Future DAMS

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

Financing sustainable hydropower projects in emerging markets: an introduction to concepts and terminology

Sanna Markkanen [1]
Judith Plummer Braeckman[1]

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

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Abstract

Hydropower is the largest single renewable electricity source globally. However, many 20th century hydropower projects were developed without sufficient regard for their adverse environmental and social impacts, resulting in diminished public acceptance of such projects. Although the construction of large dams remains a politically, environmentally and socially contentious issue, hydropower is likely to play a key role in helping countries across the world to achieve the Sustainable Development Goals (SDGs) and the Paris Agreement target of limiting global warming to below 2^{o}C. In this new context, it will be increasingly important to understand how to develop socially and environmentally sustainable hydropower projects, and how to finance them. The challenge of improved energy access that is compatible with the Paris Agreement objectives and the SDGs will affect developing countries in particular. The purpose of this Working Paper is to introduce the key terms and concepts that are relevant to finance for sustainable large hydropower projects in Non-OECD countries/emerging markets. It is designed to address the needs of readers with little or no prior knowledge of either finance or hydropower, as well as those with limited experience in one of the two topics, but extensive background in the other (such as a hydropower specialist with an engineering background, but limited familiarity with financial concepts and terminology). The three main parts of the paper provide an overview of hydropower development process, hydropower finance, and risk and risk mitigation. Each of the three sections identifies the key actors and instruments, and defines their roles and purpose. The paper does not seek to engage in any detailed analysis of the various and often complex, value-laden questions surrounding hydropower. Instead, it aims to serve as a reference document to help readers better engage with the complex material on hydropower development and finance.

Keywords

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

JEL Codes

G32, O16, O19

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Contents

Acronyms

Commonly used acronyms relating to hydropower and finance

AF	Adaptation Fund
BOO	Build–own–operate
BOOT	Build–own–operate–transfer
BOT	Build–operate–transfer
CDM	Clean Development Mechanism
CER	Certified emission reduction
ECAs	Export credit agencies
EPC	Engineering, procurement and construction
EPs	Equator Principles
ESF	Environmental and social framework
ESIA	Environmental and social impact assessment
ESMP	Environmental and social management plan
ESS	Environmental and social standards
FELT	Finance, engineer, lease, transfer
GCF	Green Climate Fund
GEF	Global Environmental Facility
GHG	Greenhouse gas
HSAP	Hydropower Sustainability Assessment Protocol
IDA	International development agency
IFC	International Finance Corporation
IFIs	International financial institutions`
IHA	International Hydropower Association
IPF	Investment project financing
IPP	Independent power producer
LDCF	Least Developed Countries Fund
MDBs	Multilateral development banks
MIGA	Multilateral Investment Guarantee Agency
NUGs	Non-utility generation [contracts]
PPAs	Power purchase agreements
PPP	Public–private partnership
PRGs	Partial risk guarantees
SCCF	Special Climate Change Fund
SDGs	Sustainable Development Goals
SEA	Sectoral environmental assessment
SPC	Special purpose company
SPV	Special purpose vehicle
UNFCCC COP	United Nations Framework Convention on Climate Change Conference of the Parties
VER	Verified emission reduction
WCD	World Commission on Dams

Some major banks involved in hydropower finance

ADB	Asian Development Bank
ADF	African Development Fund
AFD	Agence Française de Développement (France)
AfDB	African Development Bank
AIIB	Asian Infrastructure Investment Bank
AKFED	Aga Khan Fund for Economic Development
BNDES	Banco Nacional do Desenvolvimento (Brazil)
CAF	Corporacion Andino de Fomento (Latin American Development Bank)
CSFB	Credit Suisse First Boston (Switzerland)
DBSA	Development Bank of Southern Africa
DEG	Deutsche Investitions- und Entwicklungsgesellschaft (Germany)
EAIF	Emerging Africa Infrastructure Fund
EBRD	European Bank for Reconstruction and Development
ECGD	Export Credits Guarantee Department (UK)
EIB	European Investment Bank
FMO	Dutch Development Bank (the Netherlands)
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (Germany)
HERMES (Hermesdeckung)	Export credit guarantee by the German Federal Government
HSBC	Hong Kong and Shanghai Banking Corporation
ICBC	Industrial and Commercial Bank of China (China)
IDB	Inter-American Development Bank
IIC	Inter-American Investment Corporation
IsDB	Islamic Development Bank
JBIC	Japan Bank of International Cooperation (Japan)
Jexim	Export Import Bank of Japan
JICA	Japan International Cooperation Agency
KEDCF	Economic Development Corporation Fund of Korea
KfW	Kreditanstalt für Wiederaufbau (Germany)
NDB	New Development Bank
OPIC	Overseas Private Investment Corporation (USA)
RBS	Royal Bank of Scotland (UK)
SEK	Swedish Export Credit Corporation
SIDA	Swedish International Development Cooperation Agency (Sweden)
USAID	United States Agency for International Development (USA)

Introduction

This paper provides an overview of the key stakeholders involved in large-scale hydropower project development and definitions of the terminology for hydropower finance.[1] The emphasis is on new projects in Non-OECD emerging economies, i.e. countries that are extending electrification or industrialising rapidly and need to invest heavily in their productive capacity over the coming years. Some of these countries possess the largest remaining untapped hydropower resources in the world, but also face the greatest challenges in securing finance for new projects. The purpose of the paper is to provide basic knowledge of the key concepts required to engage with the more complex material on hydropower project development and finance. It has been designed to be used as a free-standing learning resource, as well as an accompanying background document to future Working Papers on sustainable finance mechanisms for sustainable hydropower projects.

The paper begins with consideration of the definition of sustainable hydropower, which is followed by a brief background section, which provides an overview of the key actors involved in hydropower project development and the various stages of the development process. This section also outlines the main challenges to hydropower project development, including factors that affect the availability of funding. Section 3 focuses more specifically on the finance landscape, with detailed descriptions of the various financing instruments and institutions. Risk and risk mitigation instruments are discussed in Section 4.

Although small-scale hydropower projects (or even micro-hydropower plants), may aid economic development and improve the quality of life in remote off-grid communities (Bhandari et al, 2018), these projects have an entirely different financial structure to large (>20–50MW depending on the country circumstances) hydropower projects. The discussion in this paper focuses on large hydropower projects. While many of the terms used are the same as for small hydropower, there is a need for further research on the financing of small hydropower projects.

There is increasing focus on the importance of decentralised renewable electricity systems and small-scale generation projects, particularly to improve electricity access in remote areas that are not currently reached by an electricity grid (Mitchell 2016). Modern renewables are key to the success of this decentralisation. However, there remains a role for large dispatchable generation schemes such as large-scale hydropower, particularly in balancing intermittent renewables at scale and supporting electricity transmission systems (Yang et al. 2018). Hence this paper concentrates on large grid-connected hydropower projects which have a long-term role in supporting the transition to a net zero carbon grid.

Within the term ‘large hydropower projects’, this paper also includes pumped-storage hydropower projects. Pumped-storage projects have two reservoirs at different heights and are able to pump water up to the higher reservoir when there is surplus electricity available on the grid, and to generate electricity by allowing water to flow to the lower reservoir when

[1] While some acronyms are included in the text, others are spelled out to avoid confusion. A full list of hydropower- and finance-related acronyms used in this paper is presented on page 4.

electricity is needed, such as during peak times of demand (see, for example, Rehman et al, 2015). This form of hydropower is growing in significance worldwide as it has the ability to balance electricity produced by intermittent renewables such as wind and solar (Tietze et al, 2016).

1 Sustainable hydropower

Hydropower is a renewable and low-carbon energy source, contributing to the avoidance of greenhouse gas (GHG) emissions and thus to the mitigation of global warming (Berga, 2016; Glachant et al, 2015). Hydropower is the single largest renewable electricity source: in 2018, it accounted for 16% of all electricity generated across the globe, and more renewable electricity than all other renewable sources combined (IHA, 2018). Like all power generation technologies hydropower is not an entirely emission-free technology: an average reservoir dam with a generating capacity of 95 MW to 500 MW will emit approximately 13.60 tCO2e/GWh, assuming a 50-year project lifespan, declining further if the dam remains in operation for longer. The exact amounts of GHG emissions are often difficult to estimate and vary depending on the climatic conditions; the size and surface area of the reservoir; the project lifespan; and the specific human activity in the catchment area. However, a GWh of electricity generated from hydropower in China is nearly 100 times cleaner than a GWh of electricity generated from coal (Jiang et al, 2018; see also World Energy Council, 2015).[2]

During the latter half of the 20th century, many hydropower projects, especially in developing countries, were implemented with little or no regard for their adverse social and environmental impacts, such as population displacement, loss of livelihoods and damage to local ecosystems. The strong association of large-scale hydropower projects with socio-environmental conflict and human rights violations (Riethof, 2017; Finley-Brook & Thomas, 2010) led to a diminished public acceptance of such projects (OECD/IEA, 2010; Finley-Brook & Thomas, 2010) and provided fuel for anti-dam protest movements such as International Rivers. In response to the growing criticism of hydropower, the World Commission on Dams (WCD) was created to produce a consensus on good practice for hydropower implementation, calling for careful consideration of the economic, environmental and social effects of the planned projects – including their impacts on directly affected communities (WCD, 2000). The WCD guidelines emphasise the need for avoidance, mitigation and compensation of all negative impacts. In 2011, the International Hydropower Association (IHA) convened a range of stakeholders to launch a new Hydropower Sustainability Assessment Protocol (HSAP) (Locher et al, 2010), which is now supported by the Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool (HESG Tool) for project owners, investors and developers. Many countries have also put in

[2] According to one study using the integrated GHG reservoir tool developed by the International Hydropower Association to analyse the GHG emissions of 95 MW to 500 MW reservoir hydropower projects in China, the average GHG intensity of a reservoir dam is 13.60 tCO2e/GWh for 50 years and 8.13 tCO2e/GWh for 100 years. However, the emission rates of hydropower stations with lower installed capacity are larger, especially if they are in operation for a period of less than 30 years. These GHG emissions compare favourably with the average GHG intensity of GWh electricity generated by coal in China (822 tCO_2e/GWh) (Jiang et al., 2018).

place national-level regulations for large hydropower projects (see, for example, Hess & Fenrich, 2017; Banerjee, 2014). Detailed analysis has resulted in praise for initiatives such as the HSAP but has also suggested a wider definition of the impact area to encompass environmental effects, and also to consider the wider grid stability benefits of hydropower (Tahseen & Karney, 2017).

Although the construction of large dams remains a politically, environmentally and socially contentious issue in many contexts, a growing consensus is emerging around the potentially crucial role of hydropower in climate change mitigation and adaptation. In the words of Tracy Lane (IHA, 2015), “when properly planned and implemented, hydropower is an affordable, reliable, sustainable and modern technology. It can help communities, nations and regions to acquire a reliable supply of electricity, supporting economic and social development throughout the world.” As the demand for large-scale energy generation from renewable sources grows, so does the need to understand – and demonstrate – how socially and environmentally sustainable hydropower projects can be developed to support the transition to a low-carbon economy. Establishing sustainable finance mechanisms for hydropower projects will constitute an important aspect of this challenge.

The Paris Agreement objective of limiting global warming to well below 2^{o}C requires countries across the world to take action to reduce energy consumption and rapidly to decarbonise their energy supply. A growing proportion of electricity will be generated from intermittent renewables, such as wind and solar. Intermittent renewable energy sources, however, provide a variable supply of energy, which is often difficult to forecast accurately. In this context, hydropower (especially dams with storage, and pumped-storage projects) can play an important role in improving grid stability (Glachant et al, 2015). Unlike any other renewable energy source, the electricity generation from hydropower can be easily adjusted up or down, and started without needing an existing energy supply (such as in the event of a blackout) (Glachant et al, 2015). In 2018, pump-storage hydropower projects accounted for over 95 per cent of energy storage capacity worldwide (IHA, 2018). However, climate change may also increase or decrease the traditional timing and flows of water for hydropower generation, so there is a need for greater flexibility in hydropower design (Kumar et al, 2011).

From a broader sustainability perspective, hydropower is expected to contribute towards the UN’s Sustainable Development Goals (SDGs), especially SDG7 (affordable and clean energy for all). It may also help achieve other SDGs – such as those focused on water (SDG 6), resilient infrastructure (SDG 9), and climate change (SDG 13) – by acting as a financing instrument for multipurpose reservoirs, which can regulate the impacts of climate change on water resources, including irrigation and flooding (Berga, 2016; IHA, 2015). Synergies between hydropower and solar, especially when co-located by placing solar panels on reservoirs, can also help reduce water loss resulting from evaporation in hot and dry conditions (Acheampong et al, 2019).

