex 1)? What alternative would you propose?

Yes in principle we agree on the selected criteria’s, and want to stress out that power plant retrofit and refurbishments can achieve very significant gains in energy efficiency. Average global efficiencies of coal fired power generation are currently in the range of 30-36% with some plant attaining significantly lower levels. Best achievable efficiency rates can be as high as 46% (attainable with state of the art equipment, such as supercritical boilers). In the EU, gas turbine plants operate at an average efficiency of 52% but the best available technology is moving towards 60%.

Relative efficiencies for both fuels, however, will vary around the world, depending on average age of plant, quality of fuels, and other elements such as reserve margins and operating parameters.

The Bank might also consider strengthening its role in supporting client countries in setting a supportive policy environment to drive efficiency improvements (as described above) as an important complement to its financing activity.

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\(^7\) In its current 5 Year Plan, China has set a 16% reduction target for energy use per unit of GDP; a target limit on total energy consumption at 4m tonnes coal equivalent (20% higher than its actual consumption) and a GDP growth target at 7/7.5%
Security of supply

Is the traditional model for electricity transmission and distribution changing? What implications does this have for future investments in electricity networks?

The power industry is facing increasing operational uncertainty driven by the expanding penetration of variable energy sources. Increasing the current low percentage of power flow between EU countries through a more interconnected and integrated European grid is essential to manage on medium to long term the growing share of intermittent renewables in the generation mix. Grid operators are increasingly keen to leverage industry best practice in guiding their own wind energy integration programs and this gives them more confidence in developing their own approaches, incorporating flexible resources on the supply-side, delivery side and demand-side.

Technology also plays a vital role in this transformation. Grid operators require the highest levels of control room situational awareness to preserve reliability, especially in systems with high penetration of variable sources. The latest control room technologies can combine wind power forecasts and other information into real-time decision support systems and planning tools.

The main changes in the traditional model are:

- New schemes with distributed generation
- Change in distribution companies’ responsibilities as “real time energy balance nodes”.
- Balancing market to-day at Transmission System Operator (TSO) level will surely have to be applied at Distribution System Operator (DISCO) level

This has a number of implications for future network investment:

- A skilled workforce of technicians and operators will be necessary for wide-scale deployment & integration of variable energy resources;
- Grid reliability standards and regulatory policies at local, regional, national and international level will affect the speed with which grid systems can adapt;
- Integrating wind generation could require changes to the physical grid network, as well as changes in operational business processes and control centre IT;
- Update existing control system and market management systems to cope with demand side management and virtual power plants represented by distributed generation capacity, within a network of islanded smart micro grids that could be interconnected with main infrastructure
- Organizing service as demand side management to consumers
- Deploying Smart meters with smarter grid functionalities connection and interface to the consumers
- Achieving national or regional targets for wind or renewables will be even more challenging if the grid’s network and control room technologies do not evolve to support them.6

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6 For more information on this topic, see Lawrence E. Jones, Strategies and Decision Support Systems for Integrating Variable Energy Resources in Control Centres for Reliable Grid Operations, 2011 (prepared for the US DoE)
What is the future role of smart grids, offshore grids and energy storage solutions?

The Smart Grid is a route to optimizing generation and transmission to increase renewables penetration, minimize losses, and enhance system affordability and reliability. It can deliver a radical evolution in power markets by enabling more information to be exchanged between a greater numbers of market participants at higher speed.

It is vital that governments understand the implications for market regulation and plan ahead for efficient upgrades and support investment. Regulatory frameworks need to incentivize the relevant investments, e.g. via simpler permitting rules or cross-border allocation of costs/benefits between TSOs.

Regulation should support information-sharing, including complex interaction between system/market operators and participants. In the short term, the focus should be on supporting demonstration projects that give practical help to commercialize the technologies.

Storage and interconnection will also have important roles to play in supporting reliable and secure supply and particularly in the integration of intermittent power. Stronger market drivers are needed to support innovation in and deployment of Pump Storage Plant (PSP), especially for pilots and demonstrations of variable speed pump storage that is capable of delivering greater flexibility in the capacity delivered to the grid.

Improved interconnection between countries and regions can support great energy security and reliability. Here, governments play a strong role in long-term planning as well as supporting financing of these major infrastructure projects. High Voltage Direct Current (HVDC) lines can deliver high efficiency transmission over long distances, minimizing losses, as well as supporting trade and job-creation.

Offshore Grid and mainly multi-terminal backbones should be a key priority for the transmission network development in EU. The largest manufacturers of the sustainable technology are located in Europe: interoperability, protection & control of those new infrastructures should be a key European focus for leadership. Safety of those infra-structures should be considered upfront and regulated.

New technology in storage solution should further be supported, starting with a grid regulatory framework:

- Regulation should cover the different support to the network from real time (frequency support) to none real time, and for the different voltage levels
- Incentive schemes for the investors in the storage should be clear, for distributed storage and concentrated storage capabilities

Smart Grid will play a major role to:

- ensure safety of supply for the TSO’ and DISCO to manage the grid with intermittent generation and storage, distributed energy and “PROSUMERS” (Stakeholder playing role of consumers or producers)
- ensure that situation awareness for security of supply and threats of the pan-European network are located at EU level and country level
- enable the control and security of the new offshore backbone
- enable micro grid security and existence of islanding capacity from the main grids
- capture the benefits of Energy positive buildings
Fossil Fuel

Gas is an important bridging fuel source in the transition to a low carbon economy: to what extent and under what conditions should gas-fired generation be supported?

Gas-fired generation is a reliable source of power, flexible and capable of load-matching to support growing renewable generation. Support can be justified as follows:

- To ensure that flexible power capacity remains available to support a growing share of renewable power, for example through capacity mechanisms;
- To support efficiency improvements in existing plant that can also reduce CO2 emissions (see comments above under Energy Efficiency);
- To support the commercial roll-out of Carbon Capture and Storage (CCS) on both coal and gas plant.

What role will coal and lignite fired generation have in the EU power system in the medium term, with or without CCS, and how is this consistent with the EU’s Climate Action goals and its security of supply objectives?

The IEA estimates that by 2035, 42% of the EU’s power-related emissions will be from coal and 56% from gas. As for gas (see above), steam power plants will continue to perform a role in providing peaking capacity and back-up as more renewable power is integrated into the grid. For this reason it will be essential for:

- new coal plants to be built to the highest efficiency standards and with consideration for the use of carbon capture technology in order to avoid locking in long-term sources of CO2 emissions; and
- CCS (on coal and gas) to be brought into commercial use as soon as possible (on both newbuilt & installed base).

The IEA has said that CCS could account for up to 20% of cumulative CO2 reductions by 2050 and without it, the investment required to meet a 2 degree pathway would rise by 40% (or $2 trillion over the 40 years). This puts rapid roll-out of CCS technology on the critical path to achieving a 2 degree scenario if we are to achieve the CCS volume that IEA project for 2050.

