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Comparing North-South technology transfer and South-South technology transfer: The technology transfer impact of Ethiopian Wind Farms☆

Yanning Chen[1]

Paul H. Nitze School of Advanced International Studies, Johns Hopkins University, United States

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ABSTRACT

The paper compares HydroChina's involvement in Adama Wind Farm in Ethiopia as a case of South-South technology transfer to that of Vergnet, a French firm involved in the construction and financing of Ashegoda Wind Farm, as a case of North-South technology transfer. The impact of technology transfer is evaluated along four dimensions: capital goods and equipment, direct skill transfer, indirect skill transfer, and knowledge and expertise. In recent years, rise of south-south technology transfer led by Chinese-financed overseas renewable energy projects in developing countries has rekindled debate on motivations and impacts of China's increasing engagements. However, the literature on impact of technology transfer in renewable energy is scarce and non-comparative in nature. This paper aims to fill in the gap. Through interviews with key stakeholders and detailed analysis of the negotiation and construction processes in both projects, the research shows although HydroChina shared a higher level of knowledge and expertise to local engineers and university scholars during the construction phase, Vergnet formed stronger long-term skill transfer linkages with local university students and employed a larger share of local workers than HydroChina. It is crucial to note the research presented here shows that host government, rather than donor country, has considerable capacity and can play a vital role in negotiating and maximizing technology transfer. In fact, the host government's expectations and demands contributed to the variations in technology transfer patterns. The paper concludes with a discussion of potential opportunities and challenges, and policy recommendations to facilitate international technology transfer.

1. Introduction

International renewable energy technology transfer refers to horizontal technology transfers that allow developing countries to acquire, adapt, deploy, localize and innovate renewable energy technologies from more developed countries. The concept was first brought up during the United Nations Framework Convention on Climate Change (UNFCCC). International technology transfer is crucial for economic development in developing countries that have little capability accessing latest technologies on their own. Similar to traditional international technology transfer models, international technology transfer in renewable energy technologies also occur through a variety of channels—trade in goods and services; (official) foreign direct investment; trade in knowledge via technology licensing or joint venture; integration into the global value chain (GVC); and international movement of people (Pietrobelli, 1996). Traditionally, developing countries rely on developed countries as sources of technology transfer. Moreover, mechanisms to facilitate international technology transfer has been limited to the few established by the UNFCCC, namely Expert Group on Technology Transfers (EGTT), Technology Needs Assessments (TNA), Clean Development Mechanism (CDM) and Global Environment Facility (GEF).

However, despite high expectations, these mechanisms have largely been ineffective in stimulating international technology transfer in renewable energy. Only a few countries, namely China, India and South Korea, have successfully adapted foreign technology to developed indigenous capability. Global international technology transfer in renewable energy remains small and ineffective (Watson et al., 2007). Some scholars have attributed the lack of success to project-based nature of CDM projects, which are not suitable for large-scale transfer and adaptation. They argue that technology transfer is a cumulative process (Withanaarachchi et al., 2015; Martinot et al., 1997; Brooks, 1995). Others point out technology encompasses both tangible goods as well as information. Technology trade, in the form of equipment import and turnkey projects, is different from technology transfer, which must be internally learned (Grubler, 1998; Cantwell, 2009). Moreover, in recent years, rise of BRICS countries has attempted to facilitate international transfer of renewable energy technology outside the

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E-mail address: ychen282@jhu.edu.

[1] Present address: 2701 Connecticut Ave. NW, Apt. 301, Washington DC 20005, United States.

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List of acronyms

AFD	French Development Bank
CARI	China Africa Research Initiative
CGCOC	CGC Overseas Construction Group
DPP	Diesel Power Products
FOCAC	Forum on China Africa Cooperation
EEP	Ethiopian Electric Power
EEPA	Ethiopian Environmental Protection Agency
EEPCo.	Ethiopian Electric Power Corporation
EEU	Ethiopian Electric Utility
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
ESIA	Environmental and Social Impact Assessment
GDP	Gross domestic product
GTP	Growth and Transformation Plan
GTZ	German Corporation for International Cooperation
HPP	Hydro Power Plant
IISD	International Institute for Sustainable Development
IMF	International Monetary Fund
IPP	Independent Power Project
KNBE	Kariba North Bank Extension Project
MoU	Memorandum of Understanding
MoWIE	Ministry of Water, Irrigation and Electricity
O&M	Operation & Maintenance
SOP	Standard Operating Procedure
WRI	World Resource Institute

framework of UNFCCC, namely through South-South technology transfer. Rise of South-South technology transfer sparks a new debate on whether it is a continuation of or significant shift from traditional international technology transfer paradigm.