The 2016 NCE report highlighted the importance of “Investing in sustainable infrastructure is key to tackling three simultaneous challenges: reigniting global growth, delivering on the Sustainable Development Goals (SDGs), and reducing climate risk” (NCE 2016). Building on this, sustainable infrastructure is defined by Yanamandra (2019) as that which considers the three dimensions of commitment 'to one or more of the SDGs '; 'a triple-bottom line perspective'; and 'consideration of financial sustainability aspects. Given the complexity of hydropower development and past failures, specific standards for sustainability have been defined through the Hydropower Sustainability Assessment Protocol (HSAP 2019a), which is in line with the World Bank, IFC and other international lenders sustainability guidelines and frameworks. This protocol identifies more than twenty five areas which must be given adequate consideration in hydropower development and operation: communications and consultation, governance, demonstrated need and strategic fit, siting and design, environmental and social Impact, project management, hydrological resource, asset reliability and efficiency, infrastructure safety, financial viability, project benefits, economic viability, procurement, project affected communities and livelihoods, resettlement, indigenous peoples, labour and working conditions, cultural heritage, public health, biodiversity and invasive species, erosion and sedimentation, water quality, waste, noise and air quality, reservoir management, downstream flow regimes, and climate change mitigation and resilience. For the purposes of this paper sustainable hydropower is defined as that which addresses each of the areas identified by HSAP. Different financial structures are associated with varying levels of sustainability due diligence.

2 Hydropower project development

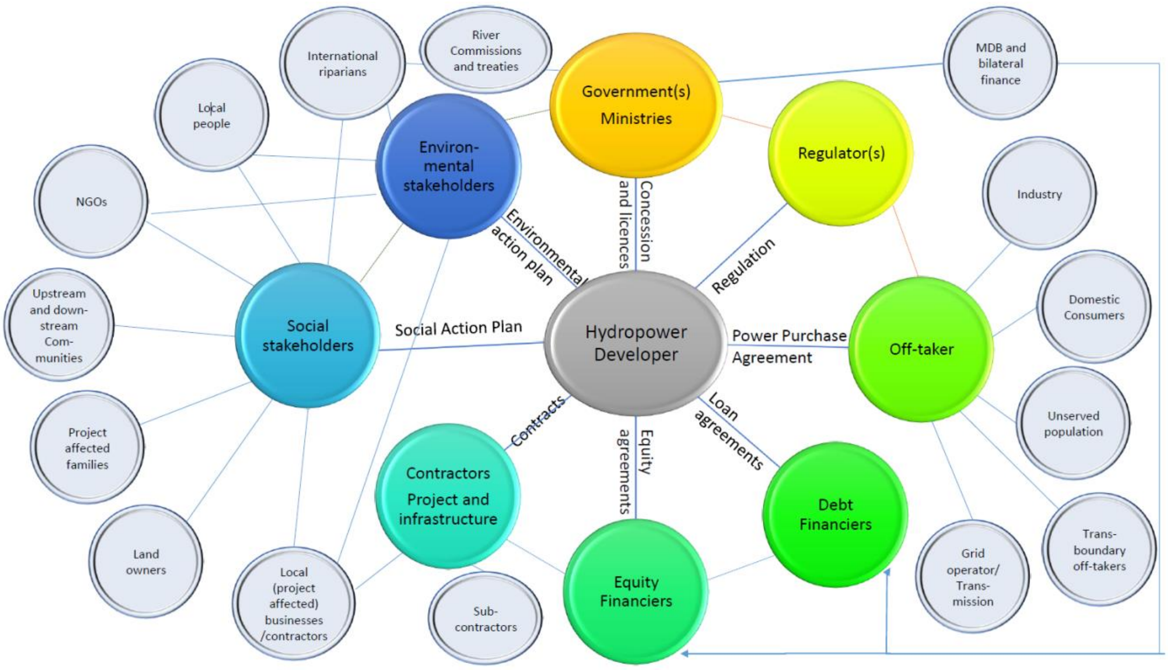
2.1 Key actors

The organisational structure and financing of large hydropower projects can be complex, involving a large number of actors, with several actors often taking on multiple roles (Figures 1 and 2). No single structure or set of actors applies to all hydropower projects. The core players vary project by project, and the relationships between roles and players are not always clearly defined or apparent. For example, some projects are developed with minimal public sector involvement, while others are developed entirely by the public sector. Almost all large hydropower projects have some government involvement, such as an off-taker owned by the government, or strict regulations requiring project developers to employ local workers and suppliers. An organisation that performs a certain role in one project may take on a completely different role (or roles) in another (Plummer Braeckman & Guthrie, 2015). An international company may invest heavily in the equity of one project, but only act as a contractor for another. In addition to the core players, numerous other parties can be involved in minor but potentially important roles relevant to the project, e.g. by providing an essential right of way (McWilliams & Grant, 2008).

The *Project Owner* is the most important party in a hydropower development. Most of the top-level relationships and contracts are between the project owner and the other key parties. The owners of hydropower projects include all equity investors. These are often electricity utilities (possibly government-owned agencies), the host country government or private sector investors – or a mixture of public and private sector investors. Companies with large electricity requirements operating in remote areas, such as mining companies, may also build and operate their own hydropower projects.

A *Special Purpose Company* (SPC) or *Special Purpose Vehicle* (SPV) is often established to develop and own private hydropower facilities, especially if the shareholders include a mixture of public and private sector investors. The SPC may comprise a consortium of interests, sometimes including government (McWilliams & Grant, 2008). The project owner is frequently also referred to as the *Developer* because of the role they typically take in planning and promoting the project, identifying off-takers, obtaining necessary permits and concessions, obtaining funding, letting contracts and running the project as the operator (or letting a concession for operation) in the long term (Plummer, 2013a). Not all investors in the project consider themselves developers, so there may be equity investors who hold a minority stake. However**,** equity investors without a collateral interest are rare.

Figure 1: Stakeholders in a large hydropower project



Full private ownership and financing of large hydropower projects in poor economic regions is rare, with private developers mostly concentrating their interests on small run-of-river hydropower projects (IHA 2019). Experience demonstrates an increasing trend towards public–private partnerships (PPPs), with finance being sourced from both public and private sources, and responsibilities, risks and rewards being shared between the public and private sectors (Head, 2006). The *Host Government* typically undertakes a key role (or several roles) in hydropower projects. As hydropower sites are unique natural resources of the host country, most governments wish to exercise some control over the exploitation of the resource, to ensure adequate public revenue from the project and to provide environmental and social protection. The host government usually acts as the *Concession Awarder*. This role involves: identifying the projects for development; assigning hydropower [concession agreements;] defining the key characteristics of the project and the principal terms of the [concession] (such as term, start date, transfer arrangements, royalty payments, and compliance requirements); monitoring the project implementation; and defining the risk sharing between the government and the owner (McWilliams & Grant, 2006).

The host government will typically be responsible for issuing various licences and permits required for the development of a hydropower project. These may include planning permission and building regulations approval, construction licences, security clearance, water rights agreements, way leaves and rights-of-way, company registration, investment licences, foreign exchange purchase and remittance licences, import licences and the licensing of designers, contractors, manufacturers, plant operators and skilled labour. Obtaining all the necessary licences can be both a laborious and a time consuming task for the project developer, especially if the licences need to be acquired from various agencies, each of which may have its own procedures. However, some countries have established 'one-stop' agencies to coordinate the licensing and permitting process. In many instances, the financing agreements list certain key licences as 'conditions precedent' (i.e. conditions which must be satisfied) for funds to be disbursed (McWilliams & Grant, 2006).

An Independent Power Producer (IPP) is a private-sector entity that owns facilities to generate electricity for sale to utilities and end users. IPPs are the private-sector equivalent of a government-owned *public utility generation company*. IPP contracts may also be referred to as non-utility generation contracts (NUGs) (Halpern & Woolf, 2001). IPPs are often also owners/developers and it remains relatively rare for an IPP to operate a plant where it is not involved in the development of that project. However, various IPP investments have been divested, such as that in Bujagali Hydropower project, where AN Power SN acquired two-thirds of Bujagali Energy Ltd (the company that owns and operates the project) from Sithe Global about six years after the project had been commissioned (SN Power, 2018). Even when a hydropower project is developed by an IPP, the design phase (including identification and conceptual studies) may be carried out in the public sector before a project is offered to IPPs for development. This approach may help attract an IPP to a project it would otherwise not want to get involved in, as thorough design-phase studies lower the perceived risks of a project for the owner. In some instances, IPPs are required to pay a fee as part of their concession agreement towards the cost of these advance studies prepared using public sector resources (McWilliams & Grant, 2008).

A *Promoter* is a party who takes on a planned hydropower project and drives it towards financial closure (defined as the point at which a firm financing package is in place for the project (Roger, 1999)), although the term is occasionally conflated with 'developer' (DECC, 2013). The promoter will typically become part of the ownership/owner–operator consortium, although some promoters specialise in the front-end development of projects and sell their share of the project before the financial closure or shortly after the commercial operation commences. The promoter is usually involved in various early-stage activities, such as identifying the project and securing rights (particularly the Concession Agreement), commissioning project studies (technical, environmental, social, economic and commercial), procuring contractors and suppliers, establishing electricity sales agreements, managing and administering project finances and construction contracts up to commercial operation, and verifying completion of the project with the contractor. In the public sector, the promoter will typically be an electricity utility or a national hydropower agency. In the private sector, the promoter tends to be an entrepreneurial organisation or an individual with an equity stake in the project and an appetite for the risks involved in the early project stages (McWilliams & Grant, 2008).

'*Contractor*' is an umbrella term covering all engineering contracts and construction contracts (Plummer, 2013). Contractors play a key role in the development of a hydroelectric scheme, and may include a diverse group of civil works contractors; mechanical, electrical and hydro-mechanical equipment suppliers; and designers, consultants, sub-contractors and specialist equipment suppliers. The traditional approach to hydropower dam construction involved the award of split-package contracts, with different elements of the work being awarded to contractors specialising in the appropriate discipline. A large hydro project might be split into four or five main contract packages, although in some cases the number of contracts could be greater. The principal civil works contract is generally separate from the principal electro-mechanical contract, but these disciplines may be further subdivided. The separate contract approach is still employed, particularly in public sector projects (McWilliams & Grant, 2008). In such situations, the owner/developer or the supervising engineer typically takes on the task of coordinating the several large contracts (Plummer, 2013a).

Most private-sector projects, particularly those developed under non-recourse finance, tend to award one contract with a single point of responsibility called an *Engineering, Procurement, and Construction (EPC) contract* (also referred to as a turnkey contract). Under a single EPC contract arrangement, the contractor takes responsibility for the design, construction, supply and installation of equipment, and the commissioning of the scheme to meet the owner's requirements (thus taking on some of the roles typically undertaken by the owner/developer in other types of contractual frameworks). This contractual approach is popular with financiers unfamiliar with hydropower development, as they gain comfort from the impression that all risks are transferred to the EPC contractor. However, the approach is known to be more costly than a traditional split-contract format, as the contractor will include a significant risk premium for accepting such a large range of risks (IFC, 2015). For example, a study drawing on existing literature on an EPC contracting method in Pakistan identified, characterised and ranked 50 risks associated with the EPC delivery method for various types of large-scale infrastructure projects (Ayub et al, 2016). Single-contract EPC risk premiums for accepting these risks may be in the range of 30per cent higher than contracts awarded separately to specialist firms (McWilliams, 2014). The EPC approach is facing challenges because of contractors' unwillingness to take on such a wide range of risks, many of which may be difficult to mitigate, especially outside the comfort of their home markets. As a result, international competitive bidding for hydroelectric projects often attracts a limited number of responses and runs the risk that lack of competition may lead to higher prices (McWilliams & Grant, 2008).

The *Off-taker* is the party that purchases the output of the hydroelectric project: predominantly electricity, but sometimes also non-energy benefits such as grid services (Plummer Braeckman & Guthrie 2015). There may also be a *Grid Operator/Load Dispatcher* between the operator and the off-taker. The off-taker will be required to adhere to the Grid Code as a mandatory requirement. Off-takers for hydroelectric projects may include electricity utilities, industrial consumers, self-consumers who also own the hydro scheme (eg mining companies, industrial consumers, transportation companies), electricity pools or power-trading entities and cross-border utilities (McWilliams & Grant, 2008).