What will be the role of local coal supplies as input for highly efficient CHPs?

No comment.

What evaluation criteria should the Bank use to assess the economic, environmental and financial viability of coal and lignite fired generation?

Coal and lignite fired power plants still retain an important global role. In many countries they represent the cheapest form of large-scale energy access for urban populations. The economic, environmental and financial viability of coal & lignite fired power plants shall be assessed in terms of how the asset is contributing to balancing the needs for affordable, secure and clean power supply.

The economic viability of coal fired power plant is mainly determined by a higher plant net efficiency to reduce fuel costs, larger plant size design to decrease capital cost per MW installed, reduced O&M cost and shorter lead time to quickly turn the investment in positive cash flow. The use of the cleanest, most efficient generation technologies of coal & lignite fired power plants either in new build or for retrofitting existing assets is the most powerful lever for increasing power production while reducing CO2 emissions. Generation efficiency increases significantly when using super critical steam cycles. For example, a super critical coal fired power plant will produce up to 16% more electric energy for the same fuel energy input when compared to a subcritical unit and yet emit around 14% less CO2. In this regard, some of the Alstom recently completed power plants set a global benchmark for coal and lignite fired power plants while proving the economic viability of the most efficient...
technologies. In Europe, the RWE’s Neurath F and G units use and build on a package of advanced optimised lignite technologies enabling a gross capacity of 1100 MW each and a net efficiency of over 43%. The RDK 8 power block being currently built by Alstom in Germany is the one of the first hard coal fired power plants in the world to run on steam to achieve a net efficiency of more than 46%.

A key further criteria or assessing the financial viability of investments in new coal and lignite-fired power plant is their readiness for a later retrofit of carbon capture and storage technologies. Power plants built today will expect a generating lifetime of around forty years. Planning ahead now to ensure these plants can be retrofitted with CCS technology avoids locking in a source of CO2 emissions over a forty-year period of time.

Related to CCS, another criteria to assess the financial viability is the additional hours of operation (capacity factor increase) that a CCS plant could envision against the same plant not equipped with CCS (defendant in particular on the priority of dispatch regulations and on the impact of CO2 price on the marginal cost).

Increasing Flexibility & Dependability is a must to ensure asset profitability and to mitigate risks associated with changing market conditions throughout the lifetime of today’s investments in coal and lignite fired generation assets. Operational flexibility (Rapid load change & high turn-down capability, quicker ramp-up and smarter control systems), but also adaptability to fuel change are key pre-requisites for a sustainable investment.

Ensuring a secure power supply requires also higher reliability, availability and maintainability of coal and lignite fired power plants to make sure that they will deliver requested power when needed and as needed. A higher reliability is also positively impacting the safety of the installation against technical failures.

Limiting the impact of coal and lignite power plants on the environment shall not be limited to reduced CO2 emissions but also include a capture of all kind of emissions such as SOx, NOx, Particulate & Mercury while minimizing the negative impact of the emissions control systems on the cost of electricity and on the required operational flexibility.

Thermal power plants are the energy sector’s most intensive users of water resources. Particularly for coal and lignite fired power plants, investment assessments shall honor design efforts related to conservation of water resources. This include a reduction of the dependency on external water resources, reduced consumption of high quality water and higher water recycling rate as well as limiting liquid and solid discharges to surrounding water sources. Such efforts are key pre-requisites for reducing the vulnerability of the asset to future natural and/or regulatory water constraints as a source for further future risks.

Furthermore, assessing environmental footprint of new coal and lignite fired power plants shall also include considerations such as land requirements which should take into account ensuring the CCS readiness of the plant.

What is the scope for the development of shale gas resources in the EU?

No comment

Do you expect the share of natural gas in EU primary energy consumption to grow further?

The IEA expects global gas demand to rise by more than 50% between 2010 and 2035, driven in part by greater accessibility of unconventional reserves e.g. shale. We would expect to see a continuing, potentially expanded role for gas in the EU, at least in the short to medium term as a source of flexible and capable of load-matching to support meeting Member States’ renewables targets.

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What would be the best approach to increase security of gas supply and reduce import dependency?

New and diversified sources of supply from outside Europe (US, FIS...) or from shale gas in Europe, in the short to medium term may help to moderate international prices and stimulate investment, though this may also spark faster growth in global gas demand, especially in non-OECD nations. Extension of interconnected Gas pipeline network would also reduce bargaining power of gas suppliers.

The best route to maintaining secure power supplies and reducing import dependency is maintaining a balanced portfolio of generation sources as well as continuing to invest in transmission and distribution, interconnection and storage.

Given the large uncertainty on future gas demand, what is the risk that investment in natural gas infrastructure may be stranded?

Gas fired generation is a reliable source of power, flexible and capable of load matching to support growing renewable generation. Capacity mechanisms that support dependable, flexible power capacity can help ensure that such plant remains available.

In addition, the investment risk in new gas plant can be mitigated if it is built:

- To highest efficiency levels;
- Is capable of incorporating carbon capture technology; and
- To support the development and deployment of CCS to ensure that thermal plant can operate with minimal emissions at the lowest possible marginal cost in particular when carbon price will ramp-up.

Nuclear

What role do you expect nuclear power to play in the European energy market?

Nuclear power is a source of reliable, zero-carbon generation; it is an ideal partner to intermittent renewable power – together they form a zero-carbon generation base. Modern reactors have much more flexible load-following capability especially between 50% and 100% loading. This gives them the potential to add capacity roughly equal to an entire CCGT within the space of 5 minutes.

CO2 pricing can help to improve the economics of investment in nuclear power, but additional policies and/or support will be necessary to support high CapEx costs of plant (e.g. capacity mechanisms, loan guarantees or clean power portfolio standards).

We also see a continuing need for public and private R&D support for nuclear technologies, especially for the development of Small Modular Reactors as is being done by the US DoE.

As nuclear power stations are ageing, should their life be extended (where possible) or should they be replaced with other generation sources?

For the reasons mentioned above, governments may consider that extending the lifetime of existing nuclear plant is justified both on the grounds of maintaining levels of low carbon generation capacity and to maintain secure power supplies. Safety and security should be at the forefront of any assessment of lifetime extension but it is also important to note that, like thermal and hydropower plant, nuclear plant can also benefit from the efficiency gains associated with plant refurbishment (see Energy Efficiency section above).
What will be the impact on electricity generation and climate action of the reconsideration of nuclear policies within EU member states, in particular after the Fukushima accident?

The IEA expects nuclear output to rise by over 70% by 2035\(^\text{10}\); if only half this rate were achieved it would make it harder and more expensive to combat climate change and maintain energy security.

It is right that EU Member States and other governments around the world have responded to the Fukushima accident with reviews of the safety systems and vulnerability at existing plants. This will be particularly important in regions of the world where the effects of climate change are already being felt in the increasing incidence of extreme weather events and threats such as rising sea levels, tidal surge, drought or flood.