This debate leads to the main question the paper seeks to address: what are the differences and similarities between North-South and South-South technology transfer in renewable energy? To answer this question, the paper compares South-South technology transfer in wind industry, exemplified by HydroChina's involvement in financing and the construction of Adama Wind Farm in Ethiopia, to North-South technology transfer in wind industry, represented by Vergnet, a French firm's involvement in the construction and financing of Ashegoda Wind Farm. It finds although HydroChina shared a higher level of knowledge and expertise to local engineers and university scholars during the construction phase, Vergnet formed stronger long-term skill transfer linkages with local university students and employed a larger share of local workers than HydroChina. It is crucial to note the research presented here shows that host government, rather than donor country, has considerable capacity and can play a vital role in negotiating and maximizing technology transfer. In fact, the host government's expectations and demands contributed to the variations in technology transfer patterns. South-south technology transfer has diversified the field of international technology transfer and promises new possibilities for developing countries to catch up in terms of renewable energy technologies.

2. Literature review

Rise of South-South technology transfer represents a significant shift from traditional North-South paradigm. This hypothesis emphasizes three important shifts in conventional notions in the field of international technology transfer—innovation, technology and institution Lema et al. (2015). First, traditional international technology transfer divides the world into developed, thus innovating countries versus developing, thus non-innovating countries. Rise of south-south technology transfer blurred this distinction. Lema and Lema pointed out that some developing countries, such as China and India, became innovating countries through technology diffusion, which was in itself an innovative process (Lema and Rasmus, 2012a). Example from Iran's success in adapting hydro technologies from middle of the innovation pipeline also demonstrated innovation in the diffusion stage (Kiamehr, 2017). However, it is crucial to note that innovation highlighted during the diffusion process is also different from the traditional innovation. It is incremental innovation from learning by doing as opposed to radical innovation bore out of university labs and research centers. Although developed countries have historically favored radical innovation, incremental innovation is ideal for countries that cannot afford large upfront R&D costs and lack human capital to do research to build up their technological capabilities (Kaplinsky et al., 2009).

Second, South-South technology transfer also differs from traditional North-South technology transfer in the technologies transferred. Kaplinsky et al. argued that developing countries constrained by financial, infrastructural and human capital can drive innovation for cheaper and easier to use products—features of the lean production paradigm.[2] Lean production paradigm has crucial implications for international technology transfer. It overcomes biased technological change, a concept introduced by Hanlin and Kaplinsky. In essence, the authors argued that technological changes are products of their market and regulatory environment. In other words, technological innovations from the North may not be "appropriate" technologies in the South. Instead, technological innovations from the South, usually adapted using the lean production paradigm, will achieve better results. They support their hypothesis with analysis from deployment of Chinese capital goods in Tanzania, Kenya and Uganda (Rebecca and Raphael, 2016).

Finally, South-South technology transfer emphasizes the importance of host country organizational and institutional capabilities. Brunel found empirical evidence through studying OECD countries that renewable energy policies have a positive effect on stimulating domestic renewable manufacturing (Brunel, 2015). Mizuno examined technology transfer in wind industry from Denmark and Germany to India. He found that demand-pull and technology-push support policies and market value creation policy are most connected to wind technology advancement in India's case (Mizuno, 2007). Studying wind power CDM projects, Lema and Lema noted CDM projects usually use technology transfer mechanisms adopted by previous projects. As a result, strengthening host country absorptive capability would effectively open up new and better mechanisms for technology transfer (Lema and Rasmus, 2012a). Gallagher categorized policies China adopted to facilitate clean technology transfer through foreign direct investment into four types—domestic manufacturing policy, innovation policy, export promotion policy and market formation policy (Gallagher, 2014). Similarly, Lewis focused on domestic policies employed by China to promote indigenous wind industry growth—particularly its innovative mechanisms to promote technology transfer through mergers and acquisitions, joint ventures and joint research collaborations (Lewis, 2013).

To narrow the scope of international technology transfer to renewable energy requires a distinction between simple, low-tech goods and high-tech, high-value capital goods, also known as, complex capital goods (Chudnovsky et al., 1983). Renewable technology produces complex capital goods. Kiamehr noted that most firms in latecomer countries catch up by moving backward across three broad stages of complex capital goods: 1) conception and design; 2) engineering and realization through projects; and 3) operation and maintenance. In the

[2] Kaplinsky et al. (2009).