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***Mobilizing private sector capital for low-emission
investments
A risk allocation framework***

**SETTORE SCIENTIFICO DISCIPLINARE DI AFFERENZA:
Climate Finance, Public Policy**

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Abstract

Fighting climate change is a key financial challenge of our times and a remarkable investment opportunity towards a more sustainable economic growth. The transition from a high-carbon to a low-carbon economic system requires the mobilization of financial resources that has only a few precedents in history, and that neither the public nor the private sector alone can meet independently. Investments are flowing towards this opportunity, yet overall financial flows toward low-carbon assets fall short of what is needed, as knowledge gaps, regulatory uncertainties and market failures make these investments perceived, often unduly, as high-risk. Policymakers and international public finance can play a decisive role in controlling, alleviating and mitigating these risk perceptions, so to facilitate private investments, while lowering the cost of the investments. This work aims to contribute to the literature and policymaking in two ways: in improving the understanding of which risks act as the main barrier to private investments and should be addressed with priority; and, second, by providing evidence of how risk allocation frameworks supported by national policies and international public finance can be effective in lowering the cost of low-carbon technologies and engaging private investments at scale.

Many of the risks perceived by investors for low-carbon assets are not different from commonplace risks in traditional infrastructure investments. However, certain characteristics of green investments increase risks perception or limit the amount of risk mitigation instruments provided by the market, hence creating *Risk Gaps: instances of demand for risk coverage unmet by an adequate supply of risk mitigation instruments*. Evidence from investment patterns and direct engagement with asset owners indicates that, in both developed and developing countries, *regulatory and financial Risk Gaps act as the main barriers to private sector engagement in low-carbon investments*. The analysis of the parallel evolution of renewable energy policies and low-carbon investments in Spain, demonstrates that, in presence of high policy instability and regulatory risk gaps, establishing a transparent and stable support framework that can combat policy uncertainty should be a higher policymakers' priority over setting a different level for the support or a new feed-in tariff.

Investment risk perceptions can be substantially higher for promising renewable technologies, such as concentrated solar power, whose costs prevent them to compete with more established renewable technologies or conventional solutions, and whose novelty and lack of track records discourage market players to provide necessary risk mitigation instruments. However, the analysis of the financial structure of two large-scale CSP plants in Morocco and India suggests that *cooperation between national policymakers and international finance can effectively de-risk these investments and successfully attract private investments*. Both examples indicates that well-executed policies can be successful in delivering technology deployment while fostering competition and drive down technology costs.

Finally, the financial structure and risk allocation framework of the Bujagali Hydropower project in Uganda serves as an example of how publicly-backed risk mitigation instruments can effectively reduce perception and impact of risk in environments with minimum private capital penetration and severely underdeveloped financial systems and institutions. The simulation of project's financial transactions and cash-flows has demonstrated how *partial risks guarantees and political risk insurance effectively improve the expected financial resilience of the project against negative outcomes while mobilizing private capital at more favorable terms*, improving the affordability of the power generated by the project for the host country.

Summary

Acknowledgments	2
Abstract	3
Summary	4
Introduction	6
1. <i>Climate finance</i> and low-carbon infrastructure needs.....	6
2. Low-carbon investment risks, returns and the cost of mitigation.....	9
3. Methodology and Research Questions.....	11
References	18
Chapter 1: Risk Gaps: A Map of Risks and Risk Mitigation Instruments for Clean Investments	21
1. Introduction.....	22
2. A Map of risk mitigation instruments for clean investments.....	24
2.1 The perception of risks for green infrastructure investing.....	24
2.2 The classification of risk mitigation instruments	26
2.3 Risk Gaps: Demand and supply of risk coverage for investment risks.....	29
2.4 An optimal risk allocation framework.....	35
3. Bridging the gaps: developments on new risk mitigation instruments	37
3.1 Policy Risk Mitigation Instruments.....	38
3.2 First-Loss Protection Mechanisms	46
4. Conclusions.....	52
References	55
ANNEX A: Classification of demand of risk coverage.....	63
ANNEX B: Classification of supply of risk coverage.....	64
Chapter 2: The Public Cost of Policy Risk: Lessons from the success and the fall down of CSP policies in Spain	68
1. Introduction.....	69
2. Evolution of the Spanish CSP policy and industry	71
3. Policy design and investment choices under the RD 661/2007.....	73
3.1. Plants profitability and investment choices	73
3.2 Inefficient policy features and technology costs	74
Box: The debate on the impact of the CSP premium on the tariff deficit.....	76
4. Retroactive policy risk: impact on returns and installations.....	77
5. Prospective policy risk: CSP costs' projections for Spain	78
6. Conclusions.....	80
References	82
ANNEX: Policies and Regulatory Acts from 1997 to 2014.....	84

Chapter 3: De risking Concentrated Solar Power Investments: the role of policy and international public finance	86
1. Introduction.....	87
2. Methodology and data: The case study approach.....	89
3. The CSP financial landscape: installations, costs and financing models.....	91
3.1. CSP Installations: geographical and technological distribution	91
3.2. Financing, risk mitigation, and public support	93
4. The CSP case studies: Results and discussion	98
4.1. The 160 MW Noor 1 CSP project, Morocco.....	98
4.2. The 100MW Rajasthan Sun Technique CSP project, India.....	104
4.3. Measuring the impact of policy support frameworks on the required tariff.....	110
5. Conclusions.....	112
References	114
Chapter 4: Effectiveness of Risk Mitigation Instruments: the case of Bujagali Hydropower, Uganda	118
1. Introduction.....	119
2. Risk Mitigation Instruments for Climate Change: current trends and issue	120
3. Bujagali Hydropower project, Uganda.....	121
3.1. Uganda Energy and Financial Landscape at the Time of the Project.....	122
3.2. Bujagali Project Financial and Risk Allocation Model.....	124
3.3. Effectiveness of the Financing and Risk model.....	133
4. Conclusions.....	141
References	143
Final Remarks	150

Introduction

1. Climate <i>finance</i> and low-carbon infrastructure needs	6
2. Low-carbon investment risks, returns and the cost of mitigation	9
3. Methodology and Research Questions	11
References	18

1. *Climate finance* and low-carbon infrastructure needs

Climate change represents one of the largest challenges to mankind. Fighting climate change poses, at the same time, a technological, political and financial challenge.

In order to prevent “dangerous anthropogenic interference with the climate system” (UNFCCC, 1992, Article 2)- that is to limit the increase of world temperatures, relative to pre-industrial levels, within the globally agreed “2 degrees Celsius” target - available scientific literature and consensus within the United Nations Framework Convention for Climate Change (UNFCCC) have identified the need to stabilize atmospheric concentration of greenhouse gases at or below 450 ppm CO₂eq¹ before 2100 (IPCC, 2014).² Achieving this goal will require emission reductions at a scale and pace that not only demand significant technological advancements and international political cooperation at global scale; they also require a paramount shift of financial investment patterns on both a geographical axis (from developed countries towards developing countries) and a sectorial one (away from conventional fossil fuel-based technologies towards low-carbon technologies and infrastructures).

There’s general consensus that neither the public sector nor the private sector can meet this challenge independently. On one hand the public sector’s resources appear insufficient to close the funding gap on their own and using the public sector to channel the required investments might be nor viable or efficient (Lütken, 2014; UNEP FI, 2012). On the other hand, high uncertainty about the commercial viability of many mitigation projects means the private sector alone is unlikely to deliver all necessary investments in mitigation (Romani, 2009).

¹ This target concentration level has been increased from the initial level of 400ppm mentioned in the first climate negotiations, but it is still expected to leave 50% chance of meeting the 2 degrees target (Lütken, 2014).

² The objective of a 2 degrees maximum global average temperature increase over pre-industrial levels was signed by the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in the 2010 Cancun Agreements (UNFCCC, 2011).

Remarkably, estimates from the International Energy Agency (IEA) and the Organization for Economic Co-operation and Development (OECD) suggest that the overall amount of investments in infrastructure needed in the next 15-30 years might not be that different in an economic scenario that considers capital change constraints, compared to our current growth path; however, the composition of this investment mix will need to be dramatically different from the current one (Kaminker *et al.* 2013): While infrastructure needs under a business-as-usual scenario will require overall investments of USD 3.2 trillion/year to 2030, a low-carbon growth scenario could imply either 11% additional investments or even a 14% reduction in the overall infrastructure bill if relevant investment savings due to fossil fuel infrastructure divestments and energy efficiencies in transport and buildings are realized (Kennedy and Corfee-Morlot, 2013). However, for the power sector, achieving the target of the two degrees scenario would imply an annual additional investment of USD 1.1 trillion between 2011 and 2050 (IEA, 2014) and critically, a shift of investments out of fossil fuel industries towards low-carbon power technologies (IPCC, 2014).

The considerable infrastructure investment need is not just a financial challenge; it's also an important investment and growth opportunity that has generated remarkable investment volumes towards low-carbon technologies in a relatively short time frame (Frankfurt School-UNEP Centre/BNEF, 2014).

Adopting a definition of *climate finance* that includes “*primary capital flows targeting low-carbon and climate-resilient development with direct or indirect greenhouse gas mitigation or adaptation objectives/outcomes*”, Climate Policy Initiative has estimated total global climate finance flow (on average) of USD 359 billion in 2012 (Buchner *et al.*, 2013). This figure includes both public (governments, international climate funds and development finance institutions) and private sources (corporates, project developers, institutional investors and households), with the latter accounting for the lion share of the total with an estimated USD 224 billion invested in 2012. Due to limited knowledge of understanding private investment in forestry and land use, energy efficiency, transport, and adaptation, this estimate represents mainly private investment in renewable energy, the vast majority of which have been directed towards developed countries where regulatory frameworks and

incentive policies have been perceived as both more clear and stable. Conversely, in emerging economies and developing countries – where the investment gap is larger and can represent, in regions like Africa, almost 70% of infrastructure needs (OECD, 2012) – most of the investments remain domestically sourced with public institutions, such as national development banks, being the largest contributors. At the same time, the majority of the investments that these countries receive through internationally flows from developed countries (USD 39-62 billion) originated from international public sources and were channeled primarily through multilateral and bilateral development institutions (Buchner *et al*, 2013). Finally, both the figures for the overall and the privately sourced flows suggest that, compared to the year before, climate finance has plateaued, if not slightly decreased (Buchner *et al*, 2013).

Allowing for differences in methodology and definitions that don't allow direct comparisons, the level of investments in renewable power and fuel³ as tracked by the Frankfurt School-UNEP Centre/BNEF have declined in the last two years, both in developed and developing countries, to USD 214 billion, approximately 20% below 2011 figures (Frankfurt School-UNEP Centre/BNEF, 2014). On a positive reading, these investment reductions reflect a decrease in the cost of certain renewable technologies (hence driving down the nominal value of the investment) and an overall lower investment volume in the whole power sector⁴ in which the share of renewable energy generation continues to rise.

However, the geographical dispersion of these investment contractions, with current investments in Europe halved compared with their level in 2011, suggests that the increased perception of investment risks due to the instability of national regulatory regimes and incentive policies could have played a major role in discouraging investments from the private sector⁵. This highlights to policymakers a crucial barrier to the scaling-up of climate investments and increased mobilization of private investors' capital that needs careful attention.

³ These figures exclude investments in large hydroelectric projects with a capacity greater than 50MW.

⁴ Total investments in fossil-fuel power generation assets fell to USD 270 billion from USD 309 billion one year earlier (Frankfurt School-UNEP Centre/BNEF, 2014).

⁵ In several European countries (e.g. Spain) renewable energy incentive policies have been completely discontinued, leading to a total stall of private investments (see the case of concentrated solar power in Chapter 2).

2. Low-carbon investment risks, returns and the cost of mitigation

The instability of regulatory regimes is certainly not the only barrier that thwarts the growth of climate finance investment volumes from the private sector, with administrative complexity, opposition from local authorities and civil society, and difficulties to access the grid or secure the land also playing a dis-incentivizing role (Coenraads *et al.* 2006). In developing countries in particular, the more prominent role of public actors in climate related investments (Buchner *et al.* 2013) is a consequence of market characteristics of several of these financially less developed economies that lead to a higher risk perception from private investors: macroeconomic conditions such as high and volatile interest rates (Eyraud *et al.* 2011), high currency risk and cost of hedging (Nelson and Shrimali, 2014; Stadelmann *et al.* 2014); incomplete financial markets with lack of long term capital (Hamilton, 2010) or power markets unsuited for private investments or with financially weak counterparties (Waissbein *et al.* 2013).

As the capital stock in the global economy needed to meet this USD 1.1 trillion per year investment challenge seems to be already available today (NCE, 2014), the challenge for policymakers is to set up the right regulatory framework and policies that can facilitate this investment shift by overcoming entrenched economic behaviors, and removing knowledge gaps and barriers that make these investments unduly perceived as 'high-risk'.

Risk and return considerations are essential decisions for any investor⁶, and low-carbon investments are no exception (IPCC, 2014). More importantly, they are *inter-related* decisions, with one factor impacting the decision over the other, so that “The higher the perceived risk, the higher the cost of capital and required return to be generated” (Romani, 2009⁷). By increasing the cost of capital, higher risks discourage investments, hamper technology deployment and technology cost reductions achievable via learning rates.⁸ Assuming risk-averse investors (von Neumann and Morgenstern, 1944),

⁶ Risk and return evaluations are not the only decisions taken by an investor, and sometimes they are not even the most important ones as investment mandates, regulatory restrictions and analytical resources might exclude certain investments regardless of their risk and return profile. They are, however, a necessary step common to all investment processes driven by financial objectives.

⁷ As quoted in IPCC, 2014, Chapter 16 page 24.

⁸ Learning rates express the amount of technology cost reductions expected with an increase of the technology deployment, as cost reductions can be driven by economies of scale and increased competition in the supply chain, by learning effects and R&D advancements (IRENA, 2013).

an investment with a *perceived* higher risk will demand a positive *risk premium*, that is an increase in the expected return that compensates for the higher level of risk compared to alternative less-risky investments (Bodie *et al.* 2005; Hamilton and Justice, 2009). In order to encourage technology deployment, policymakers can then increase investment returns by either decreasing the (private) cost of the investment, with subsidies or grants, or by increasing the expected revenues, via revenue support policies (Ward *et al.*, 2009). Both routes, however, increase the public cost of the investment that ultimately depends on the required support and the perceived investment risks.

As the recent experience of several renewable energy policy support schemes has shown, when the public cost of this support proves more expensive than what a country might be willing to pay, the stability of the policy framework is called into question, leading to an increased perception of risk and a further increase of the cost of capital (Chapter 2). Figure 1 graphically summarizes this *vicious cycle*: if low-carbon investments are

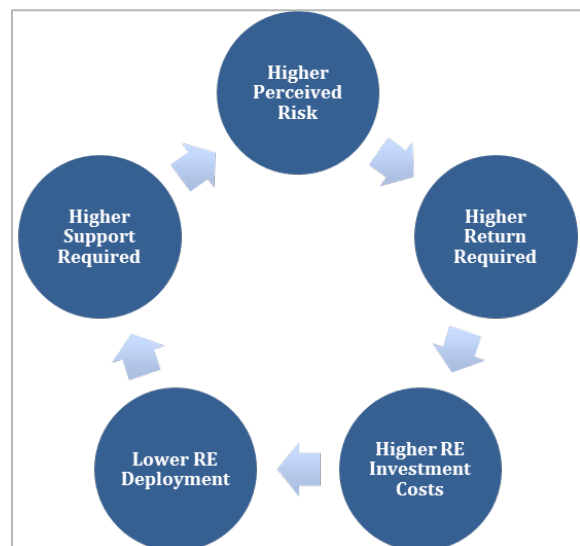


Figure 1: Investment Risk vicious cycle - source: Author

perceived as highly risky, simply increasing the level of public support might not be the most effective solution. Instead, policy needs to prioritize and tackle risk perceptions in order to mobilize investments while saving public resources.

Policymakers and the public sector can play a decisive role in controlling, alleviating and mitigating risks, not only through effective regulatory frameworks but also with dedicated financial instruments (guarantees, concessional and long-term loans, local currency finance) that markets may be unable (or unwilling) to provide (Waissbein *et al.* 2013). However, not all investment risks need mitigation from the public side. Indeed, investment risks are continuously allocated and shared among private actors, as different investors are often willing to take certain types or certain amounts of risk, and allocate others to better-placed market counterparties (e.g. insurance providers, contractors). Understanding

which sets of investors are willing to accept which types of risks, and identifying for which risks the market fails to provide necessary mitigation tools can be the starting point for designing effective policies that aim at improving low-carbon investments' risk/return profile and increasing the share of private capital in the climate finance landscape. *This work wishes to test the hypothesis of whether policymakers can deliver cost-effective de-risking solutions, and how their tools should be structured to target those specific barriers that inhibit private capital and increase the cost of the investments.* The aim of this work is, ultimately, to offer actionable insights on the financial solutions that concrete policy initiatives, such as Nationally Appropriate Mitigation Actions (NAMAs) and the Green Climate Fund – could implement to mobilize the private capital required to finance a more sustainable economic growth.

3. Methodology and Research Questions

The literature on investment risks and the strategies for their mitigation (insurance, derivatives products) in financial markets is substantial and long-dated (Markowitz, 1952; Fama and French, 1993, Bodie *et al.* 2005); on the contrary, there is much less evidence on how risks are perceived and managed in low-carbon investments and green infrastructure project finance, and more importantly, on how public actors and policymakers can mitigate them. Significant knowledge gaps exist concerning the identification of the most critical risks for low-carbon investments and their particular nature when compared to more commonplace investment risks; of those risks that could be effectively taken by the public sector and those that should be left onto the private one; of the risk mitigation instruments that are already available and effective, and of those that would be need to be improved or designed from scratch. This research performs a systematic, multi-dimensional (contractual, financial and institutional) analysis of the structure and effectiveness of specific policies and financial de-risking tools that are being deployed by national policymakers and international public finance institutions to support private investments in low-carbon technologies in developing countries – with the aim to assess what is working, and what would need further improvement. The research moves from an assessment of the nature of risk in low-carbon investments and investors' perception around risk intensities and availability of risk mitigation tools; before moving to a detailed evaluation of the

effectiveness of specific policies implemented by national governments and international public finance institutions (IFIs) in emerging countries to reduce or transfer risk in specific examples of low-carbon investments (concentrated solar power in Spain (Chapter 2), and in Morocco and India (Chapter 3); and a large hydroelectric plant in Uganda (Chapter 4).

The analysis is mainly carried out through in-depth project finance case studies, performed on selected renewable energy investments where the combined action of national policymakers and IFIs has successfully mobilized private investments (both domestic and international capital) through specifically designed risk allocation frameworks.

Combining direct engagement with public and private actors involved in each case study with modelling of the financial transactions underpinning each investment, the case-specific approach allows an in-depth analysis of both drivers and challenges of actual investment decisions. This analysis, focused on the key elements that determine the success of climate finance policies and the effectiveness of public investment programs implemented, provides an almost “real-time” feedback to policymakers concerned with the goal of scaling-up private investments in low-carbon investments. Besides, the comprehensive study of an investment case allows matching the analysis of investors’ preferences and behavior - typically elicited through questionnaires and interviews (Waissbein *et al.* 2013) - with the financial results of their decisions and their direct impact on the costs of the policies for public budgets. However, the focus on individual cases comes at the expense of a relatively limited generality of the findings beyond the single projects.

When publicly available, the analysis has been performed on actual project’s documentation and financial data, and complemented it with information provided directly through interviews with private (developers, lenders) and public (government officials and IFIs officers) project stakeholders and industry representatives (producers, consultants, trade associations) . In alternative, material available in the literature (e.g. databases, industry studies, reports from similar projects) has provided benchmarks and reference values useful for comparisons.

The analytical approach in each case study is based on **project finance modeling across three different dimensions: the analysis of contracts and institutional relationships; financial modelling and cash flows estimations; risk assessment and risk allocation.**

Contractual analysis aims to establish the role of each institution, its contractual liabilities and the key relationships in each transaction. The approach borrows from the core concepts of stakeholders' theory (Freeman et al., 2010) concerning the need, for an organization (i.e. a public entity, a private company, an investment venture) to take into account the interests of all stakeholders (governments, customers, employees, lenders) that have a stake - financial, political, moral - in the activities of the organization and can contribute to its value creation. In particular, the starting point of each case study is to map all relationships between stakeholders - as determined by laws, regulations, contracts, ownership structures - so to identify relevant decision makers in the process, and whether any particular institution acts as an enabler for others. From a public policy point of view, stakeholders' mapping can identify all the actors in the private sector that are affected by policies beyond those directly targeted, hence increasing the understanding of policies' secondary effects and, ultimately, overall effectiveness. From a private investor point of view, stakeholders' maps are crucial in understanding and assessing the sources and nature of risks of a project - from counterparty risks, to regulatory instability; but also in identifying potential sources of risk mitigation - from available technical guarantees, to financial assets that can withstand significant liabilities.

Discounted cash flow projections and financial modelling are used to simulate in high detail financial transactions across the projects' life cycle - development, construction, operation and decommissioning. The financial model traces the cash-flows originated by project operations such as capital expenditures, operations and maintenance costs, equity and debt financing, revenues generated, and taxes due, in order to assess the financial equilibrium of the investment and compute, ultimately, the capital available to be returned to investors as dividends (Table 1 includes a detailed description of the financial model elements and financial metrics).

Table 1: Financial Model Structure for a Renewable Energy Investment. Source: Author

<i>Profit and Loss Statement in year:</i>	<i>Financial Metrics</i>	
+ Operating Revenues	Total Capital	Total Capital Disbursed
Power Sales		+ EAT
Carbon Credits Sales		+ Depreciation
- Operating Expenses		+ Interest Payments
Operations and Maintenance Costs		Project Cash Flow After Tax ($CF_{t^{at}}$)
Earnings before Interest, Depreciation and Tax (EBIDT)		+ Tax
- Depreciation		Project Cash Flow before Tax ($CF_{t^{bt}}$)
Earnings before Interest and Tax (EBIT)		Project IRR before Tax: $f(CF_{1^{bt}}, CF_{2^{bt}}, \dots, CF_{T^{bt}})$
- Interest Expenses		Project IRR after Tax: $f(CF_{1^{at}}, CF_{2^{at}}, \dots, CF_{T^{at}})$
Interest Payments	Debt facility	- Debt Disbursement
Hedging Costs on Interest Payments		- Debt Service
Earnings before Tax (EBT)		Principal Repayment
- Tax Applicable		Interest repayment
Earnings After Tax (EAT)		(Debt Service Coverage Ratio: $EBIT/Debt\ Service$)
	Equity Distribution	Equity Cash Flow before Tax ($ECF_{t^{bt}}$)
		- Tax
		Equity Cash Flow after Tax ($ECF_{t^{at}}$)
		Equity IRR before Tax: $f(ECF_{1^{bt}}, ECF_{2^{bt}}, \dots, ECF_{T^{bt}})$
		Equity IRR After Tax: $f(ECF_{1^{at}}, ECF_{2^{at}}, \dots, ECF_{T^{at}})$
	LCOE Calculation	Discount Factor: $f(\text{Equity IRR or Project IRR})$
		Discounted Capital Cost ($\Sigma Capital\ Disbursed$)
		Discounted O&M ($\Sigma Operating\ Expenses$)
		Discounted Debt Service ($\Sigma Debt\ Payments$)
		Discounted Power ($\Sigma Power\ Generated$)
		LCOE: Discounted Costs/Discounted Power

Risk is hereby modeled as the perceived uncertainty around the value and timing of such transactions.

As the action of policymakers and public finance institutions (grants, concessional loans, and fiscal regulation) can have tangible impacts on the value or on the uncertainty of certain investment's financial flows, the simulated cash-flow models also allow the assessment of policies' effectiveness in improving investments' performance and management of risk.

From the private investor perspective, the financial model is essential to evaluate the project's economic convenience and its financial viability and, in this context, leads to the estimation of a few key financial metrics - internal rate of return (IRR) and the levelized cost of electricity (LCOE) - that assess the investments' appeal when compared to market opportunities, and their sensitivity to certain uncertainties and risks used then in the risk assessment section. From the public perspective, financial modeling aims at quantifying the impact on those key metrics on the effectiveness of policies and public financial support on one side, and their cost for public budgets, on the other.

Starting from NREL (2011), for a project with a fixed life of T years, an initial investment (I_0), and a fixed-tariff (Tf) power purchase agreement of the same duration, the output of such a model is the following system of equations:

$$DSCR_t = CF_t^{at} / (Fin_t + Debt_t) \quad (1)$$

$$I_0 * EqR = \sum_{t=1}^T \frac{(Tf * Power_t) - O\&M_t - Fin_t - Debt_t - Tax_t}{(1 + Equity\ IRR)^t} \quad (2)$$

$$Tf = \frac{EqR * I_0 + \sum_{t=1}^T \frac{Debt_t + (O\&M_t + Fin_t) * (1 - tx) - (Depreciation_t * tx)}{(1 + Equity\ IRR)^t}}{\sum_{t=1}^T \frac{Power_t * (1 - tx)}{(1 + Equity\ IRR)^t}} \cong LCOE \quad (3)^9$$

$$Annual\ Public\ Support_t = (Tf - E(Market\ Price)) * Power_t \quad (4)$$

where, EqR is the share of capital investments financed by equity; $Power_t$ is the annual power generated by the plant; $O\&M_t$ are the annual costs for operations and maintenance and Fin_t the annual costs to serve the debt; $Debt_t$ is the annual principal repayment of the loans; Tax_t is the taxes paid while tx is the applicable tax rate; $E(Market\ Price)$ is the expected tariff for the power at market rates. Equation (1) indicates the ability of an investment to cover its debt liabilities using net operating revenues. Project's lenders always set a minimum threshold for this ratio, as its value decreases as leverage is increased. Equation (1) typically determines the level of financial leverage¹⁰ the project (or investment company) is allowed to use and, as a consequence, the amount of equity capital required from the sponsors (EqR). Equation (2) is used to compute the equity rate of return given a fixed tariff or to compute the tariff necessary to make the investment appealing to investors once a minimum required rate of return has been identified, through direct interviews with investors or benchmark values. This rate of return is then used to compute the levelized costs of the electricity produced (Equation 3) and broken down in its components (capital, financing and operating costs). The equity rate of return links the two equations as changes in costs would result in changes of the rate of returns and hence the necessary tariff. Then, given an expected market value of the electricity, equation (4) computes the financial public support the project requires.

⁹ The LCOE can alternatively be expressed as a function of the project IRR, hence using project's cash flows before distributions of dividends and debt payments are made. This is equal to the use of the weighted-average cost of capital (WACC) as discount rate, but overcoming the limitation of WACC in reflecting the benefits of debt with longer maturities. With Project IRR, the LCOE formulation becomes:

$$LCOE = \frac{I_0 + \sum_{t=1}^T \frac{(O\&M_t + Fin_t) * (1 - tx) - (Depreciation_t * tx)}{(1 + Project\ IRR)^t}}{\sum_{t=1}^T \frac{Power_t * (1 - tx)}{(1 + Project\ IRR)^t}} \quad (3b)$$

¹⁰ Financial leverage is here defined as the amount of debt over the overall investment costs.