It is important to bear in mind the exceptionally long time-scales associated with the lifecycle of nuclear power plants. This makes the long-term clarity of regulation particularly important for nuclear power, not only for safety and security but also for management of long-term liabilities and decommissioning.

RDI

Which are the key innovative energy technologies under development? The development of which key innovative low-carbon energy technologies should receive most financial support?

It will be important to maintain support for not-yet-commercial renewable technologies, especially offshore wind power, tidal and wave power and solar CSP. But two emerging technologies have the potential to be truly transformational: CCS and smart grid technology. Support for these technologies should be prioritized.

CCS

Under the IEA’s 450ppm scenario, CCS accounts for 18% of global emissions savings, but delaying action by 10 years (deploying widely only after 2030) would increase the cost of that scenario by $1.14 trillion (8%)\(^\text{11}\). The longer deployment is delayed, the higher the risk that we will “lock-in” sources of carbon dioxide emissions for decades to come, especially in developing countries. CCS is the only technology capable of mitigating emissions from a range of industrial processes (e.g. manufacture of cement, iron and steel or oil refining). When combined with biomass generation, it is the only technology presently capable of delivering negative emissions performance – i.e. it removes CO2 from the atmosphere.

The technology has already made important advances, supported by industry R&D. Last year, Alstom published a study on the costs of CCS\(^\text{12}\) that found that:

- For hard coal (PCC), the cost of electricity generated was €73/MWhr in 2030, or 45% more than the same plant without CCS;
- For gas, the cost of electricity generated was €55/MWhr in 2030, or 30% more than the same plant without CCS;
- Marginal costs could be in the benefits of fossil plants equipped with CCS when carbon price will ramp-up on medium term, especially with low cost fuel;
- An energy penalty of 15-16 % (coal and gas) is a realistic target for 2030; and

\(^{10}\) IEA, World Energy Outlook (2011)

\(^{11}\) Ibid.

\(^{12}\) Alstom Future Dialogue: Cost assessment of fossil power plants equipped with CCS under typical scenarios, 2011 (presented at PowerGen Europe Conference, 7 June 2011)
• CCS on gas and coal is already cost competitive with wind, nuclear and large hydro plant, before it has achieved the cost reductions that will come from learning effects.

For these reasons we believe it is vital that governments:

• make faster progress in rolling out CCS demonstrations, deploying the funds already pledged;
• develop supportive policy frameworks and provide capital funding support as well as ongoing support through feed-in tariffs or similar measures.

Smart grid

Smart grids are an essential enabler to maximize the use of renewable power and achieve effective demand management. When applied together with smart generation, electricity interconnectors, back-up capacity, storage options and demand side response, smart grids can open up new possibilities in managing power supply and demand. Key benefits include:

• Managing intermittency, connection in remote areas, and connection of smaller generation sources;
• Greater flexibility in balancing electricity demand and supply – maximizing efficiency in dispatching generation, and minimizing network losses;
• Providing intelligent data/information flows to end-users and those operating the different elements of the network; and
• Lower CO2 emissions by supporting a growing proportion of renewable generation and maximizing efficiency.

The technologies exist today but need stronger regulatory and institutional drivers to reach wide-scale deployment. In particular:

• Effective planning by governments and grid operators to create the vision and help define the technologies and investment needed; and
• Funding for pilots and demonstration projects that give practical help to commercialize the technologies.
• supporting RDI programs to lower cost of Power electronics to achieve application in lower voltage for Direct Current applications at Distribution level
• Supporting eco-design RDI programs like to find, in the mid-term, substitute solution to SF6 in gas insulated switchgear.

Which barrier(s) are hindering the deployment of innovative, low-carbon energy technologies most significantly?

The most significant barriers are:

• Current persistent low carbon prices, mainly as a result of oversupply and uncertainty in the market;
• “Indicative” and not “firm” target fixed beyond 2020 (e.g.2030) for GHG emission reduction
• Policy uncertainty generated by the unexpected withdrawal or reduction of support measures such as Feed-in Tariffs (which make it harder to access commercial bank finance);
• Delays in implementing already announced policies or support programs (such as the EU’s CCS demonstration program);
• Difficulties in accessing finance from financial markets and commercial banks;
• Limited experience in deployment of new (especially renewables) technologies in some EU markets.
How can we stimulate new energy innovations?

Supportive and stable policy frameworks and the development of open markets, supported by legal frameworks to encourage competition and innovation (by protecting intellectual property) will be key to attracting investment. Stimulation needs to be delivered throughout the whole innovation chain, from:

- **Invention** - funding support for basic research in universities and encouragement of international collaboration;
- **Collaboration** - encouraging collaboration between research organizations and the private sector to take inventions out of the lab and turn them into products and services;
- **Pre-commercialization** – supporting pilot and demonstration projects to bring promising technologies to commercial scale and supporting “pathfinder” projects that help to kick-start the use of newer technologies for the first time in particular markets. **One of our suggestions would be to make available loans for pilot projects, based on all eligibility criteria’s used by EIB, which would be reimbursed in case of further successful commercial deployment.**
- **Competition** - Supporting competition in product innovation, especially through protection of IPR, and developing regulatory frameworks to drive product development and lower costs.

Looking to the longer term, support for education in maths, science and engineering in schools and universities is essential for the future R&D breakthroughs and skilled technicians that will be needed to develop and deploy future innovation.

Should financial support be spread across a large number of small research projects or be selective and concentrated on a few promising large research projects?

Larger-scale projects that can help deliver transformational technologies can be a more effective use of funds than support for smaller scale projects that may risk crowding-out commercial finance and funding e.g. from Venture Capital. For the larger-scale projects, risk-sharing between public and private sector will be essential to moving technologies out of the “valley of death” and into broader deployment.

More effective use could be made of EU funding by taking a more strategic approach to combining them or drawing on a range of different sources to supplement them. EIB could play a valuable role in helping clients access and maximize the effect of the funds.

**EIB external and Cotonou mandates**

In a developing market context, where should the balance lie between meeting local energy needs at least cost and reducing global greenhouse gas emissions – the trade-off between affordable energy for all and sustainable energy for all?

At COP17 in Durban last year, Alstom hosted a roundtable discussion with representatives from government, business, finance and NGOs to discuss ways of supporting investment in clean power sources in developing countries. The report from that meeting is attached as an annex to this response. One of the key conclusions was that it was important to plan ahead for a balanced of both on- and off-grid power. Large-scale grid connected plant can make a greater impact on energy access, so it is important that smaller, off-grid solutions are built with consideration of future expansion and connection to the grid.

