Future DAMS

Design and Assessment of water-energy-food-environment Mega-Systems

Mapping the evolving complexity of large hydropower project finance in low and lower-middle income countries

Judith Plummer Braeckman[1], Sanna Markkanen[1] and Pon Souvannaseng[2]

[1] University of Cambridge Institute for Sustainability Leadership (CISL), UK

[2] University of Manchester, UK

FutureDAMS

Working Paper 007

February 2020

ISBN: 978-1-913093-06-8

Cite this paper as: Plummer Braeckman, J., Markkanen, S., and Souvannaseng, P. (2020) Mapping the evolving complexity of large hydropower project finance on low and lower-middle income countires. FutureDAMS Working Paper 007. Manchester: The University of Manchester.

www. futuredams.org

Abstract

The structure and key actors involved in large hydropower project financing in low and lower-middle income countries (LICs and L-MICs) has changed considerably over the past 50 years. Exclusively publicly funded hydropower projects, typically financed by the host country government with support from multilateral development banks (MDBs), have become less common, while public-private-partnerships (PPPs) and new forms of bilateral finance arrangements have become more prevalent. However, purely privately financed projects with no public or MDB finance remain unusual in large hydropower projects in LICs and L-MICs.

This paper traces the evolution and complexity of hydropower financing from the early 1970s to the present day, showing how the types and roles of various actors have changed over time and how new types of financing packages have surfaced to meet the growing need for large energy infrastructure projects in LICs and L-MICs. It focuses on the three most commonly used models of hydropower project financing in LICs and L-MICs: fully public finance, PPPs, and new bilateral finance. Examples from LICs and L-MICs are used to illustrate the 'typical' features of each financing models, as well as their strengths and limitations.

Projects developed through PPPs often involve a complex mix of investors and lenders from both public and private sectors, as well as guarantees from MDBs and other risk mitigation measures. New forms of bilateral financing arrangements signal a return to 'simpler' financing models akin to the fully public projects in the pre-2000s, but typically involve a different type of contractual arrangements and sources of origin. Although 'new' bilateral finance is issued by many countries, including some OECD countries, the predominant position of China in this field has resulted in 'new' bilateral finance often being referred to as 'Chinese finance'.

Keywords

Hydropower, finance, project finance, developing countries, risk, risk mitigation, sustainability

JEL Codes

G32, O16, O19

Acknowledgements

This work was supported by UK Research and Innovation-Economic and Social Research Council [ES/P011373/1] as part of the Global Challenges Research Fund. The FutureDAMS consortium comprises some 30 researchers across various universities and research institutes working to improve the design, selection and operation of dams to support sustainable development. This paper is the second in a series of working papers emerging from the project with a specific focus on the questions around sustainable finance for sustainable hydropower projects in developing countries. The authors would like to thank David Hulme at The University of Manchester and two anonymous reviewers from the FutureDAMS consortium for their valuable comments on the content. The authors would also like to acknowledge the unfailing support of the Cambridge Institute for Sustainability leadership (CISL) Sustainable Finance Team, particularly Jake Reynolds and Nina Seega for their comments on the final draft, and Colette Bassford for her assistance with publication.

Contents

1 Introduction

Much planned hydropower development is situated in LICs and L-MICs,[1] as this is where the largest share of the world's techno-economically feasible hydropower potential remains. In these countries, large hydropower projects are regarded as attractive due to their ability to provide stable, low-carbon, cost-effective electricity to under-served populations and a growing industrial base, while delivering a range of additional benefits such as flood control, irrigation and potable water reservoirs associated with multi-purpose projects (World Energy Council, 2015; IEA-ETSAP & IRENA, 2015).[2] Sustainably developed hydropower can also perform an essential role in stabilising energy grids by backing up intermittent renewable energy sources and providing electricity storage (IEA-ETSAP & IRENA, 2015; World Energy Council, 2015).

The financing options available for LICs and L-MICs affect the way these countries are able to utilise their natural resources for social and economic development, including progress towards the United Nations Sustainable Development Goals (SDGs). In order to understand how new hydropower projects in LICs and L-MICs can be financed, it is useful to explore how the nature of hydropower financing has evolved over time, and the strengths and limitations of the various models which have been applied. This paper seeks to demonstrate the implications of these changes for countries wishing to utilise their currently untapped hydropower resources for economic development. We map out the three most commonly used models of hydropower finance – public, public-private partnership (PPP), and new bilateral finance – and illustrate, with examples, how these different forms of finance have played out in practice. The timeframe examined in this paper is the past 50 years.

Changes in hydropower finance over time have been influenced by the broader political and economic context of reduced availability of public sector funds, the sustainable development imperative, and the rise of new financing actors such as China and South Korea as key players on the global economic and political stage. A key theme that characterises the developments in hydropower finance in LICs and L-MICs, especially over the past 30-year period, is growing complexity. In the 1970s to 1990s, most large hydropower projects in emerging economics were developed using primarily public sector funding, with equity investment from the host country government and debt finance from multilateral development banks (MDBs). Since the millennium, other types of financing arrangements have become more prevalent.

Unlike publicly owned and developed projects, PPP projects tend to have a complex structure, with multiple actors, who sometimes assume multiple roles. The shift towards

[1] Low income countries (LICs) and lower-middle income countries (L-MICs) are definitions used by OECD and the World Bank. Since July 2019, a country has been classified as low-income (LI) or lower-middle income (L-MI) if its Gross national income per capita is US$3,995 or below. The term low and lower-middle income countries (LICs and L-MICS) is used to refer to all countries that meet this criterion.

[2] A large dam, as defined by the International Commission on Large Dams (ICOLD, 2011, p 3), is "a dam with a height of 15 metres or greater from lowest foundation to crest or a dam between 5 metres and 15 metres impounding more than 3 million cubic metres".

greater involvement of private finance in LICs and L-MICs does not entail simply replacing multilateral or public finance with a single source of private debt: the perceived level of risk associated with large hydropower projects means that private sector financiers are rarely willing to provide a substantial proportion of the required funds on their own. As a result, most PPP-financed projects involve a complex mix of investors, lenders, public finance and guarantees, and multiple legal agreements to protect the lenders and investors.

In some more recent financing arrangements, the debt financing for new projects comes predominantly (or exclusively) from export credit agencies, such as China Exim Bank. Under these arrangements, it is not unusual for the vast majority of debt to be provided by just one financing agency directly to the host country government. Although these bilateral financing arrangements herald a return to 'simpler' financing models (with fewer actors and more clearly defined roles), the dynamics and implications of this 'new' bilateral debt are qualitatively different from the more 'traditional' public finance model.[3]

New forms of bilateral financing arrangements come with constraints and risks, such as the absence of strong safeguards and increased government indebtedness for the countries that access them. Unlike more traditional forms of bilateral financing in the late 1980s and 1990s, which typically included a substantial grant element from a high-income country to a low-income country, or export credit finance for a small proportion of project cost, 'new' bilateral arrangements entail commercial debt or export credit issued by a middle-income country to a low income country. The debt finance provided will typically cover the vast majority of the total costs of the project (often up to 80%–85%), meaning that projects often go ahead without any other financiers involved. For the poorest countries this may include a proportion of concessionary debt finance. Although new bilateral finance is issued by many countries, including some OECD countries, the predominant position of China in this field has resulted in new bilateral finance often being referred to as 'Chinese finance'[4]. At the same time, many development banks in OECD countries continue to issue bilateral debt finance to PPP projects in LICs and L-MICs.

In LICs and L-MICs, the nature and structure of the financing options available to a given project depend on a number of factors, including the political context and conflicting sustainability pressures in the host country. Just as the geotechnical aspects of each hydropower project site are unique, so are the financing arrangements and their implications. Consequently, the extent to which PPP financing and new bilateral finance are being utilised in large hydropower project development in LICs and L-MICs varies across different regions and countries. In Southeast Asia, for example, there is a growing trend towards greater use of private finance, especially for projects in countries such as Lao PDR which exports electricity to the financially robust power market in Thailand. In Sub-Saharan Africa, private

[3] Bilateral finance from country aid programmes or export credit agencies (such as that provided by KfW or Hermes) is not new and has long been used in large infrastructure projects. 'New' bilateral finance, however, is coming from different countries, such as China and Korea, and in significantly greater quantities than that previously available. In the late 1990s, bilateral aid was dominated by funds from Japan (Tirpak & Adams, 2008). The detailed analysis of the incentives for countries like China to provide this new bilateral finance is not covered in this paper, but is discussed in other research such as Chen et al (2016) and Hensengerth (2013).

[4] See Heiser et al (2018) for a detailed explanation and discussion.

finance has been slower to take off, with private finance for the entire electricity sector sitting at a five-year rolling average of under US$2 billion (IFC & GBS Cape Town, 2018). On the other hand, Africa has been actively taking up the opportunities offered by new bilateral finance, as indicated by a five year rolling average of nearly $4.5 billion for energy infrastructure projects in Sub-Saharan Africa (excluding South Africa) from China alone (IFC & GBS Cape Town, 2018).

1.2 Methodology

This paper draws on a literature review and desk-based analysis to map out how project financing has changed over the past 50 years. Our research has concentrated primarily on the roles that various actors have taken in the financing and development of large hydropower projects in LICs and L-MICs, how these have changed over time, and what implications arise for host countries.

Three main financing approaches were identified, each with certain 'typical' characteristics which we illustrate through examples from LICs and L-MICs in South and Southeast Asia and Sub-Saharan Africa. The case study examples are drawn from varying geographical and political contexts in countries with low electrification rates and high development needs, in order to contextualise the discussion on the strengths and limitations of the three different financing models.

This paper focuses exclusively on the financing of large hydropower projects which are grid connected.[5] Although small-scale hydropower projects and micro-hydropower plants are helpful for decentralised electricity generation and micro-grids (Pepermans et al, 2005), these projects have an entirely different financial structure.

1.3 Outline of the paper

In the next section of this paper, we provide a brief overview of hydropower project development over time and discuss how large hydropower projects can facilitate sustainable socioeconomic development in LICs and L-MICs with low electrification rates. Section 3 focuses on fully publicly funded projects, while Section 4 describes PPPs with examples from Cameroon and Lao PDR. Section 5 sheds light on new types of bilateral finance, with examples from Ghana and Uganda. Section 6 discusses the relative strengths and limitations associated with each of the three financing models, with conclusions offered in Section 7.

2 Hydropower as a tool for sustainable socioeconomic development

2.1 A brief history of hydropower project development

Hydropower is an important and reliable source of renewable energy (IEA, 2018; IRENA, 2019). Since its inception in the late 1800s, hydropower has grown to provide 16% of electricity worldwide (IEA, 2018). It is used to generate electricity in some 160 countries, accounting for more than 50% of total electricity generation in at least 35 countries (IEA-

[5] For an explanation of how project size affects financing options, see Markkanen and Plummer Braeckman (2019).

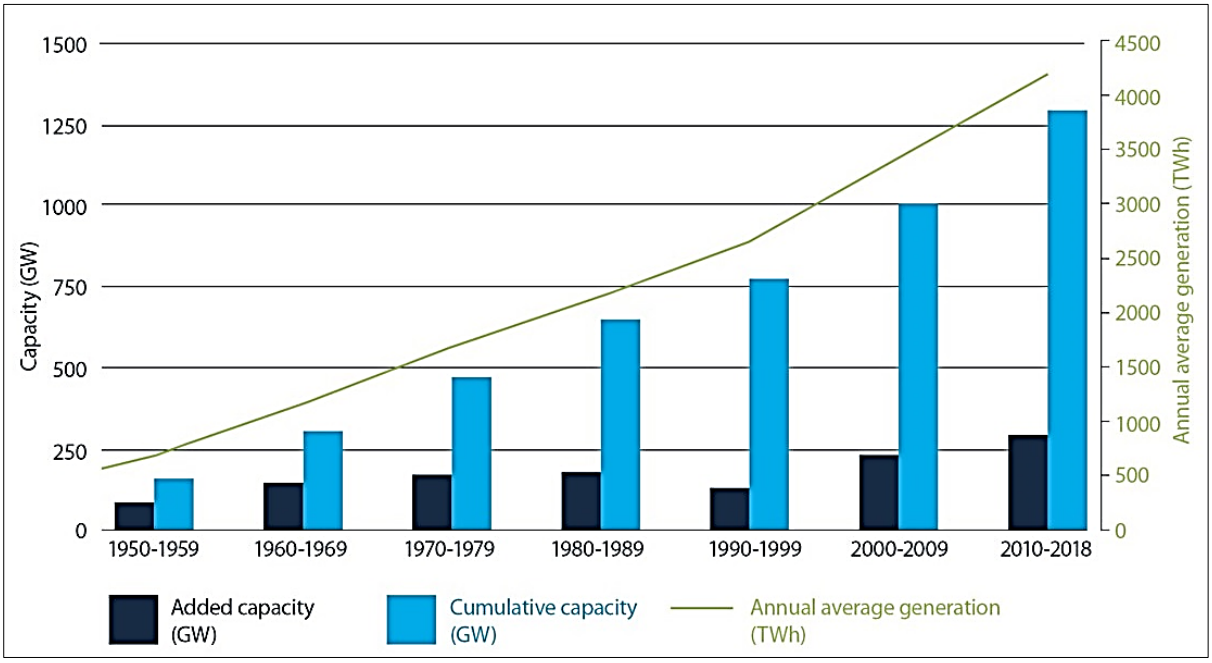
ETSAP & IRENA, 2015). Even after recent increases in intermittent renewable energies such as wind and solar, hydropower still accounts for over 50% of renewable electricity globally (IRENA, 2019) and over 95% of the world's operational electricity storage, making it an important enabler for the deployment of other renewable energy systems (World Energy Council, 2015).