The **risk assessment analysis** combines project finance risk management techniques (Gatti, 2013) and semi-structured interviews to identify and map all main risks perceived by both private and public stakeholders across the different phases of the project. Perceptions of risk are elicited from project stakeholders and qualitatively rated for their intensity as a combination of the probability of occurrence and the expected loss from an adverse outcome. Risk perceptions are also used to test the exposure of project's financial metrics to each risk and to estimate, through sensitivity tests and simulation techniques (e.g. scenario analysis and Monte Carlo simulations), the impact of the risk and risk mitigation strategies on the cost of financing (or on the rate of return required by investors). Finally, the risk allocation resulting from the risk mitigation instruments implemented is charted on a map that traces, in the different phases of a project, all risks from initial to final bearer in order to assess whether risks have been placed with the entity best suited to carry them and whether the overall risk in the project has been ultimately reduced.

This overall methodology translates into specific sub-questions that are answered through an evidence-based analysis of current investment trends, financial practices and investors' behaviors in each chapter.

Chapter 1 answers the question *"What risks matter the most in low-carbon investments and which ones need mitigation by the public sector?"* Combining existing literature with stakeholders' direct engagement, the analysis has produced a map of *Risk Gaps*: instances of significant perceived risks that create a demand for risk coverage left yet unmet by the current supply of risk mitigation instruments, and which impede investment flows toward these assets. Having identified these gaps, the focus then moves to assess the effectiveness of two publicly-backed instruments recently proposed to address them; considering the set of tools already available to investors and project developers, and the implementation challenges that the instrument providers need to face to ensure the effectiveness of mitigation.

Chapter 2 looks at the cost of unmet risk coverage for both private and public finance. Simulating the financial profile of concentrated solar power investments in Spain across several policy changes has

allowed an estimate of the financial impact of retroactive policy changes on existing private investments that led the market to a complete standstill. Financial simulation and investors' interviews have also highlighted how the higher risk regime due to perceived regulatory instability would now make eventual investments in the country more expensive than those occurring in developing countries, as higher financing costs more than offset significant technology cost reductions.

Chapter 3 answers the question *“How can policymakers and international public finance de-risk promising but yet not commercially competitive clean technologies in developing markets?”* Two case studies on two large-scale concentrated solar power projects in Morocco and India provide evidence of how successful de-risking policies implemented by national policymakers, and financial instruments supplied by development financial institutions, have enabled private investments in first of their kind investments for these emerging economies. The analysis also highlights the complexity of such transactions and potential issues in re-allocating risks amongst stakeholders in ways that could lead to less effective policy outcomes.

Chapter 4 asks *how publicly backed risk mitigation instruments can effectively mobilize investments in high-risk environments*, through the analysis of a large hydroelectric transaction in a least developed country with minimum private capital penetration. The expected financial performance of the risk mitigation instruments is analyzed at the time of the transaction's financial closure, and then simulated under different scenarios of probability and severity of the risk occurring, to highlight its risk mitigation potential for the private investor.

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Chapter 1: Risk Gaps: A Map of Risks and Risk Mitigation Instruments for Clean Investments¹¹

1. Introduction.....	22
2. A Map of risk mitigation instruments for clean investments.....	24
2.1. The perception of risks for green infrastructure investing.....	24
2.2. The classification of risk mitigation instruments.....	26
2.3. Risk Gaps: Demand and supply of risk coverage for investment risks.....	29
2.4. An optimal risk allocation framework.....	35
3. Bridging the gaps: Developments on new risk mitigation instruments.....	37
3.1. Policy Risk Mitigation Instruments.....	38
3.2. First-Loss Protection Mechanisms.....	46
4. Conclusions.....	52
References.....	55
ANNEX A: Classification of demand of risk coverage.....	63
ANNEX B: Classification of supply of risk coverage.....	64

¹¹ This chapter draws its content from a research work stream called Risk Gaps that has been published by the Climate Policy Initiative in the following papers:

Frisari G., Hervé - Mignucci M., Micale V., and F. Mazza (2013). Risk Gaps: A Map of Risk Mitigation Instruments for Clean Investments. January 2013. Venice: Climate Policy Initiative.

Hervé - Mignucci M., Frisari G., Micale V., and F. Mazza (2013). Risk Gaps: First-Loss Protection Mechanisms. January 2013. Venice: Climate Policy Initiative.

Micale V., Frisari G., Hervé - Mignucci M., and F. Mazza (2013). Risk Gaps: Policy Risk Instruments. January 2013. Venice: Climate Policy Initiative.

Results have also been presented at the Environmental Finance Annual Conference 2013 (25th April 2013, UK).

1. Introduction

Risk — whether real or perceived — is the single most important factor preventing projects from finding financial investors, or raising the returns that these investors demand. Risk and risk perceptions vary significantly from project to project, technology to technology, industry to industry, and country to country. Since higher financial returns are required to cover higher risks, the variation between project risks explains much of the difference in financing costs. More importantly, higher financing costs translate in higher costs for the public - being it the national budget that supports clean investments, or the general public that pays higher energy prices (see Figure 1 in Introduction).

As the focus on increasing the share of private capital towards low-carbon infrastructure investments has increased, a significant effort has gone into identifying risks that investors in low-carbon projects face, usually adding to the more traditional infrastructure-related risks, those specific to the nature of low-carbon and climate resilient infrastructures (Ward *et al.* 2009; OECD, 2012a; Richardson *et al.* 2010). Though all classifications are subjective and different from one to another in the methodology or focus, they agree that green investments typically suffer higher risk perceptions due to a dependence on public policy and, often, the relative immaturity of technologies, markets, and industries.

Not all risks need mitigation from policymakers; investors may be quite willing to take on some risk, although they might take on certain risk categories only if the price is very good. Understanding which sets of investors will accept which risks at what price, and whether they have available the correct instruments to manage or mitigate these risks is critical to developing policies and instruments to reduce them. Matsukawa and Habek (2007) provide a comprehensive list of risk mitigation instruments supplied by both public and private institutions for a generic infrastructure investment, while Venugopal *et al.* (2012) design a mapping of the various activities of most public institutions (both international and national ones) active in climate finance including their main lending activities and the supply of de-risking instruments. In turn, most private sector providers make available detailed information on each instrument they offer (Zurich North America, 2012). However, there is

not yet a full understanding of whether all / most critical risks faced by investors are being covered, where and to whom such risk coverage is available and, when coverage is provided, whether it is effective and meets investors' requirements. The research here has indeed shown that whenever risk falls on investors who are unsuited or unwilling to carry them, a demand for risk coverage is created, that needs to be met by an adequate supply in the form of risk mitigation instruments (investment guarantees, warranties, insurance products) provided either by the market or by public institutions. *Risk Gaps* occur when this demand of risk coverage is not adequately met by the supply of risk coverage products; and it's there presence that leads to higher financing costs and requires the intervention of policymakers.

This chapter is organized in two sections. The first describes the framework for categorizing the risks that may befall green infrastructure projects, then matches these risks with available risk mitigation instruments, in order to identify where gaps between the supply and demand for risk mitigation continue to impede investment. The second section analyzes the effectiveness of two sets of instruments designed to address them: first-loss protection instruments and policy risk insurance; considering both instruments currently available to investors and project developers and recent initiatives that are trying to increase the supply of instruments.

The analysis is a combination of a review of classifications of risk and risk instruments available in the literature (Coenraads *et al.* 2006; Matsukawa and Habek, 2007; OECD, 2012a; Richardson *et al.* 2010; Wilkins, 2012), semi-structured interviews with investors, insurers, project financiers, and bankers held between 2012 and January 2013, a roundtable discussion during a dedicated workshop¹² on the demand of risk coverage and the effectiveness of supply (CBI-CPI, 2012), and, finally, a round of expert reviews on the analysis – Table 1 describes in more details the characteristics of this audience and the type interactions held during the research. The detailed analysis of the instruments aimed at addressing the existing risk gaps has been instead conducted through analysis of instruments' factsheets, documents and contracts; and financial modeling of the instruments' cash flows in a few

¹² On June 27, 2012, Climate Policy Initiative and the Climate Bonds Initiative organized a workshop with insurers, project financiers, and investment bankers to kick-start a discussion on which perceived risks had critical bearing on investments in green infrastructure projects, as well as the desired features of risk mitigation tools that might be offered by the industry or policymakers (CBI-CPI, 2012).

detailed case studies (Section 3.1 and 3.2; Trabacchi *et al.* 2012, Falconer and Frisari, 2012, Herve-Mignucci, 2012).

Table 1: Stakeholders interviewed between January 2012 and January 2013 - Source: Author

Private Sector			Public Sector	
21			18	
Commercial Banks	Developer & Advisors	Insurers	IFI/DFI	Government
7	8	6	16	2
Bilateral Interviews		Analysis Review	Workshop Attendees	
29		15	12	

2. A Map of risk mitigation instruments for clean investments

2.1 The perception of risks for green infrastructure investing

There are various types and categories of risk that accompany investment, and more particularly, green investment, which are defined here as low-carbon or climate resilient investment. Risks are grouped into four categories according to the dimension in which they are originated:

- **Political, policy, and social risks:** originate in the social dimension (governments, public opinion, individuals, or groups of citizens). These risks derive from both legitimate actions of authorities exercising their legislative functions (policy/regulatory risks), and illegitimate and discriminatory acts by authorities and citizens, such as the consequences of repealed contracts, expropriation and political violence (political risks); or risks of social unrest and reputation (social risks) and misappropriation of resources (governance risk);¹³
- **Technical, physical risks:** derive from the physical characteristics of the assets and/or the surrounding environment. They are technology-specific (such as construction and operation risks, environmental impacts, and decommissioning risk)¹⁴ or related to the availability of natural resources (reliability of output risk);
- **Market, commercial risks:** originate in the economic dimension (the action of markets and commercial counterparties) and relate to the economic value of inputs and outputs (price volatility risks and the value of environmental markets) as well as the costs and availability of financial resources (financing, liquidity, and counterparty risks);¹⁵

¹³ The clean-cut distinction between political and policy risk is less obvious in existing and emerging policy risk instruments, which are geared toward emerging markets and mostly classified under the Expropriation clause of Political Risk coverage.

¹⁴ Decommissioning costs may exceed initial projections and/or earmarked reserves, or the infrastructure can be compulsory decommissioned much earlier than expected.

¹⁵ Some of the commercial risks stem directly from other risks and translate into market manifestations of political/policy and physical risks. Overlaps and relationships between different risk categories become highly relevant when considering how a risk mitigation instrument can impact on several different risks at the same time.

- **Outcome risks:** are perceived by the public sector and are linked to the ability of publicly-supported green projects to meet objectives, e.g. emissions reductions and co-impacts, within expected costs (budget risks).

At first glance, most of these risks do not appear unique to green investments, though particular aspects of both low-carbon and climate resilient investments frequently increase the perception of relatively commonplace risks - Annex A presents a more detailed analysis of these risks with their generic characteristics for conventional investments and their incremental features for green investments. In particular, the reliance on public support amplifies the perception of policy risks by developers and investors (AcwaPower, 2013; CBI-CPI, 2012) while, at the same time, increasing the perception of outcome risks by governments and public authorities (Del Rio and Mir-Artigues, 2012). The innovative nature of some green technologies and the lack of a track record for their performance raise the perception of technical risks (Munich Re, 2012a); multi-year investment horizons and long payback periods¹⁶ increase perceived market and commercial risks (Trabacchi *et al.* 2012).¹⁷ Often the confluence of these factors places green investments outside most investors' "comfort zone," i.e. their business-as-usual investment options, reducing the amount of available capital to meet financing needs or increasing its cost. Figure 1 briefly summarizes the specific sources of risks and elements that, in the case of green investments, increase their perception.

¹⁶ The payback period is the time needed by the investor to recover negative cash flows with the cost savings/revenues originated by the investment (Trabacchi *et al.*, 2012).

¹⁷ The life cycle of green infrastructure investments largely outlives access to finance (and refinance) and political cycles.

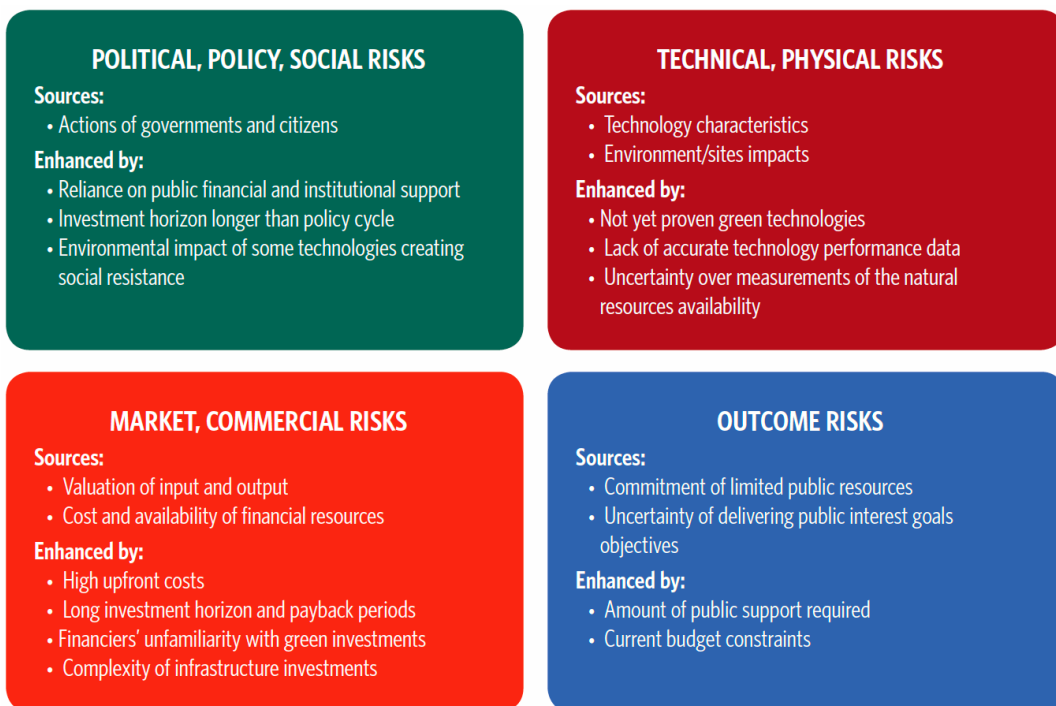


Figure 1: Classification of Perceived Risks– Source: Author

2.2 The classification of risk mitigation instruments

Before matching each instrument with the risk it aims to address, all risk mitigation instruments identified in green investments literature have been grouped in six categories related to their technical nature, while also taking into consideration whether its provider is typically a public or a private entity. A detailed analysis of each instrument mapped is included in Annex B, while Table 2 summarizes the key characteristics of each category. The analysis adopts a rather broad definition of risk mitigation instruments that includes specific de-risking tools (e.g. insurance), public and private instruments with a different primary objective but an indirect de-risking effect (concessional loans, power purchase agreements), but also support policies and institutional support (e.g. technical assistance programs). The private sector is generally the primary provider of bilateral contracts, while governments and public bodies are the primary providers of revenue support policies, direct concessional investments, and institutional support. Both the public (mostly through development banks) and private sectors provide credit enhancement instruments and insurance.

Table 2: Risk Mitigation Instruments Classification – Source: Author

Bilateral Contracts	Well-established instruments addressing specific (non-credit-related) project risks. They are usually provided by private entities to cover technical risks related to the implementation or the operation phases of projects, and/or output price risks (e.g. Power Purchase Agreements, which secure quantity and price of the power that the project will sell to an off-taker). ¹⁸
Credit Enhancement Instruments	Usually developed by specialized entities of either public and private nature (e.g. monoline insurers, guarantee funds/facilities) that guarantee partially or in full the liabilities of a project towards its lenders. They improve the quality of fixed income securities issued by projects and/or companies, and reduce borrower’s credit risk by improve the financial coverage of debt service obligations. ¹⁹
Insurance	Risk mitigation instrument, mainly provided by private companies, with the exception of political risk insurance. The instrument is used to transfer risk from one entity to another specialized in pooling risks together, in exchange for a premium and upon verification of the liability of the claim. ²⁰
Revenue Support Policies	Public sector’s main tool for promoting low-emission projects by reducing output price risks and offering resources that reduce financing risks (i.e. tax credit/equity). They have been widely used in both developed and developing countries but, in a few instances, ²¹ have become more onerous than expected for public budgets – creating, in a sort of feedback loop, incentive for governments to renegotiate them and, for investors, an enhanced perception of policy risks.
Direct Concessional Investments	Capital investments from public entities - governments’ budgets, bilateral and multilateral development banks, dedicated private-equity facilities, and international climate funds - mitigate financing risks by providing loans or equity funding that enhances the financial viability of low-emission projects. ²²
Indirect Political/ Institutional Support	Public, non-financial, interventions that usually target multiple risks: ²³ includes technical assistance for sustainable energy policies, and capacity building activities (e.g., quality certificates).

¹⁸ For more advanced technologies, contracts can often be highly specific, demanding complex drafting and implying high transaction costs. For example, an Engineering Procurement and Construction (EPC) contract for an offshore wind farm can involve several contractors with very different areas of expertise and responsibilities who need to be coordinated for the different phases of construction (i.e. installation of the monopiles foundation into the seabed, fitting of cables and turbines onto the monopoles, and the construction of the offshore substation from which power is transmitted to shore).

¹⁹ Instruments range from market-based tools developed by the private sector, such as securitization, to the use of public resources to allow credit access at concessional terms.

²⁰ Insurance policies are very common in mitigating physical risks but have also become popular in addressing political risks. See for reference policies offered by the Overseas Private Investment Corporation (OPIC) and the Multilateral Investment Guarantee Agency (MIGA).

²¹ This is the case of the very popular fixed-price Feed-in Tariff (FiT) payment policies (see for reference the case of the Spanish FiT system for solar PV that was renegotiated in 2008 (IEA, 2011b)). Recent examples of FiT include price adjustment mechanisms or an overall cap to total support available.

²² The involvement of concessional finance, while very powerful, is often accompanied by lengthy procedures, heavy compliance and monitoring requests, and stringent requirements.

²³ In institutionally weak contexts (such as those of some developing countries), the implementation of these support programs results more challenging and requires significant human and financial resources.

The universe of risk mitigation instruments includes both those that directly address specific risks (e.g., contracts and insurance policies), as well as those that address multiple risks at once (e.g., political commitments to environmental protection). At the same time, when analyzing the supply of risk coverage, it is critical to clearly identify those risks that are directly targeted by a specific tool, and those that risks that are reduced by an indirect effect.²⁴ In order to better identify areas where supply is limited or inadequate, the analysis only links instruments to the risks they are specifically designed to address (Table 3) – however, indirect mitigation of other risks would need to be considered when

Table 3: Coverage by Risk Mitigation Instruments – Source: Author

INSTRUMENT TYPE	INSTRUMENT NAME	POLITICAL, POLICY, SOCIAL	TECHNICAL, PHYSICAL	MARKET COMMERCIAL	OUTCOME	← RISK CLASSIFICATION
Contracts	1. Engineering, Procurement and Construction Contract (EPC); Operation & Maintenance Contract (O&M)		■			
	2. Emissions Reduction Purchase Agreement (ERPA)			■		
	3. Foreign Exchange Swaps / Futures			■		
	4. Power Purchase Agreement (PPA)		■	■		
Credit Enhancement	1. Interest Rate Subsidy			■		
	2. Letter of Credit			■		
	3. Loan and Credit Guarantee			■		
	4. Securitization			■		
Insurance	1. Private Insurance (general)		■			
	2. Delays in Start-up (DSU)		■			
	3. Private Political Risk Insurance	■				
	4. Public Political Risk Insurance / Guarantee	■				
Revenue Support Policy	1. Feed-in-Tariffs / Feed-in-Premia			■		
	2. Tradeable Permits / Certificates			■		
	3. Tax Credits / Tax Equity			■		
	4. Fossil Fuels subsidy policy			■		
Direct Investment	1. Concessional Loans Funding	■			■	
	2. Dedicated Private-equity Funds			■		
	3. Equity-investments of Dev Banks	■		■	■	
	4. International Climate Funds	■		■	■	
	5. Public-Private Partnership (PPP)			■	■	
Political / Institutional Support	1. Capacity Building / Technical Assistance	■				
	2. Database / Information tracking tools		■			
	3. Quality Standards	■	■		■	

²⁴ For example a better “direct” mitigation of construction risks does improve “indirectly” financial risks as well, by reducing uncertainty around construction costs and timing.

looking in detail at the effectiveness of a single instrument. Annex B presents a summary table of all instruments mapped in the exercise (expanding the content of Table 3), including a brief description of their functioning, the nature of their usual provider and the risks they directly address.

2.3 Risk Gaps: Demand and supply of risk coverage for investment risks

Matching demand for and the supply of risk mitigation instruments, alongside the life-cycle of green infrastructure projects, helps identifying whether perceived risks are being addressed by risk mitigation instruments. Both the intensity of perceived risks (colored boxes from light to dark in the figures below) and the effective supply of risk coverage have been elicited through the semi-structured interviews with investors, project financiers and advisors. Given the subjectivity of such perceptions, a qualitative ranking has been preferred to quantitative measures that would have nevertheless required direct elicitation from stakeholders.

Risk perceptions have been elicited by asking projects' sponsors and lenders to identify the risks that can materially alter their decision to invest or the remuneration they require from the project. Interviews and a roundtable discussion (CBI-CPI, 2012) have aimed at drawing a rather broad picture of risk perception that would cover most renewable energy investments in both developed and developing countries. This broad outreach has been then combined with detailed analysis of a few specific investments and projects (solar water heaters in Tunisia, concentrated solar power in Morocco and India and wind technologies in Europe), in which investors and financiers have been asked to rank project's specific risks and then review case studies risk maps (Trabacchi *et al.* 2012, Falconer and Frisari, 2012; Hervè-Mignucci, 2012; Stadelmann *et al.* 2014). For these project-specific analyses, elicited risk perceptions have also been compared with lenders' project and risk appraisals (ADB, 2012; WB, 2011). When mapping supply of risk coverage, instrument's coverage emerging from the available literature and instruments' documentation (Annex B) has been combined with investors'

perception of the instruments' costs, complexity and off-the-shelf availability in the different geographical jurisdictions and for each investor type.²⁵

Given the significant difference in the stability of political and regulatory frameworks, and the development of industrial systems and financial markets, the matching exercise has been performed separately for developed and emerging economies, leading to two distinct pictures (Figures 2a and 2b).

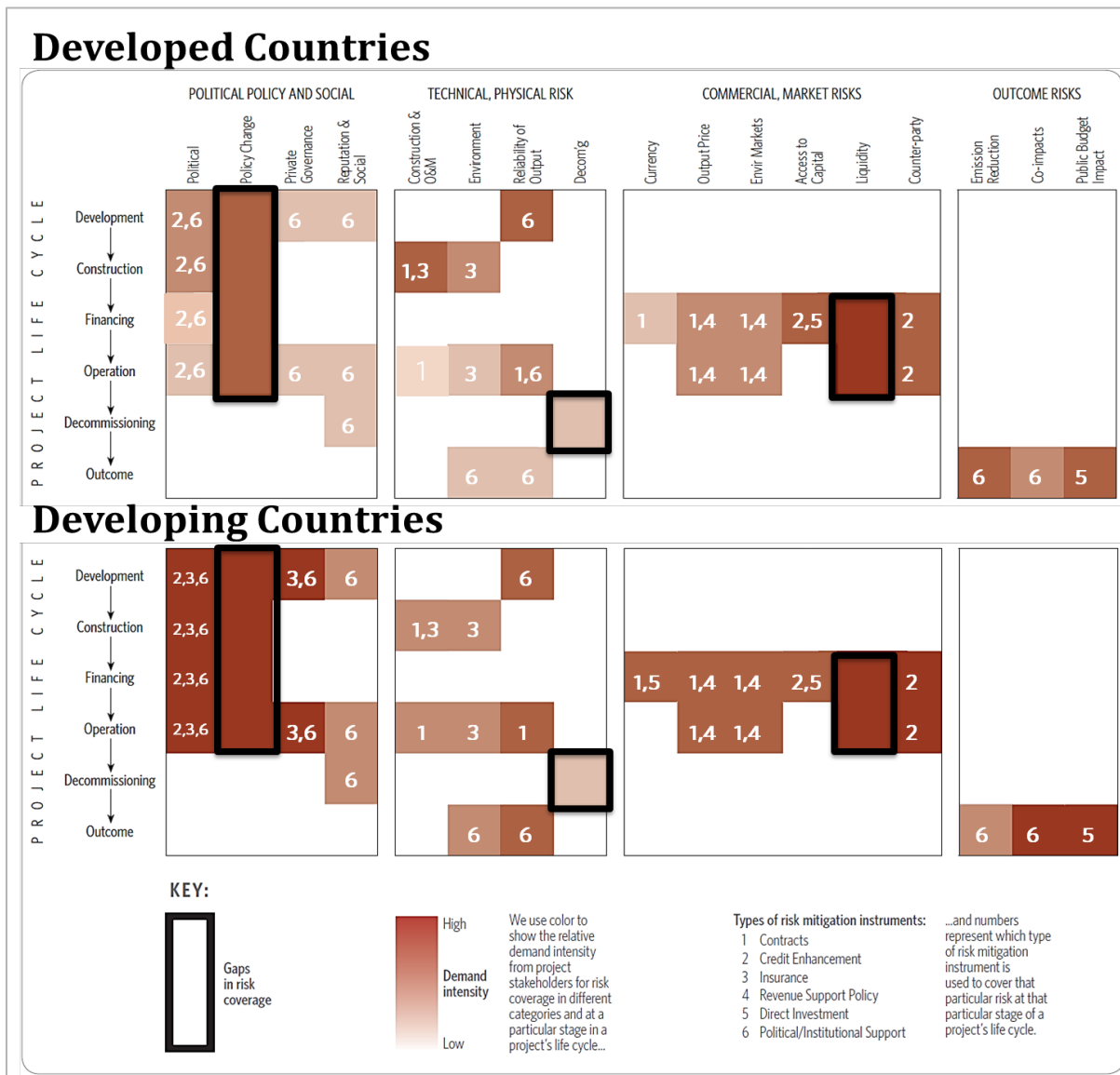


Figure 2a/b - Risk gaps for developed markets (top) and emerging economies (bottom) – Source: Author

²⁵ Although a detailed analysis of the effectiveness and adequacy of each instrument is outside the scope of this work, the mapping includes here only the instruments that are “effectively” available to investors (established and proved instruments), excluding those instruments still in their planning or testing phase.

At first glance, it's not surprising that given investors' long-standing concerns about investing in many developing countries, the majority of workshop participants/interviewees perceive the overall level of risks in developing markets to be higher than in developed ones. At the same time, the similarity of the patterns for the occurrence of gaps in coverage is a more unexpected result.

Political, Policy, and Social Risks

Retroactive cuts to support policies have significantly increased the perception of policy risks in several (both developed and developing) countries, where the budget impact of the successful deployment coupled with the economic recession and the ensuing (mainly European) sovereign debt crises have called into question the sustainability of the different revenues support policies (BusinessGreen, 2012; Del Rio and Mir-Artigues, 2012). Within the project life-cycle, political and policy risks are primarily perceived by project developers during the phases of development, construction and operation, but also by lenders and investors during the financing stage.²⁶ The high demand for policy and political risks coverage in emerging economies is only partially met by the supply of political risk insurance (*instrument n.3* in Figure 2a/2b) offered by organizations such as the Multilateral Investment Guarantee Agency (MIGA - World Bank Group) and the Overseas Private Investment Corporation (OPIC) (Venugopal et al (2012). The coverage offered by these tools appears less effective with the risk of regulatory changes, as a significant portion of foreign investors prefers to withdrawn or cancel investments whenever the perception of risk of regulatory changes is high (MIGA, 2012e).²⁷ The presence of international donors and development institutions in financing green investment projects in developing countries indirectly mitigates policy risk (*instrument n.6*), due to perceptions about their influence or ability to exert 'political leverage' on host country authorities²⁸ – the IFI *halo effect* (WB, 2103). For developed markets, the significant demand for policy risk coverage appears severely unmet by an adequate supply as most public providers of political risk insurance (MIGA, OPIC) are active only in emerging markets and private insurers are highly unwilling to

²⁶ When financing a RE project underpinned by a public revenue support policy, the future state-guaranteed revenues are typically used as collateral for loans and credit lines, hence defined *bankable*. High levels of policy risks may induce lenders to no longer accept this kind of collateral.

