



Technology transfer in the hydropower industry: An analysis of Chinese dam developers' undertakings in Europe and Latin America[☆]

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ABSTRACT

Technology transfer is essential for transitioning to a low carbon economy which can include hydropower. Chinese dam developers allegedly dominate the global hydropower industry. Studies have been carried out on technology transfer in their undertakings in Africa and Asia. However, such work is lacking for Europe and Latin America. The aim of this paper is to identify the extent, drivers and inhibitors of technology transfer of Chinese dam developers' undertakings in Europe and Latin America. We find relatively few Chinese undertakings and thus limited evidence for technology transfer both in Europe and Latin America. Transfers identified are frequently mutual with the Chinese player transferring technology to the host country and vice versa. This transfer is driven by business considerations in Europe (costs, capacities) and Latin America (costs, lacking access to finance), but also geopolitical ones (Europe: creation of a trading area; Latin America: access to (natural) resources). It is impeded by Chinese dam developers' poor reputation regarding safeguards as well as (only in Latin America) protectionist policies and significant capacities of host country players. Our research provides transparency regarding the European and Latin American hydropower industry, while also highlighting that attempts to influence what kind of technology is transferred by Chinese dam developers may be worthwhile.

1. Introduction

The transition towards a low carbon economy is seen as a major challenge by policy-makers around the world (Bridge et al., 2013; Geels, 2012). Hydropower dams are considered by many as a part of the energy mix of a low carbon economy, particularly for developing countries which have not exploited many economically viable hydropower sites yet (Gernaat et al., 2017; Zarfl et al., 2015). Hydropower already provides 16% of the global electricity and about 85% of global renewable electricity (IEA, 2016). Its role as a renewable electricity source is projected to grow in the coming years due to an unprecedented boom in dam construction currently under way with installed global hydropower capacity expected to increase by 73% until 2040 (Zarfl et al., 2015). Despite this boom, hydropower remains extremely contested due to its vast negative environmental and social impacts (Khagram, 2004; Kirchherr et al., 2016a; McCully, 2001; WCD, 2000). Some have even questioned if hydropower is an appropriate

technology to use because of these impacts (Ansar et al., 2014; Kirchherr, 2017a; Warner et al., 2017).

Mitigating hydropower dams' negative environmental and social impacts is a challenge, as is their construction from an engineering standpoint, particularly for many energy-hungry developing countries (Biswas, 2012; Hensengerth, 2015a). Traditionally, the World Bank as the largest international donor linked to hydropower facilitated technology transfer (term defined in Section 3) to enable developing countries to exploit their hydropower resources (Kirchherr et al., 2017; Park, 2010). However, a funding gap opened when World Bank decided to opt out of hydropower dam financing in the early 2000s due to the massive public protests.¹ This funding gap helped to prepare the ground for the rise of Chinese players in the global hydropower industry (Biswas, 2012; International Rivers, 2012; Kirchherr, 2017b; McDonald et al., 2009). It coincided with the Chinese government's 2001 Going Out Strategy which encouraged SOEs to expand abroad to continue their growth and increase Chinese influence (Chen et al., 2017; Motta

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¹ The World Bank has engaged again in hydropower financing again around 2010 (Kirchherr et al., 2017; Park, 2010).

and Matthews, 2017).

Chinese hydropower dam developers² are said to dominate the global dam industry nowadays (Urban et al., 2015a, p. 577 ff.; Verhoeven, 2015, p. 178 ff.). Yet a comprehensive and up-to-date public database on dam projects with Chinese involvement around the world is not available (Kirchherr, 2017b). Most scholars, e. g. Urban et al. (2013) and Kirchherr et al. (2017b), seeking data on such involvement rely on the database developed by International Rivers, an NGO mostly advocating against large dams (Eichert, 2014), which was last updated in November 2014 (International Rivers, 2014). However, the industry is dynamic and much has changed since 2014 (Tan-Mullins et al., 2017).

Sinohydro is believed to be the largest dam developer in the world allegedly constructing every second dam globally (Mang, 2012, p. 2; Verhoeven, 2015, p. 124). The second major Chinese dam developer is China Three Gorges Corporation (CTGC) which built the infamous China Three Gorges Dam (Wilmsen and Webber, 2016; Xu et al., 2011). Other major Chinese dam developers are China International Water and Electric Corporation (CWE) and China Gezhouba Group (International Rivers, 2015; Mang, 2012; Urban et al., 2015b). All of these companies are state-owned enterprises (SOEs) (McDonald et al., 2009).