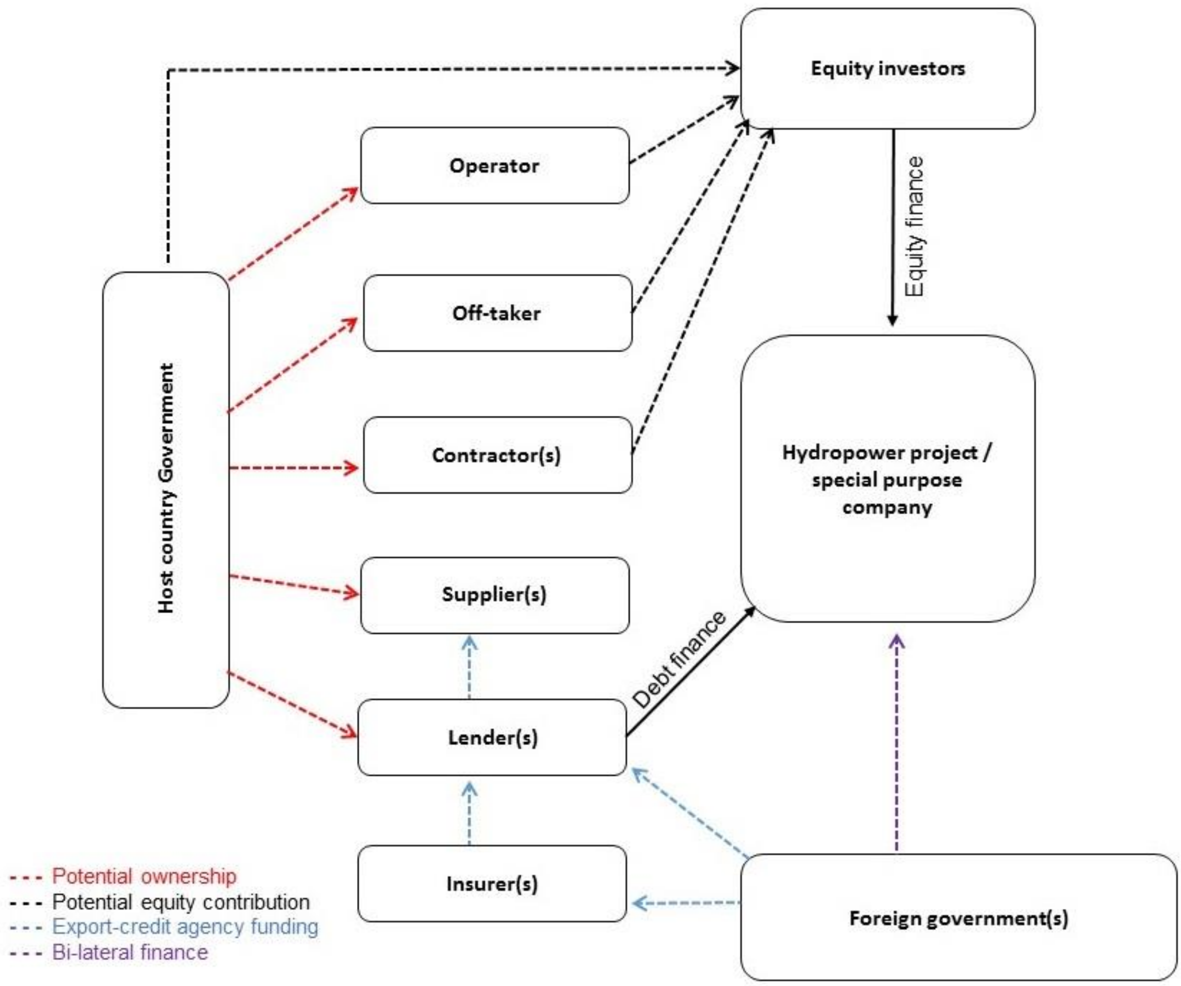
The *Electricity Regulator* is a role performed either by the host government (typically through a government agency or a ministry) or by a specially established independent regulatory body. On occasions, in the absence of a regulator, certain functions typically performed by a regulator are left to the public utility grid operator. Depending on the regulatory frameworks and the degree of centralised control and planning of the electricity industry, the functions of the electricity regulator may include:

- allocation of concessions;
- issue of generation licences;
- definition of the grid code;
- tariff setting;
- managing security of supply;
- monitoring operation and electricity production (McWilliams & Grant, 2006).

Following the completion of the development phase of the hydropower project, the project owner reverts to a more pedestrian role of *Owner–Operator* as the project enters a low-risk and low-input stage. The owner–operator is responsible for ensuring that routine maintenance is undertaken, and that the scheme is run to maximise the revenue, but also in accordance with the load dispatch instructions of the off-taker or as specified in the concession agreement.

The size of the budgets for large hydropower projects and their complex administrative structures may provide good opportunities to hide unseemly practices, such as bribery, fraud and other forms of corrupt behaviour (Haas, 2008). Corruption may lead to less sustainable hydropower projects with profound negative impacts on ecosystems, biodiversity and human livelihoods. Although corruption presents a challenge to the sustainable development of hydropower projects, the issues are country-specific rather than hydropower-specific and are not presented in further detail. (For more information on the risks associated with corruption in hydropower development, see Haas, 2008).

Figure 2: Hydropower project key actors and roles



Note: This figure illustrates the various ways that several key actors *may* take multiple roles in the development and operation of a hydropower project. For example, equity finance can come from various sources, including organisations that play other roles in the project's development (such as the off-taker, the operator, and one or more of the contractors), making these parties shareholders in the project. The off-taker, operator and contractor(s) may be independent commercial companies, or they may be owned by the host country government. The host country government may also require the project to be developed using local suppliers, in order to maximise the economic benefits from the project. Foreign governments may provide debt finance for the project through bilateral financing institutions (such as bilateral development agencies). If a project is fully or partly funded by an export credit agency, it may come with an obligation to use materials and/or contractors from that country. In some instances, an import–export credit agency may also provide insurance for commercial banks that lend money for a given project – although insurance and guarantees may also come from other sources, such as multilateral development banks (MDB)s (e.g. the International Development Agency (IDA)). Organisations providing debt funding may be diverse, and linked to either the cost country or a foreign government, or may be wholly independent (such as commercial banks and MDBs). 'Lender', in this image' is used as an umbrella category – in reality, one project may have only one type or multiple types of lenders.

2.2 Hydropower project development process

Hydropower projects are highly capital-intensive, with a long preparation phase, lengthy construction period, often considerable environmental risks and social impacts, and a typical project lifespan of more than 50 years. However, hydropower is highly cost-effective (i.e. it has a low generating cost per MW of electricity over the lifetime of the plant) once the initial investment loans have been repaid.

Hydropower dams also offer many additional benefits beyond power generation, including flood control, irrigation, water supply and river navigation (Trouille & Head, 2008). Yet acquiring financing for hydropower projects is difficult, especially during the early planning and construction stages, which, for large projects, may last around six to eight years or even longer (McWilliams & Grant, 2008).

A dam project cycle has four main phases: planning; design; construction; and operation (Kirchherr & Charles, 2016), although the process may be more complex, as shown in the IFC diagram reproduced in Figure 3. The availability of financing depends on the perceived risks and expectations of future revenue streams by the potential investors (Landry, 2015; Plummer, 2008). To access capital, project developers must identify the revenue to be used to service the debt and provide a return on investment to the equity investors. The risks are particularly high during the pre-development phases (planning and design), as the failure of the project at this stage could lead to the loss of all the finance used for preparation, which usually comes from equity investors. Once the construction has commenced, and especially once the construction phase has been completed, many of the greatest risks associated with the project will have been eliminated or managed, making the project more attractive to other investors (Landry, 2015).

Figure 3: Project development process

BANK PERSPECTIVE	MAIN ACTIVITIES (DEVELOPER)
PHASE 1	**SITE IDENTIFICATION/ CONCEPT**
	• Identification of potential sites • Funding of project development • Development of rough technical concept
PHASE 2	**PRE-FEASIBILITY STUDY**
	• Assessment of different technical options • Approximate cost/benefits • Permitting needs • Market assessment
PHASE 3	**FEASIBILITY STUDY**
• **First contact with project developer**	• Technical and financial evaluation of preferred option • Assessment of financial options • Initiation of permitting process
PHASE 4	**FINANCING CONTRACTS**
• **Due diligence** • **Financing concept**	• Permitting • Contracting strategy • Supplier selection and contract negotiation • Financing of project
PHASE 5	**DETAILED DESIGN**
• **Loan agreement**	• Preparation of detailed design for all relevant lots • Preparation of project implementation schedule • Finalisation of permitting process
PHASE 6	**CONSTRUCTION**
• **Independent review of construction**	• Construction supervision
PHASE 7	**COMMISSIONING**
• **Independent review of commissioning**	• Performance testing • Preparation of 'as built' design (if required)

Source: Adapted from IFC (2015).

2.3 Hydropower as an investment – the key challenges

Several factors have contributed to the widespread reputation of hydropower projects as challenging investments. First, hydropower projects are capital-intensive and highly site-specific. Each project needs to be individually designed, which takes time and money (Trouille & Head, 2008). Second, projects typically have significant environmental and social implications, which have not always been adequately managed or mitigated (Plummer, 2008). Third, it is often impossible to predict the precise geotechnical conditions of the project and thus its final cost may continue to vary until construction is underway (Trouille & Head, 2008). Consequently, the risk of overruns and delays is greater than in the construction of, say, a thermal power station. The award of a hydropower concession involves the use of unique natural resources and is thus much more complicated than simply making a plot of land available. Many governments lack capacity for this process, with consequent delay and uncertainty for the development (Trouille & Head, 2008).

Attracting commercial financing for hydropower projects is further complicated by the contrast between financial and economic evaluations. Standard economic valuation tends to exclude the multiple economic benefits of a dam, which are difficult to quantify in monetary terms and do not produce a revenue stream for the project (Plummer, 2008). Since many hydropower projects have strong economic impacts from the generation of electricity, when a project is subject to an economic analysis, it is relatively easy for this analysis to yield a positive economic rate of return. Most institutions, such as multilateral development banks and government treasury departments, will set a target ('hurdle') rate of return in order for a project to be considered worth pursuing. This hurdle rate may be exceeded by the economic analysis of electricity generation and more obvious economic benefits even after including the economic costs of the project and its impacts. Other more difficult areas to quantify – such as local regional development effects, flood amelioration or grid strengthening – may simply be listed as other unquantifiable economic benefits.

Having established that a project is in the economic interest of the host country government, seeking financial investment in that project may not be as straightforward as it might appear. The economic benefits do not all translate into financial streams of value and thus are not regarded as financially attractive by potential private-sector investors. Closing the gap between economic and financial viability may force the host country government to look for ways to improve the project's financial viability or to invest public funds in it (Head, 2006). To improve a project's attractiveness to financiers, the government may introduce a subsidy element, provide equity or low-cost debt (sometimes through development-based finance), or separate out the project's financially viable aspects from the non-viable aspects (e.g. by considering the dam and the power station as two projects) (Plummer, 2008).

There is a relative shortage of fully studied potential project sites that constitute a bankable hydropower project, ie a project that meets the minimum threshold for an investment-grade project, typically an investment rating of BBB+.[3] To be bankable, in the eyes of private-sector investors, a project needs to produce a predictable income stream. Thus, questions such as

[3] Investment rating is an internationally used tool for measuring how likely an investment is to meet its payment obligations. Banks often have internal procedures and controls which prevent them from investing in projects that fall short of a certain minimum rating (Country Economy, 2019).

the affordability and price of electricity, as well as the credit-worthiness of the off-taker, are crucial to bankability. The host country's credit rating also matters as, without external support, a project cannot have a higher investment rating than the country in which the project is located (Head, 2006). Projects in emerging markets with a poor sovereign credit rating are therefore the most difficult to finance, unless the project's creditworthiness can be boosted by credit enhancement mechanisms, such as guarantees. In Sub-Saharan Africa, for example, South Africa is the only national economy given an investment-grade credit rating in 2019 above B+/B1 ('highly speculative') by any of the three largest credit rating agencies that international investors rely on (Reuters, 2019; Country Economy, 2019).

2.4 Financing

In 1999, John Briscoe, then senior water adviser to the World Bank, noted that 15per cent of all public-sector investment went into water infrastructure. He went on to note the difficult transition to come in moving from public sector-led to private sector-led finance (Briscoe, 1999). Large hydropower development in emerging markets was traditionally viewed as the prerogative of the public sector (Landy, 2015). Advocates of public sector management of hydropower regret that private parties are allowed to profit from the use of precious natural resources (Merme et al, 2014). Conversely, advocates of the private sector claim that governments are not efficient enough and therefore need to employ private expertise (Landy, 2015).

