Considerations for Accommodating Renewable Energy Technologies to the Grid

THOUGHT-STARTER

February 2010

I. Introduction

The IEA estimates that, unless new policies are put in place, world electricity demand will grow at an annual rate of 2.5% from 2007 to 2030, which would be met to a large extent by increasing energy production from coal[1]. In this scenario, however, greenhouse gas (GHG) emissions would rise by approximately 1.5% per year, possibly resulting in a 6ºC increase in global average temperature and "irreparable damage to the planet"[2].

To help meet increasing electricity demand in a sustainable way, the growing integration of renewable energy technologies to the grid, and the challenges this involves, will need to be given due consideration. While they will not replace conventional power sources in the near future, renewable energy, such as hydroelectric, biomass, wind, and geothermal energy, has a role to play by increasing electricity supply and by reducing overall GHG energy emissions. The advantages of integration of renewable energies to the grid would help realise the potential of renewable energy sources and would contribute to lowering GHG emissions while boosting energy efficiency.

In designing and implementing a grid that can accommodate increasing use of renewable energy technologies, BIAC outlines in this paper various considerations that need to be taken into account, such as investment costs, energy security and regulatory issues.

[1] International Energy Agency (IEA), World Energy Outlook 2009.

[2] Ibid.

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II. Investment Requirements

Creating grids that hold enough flexibility to accommodate variable energy inputs from certain renewable energy sources would entail significant investment costs. In terms of connecting grids to renewable energy sources, such as offshore wind farms, tidal energy locations or solar energy sites, investment will be necessary for the transmission and distribution lines from these often geographically-dispersed sites. Investment will also be needed to upgrade the existing grids with the necessary hi-tech devices and sensors to be able to respond to variable inputs from renewable energy sources.

In the United States alone, for example, the introduction of additional infrastructure, whether smart or not, could require investment totalling as much as USD 1.5 trillion between 2010 and 2030[3], and that figure does not include the customers' share in paying for new technology outlays. Even in a country such as the United Kingdom, which has a far smaller land area, smaller population and much higher average population density than the United States, a significant sum of £4.7 billion by 2020 will be necessary for new investment in transmission lines (both maintenance and expansion), while a further £8.6 billion will be necessary to simply replace the current 47 million gas and electricity meters in the country[4].

While returns in the long-term may be high, policies for smart grid deployment in countries should carefully consider how to strategically finance the investment costs, particularly in the context of the current economic crisis (and thus reduced credit and liquidity). At the same time, sound analysis is needed on the expected economic returns on investment in smart grids and infrastructure for integrating renewable energies. Integrating renewable energies into the grid should make increasing use of public-private partnerships (PPPs) where possible, in order to encourage investment.

III. Security of Electricity Supply

Presently, the electric grid is tailored for the use of conventional, consistent power sources. The challenge with several renewable energies is their reliance on variable natural phenomena, such as wind and sunlight, which results in variable voltage input. Updates to the grid must therefore be able to accommodate inconsistent energy inputs, and it will be important to line up conventional base-load generating capacity and more peak power plants for use during periods of reduced inputs from renewable energy sources. At the same time, affordable and effective power storage mechanisms should be employed to capture any excess production. Ensuring that the grid has capacity to accommodate the varying input

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[3] US Department of Energy, "The Smart Grid: An Introduction" (2009): http://www.oe.energy.gov/SmartGridIntroduction.htm and the Brattle Group (2009): http://www.brattle.com/_documents/UploadLibrary/Upload767.pdf

[4] UK Department of Energy and Climate Change, "Smart Grids: The Opportunity" (2009): http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/network/smart_grid/smart_grid.aspx

from renewable energies will require significant restructuring, improved forecasting of energy production, and mathematical models to predict grid behaviour with higher integration of renewable energies.

We can also expect to see a rise in small-scale energy production from renewable energy sources at local levels, potentially adding thousands of generating sources to electrical grids. Grids must therefore be able to continuously calculate increasingly complex and variable supply and demand to ensure reliable and secure electricity supply on a scalable, real-time and per-need basis. Moreover, due to the computerised nature of a smart grid, the potential for technical disruption, or even sabotage, should be addressed in development.

IV. Regulatory Challenges

An increasingly predictable and transparent regulatory regime will be necessary for the much-needed investment in restructuring grids. BIAC calls on policy makers to consult closely with the private sector on new energy policy reforms, and emphasises that policy reforms must not inhibit innovation, obstruct competition, or undermine investment.

It will thus be important to achieve greater policy coherence and consistency between all levels of government in cases where grids span more than one provincial or national jurisdiction, thus facilitating investment and expansion by the industry. This becomes particularly relevant in the case of integrating often geographically-remote renewable energy sources, such as offshore wind farms or tidal energy, where long-distance transmission lines could potentially cross several regional or national boundaries.

Administrative simplification will also play an important role, as currently it is often highly time-consuming and difficult in many countries to seek rights-of-way and to gain regulatory approvals for new transmission lines. Administrative obstacles for siting and permitting would therefore need to be addressed to ensure that grid updates are implemented as effectively and efficiently as possible.

Furthermore, public opposition to new transmission and distribution lines in remote, local and pristine areas can make it difficult to build much-needed new infrastructure. Policy makers at national and local levels should do more to help inform the public and garner public support for new transmission lines and installation of renewable energy technologies.

Policy makers should also help to support further research and development for the integration of renewable energies into the grid. For example, it would be valuable to carry out data collection and analysis to help understand in practice the impacts of increasing integration of renewable energies into the grid. At the same time, research into enhanced forecasting techniques would be useful. Furthermore, the demand-side of grid integration practices and burden-sharing require further consideration, as well as the further analysis into the potential environmental benefits to be reaped by implementation of smart grids.

V. Conclusion

BIAC is supportive of restructuring energy grids in cost-effective ways to improve energy security and address climate change by greater integration of renewable energy technologies, where appropriate. Consultation with the private sector will be fundamental to the success of this endeavour.

In our view, the OECD and IEA have key roles to play in informing the upgrading of electricity grids. They hold several comparative advantages vis-à-vis other international organisations, including close cooperation with BIAC and other stakeholders, a whole-economy perspective, and a wealth of technical and economic expertise to help guide policy makers.

We therefore encourage more OECD and IEA analysis into issues surrounding the integration of renewable energies into the grid. It would be particularly useful to examine the costs and benefits associated with increasing integration of renewable energies, as well as further research into modelling and forecasting. The OECD and IEA can also work to provide guidance to policy makers on such issues to ensure policy coherence and administrative simplification for a sound investment environment. BIAC looks forward to providing input to OECD and IEA activities on these issues where possible.