The absence of power markets in developing countries has held back the installation of large-scale power generation which in turn has restricted economic growth. Support to build markets will help to attract investment in essential infrastructure as well as boosting local supply chains, training and sourcing. Carbon markets – especially the Clean Development Mechanism – offer real promise as a conduit of finance and technology and we support the work of the World Bank through its Partnership for Market Readiness in building institutional capacity in developing countries.
The development of Nationally Appropriate Mitigation Activities (NAMAs) offers an opportunity for developing countries to plan their power portfolio and infrastructure needs, and signal them to markets. These should also address the need for:

- balancing centralized and decentralized power;
- planning for development of transmission and distribution infrastructure;
- balancing of a diverse range of primary fuel and technology types;
- adoption of today’s cleanest available technologies (which may include highest efficiency thermal power plant); and
- Support for public-private risk sharing for transformational pilots or pathfinder projects that could help developing countries “leapfrog” older ways of producing, managing and delivering power (e.g. smart grid technology or CCS).

What should be the role of the EIB in promoting new technology and helping to transfer existing technologies to new markets?

Risk management is the most important issue to address, especially policy or regulatory risk or the many issues presented by the lack of institutional and financial capacity in developing countries. EIB (as well as other IFIs) can help by:

- Assisting governments in planning for major infrastructure and helping them assess the potential of newer or transformational technologies and build effective partnerships to finance and deliver them;
- Supporting the development of strong policy and legal frameworks to incentivize investment and provide the necessary legal protection and institutional capacity building (e.g. supporting “one-stop-shops” for permitting, standardizing processes);
- Supporting industrial development by funding projects with potential to enhance local construction, manufacturing, supply chains, especially those that may also have R&D elements;
- Supporting capacity building in local and regional financial services in developing countries: to enhance finance flows; improve the availability of local finance (reducing currency risk); and support local industrial development (e.g. improving access to finance for supply chain partners); and
- Financially supporting projects and PPPs, by partnering with IFC & MIGA and co-financing with other IFIs, to catalyze investment from other sources, including the private sector.
- Joining specific plan launched by other IFI, such as the Global Development Plan initiate by WB, which propose a facility to cover the up-stream risks for geothermal drilling, one of the main barrier to develop geothermal projects in developing countries.

Cost is directly linked to risk, so measures that reduce risk will also help to lower cost, and especially those that target the cost of debt, through delayed payment of principals or lower interest rates. Effective leverage mechanisms include: loan guarantees, risk-sharing, early stage pump priming grants, and blending or bundling of finance mechanisms (e.g. micro-finance + carbon finance + MDB seed-funding). Greater use of these, as well as development of new financial mechanisms to provide similar support could be highly effective.

In addition training is another key for promoting new technologies; either:

- by funding cooperation plan with local engineering, universities and Utilities training centers on a regional basis rather than national or,
- by financing coaching programs and university skills set up
Where can sources of low-cost finance be more effectively used by the private sector to develop energy projects?

The IEA\(^\text{13}\) has forecast that even by 2030 there may still be around 1.3 billion people without access to power and that the majority of them (perhaps 700 million) will live in sub-Saharan Africa; despite expected improvements in South Asia, there around 500 million may still live without power. ODA alone cannot address this. There is an urgent need to share risk between public and private investors to support the physical and market infrastructure needed to supply power.

In Africa, hydropower potential remains severely under-utilised. The WEC\(^\text{14}\) has estimated potential to exceed 1,800 TWh and to be located principally in Republic of Congo, Ethiopia and Cameroon. Alstom has been active in building hydropower in Africa for many years and we attach as an annex to this response a short case study describing our activities installing hydropower plant on the Nile.

We also see considerable potential to develop wind power in North Africa, especially Morocco, Egypt, Tunisia, Libya, Algeria and Jordan. We welcome the recent decision of the EBRD to start lending to Morocco, Egypt and Tunisia.

South Africa is also struggling with providing energy access and here, support for the refurbishment and life extension of existing plant can help. Alstom’s project at the Arnot power station is mentioned earlier in this response but a key driver for the project was satisfying power demand. Though the 2GW plant had passed its 30-year design life, the upgrade delivered an additional 50 MW from each of its 6 generating units through a mixture of efficiency measures (15 MW) and capacity increase (35 MW). The upgrade also reduced NOx emissions and extended the lifetime of the plant by 20 years.

As well as supporting the development of more large-scale power sources in Africa, it will be vital to ensure that adequate investment in transmission, distribution and interconnection is delivered to ensure that the power reaches those who need it. This will mean support not only for building the physical infrastructure itself but also for the developing of regional power markets to ensure that those countries endowed with the best natural resources can supply their neighbours.

With regards to Grid, the sources of low cost finance should address, too, the development of smart micro-grid dedicated first to operate as islanded autonomous network supplying an economic activity (commercial, industrial plant, hospitals, etc…) with renewable generation. This micro grid could evolve, in a second step, to be connected to main grid infrastructure to get benefit from base load and to be also a market participant when selling surplus of energy to main grid operator, through a demand/response side management.

South East Asia will also be an important location, facing combined challenges of an increasingly urgent need to deliver energy access, but also a need to develop clean power sources to address climate mitigation and also be resilient to withstand the growing need for adaptation and climate resilience measures.

\(^{13}\)IEA, Energy for all: financing access for the poor, (special supplement to World Energy Outlook, 2011)

What are the main barriers to developing sustainable energy sources in developing markets?

Political and capacity risks are a particular feature of many developing countries and can be difficult to manage because they are hard to forecast and price. These risks may include: policy or regulatory change, inconsistency of regulation or enforcement, nationalization, confiscation or expropriation of assets, or lack of IPR protection. They are especially problematic because of the mismatch between the long-term nature of sustainable energy investment (typically over decades) and the shorter-term lifetime of policy and regulation and/or electoral cycles.

The absence of free markets can also be a barrier, especially where fragmented markets make it difficult for project developers to recover costs through a consumer base and where the lack of markets contributes to a lack of commercially-relevant information.

The lack of absorptive capacity can be an issue too, affecting major public institutions (government, regulators etc), financial institutions (local lenders that maybe crucial financing intermediaries) and the availability of local skilled and trained workers and supply chain partners.

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About Alstom

Alstom is a global leader in the world of power generation, power transmission and rail infrastructure and sets the benchmark for innovative and environmentally friendly technologies. Alstom builds the fastest train and the highest capacity automated metro in the world, provides turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal and wind, and it offers a wide range of solutions for power transmission, with a focus on smart grids.

Alstom maintain relationships with many of the world’s top universities, including MIT (US), ETH (Switzerland), Imperial College (UK), HUST and Tsinghua (China), Wits (S Africa) and Indian institutes of technology. We offer funding support and the chance to participate in industrially relevant research with a major international market leader; in exchange we benefit from our own participation in world-class R&D and the opportunity to recruit high caliber graduates in key locations.

Since 2007, the Alstom Foundation has supported more than 40 humanitarian initiatives including: well construction in Afghanistan; bamboo plantations in Indonesia; installation of solar panels for a Haitian clinic; and well construction and tree planting in Mali’s Dogon lands. Projects are conducted in close partnership with a local institution, organization or NGO, as well as with international associations.