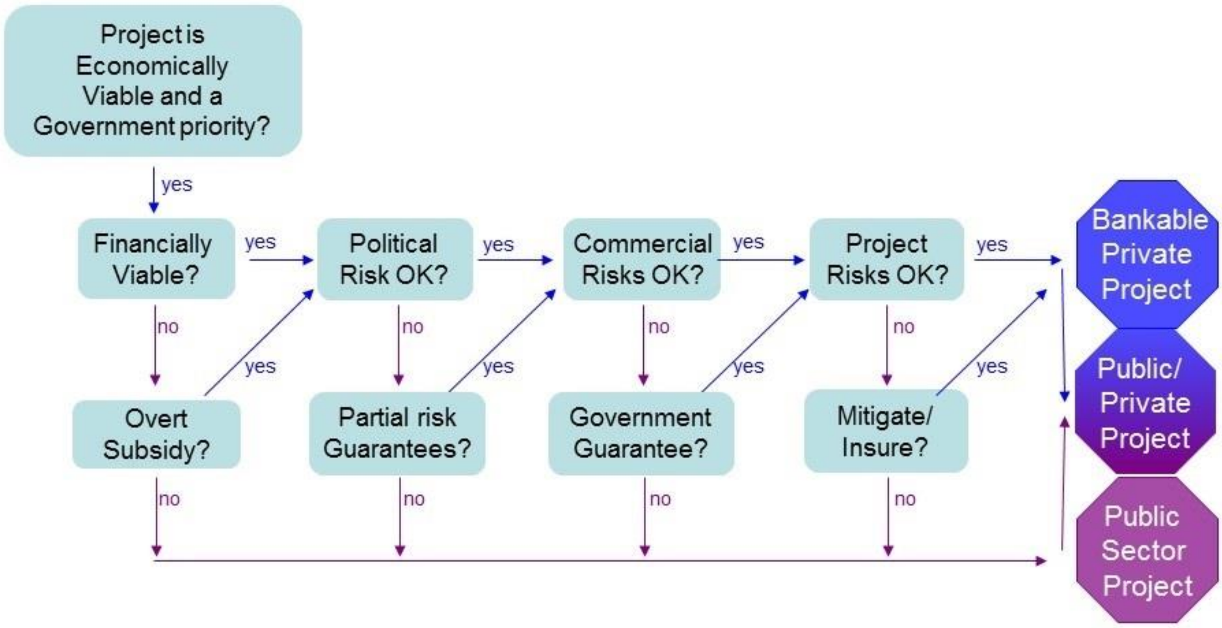
In recent years, private financiers have started to play an increasing role in hydropower development, while the traditional players, such as multilateral development banks and governments, are taking on "a more facilitating and regulatory role by providing guarantees and mitigating social and environmental impacts partly releasing the new global and regional private actors from these responsibilities" (Merme et al, 2014, p 20). However, the private sector's increased interest in large dam development and its financial opportunities has not been associated with an extensive literature on the process (Merme et al, 2014, p 20). As more hydropower projects are developed wholly or partially with private finance, a better understanding of the factors that attract such finance, as well as of the risks that hinder private-sector involvement, will evolve.

Not all private investors take the same view of a project. "Some will be prepared to contemplate higher risks than others, but they will all go through the same process of evaluating financial viability and risk" (Head, 2006, p 31). The development of an appropriate financial package to make a hydropower project bankable requires:

- finding a balance between public and private parties;
- a mix of equity and debt financing;
- identification of possible financial risks involved in various steps of project development and implementation (Trouille & Head, 2008).

The degree to which the various risks can be mitigated will influence the choice of project structure. If the risk is substantial and cannot be mitigated to any significant degree, the project will be unlikely to attract private participation and will need to be developed in the public sector. However, it may still offer opportunities for private participation (Plummer, 2008; Head, 2006). Figure 4 illustrates in outline how various factors influence the decision on project financing.

Figure 4: Factors influencing hydropower project financing



Source: Head (2006)

2.5 Processes

A hydropower concession is typically granted by a host country government and gives the owner/owner–operator of the hydropower project a right to build, design and operate a hydropower facility, including the right to use the water resources for electricity generation (a non-consumptive use) (World Bank, 2019b). A hydropower concession is typically valid for a certain period of time, sometimes with a possibility of extension at the end of the initial concession period. During the concession period, the project owner operates the facility. After the concession period expires, ownership is transferred to the concession awarder, i.e. the government or public sector utility (McWilliams & Grant, 2008). The allocation of a hydropower concession may take place through a wide range of mechanisms, from monopoly allocation to public sector utilities, such as in China (Wang & Chen, 2012), to competitive auctions that are open to all qualified promoters, such as those in Brazil (Rego & Parente, 2013). Many countries with hydropower resources have established formal policies for concession allocation and dedicated agencies for managing the concession allocation process. The concession model has been widely used in some countries, e.g. Laos (IHA, 2016) but is less effective in others, e.g. Myanmar (Kirchherr, 2018).

Hydropower projects are typically financed on the basis of the sale of electricity production, either using long-term *power purchase agreements* (PPAs) made with an off-taker or on a merchant basis (where the electricity is sold on short-term contracts or on an electricity market). A model where a private entity is awarded a concession to build and operate a hydropower project for a given period, but where the ownership remains with the government, is known as *build-operate-transfer* (BOT). A *build-own-operate-transfer* (BOOT) is similar to BOT, except that the operator owns the assets for the period of the concession (McWilliams & Grant, 2008, p 27). Other variations on these two basic models exist, such as the *build–own-operate* (BOO) model, where the asset remains in the private sector in perpetuity. However, the BOO model and models that involve leasing, like the proposed FELT (Finance, Engineer, Lease Transfer) model are not preferred for large hydropower (McWilliams, 2017).

Hydropower projects have a single main revenue stream – payments for electricity, capacity and grid services. In addition, the project may receive subsidies from government for a particular objective, such as electricity affordability and renewable energy credits or certificates, eg certified emission reduction credits through the Clean Development Mechanism (CDM) (Landry, 2015). Commercial lenders are occasionally willing to accept conservative forecasts of market prices from a reliable source to support project financing; however, the certainty of a power purchase agreement is usually required (Landry, 2015).

In sophisticated markets, non-energy benefits to power systems may also be sold to generate revenue. These benefits are available from both conventional hydro and from pumped-storage schemes and may include firm capacity/energy guarantees and rapid response services to improve grid stability. The beneficiary of non-energy benefits tends to be the grid and overall electrical network, hence the primary purchaser of these services is typically the network transmission operator. However, there is also potential for sales to third parties, including industries reliant on constant power supplies (McWilliams & Grant, 2008). Few emerging countries have energy markets sophisticated enough to value and remunerate these services, so in the majority of instances they remain largely as a free benefit of hydropower for the grid operator. There is much interest in new approaches to compensating hydropower projects for a broader range of services, such as a new programme in Ireland, which provides payment for 11 different grid services (EirGrid, 2019).

Capacity-based payments compensate generators for making the plant available to generate electricity in whatever way they are instructed by the dispatch operator. Capacity-based payments “are needed to provide revenue sufficiency and assure reliability where sole reliance on energy market revenues may not cover the long-term cost of generation” and to ensure adequate energy supply at all times in markets where intermittent renewables account for a large share of the electricity generation capacity (Griffes, 2014, p 27). The advantage, for operators, of a capacity- based payment is that they are not subject to the vagaries of the hydrological risk. The income stream is thus more predictable, making the project more bankable. On the downside, while capacity-based payments secure a project against losses from low water flows during a drought, they also mean that the project is unable to benefit from windfall gains during times of unexpectedly high water flows and increased generation.

Royalties are payments made by the developer or the special purpose company of a hydropower project to government for the right to use a natural resource. There is a wide range of methods of calculation of the level of royalty payment. In India, for example, the level of royalty to the host state for a project is set at 12per cent of the electricity generated (Karambelkar, 2017). There are also other payments to government from a hydropower project, including concession fees, taxes, licence fees, dividends and contributions to local regional development. Each of these may be waived or reduced by governments needing to facilitate the project to achieve economic development (Head, 2000; for more information on royalties, see also Pineau et al, 2017).

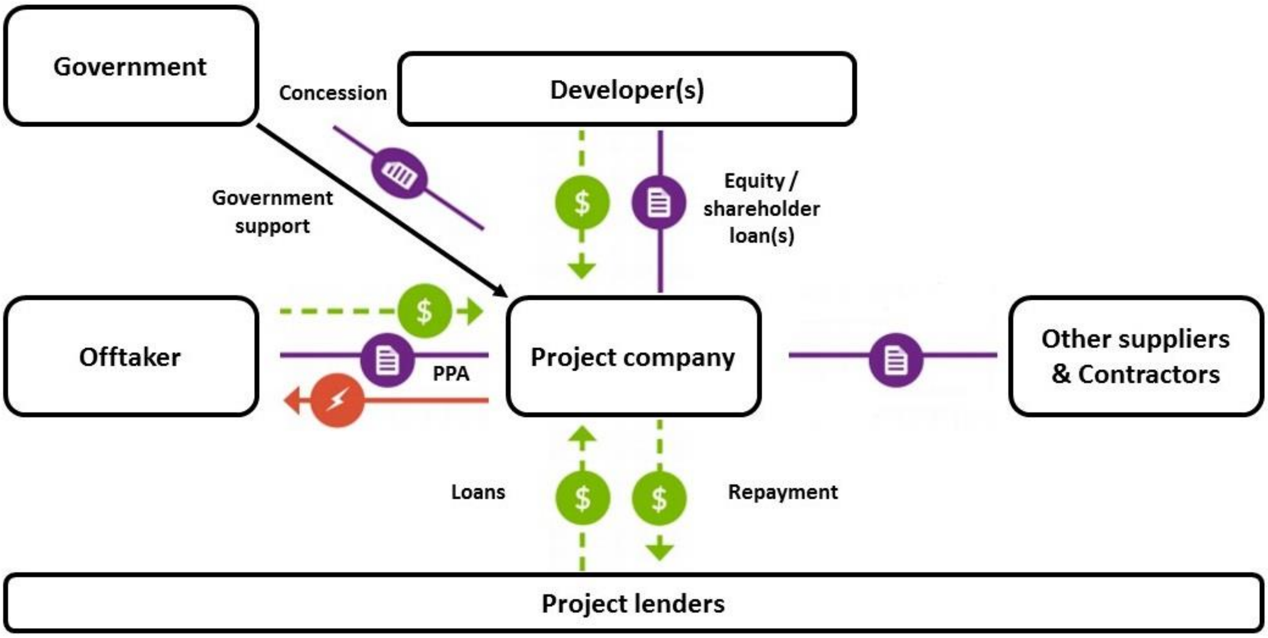
Refinancing is a process whereby the developers rearrange the project finance. Refinancing may involve swapping one form of debt finance for another; divesting some equity; selling off all or part of the project equity; or early debt repayment. The risk profile of a hydropower project drops considerably once it commences commercial operation. As a result, ownership of a project may change within the first two or three years after commercial operation starts, subject to the constraints of the concession agreement. Refinancing a hydropower project at this point in time usually results in greatly improved financing terms and can readjust currency exposure. Organisations such as pension funds and sovereign wealth funds, which have a long-term revenue horizon with a requirement for a steady income stream, may be suited to ownership throughout the operating phase of a project (McWilliams & Grant, 2008). While refinancing is still comparatively rare, certain projects, such as Bujagali in Uganda, have employed this financing technique. In 2018, the majority of the outstanding debt of the 250MW Bujagali hydropower plant 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). This allowed them to extend the tenor (repayment period) of the outstanding debt, in an attempt to reduce the cost of electricity generated by the plant (IFC, 2018).

3 Financing of a hydropower project

The financing of a hydropower project typically involves a mix of actors and financial instruments, which can be combined in various ways. All financial packages are a mixture of equity and debt in some combination, but there is no single financial structure or mix of actors universally applicable to all projects. Large hydropower projects are generally financed using project finance, as illustrated in Figure 5.

Project finance (or limited recourse finance) refers to a financing mechanism where the project itself, rather than the assets of the wider company owner, serves as collateral. This is only possible when the lender can easily step into the borrower’s shoes and continue the project in the case of the borrower’s default. To create such a set-up, a number of watertight arrangements detailing the duties and obligations of each party in various ‘what if’ scenarios – such as the concession and power purchase agreements – need to be in place for the construction period as well as for the operational phase, particularly during the debt service period. All required licences and permits, insurance policies and other important contracts must be drawn up in such a way that the lender has suitable redress or, in an extreme case, can take over the project in the event of default.

Figure 5: Typical project finance structure



Source: Adapted from IHA (2017).

A Finance plan needs to be created to the specifications of each project to combine the various financial instruments; ideally "in a manner that gives the lowest overall cost, with a repayment schedule that matches the income stream with adequate security" (Head, 2006, p 44). In this type of scenario, the financing matches the currency of the costs and income streams to minimise exchange rate exposure, but this is often not possible. The cost of the various instruments, as well as the feasibility of the various options, varies project by project. Given the long life of hydropower projects and the high up-front costs of construction, the crucial concern tends to be the length of tenor (repayment period) of any loan finance (Devernay, 2008; Ebobisse & Hott (2018).

