Leapfrogging in Energy Technologies: The Cases of Wind Power Development in China and India

Yi-chun CHEN

Keywords: *Environmental Leapfrogging, Technology transfer, Wind power, Wind turbine, Environmental technology*

"Environmental leapfrogging" (ELF) means that developing/emerging countries (DCs) currently on their way to industrialization at a rapid speed, consuming energies and emitting green house gases (GHGs), can bypass some of the pollutant phases that industrialized countries once experienced by introducing advanced environmental technologies. This is promising especially when tackling climate change. However, neither a concrete definition nor empirical conditions for ELF has been systematically researched.

The employment of renewable energies is welcomed for its zero emission. Particularly, the Fukushima Daiichi nuclear disaster after the Great Eastern Japan Earthquake also reminded people of the hazard of relying on nuclear power as a prescription for reducing GHGs. Wind technology was first developed and largely adopted in Europe, but within less than 15 years, China and India have been ranked on the top-5 list of world cumulative installation, and their manufacturers, such as China's Goldwind and India's Suzlon, are also on the top-10 list of world wind suppliers (as of 2012), showing their ability to employ and produce wind technology. Such astonishing development in the wind power industry are examined for case study of ELF in this thesis, wherein leapfrogging in energy technologies is defined not only as the adoption, but also the ability which the DCs should process to produce the technologies.

This thesis presents two research questions. The first concerns the conditions for ELF, which the author has extracted based on five papers on ELF, i.e. Goldemberg (1998) and others. The second question is on the conditions for leapfrogging in wind energy. For this research wind power developments in China and India were used as case studies to explore the factors of their rapid development in recent years. These were then compared to the conditions for ELF to see if both have the same conditions or if any additional conditions were needed.

Results indicate that the conditions for leapfrogging in wind energy are the same as those for ELF, which are: incentives for developing countries to leapfrog, potential industries/technologies, obtaining of technologies through technology transfer, absorptive capacity, a coherent set of public intervention to support leapfrogging strategy, and partnership between key actors. However, we also found in these cases (1) that technology transfer is continuous and aggressive, and within many kinds of pathways, where in-house and overseas research and development for developing countries is more emphasized than before; and (2) that absorptive capability mainly consists of major domestic firms and the government providing favorable policy and measures. While capability still has the accumulative character, in the case of leapfrogging the time is compressed.

In addition, the analysis also shows that diverse strategies for ELF resulted in different appearances of their development in the wind industry. Moreover, the acquisition of technologies by latecomer countries should be considered under the international framework. The positive dimension is that latecomer countries actively obtain technologies through technology transfer, while the passive dimension refers to the possible impact that the international transfer of technologies available in frontrunner countries may have on the latecomer countries in passively receiving such technologies.

Citation

i) Goldemberg, J. (1998). Leapfrog energy technologies. *Energy Policy*, *26*(10), 729-741.