²⁷ Section 3.1 contains a more detailed treatment of political risk insurance's effectiveness in covering regulatory changes.

²⁸ Concessional financing is frequently linked to broader policy reforms and part of complex interactions and financial relationships between local authorities, donor governments and development banks. In such circumstances, it becomes harder (and more expensive) for the host country to recede from agreed policy commitments that would damage both external private investments and concessional financing, as they can have negative effects on the financing received for other purposes.

underwrite policy risk (Parhelion, 2012a). Export credit agencies (ECAs) could be the needed exception as their export guarantees (*instrument n.2*) can cover political risks in both developed and developing markets through their export credit and investment guarantees: these provide long tenor insurance for renewable energy finance (OECD, 2012b) and can offer compensation when governments and public authorities fail to comply with their obligation - e.g. a previously agreed feed-in tariff (Hermes Euler Aktiengesellschaft, 2013; EKF, 2013) – however, the conditional use to export transactions, the limitation to the export content and the heterogeneity of terms and products offered across the different national agencies seem to limit the effectiveness of such instrument as perceived by investors and lenders in the field of climate finance as they have been used only in 15 climate specific projects so far (EKF, 2014).

Technical and Physical Risks

In developed as well as emerging markets, the perception of physical and technical risks both during the construction and the operation of the project is inversely related to the level of maturity of each specific technology, as both data and investors' familiarity with their financial performance is limited²⁹ (DB, 2012). At the same time, for less mature technologies the supply of risk coverage appears inadequate both in magnitude and scope - e.g. the more limited tenor of equipment guarantees for offshore wind farms when compared to the more established onshore ones (Swiss Re - BNEF, 2013). This originates mainly from the difficulties in measuring the impacts of risk and pricing its mitigation: for the most innovative technologies, loss histories are not available, and providers of mitigation instruments (both service contracts – *instruments n.1*- and insurance policies – *instruments n.3*) either refuse to cover these technologies outright or charge precautionary, high fees, making the coverage uneconomical for developers and investors. The impossibility of matching demand and supply of risk mitigation greatly increases investors' risk premia and often compromises the overall financing of the projects. As a technology becomes more commercially mature, uncertainty about its performance decreases and the demand for risk coverage starts to fall – almost ironically - the supply of coverage instruments actually increases: at this stage as an “industrial ecology” begins to form around the technologies (DB, 2012) and, as more performance data become available, providers of risk mitigation

²⁹ Both charts consider the different green technologies in aggregate so that their individual technologies' results are unfortunately hidden.

instruments are able to increase breadth and depth of their supply (Munich RE, 2012a; Munich RE, 2009).

In less developed markets, the lack of good quality data and sufficiently long track records on the availability of the natural resource leads to a significant gap for the coverage against the risk that projects will not produce the amount of power expected (output risks). While there are examples of performance guarantees (*instruments n.1*) offered by technology producers (and insurers) for more established renewable technologies (Munich RE, 2012b), contracts or insurance protecting from lower wind regimes or irradiation levels on exact locations are less typical. Weather derivatives can hedge against lower wind speeds or solar irradiation levels; however the transaction costs involved (most contracts are privately negotiated and priced) and the technical issues involved (correlation between actual measurement and the benchmark measurement in the contract) limit their usage to a small portion of renewable energy generation (Molloy, 2011). The public sector also perceives output risks as critical as it directly affects investors' willingness to install RE capacity and also as it determines actual emission reductions, and other co-benefits in terms of energy independency, fossil fuels savings.

Output risk mitigation could be mitigated by forms of partnerships between public and private entities (*instruments n.6* in the figures), through, for example, the provision of better quality databases for areas that lack granular natural resource measurements - e.g. the Solar Atlas commissioned by the Indian Ministry of Renewable Energy (EnergyNext, 2014) - or policies geared toward offering performance/efficacy guarantees or insurance for cutting-edge technologies (BNEF, 2010).

Decommissioning risks for green infrastructure do not rank high among perceived risks, most likely due to the small expected values for modular renewable assets (solar panels) and, on the other end, long expected lifetime for large scale renewable assets (concentrated solar power have more than 25 years life (Falconer and Frisari, 2012), hydropower plants more than 30 years (WB, 2007) – both resulting in a low present value (after discounting) attached to the decommissioning costs.³⁰

³⁰ We note however that most renewable energy infrastructure (wind, solar) are characterized by manageable and predictable decommissioning costs, especially when compared to nuclear plants and fossil fuel extraction infrastructures.

Commercial and Market Risks

Power purchase agreements and revenue support policies (*instruments n.1 and n.4*) have had reasonable success in mitigating market risks, even though the former may carry a significant counterparty risk³¹ while the latter can lead to the perception of policy risk. **By way of contrast, investors perceive financing risks as high, especially access to capital, counterparty, and liquidity risks.** Especially in developing countries, most of the relevant mitigation instruments for financing risks are provided by public entities (through loan and credit guarantees and interest rate subsidies (*instrument n.2*), public-private partnerships - *n.5*) although the private sector has a few at its disposal, such as banks' letters of credit. Until now, widespread use of the project-by-project approach of these instruments and the current limited size of the securitization market (NREL, 2013) has hindered the development of an investment-grade tradable market sufficient to address liquidity concerns and reduce the cost of capital. While some investors are able to hold less liquid securities and exploit their liquidity premium,³² the large majority of investors implementing portfolio strategies have limited appetite for unlisted, non-standard securities that are not actively traded in any market.³³ Current trends in financial regulation will amplify these issues as they point to an increase of disclosure requirements³⁴ or capital coverage³⁵ for less liquid assets held by financial companies, banks, and insurers. Recent issuance of climate and green bonds by the European Investment Bank, the International Finance Corporation/World Bank and Asian Development Bank (among others),³⁶ seems to signal a shift towards the creation of a more liquid fixed-income market, which should help to address those liquidity risk concerns. However the cumulative size of these initiatives, as of today, represents only less than 2% of the overall global project finance debt market: USD 344.6 billion in 2011 (Eckhart, 2012).

³¹ "The PPA is the primary revenue stream contract, and as such it is critical the counterparty be creditworthy", Porter Hedges (2011).

³² Liquidity premium is the excess return that a less liquid security needs to offer over an equivalent liquid (quoted and/or traded over active markets) one to compensate the investor for the extra risk.

³³ Typically, the offering memorandum of a pension fund, mutual fund, and even (as the most unregulated investment vehicle) hedge fund will state an internal limit for illiquid/unlisted securities.

³⁴ The U.S. Financial Accounting Standard Board (FASB) 157 Position paper on Fair Value Measurements, issued in 2007, classifies all securities in a three-level system and requires the inclusion of a risk premium for liquidity in the valuation of securities not ordinarily traded on active markets (Level 2 and Level 3 assets). (DBAM, 2009)

³⁵ As per Basel III requirements (please see note⁴² below).

³⁶ The European Investment Bank has sponsored the issuance of the Climate Awareness Bonds between 2007 and 2012 for a total of EUR 1.6 billion (EIB, 2012); the International Finance Corporation together with several commercial banks has issued several Green Bonds for a total of USD 3.3 billion since 2008 (www.treasury.worldbank.org); the Asian Development Bank has issued USD 600 million in Clean Energy Bonds (ADB, 2012).

Outcome Risks

A growing number of public institutions are using public-private partnerships (*instrument n.5*) and policies such as volume caps and cost limits (*instrument n.6*) to mitigate public perception of outcome risks, specifically the risk that renewable investments could overextend public budgets (NCCP, 2012). Budget constraints and sovereign debt issues in developed countries have placed a strong focus on the cost-effectiveness of public support policies, on the need to limit their burden on public resources, and on involving more private sector resources. **Most projects supported by public spending aim to achieve key development goals (i.e. poverty reduction, creation of local jobs) but frequently weigh heavily on already tight public budgets and increase the perception of outcome risks.** These risks are mostly mitigated through either quality standards imposed on project developers,³⁷ or by increasing the involvement of private sector actors via private-public financing mechanisms and partnerships. However, we note that some efforts to mitigate outcome risks add to technical and physical risks, for example by imposing local content clauses and/or extensive technical requirements.

2.4 An optimal risk allocation framework

Risk coverage's effectiveness depends on whether a risk mitigation instrument is able to transfer risks to an actor better suited to manage them: a more suitable risk allocation tends to lower overall project costs (via lower risk premia and required returns) and ultimately, the occurrence of adverse outcomes (when the risk carrier has a significant ability to control the probability of adverse events). Optimal risk allocation shifts each risk towards the party who can manage the risks at least cost (Corner, 2006) and should satisfy the following three operational conditions:

- **Good information availability:** Where perceptions of risk originate from information asymmetries, less informed parties will typically require a higher premium to carry the risk;
- **Carrying capacity:** A party who is less likely to be financially compromised by a risk event will require lower premiums;
- **Enforcement ability:** A party with high ability to enforce compliance and influence the outcome of the risk will require a lower premium.

³⁷ An example is the compulsory quality certification system (*Qualisol*) required for technology installers in the Prosol Residential program in Tunisia for the support of the solar water heaters with households (Trabacchi et al, 2012).

Building upon the OECD risk-sharing model for public-private partnerships (OECD, 2008), risks can be distinguished as: **Endogenous risk** – a risk internal to a project and that the project developer or sponsor can directly manage in order to influence the actual outcome (e.g. technology choices, management of financial resources); and **Exogenous risks** – a risk which the project developer has neither control over, nor ability to mitigate (e.g. changes in legislation, macroeconomic events). Combining these principles with the risk categories presented in Section 2 results into the optimal risk allocation model depicted in Figure 3.

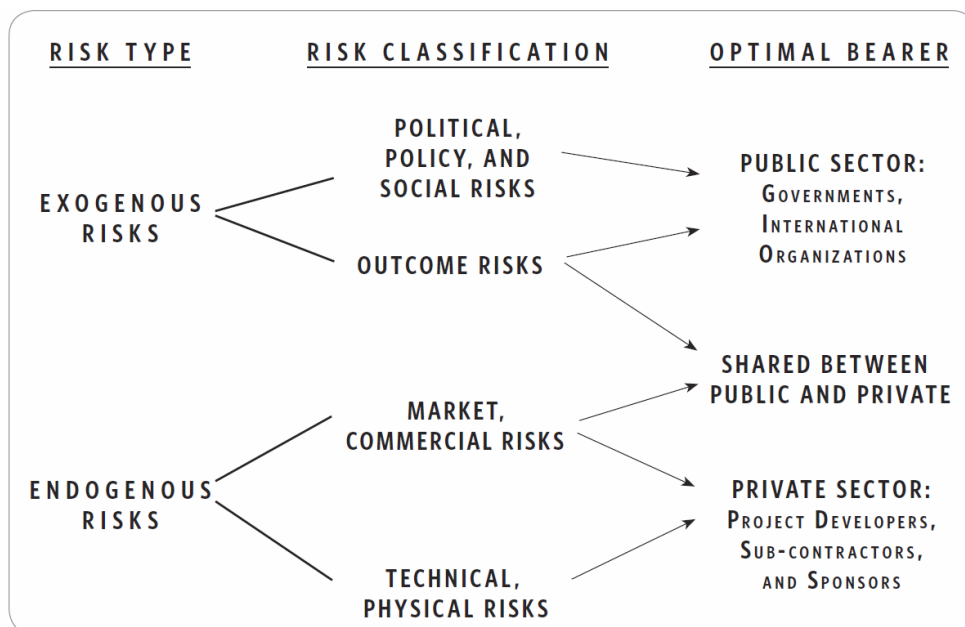


Figure 3 - Risk allocation framework - Source: Author's elaboration based on OECD (2008)

Political, policy and social risks are exogenous and difficult for private parties — who have limited ability to enforce compliance on public authorities or to social entities — to manage. This categorization suggests that the public sector (at national or international levels) would be better positioned to enforce compliance and lower the probability of their occurrence.

Technical and physical risks are usually endogenous, and hence borne more efficiently by the private sector. With proper due diligence and expertise, developers are best placed to control and manage these risks.³⁸ However, due to high uncertainty concerning pioneering technologies and the

³⁸ Even in projects with extensive public support such as the Ouarzazate I CSP project, private developers and investors are in the best position to take full charge of technical and physical risks. These risks are managed with in depth due-diligence on the available resources in situ and careful determination of technology's specifications before the completion of the bidding process and signing of concession arrangements (Falconer and Frisari, 2012).

lack of good quality data on renewable resources pooling these risks between private and public actors could improve its management by increasing the carrying capacity of the actor bearing it.³⁹

Commercial and market risks are normally borne more efficiently by the private sector either internally or outsourced to different parties, through bilateral contracts or securities exchanged in financial markets. Privately negotiated or exchange-listed contracts and derivatives (such as options, swaps and futures) can reallocate risks such as currency and prices' volatility; as well as, tradable equity and debt securities can allocate financing risks according to investors' own risk appetite.

However, in countries characterized by under-developed or non-existent financial markets, the public sector (e.g. governments, development banks, export credit agencies) might be called upon to bridge market gaps the private sector cannot overcome and share a substantial amount of these risks.

Outcome risks are often seen as exogenous to the project and, according to this classification, would be best managed by the public sector. That said, their occurrence can also be linked to project-related factors (such as technical performance, implementation, and project design), suggesting that a shared allocation between public and private might actually be more suitable.

3. Bridging the gaps: developments on new risk mitigation instruments

Within this framework for demand and supply of risk mitigation, this section presents an analysis of two new sets of instruments designed to address those instances of unmet demand: policy risk insurance and first-loss protection mechanisms; conceived to mitigate, respectively, policy risk and liquidity and financing risk. Each instrument is considered first in the context of the already existing solutions (when available) in the market; and then it's evaluated across the following dimensions:

- **The risks addressed:** At a minimum effective instruments need to address the specific risks for which they been created, but they can also indirectly mitigate other risks as well;
- **Their costs:** Both explicit fees and implicit transaction costs need to be lower than the benefits/savings that the instruments yield;
- **Complexity and availability/accessibility:** Complexity usually impedes wide utilization of instruments and increases transaction costs, making the instruments less accessible;

³⁹ Through, for example, contractual specifications in the Power Purchase Agreement (PPA) for the uncertainty on the output, or through pooled funds for environmental damages. In the Guerdane Water Project in Morocco the hydrological risk (i.e. risk of availability of a certain amount of water) shouldered by the private investor has been capped at 15% of revenues, with the excess borne by the government and the farmers (Head, 2006). However, in nascent industries still far from commercial maturity, developers may struggle to find private counterparties willing to accept those risks, calling upon public ones to step in.

- **The suitability of the party bearing the risk:** An ill-suited risk bearer would either fail to effectively control the risk or charge very high risk premia for mitigation;
- **Timeliness of the remedy:** Excessively lengthy procedures and untimely remedies greatly compromise instruments' effectiveness by reducing the perceived benefit of the mitigation; and
- **Secondary/indirect effects:** The instrument itself can, in some cases, compromise its own effectiveness (the most typical example is through moral hazard);

3.1 Policy Risk Mitigation Instruments

The challenge of providing a risk mitigation instrument for policy risk originates from policy risk's peculiar nature: policy risk concerns the possibility that national governments — acting in their sovereign capacity — amend policy environments in ways that adversely impact the financial stability of renewable energy projects. The nature of these changes defines, in general terms, two different types of policy risk:

Prospective policy risk refers to the overall uncertainty and instability of the regulatory framework (i.e. frequent, unpredictable, and irregular changes in the policy), which negatively influences the planning of new projects, resulting in higher rates of return required by investors.

Retroactive policy risk refers to policy or regulatory changes which adversely affect the financial profile of existing projects by reducing their expected revenues, impairing their ability to repay their debts and increasing the cost of capital when they need refinancing (Abos, 2012; Varadarajan et al., 2011).

Being related to a government's sovereign capacity of issuing and amend its own policies, policy risk is particularly difficult to manage and transfer via a risk mitigation instrument. However, differently from the prospective policy risk, the retrospective type involves the change or repeal of a previously agreed "contract" between the project developer and the government. It can, therefore, be managed through instruments that can enforce those contracts upon the government or seek redress for the (quantifiable) losses caused by the policy change. For this reason retroactive changes to revenue support systems (Feed-in-Tariff (FiT) regimes in particular) constitute the focus of this section; adopting a broad definition that includes direct mandatory changes to the stated level of the tariffs, but also indirect acts such as the introduction of a retroactive connection fee for those benefitting from the tariff.

3.1.1. Existing policy risk mitigation instruments

While not specifically designed to cover policy risk, some examples of established political risk insurance products and guarantees have been used to some extent to protect against retroactive changes to revenue support policies. These products have been provided by both public and private actors; however, as evidence suggests new products and solutions for policy risks will need (at least initially) to come from public institutions (CBI-CPI, 2012). The analysis is here therefore limited to instruments offered by the public sector: political risk insurances from MIGA and OPIC, and World Bank's partial risk guarantees.

- MIGA and OPIC political risk insurance instruments

Political risk insurance instruments offered by MIGA and OPIC can cover the impact of a policy change, when this change can be qualified as an expropriatory breach of investor's rights; that is a government measure which deprives investors of their main rights to operate the asset and to receive compensation for their services, leading to a confiscatory effect that essentially forces them to abandon their venture (MIGA, 2011b). The insurance offered by MIGA can cover both equity and debt provider⁴⁰ from the losses due to a tariff reduction, but only if the client can prove that the change qualifies as an expropriatory change in the regulatory scheme (MIGA, 2012f), or as an expropriatory breach of the Power Purchase Agreement (PPA) between the investor and the public off-taker.⁴¹ Similarly, OPIC offers policy risk coverage to US investors but only when policy changes can be classified as a breach of the PPA and constitute an expropriation of investors' rights (or regulatory taking) originating from the contract.⁴²

Nevertheless, a significant degree of uncertainty around the approval of each claim and the timing and requirements of the procedures for political risk insurance instruments limits the effectiveness of this coverage and seems to have prevented its wider utilization (UNEP, Parhelion, 2012). Indeed, data from

⁴⁰ MIGA covers up to 90% of equity investments, plus an additional 500% as a contribution for earnings' losses attributable to the investment; for loans, the guarantee rises up to 95% of the principal, plus 135% of the principal to cover accrued interests' loss (MIGA, 2012b).

⁴¹ MIGA also covers non-expropriatory breach of contract, in case of denial of justice, arbitral award default, or when the Government renders the Dispute Resolution Procedure impossible, hazardous or commercially impracticable to proceed (MIGA, 2011a).

⁴² OPIC has paid claims following violation of contract due to a change in legislation. In the case of Ponderosa Project in Argentina OPIC determined that a change in the legislation of the Government of Argentina under its sovereign capacity (Emergency Law) had resulted in a repudiation of a contractual obligation with the foreign company, depriving the investor of its rights in the insured investment (expropriatory effect) for more than six months. OPIC accepted the claim of the investor paying the amount of the insured investment (USD 50 million) (OPIC, 2005). OPIC has also paid similar claims in other cases such as MidAmerican in Indonesia, Bank of America- Dabhol project in India (OPIC, 2012f).

MIGA and OPIC show that timing⁴³ for reimbursement may vary significantly, ranging from one to almost five years depending on the success of efforts to find amicable solutions. More importantly, from an investor' point of view, the change of policy never triggers a systematic application of the coverage, and it is the client's responsibility to demonstrate that the specific policy change caused an expropriatory violation of an existing contract (OPIC, 2012d).⁴⁴ In both instances, a written contract that safeguards the agreed-upon tariffs and related obligations is a necessary precondition to initiate this remedy, but it requires significant negotiation skills and legal expertise, which not all project developers have.

- The World Bank's partial risk guarantee

Partial risk guarantees were introduced by the World Bank in 1994 to support the mobilization of commercial debt during the initial phase of infrastructure projects in developing countries. These contracts can offer policy risk coverage but only for the breach of specific government obligations contained in laws, regulations and agreements (Matsukawa et al., 2007).⁴⁵ These obligations can also include those affecting the stability of the agreed regulatory framework, such as a FiT scheme (Mostert, 2010); allowing the guarantee to cover a retroactive policy change, provided the regulatory framework is explicitly included in the guarantee's clauses, and the event leads to the project defaulting on its debt obligations (WB, 2012b). The contracts take the form of three-party agreements under which the World Bank issues a guarantee to a commercial lender and signs an indemnity agreement (a counter-guarantee) with the host country (Mostert, 2010). By wrapping the government into the deal, with the World Bank playing the role of debt payment guarantor and enforcer of the government's compliance to its commitments, the instrument shifts the risk from the private lender to an actor with a much larger enforcing ability and carrying capacity.

⁴³ MIGA aims to provide compensation within 6-14 months following the date of loss (MIGA, 2011a). Historical evidence made available by the Agency (MIGA, 2012c) shows that so far claims have been paid after 2-3 years from the event date, and no later than one year from the date of claim's submission. Timing is strongly influenced by MIGA's pre-claim efforts to facilitate negotiations for reaching amicable settlement of disputes (Mahaffey, T. 2012), which aim at preserving both the value for the investor and projects' constant contribution to the local economy (MIGA, 2012d). Such pre-claim efforts can only be undertaken with the participation and consent of the claimants (Mahaffey, T. 2012). OPIC data based on 13 available observations (OPIC, 2012e), out of about 70 projects determined under total expropriation clause show that claims are resolved on average 3.5 years after the event date and 1.5 years from claim's submission. Timing of reimbursement process is uncertain and varies significantly from case to case.

⁴⁴ Clients have to demonstrate that policy change, while possibly not discriminatory in face, is discriminatory in substance, or that it has been implemented for non-commercial reasons (OPIC, 2005).

⁴⁵ Risks that can be mitigated include, among others, changes in law, expropriation or breach of "quiet enjoyment" of the site, and payment default by the national power company under the power purchase agreement.

However, a number of factors limit a greater adoption of partial risk guarantees, which have only been issued 23 times since their inception and eight times only for renewable energy projects (WB, 2012c), and the effectiveness of their coverage. The World Bank's choice in the past to promote the use of partial risk guarantees mainly for large and complex projects (such as large hydro investments and cross-border projects) (WB, 2013), along with the need for an indemnity agreement from the host government, not necessary in the case of insurance (MIGA, 2012b), have increased market perceptions about product complexity, length of procedures and associated transaction costs (Parhelion, 2012b). Furthermore, partial risk guarantees directly cover only debt holders, while tariff reductions usually affect many other parties including equity owners, providers of operations and maintenance services.

3.1.2 Policy Risk Insurance: OPIC FiT insurance

With the aim of addressing the implementation limits characterizing currently available instruments, in 2010 OPIC launched a new complementary insurance product which specifically addresses **retroactive policy changes to FiTs** in developing economies (PFM, 2012). OPIC identifies 'policy risk' as an enhancement of its existing expropriation clause, and has enlarged the scope of insurance to include:

- **total expropriation** covering investment losses⁴⁶ that result from significant FiT reductions which jeopardize the overall commercial viability of the project (OPIC, 2011); and
- **partial expropriation** covering business income losses⁴⁷ for a period of one to two years.⁴⁸ The purpose is to allow project owners the time to restructure the project's financial structure in agreement with lenders and authorities (PFM, 2012; OPIC, 2012a, 2012b). If restructuring is not successful within the two-year period the client may then apply for total compensation.

Figure 4 illustrates the interactions between the different actors involved in the mechanism: The Foreign Enterprise operating the project — directly or indirectly owned by US equity holders — signs a PPA contract with the Foreign Governing Authority at a guaranteed long-term FiT rate (PFM, 2012; OPIC, 2012a); then acquires insurance coverage from OPIC. The existence of a PPA contract is required so to configure any eventual policy changes as breaches of contract (OPIC, 2012a).⁴⁹ If an adverse FiT revision occurs, clients must inform OPIC and seek direct redress from the host government to undo its actions (OPIC, 2012f) before they can submit

⁴⁶ Computed as the project's book value on the day before the policy change occurs.

⁴⁷ The difference between revenues at the predefined FiT and returns at the revised FiT.

⁴⁸ Provided that the amount does not exceed the book value of the investment (OPIC, 2012b).

⁴⁹ Desirable features for the PPA are: a) Clear obligation to take the power delivered, b) Fixed tariff rate based on cost of power generation plus reasonable rate of return, c) Guaranteed grid connection, d) Adequate term for cost recovery (15-20 years), e) Tariff payments linked to currency of project debt, f) Acceptable dispute resolution mechanism, g) Off-taker accepts change in law risk, h) Acceptable force majeure provision excusing performance, i) Acceptable termination provisions, j) Ability to assign PPA as collateral (OPIC, 2012a).

a claim.⁵⁰ In case the FiT revision is enforced for 6 consecutive months without an adequate compensation by the local authorities, and OPIC has accepted the claim, OPIC pays compensation to the investor and acquires all rights in the project's economics that are instrumental to pursue the local government for redress (OPIC, 2012b). In order to improve timeliness of remedy, claims are expected to be resolved within seven to 15 months from the effective date of political action or decree (OPIC, 2012b).⁵¹ OPIC's enforcement ability and financial stability are supported by its own reserves and a direct guarantee by the U.S. Government (OPIC, 2012f).

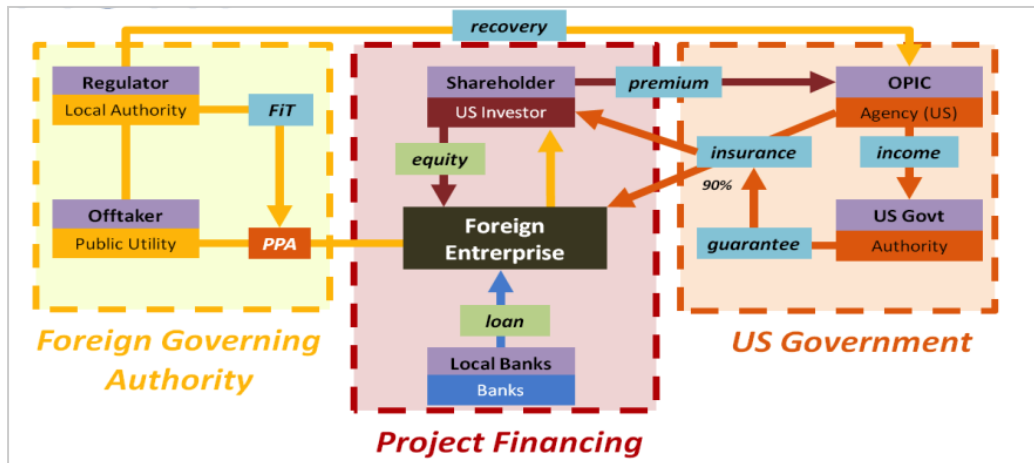


Figure 4 - Stakeholder map for the OPIC feed-in tariff insurance (as of June 2012) – Source: Author

3.1.3 Key lessons for an effective policy risk insurance

As with existing policy risk coverage instruments, OPIC FiT Insurance maintains the allocation of the risk to an entity with stronger enforcement ability and a better carrying capacity; but it aims to improve the timeliness and the certainty of the remedy. It has therefore the potential to improve the overall project risk allocation and reduce its costs. Interviews with stakeholders including practitioners, investors, and insurers, as well as a review of the relevant literature, have highlighted a few elements that would ensure effectiveness of the policy risk insurance mechanism, and that are summarized.

