Policy Briefings

PB 01-2013 / January / www.lowcarbonprogramme.org

LOW CARBON PROGRAMME
EUSKAMPUS JRP ON ENERGY AND ENVIRONMENT

CLIMATE CHANGE AND THE ENERGY SECTOR: IMPACTS AND ADAPTATION

Alberto Ansuategi

Key Points

- *In spite of contributing to nearly 70 per cent of global GHG emissions, the energy sector is also vulnerable to climate impacts. Climate change can affect the primary energy available of multiple resources such as hydropower, wind, solar and wave power, and the availability of biofuels and fossil fuels. It also can have an impact on the energy transforming technologies, and the transmission and distribution power lines. Even the energy consumption is expected to change.*

- *Adaptation measures constitute the core of actions against the impacts of climate change. With reference to the energy sector, the primary objective of adaptation solutions is to guarantee the supply of energy, balancing production and consumption throughout time and space.*

- *Policies which facilitate the access to information through research and the development of models are highly important to improve the knowledge about vulnerabilities and possible risk management strategies. Moreover, it is needed the collaboration between different public and private agents gathered in multi-sectoral partnerships.*

- *The role of governments should be central, creating a clear legal and regulatory framework, planning integrated actions, and establishing assistance for adaptation through the creation of a range of funding streams. Furthermore, international collaboration between governments is advisable to help developing countries to adapt to climate change.*

- *It is necessary to prevent negative effects and reduce risks using different sorts of "hard" and "soft" adaptation measures. Insurance also should play a central role to share responsibilities for losses and risks. Besides, climate change also brings some opportunities that should be exploited through the decentralization of the energy structure, and the development of urban designs and land use planning.*

The greenhouse effect has resulted in climate change, which is expected to increase average global temperature and produce effects such as changes in cloud cover and precipitation, a rise in sea levels, melting of ice caps and glaciers, and more frequent and severe extreme weather events. Those effects also have an impact on the energy sector, which is a major producer of emissions with nearly 70 per cent of global GHG emissions, but which can suffer some changes as a consequence of climate change.

On the one hand, it is expected to be **changes in primary energy available**, affecting to some primary resources (hydropower, wind power, solar power, wave power, availability of biofuels and fossil fuels) and with different positive or negative effects depending on the geographical area. As an example, the Gross Hydropower Potential is expected to decrease by about 6% in Europe by the 2070s. Furthermore, some studies show that it is unlikely that mean wind speeds and energy density will change by more than the current inter-annual variability (±15%) over most of Europe and North America, being these changes even larger over South America. With respect to solar power, it is estimated an increase in solar radiation of 5.8% compared to the 1992-96 time average in south-eastern Europe, while it will be a decrease of incoming solar energy on the Canadian Prairie. Moreover, the wave energy potential is expected to increase in some areas such as the coast of mid-Norway, and decrease in other areas such as the southern Californian coast. Besides, climate change provoke changes with different positive and negative effects in agricultural production (improving photosynthesis in certain crops; changes in the rate of plat development; incidence of pest and soil conditions; and presence of extreme climate conditions such as droughts, frosts and storms), what finally has an impact on the production of biofuels. Even the availability of fossils fuels can suffer a change because of the negative impact that different events such as changes in precipitation patterns and runoff, sea level rise or more intense storms could have on coastal and offshore oil and gas exploration, production and transportation.

On the other hand, there could be additional **impacts on the energy transforming technologies** such as hydro-power plants and thermal power-plants, because of the variation of water resources, temperature and humidity; **and on the transmission and distribution power lines** as a consequence of extreme weather events such as landslides, flooding, extreme wind and ice loads, or fires.

Finally, climate change could provoke **changes in energy consumption patterns**, reducing the demand for heating while increasing demand for cooling. In fact, the heating energy demand is estimated to decrease by 34% worldwide by 2100 while air conditioning demand will increase by 72%. Moreover, the demand of energy of some sectors such as transportation and agriculture could vary as a consequence of climate change.

Adaptation measures and classification

The impacts that climate change could have on the energy sector make necessary to develop some measures to alleviate them. In this way, the primary objective of adaptation solutions in the case of the energy system is to guarantee the supply of energy, balancing production and consumption throughout time and space.