Developing a feasible finance plan for a hydropower project can be difficult. It is often not possible to draw a clear distinction between public and private sector actors: commercial financing (both debt and equity) does not necessarily come only from private sector investors, and not all private sector investment is fully commercial (ie solely profit-oriented) in nature (Lumbroso et al, 2014). Governments may take low-cost aid finance and on-lend it to a project at quasi-commercial rates so that the benefit of the low-cost finance accrues to government, while the project benefits from the availability of capital. Further, some instruments like guarantees simply act to improve the bankability of a project (Head, 2006, p 44).

3.1 Financing instruments

The most widely used financing instruments may be classified broadly into five categories as follows:

- equity finance (private or public);
- commercial lending;
- concessionary finance;
- credit enhancement facilities (guarantees);
- export credit agencies.

Equity finance involves investing funds to construct a hydropower project in exchange for a share of ownership and thus a share of any future profits. Equity investors are prepared to assume some risk in return for higher rewards than lenders, making equity investment more expensive than debt (Head, 2006).

Equity investors are also known as *Equity Holders* or *Shareholders*. The risks and profits are shared among the (often various) shareholders according to their shareholding and share class. Typical *return on equity* (a measure of financial performance calculated by dividing the net income by the shareholders' initial equity investment) is 15 to 20 per cent per annum or more, depending on the perceived level of risk (Head, 2008). The shareholding may be sold to other investors during the life of the project, but the value of the share will decline as the project reaches the end of the concession, as there is generally no payment to shareholders when the project is transferred to the government. Thus, the return on equity includes an amount for recovery of the original investment. If the project experiences losses, the shareholders will receive no dividends (returns) (Head, 2006, 2008).

Equity investment may be provided from public sources, private sources or a mixture of both. *Private equity finance* may come variously from national and international sources, including:

- private sector power developers
- ‘captive’ generators who need power for their own consumption (eg mining companies, industrial conglomerates)
- regulated utilities
- manufacturers
- contractors
- investment funds
- Bilateral and multilateral development banks (through their private sector windows)
- commercial banks.

Table 1: Sources of public equity finance for hydropower projects

Internal to country	**External to country**
National governments Public utility companies National off-takers Power development authorities River basin authorities	Regional power companies Export country government Sovereign wealth funds Social welfare funds (eg AKFED) Bilateral development banks/agencies (eg AFD, FMO, KfW/DEG) Bilateral aid agencies (eg Norfund, Finnfund) MDBs and similar agencies (eg IFC, InfraCo, ADB, AfDB, IADB) Environmental funds (eg GEF)

Source: Adapted from McWilliams & Grant (2008).

There are broadly two types of equity investors. The first are 'strategic investors', i.e. organisations that have significant experience, interest or prior involvement in hydropower projects (such as sector-focused investment funds, large utility companies that may also act as an off-taker for the project, independent power producers or even be contractors). These organisations often take "an active role in the management and oversight of the projects in which they invest" (Mondik & Tarmey, 2008, p 63). The second type consists of financial investors (such as private equity funds, pension funds or insurance companies) that may have varying degrees of familiarity with the hydropower industry. These financial investors tend to be risk-averse in their investment, and passive. Equity investment may also involve the provision of in-kind assets, such as land or existing assets, from national or local government, and local and/or displaced communities. Pure equity investors are rare, as returns from hydropower project investment accumulate over a long period of time (whereas other options for investors looking for risky investment options tend to provide faster returns).

Debt finance refers to long- and short-term loans, mezzanine finance, bond finance, Islamic finance instruments (instalment sales, redeemable leases and Sukuk Bonds), and grant funds provided as soft loans or mixed credits (McWilliams & Grant, 2008). Debt financiers are known as *Lenders* and provide funds at a defined interest rate for specified periods (Plummer, 2008). Unlike shareholders, lenders are not owners of the scheme and therefore do not generally share in its risks or profits, although they accept the risk of project failure (Plummer, 2008; Head, 2006).

The relative proportions of debt and equity (otherwise known as the debt-to-equity ratio) is key to project financing. *Low-geared* projects (low debt-to-equity ratio) have a sizeable proportion of equity and thus require less debt, creating confidence among lenders as debt interest and repayments will always be paid before the equity holders in the case of financial difficulties (Head, 2006). The interest rate on a loan is generally lower than the rate of return on the total investment, meaning that the profitability of the investment increases with more debt. This is the ‘leverage effect’. In practice, this means that projects with a high debt-to-equity ratio (ie highly-geared) may be more profitable than those with low debt-to-equity ratio.

Lenders tend to be highly risk-averse and focused primarily on protecting their loans (Plummer, 2008). Legally, debt must be serviced before profits are used to pay equity returns. As a result, lenders are less exposed to risk than equity investors or shareholders, and debt finance is usually less expensive than equity finance. Loans need to be repaid over or at the end of a certain period of time (tenure) (Head, 2008; Plummer, 2008).

Commercial lending refers to debt financing offered for commercial motives, on market terms; it must be repaid (Lumbroso et al, 2014). It “consists primarily of bank loans and bonds raised on the capital markets” (Head, 2006, p 44). Much of the commercial lending for hydropower projects comes not just from commercial banks but also from international public agencies, state-owned and -controlled banks, and private companies (Lumbroso et al, 2014).

A wide range of actors may finance hydroelectric projects as lenders (McWilliams & Grant, 2006). Some of the organisations that invest in equity are also willing to provide debt. Hydropower project debt financers include, but are not limited to:

- Multilateral development banks (eg IBRD, EBRD, AfDB, ADB, IADB, IFC, IIC, EIB, AIIB, NDB)
- Bilateral development banks (eg KfW, Proparco, FMO, DBSA, DEG, NIB)
- Development agencies (eg JICA, SIDA, USAID, GTZ)
- National development banks and funds (eg BNDES, Banobras, Power Finance Corporation, PINA)
- Nationally backed funds (eg EAIF, Nadbank, Tacis)
- Export credit agencies (eg OPIC, Jexim, ECGD, COFACE, KEDCF, HERMES, SEK, China Exim Bank)
- Commercial banks (eg CitiGroup, HSBC, RBS, Santander, SocGen, ICBC)
- Islamic banks (eg Islamic Development Bank, Maybank, Meezan, Bank Islam)
- Bond underwriters (eg CSFB, Barcap, JP Morgan, Goldman Sachs).

In the past 20 to 30 years, over 30 per cent of financing for electricity generation capacity addition in Africa has come from China, particularly the China Exim Bank (IEA, 2016).

Unsecured debt or an unsecured loan (i.e. a loan without collateral or third-party guarantee) is typically available only to borrowers with a high credit rating, and rarely for hydropower projects. *Secured debt* is provided against collateral or a third-party guarantee (a commitment by a third party, such as a government agency, that the loan will be repaid even if the borrower defaults). In industrialised countries, real property regularly serves as collateral. In developing countries, borrowers often struggle with unclear land title issues, meaning that it may be more difficult to use the hydropower dam as collateral and lenders are reluctant to be left with a half-completed plant on land with unclear title. These issues need to be specified in the concession agreements if title is unclear.

Lending for hydropower projects is normally made on a *non-recourse* (project finance) basis, whereby the repayment relies entirely on the revenue of the project company. In other words, the lenders "commit their funds in the expectation that the project will deliver the revenue predicted", without being able to seize assets other than the collateral to pay off the loan if the borrower defaults (Head, 2008, p 58). Non-recourse loans are difficult and often expensive to set up and are therefore generally not cost-effective (Head, 2006; McWilliams & Grant, 2008).

Mezzanine finance ('quasi-equity' or preferred equity) refers to debt and equity financing, and includes features of both. Mezzanine finance allows the lender to convert debt to an equity interest in the company in case of default, but only after other lenders have been paid. Preferred equity is an equity shareholding enjoying preference in payment over other equity investors – usually at a fixed rate – but with no preference over debt repayments. The claims of mezzanine financiers are subordinate to those of lenders, but have priority over those of equity investors. The returns on mezzanine investments reflect this position, being typically higher than the returns on lending but lower than required by most equity investors (European Commission, 2007). As such, quasi-equity is a good solution for project sponsors who wish to obtain non- or limited-recourse senior debt financing "while minimizing the dilution of their own equity interest" (Mondik & Tarmey, 2008, p 69).

Subordinated debt is a type of mezzanine finance only occasionally used in hydropower projects. Such debt is subordinated to debt provided by senior project finance lenders in terms of cash flow and security (Mondik & Tarmey, 2008). In other words, the rights of the lender cannot interfere with the security interests of senior lenders.

For large and risky projects, such as hydropower, loans are often syndicated among a number of lenders to source sufficient funds and to distribute the risks (Head, 2008; IRENA, 2016). The term *Lead Arranger/Mandated Lead Arranger* is used to refer to a bank that is mandated to syndicate various loans. The lead arranger is responsible for negotiating the terms and conditions (including the price), the tenor (repayment period) and the structure of the loan facility with the borrower, and for sharing this with the other lenders to the project, rather than each lender negotiating individually.

Export credits are a form of official debt financing provided by export credit agencies that support national exporters. The terms of these loans tend to be more favourable than those of regular commercial lending, but the value of the loan is typically restricted to the export value of the equipment to be exported from the country concerned. Export credits are usually made available in the currency of the country issuing the credit and thus expose the borrower to exchange rate risks (Head, 2006).

Host governments can play a key role in attracting foreign investment and private sector participation through the provision of *fiscal incentives*. Fiscal incentives relevant to hydropower projects include:

- relief from taxes (corporation tax 'holidays' or VAT exemptions)
- relief from duties, such as import duties
- grants or loans on preferential terms

- accelerated depreciation of assets for tax purposes
- subsidies relating to environmental performance
- subsidised power grid access through reduced-cost access to transmission or government funding for the construction of the transmission interconnections
- subsidies to address the difference between the prevailing market or regulatory power tariff and the cost of power from the project – particularly for poor or vulnerable groups
- capital cost contributions (where, for example, a project has unremunerated non-power benefits such as flood control).

The use of such incentives needs to be carefully assessed by the government to ensure that the incentive is effective at achieving the required result in terms of project promotion and, if it is, that this is the cheapest mechanism available to achieve the desired effect. These incentives are usually defined in the national power legislation or, where negotiated in an individual project, incorporated in the concession agreement. Ministry of Finance approval is usually required for project-specific fiscal incentives (McWilliams & Grant, 2008).

Debt finance may also be provided in the form of *soft loans* or *credits*. Soft loans tend to have more favourable conditions than commercial loans and are frequently also referred to as 'low-cost loans' because they typically have lower interest rates, longer grace periods (ie initial time during which no repayment has to be made) and a longer duration so that the debt-service obligations are lower than commercial debt. Soft loans are also known as concessional loans or credits. Soft loans are mainly provided by bilateral donors and multilateral development banks as a form of external support for public benefits that cannot easily be monetised (such as poverty reduction). However, they may also be provided by national governments where there is a strong economic benefit from the project, such as flood control. Concessional/soft loans are generally not available in sufficient quantities to finance an entire hydropower project, but they can play a key role by leveraging other forms of financing (Head, 2006).

Grants provide finance that does not need to be repaid. As such, grant funding can relieve the financial burden from the investor or developer. However, grant funding may also distort the development of commercial markets, so, as with other financial incentives, the purposes and consequences of providing grants must always be carefully assessed. In some cases, grants made available to governments by, for instance, multilateral development banks or bilateral agencies, may be used by the government to purchase its equity stake in the project or on-lent to the project at low cost and long tenure in order to ensure that the long-term benefits from the grant remain in the public sector.

PPPs draw finance from both public and private sources, and share the responsibilities, risks and rewards between the public and private sectors. PPPs come in many forms and do not always include an equal split of the equity investment between public and private sectors: "due to the individual nature of water projects, there is no single prescriptive formula for the structuring of a PPP" (Head, 2006, p 12). For example, private-sector debt may be used to finance public-sector projects (subject to the existence of an accountable project entity to which the loans can be made, such as a special purpose company), while the physical assets of a project developed by the private sector may be retained in public ownership

(Head, 2006; Devernay, 2008). A PPP can enable cost-effective risk sharing between the public and private sector by the host country government (public sector), with the government assuming responsibility for risks with a very low probability of occurrence but very high impact, while the private sector manages the lower cost but higher probability risks (Devernay, 2008, p 42).