- Promoting systematic and streamlined protection

In order to facilitate the systematic application of the coverage once policy changes occur, insurance instruments themselves should contain a clear characterization of policy risk, and clearly identify

⁵⁰ OPIC does not require that the investor go to arbitration or utilize other dispute resolution procedures (OPIC, 2012f).

⁵¹ Claims can be submitted once a FiT revision is enforced for 6 consecutive months without an adequate compensation by the local authorities.

which negative changes in the support policies could be classified as violations, breaches, or expropriation of pre-existing obligations.⁵² Conversely, the client would have the burden of demonstrating that the specific policy change represents violations of contractual obligations (OPIC, 2012d). Furthermore, policy insurance contracts need also to be supported by underlying contracts that clearly articulate the level of support to which the government has committed. While this is often true for FiT schemes, whose specifications are normally detailed in the long-term contracts and purchase agreements (Couture et al., 2010), OPIC has also published a set of requirements for a PPA contract to be insurable under its FiT insurance (OPIC, 2012b).

- Ensuring strong enforcement power and alignment of interest

For policy risk insurance to be effective, providers should have a strong enforcement power over governments. This involves the ability to discourage political decisions that revoke previous commitments, or in the event of such decisions, the ability to enforce remedies against public authorities. Both MIGA and OPIC have demonstrated capacity to enforce political risk insurance as their ties with the World Bank and the US Government respectively, appear to have significantly limited moral hazard behaviors by host countries.⁵³ MIGA has paid out only six claims from more than 620 guaranteed projects; of the 292 claim settlements disbursed to its investors since 1971, OPIC has recovered up to 92% from host governments (OPIC, 2012h).

- Extending scope and coverage

As policy changes can take different and more articulate and creative forms, to increase their effectiveness and value, policy insurance mechanisms should expand coverage to a wider range of policies. If, on one hand, OPIC FiT insurance represents a significant achievement in terms of mainstreaming insurance protection related to a specific policy, on the other hand, such an insurance instrument would be more effective and valuable if it is able to cover other policy instruments, and deal with cross-borders variations as well (Parhelion, 2012b). Moreover, the availability of insurance solutions for policy risk mitigation needs to be significantly expanded across countries. Both OPIC and MIGA products cover only developing economies and emerging markets, but the perception of policy

⁵² The specific mandate for climate-change policies of the new OPIC FiT insurance is the first of its kind. Other insurance providers such as MIGA, for example, lack a specific strategy to cover climate related investments (Venugopal et al., 2012).

⁵³ The situation in which an agent (such as a government) is incentivized to behave in an opportunistic or riskier way as the negative effects of her actions are covered by an insurance

risk has increased significantly in some developed countries as well. Furthermore, OPIC provides coverage for US investors and project developers only,⁵⁴ while MIGA Expropriation Coverage protection does not extend to cover local project developers.

- Reducing costs and complexity

The existing instruments have costly compliance requirements, which limit their application to large (and well-resourced) projects only. The instruments are largely unaffordable for smaller projects and programs dedicated to wide-spread, small-scale installations (UNEP-Parhelion, 2012b) due to high transaction costs implied by complex negotiating and drafting processes, the availability of resources needed to seek justice locally, and the need to keep investments solvent before compensation is paid. It is difficult to define the exact cost of providing policy risk insurance, as it varies from country to country, however two main cost components can be identified in all insurance structures:

- **Explicit costs**, or known costs, relate to the premium itself. The lack of track records specific to policy risk (the “loss histories”) makes it difficult for insurers to price this risk - a concern expressed in particular by private insurers. As a general rule, those providers who currently price this risk link it to the host country’s political history and stability (OPIC, 2012d). The development of more products and expertise in the sector will, naturally, increase the accuracy of the pricing and, if more providers enter the market, make it more competitive.
- **Implicit costs** refer to the transaction costs related to the insurance: negotiation and drafting of PPAs, claim filing procedures, self-insurance,⁵⁵ and eligibility conditions. While aimed at discouraging investors’ moral hazard, and increasing the chances of the insurer to receive compensation from the host government (OPIC, 2012d), these costs increase the overall costs of the instrument for the end user and significantly impact the certainty of the coverage.⁵⁶

Importantly, efforts to streamline the adoption of standardized clauses, procedures, and documentation would reduce implicit costs and accelerate the verification and settlement of claims. OPIC FiT seems to move in the right direction by not only formally recognizing retroactive FiT change as a specific clause within expropriation, but also by setting the contractual requirements for eligible PPAs before coverage is granted. To speed up the proliferation of these kinds of instruments, international agencies providing them could encourage the adoption of standardized PPAs that meet

⁵⁴ Conditions for project eligibility project ownership by a US citizen or by a US corporation with more than 50% interest owned by US citizens, or a foreign corporation with more than 95% of interest owned by any of the previous entities (PFM, 2012).

⁵⁵ This is the amount of losses that the insured party has to sustain before the insurer pays any compensation.

⁵⁶ For a single project developer, drafting PPAs to ensure that adverse policy changes will systematically trigger breach of contract requires expertise and further increases transaction costs (UNEP, Parhelion, 2012). Negotiations of the PPA can last a very long time, determining an increase of overall project costs. This is the case, for example, of Lake Turkana project (WB, 2011), where negotiations lasted 4 years despite the financial soundness of the off-taker (WEF, 2012). In general PPAs need to be assessed taking into account the sustainability of the off-taker in the long run (MIGA, 2012f).

all requirements (Couture et al. 2010). Nonetheless, previous attempts to harmonize PPA specifications across different countries have proved challenging and faced strong resistance from local authorities (UNEP, Parhelion, 2012).

- Improve project's credit worthiness through certainty and timeliness of remedy

Since most institutional investors seem to rely on credit rating for their investment decisions, the ability of policy risk insurance to improve project ratings becomes relevant for the product's overall effectiveness, just as the stability of the policy framework and sovereign credit rating is a key driver of project's credit worthiness (S&P, 2011).⁵⁷ Unfortunately, certain features of policy risk insurance may fall short of improving credit worthiness from the bondholders' perspective, as assessed by credit rating agencies: the significant degree of uncertainty on whether the insurance will cover losses, and on the timing and amount of the final compensation, translates into high uncertainty over the project's ability to service its debt obligations. For these reasons, rating agencies have a strong tendency to demand a "pay first, investigate later" approach, as in the case of the full financial guarantee offered by monoline insurers. On the other hand, insurance providers ask rating agencies to expand the scope of their methodology to include the impact of all available mitigation instruments (beyond the straightforward insurance of lenders' cash-flows) able to improve the overall risk profile of the project⁵⁸ (Munich Re, 2012a). In this context, the new partial expropriation feature of OPIC FiT, while not designed with the specific objective of improving ratings, can significantly shorten lag-times and improve prospects for refinancing, and should be well received by rating agencies (OPIC, 2012a).⁵⁹ Notwithstanding these issues, the recognition of political risk insurance and risk guarantees as credit enhancement tools (especially for emerging market debt) offers a useful precedent in the right direction for policy risk insurance and often translates in a significant improvement of green projects' economics:⁶⁰ as a general rule, without political risk coverage, investment ratings are strongly constrained by the host country perceived risks (MIGA, 2012a); besides, for projects in high-risk

⁵⁷ More significantly so whenever the government is also an off-taker of the project's output.

⁵⁸ A lot of risk management work for the whole project- for example - is done in construction insurance lowering the probability of occurrence and expected severity of losses from construction risks (Munich Re, 2012a).

⁵⁹ Under partial expropriation coverage, policy risk is then partially mitigated by the possibility of restructuring project's financing in order to preserve its economic viability under the new FiT.

⁶⁰ Meaningful is the case of MSF Holding in 2000, a Brazilian loan and lease company financier of medical equipment which, after purchasing a MIGA guarantee against Transfer Restrictions and Expropriation of Funds, got an unprecedented 6 notches rating enhancement above the Brazilian sovereign rating, from the three main rating agencies (Fitch, S&P and Moody's) (MIGA, 2005).

countries, lenders and investors frequently demand political risk coverage as a necessary pre-condition for their involvement (OPIC, 2012d); finally, the ability of publicly-backed political risk insurers to provide coverage with terms longer than the typical maturity of project loans (five to seven years) significantly improves projects' creditworthiness (Venugopal et al. 2012).

3.2 First-Loss Protection Mechanisms

The existence of a gap in the coverage of financing risks perceived by investors for green infrastructure, it's a severe obstacle to the mobilization of the resources required to meet the financial challenge posed by climate change mitigation.⁶¹ In order to address financing risks and unlock green finance, risk mitigation instruments are needed to render green infrastructure investments attractive to previously untapped sources of finance — such as institutional investors.⁶² Unfortunately, in order for these investments to appeal to institutional investors, banks and project sponsors need to improve the credit worthiness of underlying projects, as the investments securities that they originate would very likely be rated below investment grade.⁶³ First-loss protection instruments support this goal by shielding investors from a pre-defined amount of financial losses, thus enhancing credit worthiness, and improving the financial profile of an investment. They directly mitigate a project's financing risks by transferring a portion of potential financial losses from the investor to the protection provider. By making projects more appealing to mainstream investors (or by aggregating them under the same mechanism), they also mitigate the perception of liquidity risks: that is, they can overcome “the absence of liquid, investment grade asset-backed securities and a small secondary market” (Wilkins, 2012).

3.2.1 Existing First-loss Protection Mechanisms

A first-loss protection mechanism refers to any instrument designed to insure the amount of capital which is exposed first should there be a financial loss on a security, including equity, debt, and

⁶¹ The International Energy Agency estimates that halving carbon dioxide emissions by 2050 would call for approximately USD 36 trillion to fund infrastructure investments for energy generation and use alone, above a business-as-usual scenario (IEA, 2012).

⁶² The term 'institutional investors' includes mainly pension funds and insurance companies, but also endowments, foundations and sovereign wealth funds. “With USD 71 trillion in assets under management, they can certainly play a major role in meeting the climate investment challenge (Kaminker *et al.* 2012)”.

⁶³ Standard & Poor's rating distributions in October 2011 show that only 16% of project finance loans have a rating of A or higher (Wilkins, 2012).

derivatives instruments.⁶⁴ First-loss protection mechanisms have been structured in several different ways over the years: they can, for example, be insurance mechanisms such as monolines — insurance companies that specialize in providing insurance to debt security providers who are liable to pay investors compensation — no matter the cause of loss. These mechanisms can also take the form of cash facilities or collateral mechanisms based largely on precedents in the securitization space, such as excess spread (the difference between the gross yield on the pool of securitized assets and the vehicle's cost of financing), cash provisions (unencumbered liquidity pools or contingent credit lines available in case of liquidity needs) or overcollateralization (which occurs when more collateral than needed is posted to secure financing).

3.2.2 The EC-EIB Project Bond Initiative

Project bonds have the potential to tap resources directly from investors in capital markets and supply projects' sponsors with long-term capital, as an alternative to the more short-term oriented commercial bank financing (e.g. bank loans). However, the current market share of project bonds, with USD 17.5 billion, is still much smaller than the market share of loans, with USD 327 billion (Eckhart, 2012). This is because infrastructure investors continue to favor bank financing given a loan's higher flexibility, in general, and banks' higher appetite for risk, which results in lower pricing of the borrowed capital and thus lowers financing costs.

The European Commission – European Investment Bank Project Bond Initiative (EC-EIB PBI) aims to support the credit rating of individual infrastructure projects⁶⁵ with a guarantee facility that, depending on the project specifics, can take the form of a funded subordinated debt tranche (a direct loan from the facility to the project that in case of default would be repaid only once other lenders have been repaid in full — hence the subordination), or of a contingent credit line (a credit line made available on demand in case of contingencies that, once claimed, can be converted into a subordinated loan). As a claim that is senior to equity investors but junior to debt investors, the EC-EIB facility can improve the coverage of the senior debt⁶⁶ and improve the loans' credit rating to an investment grade

⁶⁴ The term security indicates any form of financial instrument usually including equity, debt, and derivatives instruments.

⁶⁵ During its pilot phase (2012-2013) the PBI will not include any renewable energy generation projects; however renewable energy will probably be included in the final form of the facility, once the pilot phase is complete (EIB, 2012).

⁶⁶ Debt coverage is the amount of cash available to cover both capital and interest payments due to lenders. As the seniority of loans determines the priority with which debt payments are paid, different classes of seniority may have very different debt coverage metrics.

level, in line with institutional investors' minimum requirements (EC, 2012b; Wilkins, 2012). The facility's structure could potentially be used to finance projects at an early stage of construction as well as those seeking refinancing capital. That said, the PBI's actual mandate is to finance the construction of new assets and as such, fully-built projects in the operation phase will not be considered. Figure 5 illustrates the mechanism: New infrastructure projects (Infra Projects) benefiting from credit enhancement, either as the "subordinated loan or credit line," would be able to issue new, single project bonds⁶⁷ with an investment grade level that could be sold to institutional investors. Whether these investors will have the appetite for such securities is uncertain. However, more than half of the respondents — investors, banks, developers, associations, and governmental bodies — in a public consultation held before the launch of the initiative responded positively on this point (EC, 2012b). The facility is financed by a capped contribution from the EU budget and by the EIB, which will manage the funds, assess the projects, price the loans, and absorb the risks beyond the EU funds – with an expected leverage factor of private funds over public resources (EU+EIB) of 5 times, the PBI aims to finance between EUR 4.5 and 5 billion worth of project bonds in its pilot phase.

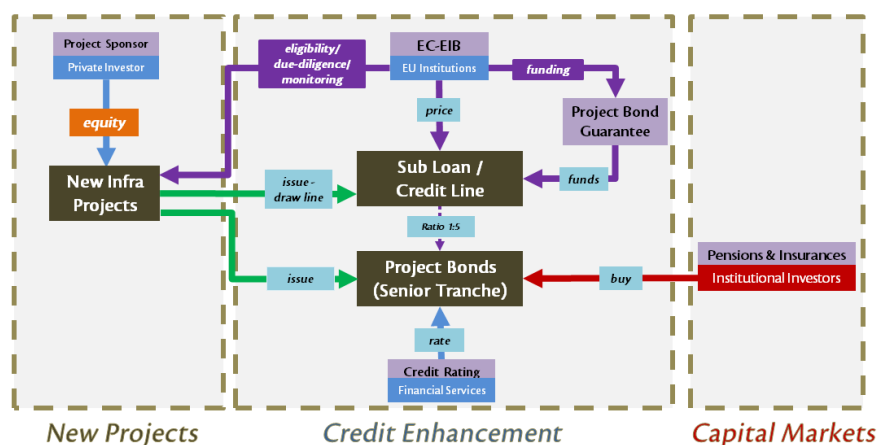


Figure 5 - Stakeholder mapping for the EU - EIB PBI (as of June 2012) – Source: Author

⁶⁷ During the pilot phase, each project will issue a single bond. The aggregation of several projects into a single issue (i.e. securitization) could be a feature of the facility's final structure (2014-2020). If this were the case, it would likely need to be set up by, or outsourced to (EIB, 2012), a bond aggregator facility.

3.2.3 Key lessons for effective first-loss protection instruments

Experience shows that providing effective first-loss protection instruments may not be an easy task.

Similarly to the analysis performed for the policy risk insurance instruments, this section looks at the design elements that could ensure effectiveness of a first loss protection mechanism such as the PBI facility.

- **Match investors' required risk-adjusted returns**

In order to be effective, first-loss protection mechanisms need to allow the credit-enhanced instruments to match investors' required risk/return profiles – that is, reduce perceived risks while allowing a level of returns sufficient to attract institutional investors. Recent data on interest paid by renewable energy project debt show that these investments tend to offer returns slightly higher than investment grade corporate debt (e.g. 1.75-3.25% versus 1.8-2.5% in the US market in 2010-2011), making them a potential candidate for institutional investors' portfolios, from a return perspective. Nevertheless, issuances of project debt and institutional investors' interest have been minimal to date (Eckhart, 2012), suggesting that these returns prove not competitive once adjusted for investors' perceived risks. Among these risks, Nelson and Pierpont (2013) have identified two main challenges for institutional investment in renewable energy: a significant perception of investments' illiquidity and high barriers to take single investment risk given the costs of due diligence on a single project – indeed avoiding construction risk is often a core requirement for most institutional investors, who, as a consequence, get involved only during the refinancing stage once construction is completed.⁶⁸ Interestingly, the EU-EIB PIB challenges this current practice and aims to engage institutional investors in the first financial closing of projects. The effectiveness of the initiative would then depend on whether the financial support from the PBI guarantees and the due-diligence performed by the EIB on each project changes investors' willingness to take direct exposure to projects whose construction is not yet completed once given;⁶⁹ and whether this project by project approach manages to reach a

⁶⁸ Typically, as the construction phase is completed and assets enter in operation, sponsors look to replace initial financing (usually bank loans) with long term cheaper debt that should match, at least in theory, institutional investors risk appetite.

⁶⁹ Nelson and Pierpont (2013) elicitation of institutional investors' investment practices has identified a portion of around 10-20% of total infrastructure investments that is performed by smaller investors with no resources for direct due-diligence that invest relying on the project analysis of large players (the EIB in this case).

sufficient scale to create liquidity and diversification in the, so far, very concentrated project bond market.⁷⁰

- **Allow projects to achieve investment grade credit rating**

Effective first-loss protection mechanisms need to encourage credit rating agencies to rate project bonds as investment grade securities, by decreasing the probability of default and in the case of default, reducing the “loss given default”⁷¹ for the senior lenders. Published simulations assign a higher credit enhancement in case of unfunded guarantees/credit lines (as opposed to funded ones) as these would make emergency funds available to projects facing liquidity shortages in both construction and operation phases (especially for projects with volatile cash flows); and, in case of default, the undrawn funds could be used to repay senior debt first, potentially zeroing the loss given default (Fitch 2011, Moody’s 2011). Still — especially in the eyes of insurance providers — **the approach of credit rating agencies is far from perfect; these agencies should consider whether the investments cover risks adequately, not just whether they provide full financial guarantees** (which is their standard default). The sole focus on the ability of a project’s cash flows to meet debt service obligations induces credit rating agencies to largely prefer full financial guarantees, instead of mechanisms that insure against or mitigate specific risks. Particularly in the current financial environment, offering full financial guarantees is beyond the resources of most institutions,⁷² which could unnecessarily exclude climate-related investments from fair consideration. Finally, as discussed in greater detail later, full financial guarantees also carry significant issues of moral hazard by attracting low-quality projects and, at the extreme, can even increase the overall risk profile of the project.

- **Ensure the first-loss provider has sufficient carrying capacity**

First-loss protection instruments can be effective only when their provider has a higher carrying capacity than project’s investors so to withstand a certain degree of financial losses. In practice, this requirement significantly limits the number of eligible provider to those institutions able to: **meet the**

⁷⁰ In 2012, total issuance of project finance debt was less than USD 5 billion, with only one large size deal, the USD 850 million Topaz Solar Bond (Chadbourne & Park, 2013).

⁷¹ This reflects the difference between the face value of the investment on a ‘going concern basis’ and the amount that is recovered once a default occurs.

⁷² Please see the details on capital requirements for monolines in footnote 25.

capital requirement mandated by regulators and credit rating agencies;⁷³ obtain sufficiently high credit ratings demanded by institutional investors, as the extent of credit enhancement for the insured bond ultimately relies on the credit quality and capital adequacy of the institution that is the payer of last resort; and finally to those holding sufficient **financial expertise** to manage the facility and perform detailed due-diligence on all projects.

- **Reduce the cost of the protection mechanisms**

Typical cost components for guarantee providers include due diligence, credit rating agency fees, structuring costs, marketing support, and more importantly, **the cost of the capital required**. The case of the Asian Development Bank India Solar Power Generation Guarantee Facility (ADB PGG Facility) - detailed in Box 1 – shows the critical role of the cost of capital in making first-loss protection competitive in the market: when provided on a commercial basis, this partial risk guarantee⁷⁴ proved too expensive to find any buyers in the context of the Indian renewable market, and became competitive (thus favoring its uptake) only when the UK Department of Energy and Climate Change (UK DECC) injected grant money, halving the cost of the service.

- **Risks induced by first-loss protection mechanisms**

First-loss protection mechanisms can create extra risks that need to be borne, allocated to a third-party, or managed in a cost-effective manner. Crucially, first-loss protection mechanisms can create moral hazard: that is, attracting developers and banks with very risky projects, or inducing investors to take excessive levels of risks. Moral hazard is managed best by ensuring alignment of interest between the provider of the protection and the investor: in the case of PBI, the likelihood of moral hazard is low, as the mechanism only insures part of the loss of the senior debt tranche and does not absorb any losses associated with the equity tranche. This minimizes the risk of perverse incentives to run any sub-standard project (as was the case with subprime mortgages fully insured by monolines).⁷⁵

⁷³ Moody's and S&P indicate that prior to applying for a credit rating, start-up monolines aiming to achieve credit ratings of A or above (upper investment grade), should achieve, at a minimum, equity capital of USD500 million, and have a senior management structure with proven track record in providing such insurance, in addition to a period of operating history (Moody's, 2006; S&P, 2011b).

⁷⁴ Different from a first-loss protection, a partial risk guarantee doesn't transfer all the risks from the investor to the sponsor but shares them (according to the specific terms of the facility) on an equal basis.

⁷⁵ The risk of moral hazard has been quoted by the EC as the main reason for not considering a full debt service guarantee, as a monoline insurer would do (EC, 2011).

Box 1: Asian Development Bank Partial Credit Guarantees

In January 2010, the Government of India launched the Jawaharlal Nehru National Solar Mission (NSM) to promote the commission of 20,000 MW of solar power by 2022, of which 1000 MW of photovoltaic solar and Concentrated Solar Power (CSP) have been awarded to private developers and should be financed mainly with private resources. At launch, it was thought that the Feed-in-Tariff scheme and the Renewable Purchase Obligation regulation would be enough to support private investments; however, the technology, policy, and commercial risks perceived by commercial banks and investors were too high to prompt them to commit resources with a 20-25 year-time horizon (UK DECC, 2012). The Asian Development Bank (ADB) partnered with commercial banks to offer a risk-sharing facility that would guarantee up to 50% of the present value of a project's loan. In essence, the facility replaces 50% of project debt with typical ratings of B/BB with ADB's AAA credit rating, lowering the cost of debt financing and lengthening its tenor up to 15 years. To improve the coverage effectiveness, but mitigate moral hazard issues, the partial risk guarantee would cover against all possible risks within 90 days from the event (ADB, 2011a) but sharing eventual losses in equal parts with commercial banks.

The facility, approved in April 2011 for USD 150 million over three years, was financed by ADB Private Sector Operations Department (PSOD) which therefore charged a commercial fee for the guarantee. However, the guarantee's price proved too high when compared with fees investors were willing to pay – to make it competitive, a USD 10 million grant⁷⁶ from the International Climate Fund (ICF) halved the fees charged to 0.87-1.25% per annum (plus an upfront fee of 0.2%).⁷⁷

4. Conclusions

The scarcity of capital available from traditional providers, together with political and financial constraints faced by governments, has significantly increased the perception of different kinds of risk that, if placed on parties unwilling or unsuited to carry them, hinder the flow of resources towards low-carbon, climate resilient investments. Some of these risks are very specific to green investments (natural resource variability, environmental markets value, renewable technology performance); others are commonplace for infrastructure investing in general but face particularly high perception

⁷⁶ The GBP 6 million grant was part of a wider GBP 15 million ICF package directed to support ADB risk mitigation efforts between 2011 and 2014. It was approved by UK Department of Energy and Climate Change in the first quarter of 2012 (UK DECC, 2012).

⁷⁷ Depending on the technical form chosen for the guarantee and the timing of cash disbursements, there might also be Commitment fees, Stand-by fees. More details on pricing are available in (ADB, 2011b).

for green infrastructure, often due to lack of experience with these technologies, lack of performance data and investors' familiarity with the sector. While certain investors are willing to take some of the perceived investment risks, and public and private entities provide several risk mitigation instruments, the current supply of risk coverage appears incomplete. In particular, elicited investors' perceptions on demand and supply of risk coverage, indicates that policy risk and financing risks are not fully covered by existing instruments, inhibiting the flow of finance towards both developed and developing markets.

Analysis of currently available instruments and requirements for an effective mitigation of these particular risks has highlighted the role public resources can have in addressing instances of unmet demand for risk mitigation, when the private sector is unable or willing to do so. Public entities have already been providing new risk mitigation instruments to address these climate investments-specific risks, and while it is too early to conduct a full evidence-based assessment of their effectiveness without a longer history of risks and experience with the instruments; this research has aimed instead to highlight the critical design issues for effective risk solutions for low carbon investments.

For **policy risk coverage**, building on the positive features and the limits of political risk insurance products would be a step in the right direction:

- Political risk insurance offered by organizations such as MIGA, OPIC and national ECAs could be enhanced to cover more effectively policy risk, as the public nature of these providers and the strong government backing can improve their ability to enforce remedies against host governments;
- However, perceived uncertainties about timing of compensation, significant transaction costs, and compliance requirements on the insured party reduce the ability of these instruments to address policy risk and limit their scope to medium and large projects.
- Streamlined and standardized procedures and contracts could significantly enhance certainty and improve the timeliness of remedies.
- Engaging credit rating agencies to acknowledge the ability of policy risk insurance in improving investments' creditworthiness will be crucial to unlock the full transformative

impact of these instruments in changing mainstream institutional investors' behavior towards green infrastructure investments.

For financing and liquidity risks, first-loss protection instruments could make green investments more suitable for a wider base of financial investors, institutional ones in particular. However, several challenges need to be faced for effective risk coverage:

- Instruments would need sponsors with substantial resources, financial expertise, and a committed green agenda, in order to offer a sufficiently large carrying capacity that can lower the cost of bearing risk;
- Instruments would need to appeal to financial markets, banks and investors: containing costs and complexity would make instruments competitive with investment alternatives and with the cost of carrying the risks.
- Credit rating agencies would need to recognize the significantly improvement on project's credit worthiness allowed by the instruments, with the goal of providing investors with investment grade securities;
- Interests of both instrument provider and its user must be aligned in order to avoid undesired secondary effects such as moral hazard and perverse incentives, leading to excessive risk taking and low quality investments.