The period between the 1940s and 1970s was, in many ways, the 'golden age' of hydropower, with large numbers of projects built, especially in Western Europe, the Soviet Union, North America and Japan (IHA, 2019). Many of these hydropower plants remain in operation, although most have undergone rehabilitation, modernisation or re-development (IEA-ETSAP & IRENA, 2015). In the 1980s new project development stagnated before declining in the 1990s, largely as a result of growing financial constraints and concerns over the environmental and social impacts of hydropower development (IHA, 2019; World Energy Council, 2015). However, a few very large projects of over 10,000 MW were planned during the 1990s, particularly in Brazil and China (IHA, 2019).

The shift towards greater involvement of private finance in emerging economies does not entail simply replacing multilateral or public finance with a single source of private debt.

From 2000 onwards, hydropower development gained a renewed momentum, particularly in the LICs and L-MICs of Asia, Africa and South America (World Energy Council, 2015; IEA-ETSAP & IRENA, 2015) – see Figure 1. Nearly 500 GW of new hydropower capacity was installed between 2000 and 2017, with the annual increase in capacity from 2010 onwards double that of the previous decade (World Energy Council, 2015; IHA, 2019).

Figure 1: Hydropower growth in capacity through the decades



Source: International Hydropower Association (IHA) (2019).

In 2018, global investment in hydropower slipped below $50 billion for the first time in a decade (IEA, 2018).[6] This decline does not signify a lack of potential capacity – in fact, approximately 50% of global hydropower capacity remains untapped (World Energy Council, 2015; IEA-ETSAP & IRENA, 2015). However, much of the untapped potential is in LICs and L-MICs with limited public sector resources, affecting the hydrological data and analysis available to assess potential projects. Low country credit ratings and unsettled political conditions further discourage private sector participation in these geographies (World Bank, 2009). As a result, while there is no shortage of finance for complex hydropower projects, there is a shortage of projects with suitably managed risk profiles (IHA, 2016).

The key challenge for future hydropower development is to match available financing to projects with suitably managed risk profiles, in particular optimal economic and developmental benefits alongside robust environmental and social protections. This is both complex and challenging, yet critically important for LICs and L-MICs with untapped hydropower resources and growing demand for additional electricity generation capacity (IHA, 2019).

2.2 Utilising sustainable hydropower to improve electricity access rates and to stabilise supply

Reliable energy supply and productive use of electrification are essential prerequisites for economic development (Blimpo & Cosgrove-Davies, 2019), placing low-carbon energy generation and improvements to electricity distribution infrastructure at the forefront of the sustainable development challenge. Despite significant expansion of electricity access in the past few decades, partially through the deployment of decentralised renewable electricity technologies, access to modern energy services remains incomplete in many parts of the world, especially in South and Southeast Asia and Sub-Saharan Africa (IEA, 2017; Blimpo & Cosgrove-Davies, 2019). South Asia, Southeast Asia and Sub-Saharan Africa have the lowest electricity access rates globally (World Bank & IEA, 2015), with businesses in these regions most likely to experience electricity outages which hinder economic development (Blimpo & Cosgrove-Davies, 2019). In Sub-Saharan Africa, only 43% of the population have access to electricity, and the total number of people without electricity access has increased rather than decreased over the past decade, as population growth has outpaced the improvements in grid extensions (although the averages again hide considerable variation between more developed countries such as South Africa and countries with very low electricity access rate such as Chad and South Sudan) (Blimpo & Cosgrove-Davies, 2019).

In Southeast Asia, 65 million people continue to live without electricity and 250 million are reliant on solid biomass as a cooking fuel, although considerable variation exists between countries such as Thailand and the Philippines and the less developed Lao PDR, Cambodia and Myanmar (IEA, 2017). Although electricity access rate in South Asia increased from 57% to 80% over the period from 2000 to 2014, more than 250 million people in India still lack access to electricity (World Bank, 2017a). In all these regions, indoor and outdoor energy-related air pollution associated with the use of biomass in cooking and heating continues to present major risks to public health and contribute to rising carbon dioxide

[6] For a more general view of renewable energy finance, see Donovan (2015).

(CO_2) emissions (IEA, 2017) and deforestation (World Bank & IEA, 2015; World Bank, 2017a).

Although approximately half of the existing hydropower potential is already utilised for electricity generation in developed countries, the untapped potential for hydropower remains high in LICs and L-MICs (IEA-ETSAP & IRENA, 2015). In Nepal, for example, the electricity access rate is around 50% in urban areas and below 25% in rural areas (World Bank & IEA, 2015). Less than 1% of the country's 90,000 MW hydropower potential is currently exploited (Alam et al, 2017), while wood and agricultural waste constitute the two largest energy sources (World Bank & IEA, 2015). In Sub-Saharan Africa, according to figures in 2013, more than 90% of the available economically feasible hydropower potential was yet to be harnessed for energy generation, in spite of a sustained and chronic power crisis throughout the region (Corfee-Morlot et al, 2019; World Bank & IEA, 2015; World Bank, 2017a),[7] with negative implications for health, employment and economic growth (Blimpo & Cosgrove-Davies, 2019).

New hydropower development in LICs and L-MICs has the potential to foster sustainable economic growth and improve electricity access rates without forcing these countries to compromise their commitment to the Paris Agreement (World Energy Council, 2015). Small-scale renewable electricity technologies (including micro-hydropower) can provide a good low-cost solution to improving electricity access in rural off-grid communities. Large hydropower projects, on the other hand, can provide electricity to densely populated urban areas and help stabilise the grid-based electricity supply to ease power shortages. In addition to being cost-effective, sustainable hydropower provides a stable electricity source to support a growing industrial base, while also delivering a range of additional benefits such as flood control, irrigation and potable water reservoirs associated with multi-purpose projects (World Energy Council, 2015; IEA-ETSAP & IRENA, 2015). Increased investment in hydropower in LICs and L-MICs could have multiple benefits, ranging from improved productivity and new economic opportunities to the environmental and health impacts arising from access to cleaner cooking fuels. Bujagali hydropower project in Uganda nearly doubled the country's electricity supply, while Nachtigal hydropower project in Cameroon, which achieved financial closure in 2018,[8] is expected to increase Cameroon's electricity supply by 30% (World Bank, 2018; MIGA, 2018) and to help ease the frequent power outages which currently occur for approximately 160 hours per a year (MIGA, 2018).

Better utilisation of the untapped hydropower potential in LICs and L-MICs can also facilitate progress towards the broader United Nations Sustainable Development Goals (SDGs): directly for SDG7 (access to affordable, reliable, sustainable and modern energy for all), and indirectly for SDG8 (decent work and economic growth) and SDG9 (resilient infrastructure and inclusive and sustainable industrialisation). Non-energy functions of multi-purpose dams, such as irrigation and water resource management, can support progress towards SDG 1 (no hunger), SDG2 (eradication of poverty) and SDG6 (clean water and sanitation). Hydropower can also help stabilise power grids by backing up intermittent renewable energy

[7] The economically feasible hydropower potential of a country will change over time, as there are changes in technology and the cost of energy from other sources (IRENA, 2012).

[8] For definitions of terms such as 'financial closure', see Markkanen & Plummer Braeckman (2019).

sources and providing electricity storage (IEA-ETSAP & IRENA, 2015; World Energy Council, 2015).

However, the full range of benefits is likely to materialise only if the development and financing of new projects is socially, economically and environmentally sustainable. This entails incorporating global best practice through a framework such as the Hydropower Sustainability Protocol (Locher et al, 2010; IHA, 2015) or development bank standards such as the International Finance Corporation's (IFC) performance standards and equator principles (Equator Principles, 2013). Meeting these standards and mitigating any adverse impacts, in both the short and long term, should be pre-requisites for all transactions. The economic sustainability of a dam can be enhanced by utilising its hydropower generation capacity to finance the construction of a multipurpose reservoir or a project that aids adaptation to climate change (Berga, 2016).

In addition to environmental and social sustainability criteria, new projects in LICs and L-MICs must be sustainably financed so that the electricity generated from hydropower will be accessible and affordable to local consumers without crippling the host country government finances. Although some international standards exist, including the Equator Principles (adopted by most international banks), the challenge of deciding what constitutes a sustainable financing model for a hydropower project is less straightforward than identifying potential social and environmental impacts and outlining the minimum standards for mitigating them.[9] This is a result of the growing complexity of financial packages and the variety of ways in which these can be structured.

The nature and structure of the financing options available to a given project depend on a variety of factors, including the political context and conflicting resource management and sustainability pressures in the host country. Just as the geotechnical aspects of each hydropower project site are unique, so, increasingly, are the financing arrangements and their implications; a financing package that may work for a specific project in a certain country may not be available or suitable for another project elsewhere. The need for significant equity and debt investment may constrain project development, especially in countries with a low credit rating. Thus the discussion of financing in the following sections generalises to types of financing package, while recognising that individual variations exist.

3 Hydropower financing: fully public projects

This section provides an overview of hydropower project financing when only public sector actors are involved. The history and key features of this approach to hydropower financing are illustrated with an example of the Itezhi Tezhi hydropower project in Zambia.

3.1 Host country governments and MDBs

After the post-World War II reconstruction of Europe was completed, the World Bank shifted its focus to supporting public sector projects in LICs and L-MICs. It was around the same time, in the late 1950s and early 1960s, that several of the large regional development banks

[9] For a more detailed definition and discussion of 'sustainable hydropower', see ibid.

were first established, including the Asian Development bank (ADB), the African Development Bank (AfDB) and the Inter-American Development Bank (IADB).

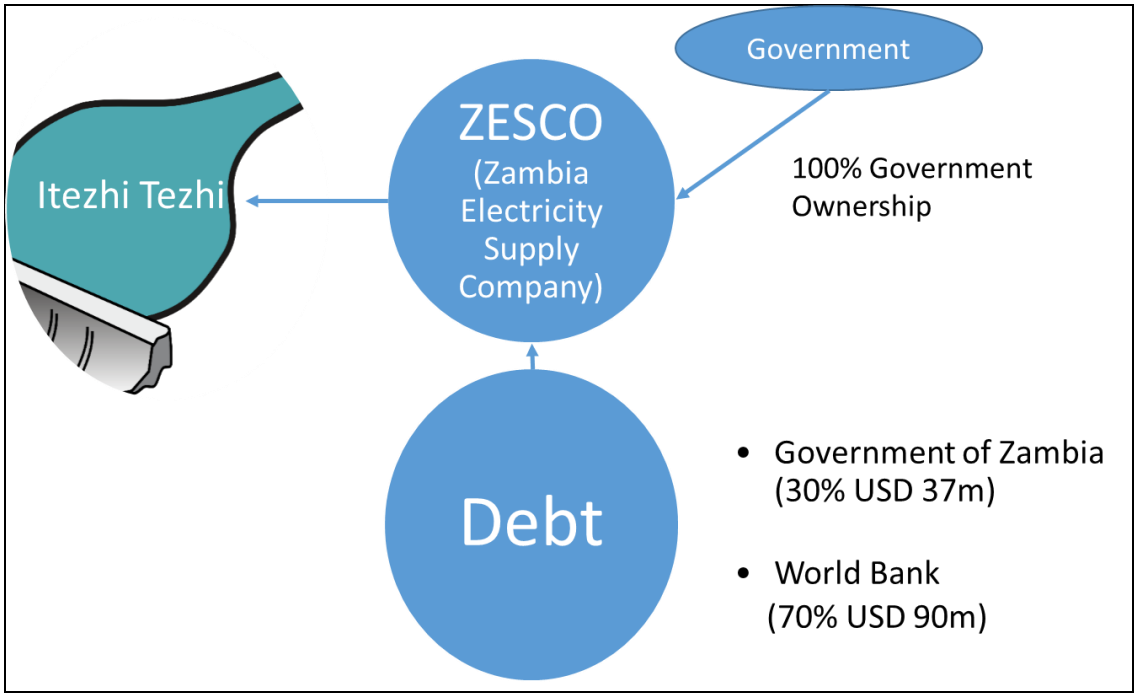
Until the 2000s, the majority of large hydropower projects in LICs and L-MICs were fully publicly funded. These projects involved support from MDBs or bilateral aid agencies in all but the most straightforward cases (such as company owned captive power projects[10]). Available sources of national public finance ranged from full public sector development financing to quasi-commercial government-owned utilities and parastatals (Oud, 2002).