Numerous scholars have studied Chinese dam developers' engagement overseas in recent years. Two observations stand out when examining this body of literature. First, only a single study, Urban et al. (2015b), considers Chinese dam developer' involvement from the perspective of technology transfer despite hydropower dams' alleged role as a (challenging to develop) source of renewable electricity for developing countries aiming to transition to a low carbon economy. Second, current studies focus on dam projects with Chinese involvement in Asia (e. g. Matthews and Motta, 2015, Hensengerth (2015a, 2015b), Chan, 2017, Lamb and Dao, 2017) and Africa (e. g. Hensengerth, 2012, Kirchherr et al., 2016b, Yankson et al., 2017) or both Asia and Africa (e. g. Tan-Mullins et al., 2017, Siciliano and Urban, 2017, Urban et al., 2015a), while neglecting other parts of the world.³

The regional focus of this study is Europe and Latin America (we consider those countries to be part of Europe respectively Latin America that have been outlined as such by WHO (2017a, 2017b). Europe and Latin American may be regions of specific interest for at least two reasons. First, both regions are viewed as regions declining in power (Edwards, 2009; Webber and Douglas, 2016) with rising powers such as China possibly exploiting this decline (Christensen, 2015). Second, Europe and Latin America appear as notable markets for Chinese hydropower players with every tenth dam with Chinese involvement being constructed in Europe and Latin America, according to International Rivers (2014).

This paper aims to advance the literature on Chinese dam developers by providing a helicopter view on technology transfer in Chinese dam developers' undertakings in Europe and Latin America.⁴ This is the first study that specifically examines Chinese undertakings in Europe and Latin America and thus also technology transfer in Chinese dam developers' undertakings in these parts of the world, as far as we are aware. We examine the extent, drivers and inhibitors of technology

² We usually abbreviate 'Chinese hydropower dam developers' with 'Chinese developers' throughout this study to enhance readability. We note that a 'Chinese hydropower dam developer' can also be a firm that merely provides elements of the hydropower dam, e. g. turbines.

³ Two exceptions regarding the second observation are acknowledged. First, McDonald et al. (2009) provide a global overview regarding Chinese dam developers' undertakings. Second, Nordensvard et al. (2015) examine Sinohydro's policy documents. Yet both of these studies lack specific discussions regarding relevant undertakings in selected regions such as Europe and Latin America. We further note that information regarding technology transfer in undertakings involving Chinese dam developers can be retrieved from studies mentioned in this paragraph beyond Urban et al. (2015b), whereas technology transfer is not the theoretical framing of these studies.

⁴ We do not examine European and Latin American dam developers' undertakings in China via this work.

transfer in Chinese dam developers' undertakings in Europe and Latin America. To do so, we have carried out more than 40 semi-structured interviews with relevant industry players in 2015, 2016 and 2017 including interviews with several Chinese dam developers such as CTGC and CWE. These interviews are complemented by document analysis. Overall, we find relatively few undertakings of Chinese dam developers both in Europe and Latin American and thus limited evidence for technology transfer. The technology transfer identified is frequently mutual with the Chinese dam developer transferring technology to the host country and vice versa. It is driven both by business and geopolitical considerations. Meanwhile, it is inhibited by Chinese dam developers' dismal reputation regarding safeguards and (only in Latin American) protectionist policies and significant capacities of host country players.

The remainder of this paper is organized as follows. Section 2 provides background regarding the hydropower industry in Europe and Latin America. Section 3 outlines technology transfer as the theoretical framing for this study. Section 4 presents our methods. Meanwhile, Section 5 analyzes the technology transfer and its drivers and inhibitors for Chinese dam developers' undertakings in Europe and Latin America. We summarize our argument and outline policy implications of this work in Section 6.

2. Background

While Europe as a global power may be declining, electric power consumption per capita in Europe remains among the greatest in the world (World Bank, 2017a). Hydropower provides around one-third of this electricity (World Bank, 2015). Countries such as Norway gain more than 95% of their electricity from hydropower (World Bank, 2015). Yet hydropower development in Europe is stagnating since the most lucrative sites have already been developed in the first half of the 20th century (Biswas, 2012). The exception are selected countries in Eastern Europe which can still hold large unexploited and economically viable hydropower potential (IHA, 2017; World Energy Council, 2016a). Interviewees noted that the general stagnation of hydropower development in Europe has led to a decay of hydropower capacities among many European players (further information on interviewees in Section 4). "The Chinese outcompete us on [technical] capacities to construct large dams", a European dam developer said. This resonates with Kirchherr et al. (2016b) who writes that Chinese developers would be known for delivering "large dam projects with relatively few overruns in either the schedule or budget".

Interviewees shared the impression that Chinese dam developers are extremely active in Europe and even felt threatened by them at times. For instance, a policy-maker at the European Investment Bank (EIB) complained that "the Chinese are trying to steal our projects", whereas he acknowledged that EIB does not systematically scan Chinese dam developers' undertakings in Europe. However, the extent of Chinese undertakings in Europe is limited, according to our study. A total of 15 Chinese undertakings were identified via our work (Table 4). This accounts for a maximum of one-tenth of total undertakings in Europe, according to estimates from our interviews. The identified undertakings are concentrated in Eastern Europe. Most (three) are in Russia, followed by Macedonia and Georgie (two each). Of the identified undertakings, five are proposed, one under-construction, seven are completed and one is suspended.⁵

While electricity consumption in Europe is significant, the opposite is true in Latin America. Only Africa consumes less electricity per capita than Latin America. Much of Latin America's energy stems from hydropower, with the region accounting for over 20% of global hydropower production (IHA, 2017; Rubio and Tafunell, 2014). Excluding China, Latin America has experienced the fastest hydropower growth in

⁵ We could not determine the status of one undertaking.

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