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ANNEX A: Classification of demand of risk coverage

Political, policy, and social risks

	Risk type	Traditional features	Green Investments Additional Risk	Impact	Response	Initial Bearer	Optimal Bearer
Political, Policy and Social	Public Governance / Corruption	Corruption and bribes; Unreliability of government's liability; Repeal of contracts; Capital controls	High as most green projects need to be developed together with the public sector	Project unfeasibility / Higher Costs	Abandon	Project Sponsor	International Organization
	Legal and Ownership rights	Risk of property expropriation; Ownership claims; Land tenure claims		Project unfeasibility	Abandon	Project Sponsor	Domestic Public Sector/ International Organization
	Permitting / Siting	Permitting delays, denial or repeal; Forced relocation	Some technologies (Wind, Hydro, Concentrated Solar) are highly site-specific	Project unfeasibility	Abandon	Project Sponsor	Domestic Public Sector
	Policy	Change of support to tariffs or to overall level of subsidization	High reliance on public support for technologies not yet commercially mature	Lower revenues	Increase Req Return / Abandon	Project Sponsor	International Organization / 3rd party Insurance
	Private Governance	Resources misuse and misappropriation		Project unfeasibility / Higher Costs	Abandon	Project Sponsor	Project Sponsor / 3rd party Insurance
Reputation / Social Opposition	Reputation damages ; Protest from local citizens	Some technologies (Wind, Hydro) face high social resistance	Damage costs and delays / Unforeseen Liabilities	Abandon	Project Sponsor	Domestic Public Sector	

Technical and physical risks

	Risk type	Traditional features	Green Investments Additional Risk	Impact	Response	Initial Bearer	Optimal Bearer
Technical, Physical Risk	Construction	Construction delays ; Standard construction	Increased risk due to novelty of some technologies	Higher costs	Increase Required Return	Project Sponsor	Sub-contractor / Insurance
	Environmental (impacts, acceptance)	Unforeseen impacts on environment; Clean up liabilities	Uncertainty due to novelty of most RE technologies	Unforeseen Costs	Increase Req Ret / Abandon	Project Sponsor	3rd party Insurance
	Reliability of Output	Actual production regimes below projections	Increased due to natural variability, intermittency etc	Lower revenues	Increase Required Return	Project Sponsor	Project Sponsor / Off-taker
	Operation and Management	Inability to operate and manage the asset as budgeted	Increased risk due to novelty of some technologies	Higher costs	Increase Required Return	Project Sponsor	Sub-contractor
	Decommissioning	Forced anticipated dismantling ; Inability to dismantle at planned costs	Technology specific - higher and uncertain for some RE (Offshore Wind)	Higher Costs / Liabilities	Increase RoR/ Abandon	Project Sponsor	Sub-contractor / Public authorities

Market and commercial risks

	Risk type	Traditional features	Green Investments Additional Risk	Impact	Response	Initial Bearer	Optimal Bearer
Commercial, Market Risks	Currency Risk	Unfavorable currency fluctuations		Uncertain financial performance	Increase Required Return	Project Sponsor/ Debt Investor	Development and Commercial Banks/ Currency Funds
	Output Price Volatility	Uncertainty on realized output price; excessive market volatility, lack of demand	High risk due to long horizon of investments and lack of commercial maturity	Lower / unstable revenues	Increase Required Return	Project Sponsor	Power Off-Taker, Public Authorities
	Market-based Environmental Instruments Volatility		Uncertainty on realized GHG/pollutant externality price, excessive market volatility	Lower revenues	Increase Required Return	Project Sponsor	International Carbon Market / Carbon off-taker
	Access to Capital	Shortage of required capital; capital charges higher than budgeted	Lack of understanding of RE in financing communities; Long investment horizon	Excessive cost of capital / capital shortage	Increase Req Ret / Abandon	Project Sponsor/ Debt Investor	Market/ Development and Commercial Banks / Export Credit Agencies
	Counterparty / Credit Risk	Lack of enforceable collateral; Unreliable counterparties (public/private)	Lack of established investment networks	Full or partial loss of capital	Increase Req Ret / Abandon	Project Sponsor/ Debt Investor	Market / Development and Commercial Banks / Export Credit Agencies
	Investment Liquidity / Exit	Significant mark-down on secondary markets; Excessive transaction costs	Niche and specialized market; Lack of dedicated investors/markets	Uncertain financial performance	Increase Req Ret / Abandon	Project Sponsor/ Debt Investor	Market / Development and Commercial Banks

Outcome risks

	Risk type	Traditional features	Green Investments Additional Risk	Impact	Response	Initial Bearer	Optimal Bearer
Outcome risks	Emission Reduction Targets		Failure of policies to achieve direct benefits and primary effects (Emission Reduction)	Primary targets missed	Amendment, repeal of policy	Governments and public backers	Shared between Governments and Private Sector
	Co-impacts	failure of policies to achieve in-direct benefits and secondary effects	Secondary targets of Green Growth / creation of local jobs-industries / energy security	Secondary targets missed	Decrease of public backing for policy	Governments and public backers	Shared between Governments and Private Sector
	Public Budget Impact	Policies' costs overruns	Production support policies spur excessive growth that inflates policies' costs	Costs greatly above budget's projections	Renegotiation, amendment, repeal of policy	Tax-payers and rate-payers	Shared between Governments and Private Sector

ANNEX B: Classification of supply of risk coverage

This classification of instruments for the supply of risk coverage adopts a broad definition of risk mitigation instruments that includes specific de-risking tools (such as contracts and insurance policies) but also instruments and policies whose primary objective is different from de-risking but that, by reducing uncertainty or transferring risk, have a significant risk mitigation effect perceived by investors (e.g. concessional loans, revenue support policies). The table below includes a summary description of each instrument with an indication on the nature of the provider and the risk types typically covered directly, as derived from examples of instruments offered for clean investments.

BILATERAL CONTRACTS	
Engineering, Procurement and Construction Contract (EPC); Operation & Maintenance Contract (O&M)	<p>Provider: Private</p> <p>Risk type: Technical, Physical Risk</p> <p>Description: EPC and O&M contracts transfer the project risk for schedule changes, changing prices for materials, and labor (EPC), as well as risk related to the maintenances of the asset (O&M) to the contractor, in exchange for a fixed price. Payments can be done in mutually agreed installments, while contracts may include penalty clauses for failure to achieve performance parameters.</p> <p>Reference: WB, 2011.</p>
Emissions Reduction Purchase Agreement (ERPA)	<p>Provider: Private</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: An Emissions Reduction Purchase Agreement is an agreement between the buyer and the seller of carbon credits from CDM/JI Projects. An ERPA identifies responsibilities, rights, and obligations to manage risks, related to price fluctuations and delivery of emissions reductions.</p> <p>Reference: ODI, 2012.</p>
Foreign Exchange Swaps / Futures	<p>Provider: Private</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: A Foreign Exchange Swap is a contract in which one party borrows one currency from, and simultaneously lends another to, the second party. The purpose of a currency swaps is to hedge against risk exposure associated with exchange rate fluctuations, ensure receipt of foreign money, and to achieve better lending rates.</p> <p>Reference: BIS, 2008.</p>
Power Purchase Agreement (PPA)	<p>Provider: Public/Private</p> <p>Risk type: Technical, Physical Risk</p> <p>Description: A Power Purchase Agreement is a legal contract between an electricity generator (provider) and a power purchaser (typically a utility). It is used to cover uncertainty of the seller related to expected revenues of the project (which hamper its viability), or when the purchaser wants to secure supply of power at a predefined price (to know of any potential constraints for budget in advance).</p> <p>Reference: Eriksson <i>et al.</i> 2010.</p>
Decommissioning Contract	<p>Provider: Public/Private</p> <p>Instrument type: Technical, Physical Risk</p> <p>Description: Decommissioning contracts may include clauses for the distribution of risks related to the decommissioning phases of the project, in proportion to relative rewards and for minimizing potential for dispute.</p> <p>Reference: IMCA, 2011</p>
CREDIT ENHANCEMENT	
First Loss Insurance	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: First loss insurance funds can be made available (by i.e. multilateral agencies) to cover part of the project losses in the event of its failure.</p> <p>Reference: EC. 2012a.</p>
Interest Rate Subs	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: An Interest Rate Subsidy is provided to lower the cost of borrowing by reducing the amount of each payment for interests.</p> <p>This makes the project more affordable and, at the same time, allows banks to keep loans in line with their commercial rates.</p> <p>Reference: te Velde <i>et al.</i> 2007</p>

Letter of Credit	<p>Provider: Private</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: A Letter of Credit is a guarantee to a seller that goods or services will be paid for by the issuer of the letter of credit - usually a financial institution - regardless of whether the buyer ultimately fails to pay. In this way, the risk that the buyer will fail to pay is shifted from the seller to the issuing bank.</p> <p>Reference: IFC, 2012.</p>
Loan and Credit Guarantee	<p>Provider: Public/Private</p> <p>Risk type: Political, Commercial, Market Risk</p> <p>Description:</p> <p><u>Loan Guarantees</u> - Contractual obligation by which a guarantor assumes the responsibility of assuring payment or fulfillment of a borrower's debt or obligation, in case of default. Loan guarantees can refer to a private agreement with a bank, or to an agreement in which the government is the guarantor of the debt's obligation. They can be direct, to intermediaries that provide finance directly to project developers, or counter-guarantees, to intermediaries that issue guarantees for the benefit of lending institutions.</p> <p><u>Partial Credit Guarantees</u> - Provided by Development Financial Institutions (both multilateral and some bilateral) at commercial rates to cover private lenders against the risk of debt service default by government or public (and recently private) sector borrowers, versus the payment of a guarantee-fee. "Partial" is intended for a guarantee coverage amount lower than 100% of the principal and/or interest. PCGs can be used for any commercial debt instruments (loans, bonds) provided by any private institution, and are flexible with regards to the balance of risk sharing of the borrower's credit.</p> <p><u>Export Credit Guarantees</u> - Insurance policies provided by Export Credit Agencies, usually governmental agencies, which ensure that exporters are paid for goods shipped in the event the customer defaults, thus allowing exporters to keep their prices competitive.</p> <p>Reference: WB, 2007; EKF, 2012</p>
Securitization	<p>Provider: Private</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: When raising financing through a project bond, the company or Special Purpose Vehicle will issue senior and subordinated tranches of debt. The subordinated tranche will take first losses and the credit standing of the senior debt will be enhanced because it will carry less risk.</p> <p><u>Asset-backed securities</u> - Securities which are based on pools of underlying assets, usually illiquid and private in nature. The "pooling" of assets makes the securitization large enough to be economical and to diversify the qualities of the underlying assets (diversifying risk).</p> <p><u>Credit Tranching</u> - Senior/Subordinated structures are the most popular technique to create internal credit enhancement. The subordinated tranches function as protective layers of the more senior tranches.</p> <p>Reference: NREL, 2013.</p>
INSURANCE PRODUCTS	
Private Insurance (general)	<p>Provider: Private</p> <p>Instrument type: Technical, Physical Risk</p> <p>Description: Insurance is a risk management tool used to address the risk of a contingent, uncertain loss. Insurance consists in the transfer of the risk of a loss, from one entity to another, in exchange for payment of a predefined amount of insurance coverage, called a premium.</p> <p>Reference: Munich RE, 2009</p>
Delays in Start-up (DSU)	<p>Provider: Private</p> <p>Instrument type: Technical, Physical Risk</p> <p>Description: Also referred as delayed completion coverage, Delays in Start-up insurance indemnifies the insured in respect of ascertained income loss or specified additional expenses (i.e. additional interest charges, or advertising expenses) that result from a delay in the completion of a project when the delay is caused by an insured event.</p> <p>Reference: Swiss RE, 2002</p>
Private Political Risk Insurance	<p>Provider: Private</p> <p>Instrument type: Political, Policy, and Regulatory</p> <p>Description: Private political risk insurance policies generally guarantee asset coverage in the events of confiscation and expropriation, as well as contracts coverage such as license cancellations, currency inconvertibility, trade embargoes, strikes, riots, and loss of income following expropriation. Compensation is usually based on book value, while premiums are relatively higher than for public insurers, but still attractive for investors falling outside eligibility requirements for government-sponsored insurance.</p> <p>Reference: Zurich North America, 2012</p>
Public Political Risk Insurance / Guarantee	<p>Provider: Public</p> <p>Instrument type: Political, Policy and Regulatory</p> <p>Description: Public political risk insurance providers include: multilateral banks, export credit agencies and multilateral and bilateral organizations and corporations that promote private investment. Premiums are lower than for private insurers, but provision of insurance depends on the satisfaction of eligibility requirements. Risk guarantees are also designed to mitigate perceived risk related to the investment in a foreign country. This is done by providing support to project companies against a government's failure to</p>

	<p>meet specific contractual obligations to a private or public project due to sovereign risks or political force majeure events which are usually under government control.</p> <p>Reference: Nolan <i>et al.</i> 2011</p>
REVENUE SUPPORT POLICIES	
Feed-in-Tariffs (FiT) / Feed-in-Premia (FiP)	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: FiT are policies that provide price certainty and long-term contracts to energy producers in order to help investment in renewable energy. Usually FiTs are accompanied by a "tariff digression" mechanism that decreases the tariff over time. FiP are composed of both a premium (like FiT) and the market value of electricity, exposed to market fluctuations. Risks related to market fluctuations are thus only partially addressed.</p>
Tradable permits	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: Market-based transferable permits give a value to environmental goods. This value can either be based on emissions reduction targets or renewable energy reduction targets. Credits can be allocated based on historical emissions (grandfathering) or actual emissions compared to projected business-as-usual emissions (baseline and credit). Although tradable permits are a valuable instrument for addressing revenue concerns from investors, they may generate new risks associated to price fluctuations in related markets. Central authorities can mitigate these risks by establishing price floors or allowing the banking of instruments.</p> <p>Reference: Buckley <i>et al.</i> 2005</p>
Tax Credits / Tax Equity	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: A tax credit is a sum deducted from the total amount a taxpayer owes to the state. A low-carbon technology tax credit is any tax credit offered by a governmental authority as an incentive for the installation and operation of low-carbon technologies. In the US, Tax equity in particular is a mezzanine investment instrument generated by the structure of tax incentives for renewable energy.</p> <p>Reference: Varadarajan <i>et al.</i> 2011</p>
Fossil fuel subsidy policy	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: Fossil fuel subsidies are governments' actions that lower the cost of fossil fuel energy production, raise the price received by energy producers, or lower the price paid by energy consumers. They include energy prices control measures, direct government outlays or purchase requirements, tax breaks, and loans and insurance at favorable rates. Any action that removes fossil fuel subsidies very often narrows the viability gap for low-carbon technologies.</p> <p>Reference: IISD, 2012</p>
DIRECT INVESTMENT	
Concessional Loans Funding	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: In a concessional loan, while the principal loan amount needs to be paid back, the interest rate payments are still significantly reduced and can include a longer repayment period or even a gracing period. A concessional loan is classified as Official Development Assistance when it conveys a grant element above 25% and has an interest rate below the prevailing market rate.</p> <p>Reference: ADB, 2012; WB, 2007</p>
Dedicated Private-equity Funds	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: A dedicated private equity fund is a collective investment scheme used for making investments in specific equity securities according to the investment strategy of the managing private equity firm. The aim of these funds is to provide equity capital to attract, in particular, commercial investors that normally would avoid risky investments in developing countries.</p> <p>Reference: Bird, 2009</p>
Equity-investments of Development Banks	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: Development Banks can invest in project equity. This enhances the capital base of the project and reduces its overall perceived risks by giving investors increased comfort. Equity-investments typically correspond to about 5%-15% of a company's total equity as the aim is not to take control of the company.</p> <p>Reference: te Velde <i>et al.</i> 2007</p>
International Climate Funds	<p>Provider: Public</p> <p>Risk type: Commercial, Market Risk</p> <p>Description: International Climate Funds are operating entities whose mission is to finance projects, programs, and policies, mainly in developing countries, related to global climate change mitigation and</p>

	adaptation. Reference: CIF, 2009
Public-Private Partnership	Provider: Public/Private Risk type: Commercial, Market Risk Description: A Public-Private Partnership is a contractual agreement between a public agency and a private sector entity for the execution of a project, service, or facility for the use of the general public. Public-Private Partnerships provide for the sharing of resources (skills and assets), risks, and rewards between the public and the private sector. Reference: NCCP, 2012
POLITICAL/ INSTITUTIONAL SUPPORT	
Capacity Building / Tech Assistance	Provider: Public Instrument type: Political, Policy, and Regulatory Description: Capacity building grants can help reduce information barriers, provide technical assistance to projects, or help develop financial markets. The purpose of capacity building is to remove the obstacles that inhibit people, governments, international organizations, and non-governmental organizations from realizing their developmental goals and achieve measurable results. Reference: te Velde <i>et al.</i> 2007
Database / Information tracking tools	Provider: Public/Private Instrument type: Political, Policy and Regulatory Description: The lack of databases makes it difficult to comprehensively assess the risk of innovative investments. Data tracking and project classification tools make it possible to know the historical risk-return performances of similar infrastructure investments thus reducing uncertainties. Reference: Kaminker <i>et al.</i> 2012
Quality Standard	Provider: Public Instrument type: Technical, Physical Risk Description: Minimum quality requirements in infrastructure specifics at national level or between different countries help address many construction and operational risks. Quality standards are provided by national / international public and private organizations, and are usually based on best practices.

Chapter 2: The Public Cost of Policy Risk: Lessons from the success and the fall down of CSP policies in Spain⁷⁸

1. Introduction.....	69
2. Evolution of the Spanish CSP policy and industry	71
3. Policy design and investment choices under the RD 661/2007.....	73
3.1. Plants profitability and investment choices.....	73
3.2 Inefficient policy features and technology costs	74
Box: The debate on the impact of the CSP premium on the tariff deficit.....	76
4. Retroactive policy risk: impact on returns and installations.....	77
5. Prospective policy risk: CSP costs' projections for Spain	78
6. Conclusions.....	80
References	82
ANNEX A: Policies and Regulatory Acts from 1997 to 2014.....	84

⁷⁸ This chapter draws its content from the research performed for the paper:

Frisari G. and Féas J., 2014. **The Role of Public Finance in CSP: How Spain created a world-leading industry then shattered investor confidence**. August 2014. Venice: Climate Policy Initiative.

Results have also been presented at the **Second Annual Conference of the Italian Society for Climate Sciences: Climate Change: Scenarios, Impacts and Policy** (29th September 2014, Venice, Italy)

1. Introduction

As Chapter 1 showed, the reliance on public support of many renewable energy technologies makes investors particularly weary of policy risks and of the overall stability of policy frameworks, leading them to increase required returns before they decide to commit resources. Model simulations in the literature show that increase in policy risks could drive up renewable energy financing costs by more than 10% in wind and solar projects (Varadarajan et al., 2011) or the required Feed-in Tariff for solar photovoltaic by almost 50% (Lüthi and Wüstenhagen, 2012). This is particularly true for renewable technologies, such as concentrated solar power (CSP), still far from grid parity, that is from being competitive with other alternative sources of energy based on prevailing market prices (IRENA, 2012). CSP's high investment and production costs make public support necessary to ensure profitability of private investments and compensation of investment risks.⁷⁹ Furthermore, the substantial capital expenditures of CSP projects and its required upfront costs increase the share represented by financing charges on the overall project costs, amplifying the effect of perceived risks (including policy ones) on technology costs.

In this context, the evolution of CSP support policies in Spain provides a very interesting real-life example of the strong relationship between renewable energy installations, projects costs and the stability of the policy framework. Spanish policymakers were very successful in prompting the development of a national CSP industry that is now also leading installations on a global scale. At the same time, issues in policy design led the industry to develop much faster than expected, exceeding the country's initial targeted capacity and the planned public support for the technology.⁸⁰ In the end, the government's efforts to control the industry's growth by retroactively amending support policies hurt both investors' confidence and CSP investments' financial profile in Spain, and brought the local CSP market to a complete standstill. The events that occurred in the country between 2007 and 2014 permit the quantification of the financial impact of retroactive policy changes on existing private

⁷⁹ Chapter 3 contains a more detailed analysis of the financial landscape for CSP and of de-risking strategies available to policymakers.

⁸⁰ The policy framework in the RD 661/2007 aimed to support up to 500 MW of CSP installations (BOE, 2007).

investments, but also the financial impact of prospective policy changes on technology costs and required public support.

The analysis is supported by data collected from publicly available databases (Bloomberg New Energy Finance – BNEF, 2014; and the National Renewable Energy Laboratory – NREL, 2014), literature review and direct interviews with key stakeholders in the local CSP industry.⁸¹ A project finance cash-flow model as described in the Introduction – Section 3 - has been simulated by modeling a “representative” CSP plant whose investment costs, capital structure and production estimates are the national averages of all the plants (categorized by technology types) commissioned during the period in analysis (2007-2013), while the financing terms are the average of those indicated directly by investors in a few plants.

Table 1: Financial inputs for CSP Plants commissioned in Spain in 2007-2013 – Source: Author’s elaborations on BNEF (2014) and NREL (2014)

Data Assumptions	Parabolic Trough	Parabolic Trough with Storage
Number of Plants	25	23
Plant size	50 MW	50 MW
Capacity factor	24%	38%
Investment costs	€263 million	€370 million
Debt Leverage	75%	75%
Debt Maturity	20 years	20 years
Financing terms	Euribor + 150 basis points	Euribor + 150 basis points

For this analysis the project finance model only focuses on three key financial metrics:

- The *equity internal rate of return* as the key measure of the project’s profitability for the project sponsors. In order for a project to be viable, this value needs to match the sponsors’ cost of capital; for a project to be appealing, it needs to be in line with benchmark returns from investments of comparable risk and, obviously, higher than the “risk-free” rate offered by the country’s government bonds. While the internal rate of return is typically an output of the cash-flow model; here it is also used as an input as, for a given set of technology costs and

⁸¹ Interviews conducted: one policymaker from a regional government, two project sponsors, two project developers, two lenders and one representative from the European trade association. The identity of the stakeholders interviewed remains confidential given the political sensitivity of the matter and ongoing lawsuits between the Spanish government and a few investors.

financing terms available from lenders, it ultimately drives the amount of public support needed to make a project attractive to private investors.

- The *levelized cost of electricity* as a key measure of project costs for each unit of power produced. It's a measure of the cost of the power after all resources (including financial ones) are remunerated (NREL, 2011).
- The *debt service coverage ratio* (DSCR) is the share of periodic debt payments (both principal and interest) covered by the free cash flows from project's operations, e.g. revenues from sale of power net of all operative costs (Gatti, 2013). The ratio indicates a project's ability to repay its financial liabilities and is typically monitored by lenders, who also set a minimum threshold to be kept at all times. A DSCR below 1 indicates that the project is not generating enough financial resources to repay its debt and might soon encounter financial stress.

Section 2 provides a summary of the context in which support for CSP and renewable energy developed in Spain; Section 3 analyzes the key policy features that made the development of the CSP industry possible in a short space of time, and measures their impact on investments' profitability and other relevant measures (e.g. incentives for storage). Section 4 identifies and measures the impact of the policy changes on existing investments. Section 5 shows the impact of investors' higher risk aversion and lower confidence on the industry's outlook in the country.

2. Evolution of the Spanish CSP policy and industry

Spanish support to CSP, and renewable energy overall, has been part of a broader national effort to liberalize the national energy market. It began in 1997 with Electricity Act 54/1997 and continued in the following years with several pieces of legislation (Figure 1 contains a summary of the main policies, detailed descriptions can be found in Annex A). This first act established the "special regime" for facilities based on renewable, cogeneration and waste energy and set capacity targets for energy efficiency, environment protection and energy production from renewable sources. The remuneration system for the special regime was introduced in 2004 with the Royal Decree (RD) 436/2004 – though most plants were announced and, later, commissioned under the RD 661/2007 system that replaced

the variable “reference price” as base for the incentive with a fixed amounts for both the tariff and the premium over the negotiated market price (the “pool price”⁸²). In 2011, in slightly less than 5 years, the CSP industry was estimated to employ more than 20 thousand people and generating an annual contribution to the Spanish GDP of 1.65 billion Euros (Deloitte-ProtermoSolar, 2011).

The 2.3GW of plants commissioned under the 661/2007 policy contributed 700 GWh of electricity in 2010 (0.25% of total national demand) and more than 4,000 GWh in 2013 (1.70%) (CNMC, 2013b) – saving 361,250 tons of CO₂ in 2010 and more than 2 million tons of CO₂ in 2013 (author’ estimations on parameters from Deloitte-ProtermoSolar, 2011).

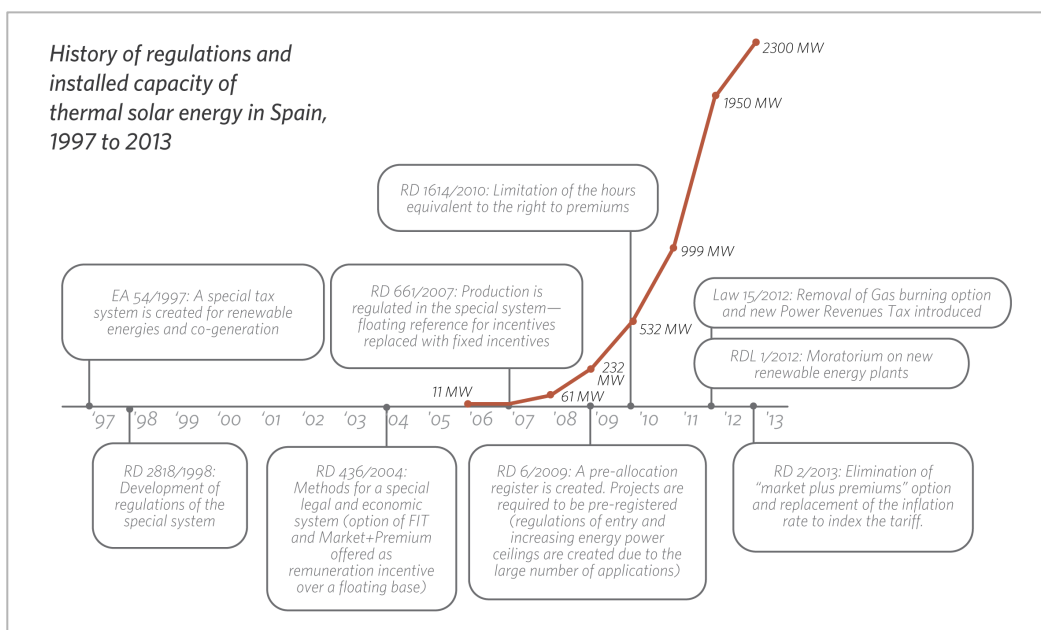


Figure 1: History of regulations and installed capacity for concentrated solar power in Spain– Source: Author

From an industrial economic perspective, Spanish companies owned more than 75% of the national solar thermal market, with one third of the plants being financed by foreign equity investors.

Interestingly, the same companies have developed (as sponsors or contractors) more than 55% of the global CSP capacity installed outside Spain in the last 10 years (BNEF, 2014). These several benefits of the policy framework have to be put in context with the financial burden on the electricity rate-payers budget: under the 661/2007 incentive system, all Spanish CSP plants required a financial incentive of EUR 185 million in 2010 and up to EUR 1.1 billion in 2013 (author’s estimations on CNMC, 2013b).

⁸² The electricity market sets the pool price by adjusting the supply and demand of energy scheduled for the next day. The first offers come from nuclear power and renewable energy. Both offer energy at zero prices to give them priority. Then the most expensive (gas and coal) energy offered to meet the demand, thus setting the marginal price that becomes the “pool price”. All other sources offered are also paid at this price, even if they were offered initially at lower prices.

3. Policy design and investment choices under the RD 661/2007

Royal Decree (RD) 661/2007 was in fact the centerpiece of the Spanish renewable energy support framework and was eventually responsible for the vast majority of RE installations in the country. While not being very different from its predecessor RD 436/2004, it crucially removed the variable base on which the support was calculated and provided high certainty on investments' long-term revenues. This section examines the impact on the technology and the energy sector of its main design features.