Although financing from MDBs was available to all countries regarded as eligible for international assistance, many of the large energy infrastructure projects developed with MDB and bilateral development finance were located in middle-income countries with fast-growing economies, such as Brazil, China and India (Zimny et al, 2013; Bottelier, 2007). For example, the 1,960 MW Koyna Hydropower project in India, which was commissioned in several stages from 1962 to 1981, was financed entirely by loans from the Government of India to the Maharashtra State Government. The World Bank provided the Government of India with a in US dollars to cover the foreign exchange portion of the cost, which the Government of India then on-lent to the project (World Bank, 1962. The 1,500MW Nathpa Jhakri hydropower project, which began construction in 1993, was initially financed with a single World Bank loan and Government of India equity (World Bank, 1989).

In Zambia, the Itezhi-Tezhi hydropower project was built in 1974–77 with a combination of a World Bank loan, a Government of Zambia loan and internal resources of the government-owned power company, ZESCO. In the absence of a special purpose company, the World Bank funds were lent to ZESCO rather than to the project (World Bank, 1973). As a result, the project's financial structure was relatively simple, as shown in Figure 2. In common with most projects of the time, the project was divided into separate civil works and electro-mechanical contracts through competitive bidding (so called 'traditional contracting').

[10] Company owned captive power projects are electricity generation facilities that are used and managed by an industrial or commercial energy user for their own energy consumption. These projects are typically fully private projects financed, developed and owned by the user, although, under certain arrangements, surplus supply may be sold to the grid.

Figure 2: Itezhi Tezhi financing structure



Source: World Bank (1973)

From the 2000s onwards, fewer hydropower projects in LICs and L-MICs have been financed exclusively by the public sector. Even in Brazil and India, where many projects were previously developed with government funding (sometimes with World Bank support), most projects now have some private sector involvement. A notable exception to this is China, where wholly public sector mega-projects are still being constructed, although more recently these rarely involve MDB finance. For example, the $ 6.3 billion, 16,000 MW Baihetan hydropower plant (expected to be completed in 2021) is jointly financed by three government-owned agencies: the China Development Bank, the China Construction Bank, and the Yangtze Power Company (a subsidiary of the China Three Gorges Corporation) (Poindexter, 2017).

3.2 Strengths and limitations of fully public financing

Fully publicly financed large hydropower projects enabled countries at various stages of development to use their natural resources to meet growing industrial and domestic demands for electricity at low cost, while also improving energy security and self-sufficiency and reducing vulnerability to energy market price fluctuations (Mott MacDonald, 2009). Multipurpose reservoir dams facilitated a wide range of other benefits, including irrigation, flood control, and recreation (World Energy Council, 2015). As the main (or only) shareholder, the host country government retained control over the ownership and operational aspects of these key infrastructure projects from the start, including the ability to set the electricity price to maximise economic benefits and productive uses.

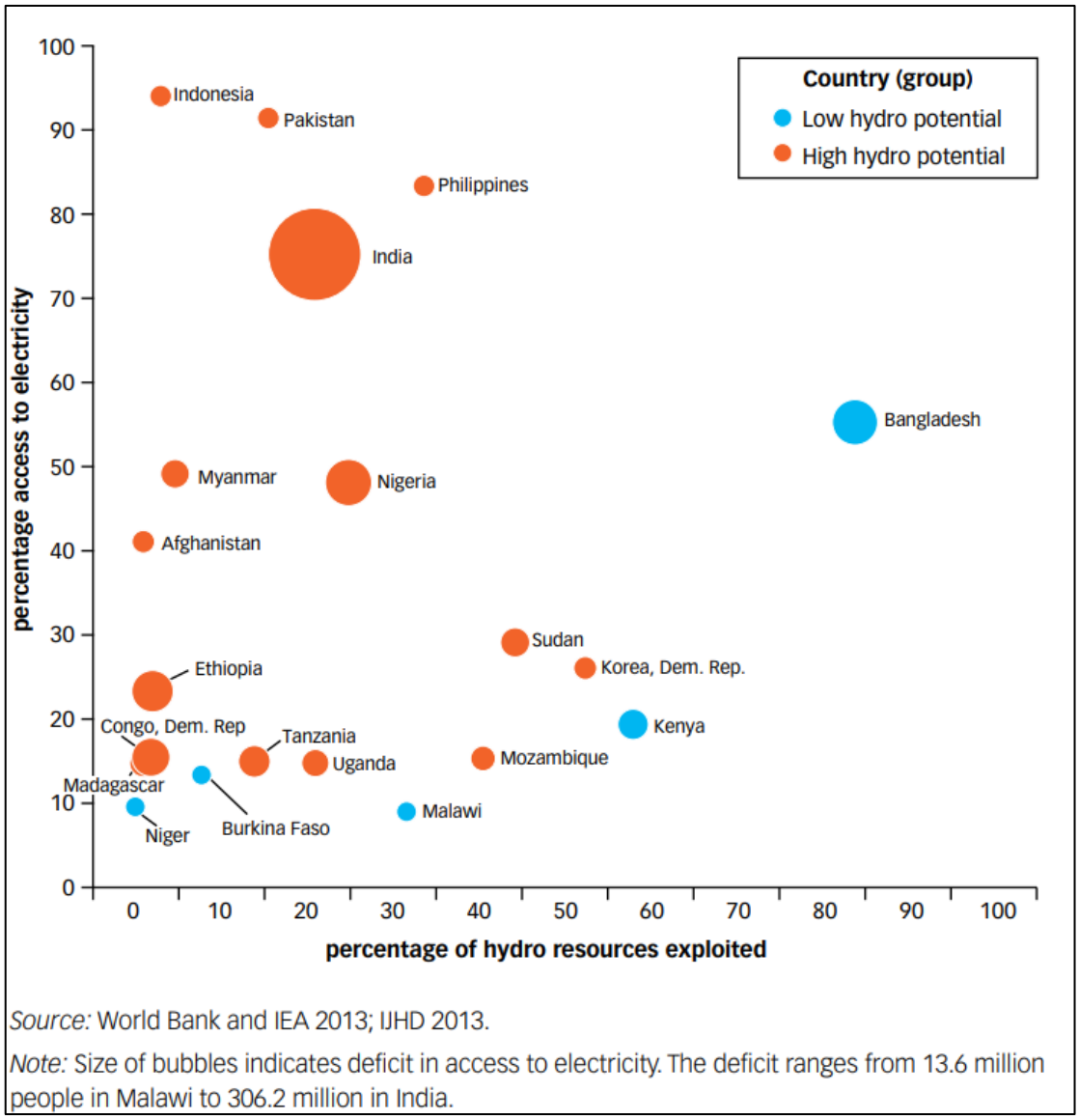
However, large energy projects are costly to develop and, as such, can absorb a substantial proportion of a county's available investment and borrowing potential, disadvantaging other sectors of the economy (Plummer Braeckman et al, 2019). The poorest countries built comparatively few hydropower projects during the second half of the 20th century, as limits to

their indebtedness and constraints on the amount of concessional finance available meant that it was difficult to justify the spending required to finance large-scale hydropower. Although projects such as Owen Falls in Uganda (World Bank, 1961) and Nkula in Malawi (World Bank, 1977) went ahead, there were competing development priorities for the poorest nations' allocation of development finance. As a result, as shown in Figure 3, much of the available technologically and economically feasible hydropower potential in Africa and South and Southeast Asia remains largely untapped, including in countries with low electricity access rates (IEA-ETSAP & IRENA, 2015; OECD/IEA, 2012; World Bank, 2014).

During the heyday of fully public large hydropower projects, the social and environmental impacts of such projects were not always adequately assessed, managed and mitigated. This was a problem especially in LICs and L-MICs. Most public electricity projects in the 1970s to 1990s followed the relevant government frameworks for social and environmental safeguards, which varied in terms of requirements, implementation and enforcement, and were often lacking or absent in developing country contexts. The majority of these frameworks focussed on compensation for compulsory purchase of land, but included little consultation or benefit sharing (WCD, 2000). Even where MDBs were involved, the social and environmental safeguard systems were not always well understood or implemented (World Bank, 2009). The World Bank approved its first policy on involuntary resettlement in 1980 but, for some time afterwards, was still working on the basis of restoring rather than improving livelihoods (Goodland, 2000).

Projects supported by MDBs also gained a reputation for being delayed in preparation and even during implementation (Plummer, 2013). However, there is little evidence as to whether these delays are larger or smaller than those encountered by complex PPP projects which include MDBs, and some research suggests that the extent of delay is related to the country context as much as to the source of funds (Plummer Braeckman et al, 2019).

Figure 3: Hydropower potential, access to electricity and access deficit in 20 LICs and L-MICs



Source: World Bank and IEA 2013; IJHD 2013.

Note: Size of bubbles indicates deficit in access to electricity. The deficit ranges from 13.6 million people in Malawi to 306.2 million in India.

Source: World Bank Group (2014) *Live Wire: A Knowledge Note Series for the Energy & Extractives Global Practice* 2014/36 (page 2) [Available at file:///G:/Projects/External%20Projects/Centre%20for%20Sustainable%20Finance/DAMS%202.0/Library/World%20Bank%20Group%202014_Supporting%20hydropower%20brief%20read%20with%20graphs.pdf]. Accessed 07 February 2020.

4 Public–private partnerships (PPPs)

The amount of finance needed to ensure the continued development of sustainable hydropower is beyond the capacity of the public sector; thus governments are looking to the private sector to support more hydropower projects also in developing countries. In the past 20 years, financing arrangements for large hydropower projects in LICs and L-MICs, such as PPPs, have largely replaced the more traditional models that involved financing projects fully or predominantly from public sector sources. This section explores the issues that arise when PPPs are utilised for financing large hydropower projects in LICs and L-MICs, using

three examples: Nam Theun 2 in Lao PDR, Nachtigal in Cameroon and Xe Pian Xe Namnoy in Lao PDR. The three case studies illustrate the complexity of the financial agreements, the various roles that an actor may perform in PPP projects, and the strengths and limitations associated with the PPP financing model.

4.1 The shift to greater private sector involvement

Towards the end of the 20th century, funding for large hydropower projects was constrained by a shortage of concessionary finance, competing development needs and the negative publicity the hydropower sector received during the 1990s. This negative publicity gained momentum after several projects, especially in the Global South, had been implemented with insufficient consideration of adverse social and environmental impacts (Riethof, 2017; Finley-Brook & Thomas, 2010; Mott MacDonald, 2009).

In 1998, the World Commission on Dams (WCD) was established to find a common understanding on the development of large dams amongst a range of stakeholders, eventually concluding that all projects must contribute to "the sustainable improvement of human welfare" (WCD, 2000). The concrete outcome of the WCD consultation was the establishment of a set of criteria and guidelines to assist stakeholders to meet societal expectations when assessing dam projects (Schulz & Adams, 2019). This was followed by the first International Hydropower Association (IHA) Sustainability Guidelines in 2004 and, a decade later, the Hydropower Sustainability Assessment Protocol (HSAP) (Locher et al, 2010; IHA, 2019; HAS, 2019). Some countries with many existing dams and large untapped potential, such as India and Brazil, have also put in place national-level regulations for large hydropower projects (Hess & Fenrich, 2017; Banerjee, 2014). Whilst these protocols and guidelines emerged too late to influence the fully public projects of the 20th century, they have had a significant impact on the MDB-supported projects developed under PPPs.

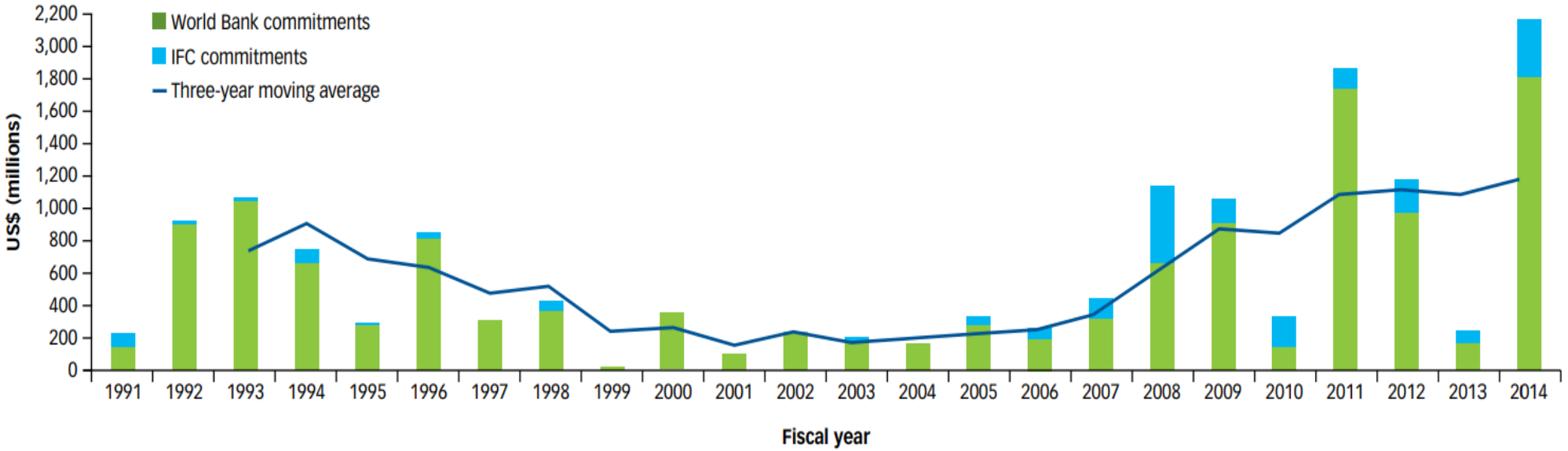
The improved understanding of the social and environmental impacts of large hydropower projects, and the implementation of measures to mitigate them, resulted in renewed acceptance of hydropower. In 2004, the Bonn International Conference on Renewable Energies and the United Nations Beijing Declaration on Hydropower and Sustainable Development both recognised hydropower as an important renewable energy source (World Energy Council, 2015). However, while waiting for the results of the WCD review, many funding agencies, including the World Bank, put planned hydropower projects on hold, resulting in a significant drop in hydropower finance around the turn of the century (as illustrated in Figure 4) (World Bank, 2013; World Energy Council, 2015). By the time confidence in the hydropower sector began to return, MDB interest in energy projects capable of generating revenue had waned (Manibog, 2004). The move away from hydropower was bolstered by an assumption that the private sector would step up to finance energy projects with the potential to generate revenue, while public sector funding should be directed to sectors like health and education that could not be self-funding.

