The rapid growth of wind power is a model of successful public policy

Antoine Dechezleprêtre *and* **Matthieu Glachant** *see the rapid growth of wind energy and supportive public policies going hand-in-hand. Learning-by-doing has given rise to efficient technologies and a competitive manufacturing industry.*

Wind energy has been developing very quickly in the past years. Installation of wind turbines grew at an annual average rate of 30 per cent between 2000 and 2009 and global installed capacity now represents 238 GW, of which 62 GW are in China, making it the largest wind energy provider worldwide. As a result, a significant fraction of electricity is now produced by wind in certain areas (e.g., 6 per cent in the European Union, 3 per cent in the USA).

The massive deployment of wind turbines across the world has been driven mainly by public policy support. European countries like Spain, Portugal, Germany or Ireland have mostly relied on feed-in tariffs. In the USA, Renewable Portfolio Standards and systems of tradable certificates have been implemented. The Clean Development Mechanism has played a prominent role in emerging countries. For instance, almost all Chinese wind farms are either registered as CDM projects or are in the pipeline.

The spread of wind policies and the rapid growth of wind energy have gone hand in hand. So can we consider these policies a success? Installation of wind capacity is not an end in itself, and in the short term these policies have actually increased the cost of energy. The cost of wind power generation is still high relative to conventional electricity. According to the International Energy Agency, the cost of onshore wind ranges from 70 to 130 US$/MWh compared to 20-50 US$/MWh for coal-fired power plants and 40 to 55 US$/MWh. Offshore wind is even more expensive (USD 110 -130/MWh).

Even counting the benefits of avoided carbon emissions, it is not clear whether the social cost of wind energy is lower. The social cost of carbon according to the World Bank is around $20/ton, which in the best conditions puts wind energy and coal at parity. However, the net impact of wind energy on carbon emissions remains a controversial issue as the intermittency of wind power production requires a carbon-emitting backup such as combined cycle gas turbines. Moreover, in developing countries, the so-called additionality of some CDM wind projects has been challenged, casting serious doubt about their net carbon impacts.

The main testament to the success of wind policies is not the cost today, but that they have initiated learning-by-doing and innovation, paving the way for the availability of competitive wind technologies in the near future. The improvement of wind technology through economies of scale and experience in manufacturing and installing turbines has driven a constant decrease in the cost of wind power production. Most studies have found that the cost of wind generation has decreased by more than 10 percent with each doubling of cumulative capacity.

Technological innovation in wind power has also dramatically accelerated. In 2009 – the latest reliable figures available – 7,500 wind power-related patents have been filed worldwide, up from only 1,500 in 2000. This growth in innovation activity has been directly promoted by research and development subsidies and tax credits (called technology-push policies). But it has also been indirectly encouraged by feed-in-tariffs and other policies that have increased the demand for wind turbines (these policies are thus referred to as demand-pull policies). As a result of learning-by-doing and innovation, the cost of onshore wind power production is expected to reach grid parity in the next few years.

Wind power policies have also accelerated the international diffusion of technology, in particular towards

China and India. With over 2,200 patents, the Chinese patent office has been the largest recipient for wind power related patents in 2009, before the U.S., the European patent office, Korea, and Japan. About 20 per cent of these patents have been filed in China by foreign inventors, mostly from the U.S., Japan and Denmark.

This has created a highly competitive industry in emerging economies. In 2011, following the Danish wind turbine maker Vestas, four Chinese manufacturers could be found in the top 10 manufacturers (including Sinovel and Goldwing, which respectively rank 2nd and 3rd, each with a market share of about 9 per cent worldwide) and one Indian manufacturer (Suzlon).

At first glance, this is remindful of the photovoltaic (PV) industry in which Chinese panel and cell producers are also major players. But in fact, the situation is totally different: unlike Chinese PV manufacturers who almost exclusively export to industrialized countries, Chinese wind turbine manufacturers mostly produce for the domestic market. Suzlon, the only significant producer from a developing country on the U.S. market in 2010, claimed only a modest market share of 6 per cent. The wind power industry has thus followed a very different development path with limited international trade and domestic firms producing turbines to meet domestic needs. In this respect, the role of the CDM again has to be underlined. Technologies used in wind power CDM projects were initially provided by companies located in OECD countries but more recent projects use locally produced turbines.

What makes the wind industry so different from the PV industry? Two major reasons come to mind. The first is technological. As compared to solar modules or cells, wind equipment – such as blades and towers – are costly to transport long distances. The second reason is political: China, and to a lesser extent India, have made more efforts to promote domestic installations of turbines, most probably because wind is a much cheaper source of renewable energy than PV.

The first generation of wind power policies has thus given rise to efficient technologies and to a competitive manufacturing industry. We see however two major challenges for the future. The first is offshore wind, which has higher prices than onshore wind. Although offshore wind is a more recent technology, it is not certain that learning-by-doing an innovation can drive the costs down quickly, because of consistently higher installation and maintenance costs. The second challenge is public acceptability. As wind power develops, local population may be increasingly reluctant to new wind farm installations.

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