The Group employs 92,000 people in around 100 countries. In 2011/12, it had sales of €20 billion and booked close to €22 billion in orders, whilst investing €780 million R&D and €521 million in capital investment to strengthen our presence in emerging markets and modernize production facilities.

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Annexes

1. Technology Transfer: Alstom Global Hydropower Technology Centre, Vadodara, India.


4. Technology Transfer: carbon neutral lean manufacturing and R&D in Tianjin, China.

5. Technology Transfer: Alstom’s investments in education and skills in South Africa.

1. **Technology Transfer: Alstom Global Hydropower Technology Centre, Vadodara**

**Gujarat and Vadodara**

With almost 5% of India’s total population, strong transport links and growing investment from major power, chemical and textile companies, Gujarat state is one of the strongest drivers of growth in the Indian economy. And within Gujarat, the power sector is one of the main sources of growth.

India’s 2003 Electricity Act restructured the industry, gave states the power to set their own electricity tariffs and required them to set renewable portfolio standards. The National Government also implemented measures to support renewable power, including fiscal incentives such as tax exemptions. India’s Eleventh Five Year Plan (2007-2012) targeted capacity additions of almost 80GW, of which nearly 20% was to be hydropower.

**Alstom’s investment**

In 2004, Alstom’s Chairman & CEO, Patrick Kron, visited India for meetings with government ministers and as a result decided to enhance operations in the country. Among other actions the company upgraded its factory in Vadodara to become one of its global engineering and manufacturing centers for hydropower equipment.

The Vadodara factory received a fresh injection of investment in 2006, by which time it employed 600 people and supplied the full range of hydro and mechanical equipment and services. In November 2008, Vadodara was inaugurated as one of the company’s Global Hydropower Technology Centers.

Today the Centre continues to expand and currently employs around 1,500 (an increase of around 500 since last year). It includes:

- A manufacturing facility, equipped for machining new stationary components, the repair and servicing of rotors and the assembly of turbines and generators of medium and large hydro units;
- A Thermal Service workshop, capable of a range of service functions e.g. high speed balancing of rotating equipment, blading/de-blading, welding, casing repairs, rotor straightening, rotor rewinds, insulation changes; and
- The technical laboratory to carry out diagnostics and develop highly innovative integrated products and technologies for the Indian market and for other regional markets.

India is the world’s biggest market for Pelton turbines but hydro resources in the Himalayan region suffer from high silt content. The Vadodara Centre focuses on the particular needs of this market, with a Pelton turbine scale model test laboratory with one of the highest head testing capacities in the world and a silt-abrasion test rig to support research on abrasion protection.

By focusing on the specific issues of the Indian hydro market, the new Global Technology Centre at Vadodara will enable Alstom to develop highly innovative integrated products and technologies for new and rehabilitation projects.

The Centre will be supplying a Pelton turbine to the Tidong I (2 x 50 MW) hydro project in the Kinnaur district of Himachal Pradesh. This will not only provide the opportunity for high performance machining of a piece of leading edge technology, but also the in-house manufacture of complex structures such as inlet collectors, which involves intricate welding of 100% RT (Radiography Testing) quality.

In January 2010, the Vadodara Centre produced a 78 ton Kaplan runner (similar to an aeroplane propeller), the largest ever produced by an Indian firm, destined for the Bujagali power project in Uganda. This is one of the most complex components for hydropower generation.
At present, the Centre is executing contracts on 13 projects, both for a range of Indian customers and also for export. In addition to manufacturing a 78 ton Kaplan runner, the facility has also delivered India’s largest Francis turbine runners (for the Subansiri Project in Assam and Arunachal Pradesh) and is also involved in the execution of the Tehri Pump Storage project, which adopts variable speed technology for the first time in India.

In May 2011, we added our most advanced bearing production factory to the Vadodara complex. It will manufacture bearings for medium and large hydro projects both for the Indian market and for export. The factory has 200 employees and is itself a demonstration of sustainability through its use of measures such as heat-insulated panels, a fume extraction system, rainwater recycling system, skylights and turbo ventilators and demand-controlled air conditioning. It also adopts lean manufacturing techniques to deliver high efficiency, productivity and quality.

In July 2011, Alstom launched a new induction program for Young Engineering Graduates in India. For the 126 students selected for the first intake, it will offer a 75-day induction program followed by nine months of on-the-job training. It aims to promote a new generation of engineering excellence and help the students make an effective transfer from the academic world into industry.

The Vadodara unit’s reputation has also been burnished by winning a Silver Certificate of Merit from Indian publication, the Economic Times at its India Manufacturing Excellence Award Summit 2011. The award recognised the facility’s demonstration of best practice in its quality control processes.

**Conclusions**

Policies implemented at national and state level together with the local authorities’ desire to attract inward investment helped to make this possible. Specifically, they stimulated market demand with incentives to invest while also liberalizing the electricity market to encourage new entrants and boost competition. Vadodara itself offered excellent transport links (important to the logistics of moving heavy machinery) as well as a strong education system, supplying a robust and flexible labour market.

As a result, our investment in the area has developed from a factory into a global R&D and export hub, capable of delivering the largest and most complex components and leading research into turbine blade corrosion. We have built partnerships with a range of Indian businesses and developed an induction and training programme for young Indian engineers.
2. **Delivering Energy Access: Hydropower on the Nile.**

Alstom is helping to deliver sustainable access to energy in Africa through a number of hydropower projects, including:

- **Cahora Bassa** (2075 MW) in Mozambique;
- **Kafue Gorge** (900 MW), **Kariba** (600 MW) **Victoria Falls** (108 MW) in Zambia;
- **Ruacana** (new 90 MW unit added to existing 3-unit 240 MW plant) in Namibia;
- **Merowe** (10x125 MW) in Sudan; and
- **Bujagali** (250 MW) and **Kiira** (200 MW) in Uganda.

### Bujagali run-of-the-river power plant on the Nile, Uganda (250 MW)

Alstom is executing a turnkey contract, signed in 2008, with Italian civil works constructor Salini Hydro Ltd for the owner of the plant Bujagali Energy Limited. Under the terms of the contract, Alstom Hydro will design, construct, test and commission the hydro-mechanical and electromechanical work. We will also supply equipment including 5x 50 MW turbine/generator units, transformers, electrical & mechanical plant, control & instrumentation and hydro-mechanical equipment.

**Most of the equipment has been produced by Alstom Hydro India** and included the largest Kaplan runner ever manufactured at our Vadodara plant, with a diameter of 6.1 meters and weighing 78 tons. The project is currently undergoing wet commissioning – first introduction of water into the turbine - and reliability runs prior to putting the units into service. Completion is due in mid-2012.

The Bujagali project is a run-of-river scheme on the Nile near the town of Jinja that will reuse the water released from two existing upstream hydro plants, Nalubaale (180 MW) and Kiira (200 MW), which are currently the country’s only important electricity generating facilities. Once commissioned, Bujagali will almost double the generation capacity of the country, helping to relieve Uganda’s acute power shortage.