In 1999, it was estimated that annual investment of some $15 billion would be needed for hydropower projects in LICs and L-MICs (Briscoe, 1999). In the context of reduced availability of multilateral and bilateral concessional lending to developing country governments from OECD Development Assistance Committee (DAC) institutions, increasing proportion of this finance would need to come from the private or 'for-profit' sector. The shift

to a greater use of private financing in LICs and L-MICs seemed unlikely: between 1990 and 1995 private finance supported just 7% of new hydropower projects (Briscoe, 1999). This was explained by the reluctance of private sector investors to invest in hydropower projects in unfamiliar markets because of the perceived political, commercial and financial risks, particularly the concern about the long-term payment risk (IFC, 2015). The need for substantial investment to cover set-up costs, such as the various surveys that need to be completed before construction can commence, further increases the level of risk, as the losses will be high if a project fails to reach financial closure (for more detail on the process of achieving financial closure, see Markkanen and Plummer Braeckman (2019)).

To address the challenges listed above, financing models that enable greater private sector contribution but retain some form of MDB involvement are needed to address the financing gap for complex energy generation projects, such as large hydropower in LICs and L-MICs. Consequently, MDBs assumed a new role that focused on leveraging financing for emerging economy projects from private sources. The need for MDBs to 'crowd in' a spectrum of finance from various private and public sources to support sustainable growth and progress towards the SDGs in LICs and L-MICs is reflected in the World Bank's Maximizing Finance for Development (MFD) approach approved in 2017 (World Bank, 2017b). Under the MFD agenda, approaches such as 'blended finance' (IFC, 2017) and complex multilateral guarantees for PPPs are becoming pivotal for large energy infrastructure projects in LICs and L-MICs, including hydropower.

Figure 4: World Bank Group approved contributions to multipurpose hydropower components by year showing decline and resurgence in investment



Note: Lending volumes represent funding for hydropower components in the year of approval. Volume of lending does not necessarily reflect the numbers of projects supported, since it is heavily influenced by the relative cost of projects and the proportion of total project financing that is contributed by the World Bank Group.

Source: World Bank Group (2014) *Live Wire: A Knowledge Note Series for the Energy & Extractives Global Practice* 2014/36 (page 3) [Available at file:///G:/Projects/External%20Projects/Centre%20for%20Sustainable%20Finance/DAMS%202.0/Library/World%20Bank%20Group%202014_Supporting%20hydropower%20brief%20read%20with%20graphs.pdf]. Accessed 07 February 2020.

4.2 Multiple actors, multiple roles

PPP-financed hydropower projects in LICs and L-MICs are fundamentally different from the earlier fully public projects in terms of who is involved, how the projects are structured and what roles the MDBs play. Unlike publicly owned and developed projects, PPP projects tend to have a complex structure, with multiple actors.

The shift towards greater involvement of private finance in hydropower does not involve simply replacing the previously prominent financiers (such as an MDB) with a private provider, as no single institution will accept the risk of such a project alone. The debt arrangements for a large hydropower project typically involve a large number of banks who all take on a proportion of the debt obligation and, consequently, share the risk. These syndicated loans are used especially by development finance institutions (including bilateral development banks) to broaden their co-financing base, co-financing structures and co-financing methods.[11] The additional benefit of syndicated loans is that they can reduce transaction costs by harnessing the due diligence capacity of a multilateral development bank or another lead arranger on behalf of a group of investors to increase the pool of prospective debt financiers for large hydropower projects in unfamiliar country contexts.

In a typical 'blended finance' model, resources are pooled by blending official development assistance (ODA) and domestic public funds with commercial finance. This approach lowers overall borrowing rates and makes developing country projects attractive to private finance institutions (IFC, 2017). Sources under a 'blended finance' model can also include Collective Investment Funds (CIVs), such as United Overseas Bank's ASEAN China Investment Fund III, which made a $25 million private equity investment in Vietnam's largest private hydropower company (Bitexco Power, 2016). Another example of a CIV is Africa50, which is funded by a range of African governments together with the AfDB, and which has recently taken a 15% equity stake in the Nachtigal hydropower project in Cameroon (African Energy, 2018). CIVs are still unusual in hydropower financing, but may play a greater role in the future.

On the equity side, the host country government or a government-owned utility is replaced by a range of private sector investors. Although the government often retains a share of the ownership under a PPP finance structure, this may be significantly smaller than in a typical publicly funded project. Successful examples of private (or public/private) finance for large hydropower in poorer countries tend to find equity investors from other parties involved in the project, such as a major contractor or the off-taker. In the case of the 1,075MW Nam Theun 2 project in Lao PDR, for example, EDF were both the principal shareholder and the principal contractor, and the Electricity Generating Company of Thailand was both an off-taker and a shareholder. Although such arrangements may be necessary to achieve financial closure, they may create potential conflicts of interest, which require careful management to avoid.

The complexity of the resulting structure is illustrated in Figure 5 for the Nam Theun 2 project, which was commissioned in 2010. The financing package for this project involved

[11] For more detail on syndicated loans and how syndicated loans are used in the development finance context, see https://www.ebrd.com/work-with-us/loan-syndications.html.

the Government of Lao PDR, four MDBs, four export credit agencies, French bilateral funds from two agencies, nine international commercial banks, and seven Thai banks (Porter & Shivakumar, 2010). This included two syndication packages: one for Thai banks and one for international banks. The level of complexity becomes even more apparent when the links between the various financing agencies are highlighted. The ADB, for example, provided three different types of funds: grant funds of $20 million to help fund the Government of Lao PDR's equity contribution; a project loan of $50 million; and a partial risk guarantee of $42 million.

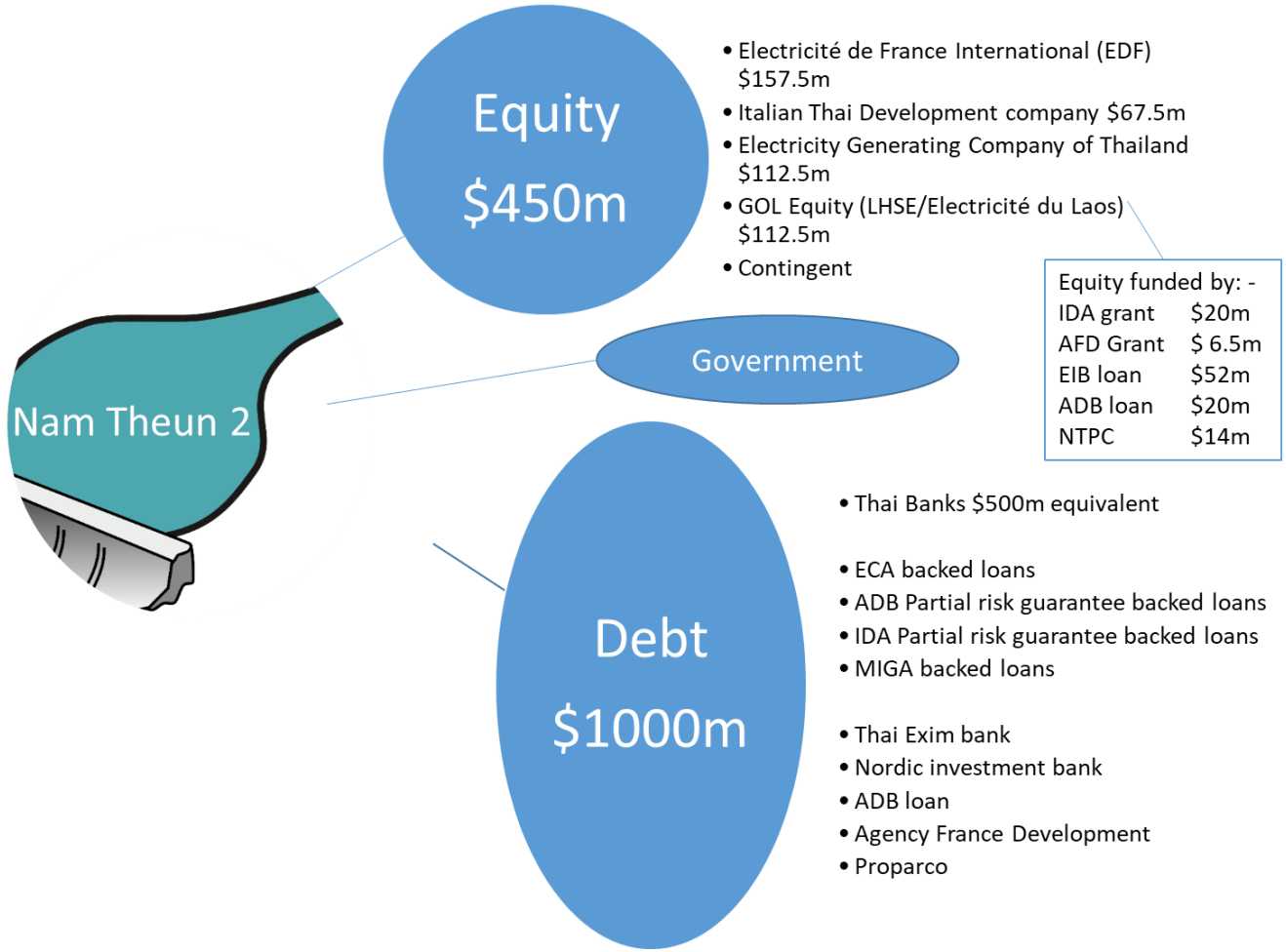
4.3 Project ownership

PPP projects often involve a 'for-profit' special purpose company (SPC)[12], which is set up to bring together various equity investors. Most of the debt required for the project is typically lent directly to the SPC. However, some debt may still be issued to the host country government, in particular where the loan is of a sovereign nature and the host country government owns shares in the SPC.

Ownership models such as BOOT (Build Own Operate Transfer[13]) allow private sector equity investors to generate income from the hydropower project for the duration of a pre-agreed concession period, which enables them to repay the debt and generate a profit before the asset is returned to the host country government ownership. In common with many PPPs, such as Nam Theun 2, the BOOT ownership model was used in the Nachtigal hydropower project in Cameroon, where a special purpose company (Nachtigal Hydro Power Company – NHPC) was set up by the equity investors to deliver the project, with debt issued by multiple lenders to the NHPC under a 35-year BOOT concession agreement (shown in Figure 6).