There are multitude of behavioural, structural and technological adjustments, and the classification of them is also wide. Thus, attending to the *timing* of the action, a measure can be **proactive**, when it reduces exposure to future risks, or **reactive**, when it only alleviates impacts once they have occurred.

Based on *the nature of the agents* involved in the decision-making, adaptation solutions can be **private**, when they offer private benefits that accrue to individuals or firms, or **public** when they provide public benefits and therefore it is the government who provide them as a public good.

Another classification can be depending on the *spatial scope*, as **localized** when the impact is local, or **widespread** when the measure can be supported by national or even international policies and strategies. Moreover, taking into account the *temporal scope*, adaptation policies can be **short-term** or **longer term**, which has to do with the pace and flexibility of adaptation measures.

Furthermore, with respect to the *form*, they can be **infrastructural**, when they reduce the vulnerability of energy infrastructure to environmental change; **behavioural**, which target the behaviour of economic and social agents; **institutional**, when stakeholders are organized in civic bodies that are able to contribute to decision-making processes; **regulatory**, if governments are more likely to resort to prescriptive regulation and controls to ensure that critical actors take appropriate action on adaptation; **financial** when they take into account the use of available financial resources and instruments; and **informational**, when they consist of scientifically sound measures of adaptation that improve information and knowledge.

And finally, based on their *ability to face associated uncertainties and/or to address other social, environmental or economic benefits*, measures can be **no-regret** options, when socio-economic benefits exceed their cost whatever the extent of future climate change; **low-regrets** options, for which the associated costs are relatively low and for which the benefits under projected future climate change may be relatively large; and **win-win** measures, which minimize social risk and/or exploit potential opportunities but also have other social, environmental or economic benefits.

Adaptation measures and strategies in the energy sector

In the energy sector we can differentiate between two sorts of measures: **building adaptation capacity measures** and the **delivering adaptation actions**.

Building adaptation capacity measures

The first group of measures include the access to information, supportive social structures and supportive governance. In this way, the **access to detailed information** about the impacts of climate change in space and time is considered of high interest for policy-makers to make optimal decisions. Generating data and knowledge is a necessary condition for effective action and it is also important to succeed in persuading businesses, communities and individuals to adjust their behaviour in ways to promote adaptation and limit emissions. In fact, Article 5 of the United Nations Framework Conference on Climate Change (UNFCCC) refers to the need for

the international community to support and further develop climate research and systematic observation systems. This include the need to develop higher resolution regional models, also for developing countries, and to continue to provide reliable and timely observations as required by weather forecast models. Furthermore, data is needed to improve the use of energy demand and energy production models. To make this possible, it is advisable to use grid computer technology, and to promote research.

In the case of **supportive social structures**, nowadays clear policies on adaptation are developed in broad consultation and participation of staff and supported by senior management. Thus, adaptation to climate change is becoming increasingly important from the perspective of corporate governance, strategic risk assessment, and community planning. An example is the Carbon Disclosure Project, which encourages industry to better identify and manage risks, including those posed by climate change, to support the investor in making decisions. In this way, local public institutions, civil society institutions and private institutions have an important operational significance in the context of climate change adaptation, and multi-sectoral partnerships between these agents should play a core role.

Finally, adaptation has to be **supported by governments** in a variety of ways, what requires administrative executive bodies, and enabling legal and regulatory frameworks. Thus, governments play an important role in providing a clear policy framework to guide effective adaptations by social and economic agents in the medium and longer term. This includes the provision of high-quality climate information, the establishment of land use plans and performance standards, the definition of long-term policies for climate-sensitive public goods, and the provision of a safety net for those least able to afford protection and/or insurance. Furthermore, integrated planning within the energy sector and with others such as the water sector is highly important. Moreover, international assistance for adaptation is critical, specially to support adaptation in developing countries. In this way, The Global Environment Facility under the UNFCCC and the so-called "Adaptation Fund" established by the Parties to the Kyoto Protocol of the UNFCCC are examples of funds to finance concrete adaptation projects and programmes in developing countries. In fact, total climate finance for these countries is $10 billion a year today, compared with projected annual requirements by 2030 of $30 to $100 billion for adaptation.