The project is a PPP financed by a combination of International Financial Institutions (including the World Bank, International Finance Corporation, European Investment Bank and African Development Bank) and bilateral development institutions. The project’s sponsors have signed a PPA with the Ugandan Government and the World Bank’s Multilateral Investment Guarantee Agency is supporting the project with political risk insurance cover.

### Merowe hydroelectric power plant, Sudan (1.25 GW)

The Merowe multi-purpose hydro project in Sudan is one of the largest contemporary hydropower projects in Africa. Alstom supplied the ten 125MW Francis turbine and generator units for this project as well as associated equipment and control systems.

The project, situated on the Nile about 350 km north of the capital Khartoum, has been in operation since 2010 supplying more than the half of the overall installed capacity in the country. The annual electricity yield of the project is 5.5 TWh, corresponding to an average load of 625 MW, or 50% of the rated load. The power is fed into the Sudanese power grid using two separate aerial transmission line routes across the Bayudah desert to Atbara continuing to Omdurman/Khartoum, as well as 220 kV lines eastwards to Port Sudan.

### Ruacana hydroelectric power plant in Namibia (240 MW + new 90 MW unit)

In April 2012, Alstom delivered the Ruacana hydro project to our customer, NamPower, in Namibia. The project, which adds another unit to an existing power plant, will add 90 MW of capacity to the nation, halving the country’s current shortfall in generation capacity and providing 25% of the country’s electricity generation.

Alstom, in consortium with Andritz, supplied a generator along with balance of plant equipment including the generator control system. The project took three years to deliver, with everything ready on time for the customer to start generating electricity before the dry season.
3. **Energy Efficiency: Arnot Capacity increase Project, South Africa.**

In 2006, Alstom undertook the upgrade of the six units of Arnot Power Station, a coal-fired plant owned by Eskom, increasing power output from 350 MWe to 400 MWe per unit, while at the same time improving efficiency and extending the plant’s lifetime by 20 years. The project included retrofitting the turbines and boilers to increase capacity to 400 MWe, a complete retrofit of high-pressure and intermediate-pressure steam turbine internals, upgrade of the low-pressure steam turbine and the replacement and upgrade of associated turbine pumps and auxiliaries. The project will be completed in 2012.

**Alstom in South Africa**

Close to 25% of the world’s power production capacity depends on Alstom technology (including hydro, nuclear, wind, clean coal and gas-fired plant and plant efficiency products); we offer an integrated approach to power plant design, construction and management. Alstom employs around 93,500 people in 100 countries, possessing expertise in project management; engineering procurement and construction; and component design and manufacture. The development of clean technology is fundamental to our business – with an R&D spend in 2010-11 of €700 million (almost $925m). Alstom has been present in South Africa for over 100 years and with 80% of the installed turbine capacity coming from Alstom, the company has developed a position as a leading power generation provider– our current projects include Medupi, Kusile & Arnot (coal), Koeberg (nuclear) and Gariep (hydro). We source around 50% of the equipment for production from South African suppliers and seek to develop long-term relationships with local suppliers, supporting them with training in our products, standards and specifications.

**The Arnot project**

By 2006 Arnot power station (6X350 MWe) had passed its 30-year design life but rising demand for power meant there was greater need than ever for its output. We worked with Eskom, the plant’s owners, to upgrade the six units of the plant to deliver 400 MWe, the additional output coming from a mixture of supply-side efficiency (15 Mwe) and capacity increase (35 Mwe). The upgrade also reduced NOx emissions and extended the lifetime of the plant by 20 years.

An engineering study of the steam water cycle assessed how much of the existing equipment could be re-used but determined that the turbines and boilers had to be retrofitted if capacity was to be increased to 400 MWe. This included complete retrofit for the high pressure and intermediate pressure steam turbines, a capacity upgrade of the low pressure steam turbine and the replacement and upgrade of turbine side pumps and auxiliaries. Alstom also upgraded the boiler, supplying new pressure part components, a new burners system, and made modifications to coal mills, classifiers, fans and air heaters.

**Supporting local industry**

Alstom has so positioned itself in the South African market as to comply with and respond to the unique nature of contracting in South Africa. The Government’s transformation and socio-economic development objectives for the country are articulated in the Broad Based Black Economic Empowerment Act (B-BBEE) of 2003, and the Department of Trade and Industry’s Codes of Good Practice. According to these standards, Alstom has achieved Level 4 compliance, with 100% recognition, and is thus recognized as a significant contributor towards economic development and empowerment, skills development and job creation in the country.

For this project, work was localised wherever possible. Alstom supported hundreds of jobs, from skilled manufacturing and construction personnel to local clerical staff. Significant extra company resources had to be put in place to manage and support local sub-contractors. The manufacture of the turbine retrofit inner cylinders themselves was undertaken mostly in China, though two of the six units were made in Europe, but virtually all manufacturing for the boiler upgrades (including materials)
was handled locally, either at Alstom’s own South African facilities or by local sub-contractors. Substantial local labour was also used during the site outage phases of work.

Conclusion

There is huge global potential to deliver power more efficiently, with lower Co2 emissions, from existing plant. According to the IEA each one percentage point increase in efficiency delivers a 2-2.5 percentage point reduction in CO2 emissions. Performance will vary depending on the plant but for example:

- A super critical unit can produce up to 16% more power and emit 14% less CO2 than a sub-critical unit.
- For a 600 MW plant this could save around 440,000 tons CO2 per year.

The Arnot Integrated Retrofit Project, the first project in South Africa to result in a capacity increase through retrofit, is a good example of how existing plant can deliver greater output and lower emissions, even beyond its intended lifespan. This project was a solution to bring more electricity to the grid quickly, in a country where demand, driven by economic and demographic growth, had far outstripped supply.

Coal continues to account for the largest share of the global fuel mix for the power sector. Many of the units supplying coal-fired power today are situated in the developing world and may have decades of potential lifetime ahead of them. If we are to make any significant impact on reducing CO2 emissions, bringing these plants up to their maximum levels of efficiency will be vital to achieving significant reductions in emissions whilst also enabling continued access to the electricity these plants supply.
4. **Technology Transfer: carbon neutral lean manufacturing and R&D in Tianjin, China.**

**Introduction**

Development of an innovative free-trade zone in an area of strong engineering skills encouraged investment in a carbon neutral hydropower R&D centre transferring lean manufacturing techniques to China, expanding the technological base and building trade capacity.

**The development of Alstom Hydro China**

Close to 25% of the world’s power production capacity depends on Alstom technology (including hydro, nuclear, wind, clean coal and gas-fired plant and plant efficiency products); we offer an integrated approach to power plant design, construction and management. Alstom employs around 93,500 people in 100 countries, possessing expertise in project management; engineering procurement and construction; and component design and manufacture. The development of clean technology is fundamental to our business – with an R&D spend in 2010-11 of €700 million (almost $925m). Alstom has been manufacturing turbines for hydropower in Tianjin since 1995 and it has become our largest hydropower installation base, capable of designing, manufacturing and supplying world class products to its customers, both at home and abroad.