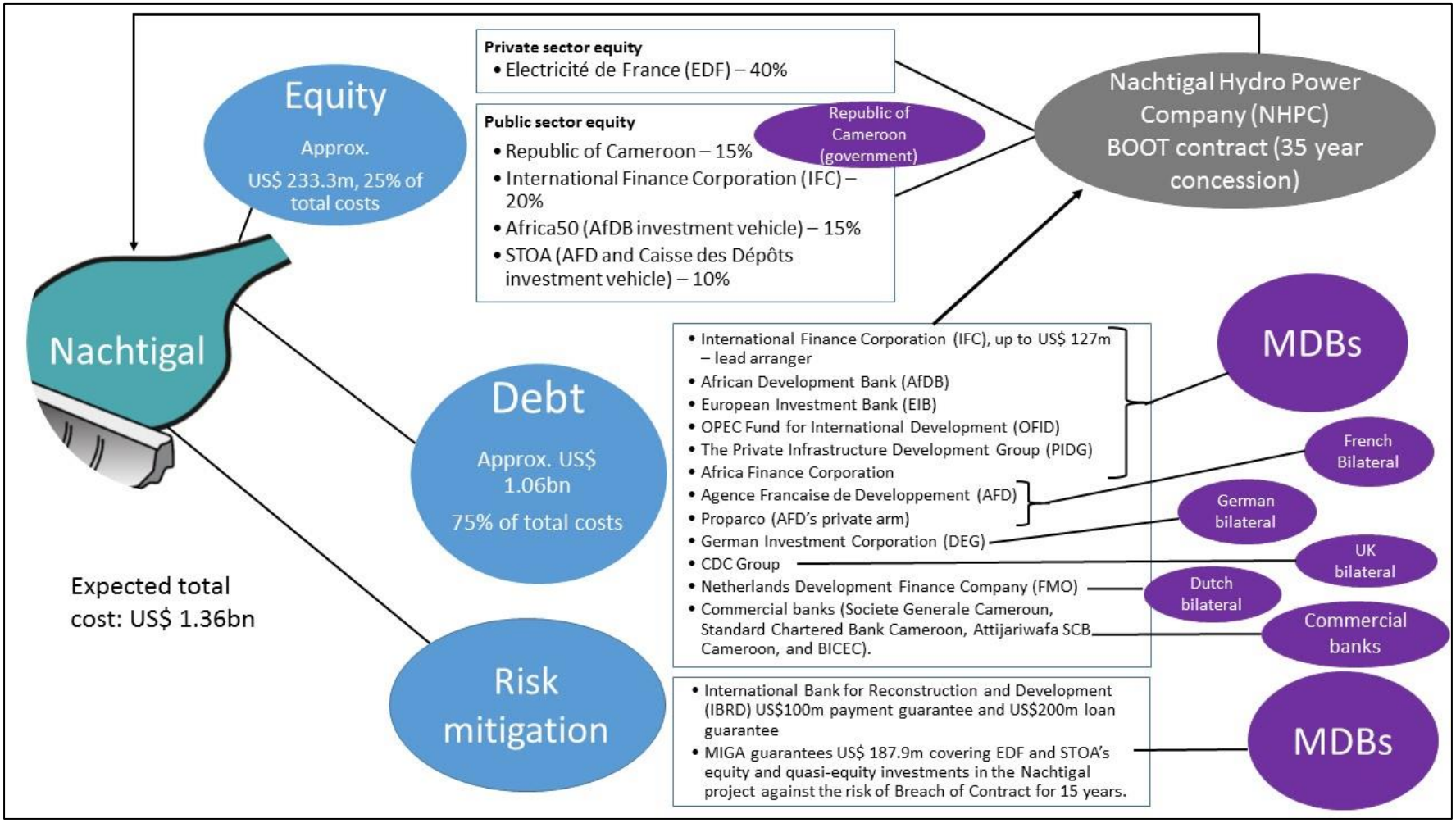
[12] Also known as a Special Purpose Vehicle (SPV).
[13] See Markkanen and Plummer Braeckman (2019) for a full description of various ownership models used under a PPP project financing structure, including BOOT and BOT.

Figure 5: Nam Theun 2 financing structure showing multiple roles



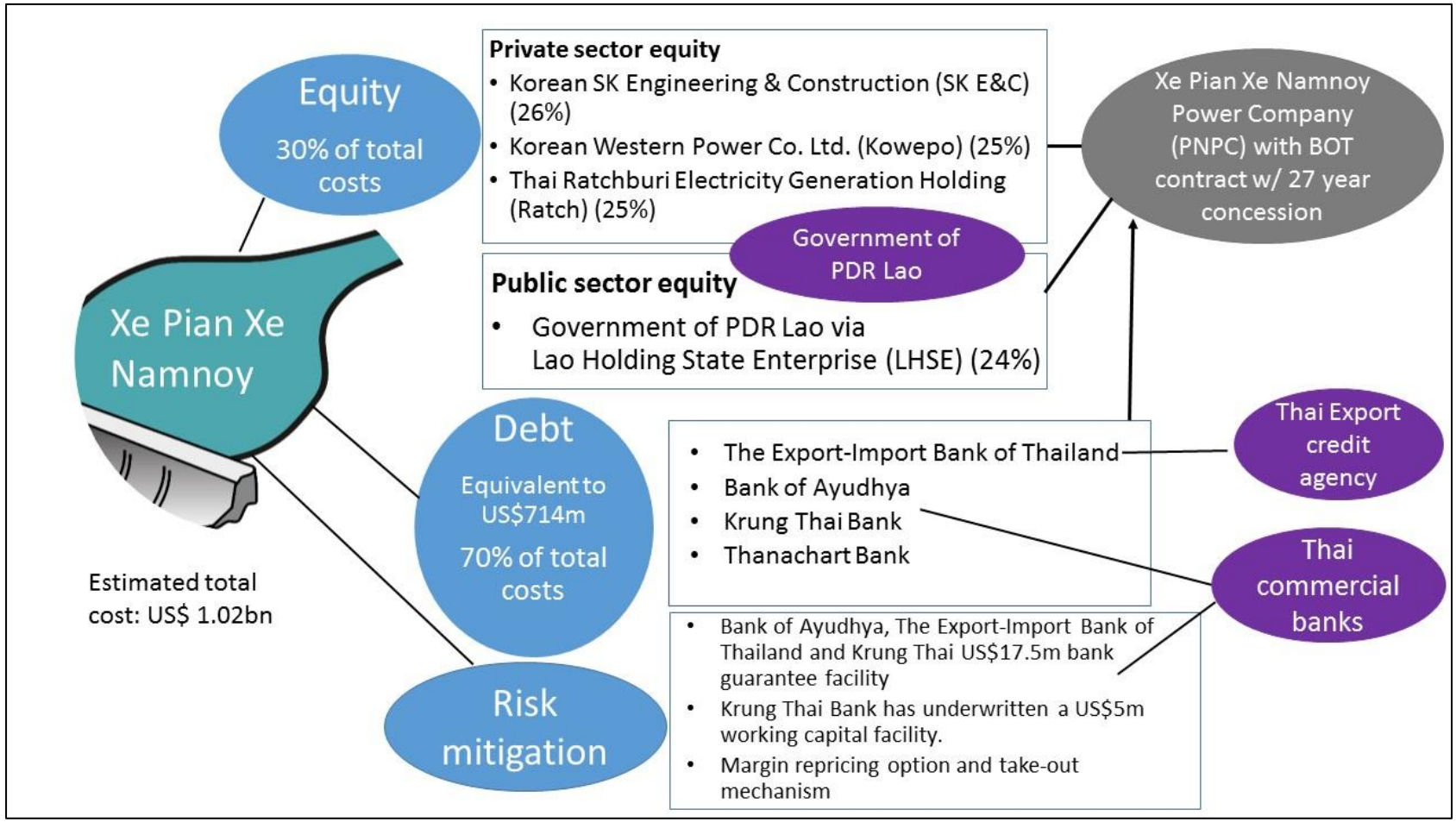
Source: World Bank (2005)

Figure 6: Nachtigal hydropower project financing structure involving a special purpose company (SPC)



Sources: Equity investment distribution of shares from African Energy (2018); data on guarantees from World Bank (2018) and MIGA (2018); total (estimated / expected) cost of project and sources of debt from Ingram (2018).

Figure 7: Xe Pian Xe Namnoy hydropower project



Source: Equity distribution from PNPC (2019); debt amounts and total cost from Morakotkarn et al (2014)

4.4 Linking project finance to capital markets

In some instances, especially in a context where several hydropower projects are developed simultaneously over a short time period, project finance may be linked to capital markets to secure financing for projects and to improve the host country's ability to service its debt. This approach has gained some traction in Lao PDR, where several large hydropower projects were approved over a short time period, financed by a mixture of public and private sector organisations, including Korean and Chinese export credit agencies, Thai commercial banks and the Government of Lao PDR.

To pay for its investment in hydropower projects, amongst other things, the Government of Lao PDR issued its first sovereign bond on the Thai stock exchange in 2013 for BT1.5 billion ($ 49.2 million) underwritten by three Thai commercial banks,[14] followed by ten more between 2013 and 2015 (IMF, 2017).

One of the hydropower projects paid for through Lao PDR sovereign bonds on the Thai stock exchange is the 410 MW Xe Pian Xe Namnoy (PNPC), now infamous for the tragic loss of life caused by the collapse of one its auxiliary dams in 2018.[15] The PNPC project received debt financing from Thai commercial banks in the form of a dual-currency syndicated loan equivalent to $714 million (Lee, 2014). The debt, which constituted the "largest limited-recourse financing in Lao PDR since 2011" (PFI, 2014, p 3), was divided between US dollars and Thai baht. The project included three innovative features: (1) a margin re-pricing option, which allows adjustment of the margin on US dollar loans on the sixth anniversary date and every five years thereafter; (2) a 'take-out' agreement, which allows PNPC to refinance if new financing becomes available from the ADB or the EximBank of Korea (Kexim) within a three-year period of the project signing date; and (3) the inclusion of a clause which allows third parties to access the project transmission lines on payment of a pro-rata proportion of the cost (PFI, 2014). The detailed financing structure of PNPC is shown in Figure 7 (PNPC, 2019).

4.5 Strengths and limitations associated with a PPP financing structure

The PPP financing model enables LICs and L-MICs to develop essential energy infrastructure that addresses their development needs without committing too large a proportion of their financial resources to any one project. Infrastructure assets financed through a PPP approach generally transfer to state ownership at the end of the concession period.

MDB involvement can effectively leverage finance from other sources by acting as an 'assurance' that due diligence has been carried out, that the social and economic impacts of the projects have been thoroughly assessed and that appropriate action plans are in place to mitigate any negative impacts. By providing seed capital and guarantees, MDBs extend the

[14] See 'Thailand helps Laos to bond market', *Financial Times* [online at https://www.ft.com/content/936cf3aa-f4ea-3e7b-ae9f-950af412e609]. Accessed: 29 August 2019.
[15] 'A day before Laos dam failed, builders saw trouble', *New York Times* [online at www.nytimes.com/2018/07/26/world/asia/laos-dam-collapse.html]. Accessed: 1 September 2019.

reach of their funds, reduce the cost of debt finance for host country governments and SPCs, and catalyse further development with a limited funding commitment.

However, the complexity of a typical PPP financing package requires host country governments in LICs and L-MICs to address a set of substantial challenges, including attracting interest from sufficient numbers of potential financiers. To secure financial closure and avoid corruption, governments must manage an array of legal contracts and documentation, whilst ensuring transparency. The host countries are also responsible for making sure that the social and environmental impacts of large hydropower projects are thoroughly assessed, and that a strategy to mitigate any negative impacts is developed and implemented. Last, but not least, emerging economy governments need to build capacity to negotiate the best deal possible in order to maximise the economic benefits from the project. MDBs hold the host country accountable for appropriately assessing and mitigating the social and environmental impacts, and projects that fall short of the set criteria risk the withdrawal of funds or guarantees.

The use of the PPP project financing structure for large hydropower projects specifically to improve energy access in LICs and L-MICs has some limitations. These limitations relate primarily to the cost of electricity and the question of expansion to existing grid infrastructure, which is typically not a part of a PPP hydropower project. Addressing these challenges is possible, but requires concerted effort and commitment on the part of the host country government. For example, the 250 MW Bujagali hydropower project in Uganda was initially financed during a period when few PPP projects had been successfully concluded in Africa. An innovative PPP financing arrangement involved splitting it into two separate but interconnected projects: the actual hydropower project (which was awarded to a SPC and financed through a PPP) and the interconnection project, which was financed by the Government of Uganda with loans from The African Development Fund and Japanese International Cooperation Agency (AfDB, 2019). Whilst this approach enabled the hydropower project and the related energy transmission infrastructure to be developed, it was also slow and expensive (Eberhard et al, 2016; Plummer, 2013): after 13 years of negotiations followed by a five-year construction period, the project was finally commissioned in 2012, with an estimated price tag of $1.3 billion. As a result, Bujagali yielded expensive electricity when compared with the national electricity tariff, and anticipated decreases in tariff proved impossible.

However, once the power project was operational and the risk profile was substantially reduced, the Government of Uganda was able to refinance the project. The outstanding debt was consolidated into a new debt package by a consortium of public- and private-sector investors (with Multilateral Investment Guarantee Agency and International Development Agency guarantees). The longer tenor (repayment period) of this loan reduced annual debt service, a saving which was passed on to consumers, cutting the cost of electricity generated by the plant by 30% (IFC, 2018).

5 ‘New’ bilateral finance

The slowness of the process of securing financial closure under a PPP financing structure is pushing LICs and L-MICs to consider alternative financing options, such as new forms of bilateral finance that enable faster utilisation of their natural resources and production of

electricity. This section examines the nature and structure of new bilateral financing arrangements that are increasingly utilised by LICs and L-MICs to finance hydropower and other large infrastructure projects. Examples from Uganda and Ghana are used to illustrate the challenges and benefits associated with this new model.

5.1 Fewer actors, faster progress

The complexity of PPP financing arrangements means that they often take several years to reach financial closure (Eberhard et al, 2016). For LICs and L-MICs eager to develop their energy infrastructure, this delay can be regarded as one of the greatest barriers to hydropower development using PPP financing. The process of achieving financial closure can be further slowed down if MDB support is required to leverage private investment (Plummer Braeckman & Guthrie, 2015).

As a result, new forms of bilateral financing flows to LICs and L-MICs are on the rise, predominantly (but not exclusively) from upper-middle income country export credit agencies. Countries as varied as Ghana, Myanmar, Uganda, Lao PDR and Zambia are increasingly turning to multi-sector and multi-project bilateral infrastructure agreements to access concessional lending from Brazil, Russia, India, China (BRIC) development banks such as the Brazilian Development Bank (BNDES), the China Exim Bank and China Development Bank, and from highly developed Asian economies, such as the Korea Exim Bank.