Delivering adaptation actions

Certain short and medium term effects of climate change will be almost unavoidable. In this way, **preventing effects or reducing risks** is of high importance. Some adaptive actions should try to alleviate or minimize these negative effects. Thus, there are several examples of **"hard"** and **"soft"** adaptation measures in the energy sector intended to minimize negative impacts due to long-term changes in meteorological variables and extreme events.

On the one hand, a **"hard" adaptation strategy** is to invest in protective infrastructures to physically protect the energy infrastructure of the damages and loss of function that may be caused by climate change extreme events. Examples of hard adaptation measures are the improvement of the robustness of offshore installations that are vulnerable to storms; build dikes and disilting gates;

increase dam height; enlarge floodgates; improve the design of turbines to withstand higher wind speeds; installation of mobile ventilation and refrigeration; burying or cable re-rating of the power grid; etc.

On the other hand, there are **four types of soft adaptation strategies**. The first one is to *reconsider the location of investments* for adapting energy infrastructure to climate change. Thus, location decisions of investments such as power plants should take into account the impact of a changing environment in the infrastructure. Another sort of soft measure is the *anticipation of the arrival of a climate hazard* through the development of meteorological forecasting tolls inside the energy companies or improving the communication with meteorological services. A third group of soft measures includes all the *changes in the operation and maintenance of existing infrastructures*, such as the management of on-site drainage and run-off of mined resources, changes in coal handling due to increased moisture content, and so on. Finally, the fourth group of "soft" measures comprises *technological changes and improved design of infrastructures*, such as wind and gas turbines in order to cope with changing climate conditions.

Furthermore, it is also important to **share responsibilities for losses and risks**. In this way, **insurance** is an important tool to deal with risk. Thus, it should be evaluated whether certain private actors/sectors that provide public services such as the energy sector need to be covered by compulsory standard weather-related insurance, or whether in cases where insurance is not available publicly supported insurance schemes should be required. A good example of this is the Weather Risk Management Facility (WRMF) which is a joint International Fund for Agricultural Development (IFAD) and World Food Programme (WFP) initiative to support the development of weather risk management instruments in developing countries. Weather index insurance is a financial product linked to an index highly correlated to local yields.

Another way to reduce risk comes from **energy diversification**, which can be seen as an adaptation measure to increase resilence within the energy sector in responding to anticipating impacts of climate change. One approach would be to further expand the portfolio of energy sector, adopting on new forms of energy production such as solar, wind, and hydro power.

Finally, there are some **opportunities** to decrease the vulnerability of energy sector to weather extremes and climate change variability. For instance, ageing of existing infrastructures may open a new window of opportunity to **build a more decentralized energy structure**, preferably based on locally available renewable energy resources situated in secure locations. Furthermore, other opportunities arise from **urban design and land use planning**, which can play an important role in improving resilence of the energy system. In this way, **demand side management policies** with codes, standards and changes of the consumption patterns are important. Besides **supply-side opportunities** are relevant, because there are major challenges in providing new generation capacity and supply reliability within urban areas, and in the future they will need to develop a new supply and demand system where consumers can also be suppliers with a variety of home generators.

*This Policy Briefing was written by **Josu Lucas** **
** Corresponding author address: josu.lucas@bc3research.org*
Cite as: "Ansuategi, A." (2013) "Climate change and the energy sector: impacts and adaptation"

The Low Carbon Programme (LCP) is a Joint Initiative of Fundacion Repsol, BC3 and the UPV/EHU on the Economics and Policy of Energy and Climate Change. It is setup to promote energy economics and climate change research to help deliver a low carbon future.

The LCP Public Policy Briefings are available on the internet at
http://www.lowcarbonprogramme.org/policy-briefings.html
Enquiries regarding the LCP Policy Briefings:
*Email: **info@lowcarbonprogramme.org***

LOW CARBON PROGRAMME
EUSKAMPUS JRP ON ENERGY AND ENVIRONMENT