Significant capacity is required on behalf of the host government to manage sustainable public-private hydropower development. “Many developing countries, especially the poorest ones, do not have the necessary resources, whether human or financial, required from the public sector either to develop a project on their own or to make a successful public–private partnership happen” (Devernay, 2008, p 46). In such instances, multilateral development banks may play an important role as a ‘catalyst’ to facilitate PPPs through the provision of loans, partial risk guarantees, or political risk insurance cover. ECAs may also provide insurance to private sector investors to cover part of the commercial or political risk (Devernay, 2008). The multilateral development bank involvement through technical and financial assistance is particularly important in developing country contexts perceived as risky (Devernay, 2008). (These risk mitigation instruments are discussed below.)

However, there are problems with private participation, even though it may be the only way to ensure that projects are developed rather than endlessly delayed. For example, the short tenor of private sector loans may push up electricity prices during the early years of operation, making electricity less affordable to consumers (OECD/IEA, 2012). Lack of transparency may also be a problem, especially in developing country contexts: some privately (or PPP) financed hydropower projects have faced lengthy delays as a result of corruption scandals, investigations of alleged corruption or accusations over insufficiently completed social and environmental impact assessments (FIVAS, 2014). Such delays are costly to host country governments in both economic and developmental terms, and create uncertainty for project-affected populations, delaying relocation and compensation (Plummer, 2013a). Finally, some parties have expressed concerns over how well various safety aspects (including social, environmental and workers’ health and safety issues) are being considered by private sector investors, especially in developing country contexts. This includes the limited ability (or willingness) of host country governments and local authorities or international organisations to monitor private sector developers’ adherence to safety regulations (Merme et al, 2014). It is also possible that privately funded projects will be designed to deliver maximum commercial returns rather than economic benefits for the host country (e.g. through integration of multi-purpose functions) (IEA/OECD, 2012).

Islamic finance (or sharia-compliant financing) refers to finance that is compliant with Islamic religious principles (sharia). In Islam, money does not have intrinsic utility and is only a medium of exchange that retains equal value through time. Islamic principles forbid financial transactions relating to the receipt of interest or usury (*riba*), uncertainty (*gharar*) or gambling (*maysir*), as well as transactions that are inclined to concentrate wealth in a small minority. Ethical values and the principles of economic balance, distributive justice and equal opportunities are central to Islamic finance, and financed activities should increase social and economic welfare (Rarasati et al, 2018, p 2).

Islamic finance is created and based on real, illiquid assets and inventories, which makes it suitable for large-scale infrastructure projects. '*Mudaraba*' and '*musharaka*' are equity-based financing instruments based on profit–loss sharing contracts. *Mudaraba* involves co-operation between two parties as follows: "the first party provides 100 per cent equity to the second party, who will act as the executor. The profit will be shared by both parties based on the percentage of actual profit as previously arranged in an agreement…the second party is not liable for loss unless the loss occurs due to the mismanagement or negligence of the second party" (Rarasati et al, 2018, pp 2–3). *Murabaha* is based on the transaction cost, with a mutually agreed fee written into the contract to compensate for the service. The asset must be real, but not necessarily tangible. The seller must state the original price and the additional expenses in truth (Ayub et al., 2008). If the original price is not stated in the contract, the transaction is known as *musawama*, which is identical to a cost plus fee contract in conventional infrastructure procurement. In *musharaka* (or a joint venture), all parties share equity. "Profit will be shared based on the percentage of actual profit sharing as stated in an agreement, and loss will be shared based on the ratio of equity shared" (Rarasati et al, 2018, p 3).

Although the Islamic system forbids debt through direct lending and borrowing, it allows debt through selling or leasing real assets governed by the following principles: sharing of profit, loss and risk; no unfair gain; no speculation; no uncertainty; no hoarding money; and no deception. *Sukuk* is an Islamic investment certificate or bond supported by a real asset (such as land, a building or equipment). Sukuk Bonds are issued for a fixed period, from three months to five or 10 years. Sukuk Bonds are suitable for Islamic banks, Islamic insurance companies and sharia management funds that cannot invest in conventional securities.

Hydropower projects have so far used Islamic finance primarily for small-scale hydropower projects and to modernise or rehabilitate existing dams, often with financial support from the Islamic Development Bank (IsDB) (Rarasati et al, 2018; IsDB, 2019). However, the fact that hydropower dams are real, illiquid assets that have the capacity to generate revenue makes them suitable for Islamic financing through profit–loss sharing contracts (Rarasati et al, 2018). Given the rise of Islamic finance over the past two decades, this sector may play a growing role in hydropower finance in coming years. Financing from the IsDB enabled the completion of the (now operational) Khwar Hydropower Project in northern Pakistan (*The Nation*, 2017), and the World Bank is expressing growing interest in greater mobilisation of Islamic financing for infrastructure projects through PPPs (Ahmad & Alawode, 2017).

3.2 International Financial Institutions

Also known as the International Financial Institutions (IFIs), the multilateral development banks include such bodies as the World Bank, the European Investment Bank, Islamic Development Bank , Asian Development Bank, European Bank for Reconstruction and Development, Latin American Development Bank, Inter-American Development Bank Group, African Development Bank, New Development Bank – a BRICS-supported development bank[4] – and the new Asian Infrastructure Investment Bank. Unlike commercial banks, IFIs do not seek to maximise profits for their shareholders and often lend money at low or no

[4] BRICS comprises Brazil, Russia, India, China and South Africa.

interest and with longer tenure than is generally available from commercial banks. As such, IFIs play a major role in supporting developing countries and emerging economies by advising on and financing development projects (including issuing guarantees to leverage private-sector investment, including foreign direct investment) and assisting in the implementation of projects. Although IFIs operate independently of each other, they share a set of goals and objectives: to reduce poverty and improve people's living conditions and standards; to support sustainable economic, social and institutional development; and to promote regional cooperation and integration. Projects funded by IFIs are generally implemented by the borrowing country government (or by government-owned special purpose companies, in the case of many hydropower projects). Private-sector funding arms such as the International Finance Corporation (IFC) primarily lend directly to private-sector entities. However, the IFI rules and procedures, such as social and environmental impact assessments, need to be followed by all projects receiving IFI funding.

There are also national development banks, such as the Brazilian National Development Bank (BNDES), which focus on national projects and export promotion.

The World Bank Group consists of sister organisations, such as the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the Multilateral Investment Guarantee Agency (MIGA) and the IFC, which is effectively a private sector ‘arm’ of the World Bank Group. IBRD functions as a self-sustaining business and provides loans and advice to middle-income and credit-worthy poor countries. IDA complements the IBRD with a remit to reduce poverty in the world’s poorest countries by providing loans (called ‘credits’) and grants for economic and social development and poverty reduction initiatives (IDA, 2018). MIGA promotes cross-border investment in developing countries by providing guarantees (political risk insurance and credit enhancement) to investors and lenders. The IFC’s key focus is on supporting private infrastructure projects with a strong development impact whose business models are replicable elsewhere. The IFC also mobilises funding through its syndications programmes and work with its Asset Management Company to engage with institutional investors (IFC, 2019a). As a private sector financier, the IFC raises virtually all funds for lending activities through the issuance of debt obligations in international capital markets (IFC, 2019b). The IFC’s InfraVentures programme provides upfront equity at the early stage of infrastructure projects and allows others, such as large insurers, to co-invest on a portfolio basis across key infrastructure sectors (Landy, 2015).

Bilateral development agencies also finance projects that contribute to the economic and social development of recipient countries. Unlike IFIs, bilateral agencies are responsible to a single government and are often part of a government ministry. Some of the best-known bilateral development agencies active in financing hydropower projects include the Agence Française de Développement (AFD), Japan International Cooperation Agency (JICA) and the Norwegian Agency for Development Cooperation (Norad). Also active is the German Development Bank (KfW) and its subsidiary Deutsche Investitions- und Entwicklungsgesellschaft (DEG).

3.3 Climate finance

Climate finance refers to “local, national or transnational financing – drawn from public, private and alternative sources of financing – that seeks to support mitigation and adaptation actions that will address climate change” (UNFCCC, 2019a).

The UNFCCC (the Convention), the Kyoto Protocol and the Paris Agreement all call for financial assistance from Parties with more financial resources to support the objectives of the Convention in development pathways that have low greenhouse gas emissions and are resilient to climate change impacts. To facilitate the provision of this financial assistance, Article 11 of the Convention provides for the establishment of a financial mechanism. This provision has taken several forms in practice, including multilateral climate funds such as the *Global Environment Facility* (GEF) – which predates the Convention – and the *Green Climate Fund* (GCF).

The GEF has served as an operating entity of the financial mechanism since the Convention’s entry into force in 1994. The GEF was established as a US$1 billion pilot in 1990 to help tackle the most pressing environmental problems in developing countries and enable them to meet the objectives of the international environmental conventions and agreements. Thirty-nine donor countries contribute to GEF funding to support the projects (GEF, 2018). Parties subsequently established two special funds – the *Special Climate Change Fund* (SCCF) and the *Least Developed Countries Fund* (LDCF), both managed by the GEF – and the *Adaptation Fund* (AF) established under the Kyoto Protocol in 2001 (UNFCCC, 2019b).

The mandate of the SCCF is to cover the incremental costs of interventions to address climate change, largely adaptation related, relative to a development baseline. The mandate of the LDCF is to meet the adaptation needs of the least developed countries. Finally, the mandate of the AF is to finance concrete adaptation projects and programmes in developing country Parties in an effort to reduce the adverse effects of climate change facing communities, countries and sectors (Climate Funds Update, 2019).

The GCF was established in 2010 as an operating entity of the financial mechanism. The GCF is accountable to the UNFCCC COP, which provides guidance to it on policies, programme priorities and eligibility criteria for funding. The GCF’s mandate is to support developing countries responding to the challenges presented by climate change. It aims to fund adaptation and mitigation actions equally. The GCF provides funding through intermediaries as well as directly to national and sub-national organisations in the form of grants, loans, equity or guarantees. These funds come primarily from developed countries, but also from some developing countries, from regions and from one city (Paris).

There are several overlapping criteria held by the various climate funds for providing financing. Key among these are: environmental and social sustainability requirements; low-carbon solutions; climate resilience; additionality; transformational or paradigm shift potential; and private finance leveraging ability.

Environmental and social sustainability is a basic requirement in accessing climate funds, ie all interventions must be environmentally and socially sustainable. Climate funds look for interventions that have a positive, or at least not a negative impact on the environment and society. Unavoidable impacts must be appropriately mitigated. Climate funds are risk-averse sources of finance that, in line with their mandates, aim to finance interventions likely to have benefits for environmental and social systems. Concerns about the history of hydropower projects built without engaging with communities to be displaced and with significant environmental costs have created barriers in relation to climate funds' environmental and social sustainability aims.

In addition to internal considerations by climate funds, proposals and fund actions are closely scrutinised by the international community, including NGOs. These seek transparency and hold the climate funds accountable for their decisions and actions. NGOs also hold environmental and social concerns based on the historical experience of hydropower dams. This translates as pressure on climate funds to be able to justify financing certain interventions.

A low-carbon requirement means that projects which are recipients of climate financing need to be low-carbon. Hydropower dams do not necessarily produce low-carbon energy. The typical lifecycle emissions of a hydropower dam are between 5 and 15g CO_2e/kWh, which is comparable to solar, wind and nuclear. However, for some hydropower facilities emissions are significantly higher. Sources of emissions for hydro come from its construction and from the release of carbon dioxide and methane from the reservoir during the lifetime of the dam. The latter varies considerably with the design and location of the dam (Dones et al, 2004). Climate funds look for projects that acknowledge and aim to mitigate these potential emissions.

The climate resilience criteria involve the impact of the dam on the water and energy system, and on the resilience of the environmental and ecological systems into which a dam is placed. Hydropower projects need to have considered the implications of the relevant wider water and energy systems and climatic context into which they will be placed. Changing rainfall patterns and variabilities in the hydrological cycle in the face of climate change hold risks in the functioning of hydropower systems. The change of flows, drought frequency and/or rainfall intensity may lead to unreliable water and energy outputs from hydropower dams. These are important considerations for climate funds when they assess projects.

Within the context of the grid system in which the hydropower project is placed, increasing hydrological risks may reduce the resilience of the energy system. Changing hydrological patterns pose a risk especially for grids that already have a large proportion of hydropower supply – climate funds may view them as 'over-dependent' on this energy source. The role of hydropower in the grid system as part of the grid generation and of balancing the grid needs to be considered. The services that hydropower provides in grid balancing and stability may be highly valuable from a grid-level perspective.

Another aspect of climate resilience is the impact of hydropower dams on the environment. Hydropower projects need to demonstrate commitment to not harming the climate or the ecological resilience of the river basins through an impact assessment, which must include plans to mitigate these impacts.

The demonstration of 'additionality' is another key criterion for accessing climate fund financing. Additionality refers to benefits to the climate beyond those that would already occur in the project or initiative without the addition of climate finance. This means that business-as-usual projects, which are already part of the country's least-cost energy development plan, would not meet this criterion.