As mentioned above, the new bilateral finance typically involves only two parties: one financing agency (which is often an export credit agency) and the host country government. Occasionally, a small proportion of the debt is issued by a commercial bank from the same country as the financing agency. All the debt is lent directly to the host country government and tends to cover the vast majority of the costs of the project (often up to 85%). There is rarely any MDB or other international agency involvement or oversight. For the poorest countries, some or all of the debt may be issued at a reduced interest rate (Bräutigam, 2011) The small number of actors means that the process of achieving financial closure can be significantly quicker than under a PPP, as long as the host country government is willing to comply with the conditions offered by the financing agency.

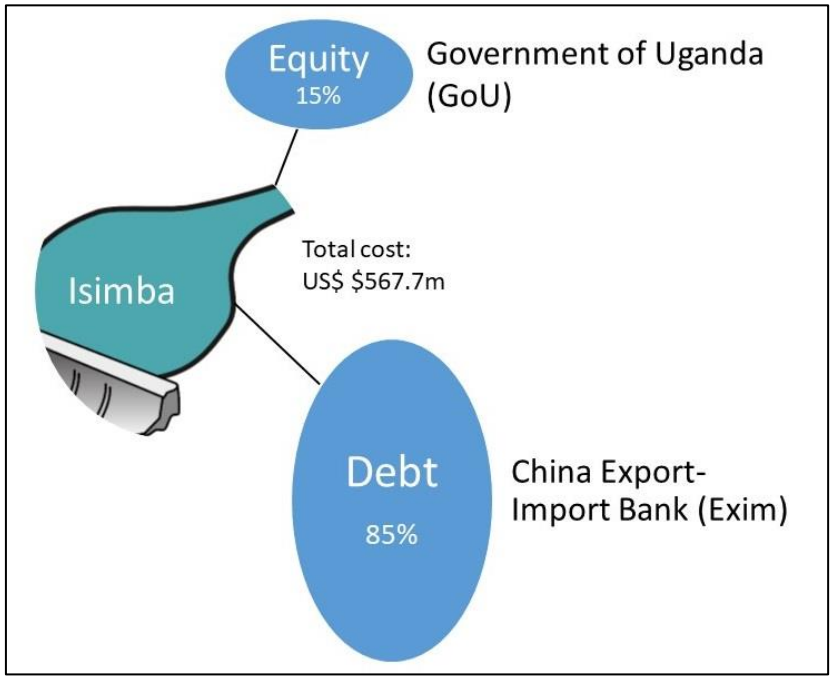
New bilateral finance is often referred to as ‘Chinese finance’ because of that country’s dominant position in utilising this financing approach. Although precise figures on Chinese investment in hydropower are difficult to obtain, one estimate puts the five-year rolling average investment of Chinese finance in hydropower worldwide at $ 4.4 billion (Gallagher, 2018).

As examples from Isimba and Bui hydropower projects show, for cash strapped LIC and L-MIC governments, new bilateral finance from China offers a comparatively straightforward financing proposition. However, as the following discussion illustrates, ‘new’ forms of bilateral finance come with conditions and constraints that can have long-term implications for the host countries.

5.2 Securing finance under 'new' bilateral arrangements

The 183 MW Isimba hydropower project in Uganda had a debt to equity ratio of 85/15. The debt was provided by China EximBank loan with requirements for payment guarantees from the Ugandan Government (Eberhard et al, 2016), and equity investment came from the Government of Uganda (Dreher et al, 2017) (see Figure 8). In some ways, the Isimba dam compares very favourably with the nearby PPP-financed Bujagali hydropower project. While Bujagali took 13 years to achieve financial closure and then five years to build (partly as a result of delays associated with corruption allegations) – and came with a price tag of over $1 billion – the Isimba dam went from concept to commissioning in less than six years. As a result, it has been widely expected that the cost of electricity generated by Isimba will be significantly lower than that generated by Bujagali (ODI, 2016). Whether or not this price difference materialises – or is passed on to end consumers – remains to be seen (Meyer et al, 2018; ODI, 2016).

Figure 8: Financing structure of the Isimba hydropower project, Uganda



Source: Meyer et al. (2018); ODI (2016)

However, the bilateral financing arrangement for the Isimba hydropower project came with its own set of risks and drawbacks. First, the government-led public procurement that awarded the EPC contracts to Chinese firms enabled speedy progress but 'tied' finance to the skills and technology of Chinese firms, raising concerns over the restrictions on procurement and the potential for reduced transparency (ODI, 2016). The Engineering, Procurement and Construction (EPC) arrangement into which the Government of Uganda (GoU) entered with China International Water and Electricity Corporation (CWE) stipulated that the CWE contractors be hired only as builders, with no longer-term role as the hydropower project's owner or operator. The benefit of this type of arrangement for the host country government is that it acquires control over the hydropower plant as soon as it becomes operational. On the other hand, such arrangements can tempt contractors to cut

costs by compromising quality, as they will not be around if problems are discovered after the project commences operation, and their long-term guarantees of project performance are limited (Le, 2017).

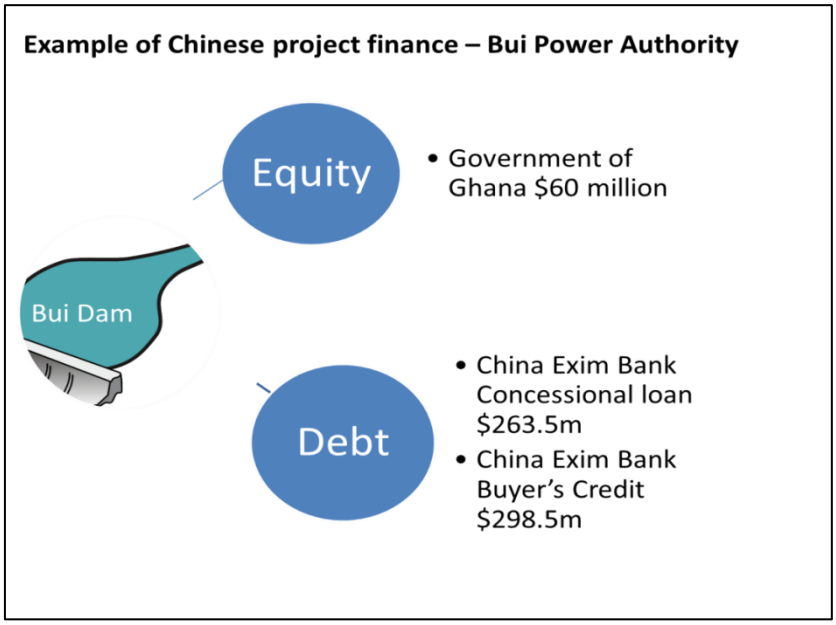
Second, Isimba is one of several large infrastructure projects (including road, rail and hydropower developments) to be built by Chinese firms in Uganda over the next decade or so. The loan repayments for the various projects will overlap, requiring a separate government sovereign guarantee and resulting in a heightened level of indebtedness for Uganda, raising the risk that project-related revenues may be insufficient to support future debt servicing (ODI, 2016). After passing China's Sinosure assessment for project insurance, the Eximbank loan required 45% of the loan to be in the form of an export buyer's credit with floating interest rate (equal to LIBOR + 3.5%). As a result, the interest on the loan may increase substantially over time if market conditions become unfavourable, exposing Uganda to possibly unaffordable interest payments (ODI, 2016). With the risk of insolvency in mind, bilateral lenders' willingness to offer the loan has been predicated on Uganda's oil reserves, which are also subject to volatility in the oil market (Eberhard, 2016). A joint report by the World Bank and the Ugandan Ministry of Finance Planning and Economic Development raised concerns that the government may be tempted to spend in advance some of its future oil revenue through substantial borrowing on the financial markets. Whilst this can generate short-term benefits through growth of infrastructure, it might have negative long-term consequences if the promised oil revenues are not forthcoming.

Using national natural resources to collateralise financing for hydropower projects has enabled Chinese contractors and lending consortia to achieve financial closure for projects in developing countries that would otherwise be considered 'at risk' of insolvency or plagued by their unrated credit status by OECD-based credit agencies. The Bui dam project in Ghana, which reached financial closure in 2008 and was completed in 2013, was collateralised with earnings from cocoa exports in a structured deal with the China EximBank. The Government of Ghana received two credits from the China Exim Bank for the Bui Dam: a concessional loan of US$ 263.5 million and a buyer's credit of US$ 298.5 million (Figure 9)[16]. These loans were secured against the proceeds from the sale of 30,000 tonnes of cocoa a year to China until the project generates enough funds from the sale of electricity to cover the loan repayments (Obour et al, 2016; Hensengerth, 2013). The Government of Ghana provided $ 60 million in equity (Bui Power Authority, 2011). While this appears simple in comparison to PPPs such as Nam Theun 2 and Nachtigal (Figures 5 and 6), the arrangements for the Bui dam took a long time to negotiate because Ghana was reluctant to commit to a link to cocoa exports (Hensengerth, 2011). The environment and social implementation record of the Bui project has also been subject to criticism (Kirchherr et al, 2016; Hausermann, 2018), and it has been argued that the World Bank and international agencies declined financial support for the project due to its perceived social

[16] The exact figures for actual and estimated total project costs, concessionary debt and Exim Bank's buyer's credit issued to the project vary between sources. The figures used here are from Obour et al. 92016), drawing on the documentation available from the Bui power Authority (BPA, 2011). However, the figures provided in Hensengerth's analysis (2013) differ marginally from those given in Obour et al. (2016).

and environmental threats, including the flooding of over a fifth of the Bui National Park (Yankson et al, 2018; Obour et al, 2016; Hensengerth, 2013).

Figure 9: Example of Chinese project finance – Bui Power Authority, Ghana



Source: Obour et al. (2016)

5.3 Strengths and limitations associated with new forms of bilateral finance

The main benefit of acquiring finance from new bilateral finance agencies is the speed at which the projects reach financial closure, especially when compared to PPP arrangements involving MDB debt or guarantees. Also, as the debt is made directly to the host country government, the projects will be in host country government ownership from the beginning – ie there is no privately-owned SPC who will need the security of a power purchase agreement or a concession agreement. As a result, bilateral finance from new financiers such as the BRIC countries can, at least in theory, enable LICs and L-MICs to develop their energy infrastructure faster, while also providing their citizens with access to electricity at a lower cost.

However, new bilateral financing is generally tied to the source country's contractors and thus reduces the choice over materials and technologies and limits the scope for competitive procurement. Moreover, the absence of extensive development agreements may make the contracts difficult for the recipient countries to enforce. Thus the extent to which these outcomes materialise (and at what social and environmental cost), is debateable (Kirchherr et al, 2017).

New bilateral financing arrangements may also enable compliance with international environmental protection requirements and social responsibility guidelines to be circumvented, with potentially negative impacts. Chinese hydropower contractors, for example, have been content to allow host government agencies to take full responsibility for the assessment and mitigation of the social and environmental impacts of projects undertaken in turnkey arrangements with Chinese contractors and financiers (Hensengerth,

2013). While leaving the responsibility for impact assessment and management to the host country government may seem logical, a lack of capacity in the that government may lead to poor and delayed implementation of protocols, or even the overlooking of social and environmental impacts (Kirchherr et al., 2017). However, China Exim Bank is increasingly adopting corporate social responsibility policies and is beginning to work with MDBs and bilateral agencies to gain greater exposure to international best practice (China Exim Bank, 2016; Gugler & Shi, 2009; Hensengerth, 2013).

6 Discussion

The three financing models that are (or have been) most widely used for hydropower project development in LICs and L-MICs each have strengths and limitations, as summarised in Table 1.

In the least developed countries, such as much of Sub-Saharan Africa and parts of South and Southeast Asia, governments struggle to address a complex mixture of social and economic development needs and environmental conservation pressures (as exemplified by the breadth of the SDGs). With limited budgets and dwindling support from MDBs for large energy infrastructure projects, the demand for private sector financing for such projects is increasing. However, acquiring private sector financing for large hydropower projects in countries with a below-investment-grade credit rating, and perhaps an unstable political situation, is not easy. A widespread perception of large hydropower as risky (especially in the early stages) and subject to negative publicity as a result of potential environmental and social impacts that attract public attention, further reduces the appeal of such projects to the private sector.

Table 1: Strengths and limitations of three financing models for large hydropower in LICs and L-MICs

	Public finance	PPP finance	New bilateral finance
Strengths	Simple Government retains control and can ensure economic benefits are secured and that sustainability targets are met. Long-term financial gains of the project accrue to the public sector and/or can be used to keep electricity tariffs affordable. MDB involvement can set a benchmark for country standards for sustainability.	Enables the construction of infrastructure for development despite limits on government investment and borrowing. Long-term financial gains of the project partially accrue to the public sector and/or can be used to subsidise tariffs for vulnerable groups. MDB involvement can set a benchmark for country standards for sustainability.	Simple Enables the construction of new public sector infrastructure for development, often in an accelerated timeframe.
Limitations	Large projects absorb a substantial proportion of available public investment, limiting investment in other sectors. Limited availability of public funds and concessionary debt finance for energy infrastructure projects. MDB involvement perceived as causing delays. Governments may lack capacity and regulatory frameworks to manage environmental and social impacts without support from MDBs.	Complex packages and contracts to negotiate may stretch government capacity. Overall complexity causes delays. Can be perceived as diluting government control of natural resources and allowing the private sector to profit from natural resource exploitation.	Government may lack capacity to protect the host country interest or may have a poor negotiating position Increases government indebtedness Lack of regulatory framework on social and environmental impacts may mean these are overlooked or not adequately mitigated. Can be perceived as foreign interference in domestic affairs and natural resources.