3.1. Plants profitability and investment choices

Under the incentive framework set out in the RD 661/2007, project sponsors could choose (annually) between a 26.9 ¢cents/kWh fixed regulated rate (feed-in tariff) and a 25.4 ¢cents/kWh premium over the market price (feed-in premium). Both incentive schemes were set for the whole useful life of the plants (estimated at 40 years) but were to be marginally reduced after the first 25 years. The financial model indicates that, while at market rates without the revenue support, a CSP project would not have achieved a positive rate of return;⁸³ these incentives allowed a generic CSP project to reach a 10% rate of return, and its equity sponsors to enjoy a levered 12.5% return (after taxes). Bearing in mind the higher risks associated with an innovative technology such as CSP, these returns appeared favorable compared with an estimated cost of capital for the utilities in the country at around 8%, and rate of returns offered by wind investments in Europe at 8 to 16% (Macquarie, 2011). However, they appear in line if not below those offered by solar PV installations in Europe, estimated at 15 to 18% for equity owners in the year 2011 (Varadarajan et al, 2011).

The structure of the incentive, along with favorable financing terms, encouraged investment in less proven thermal storage technology. Storage helped plants to reach significantly higher capacity factors (increasing from 24% without storage to 38% in our estimation) and resulted in much lower levelized costs of electricity (0.24 Eur/kWh for those with storage compared to 0.27 Eur/kWh for the others). Lower levelized costs coupled with the possibility to earn a premium over the market price and favorable financing terms from lenders, allowed plants to achieve higher internal rate of returns

⁸³ Without any tariff incentive, simulated rate of returns would be -2%.

(11%) and their sponsors' levered returns of 14% (after tax). The higher profitability induced several sponsors to invest in this more efficient technology, despite it being much less proven⁸⁴ and more capital intensive than the proven parabolic trough. Almost half of the plants commissioned in the country featured storage facility with an average seven hours of capacity. Very interestingly, despite the typical perception of higher risk related to thermal storage technology, banks and lenders did not demand a premium for the loans. As shown in Table 1, the average financing terms were basically the same for both types of plants. This is also explained by the availability - reported by stakeholders - of project developers and sponsors to offer banks comprehensive guarantees from their corporate assets, making project finance deals more similar to balance sheet financing.⁸⁵

3.2 Inefficient policy features and technology costs

Several features of the policy framework proved inefficient and, ultimately, led to a much higher cost of the policy than expected (and politically acceptable), prompting the government to amend the framework with severe effects on projects' financial performance and the overall market.

The incentivized tariff in the Royal Decree 661/2007 was conditional to a maximum plant capacity of 50 MW, far below the 100 to 250 MW indicated as the optimal scale for CSP (IEA, 2010). This condition was initially due to concerns from the grid operator about connecting plants generating non-dispatchable⁸⁶ power, but more importantly due to the preference from policymakers to keep the approval of renewable energy projects a responsibility of regional governments (plants higher than 50 MW would have needed the approval of the central government).

As a result of this limit, all the plants installed in Spain between 2009 and 2013 had a capacity of 50 MW or below, even though many were built in adjacent 50 MW modules for a total of 100-150 MW.

Considering that many parts of a generic CSP plant do not depend on scale (such as the conventional power block and project development costs), a large plant with 150 MW capacity could have produced

⁸⁴ The first commercial-scale CSP plant with thermal storage to be commissioned was the Andasol I plant by ACS SA which started operations in 2008. A previous attempt with one of the plants in the SEGS project in the Mojave Desert (US) caught fire after a short period of operation and was never replaced (NREL, 2014).

⁸⁵ The key difference between project finance financing and balance sheet financing is the limited recourse to the borrower's assets offered to the lender. In a project finance loan, in case of default, lenders have rights only to the assets owned by the project company and cannot claim any right on any other sponsors' asset outside the project.

⁸⁶ Without storage or back-up fuel, the power generated by a CSP plant follows the rise and setting of the sun and cannot be managed to the grid's needs.

power at a 15% lower levelized cost and a 20% lower investment cost per MW installed than a 50 MW plant.

The incentive mechanism in RD 661/2007 had no systematic link to the cost of the technology or of individual plants, and no periodic price revision system⁸⁷ that would provide an incentive for developers to seek cost reductions. While it is true that developers could increase project profitability by reducing the plant's costs, the large number of installed projects, and the limited amount of both developers and suppliers meant that competition was not sufficient to prompt cost reduction.

Although most of the plants were built in a relatively short amount of time, policymakers seem to have struggled to exert any downward pressure on the plants' costs as capacity was being deployed and, the policy design meant they would not have benefitted from any cost reduction. Looking at both investment costs per capacity installed and levelized investment costs⁸⁸ for all plants financed between 2006 and 2012 and later commissioned, no downward trend emerges in Spain (Figure 2), while other markets have experienced cost reductions especially when using competitive tender

auctions to award projects (Section 3 in Chapter 3; Stadelmann et al, 2014c), with average technology costs outside Spain approximately 20% lower for plants with storage and more than 30% for those without.⁸⁹



Figure 2: Investment and levelized costs for parabolic trough plants between 2006 and 2012 – Source: Author

⁸⁷ Policy for the solar photovoltaic project was structured differently. The RD 1578/2008 introduced in 2008 a "quota" system that aimed to control costs as capacity grew: installations were staggered in annual quotas that, once reached, would proportionally reduce the FIT for the following year (Del Rio and Mor-Artigues, 2012).

⁸⁸ Discounted at utilities' estimated cost of capital (Varadarajan et al, 2011).

⁸⁹ Average levelized investments costs estimates are USD 0.35 /kWh for Spanish plants with storage compared with USD 0.27/kWh elsewhere. For plants without storage, average values for Spain are USD 0.42 /kWh and USD 0.28/kWh elsewhere.

Box: The debate on the impact of the CSP premium on the tariff deficit

Soon after the electricity market liberalization in 1997, the difference between the overall regulated costs of the electricity sector⁹⁰ (generation, transportation and distribution) and the revenues obtained through regulated tariffs set by the government and paid by consumers generated a sector-wide deficit that later on, in 2011, reached more than 30 billion euros (Fabra, 2012; CNMC, 2013b). This tariff deficit quickly became one of the major problems in the Spanish electricity sector and has indeed driven most of its regulatory changes in the last few years. The deficit emerged before significant installations of renewable energy started, and worsened also due to the financial crisis and economic downturn that reduced energy demand more than expected. Nevertheless, as renewable energy installations (including CSP ones) increased – also exceeding initial expectations and national targets⁹¹ – the impact of their premium on energy production costs grew, contributing to the widening of the national tariff deficit. Along other renewable energy sources, support to CSP soon became a political issue despite the rather limited absolute size of installations and its positive financial effects on the electricity market and the deficit itself: savings in fossil fuel imports, and a reduced average electricity market price, via the “merit order”⁹² effect given their null marginal costs of production (see figure 3).⁹³ An in-depth analysis on the net financial effect of CSP on the tariff deficit is rather complex and would fall outside the scope of this work; we note however, that regardless of the net financial effect on the sector, the presence of a budget expenditure growing beyond their zone of political tolerance drove Spanish policymakers to the draconian measures that followed and are analysed in the next section.

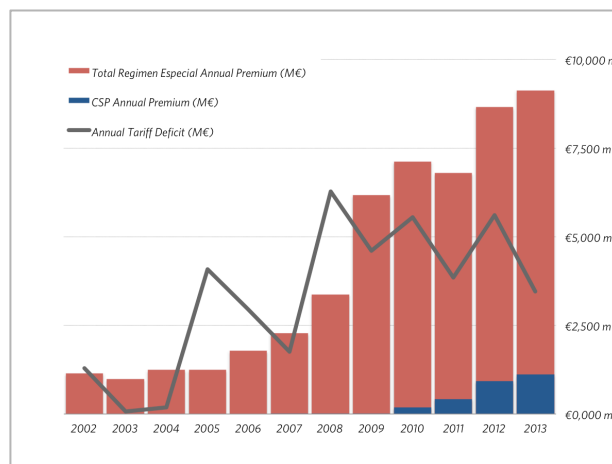


Figure 3: Annual tariff deficit, renewable energy and CSP premiums - Source: CNMC (2013b)

⁹⁰ These regulated access costs include, among others, transmission, distribution, costs of diversification and security supply (including nuclear moratorium and special regime premium), permanent costs and deficit of regulated activities.

⁹¹ Solar PV capacity installed in 2010 alone stood at 3.8GW against a target of 400MW (CNMC, 2013b).

⁹² The merit order is a system of allocating energy production to different sources by giving priority to the ones with the lowest marginal cost of production. As renewable sources have an almost null marginal cost, they are always granted full dispatchment and displace sources with higher costs.

⁹³ Gelabert *et al* (2011) estimated for Spain that a marginal increase of 1 GWh of electricity production using renewables and cogeneration is associated with a reduction of almost 2 € per MWh in electricity prices (around 4% of the average price for the analyzed period).

4. Retroactive policy risk: impact on returns and installations

In 2009, the objective of national CSP policies switched from supporting installations to limiting connections. Five years after Royal Decree 436/2004 and two years after Royal Decree 661/2007, announcements of CSP projects significantly overshoot the 500 MW short-term targets set by the Spanish Government in the Renewable Energy Plan for 2005-2010 and in the RD 661/2007 (BOE, 2007; GDE, 2005). Plants had been planned for a total capacity of 500MW with 1 GWh of annual production forecasted for 2010 (GDE, 2005).

To control deployment of support and connection to the grid, the Royal Decree 6/2009 published a pre-assignment register for the special regime listing 51 plants, worth 2.3GW of capacity, to be commissioned and connected between 2009 and 2013. As a result, the pre-register put on hold almost 50% of the plants that had been announced in the three years prior. Those plants, unable to get financial closure while outside the register, were later dropped as the special regime register was ultimately closed to new plants in 2012 when the Royal Decree Law 1/2012 introduced a moratorium on new renewable energy plants that cancelled the incentivized remuneration (Figure 4).

Later in 2012, new policies introduced further hurdles for CSP by first limiting the amount of power eligible for the incentives through an operating hours curtailment (RD 1614/2010), non-eligibility of gas-fired back-up power for beneficial tariffs and new taxation to help finance the tariff deficit (Law 15/2012); and finally removed the “premium over market-price option” to make the overall renewable expenditure less variable (RD 2/2013). These policy changes, described in more detail in the Annex, amended the RD 661/2007 and applied retroactively to plants already in operation.

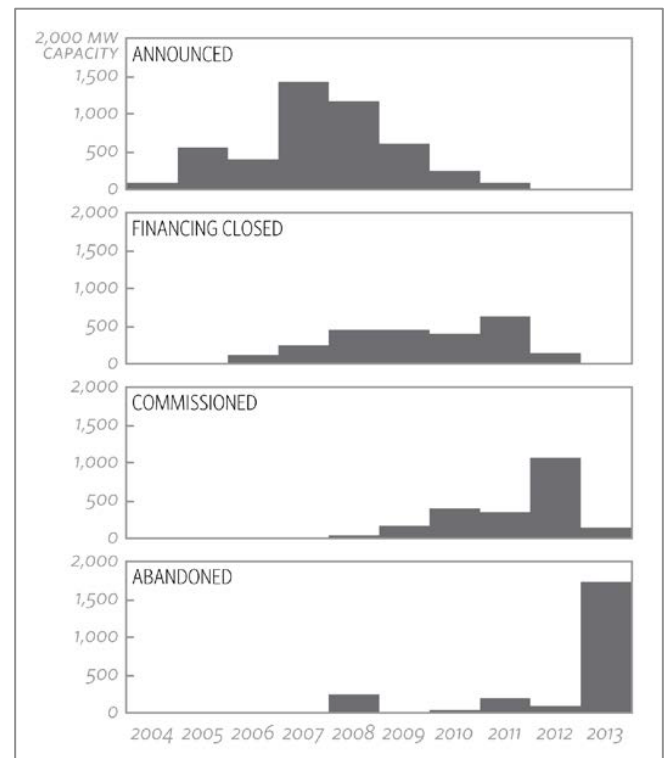


Figure 4: CSP Installations per calendar year - Source Author's elaborations on BNEF (2014)

Modifying financial simulations' initial inputs in compliance with these regulatory changes severely, the profitability of equity investors results significantly reduced, as well as projects' ability to repay debt and interest due. Simulations for a plant with parabolic trough without storage show that the set of 2012 policy changes reduced plants' profitability from 12% to 7% rate of return. They also decreased projects' ability to repay their loans to a very limited level (the plant minimum DSCR goes from 1.6 to 1.29).

A new sector reform for the renewable energy sector is currently being discussed, with further reduction of operating hours - differentiated per technology type and 30% on average- and remuneration profile - 13% reduction from the RD 661/2007 FiT (CNMC, 2013c). Plants' profitability and financial health deteriorate further when these inputs are included: equity rate of return after tax is lower than 6% and less than 2% more than 10 years government bonds; debt coverage is only slightly above 1.

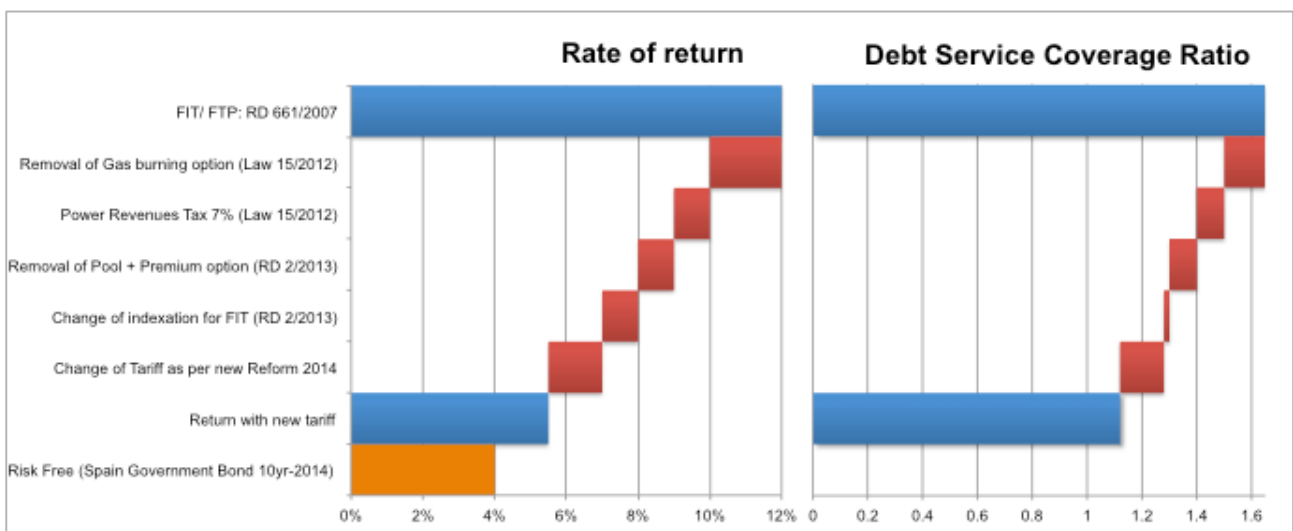
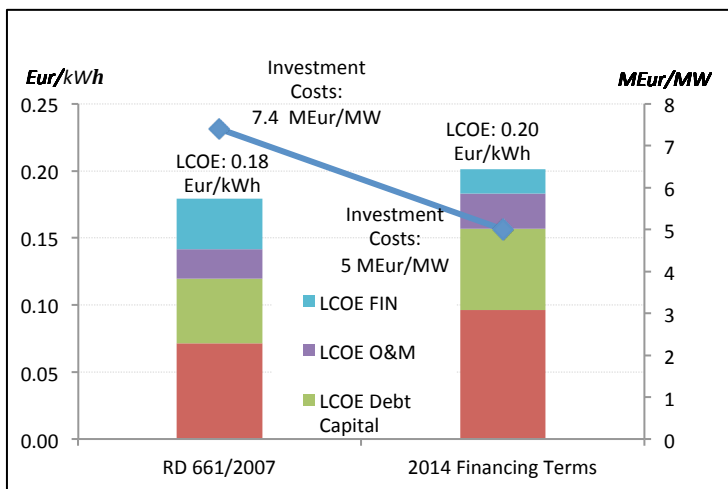


Figure 5: Effect of policy changes on plants' rate of returns and debt coverage – Source: Author

5. Prospective policy risk: CSP costs' projections for Spain

No new plants have been announced in Spain since 2012 and those planned prior to 2010 that did not qualify for the 2009 register have been put on hold or abandoned. Spanish policymakers changed policy to control CSP deployment to be within 500 MW CSP target for 2010 in Spain's Renewable Energy Plan (GoE, 2005). They now risk falling short of the 5GW target set for CSP for 2020 (GoE,

2010).⁹⁴ Given the lack of projects seeking financing and the lack of investors willing to commit resources to the Spanish renewable energy sector, it is difficult to estimate what financing terms a project developer could find in the market today and quantify the impact of the regulatory instability on projects cost. However, six investors interviewed suggest that risk aversion has significantly increased, leading to expectations (if a project is considered) of increased financing costs, shorter loan maturities (from 20 to 10 years) and much lower leverage available (e.g. debt/equity ratios reduced from 75/25 to 60/40). Even assuming significantly lower capital costs as indicated by the latest CSP installations in Morocco and India (see Chapter 3 for more details), current unfavorable financing terms would increase levelized production costs (as measured by LCOE in Figure 6) by increasing the weighted cost of capital (given the higher equity investment required) and frontloading a significant part of the capital expenses financed by debt to be repaid in half the time. This would ultimately require more than a 20% increase from the former RD 661/2007 tariff to bring the profitability of a Spanish 50 MW plant with storage in line with both the Spanish market and CSP investments in other countries (Table 2).



Reference CSP Plant	Equity IRR	Required Tariff Eur/kWh
Morocco (Noor 1 CSP)	13.6%	0.266 ^a
India (SunTechnique)	11.5%	0.178 ^a
Spain RD 661/2007	11.8%	0.270
Spain 2014 Financing	11.8%	0.334

^a To allow comparisons across CSP plants, concessional finance impact on Noor 1 has end SunTechnique has been removed.

Table 2: CSP International Comparisons – Source: Author

Figure 6: LCOE Comparison for CSP plants with Storage – Source: Author

While not advocating for an even more expensive - hence less sustainable - policy for the country, the analysis highlights that restoring investors' confidence and mitigating their perception of policy risk needs to be a higher priority for policymakers than setting a new feed-in tariff or a new level of

⁹⁴ However, current installation plans for RES do not reflect the significant overcapacity of the Spanish market with a cumulative generation capacity of 108GW and peak demand at 40GW in 2013 (REE, 2013).

subsidy. Current high financing costs due to an increased perception of risk would make it impossible for the government to reduce the value of the incentive scheme (compared to the 2007 feed-in tariff) if 2020 renewable energy targets are to be met with almost 2 GW of CSP capacity yet to be commissioned.

6. Conclusions

Spanish CSP policy history is a tale of extremes and provides valuable lessons on what to look for and what to avoid when designing effective support policies for expensive renewable technologies. In particular, it shows the impact of retroactive policy changes on both private investor's expected returns and market confidence, with the latter translating in increased costs for all future projects. The 2007 incentive framework anchored on a feed-in tariff/premium system was very effective in prompting installation of CSP plants and the development of a Spanish CSP industry that prevailed not only in the domestic market but also in foreign projects. However, the lack of policy control over the volume of deployed capacity led to the announcement of a greater number of projects and a much more expensive support program than initially planned. To fight excessive installations and costs to the public, the government approved several retroactive changes that, aiming to reduce the amount of support CSP investments were receiving, directly hurt the financial performance of operating plants and brought the domestic market to a complete standstill. Retroactive policy changes have now translated into prospective policy risk and significantly increased risk aversion and financing costs for this technology in the country – and it cannot be excluded that such risk aversion has spilled over to other sectors whose economics highly depend from government support or regulation. If investors' confidence is not restored and risk perception mitigated, any new eventual investment would need more public support than before, even assuming a significant reduction in technology costs. Policy uncertainty has ultimately made Spain much less attractive for CSP than many other developed and emerging countries, despite the significant national expertise of Spanish CSP companies: looking forward, establishing a transparent and stable support framework that can combat this policy uncertainty should be a higher priority in Spain even over setting a different level for the support or a new feed-in tariff.

Several other lessons also emerge from the Spanish example for other countries looking to support renewable energy technologies still far from grid parity:

- Support policies need to foster competition and cost reduction, while also systematically and transparently reducing subsidy levels as technology costs decrease;
- Policymakers need to be able to control the amount of support that public budget or rate payers are liable to pay as a result of the capacity installed, plan these liabilities in advance and avoid late and retroactive cut-backs;
- Policymakers need to avoid retroactive policy changes that significantly damage existing project's financial profile and increase investors' overall risk aversion, as this translates into increased costs for all projects yet to be financed.

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ANNEX: Policies and Regulatory Acts from 1997 to 2014

Year	Status	Regulation Code	Title	Description
1997	In force	General Electricity Law 54/1997	On the Electric Power Sector	Establishes the principles of a new operating model, in regards the production of electricity based on free competition. The Act settle up, among others, objectives such improving energy efficiency, reducing consumption and environmental protection. It could be considered as the first step in the general framework supporting RES-E in Spain
1998	Superseded by Special Regime for the production of electricity from RES (Royal Decree 436/2004)	Royal Decree 2818/1998	On the generation of electric power by plant fuelled by renewable energy resources or sources, waste and co-generation is passed.	Development of regulations of the special system
2004	Superseded	Royal Decree 436/2004	On the methodology for updating and systematization of the legal and economic framework of the activity of electricity production in the special regime.	Methods for a special legal and economic system (premiums are established according to percentages based on the electricity market averages).This special regime is applicable to electricity produced from renewable energy sources.
2007	In Force Last modification: 1st February, 2013, by Royal Decree-Law 2/2013	Royal Decree 661/2007	On the methodology for updating and systematization of the legal and economic framework of the activity of electricity production in the special regime.	Feed-in tariffs for electricity from renewable energy sources (Special regime). Establishing new tariffs and premiums for each kind of facility covered and incorporating renewable energy, waste to energy, hybrid systems and cogeneration plants into the special regime. The cost of the regime is borne by the grid operator, who can pass on costs to consumers. The grid operators' costs are balanced monthly, and where there is a deficit, this is covered by the National Energy Committee (CNE). The new scheme generally applies to all technologies, with technology-specific and capacity-specific limits, as well as a combined feed-in tariff and feed-in premium scheme
2009	In force	Royal Decree-law 6/2009	On certain urgent measures taken to ensure the financial stability of Spain's electrical system: Modification of the special regime	A pre-allocation register is created. Projects are required to be pre-registered (regulations of entry and increasing energy power ceilings are created due to the large number of applications)

2010	In force	Royal Decree 1614/2010	New regulation on electrical energy from wind and thermal electric technologies	Limitation of the hours equivalent to the right to premiums. Once achieved the limit, the exceeded hours will not be financed by the FiT's
2012	In force	Royal Decree-law 1/2012	On tax policy aimed at energy sustainability	Revocation of public financial support for new electricity plants from renewable energy sources, waste or CHP
2012	In force	Law 15/2012 of 27 December	On tax policy aimed at energy sustainability	7% tax and withdrawal of premium of the part which is proportional to the natural gas used at the plants
2013	In force	Royal Decree-law 2/2013	On urgent measures in the electricity system and in the financial industry	Replacing the current system for remunerating regulated activities linked to the Consumer Price Index with a system linked to the Consumer Prices Index at constant tax rates. This legislation also amends the options available to sell energy produced by CHP/renewable energy facilities.

Chapter 3: De-risking Concentrated Solar Power Investments: the role of policy and international public finance⁹⁵

1. Introduction	87
2. Methodology and data: The case study approach.....	89
3. The CSP financial landscape: installations, costs and financing models.....	91
3.1. CSP Installations: geographical and technological distribution.....	91
Box: Overview of CSP technologies.....	94
3.2. Financing, risk mitigation, and public support.....	93
4. The CSP case studies: Results and discussion	98
4.1. The 160 MW Noor 1 CSP project, Morocco.....	98
4.2. The 100MW Rajasthan Sun Technique CSP project, India.....	104
4.3. Measuring the impact of policy support frameworks on the required tariff.....	110
5. Conclusions.....	112
References	114

⁹⁵ This chapter draws its content from the research performed for the paper:

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Frisari, G., Falconer, A., 2013. *San Giorgio Group Case Study: Ouarzazate I CSP. Update*. June 2013. Venice: Climate Policy Initiative.

Stadelmann, M., Frisari G., Boyd R., Faes, J. 2014. *The Role of Public Finance in CSP: Background and Approach to Measure its Effectiveness*. January 2014. Venice: Climate Policy Initiative.

Stadelmann, M., Frisari, G., Konda, C., 2014. *The Role of Public Finance in CSP: Case Study Rajasthan Sun Technique, India*. March 2014. Venice: Climate Policy Initiative.

1. Introduction

Concentrated solar power (CSP) is a promising energy technology for low-carbon energy systems, as in combination with thermal storage it can store solar energy in the form of heat and can therefore deliver clean power as peak or base load, while increasing energy security and grid stability, especially in contexts of high penetration from renewable energy sources (IEA, 2010, 2014; Jorgenson et al., 2014). CSP has particular potential in some emerging markets that are planning to use their high solar irradiation for power production: in a carbon-constrained energy scenario, CSP is expected to supply approximately 11% of global electricity by 2050, with more than 65% of CSP capacity installed in countries such as Africa, China, India, and MENA (IEA, 2014). China is currently planning its first CSP plants (BNEF 2014), India plans to deploy 20 GW of solar power until 2020 (MNRE, 2013), South Africa has set up ambitious plans for deploying 30GW of renewable energy until 2030, including 3.3 GW of CSP (DoE, 2013), and several countries in the Middle East and Northern Africa (MENA) have plans to deploy CSP, e.g. Morocco is advancing towards 2 GW of CSP before 2020 (Norton Rose, 2010), and Saudi Arabia announced a target of 20GW of CSP by 2030 (KACARE, 2013).

Massetti and Ricci (2013) model that up to 2500 GW of CSP could be installed in China and 1500 GW of CSP in the MENA region by 2100, requiring around USD 250 billion of annual investment in CSP in the latter region. In case of stringent climate policies, the MENA region may even export CSP electricity to Europe (Bauer et al., 2008), up to 750-800 GW⁹⁶ by 2100 (Massetti and Ricci, 2013).

The high cost of CSP - the financial viability gap - is the main barrier to rapid deployment. The difference between the cost of generating power from CSP plants (around 0.2-0.3 USD/kWh, see IRENA, 2013) and the revenues that project developers can make in the electricity market is substantial, resulting in 98% of the investments in CSP so far needing some form of public support in both developed and developing countries (Stadelmann et al., 2014a). A larger amount of installations is expected to reduce costs: 5-15 GW of new CSP capacity in addition to the existing 3GW may enable enough economies of scale and learning to bring CSP costs down to a level where the technology can

⁹⁶ 750-800 GW is the capacity corresponding to 3000-3200 TWh of CSP power exported to Europe per year.

compete in some markets (Stadelmann et al., 2014c).⁹⁷ Currently, each GW installed demands up to USD 10 billion of investment (IRENA, 2013); however these costs are projected to fall below 2 billion/GW from 2050 on (Masseti and Ricci, 2013). Higher investment costs should be compared with higher value for the grid given the potential for CSP power to meet energy demand when it's most needed (e.g. in peak load times) and in a more reliable way compared to intermittent renewable energy sources such as wind and solar photovoltaic (PV). Although these evaluations require granular data of each regional power system in which CSP power is installed, available measurements in literature suggest that CSP added value, measured as *operational value* (the value of avoided cost due to conventional generation with fossil fuels) and *capacity value* (the value of avoided new capacity built to meet current demand), can be significantly higher than solar PV (given an equal solar resource available) and increases when renewable energy penetration is higher (Jorgenson et al. 2014). For policymakers drafting support measures for CSP, most of this added value is due to the storage component.