'Transformation and paradigm shift potential' refers to a change from business-as-usual systems, specifically through an approach, initiative or technological innovation that supports the transition to a low-carbon, climate-resilient development pathway. Hydropower projects in themselves are not considered a new technology, and so are not generally seen by climate funds to hold transformational or paradigm shift potential. However, certain characteristics of hydropower dams at the grid level could support the transition of the energy system to a low-carbon system, especially as hydropower can provide game changing contributions, particularly in terms of energy storage and grid stability.

A further consideration by climate funds is the ability of the project to use the climate finance and other sources of public finance support it is receiving to leverage private finance. With limited public finance available, climate funds aim to use their funds as effectively as possible, in order to support as many interventions as possible. This means positioning climate finance as an enabler of interventions that would not be viable without its input. It also means working to leverage as much private finance as possible to help ease the financial burden.

The main multilateral climate funds that have supported hydropower are summarised in Table 2. The table also highlights what sort of projects the funds have helped finance (wholly or in part).

Table 2: Examples of funding of dam projects by multilateral climate funds

Fund	Funding mandate and the dam projects that have been supported
CTF	With an average funding size of US$76 million, the Clean Technology Fund (CTF) has provided loans for large-scale dam construction projects. This is in line with the fund's mandate of "providing resources to scale up low-carbon technologies with significant potential for long-term greenhouse gas emissions savings" (CTF, 2019)
GCF	The GCF's mandate is to help developing countries limit or reduce their GHG emissions and adapt to climate change. The two projects that it has funded are in line with its objectives of promoting a paradigm shift to low-emissions and climate-resilient development, taking into account the needs of nations that are particularly vulnerable to climate change impacts.
SREP	Four projects have been funded under the Scaling Up Renewable Energy Program in Low Income Countries (SREP) mandate to support projects that demonstrate the economic, social and environmental viability of low-carbon development pathways in the energy sector in low-income countries.
GEF	These have tended to be small-scale marketing, promotion (through small pilot constructions), and capacity building-projects, in-line with the GEF's mandate to cover the incremental costs of a measure to address climate change relative to a business–as-usual base line.

An older, and now largely defunct, financial mechanism is the *Clean Development Mechanism* (CDM). This was previously used by large hydropower projects and has been deployed more often than funding from other mechanisms such as the GEF or GCF. The CDM was a flexible climate finance mechanism managed by the UNFCCC. Its purpose was to assist parties in achieving emissions reductions (United Nations, 1998, Art 12). The carbon offsets were known as certified emission reduction (CER) credits or verified emission reduction (VER) credits and could be generated from operations that were classified as reducing GHG emissions, such as renewable energy generation that displaces a fossil fuel source. The CERs or VERs could be sold at the carbon price. In terms of finance, the limitation of the scheme was that CER/VER accreditation could take place only after their emissions reduction capacity had been verified (typically a year or so after operation commenced) and thus, while a valuable source of foreign currency revenue, the income could not be used to finance construction activities (UNFCCC 2019b). The CDM has also been subject to substantial criticism because of the heavy administrative burden associated with its registration and validation requirements (see Smits & Middleton, 2014).

While government and corporate bonds have been used as a source of finance for hydropower projects over the years, not least to finance the Three Gorges Project in China, these bonds do not currently have the status of 'Green Bonds' as defined by the Climate Bonds Initiative (CBI). In 2016, the CBI launched a Hydropower Technical Working Group to explore how to identify and monitor hydropower investments, which deliver climate mitigation benefits and/or incorporate adaptation and resilience impacts. The purpose of the Working

Group is to develop appropriate criteria for climate-friendly investment in the hydropower sector (Climate Bonds Initiative, 2019). While CBI authorised Green Bonds have not been acredited for specific hydropower projects, Landsvirkjun (Iceland's power company), which has an overall renewable energy focus, has issued Green Bonds through a private placement to finance its forthcoming projects, which include hydropower (Landsvirkjun, 2019).

4 Risk mitigation

A risk is anything that can have a negative effect on a project's outcome, and may be real or perceived (Plummer, 2008). Hydropower projects are often regarded as high-risk investments, especially until the construction stage has been completed. Risks occur across a broad spectrum of aspects of hydropower projects including political, institutional, environmental and social risks as well as the more well understood technical risks. Early risk identification tends to focus on construction but some risks, such as hydrological, environmental and political risks, will remain high in certain countries even beyond the construction stage (Plummer, 2013a and 2013b).

4.1 Insurance and guarantees

Insurance and guarantees help mitigate the risks associated with hydropower project investment. Insurance is typically provided by insurance companies, while guarantees are provided by banks. Organisations such as export credit agencies may provide either insurance or guarantees. Various risk mitigation instruments are designed to cover specific types of risk; the cost of coverage is determined by the insurance or guarantee provider, and based on the type and extent of the coverage and the creditworthiness of the creditor. Some public guarantee schemes (such as those run by IFIs), also offer preferential or concessional terms for targeted classes of borrowers or for certain types of projects in developing countries (UNDP, 2016). Commercial debt supported by an IFI guarantee may be financially more appealing to a host government than direct debt financing from IFIs, as the host government will be required to make contingency provision for only 25 per cent of the total debt amount. This contrasts with the 100 per cent provision required for a conventional IFI loan or credit, such as those from IBRD or IDA, and hence reduces the pressure on the public balance sheet and raising the ceiling on lending for that country (Head, 2008).

Some risks are more insurable than others. Country risk or political risk (such as the risk of nationalisation of the hydropower plant or changes in law affecting the status or financial position of the project or company) may be insurable through guarantees (such as MIGA, IDA and IBRD political risk guarantees and partial risk guarantees). Commercial risks (such as the risk to revenue because of a change in regulation or difficulties in enforcing payment) are also partially insurable. However, project risks (including site-specific risks such as cost and time overruns during construction, difficulties in obtaining necessary environmental permits and clearances, uncertainty about addressing social issues which may arise) may not be insurable (Plummer, 2008). Hydrological risk is insurable (for example through an innovative scheme created by the World Bank and Swiss Re used in Uruguay), although this insurance is generally considered expensive (Blomfield & Plummer, 2014). Insurance companies play significant roles in a wide range of areas of hydropower development, providing services to many of the other parties involved in the project, such as construction insurance, loss of profits insurance, political risk insurance, and financial insurance (McWilliams & Grant, 2008).

Construction insurance usually includes contractors' all-risk policies, as well as third-party, transport, employee and vehicle coverage, ie all aspects of a project's construction. The designers are typically covered by *professional indemnity insurance,* as well as other normal business insurances. Parties involved in the provision of such coverage include insurance companies, insurance advisors and brokers, and reinsurers. Construction contractors may be required to submit bonds or sureties to cover various activities during the construction phase of a hydropower project. The project owners may also be required to issue performance bonds or other sureties to secure financing for the project. The parties involved in providing sureties are typically the same as those providing construction insurance (McWilliams & Grant, 2008).

Project owners and operators also require insurance for their projects from the start of the construction and throughout the operating phase of the project. In addition to normal business insurance, it is common to take out *Advance Loss of Profit insurance* to cover losses resulting from insurable events during the construction phase, and *Business Interruption Insurance* to protect the revenue stream during the operational phase. The parties involved in providing such coverage are usually the same as those involved in providing construction insurance (McWilliams & Grant, 2008).

Political Risk Insurance (PRI) can be taken out to cover the obligations of the host nation and provides a cost-effective element of the security package, especially where a sovereign guarantee is available to cover the obligations of the power purchaser. Parties providing political risk cover include MIGA and IDA (both part of World Bank Group), export credit agencies and commercial insurers (McWilliams & Grant, 2008).

Guarantees are financial insurance instruments, risk-mitigation mechanisms or credit enhancement facilities, which cover specific, mainly financial events, such as timely payment of debt service (McWilliams & Grant, 2008). As such, "guarantees offer an efficient way of leveraging private investment with limited public capital" (IRENA, 2016, p 48) and help create a more stable financing structure in emerging countries "by mitigating government performance risks that private lenders are reluctant to assume" (Soopramanien, 2016, p. 57; see also World Bank, 2012). Guarantees improve access to new sources of funding, reduce borrowing costs and may help extend loan maturities. They are most commonly issued by multilateral development banks, with a specific purpose to protect private debt against the host country government's failure to meet its obligations in respect of either private or public projects. In most cases, such guarantees require counter-guarantees from the host government (sovereign guarantees). In all instances, guarantees are considered costly and the project in question is required to meet all a multilateral development bank's normal environmental and social acceptability criteria for a guarantee to be issued (Head, 2006).

However, to warrant against a guarantee providing an investor with a counterproductive incentive to engage in riskier behaviour, guarantees are typically subject to "comprehensive due diligence and screening” (IRENA, 2016, p 48) and, in most instances, MDBs prefer to offer guarantees to cover only a proportion of the entire amount borrowed (Norton Rose Fulbright, 2016). Guarantees come in a variety of different forms tailored to match individual project requirements (Head, 2006). They tend to have clear terms of default under which they can be invoked (McWilliams & Grant, 2008). The borrower may be a national or sub-national government, state-owned enterprise or private investor (Norton Rose Fulbright, 2016).

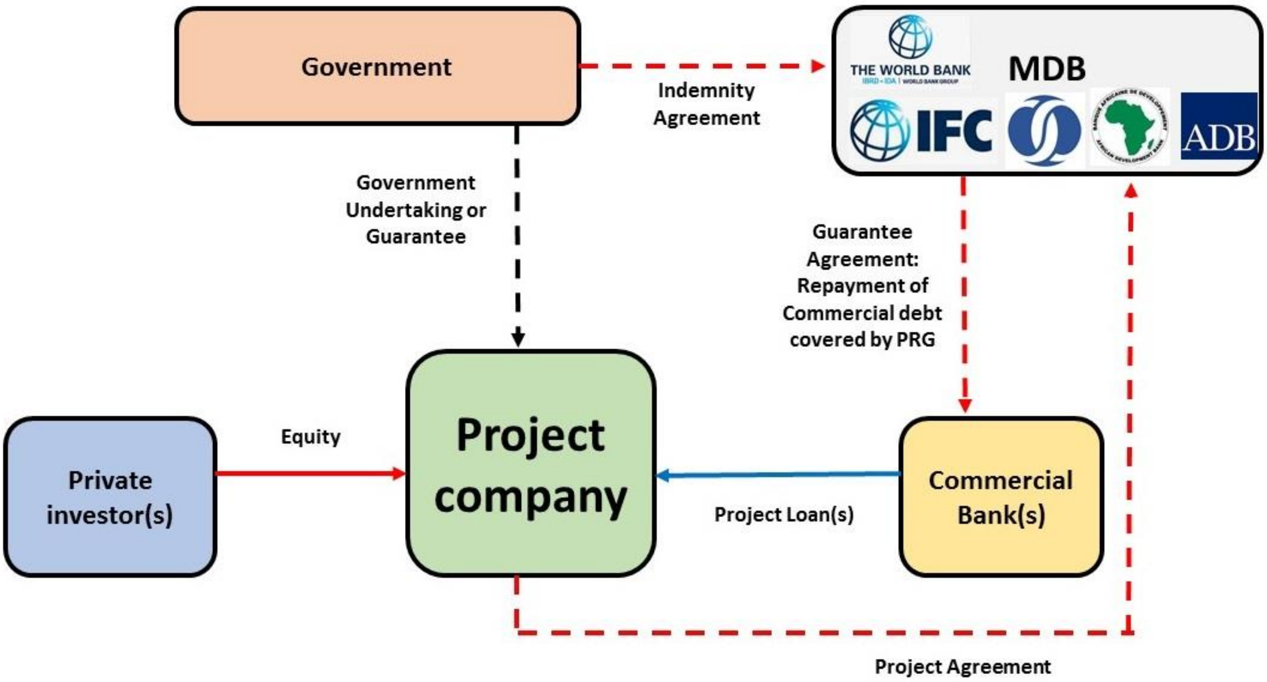
Partial Risk Guarantees (PRGs) cover lenders against the risk of a government (or government-owned entity) failing to perform its contractual obligations. Such risks include non-payment, a change in the law or regulatory regime, expropriation, currency inconvertibility or non-transferability, war and civil disturbance, frustration of arbitration and certain uninsurable *force majeure* events (World Bank, 2012; World Bank 2008). PRGs are typically used to cover any commercial debt instruments (usually a loan or a bond) in foreign currency or local currency provided by any private institution. PRGs usually cover the outstanding principal and accrued interest of the debt owed to the lender (World Bank 2008). The typical structure of a PRG is illustrated in Figure 6. The World Bank also now calls all its guarantees ‘project’ or ‘policy’ based guarantees.