The ownership structure and financial flows are more complex under a PPP model than either of the other approaches. Owing to the perceived level of risks associated with large hydropower projects in LICs and L-MICs, and the risk-averse nature of private sector investors and financiers, private sector involvement in these countries tends to be conditional on MDB guarantees, insurance, and legal agreements, including a long-term power-purchase agreement (PPA) and concession agreement. The amounts that various financiers are willing to invest or lend for any specific project in a LIC or L-MIC also tend to be lower than would be the case in an OECD country. As many of the debt financiers provide loans that account for only a very small proportion of the overall costs, it is not unusual for PPP-financed large hydropower projects in LICs and L-MICs to have a complex mix of both public and private sector institutions, as illustrated in our Nachtigal and Xe Pian Xe Namnoy examples. In some instances, the debt financiers or equity investors also assume other roles in an attempt to raise the sufficient funds to achieve financial closure, further complicating the picture, as the example from Nam Theun 2 shows.

Unlike in fully public sector or bilaterally financed projects, debt under a PPP structure is generally lent to an SPC that has been set up to deliver the project (and in which the host country government may own shares). The ownership of a PPP-financed project generally lies with a majority privately owned SPC, while projects financed with fully public sources or through bilateral debt are owned by the host country government, government agency or government-owned SPC. A PPP project is unlikely to reach financial closure without having a PPA and a Concession Agreement in place, which may take both time and capacity to negotiate.

The benefit of PPP projects is that they have enabled large hydropower projects in LICs and L-MICs to be developed in circumstances where the host country government lacks funds to undertake them on their own, and where sufficient concessionary lending from MDBs is not forthcoming. These projects can play a critical role in industrial, economic and social development in these countries by providing an additional (and reliable) power supply to underserved consumers. The conditionality of MDB involvement on (increasingly stringent) environmental and social impact assessments and mitigation protocols works to ensure improved standards or social and environmental impact assessment, mitigation and management are observed.

The downside of PPP projects is that the complexity of PPP financing arrangements and the need to address the concerns of all the parties involved (including the MDBs) mean that PPP projects in emerging economy contexts typically take a long time to reach financial closure. This delay slows down electrification, limits development and impedes progress towards the SDGs. Many governments also lack the resources and capacity to negotiate the best deal possible with multiple lenders under a PPP arrangement, resulting in projects that do not maximise the potential economic benefits for the host country.

New bilateral finance offers a simpler financing option for LICs and L-MICs frustrated by the delays and complexity associated with the PPP structure. This type of finance generally comes in the form of bilateral debt or export credit, typically from China, but also from other countries such as Brazil or Korea. As illustrated by the case studies on Bui and Isimba, new bilateral finance heralds a return to a more straightforward structure with fewer players, often involving just the host country government, a government agency, and a foreign financing

agency which provides the debt financing to cover up to 80%–85% of the total cost of the project. These arrangements can be quick to finalise, as illustrated by the case of Isimba.

New bilateral debt financing has many benefits: it enables LICs and L-MICs to improve their energy (and other) infrastructure at a pace that is just not possible using the PPP model. Given the economic benefits for the lending country, financing from new bilateral financing agencies is more plentiful and more easily accessible than concessionary debt from MDBs. From a contractual point of view, the simplicity of the bilateral financing arrangements means that they usually take less time to confirm, as the ownership of the project rests with the host country government, thus allowing simpler project documentation than for PPP projects. Public sector procurement rules can be sidestepped, as the debt comes with conditions to purchase much (if not all) of the required machinery, technology and materials from the country where the funding originates. Moreover, the environmental and social impact assessment requirements may rely on the host country's own protocols, which are well understood.

On the other hand, new bilateral finance arrangements are not risk-free. Although the process is faster, the social and environmental impacts may be given less thorough attention than they would under international guidelines. As with PPPs, the host country government may lack capacity and information to assess and mitigate the long-term impacts of the conditions associated with new forms of bilateral finance or to fully appreciate the consequences of the financing arrangements they choose. These financing conditions may be stringent, and host country governments desperate to increase their energy generation capacity are rarely well positioned to negotiate particularly favourable loan conditions. The high level of debt that countries are taking on to finance large infrastructure projects may also be a cause for concern, especially if several large projects are being developed simultaneously.

7 Conclusions

The number of new hydropower projects in OECD countries and other advanced economies has dropped to a trickle, as most of the best hydropower sites have already been developed. The majority of new large hydropower assets are now being built in LICs and L-MICs, where much of the untapped potential still remains. Environmentally sustainable utilisation of hydropower potential in these countries can facilitate social and economic development, improving their ability to respond to the multiple pressures associated with improved energy access and decarbonisation of both existing and future energy supply. For many of these LICs and L-MICs, sustainable hydropower provides a potential solution to the growing need to generate large amounts of electricity to improve energy access and support economic activity, as mandated by the SDGs, without compromising progress towards the Paris Agreement goal on carbon emissions. Hydropower also has a strong role in backing up and storing power to enable the management of intermittent renewables and strengthen transmission grids.

As the political and economic situation has evolved over the past 20 years, the financing for large-scale energy infrastructure projects such as hydropower has become more complex. Fully publicly financed projects are now increasingly the exception, and most new large hydropower projects in LICs and L-MICs are developed either with significant private sector

involvement or with debt financing under ‘new’ bilateral financing arrangements. Although MDBs remain active in hydropower project development in LICs and L-MICs, they are increasingly seeking to maximise their impact by spreading their resources across various development priorities and leveraging finance from the private sector through credit enhancement mechanisms, such as guarantees.

PPP arrangements can help projects obtain finance, but they are particularly complex and thus can cause delays in reaching financial closure, as they may involve multiple actors, including one or more MDBs. This has incentivised LICs and L-MICs to seek simpler financing solutions that facilitate faster socioeconomic development. New bilateral financing arrangements have emerged to meet this demand. Unfortunately, LICs and L-MICs are not in a strong negotiating position to achieve deals that maximise the developmental benefits *and* minimise the adverse social and environmental impacts under these new bilateral financing structures. The governments in many LICs and L-MICs may also lack the capacity and experience to be able to achieve an outcome that is most beneficial for the host country in the long term.

In order to maximise the economic and developmental benefits of sustainable hydropower, it is essential that new hydropower projects in LICs and L-MICs are environmentally, economically and socially sustainable, including being financed in a way that does not enable exploitation of the host countries’ lack of capacity for financial gain by others. To achieve this, LICs and L-MICs need to be adequately supported to access finance for projects that can address their needs without compromising their progress towards a zero carbon future. One of the key challenges is to develop financing models that ensure that the electricity generated from hydropower will be accessible and affordable to local consumers, without crippling the host country government’s finances. In this context, there is a pressing need for further research to better understand the private finance sector’s attitude to risk and consider why it remains so challenging, complex and time-consuming for large hydropower projects in LICs and L-MICs to obtain finance. In undertaking this research, the goal should be to simplify and thus accelerate the process of putting a PPP financing package in place. Future research should also consider the relationship of hydropower to intermittent renewables and green finance initiatives, such as green bonds, and the extent to which these synergies can be used to enhance the opportunities for project finance.

References

AfDB (2019). 'Bujagali Interconnection Project – project completion report' [available at https://www.afdb.org/en/documents/document/uganda-bujagali-interconnection-project-project-completion-report-101626]. Accessed: 1 September 2019.

African Energy (2018). 'Cameroon: Africa50 and Stoa acquire stakes in Nachtigal' [available at https://www.africa-energy.com/live-data/article/cameroon-africa50-and-stoa-acquire-stakes-nachtigal]. Accessed: 19 August 2019.

Alam, F., Alam, Q., Reza, S., Khurshid-ul-Alam, S.M., Saleque, K. and Chowdhury, H. (2017). 'A review of hydropower projects in Nepal'. *Energy Procedia 110*, 581–585.

Banerjee, P. (2014). 'Energy security through privatisation: policy insights from hydroelectric power projects (HEPs) in India's northeast'. *Perceptions XIX*, 39–53.

Berga, L. (2016). 'The role of hydropower in climate change mitigation and adaptation: a review'. Engineering 2, 313–318. http://dx.doi.org/10.1016/J.ENG.2016.03.004.

Bitexco Power (2016). 'Investment signing ceremony'. Press release, 13 September. [Available at http://bitexco.com.vn/newdetail/uob-orix-to-invest-50m-in-vietnambased-bitexco-power-113.html]. Accessed: 19 December 2019.

Blimpo, M.P. and Cosgrove-Davies, M. (2019). *Electricity Access in Sub-Saharan Africa: Uptake, Reliability, and Complementary Factors for Economic Impact.* Washington DC: World Bank.

Bottelier, P. (2007). 'China and the World Bank: how a partnership was built'. *Journal of Contemporary China 16*, 239–258.

Briscoe, J. (1999). 'The financing of hydropower, irrigation and water supply infrastructure in developing countries'. *International Journal of Water Resources Development 15*, 459–491. doi: 10.1080/07900629948718.

Bräutigam, D. (2011). 'Aid "with Chinese characteristics": Chinese foreign aid and development finance meet the OECD–DAC aid regime'*. Journal of International Development 23*, 752–764.

Bui Power Authority [BPA]. (2011*). Leaflet describing the Bui hydropower project, background and proposed benefits.* Accra: Bui Power Authority.

Centre for Public Impact (2017) *The Bujagali Dam Project in Uganda*. [https://www.centreforpublicimpact.org/case-study/bujagali-dam-project-uganda/]. Accessed 19 August 2019.

Chen, W., Dollar, D. and Tang, H. (2016). 'Why is China investing in Africa? Evidence from the firm level'. *World Bank Economic Review 32*, 610–632.

China Exim Bank (2016). *White Paper on Green Finance* [available at english.eximbank.gov.cn]. Accessed: 12 March 2019.

Corfee-Morlot, J., Parks, P. & Ogunleye, J. (2019) *Achieving Clean Energy Access in Sub-Saharan Africa*. [Available at https://www.oecd.org/environment/cc/climate-futures/case-study-achieving-clean-energy-access-in-sub-saharan-africa.pdf]. Accessed 07 February 2020.

Donovan, C.W. (2015). *Renewable Energy Finance: Powering the Future.* Singapore: World Scientific.

Dreher, A., Fuchs, A., Parks, B.C., Strange, A. M. and Tierney, M. J. (2017). *Aid, China, and Growth: Evidence from a New Global Development Finance Dataset.* AidData Working Paper #46. Williamsburg VA: AidData.

Eberhard, A., Gratwick, K., Morella, E. and Antmann, P. (2016). 'Case study 5: power generation developments in Uganda'. *In Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries*. Washington DC: World Bank.

Equator Principles (2013). 'Equator Principles' [available at https://equatorprinciples.com/wp-content/uploads/2017/03/equator_principles_III.pdf]. Accessed: 17 June 2019.

Finley-Brook, M. & Thomas, C. (2010). 'From malignant neglect to extreme intervention: treatment of displaced indigenous populations in two large hydro projects in Panama'. *Water Alternatives 3*, 269–290.

Gallagher, K. (2018). 'China's global energy finance'. Global Development Policy Center, Boston University.

Goodland, R. (2000). *Social and Environmental Assessment to Promote Sustainability: An Informal View from the World Bank*. Environment Department Papers 74. Washington DC: World Bank.

Gugler, P., & Shi, J. Y. J. (2009). 'Corporate social responsibility for developing country multinational corporations: Lost war in pertaining global competitiveness?'. *Journal of Business Ethics*, 87(1), 3–24.

Hausermann, H. (2018). 'Ghana must Progress, but we are Really Suffering": Bui Dam, Antipolitics Development, and the Livelihood Implications for Rural People'. *Society & Natural Resources*, 31:6, 633-648, DOI: 10.1080/08941920.2017.1422062.

Heiser, W., Liu, I. and Sachdev, K.B.S. (2018). 'Chinese financing options for Southeast Asian hydropower projects'. *Hydropower & Dams* 25(*2) pp40-44*.

Hensengerth, O. (2011). 'Interaction of Chinese institutions with host governments in dam construction: the Bui Dam in Ghana' [available at http://nrl.northumbria.ac.uk/15230/1/Interaction_of_Chinese_Institutions.pdf]. Accessed: 27 February 2019.

Hensengerth, O. (2013). 'Chinese hydropower companies and environmental norms in countries of the global South: the involvement of Sinohydro in Ghana's Bui Dam'. *Environ Dev Sustain* (2013), 15:285–300, DOI 10.1007/s10668-012-9410-4.

Hess, C. and Fenrich, E. (2017). 'Socio-environmental conflicts on hydropower: the São Luiz do Tapajós project in Brazil'. *Environmental Science & Policy 73*, 20–28.

HSA (2019). Hydropower Sustainability Assessment Guidelines and Protocols. [Available at www.hydrosustainability.org]. Accessed 13 January 2020.