In emerging and developing economies, investors face acute technology, regulatory and financing barriers (Stadelmann et al., 2014c). The limited experience with CSP in many of these countries increases technology risks, including the risk of solar resources being lower than predicted. In emerging and developing economies, regulatory risks are also high, increasing financing costs: Komendantova et al. (2011, 2012) identified regulatory and political as main risks of solar power investment in North Africa. Finally, CSP projects face additional financing risks in these countries as financial markets are often not fully developed or well suited for project financing, offering high interest rates and short maturities on debt (Nelson et al., 2012, Stadelmann et al., 2014b). Despite this literature on risk perception and investment challenges, little has been written about the nature of de-risking tools for CSP investment and the impact they could have on the cost of CSP power, by reducing investors' required returns and lenders' interest charges. Komendantova et al. (2011) suggest that policies can mitigate these risks, thereby reducing required rate of returns on investment and saving up to an estimated USD 200 billion of subsidies in the North Africa region. Trieb et al. (2011) suggests

⁹⁷ As comparison, already 90 GW solar photovoltaic and 270 GW wind power plants are on the grid (Stadelmann et al, 2014a).

long-term power purchase agreements (PPA) based on peak power prices as way to reduce risks and bring CSP closer to the market.

International financial institutions (IFIs) have emerged as key public players to enable CSP in emerging economies: they invested more than 2 USD billions of low-cost and long-term loans in CSP plants in Chile, India, Morocco and South Africa (Boyd *et al.* 2014, Falconer and Frisari, 2012, Stadelmann *et al.* 2014b); and their low-cost and long-term loans have proven their potential to substantially reduce the required subsidies for renewable energies (Nelson and Shrimali, 2014; Shrimali *et al.* 2014). However, the literature has not yet answered the following two questions: (1) how effective are IFIs in reducing risks and costs of CSP in emerging economies? And (2) How can these IFIs' efforts be combined with national policies to enable effective deployment of CSP and relieve developing countries' budgets from some of the financial burden?

This paper addresses this literature gap by analyzing the overall financing landscape of the CSP market and then the project context (energy market, policies, stakeholders), financial structuring and risk profiles of two CSP plants in India and Morocco where IFI provided the lion's share of finance. The impact of IFI and policy risk mitigation on the electricity production costs of these plants and the mobilization of private investments⁹⁸ is estimated through project finance models based on discounted cash flow analysis, and a stakeholder-centered approach for valuing risk mitigation, as described in Section 3 of the Introduction. Section 2 describes the data supporting the empirical analysis and presents key elements of the methodological approach. Section 3 offers an overview on the financial landscape for CSP, mapping installations, support policies and financing models; Section 4 discusses the main results from the two CSP plants analyzed and Section 5 concludes.

2. Methodology and data: The case study approach

The research on the CSP financing and policy landscape has been performed on a database provided by Bloomberg New Energy Finance (BNEF) filtered to comprise only those "utility-scale"⁹⁹ CSP

⁹⁸ Private sources will be crucial for providing the vast amount of capital needed for future CSP plants (Komendetova *et al.* 2012, Stadelmann *et al.* 2014b). Currently up to USD 10 billion of investment are needed per GW (IRENA 2013), but these costs are projected to fall below 2 billion/GW from 2050 on, see Massetti and Ricci (2013).

⁹⁹ Utility-scale is here defined as a plant capacity larger than 50 MW. Given the substantial economies of scale possible with CSP, the financial and cost dynamics of large and small plants can be very different, hence not comparable.

installations that had achieved financial closure at the end of 2013. The financial structure of each project in the database has been analysed with a particular reference to the project business model, the providers of financial resources and the national policy framework in which the projects have been developed.

The project's specific research is instead carried out through a systematic case study approach performed on two large-scale CSP projects: the 100 MW Noor 1¹⁰⁰ project in Morocco, and the 100 MW SunTechnique project in India, both involving national and international public actors that have enabled private investments. Both these projects can offer interesting insights in shaping support policies for a still immature technology like CSP in developing markets with significant solar resources and the need for a more stable and dispatchable clean energy source. The case of Noor 1 in Morocco provides a testing ground for a public-private partnership (PPP) model applied to a renewable technology with a significant viability gap and upfront investment needs that neither the domestic financial sector nor foreign private investors can manage. The project in India instead shows a more proactive role of the private sector in developing and managing CSP projects, however still leaving to public policymakers and public financial institutions the crucial role of mitigating market and revenues risks and of overcoming specific limitations of the domestic private financial sector. Finally, both case studies can provide interesting evidence on the amount of cost reduction achievable for CSP energy when projects are allocated through competitive auctions and tenders.

When publicly available, the analysis relies on the actual project's documentation and financial data, complemented with information provided directly through interviews with 7 private (developers, lenders) and 12 public (government officials and IFIs officers) project stakeholders and industry representatives (producers, consultants, trade associations).¹⁰¹ In alternative, the available literature is used to provide benchmark and reference values (e.g. Attijari, 2011; BNEF, 2014; IndiaStat, 2013; IRENA, 2013; Kulichenko and Wirth, 2011).

¹⁰⁰ The Noor 1 project was formerly known as the Ouarzazate I CSP and indicated as such in most of the literature referenced in this work.

¹⁰¹ In the case of the Noor 1 CSP case study, interviews were performed with: 3 private sector representatives (AcwaPower, Archimede Solar Energy and Enel Green Power), 4 representatives from public lenders (African Development Bank, KfW and World Bank) and 2 representatives from the national solar energy agency (MASEN). In case of the Indian case study, 4 private sector representatives from Reliance Power, 5 representatives from international financial institutions (ADB, FMO, US Exim) as well one representative of the Ministry of New and Renewable Energy.

As described in the Introduction- Section 3, the analytical approach is anchored around three different dimensions: the analysis of contracts and institutional relationships; financial modelling and cash flows estimations; risk assessment and risk mitigation. **Contractual analysis** aims to establish the role of each institution, its contractual liabilities and the key relationships in each transaction; in this context, such analysis is instrumental in identifying the key elements of the policy framework underpinning each project, and in providing the initial structure of each project risk maps. **Financial modelling** is used to simulate project's financial transactions (Table 1 in Introduction, page 12) and estimate the levelized cost of producing electricity (LCOE) and the remuneration perceived by project sponsors (Equity rate of return). Such detailed cash flow model allows a quantitative assessment of the impact of both national policies and public finance interventions on the production cost of the project (Equation 3, page 13), on private investors' remuneration (Equation 2, page 13) and, ultimately, from the public perspective, on the required public financial support on one side, and their cost for public budgets on the other (Equation 4, page 13).

Finally, in the **risk assessment** analysis, the risk mitigation strategies put in place by public actors that unlock private resources are analysed with the resulting risk allocation between private and public actors to determine whether risks have been placed with the entity best suited to carry them and whether the overall risk in the project has been ultimately reduced.

3. The CSP financial landscape: installations, costs and financing models

3.1. CSP Installations: geographical and technological distribution

In terms of current installations, after the first modern CSP plants were built in the United States in the mid-80s, almost no new facilities were developed around the world for over two decades. This situation has changed in the past five years, with several large-scale CSP installations securing finance. Indeed, following almost 20 years of standstill, CSP power installations have picked up significantly in the last five years, mainly in Spain and the United States, and mostly using parabolic trough technology. In the years since 2008, overall CSP installed capacity has increased five times to 2.5 GW (Figure 1a).

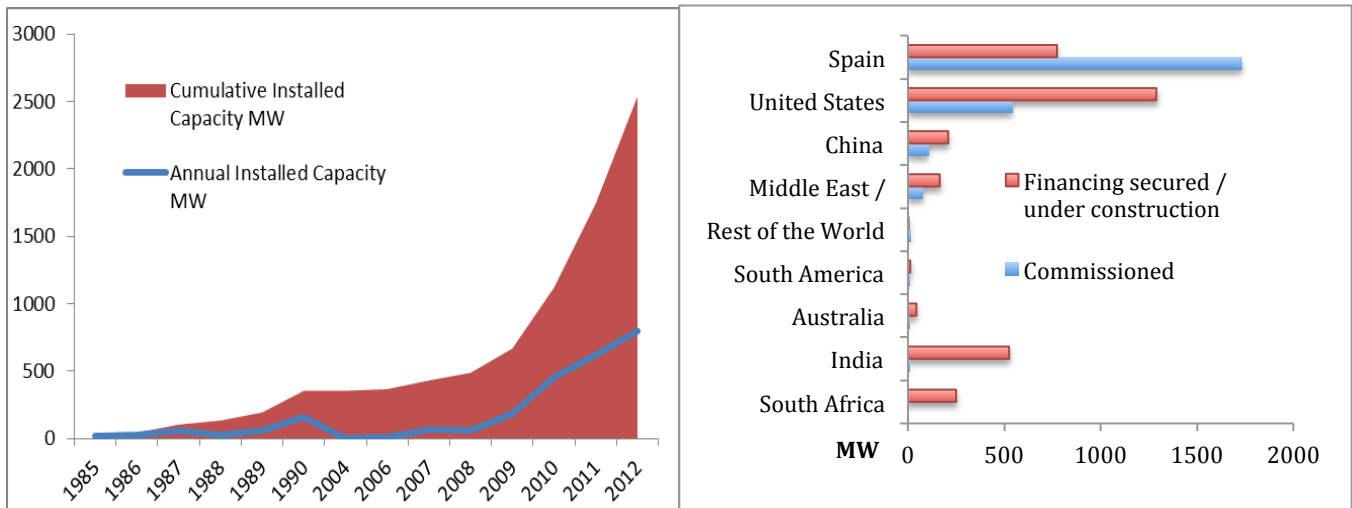


Figure 1a-b: Installed Capacity by Year and by Country in MW – Source: Author’s elaboration on BNEF (2014)

Spain is currently the industry leader with 70% of global installed generation capacity, followed by the U.S. with about 21%. Coming years will also see significant investment in CSP in emerging economies as approximately 1 GW in capacity is currently under construction in India, South Africa, and the Middle East and North Africa (MENA) (Figure 1b). This shift of focus towards emerging markets is a result of these countries’ desire to exploit fully their solar thermal resources, to diversify their energy generation portfolio away from fossil fuels, to increase their energy security, and to foster the development of a local industry. Looking forward at plants already announced and soon to be commissioned, the future CSP landscape appears already quite diverse also from a technological terms. There are four types of concentrating solar thermal technologies currently available for commercial use: parabolic trough, dish Stirling, linear Fresnel, and power tower (see Box 1 for more details). Each of these technologies concentrate solar thermal energy by reflecting the sun’s rays using mirrors, but differ in how they capture the solar resource, and in the ways they convey this energy to a turbine to generate power. These technical differences have significant impacts on cost, achievable electrical efficiency,¹⁰² and water needs; and given the different level of development of each technology, this has significant consequences on investors’ risk perception. Of the four technologies, parabolic trough is currently the most widely deployed, and until 2008, was practically the only technology used in CSP plants. At the end of 2012, parabolic trough technology represented 90% of

¹⁰² Electric power plant efficiency is typically defined as the ratio between the useful electricity output from the generating unit, in a specific time, and the energy value of the energy source supplied to the unit in the same time period.

the total installed capacity with about 2.3 GW. The remainder was made up of dish Stirling (5%), power tower (4%) and linear Fresnel (2%). Interestingly, the coming years will see large changes in the portfolio of CSP technologies, as project developers and investors aim to exploit the potential for CSP to store power and dispatch it with high flexibility: power towers account for 26% of the projects under construction, and almost 42% of those in planning phases (Figure 2).

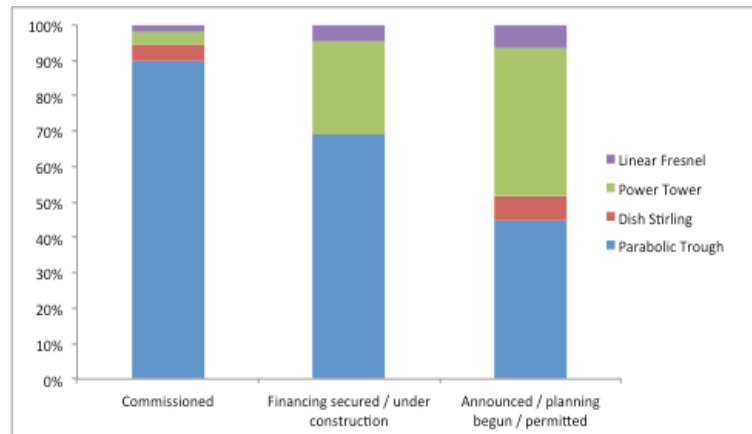


Figure 2: Installed & Expected Capacity by technology – Source: Author’s elaboration on BNEF (2014)

3.2 Financing, risk mitigation, and public support

In order to map the source of the financing and the bearer of the investment risks, projects have been classified according to the public or private nature of the equity and debt capital that supports them, identifying three equity financing models and four debt financing ones (Table 1).

Table 1: Equity and Debt financing models used in CSP projects, 2005-2013 – Source: Author

Equity Financing Models	<p>Private Producer model: private investors provide risk capital for the construction of the project, operate the asset, and take the venture’s business risk.</p> <p>Public-Private-Partnerships (PPP): blending private and public equity capital for project’s construction and operation; various forms of PPP are possible that allocate business and operation risks between the public and the private actors differently.</p> <p>Public Procurement: the public sector commissions a private actor to build the project, but it retains ownership and the right to operate it. The private actor provides services (construction, operations and management) but doesn’t share any development or operational risk (Burger, Hawkesworth, 2008).</p>
Debt Financing Models	<p>Private Debt: capital typically provided by debt investors (through bonds issued by the project company), or banks (through loans from their project finance desk), similar to common-place investments in conventional power infrastructures.</p> <p>Private Debt with Public Support: capital from private sources (again either loans or bonds) but with a portion of the financial risks transferred to public entities through credit guarantees or revenue support tools (e.g. feed-in-tariffs or tax credits).</p> <p>Private-Public Blended: the investment capital is provided by both private and public investors (either at concessional or market-based terms). The public sector investors not only provide a risk mitigation service, but also fill a capital shortage in the market.</p> <p>Public Investment: the full amount of investment capital is provided (either at concessional or commercial terms) by the public sector (state-owned utilities, state-owned banks, development banks, public investment funds).</p>

Evidence from the projects’ data shows that, while the private sector has so far been the main provider of both equity and debt capital, strikingly, **99% of the investments in CSP have required some form**

of public support; this has taken the form of revenue support for 64% of projects, public guarantees for 19% and direct participation to the project's capital structure for 16% of the total (Figure 3).

Box: Overview of CSP technologies

All CSP technologies use mirrors and lenses to concentrate the sun's thermal power to heat a heat transfer fluid (HTF) and generate steam. The conversion of this steam into power then occurs through the same steam turbines you would find in any fossil-fuel or nuclear powered plant. CSP technologies differ mainly in the ways in which the sun's energy is concentrated. They can be grouped in:

Line-focusing systems: parabolic trough and linear Fresnel. Both systems track the sun along one dimension only and focus it onto a horizontal line. Parabolic trough uses a very accurate and efficient curved mirror. Linear Fresnel technology uses flat mirrors that concentrate the sun's heat on a receiver placed above the collectors. Their optical efficiency is much lower than parabolic troughs but the simplicity of the mirrors' manufacture and installation and a lighter support structure (concrete and steel), has a significant impact on the overall costs of the plants and makes it easier to develop a local supply chain in emerging economies (IRENA, 2012). While parabolic trough can use oils or molten salts as the HTF and has been already combined with thermal storage, linear Fresnel has instead been developed so far with water/steam. This means storage would then require a further conversion to a different HTF, adding to costs and efficiency losses.

Point-focusing systems: power tower and dish-Stirling. They employ a double-axis tracking system that concentrates the sun's energy onto a single point, allowing much higher operating temperatures, and therefore higher operational efficiency levels. In the power tower, the focal point is on a tower at the center of a field of ground-mounted flat mirrors. In the dish Stirling, the heat is concentrated at the focal point of the parabolic dish, where a Stirling engine converts heat into power. For the power tower in particular, the higher temperatures make thermal storage more effective, allowing a more flexible generation strategy and the maximization of the value of the power sold (IRENA, 2012).

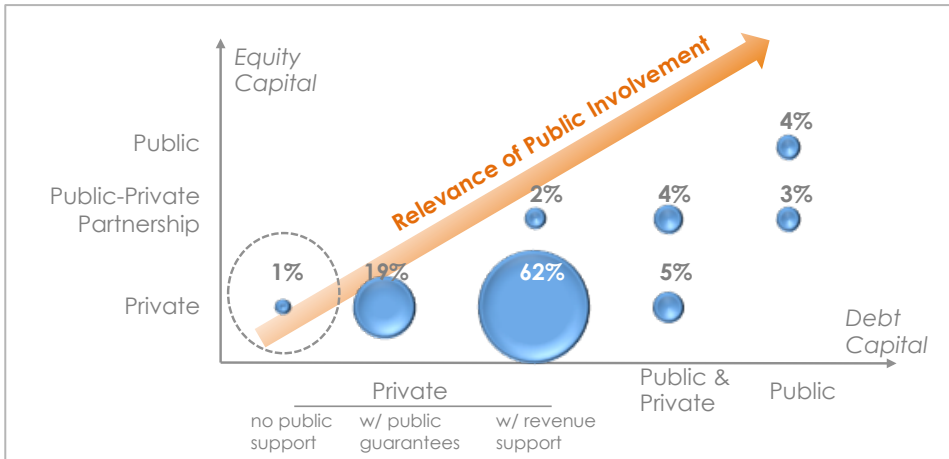


Figure 3: Equity and Debt Capital for CSP financing - Source: Author's elaborations on BNEF (2014)

Public finance mechanisms to support CSP investments

Public finance mechanisms used for CSP installations can be characterized as revenue support policies, which aim to increase the value or the stability of the project's revenues; tools that reduce the financing costs of the investments by either agreeing to absorb potential losses (guarantees), providing finance at concessional terms (concessional loans and grants); and fiscal support policies that reduce taxes to increase net revenues, reduce upfront investments or operating costs.

Revenue Support Policies typically take the form of an above-market-rate revenue stream provided by the public sector, directly or via a levy on electricity sales. When properly managed, they can ensure the financial viability of projects, while at the same time mitigating revenue risks by providing certainty of power dispatchment at pre-agreed prices. These subsidized revenues can be awarded via different delivery mechanisms, including:

- *Feed-in-tariffs* that guarantee a level of revenue per amount of CSP electricity fed into the grid (eg. the case of the projects in Spain);
- *Competitive tenders*: a bidding process to build and run a CSP plant of a specific size at the electricity price fixed in the power purchase agreement between the winning bidder and the power distributor (as used in the projects in MENA);
- *Reverse auctioning* is a hybrid between feed-in-tariff and competitive tenders. The reverse auctioning of the final tariffs obliges project developers to compete up to a fixed tariff ceiling

for the right to provide electricity to utilities (the Indian National Solar Mission and the REIPPP support policy in South Africa).

Tools to reduce the financing costs¹⁰³ are forms of public support that aim to reduce the costs of capital for the private sector, via transfer of certain investment risks, provision of concessional finance, or improvements of financial markets' functioning:

- *Public guarantees* from the public sector in the form of full or partial debt repayment to investors (e.g. the U.S. Department of Energy Loan Guarantee Program) or in the form of insurance to equity investors (e.g. the *Multilateral Investment Guarantee Agency's* (MIGA) political risk insurance).
- *Public investment* (concessional loans, grants): subsidized equity and/or subsidized debt provided by public entities, typically necessary when the returns from the investment are not enough to compensate the risks perceived by private investors (international public investment in Morocco, national public investment in the U.S.).

Fiscal support policies: represent changes in fiscal regulation to increase net revenues, or reduce the upfront investments or operating costs of renewable energy investments.

- *Investment tax credits*:¹⁰⁴ tax credit for the investor equal to a specific percentage of the investment in CSP (U.S.). Its impact may be limited to the extent that the applicant has enough revenues to benefit from tax credits.
- *Bonus depreciation*: higher depreciation of asset's value which, in the case of U.S., allowed project developers to expense 50% of the project capital costs for tax purposes in the first year of operations.

The different types of public support offered reflect different context-specific barriers to investment from the private sector. Direct injections of public capital (investment grants, concessional loans) are more relevant in markets where capital is constrained or perceived risks are so high that investors demand a return that makes capital "economically" unavailable. Revenue support policies (e.g. feed-in-

¹⁰³ It is important to note that whenever these tools simply transfer part of the costs from the private to the public actor, they reduce the cost "seen" by the private investor, but not a project's "economic" cost.

¹⁰⁴ Further tax credits: reduced or alleviated taxes when investing in CSP and producing CSP electricity, including 1) Sales tax credit (U.S.), 2) Property tax credits (U.S.), 3) Tax credits for manufacturing plants (U.S.), and 4) Tax credit bonds (Clean RE Bond, U.S.): "tax credit bond, in which interest on the bonds is paid in the form of federal tax credits by the United States government in lieu of interest paid by the issuer", actually only around 20% of USD 2.4 bn possible bonds have been used, see Kidney (2012).

tariffs) or credit-enhancement tools (e.g. public guarantees) are best used to address uncertainties arising because of a technology’s lack of track record and innovative nature. Finally, public-private partnerships (PPPs) have the potential to align the interest of the public actor as service commissioner and the private investor as service provider (OECD, 2008), so PPPs seem particularly effective in contexts where regulatory risks are perceived as high (Frisari and Falconer, 2013). Public finance mechanisms can also significant impacts on technology costs’ evolution and the overall rate of deployment of CSP.

Figure 4 below charts the levelized investment costs (the project capital investment divided by the expected power produced over the plant’s estimated lifecycle) for the projects grouped by country (hence policy support system) and technology.

Feed-in tariff have had so far the greatest effect on technology deployment but their impact on cost reduction has been negligible as in the specific case of the Spanish policy, there was no systematic adjustment with cost reductions and no competitive mechanisms to induce cost reduction (Chapter 2 and Frisari and Feas, 2014). Data suggest that auctions and tenders, on the contrary, have performed better on reducing costs of CSP projects, but their impact on technology deployment has been more limited. The case studies in the next section and a comparative analysis on the component of the CSP tariff in the two projects considered aim to shed some light on how these policies improve the financial profile of CSP investments to ensure deployment while trying to reduce its cost to make the public support more sustainable over time.

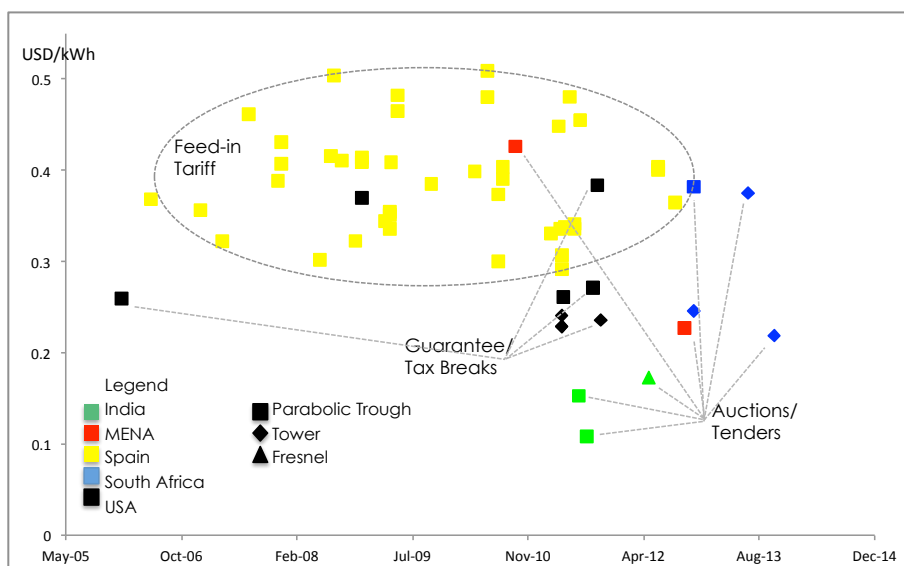


Figure 4: CSP levelized investment costs since 2005. Source: Author’s elaboration on BNEF (2014)

4. The CSP case studies: Results and discussion

This section presents the results from the case study analysis of two large scale CSP projects: the 160MW Noor 1 project in the town of Ouarzazate, Morocco (Section 4.1); and the 100MW SunTechnique project in the state of Rajasthan, India (Section 4.2). The analysis is presented in a three-parts structure: the policy and stakeholders context, the project financial metrics and the risk allocation framework. Finally, in Section 4.3, a comparative analysis attempts to quantify in a common framework the impact of both policy and financial de-risking tools on the cost of each plant.

4.1. The 160 MW Noor 1 CSP project, Morocco

The Noor 1 CSP project is part of two public policies programs: the *Moroccan Solar Plan* launched in 2010 by the Government of Morocco and the *Investment Plan for Concentrated Solar Power in the MENA region* launched in 2009 by the Clean Technology Fund (CIF, 2009). While mostly driven by public actors, the project also features private project developers in partnership with a local governmental agency, hence allowing interesting considerations on risk sharing between public and private stakeholders.

The context: the Moroccan Solar Plan and project's stakeholders

To address the twin challenges of improving energy security and promoting sustainable development, the Government of Morocco announced a new energy strategy in 2010¹⁰⁵, established the Moroccan Agency for Solar Energy (MASEN) and tasked it with the execution of the Moroccan Solar Plan, an ambitious investment plan aimed to install 2000MW of solar power capacity by 2020. The plan's pilot project is a 500MW solar facility in Ouarzazate, with the construction in its first phase of the Noor 1 160MW CSP plant with 3 hours of thermal storage to be completed by 2015 (Falconer and Frisari 2012).

Noor 1 CSP has been designed as a public-private partnership between MASEN and a private sponsor that was selected with a competitive two-stage auction in which interested parties would first qualify

¹⁰⁵ With the 13-09 Renewable Energy Law, the government established a set of overarching goals for the energy sector to: reduce reliance on oil to 40 percent of energy consumption by 2030; increase energy efficiency, inducing energy savings of 15 percent by 2020 and 25 percent by 2030; and increase renewable power generating capacity to 42 percent of installed power generating capacity by 2020, through the commissioning of an additional 6000 MW of wind, solar and hydro (Falconer and Frisari, 2012).

for eligibility on a set of technological and financial criteria; then they would competitively bid for the price of the energy produced by the plant. The winning bidder would enter into an equity agreement with MASEN to establish a special-purpose vehicle that manages the project, owns the assets and sells the renewable power. MASEN would retain 25% ownership of this company and, at the same time, purchase all solar power produced through a 25 years power purchase agreement (PPA) set at the price bid in the auction (Falconer and Frisari, 2012). The PPA specifies two different prices (for base and peak load) to better remunerate the power that the plant will dispatch during peak hours in terms of electricity demand (from 6pm to 9pm on average) thanks to its 3 hours thermal storage facility (WB, 2011). As this CSP price is significantly higher than the one MASEN can fetch from selling the power to the national grid company; the Government of Morocco is called to provide funding to MASEN to guarantee its financial equilibrium and ensure it doesn't default on its liability as power off-taker (WB, 2011). Table 2 summarizes the key features of the Moroccan Solar Plan program for CSP based on official documentation (MEM, 2010; Norton Rose, 2010) and interviews with MASEN and representatives of the World Bank.