**Hydropower in China and economic policy in Tianjin**

China is one of the world’s largest users of hydropower. Hydropower makes up 22% of the country’s installed power base, increasing by 15 GW every year, and expected to reach 380 GW by 2020 from just under 200 GW today. Alstom is one of China’s leading hydropower suppliers. To date, the company has signed contracts for turbines and generators covering 43 GW, out of which approximately 28 GW are already in commercial operation. Alstom was directly involved in the construction of the Three Gorges Dam, supplying 14 of the dam’s 32 units, each with an output of 700 MW and we designed, engineered and installed the world’s largest hydropower turbines at the Xianjiaba project (four 800 MW units).

In 2008, the Tianjin municipality embarked on reforms to transform the Tianjin Binhai New Area into an economic hub, piloting a number of policy reforms aimed at attracting investment offering financial support, tax incentives, etc. It has enjoyed high-level support from the Tianjin Municipality and the Mayor and has convened taskforces to focus on infrastructure construction, encouraging innovation, policy reform (covering financial regulation, land management etc), and environmental improvement (to improve air quality and preserve or expand green spaces).

The Beijing-Tianjin-Hebei region accounts for about 27% of China’s science and technology expertise and has trained a large number of highly-skilled workers. The region includes 50 engineering state centers, 83 corporate Technology R&D Centres, 41 foreign-invested R&D centres, 52 post-doctoral workstations and 32 Science and Technology incubators and services institutions.

**Alstom’s initiative**

This combination of strengths encouraged Alstom to expand and upgrade our manufacturing facility and to develop a Global Technology Centre that will enable us to carry out R&D and turbine testing activities. It will be Alstom Hydro’s third global technology centre, following the opening of Alstom’s centers in Grenoble, France and Vadodara, India in 2008.

Our new facility, Alstom Hydro China Co. Ltd (AHC) will be capable of delivering up to 30 turbine and generator units per year with outputs ranging from 20 MW to 1000 MW. It houses more than 260 engineering experts and engineers, as well as various types of skilled workers including welders, fitters, machining operators, crane drivers and mechanics. Around 1,850 employees will be able to work on the new site by the time it is fully completed. Products made there will supply the global
market and it is already engaged in the manufacture of the first turbine unit for a hydropower facility in Vietnam that Alstom will deliver in partnership with Hydro China Zhongnan Engineering Corporation.

**A world class carbon-neutral factory for long-term sustainability**

Energy efficiency in buildings is at the top of the Chinese government’s agenda in honoring its commitment to reduce CO2 emissions per unit of GDP by 40-45% by 2020 from 2005 levels, following its promise for a 20% cut by 2010.

Representing an investment of one billion RMB (just under €110 million), AHC is Alstom’s first carbon neutral manufacturing site in China. Its energy-efficient design includes:

- double insulation,
- an exhaust heat recovery system to reduce heat loss
- a geothermal heating and cooling system that consumes 34% less energy than a traditional air conditioning system,
- rainwater recycling, and
- Skylights to make full use of natural light and reduce the need for artificial illumination.

The facility also boasts an award-winning solar photovoltaic system to power heating, cooling, lighting and ventilation for the entire factory. With 2,000 solar panels installed on the roof, generating 500,000 kwh/year, the system is Tianjin’s largest solar project and will be the first to be connected to grid. The project has won one of China’s national “Golden Sun” awards as a pioneering solar power initiative.

**Results**

One of the significant innovations adopted in Alstom Hydro China is the deployment of “lean” manufacturing to streamline work processes, improve efficiency, reduce waste and create safer and healthier working conditions whilst maintaining high quality and low cost.

The manufacturing process at the site has been organised into seven specialised individual factories. Each functions as a self-supporting production unit, with all the processes necessary to manufacture a product contained in one dedicated factory (for example, welding, machining, assembly, planning and industrial engineering). One specialised factory manager is responsible for business performance and delivery to the customer in each unit.

This concept is already producing tangible benefits including:

- A stronger sense of personal responsibility amongst all staff to plan and achieve on-time delivery to the customer;
- Enhanced ability to out-perform the competition on lead-time, cost and quality;
- Increased focus on continuous improvement;
- Standardized and optimized processes to improve expertise.
- Increased trade capacity in the area.
5. Technology Transfer: Alstom’s investments in education and skills in South Africa.

Introduction

Technology transfer is about much more than equipment and components. Know-how and skills are essential not only for day-to-day operations but as the foundation for endogenous innovation. By 2017, Alstom’s investments will have trained over 800 South Africans as artisans, engineers and managers in a range of disciplines (manufacturing, project management, sourcing, quality assurance, sales, engineering, construction, contracts etc). These long-term investments directly support economic growth whilst also enhancing our supply chain, enabling us to deliver projects more quickly, safely and efficiently. They also benefit the local population and indirectly enhance trade capacity.

Industrial development in South Africa

Addressing South Africa’s skills shortage is key to unlocking its economic growth, not least in the power generation sector where it has the potential to raise the cost and slow the rate of project delivery in new power generation. Though some local industrial capacity remained from the power generation expansion of the 1980s, capacity and skills in this field had been eroded. Reinforcing industrial capacity not only helps to speed electrification but also acts as a spur to the economy in itself through the creation of high quality engineering jobs, raising the skills of the population and encouraging the development of local supply chains that will support ongoing growth in capacity. This is in line with South Africa’s national initiatives for economic growth, skills and industrial capacity development: the Accelerated & Shared Growth Initiative for South Africa (ASGISA), the Joint Initiative on Priority Skills Acquisition (JIPSA) and the Competitive Supplier Development Program (CSDP).

Alstom’s initiative

In 2007 Alstom established a Project Execution Centre in Johannesburg to co-ordinate our activity across our major projects and to manage our relationships with customers and the development of our local supply chain. This has resulted in our investment in human and material resources, with support for training, education and the development of industrial capacity in the country.

One of the local suppliers to benefit from this activity was ELCA-Malitech, a manufacturer of pressure vessels. In order to meet our order, the firm required investment in new equipment and techniques to enable them to become internationally competitive. Alstom supplied almost half of the total investment of ZAR9.1m ($1.36m or just under €1m) that was required. As a result, the firm has acquired the necessary technology (under license) and, using benchmarking, upgraded the efficiency of its design and manufacturing processes to a level higher than its competitors. This has created new jobs and skills within the company and opened up a promising new market for them in supplying a key component for a range of applications in power generation, petrochemicals, mining, sugar refining and paper & pulp processing.

Supporting education & skills over the long term

Recognising the need for investment in the socio-economic development of the country, we are investing over ZAR 17.5m ($2m/€1.4m) over the period 2008-2013. This includes funding for projects in underprivileged communities in the areas of:

- Education in environmental issues and in maths & science; and
- Promotion of the use of energy efficient and renewable energy solutions through microfinance.