Political Risk Guarantees are a specific type of guarantee that covers losses to commercial lenders caused by specific political events. Political risk insurance covers losses to equity investors for events such as war, expropriation of assets, or lack of convertibility of currency (Plummer, 2008).

Credit Guarantees cover losses in the event of a debt service default, regardless of whether the cause is a political or commercial risk. As such, credit guarantees convert sub-investment-grade projects to investment grade by covering risk that the market cannot assume, thus facilitating private commercial financing. For hydropower projects, credit guarantees improve loan terms and provide wider access to funds. Credit guarantees are provided mainly by the MDBs (Head, 2006).

Partial Credit Guarantees cover a ‘part’ of the debt service. Again, these are largely offered by multilateral development banks or bilateral aid agencies (McWilliams & Grant, 2008). The purpose of such guarantees is to improve the terms (reduced interest and extended maturity) and increase the availability of debt finance to the borrower by sharing the risk between the guarantor and the lenders (Head, 2006).

Figure 6: Example of a typical MDB PRG structure



Source: World Bank, 2012.

Export Credit Guarantees are a form of insurance that covers losses to lenders or exporters where the aspect of the project concerned is tied to the export of goods or services. Export credit guarantees are offered by export credit agencies and supported by the country interested in promoting its exports. The agencies may also effectively provide finance for export-related transactions (Plummer, 2008).

Sovereign Guarantees are offered by the host government to underwrite the obligations of public-sector agencies, particularly where the off-taker is a host government agency. For export projects, which sell power to a neighbouring country, it may be possible to obtain a sovereign guarantee from the importing government where their credit rating is better than that of the host government (McWilliams & Grant, 2008).

*Multilateral Investment Guarantee Agency (*MIGA) guarantees can be made available to protect investments against non-commercial risks (such as political risks), helping investors obtain access to funding sources with improved financial terms and conditions. MIGA derives its unique strength from the World Bank Group and from its structure as an international organisation whose shareholders include most countries. This enables it to provide an umbrella of deterrence against government actions that could disrupt projects, and to assist in the resolution of disputes between investors and governments. MIGA can also add value to a project through its ability to offer clients extensive knowledge of emerging markets and of international best practice in environmental and social management (MIGA, 2019).

The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing projects' environmental and social risk.

It is primarily intended to provide a minimum standard for due diligence and monitoring to support responsible risk decision making. First designed in 2003 in conjunction with the IFC, the principles have continued to be updated in line with IFC's own environmental and social guidelines. The EPs apply globally, to project and corporate finance in all industry sectors. Worldwide, 94 financial institutions in 37 countries have signed up to the EPs, and are insisting on their use in most financial transactions (Equator Principles, 2013).

4. 2 Legal agreements

Legal agreements reduce the risk of investing in hydropower projects and take various forms. The most common types of legal agreements relevant to hydropower projects are described below.

A hydropower *Concession Agreement* regulates the rights and obligations between the Grantor (owner of the hydropower project) and the Concessionaire (usually a host country government) resulting from the granting of a concession for using water for electricity generation, and from the design, building, operation and transfer of the facility. Many countries with hydropower resources have established formal policies for concession allocation and dedicated agencies for managing the process (McWilliams & Grant, 2008).

A Power Purchase Agreement (PPA) is a legal contract between an electricity generator and a power purchaser/off-taker (typically a grid operator, utility company or large power buyer/trader). PPAs play a key role in the financing of hydropower projects not owned by a utility as they secure the project's revenue stream. The seller under the PPA is typically an independent power producer who is responsible for maintaining the system, while the purchaser only pays for the power produced (Kerf et al, 1998). PPAs may also include clauses to detail acceptable price adjustments during the contract period.

While most PPAs are remunerated on a per MWh basis, it may be more beneficial to the long-term arrangement to calculate the remuneration mostly based on a capacity charge akin to a lease. In this case revenues are guaranteed to the owner, provided that the latter keeps the plant available, while the off-taker gains the freedom to use the plant and dispatch generation to best meet real-time needs (Fernandes et al., 2018). This model of a PPA is particularly appropriate for a pumped-storage plant (Devernay, 2008). Some PPAs include obligations to sell power from a certain date. If such a project experiences delays during the design or construction phases after a firm PPA has been signed, the owner/developer may have to buy power in the market (often at high cost) in order to meet the delivery contract (Plummer, 2008). Other PPAs include a 'take or pay' arrangement, where the off-taker must dispatch the power or will need to pay for it regardless of whether it is dispatched. These arrangements are designed to avoid 'stranded asset' situations, where the price of power is higher than the average on the grid and thus the off-taker will prefer to buy power from cheaper sources. While this seems to be less than optimal for the power system, without such guarantees developers would not embark on large capital-intensive projects.

'Project-affected' is a term encompassing all the people living in the environs of a hydropower project who are affected by it, either because they lose land or homes (directly affected) or because they suffer from such issues as increased traffic flows (indirectly affected). The term can also be phrased as 'project-affected communities' or 'project-affected families' (Plummer Braeckman and Guthrie, 2015).

Benefit-sharing Agreements (such as those included in environmental and social action plans) refer to the various agreements put in place to ensure that directly and indirectly affected populations are appropriately consulted and compensated. These agreements aim to ensure that the affected population benefit from the project in the long term and also avoid repeating past mistakes in hydropower project construction, such as failures to finance environmental mitigation measures or to honour commitments to affected communities (Haas, 2009). Benefit-sharing agreements may be used to formalise the commitment to the affected communities. This can be done through the following means:

1) *"Equitable sharing of project services:* where local populations as target beneficiaries receive equitable access to the water and energy services produced by dam projects to support their development and welfare opportunities.
2) *Non-monetary forms of benefit sharing:* where target beneficiaries receive entitlements enabling their access to other natural resources, or support to pursue other forms of livelihood and welfare improvement, which offset permanent loss or reduction of land or water resource access caused by the dam.
3) *Revenue sharing:* where target beneficiaries share part of the monetary benefits the project generates, typically expressed as a portion of revenue from bulk electricity sales or bulk water sales on an annual basis." (Haas, 2009, p 27)

The requirements and recommended actions for benefit sharing in large-scale hydropower projects are included in the operating guidelines of IFIs, the Equator Principles and the Hydropower Sustainability Assessment Protocol (HSAP, 2019a), as well as most national legislations (McWilliam & Grant, 2008).

The principles of benefit sharing also apply to the sharing of benefits (and costs) associated with projects on international waterways (Skinner et al, 2009; Hensengerth et al, 2012). Riparian rights agreements concern the benefit sharing and water usage agreements affecting hydropower projects built on rivers that are shared across national boundaries. The purpose of riparian rights agreements is to avoid neglecting negative environmental and social concerns that may lead to conflict and lengthy renegotiations at a later stage (Hensengerth et al, 2012).

A specific example of a riparian rights agreement is the Indus Waters Treaty between India and Pakistan. The treaty was signed in 1960, following nine years of negotiations, with the help of the World Bank, which is also a signatory. It "sets out a mechanism for cooperation and information exchange between the two countries regarding their use of the rivers, known as the Permanent Indus Commission" (World Bank, 2018a). Where such a treaty is in place, it may be easier to reach an agreement on water usage than where a specific agreement needs to be designed for a particular project.

4.3 Environmental and social action plans

Hydropower projects, particularly medium- to large-scale, have a range of significant and permanent impacts on aquatic and terrestrial ecosystems, ecosystem services and communities. Projects need to be adequately planned to avoid and manage significant impacts and risks. Dealing correctly with the environmental and social issues from the start will reduce the risks associated with lengthy (and costly) delays caused by an initial lack of attention to mitigating adverse environmental and social effects (Plummer, 2008).

The need for well-drafted and comprehensive social and environmental action plans – and the risk of project failure associated with incomplete identification and management of social and environmental risks – are now widely accepted. *Environmental and social impact assessments* (ESIAs) are the key tools for identifying and assessing social and environmental risks and benefits at the planning stage of a hydropower project. These assessments flow into *environmental and social management plans* (ESMPs) for building risk mitigation measures into project design and implementation. Conducting the ESIA and drafting the ESMP are often the responsibility of an investor, but they may be prepared in advance by the government, in parallel with the project design. ESIAs and ESMPs are typically legal requirements that form a prerequisite for project approval by the host country government. In principle, "the investor should not be granted the licenses or permission to start production until the ESIA and ESMP are completed, independently verified, and approved by government, in accordance with the applicable laws" (World Bank, 2018b, p 2).

Increasingly there is a trend to use *sectoral environmental assessments* (SEAs) and cumulative impacts assessments to consider the wider impacts of hydropower sector development or river basin development (Tshibangu & Montano, 2016; Saxena et al, 2016). SEAs are often encouraged by multinational development organisations for their ability to recognise and integrate environmental, social and economic considerations into policies, plans and programmes, and for their potential in helping to synchronise conservation and sustainable development objectives (Saxena et al, 2016). Examples of SEA use in hydropower development include those carried out in the Indian Himalayan Region (Lodhi et al, 2016) and the Mekong River Basin (Saxena et al, 2016).

An ESIA would involve consultations with the interested and affected parties, including local communities, and its findings would be reflected in the development of the ESMP. In practice, however, "enforcement continues to be lacking in many cases, thereby limiting monitoring of whether investors are meeting legislative requirements", despite most countries having sufficient regulatory requirements in place (World Bank, 2018b, p 1). Moreover, each ESIA and ESMP is case-specific; conducting a high-quality and comprehensive ESIA "is complex and costly, and demands specialized professional expertise" (World Bank, 2018b, p 2), which often entails commissioning external consultants to carry out the work (World Bank, 2018b).

The *Hydropower Sustainability Assessment Protocol* (HSAP) promotes and guides more sustainable hydropower projects by "providing a common language that allows governments, civil society, financial institutions and the hydropower sector to talk about and evaluate sustainability issues" (HSAP, 2019a). The purpose of the HSAP is to support hydropower investors in the design and execution of high-quality, comprehensive ESIAs and the subsequent drafting of an ESMP. The HSAP covers topics across environmental, social, technical and economic areas from the early (pre-construction) stages of a hydropower project to operation. Each of the topics is judged on up to six criteria, all of which have basic and best practice requirements that can be used to 'score' a project. A standardised way of presenting the results makes it easy to assess how well existing facilities are performing and how they compare with new projects being developed (HSAP, 2019a; HSAP 2019b).

The HSAP was developed though a cross-sector engagement process and builds on a review of the World Commission on Dams Recommendations, the World Bank Safeguard Policies and the IFC Performance Standards. It is governed by a multi-stakeholder body and supported by various institutions, including the World Bank, NGOs, energy companies and financial institutions (HSAP, 2019a).

The *World Bank Group Environmental, Health, and Safety Guidelines* (known as the EHS Guidelines) contain information on cross-cutting environmental, health and safety issues potentially applicable to all industry sectors. In August 2016, the Bank adopted a new set of environmental and social policies called the *Environmental and Social Framework* (ESF). The purpose of the ESF is to enable the World Bank and borrowers to better manage environmental and social risks and to improve development outcomes. As of October 2018, the ESF applies to all new World Bank investment project financing (World Bank, 2019a). Like HSAP, the ESF offers broad and systematic coverage of environmental and social risks, including areas such as transparency, non-discrimination, public participation and accountability, with expanded roles for grievance mechanisms. The ESF consists of:

- the World Bank's Vision for Sustainable Development;
- the World Bank's Environmental and Social Policy for Investment Project Financing, which sets out the requirements that apply to the Bank;
- 10 Environmental and Social Standards, which set out the requirements that apply to borrowers;
- the Bank Directive on Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups.

The World Bank also provides guidance on the conduct of ESIAs and ESMPs (World Bank, 2019a), as does the International Hydropower Association. In addition, some national governments have also published their own social and environmental impact assessment guidelines and manuals for projects taking place in their territories (see, for example, Government of Nepal, 2018).

5 Closing comments

Hydropower remains a powerful tool for development of a low carbon grid and for the provision of other economic benefits, when developed in accordance with strict sustainability guidelines. However, finding financing for these “sustainable hydropower” projects remains a challenge in many countries and the issues are often not well understood. The purpose of this working paper has been to provide a brief overview of the various aspects influencing hydropower project development and finance in developing countries, with a focus on how to develop financially, socially and environmentally sustainable hydropower projects. The three main sections of the paper provide a basic understanding of the key concepts and terminology to readers with limited prior familiarity with hydropower finance.

This document is not a comprehensive overview of hydropower development. The paper has not sought to provide detailed analysis of the various and often complex, value-laden questions involved in hydropower development such as: whether hydropower is the correct solution in any particular circumstance; what role the private sector *should* play in large-scale infrastructure projects in the developing economies; or what responsibilities countries have in supporting a net-zero-carbon transition.

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