ICOLD (2011). 'Constitution status' [available at https://www.icold-cigb.org/userfiles/files/CIGB/INSTITUTIONAL_FILES/Constitution2011.pdf]. Accessed: 28 August 2019).

IEA (2018.) 'International Energy Agency statistics' [available at www.iea.org/topics/renewables/hydropower/]. Accessed: 27 February 2019.

IEA (2017). 'Southeast Asia energy outlook 2017' [available at https://www.iea.org/publications/freepublications/publication/WEO2017SpecialReport_SoutheastAsiaEnergyOutlook.pdf]. Accessed: 6 June 2019.

IEA-ETSAP and IRENA (2015). *Hydropower Technology Brief*. Technology Brief E06. [Available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2015/IRENA-ETSAP_Tech_Brief_E06_Hydropower.pdf]. Accessed: 9 August 2019.

International Finance Corporation (IFC) (2015). *Hydroelectric Power: A Guide for Developers and Investors* [available at: www.ifc.org/wps/wcm/connect/06b2df8047420bb4a4f7ec57143498e5/Hydropower_Report.pdf]. Accessed: 24 February 2019.

IFC (2017). ‘Blended finance at IFC’ [available at https://www.ifc.org/wps/wcm/connect/b775aee2-dd16-4903-89bc-17876825bad8/BF-factsheet-dec2017-01-print.pdf?MOD=AJPERES&CVID=m0Bft1u]. Accessed: 20 August 2019.

IFC (2018). ‘Raising environmental, social and governance standards – the Equator Principles at 15’. *Perspective*, 2 October. Washington DC: IFC.

IFC and GBS Cape Town (2018). ‘Reflections on the last twenty years how far have we come’. Paper prepared for the African Energy Forum, June 2018 [available at http://www.energynet.co.uk/webfm_send/2905]. Accessed: 20 August 2019.

International Hydropower Association (IHA) (2015). ‘Sustainable Development Goals: how does hydropower fit in?’ [available at https://www.hydropower.org/blog/sustainable-developmentgoals-how-does-hydropower-fit-in]. Accessed: 19 April 2019.

IHA (2016). *International Hydropower Association Status Report 2016* [available at www.hydropower.org/2016-hydropower-status-report]. Accessed: 7 April 2019.

IHA (2019). *2019 Hydropower Status Report* [available at https://www.hydropower.org/status2019]. Accessed: 20 December 2019.

IMF (2017). ‘Lao People’s Democratic Republic Staff Report for the 2016 Article IV Consultation — Debt Sustainability Analysis’ [available at https://www.imf.org/external/pubs/ft/dsa/pdf/2017/dsacr1753.pdf]. Accessed: 1 September 2019.

Ingram, E. (2018). ‘EDF, IFC, Republic of Cameroon sign agreements to build 420-MW Nachtigal hydropower plant’. *Hydro Review,* 11 September 2018. [Available at https://www.hydroreview.com/2018/11/09/edf-ifc-republic-of-cameroon-sign-agreements-to-build-420-mw-nachtigal-hydropower-plant/]. Accessed 07 February 2020.

IRENA (2012). *Hydropower*. Renewable Energy Technologies: Cost Analysis Series (June 2012). Volume 1: Power Sector, Issue 3/5 [available at https://www.irena.org/documentdownloads/publications/re_technologies_cost_analysis-hydropower.pdf] Accessed: 27 August 2019.

IRENA (2019). ‘Renewable capacity highlights’ [available at https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/Mar/RE_capacity_highlights_2019.pdf?la=en&hash=BA9D38354390B001DC0CC9BE03EEE559C280013F]. Accessed: 4 June 2019.

Kirchherr, J., Disselhoff, T. and Charles, K., (2016). ‘Safeguards, financing, and employment in Chinese infrastructure projects in Africa: the case of Ghana's Bui Dam’. Waterlines 35(1), pp.37-58.

Kirchherr, J., Matthews, N., Charles, K.J. and Walton, M.J. (2017). ‘Learning it the hard way”: social safeguards norms in Chinese-led dam projects in Myanmar, Laos and Cambodia’. *Energy Policy 102*, 529–539).

Le, L. (2017). *Building Hydropower Plants in Uganda: Who is the Best Partner?* Freeman Spogli Institute for International Studies, Stanford University and Johns Hopkins School of Advanced International Studies. [Available at https://fsi.stanford.edu/publication/building-hydropower-plants-uganda-who-best-partner]. Accessed: 11 September 2019.

Lee, A. (2014). ‘Laos hydro project creates new frontier financing model’. *International Financial Law Review* 33(3), pp. 25-26.

Locher, H., Hermansen, G.Y., Johannesson, G.A., Xuezhong, Y., Phiri, I., Harrison, D., Hartmann, J., Simon, M., O’Leary, D., Lowrance, C., Fields, D., Abadie, A., Abdel-Malek, R., Scanlon, A., Shichun, Z. and Nyman, K. (2010). ‘Initiatives in the hydro

sector post-World Commission on Dams – the Hydropower Sustainability Assessment Forum'. *Water Alternatives 3*, 43–57.

Manibog, F. (2004). *Power for Development: A Review of the World Bank Group's Experience with Private Participation in the Electricity Sector*. Washington DC: World Bank.

Markkanen, S. and Plummer Braeckman, J. (2019). *Financing Sustainable Hydropower Projects in Emerging Markets: An Introduction to Concepts and Terminology*. FutureDAMS Working Paper 003. Manchester: The University of Manchester.

Meyer, R., Eberhard, A. and Gratwick, K. (2018). 'Uganda's power sector reform: there and back again?'. *Energy for Sustainable Development 43*, 75–89.

MIGA (2018). 'Nachtigal Hydro IPP'. [Available at https://www.miga.org/project/nachtigal-hydro-ipp]. Accessed 07 February 2020.

Morakotkarn, W., Poensamut, A. & Snitwongse, S. (2014). 'Xe-Pian Plants: A Milestone'. *Project Finance International, Asia-Pacific Report* [Available at https://www.lw.com/thoughtLeadership/xe-pian-plants-a-milestone]. Accessed 07 February 2020.

Mott MacDonald (2009). *Enhancing Development Benefits to Local Communities from Hydropower Projects: A Literature Review* [available at http://documents.worldbank.org/curated/en/406951468326991910/pdf/702810ESW0P1100tBenefits0Lit0Review.pdf]. Accessed: 12 August 2019.

Obour, P., Owusu, K., Akwasi Agyeman, E., Ahenkan, A. & Navarro Madrid, A. (2016). 'The impacts of dams on local livelihoods: a study of the Bui Hydroelectric Project in Ghana'*. International Journal of Water Resources Development*, 32:2, 286-300, DOI: 10.1080/07900627.2015.1022892.

Overseas Development Institute (ODI). (2016). *Age of Choice: Uganda in the New Development Finance Landscape* [available at https://www.odi.org/sites/odi.org.uk/files/resource-documents/10459.pdf]. Accessed: 13 August 2019.

OECD/IEA (2012) *Technology Roadmap: Hydropower*. [Available at file:///G:/Projects/External%20Projects/Centre%20for%20Sustainable%20Finance/DAMS%202.0/Library/IEA_OECD_2012_Hydropower_Roadmap.pdf]. Accessed 07 February 2020.

Oud, E. (2002). 'The evolving context for hydropower development'. *Energy Policy 30*, 1215–1223.

Pepermans, G., Driesen, J., Haeseldonckx, D., Belmans, R. and D'haeseleer, W. (2005). 'Distributed generation: definition, benefits and issues'. *Energy Policy 33*, 787–798.

PFI (2014). *Xe Pian Plants a Milestone*. Project Finance International Asia-Pacific Report. [Available at http://www.pfie.com/xe-pian-plants-a-milestone/21133731.article]. Accessed: 15 September 2019.

Plummer Braeckman, J., Disselhoff, T. and Kirchherr, J. (2019). 'Cost and schedule overruns in large hydropower dams: an assessment of projects completed since 2000'. *International Journal of Water Resources Development*, 1–16.

Plummer Braeckman, J. and Guthrie, P. (2015). 'Loss of value: effects of delay on hydropower stakeholders'. *Proceedings of the Institution of Civil Engineers – Engineering Sustainability 169*, 253–264.

Plummer, J. (2013). 'Assessing the effects of pre-construction delay in hydropower projects'. PhD Thesis. Department of Engineering, Centre for Sustainable Development, University of Cambridge.

PNPC (2019) 'Business structure and shareholders' [online at www.pnpclaos.com].

Poindexter, G. (2017) 'CTGC begins construction on the 16-GW Baihetan hydropower station in Southwest China'. *Hydroworld*, 8/2017. [Available at https://www.hydroreview.com/2017/08/03/ctgc-begins-construction-on-the-16-gw-baihetan-hydropower-station-in-southwest-china/#gref]. Accessed 07 February 2020.

Porter, I.C. and Shivakumar, J. (eds) (2010). *Doing a Dam Better: The Lao People's Democratic Republic and the Story of Nam Theun 2*. Washington DC: World Bank.

Riethof, M. (2017). 'The international human rights discourse as a strategic focus in socioenvironmental conflicts: the case of hydro-electric dams in Brazil'. *International Journal of Human Rights* 21, 482–499.

Schulz, C. and Adams, W.M. (2019). 'Debating dams: The World Commission on Dams 20 years on'. *Wiley Interdisciplinary Reviews: Water*, e1396. DOI: 10.1002/wat2.1369.

Tirpak, D. and Adams, H. (2008). 'Bilateral and multilateral financial assistance for the energy sector of developing countries'. *Climate Policy 8*, 135–151.

WCD (2000) *Dams and Development: a new framework for decision-making*. World Commission on Dams (WCD).

World Bank (1961). 'Report to the International Bank for Reconstruction and Development – Uganda Electricity Board Project' [available at documents.worldbank.org]. Accessed: 23 June 2019.

World Bank (1962). 'Report and recommendations of the President to the Executive directors on a proposed development credit to India for the second Koyna power project'. [Available at http://documents.worldbank.org/curated/en/560331468285881087/pdf/multi0page.pdf]. Accessed: 07 February 2020.

World Bank (1973). 'Appraisal of Kafue Hydropower Project stage II, Zambia'. 7 May. World Bank staff appraisal report. [Available at documents.worldbank.org]. Accessed: 27 February 2019.

World Bank (1977). 'Report and Recommendation of the President of the International Development Association and the International Bank for Reconstruction and Development to the Executive Directors on a proposed credit and proposed loans to the Republic of Malawi for a Third Power Project'. [Available at documents.worldbank.org]. Accessed: 23 June 2019.

World Bank (1989). 'Staff Appraisal Report Nathpa Jhakri Power Project, India' [available at http://documents.worldbank.org/curated/en/783631468266143063/pdf/multi-page.pdf]. Accessed: 23 June 2019.

World Bank (2005). Project appraisal report for Nam Theun II, Laos PDR. [Available at http://documents.worldbank.org/curated/en/250731468277466031/pdf/317640corr.pdf]. Accessed 23 June 2019.

Word Bank (2009). 'Directions in hydropower: scaling up for development'. *Water Working Notes 21*. [Available at http://documents.worldbank.org/curated/en/846331468333065380/pdf/490170NWP0Box31directionshydropower.pdf]. Accessed: 12 August 2019.

World Bank (2014). *Supporting Hydropower: An Overview of the World Bank Group's Engagement* [available at https://openknowledge.worldbank.org/bitstream/handle/10986/20351/Live%20Wire%202014-36_Supporting%20Hydropower%20in%20the%20Developing%20World.pdf?sequence=6&isAllowed=y]. Accessed: 11 September 2019.

World Bank (2017a). *State of Electricity Access Report 2017* [available at http://documents.worldbank.org/curated/en/364571494517675149/pdf/114841-

REVISED-JUNE12-FINAL-SEAR-web-REV-optimized.pdf]. Accessed: 9 August 2019.

World Bank (2017b). *Maximizing Finance for Development (MFD)* [available at https://www.worldbank.org/en/about/partners/maximizing-finance-for-development]. Accessed: 12 August 2019.

World Bank (2018). 'Cameroon: World Bank Group helps boost hydropower capacity'. Press release. [Available at https://www.worldbank.org/en/news/press-release/2018/07/19/cameroon-world-bank-group-helps-boost-hydropower-capacity]. Accessed: 19 August 2019.

World Bank and IEA (2015). *Progress toward Sustainable Energy 2015* [available at https://openknowledge.worldbank.org/handle/10986/22148]. Accessed: 9 August 2019.

World Energy Council (2015). *World Energy Resources: Charting the Upsurge in Hydropower Development 2015* [available at https://www.worldenergy.org/assets/downloads/World-Energy-Resources_Charting-the-Upsurge-in-Hydropower-Development_2015_Report2.pdf]. Accessed: 9 August 2019.

Yankson, P., Asiedu, A., Owusu, K., Urban, F. and Siciliano, G. (2018). 'The livelihood challenges of resettled communities of the Bui dam project in Ghana and the role of Chinese dam-builders'. *Dev Policy Rev*, 36, pp. O476–O494.

Zimny, J., Michalak, P., Bielik, S. and Szczotka, K. (2013). 'Directions in development of hydropower in the world, in Europe and Poland in the period 1995–2011'. *Renewable and Sustainable Energy Reviews 21*, 117–130.