Within a partnership developed to promote excellence in engineering studies in South Africa, Alstom has provided funding for the expansion of the Engineering Faculty of Wits University. Furthermore, the Alstom Chair for Clean Energy Systems Technology (ACCEST) has been established to focus research on the country’s future energy needs as well as meet Alstom’s R+D objectives.
Results

In the course of delivering projects for Eskom and in line with the objectives of ASGISA, we are funding training initiatives that have helped to rebuild capacity in the workforce required to sustain and service the expansion and servicing of the power generation industry.

As a result of these projects, we will have trained:

- 650 artisans including pipe & turbine fitters, welders & welding inspectors, technicians, sheet metal workers and boilermakers; and
- 176 professionals including project managers, planners, quality control, safety & finance managers, as well as providing bursaries for over 55 engineers (mechanical, electrical & civil/structural).

The Government’s transformation objectives for the country, are articulated in the Broad Based Black Economic Empowerment Act (B-BBEE) of 2003, and the Department of Trade and Industry’s Codes of Good Practice. According to these standards, Alstom has achieved Level 4 compliance, with 100% recognition, and is thus recognized as a significant contributor towards economic development and empowerment, skills development and job creation in the country.

Key drivers for our activities were government policies that stimulated market demand with long-term incentives to invest. We are continuing to deepen our relationships with Eskom and our other key business partners. We remain committed to building educational and training capacity in South Africa through our investments and partnerships with Wits University and other educational establishments.
6. **Alstom Energy Policy Position: Clean power as a path to development.**

**CLEAN POWER AS A PATH TO DEVELOPMENT**

Sustainable economic development depends on the provision of clean, reliable and affordable access to energy for all.

The UN designated 2012 as the International Year of Sustainable Energy for All, launching their energy access awareness campaign ahead of the Rio+20 Earth Summit in June 2012.

During COP 17 in Durban, Alstom hosted a Roundtable to discuss what it takes to ensure clean power for development. We invited representatives from government, business, finance (public and private) and non-governmental organisations.

The event was opened by South Africa’s Minister for Public Enterprises, Malusi Gigaba, who offered his perspective on the challenges faced within sub-Saharan Africa:

- 74% of people have no access to energy, 89% of them in rural areas;
- the majority of sub-Saharan Africa’s energy consumption is in South Africa, where the government is exploring the potential of renewable power;
- nevertheless 80% of sub-Saharan Africa’s potential renewable energy supply remains unused;
- clean coal technologies, including Carbon Capture and Storage (CCS), will remain an important element of expanding energy access.

This note captures some of the participants’ observations around the seven key drivers of investment in clean power for development that were identified.

**Integrated strategic planning for development**

Balancing country-specific circumstances with the need for regional development will facilitate collaboration and help countries to move forward at a similar pace, reducing the risk of imbalances. Roadmaps clearly outlining goals and plans for ten years or more can help create investor confidence.

**Stable, long-term policy frameworks**

These are the single most important thing for building investor confidence. Carbon markets and financing can play an important role in providing long-term financial stability within regions. The World Bank’s Partnership for Market Readiness can support development and capacity building in this area.

**Institutional capacity building**

This is also fundamental to building investor confidence, for example to develop simple, transparent and fast permitting for power plants or to meet Multilateral Development Banks’ (MDBs) conditions for loans. Using “one-stop-shops” for all permitting, standardising processes (e.g. procurement) and drawing on MDBs’ expertise in infrastructure planning also helps to encourage investment. Clarity and predictability of regulatory processes can be even more important than the time required to reach a decision.
Supporting innovation

Innovative business models have already proved important in delivering energy access. Flexibility to allow companies to adapt and develop innovative business models could result in huge market opportunities, delivering growth as well as energy access. The potential market could be in excess of $500bn.

Planning for a balance of on- and off-grid power

Universal energy access requires significant investment in large-scale, grid connected plants as well as smaller local generation. Planning ahead for such major infrastructure creates an effective basis for attracting public funding and private investment. Smaller, local scale, generation should be provided in a way which can be linked to an evolving grid, thus helping avoid lock-in of assets which are less efficient or reliable, and maximising flexibility in managing the overall system.

Flexibility to adopt and adapt a range of finance models

The IFAc World Energy Outlook 2011 estimates that meeting basic energy needs of all will require a five-fold increase in investment over current levels. The private sector currently accounts for one-fifth of investment in energy access. If the private sector is to provide a larger share of the financing in the future, investors need to be assured that risk is commensurate with reward.

Both governments and MDBs have roles to play in risk-sharing with private investors. Minimising risk and/or allocating it between the private and public sectors helps contain cost. Effective mechanisms for leveraging private sector investment include: loan guarantees, risk-sharing, early stage pump-priming grants, and blending or bundling of finance mechanisms (e.g. microfinance + carbon finance + MDO seed-funding). The UNFCCC Green Climate Fund could incorporate a dedicated facility for leverage instruments such as these.

Effective engagement of the private sector

A public-private partnership approach, bringing together a range of relevant partners, will greatly facilitate delivery. The Alstom Roundtable conclusions themselves demonstrate the value of drawing on a range of perspectives and experience as the basis for delivering effective solutions.

IMPORTANT INFORMATION:

This note captures the key points of a discussion among the participants listed below. The discussion was held during COP 17 under the Chatham House Rule and not every participant can be assumed to support every opinion expressed in this note.

PARTICIPANTS AT ALSTOM ROUNDTABLE

Mr Philippe Joubert (host) Deputy CEO, Alstom | Minister Malusi Gigaba Minister of Public Enterprises, South Africa |
Mrs Joan McNaughton (moderator) SVP Environmental Policy & Global Advocacy, Alstom

Mr Peter Bakker CEO and President, WBCSD | Dr Albert Butare CEO, Africa Energy Services Group, Rwanda | Mrs Joulie Chassard Manager, Carbon Finance, Environmental Department, Sustainable Development, World Bank | Mrs Hela Chebbihouhou Director, Energy Environment and Climate Change Department, African Development Bank | Ms Laura Cozzi Deputy Head and Principal Analyst, International Energy Agency | Mr Hans-Olav Ibrekk Policy Director, Ministry of Foreign Affairs, Norway | Mr Jack Jenkins-Stark CFO, Bright Source Energy | Mr Abdur Karmal MD, Bank of America | Ms Jeanne Ng Director, Group Environmental Affairs, China Light & Power | Mr Joseph Njiru CEO, Renewable Energy Ventures (N) Ltd, Kenya | Mrs Leera Srivastava Executive Director, The Energy and Resource Institute, India | Mr Halldor Thorgnsson Deputy Executive Secretary, UNFCCC | Mr Lutz Weihe Research Analyst, WRI

Mrs Gwen Andrews VP Environmental Policies and Global Advocacy | Mr Jerome Boyet Country President South Africa, Alstom