Concessional loans and grants play also a significant role on the financing of the project, which has been approved within the *Investment Plan for Concentrated Solar Power in the MENA* region issued by the Climate Investment Funds (CIFs) for the Clean Technology Fund (CTF). This 750 USD million-investment program was aimed to support the effort of five countries¹⁰⁶ in the MENA region to exploit their solar potential with an overall program's target capacity of 1GW of CSP installed and a strategy to export solar power into the European grid (CIF 2009; 2010). The plan is designed to provide significant capital with high level of concessionality to reduce the investment needs of large-scale CSP plants and leverage other capital contributions from both public and private sources. Together, the CTF and six international financial institutions have pledged over USD 1 billion in concessional loans to support construction costs in Noor 1 CSP and a further USD 200 million loan, which provides the Government of Morocco with a safety net should it be unable to provide the viability gap funding to MASEN (Falconer and Frisari 2012).

¹⁰⁶ The investment program has lately been reduced to four countries and a total of USD 660 million in public financing (CIF 2013).

Table 2: Key features of CSP policies under the Moroccan Solar Plan – Source: Author

Feature	Objective
Two-stage competitive bidding	To procure solar power in a cost-effective manner and ensure reliability of the power, MASEN has issued a two-stage competitive bidding with first a check on technical and financial eligibility of bidders, and then an auction on project costs.
Long-term PPA and guaranteed off-take	To provide long-term revenue certainty to the solar power developer, MASEN enters in a get a 25-year PPA set at the price prevailing from the bidding. The contract obliges MASEN to guarantee the purchase the agreed amount of solar power from the project.
Private-Public Partnership	The PPP model allows the government to share costs and risks with international and private financiers and project developers, with the potential of keeping interests aligned. Performance guarantees issued by the private developer completely shield the domestic public actors from construction and technical risks.
Guarantees for Viability Gap Funding	To mitigate the off-taker default risk, the Government of Morocco has provided MASEN with a guarantee to ensure its financial viability. International financial institutions have awarded the government a credit facility to be used to cover MASEN financial obligations.

Project Financial Metrics

Table 3 below reports the main results of the project’s financial model and compares them with the projections before the bidding to highlight the impact of the policy design on the costs, the investment needs and the public subsidy.

The key drivers behind the reduction of CSP costs below projections¹⁰⁷ are: higher power generation expected due to a better optimization of the plant allowing for a lower unit cost of the power produced; lower investment costs reduced from around 6000 USD/kW to 5300 USD/kW; and a rate of return much lower than benchmark values for the country ¹⁰⁸ due to a combination of a lower perception of risks allowed by the partnership with the government and a first-mover strategy by the developer (Frisari and Falconer, 2013).

The results of the bidding have actually placed Noor 1 as one of the least expensive large scale¹⁰⁹ CSP plants with storage to be financed in the past few years: the capital cost of 5,300 USD/kW compares with the average of 10,200 USD/kW for all the projects with storage financed since 2006 (Frisari and Falconer 2013; Stadelmann et al. 2014).

¹⁰⁷ Differently from the calculations in section 4.3, these projections already included the positive impact of concessional finance on the overall costs.

¹⁰⁸ Current project IRR projections for energy production in Morocco are 10% for power generation under concessional schemes with the national utility (ONE); greater than 12% for independent producers selling the power on the market (Attijari 2011). Kulichenko and Wirth (2011) estimate at 15% the equity IRR for a CSP CSP project developer in Morocco.

¹⁰⁹ To allow comparison across projects, we define large-scale CSP CSP as plants with a capacity equal or greater than 50MW.

The **viability gap subsidy ensures the project is able to attract private investors**: at current Moroccan electricity prices (ONEE, 2014), the equity IRR without subsidies is estimated at around 5%, much lower than estimated profitability of comparable investments in the country's power sector (Attijari 2011), and certainly not sufficient to appeal to either domestic or international private investors.

Concessional financing from international financing institutions has had a significant impact on the project's affordability for the country: at commercial rate of financing,¹¹⁰ the prevailing tariff in the tender would have been around 265 USD/MWh (compared to 184 USD/MWh in the final bid), with financial expenditures accounting for more than 20% of the higher LCOE. At these higher costs, the project would have required an annual subsidy of more than 50 USD millions (compared to 20 USD millions) from the domestic budget.

Table 3: Noor 1 CSP financial metrics – Source: Author

Noor 1 CSP	Final Bid	Initial Projections ^a
Annual Energy Generated	425 GWh	370 GWh
PPA tariff (peak)^b	184 USD/MWh	243 USD/MWh
Annual Revenues	75 USD mln/yr	97 USD mln/yr
Solar Subsidy (Viability Gap Funding)	20.4 USD mln/yr	42.8 USD mln/yr
Investment Cost	850 USD million	1000 USD million
LCOE	185 USD/MWh	245.7 USD/MWh
- CAPEX	77%	76%
- OPEX	9%	10%
- FINEX	14%	14%
Project IRR (after tax)	6.7%	6.5%
Equity IRR (after tax)	13.6%	13%

MWh =Megawatt hours, GWh = Gigawatt hours, USD= US Dollar

^b PPA in this case indicates the (peak) tariff at which the solar company will sell its power to the off-taker. In Ouarzazate I this has been set so to approximately match the LCOE.

Finally, the project will also help to shift subsidies, and the overall Moroccan energy system, away from fossil fuels, while saving the national budget around 8.5 USD million/year. Using projections from the country's authority for electricity (Office National de l'Electricité (ONE) projections contained in WB, 2011), savings for the government amount approximately to USD 64

¹¹⁰ Kulichenko and Wirth (2011) consider probable terms for commercial loans for CSP in MENA a maximum maturity of 16 years (including 4 years of grace) and a blended rate of 9% per annum. These values compare to a blended financial package offered to MASEN with maturity of 21 years (including 4 years of grace) and a rate of 3.7% per annum.

million in subsidies over the lifetime of the project.¹¹¹ In the first few years of the project, this corresponds to approximately USD 8.5 million/year saved, compared to the Government of Morocco's total annual fossil-fuel subsidies cost of between USD 1 and 4.3 billion between 2009 and 2011 (WB, 2011). Most of the value of the fossil-fuel subsidy savings derives from the plant's storage technology, which allows it to displace (imported and expensive) oil-based generation used to fulfil peak demand.

Risk Allocation Framework

The risk allocation framework confirms the crucial role that public stakeholders have in the Noor 1 CSP as a large portion of the risks in all project phases are either transferred to or mitigated by national policymakers, and international financial institutions. Figure 5 shows the allocation of the different risks to both public and private stakeholders, the intensity of their perception and the tools used to transfer or mitigate risks.

In the project development phase, the **public-private partnership model shares the management of the project risks between the public** (Government and MASEN) **and the private stakeholders**, but more importantly, the position of equity partner for the national agency for solar energy mitigates the **perception of policy risk** for the private developer (personal communication with AcwaPower management, January 2013): any change or default of government's obligation would also cause the default of the agency as well.

International financial institutions crucially absorb almost entirely the financing risk as all investment capital has been pledged ahead of the tender and bidding process (WB, 2011). This pre-emptive financing directly reduces the project developer's risk of capital shortages during construction (capital expenditures risk), but also reduces the cost of capital and required rate of return. Importantly, at the same time, the explicit backing of multiple IFIs greatly improves investors' confidence on the government commitment to support the project over its life cycle.

The **construction and operation risk are borne by the private sector** - the plant developer and subcontractors – and contractually allocated by the engineering, procurement, and construction (EPC)

¹¹¹ Amounts of fossil fuel displaced have been estimated by the Office National de l'Electricité et de l'Eau Potable (ONEE) and valued at the following prices and quantities: Coal: 32,000 tons at 150 USD/ton; Natural Gas: 354,000 mbtu at 10 USD/mbtu; Fuel Oil: 67,000 tons at 450 USD/ton (WB, 2011). The estimate assumes that the Government of Morocco follows through on its subsidies phasing-out policy expected to completely remove any fuel subsidy by 2025 (WB, 2011).

and operations and management (O&M) agreements. This risk allocation is based on the assumptions that the private sector has the best information on their occurrence. Indeed, to protect MASEN from construction and operation risks, the PPA agreement grants the agency a put-option, that is, the right to sell back its shares to the developer at a pre-defined price in the event the private partner fails to deliver on its performance obligations (WB, 2011).

The project developer also bears the solar resource risk but MASEN has provided the bidders with a full year of on-site measurements of solar resource that greatly reduce the uncertainty around expected irradiation levels (WB, 2011).

The PPA between the project company and MASEN **shifts both electricity price and quantity risk (revenue risk) from the project developer to the public sector**. Given the difference in values between the prices at which MASEN buys and sells the power, this creates a substantial off-taker risk (credit risk) with MASEN that requires the support from the national budget in form of an explicit subsidy and guarantee (the viability gap funding). Furthermore, should any public budget difficulties arise (shortfall risk), a loan facility from the International Bank for Reconstruction and Development (IBRD) supports the Government of Morocco. Besides, given denomination of the tariff in the PPA in both euros and dollars,¹¹² **the national agency and, ultimately, the government take a significant currency risk (FX risk) out from the developer** (Saimi, 2011).

Finally, the presence and backing of international donors partially relieves local authorities of the project implementation burden, mitigating the risk of the project failing to meet higher-level objectives (outcome risk). However, the conditions placed on the loans and the IFI's right to object to all significant decisions increase MASEN's (and the Government of Morocco's) risk in managing the project.

¹¹² The details of the hard currency denomination have not been disclosed but they are supposed to mirror the financial liabilities on the loans that the project company needs to honor during the expected life of the project.

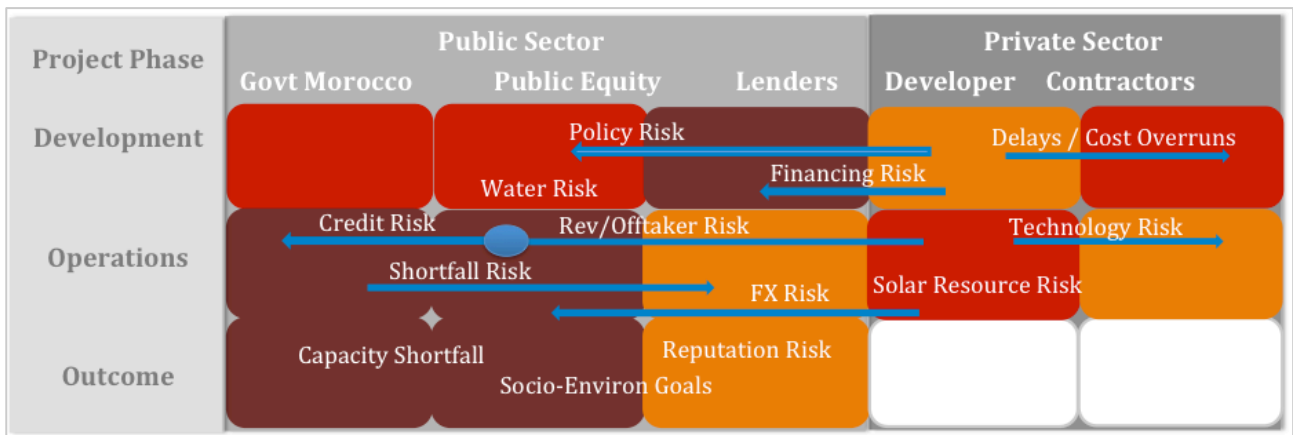


Figure 5: Risk allocation framework for the Noor 1 CSP Project – Source: Author

4.2. The 100MW Rajasthan Sun Technique CSP project, India

The 100MW Rajasthan Sun Technique project is highly interesting for the combination of local private resources in the form of equity investments, a countrywide CSP policy framework and the use of public debt investments at markets terms (differently from the previous case of Noor 1 CSP). The project is also interesting from a technological point of view as it is the largest installation of Linear Fresnel CSP technology worldwide and the first of its kind in the country.

The context: the Indian Solar Mission and the project's stakeholders

The Rajasthan Sun Technique project is one of the seven projects that were awarded the tender in 2010 in the first phase of the Indian National Solar Mission. The National Solar Mission (NSM) was announced by the government in 2010 with a target to install 20 GW of grid-connected solar power capacity (including rooftop) by 2022 (MNRE, 2013) with its primary objective being the creation of an enabling environment for the diffusion of solar power technology across the country as quickly as possible. The NSM not only aims to help the country meeting internationally pledged domestic actions on low-carbon development (MEF, 2010), it also helps to improve energy security and diversification for a country with limited fossil resources.¹¹³

The NSM aims to reach its full allocation in three phases, with the first one launched in 2010 with a target capacity of 2GW by 2013 and an allocation of 470MW awarded by a competitive tender to seven CSP projects (MNRE 2009). The main features of the NSM policy to enable CSP installations are listed

¹¹³ Several stakeholders mentioned that the extraction of coal and gas in India is currently low (see also Economic Times 2011) both because of limited resources and political reasons.

in Table 4, combined through interviews with the Ministry of New and Renewable Energy (MNRE), project developers (Reliance Power) and project lenders (ADB, FMO, US Ex-Im), and official documentation (CERC, 2010; MNRE, 2013, 2009).

In Phase 1 all projects have been awarded through a competitive bidding with a reverse auction: each interested developer would bid a certain discount to a reference tariff published by the Central Electricity Regulatory Commission (CERC) and, in case of success, commit to build and commission the plant within a defined time frame (CERC, 2010). The tariff bid would be the price for a long-term (25 years) PPA between each project company and a national public agency who acts as the power off-taker before selling the power to state utilities (DISCOMs). As this price is above market levels, the Government of India has packaged it with very cheap coal produced by public plants, in order to create a power bundle whose price equals prevailing market prices (MRNE, 2009). Besides, the national government provides an explicit payment security guarantee to the project company to cover the risk that the off-taker defaults on its PPA liabilities. Differently from the case of Morocco, there are no higher tariffs for peak power, or any other incentives for storage – resulting in no winning bid featuring a thermal storage component (EVI, 2011).

The project follows an independent power producer model (IPP) with the equity capital being provided by a private company (Reliance Power), a subsidiary of a large conglomerate (Reliance ADA). Project debt is provided in large part by public financial institutions: the Asian Development Bank, the Dutch FMO and the Export-Import Bank of the United States (US Ex-Im); and to a lesser extent by a local private bank Axis (ADB, 2012; FMO, 2012a; US Ex-Im, 2012). The involvement of public financial institutions is due to the unsuitability of the Indian domestic banking market for infrastructure finance: domestic banks struggle to lend at the long maturities required by these large infrastructure projects (Nelson *et al.* 2012). Offshore investors provided for 67% of financing in the form of senior loans with long-term maturities of 18 years;¹¹⁴ the domestic investor provided capital in local currency but agreed on the same maturity and conditions of the public lenders. Very interestingly, the debt provided for this project does not feature any direct subsidies for lowering the costs of capital -

¹¹⁴ The only exception is a subordinated loan provided by FMO when channeling funds from the Interactive Climate Change Fund (“ICCF”), which’s funds are provided by a group of 11 European Development Finance Institutions (FMO, 2012b).

the loans are priced according to the cost of capital of those financial institutions (Stadelmann *et al.* 2014b).

Table 4: Key features of CSP policies under National Solar Mission – Source: Author

Feature	Objective
Reverse auction/ competitive bidding	To procure solar power in a cost-effective manner. The auctions followed the pay-as-you-bid mechanism in allocating capacity.
Long-term PPA	To provide long-term revenue certainty to solar power generators all projects commissioned under Phase 1 could get a 25-year PPA.
Guaranteed off-take	To provide offtake guarantee for the solar power generated Phase 1 projects were guaranteed offtake from NVVN, which will act as an agent of Ministry of Power, Government of India.
Payment Security Scheme (PSS)	To provide partial payment security for solar project developers in case of a default by state distribution utilities. The PSS ensured financial closure of projects sanctioned under Phase 1.
Bundling of power	To make the relatively expensive solar power affordable to distribution utilities ^c . NVVN will re-sell the solar power procured at a lower cost to distribution utilities after bundling it with government-owned cheaper coal power.

^c Under the bundling mechanism, the designated agency for Phase 1 projects – NVVN, will purchase solar power from developers (projects connected to the grid at 33kV and above) and sell it to distribution utilities after bundling with power from unallocated quota of NTPC coal stations at the rates notified by the CERC. (<http://www.energyaccess.in/renewable-energy>)

Project Financial Metrics

Table 5 reports the main results of the project’s financial model computed with the values and data available at the time of developers’ bidding in terms of solar irradiance and plant’s capacity factor¹¹⁵ (CDM 2011a, CDM, 2011b), financing terms (from stakeholders interviews and ADB, 2012; FMO, 2012b and US Ex-Im, 2012), solar and market tariffs (CERC, 2010; EVI, 2011; IndiaStat, 2013).

The tariff bid by Reliance (11.97 INR/kWh) determines the majority of the project revenues (given the small value of the carbon credits) and the **overall project profitability, that in this case appears on the lower range of industry’s literature and the reference values** set by Indian electricity regulator (CERC, 2010; Kulichenko and Wirth, 2011). The low level of both costs and remuneration results in a project’s LCOE of 0.24 USD/kWh, making the **project one of the cheapest CSP installations commissioned so far** (Stadelmann *et al.* 2014a; IRENA, 2013).

As with many CSP projects, most of the costs are upfront capital expenditures (equipment, land, infrastructure services) while operations and maintenance represent a much smaller portion.

Interesting, in this case, almost **half of the costs due to financing are represented by currency**

¹¹⁵ Capacity factor is a measure of how often an electric generator runs for a specific period of time. It indicates how much electricity a generator actually produces relative to the maximum it could produce at continuous full power operation during the same period (EIA, 2014).

hedging costs. Even considering those financing costs, however, plant's investment costs are at the lower end of the global cost spectrum for CSP (see Stadelmann *et al.* 2014a).

Finally, though there is **no direct government's budget outflow** for Phase 1 of the NSM, as the expensive CSP electricity is bundled with very cheap coal owned by public entities (MNRE, 2009), the value of this public support can be derived as the difference between CSP costs and average electricity prices available on the market and estimated at around USD 42 million per year.

Table 5: Rajasthan Sun Technique financial metrics – Source: Author

Rajasthan Sun Technique (estimated values at the time of bidding)	Value
Annual Energy Generated	265 GWh
Total Annual Revenues	USD 60.5 million
- <i>Power sold through PPA</i>	USD 59 million
- <i>Sale of carbon credits</i>	USD 1.5 million
Solar Subsidy (Viability Gap Funding)	USD 42 million
Investment Costs	USD 410 million
	USD 4,100 /kW
Levelized Cost of Electricity (LCOE)	INR 12.5 /kWh
	USD 0.24 /kWh
- <i>CAPEX</i>	70%
- <i>OPEX</i>	9%
- <i>FINEX</i>	21%
Internal Rate of Return (IRR)	Project: 9.5-10.5%
	Equity: 9.5-12%

kWh = kilowatt hours, GWh = Gigawatt hours, USD= US Dollar, INR = Indian Rupees

Financial modelling of project's costs and revenues allows a few interesting conclusions on the role of public institutions in lowering the cost of the energy generated:

At market revenues (even considering carbon revenues) the project would not be profitable:

loans could not be repaid and the IRR for the equity investors would be negative. The plant's viability gap¹¹⁶ is estimated at around USD 42 million per year.

The longer maturities offered by the two development banks and the export credit agency have allowed the project developer to keep its required rate of return while bidding a tariff roughly

¹¹⁶ We define the viability gap as the amount of required revenues above those offered by the market that allow the project to make profits and remunerate investors (both equity and debt) at their required rate of returns.

7-8% lower than the one that would have resulted with the short term financing offered by Indian domestic banks.¹¹⁷

The hedging costs of the dollar denominated loans account for almost 10% of the overall cost of energy.¹¹⁸ Halving these costs through policy interventions could lower the cost of the energy by approximately 5-7% and reduce plant’s viability gap from USD 42 million to USD 37 million per year.

Risk Allocation Framework

Financial support to cover the viability gap, long maturities loans and the off-take contract are not the only policy tools that ensure this CSP project is viable and has been able to mobilize private capital. Risk mitigation and transfer from private actors to public ones has proven to be equally important in reducing risks perceived by investors, hence lowering their required returns, or in overcoming obstacles to their involvement (Figure 6).

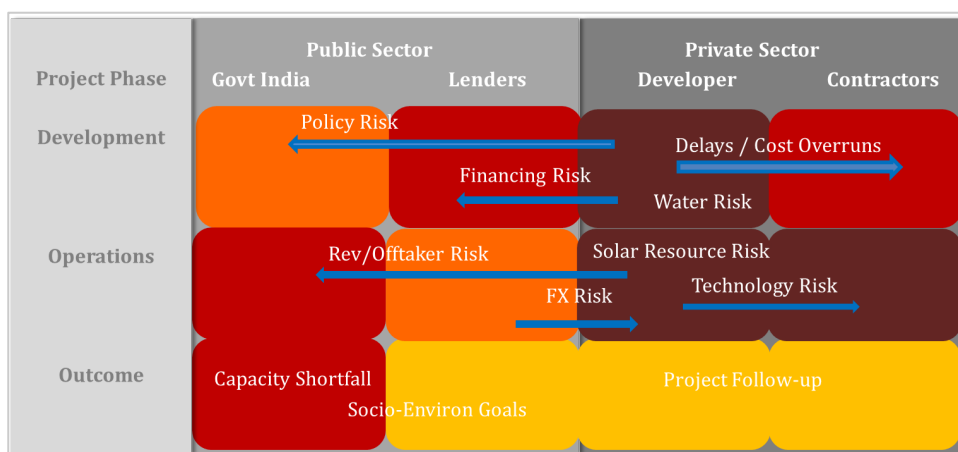


Figure 6: Risk allocation framework for the Rajasthan Sun Technique CSP Project – Source: Author

Development institutions take most of the financing risks by providing 70% of the overall capital needed; while **the Indian government** (either directly or through its fully owned power trading company) takes the risks of setting the policy framework and **completely removes any market/revenue risk** (price of power and dispatchability) from the project sponsors via the long-term PPA (CERC, 2010). Besides, as requested by investors during the negotiation of the financing, the **Government further guarantees the liability of the PPA off-taker with a publicly-funded**

¹¹⁷ Nelson et al, 2012 estimate that the longest maturity available for loans in the Indian domestic banking market is around 10 years but typically, most loans are of 7 years or shorter.

¹¹⁸ Considering that lenders have allowed the borrower to hedge the currency exposure only partially and to adjust it dynamically, we believe our estimate possibly underestimate the total impact of these hedging costs on the LCOE.

payment security scheme that would cover any eventual default of the PPA obligations by the public power trading company (MNRE, 2013).

Despite the immaturity of the technology and the lack of similar installations in the country, **the amount of risk that the private sector is willing and able to take in this project is substantial, and partly a result of the Indian policy setting and the involvement of public finance institutions.** In fact, once the level and uncertainty of revenues is mitigated with the government-backed PPA and public financial institutions provide long-term debt, the project developer and its contractors are able to manage all risks internal to the project. **Private developer takes the majority of the development and operations risks**, in particular construction delays and cost overruns, the natural resource risk and the risk that the technology performs worse than expected. Construction delays and costs overrun - quite high given the lack of track record of the technology at this scale and the issues reported by the developer in gathering material on site (personal communication with Reliance Power in September 2013) - are transferred to a contractor via the Engineering and Procurement Contract (EPC); while **technology performance risk is transferred to the technology provider** (AREVA) that, aiming to get market penetration, was willing to provide a comprehensive guarantee on the technical performance of its equipment (ADB, 2012). After this risk mitigation, the **highest risk left onto the developer seems to be the natural resources risk**: in fact, a reduction of the power generation of even 10% due to lower solar irradiation would reduce the project profitability by more than 30% and, more importantly, reduce the financial ability of the project to repay its debt, with the debt service coverage ratio (DSCR) decreasing below the critical level of 1 if this measurement error exceeds 10% for long periods (Table 6).

Currency risk is due to the dollar denominated loans from two developing banks and an export credit agency (further increased by the volatility of the Indian Rupee) and **project developers need to mitigate it¹¹⁹ via financial derivatives** contracts, such as currency swaps. Neither the project company, nor its larger parent appear in a good position to manage such risk: From direct conversations with Reliance Power, the project sponsor, the costs of currency swaps is estimated at

¹¹⁹ A very unbalanced currency exposure (loans are in dollars while project revenues are in Indian rupees) creates a significant risk also for lenders who have requested the borrower to put in place risk mitigation strategies before their loans can be disbursed.

7% per annum, which brings the financing cost of the offshore loans in line with the much more expensive domestic ones. Project sponsors have opted for a partial hedging of the currency exposure that, on one side contains the cost of protection, on the other leaves the project partly exposed to the risk.¹²⁰ A sensitivity analysis on the exposure of the equity IRR to an eventual currency shock of different magnitude shows that, despite being a significant risk, **high hedging costs actually make optimal for the sponsor to choose not to hedge it**, unless the expectations of currency devaluation exceed the 50% threshold (Table 6).

Table 6: Risk sensitivity analysis – Source: Author

Generation Shortfall	No shortfall	-10%	-20%
Equity IRR	11.9%	8.0%	4.3%
DSCR	1.2	1.06	0.9
Rupee Devaluation	No hedging	60% hedging	Full hedging
No Change	IRR of 17.8%	IRR of 11.9%	IRR of 8.5%
10%	IRR of 15.8%	IRR of 11.2%	IRR of 8.5%
20%	IRR of 13.8%	IRR of 10.5%	IRR of 8.5%
30%	IRR of 12.0%	IRR of 9.8%	IRR of 8.5%
50%	IRR of 8.7%	IRR of 8.6%	IRR of 8.5%
100%	IRR of 2.6%	IRR of 5.8%	IRR of 8.5%

DSCR= debt service coverage ratio, IRR = Equity IRR (before tax)

4.3 Measuring the impact of policy support frameworks on the required tariff

To quantify the impact of national policies, the auctioning of projects and the public finance support, on the cost of CSP power, a parallel analysis compares the actual tariffs of the two projects, with a hypothetical national CSP reference tariff, that could have resulted if projects had been developed at the technology costs, rates of return and commercial lending, prevailing in each country in the years leading to the projects financial closure (the data is provided by Kulichenko and Wirth, 2011). Using these benchmark values as inputs for the financial models, these CSP reference tariffs would have resulted close to 390 USD/MWh in Morocco and 317 USD/MWh in India (Figure 7). The difference between such tariffs and the actual ones that prevailed in the auction can be explained by the de-

¹²⁰ However, with the backing of Reliance Power in case the project financial health deteriorates significantly as a consequence of large devaluation, that has not been very uncommon in the Indian Rupee past history.

risking allowed by the national policy frameworks, the competition between bidders, and the more favorable terms offered by public finance institutions.

First, the lower rate of equity return (compared to the initial benchmark) implied by the median tariffs bid in both auctions¹²¹ suggests that the policy settings in the two countries (the public-private partnership with government guarantee in Morocco, and the government backing of the power off-taker in India) has successfully reduced risks perceived by the average investor (“policy de-risking” in Figure 7). Assuming a similar cost structure across bidders, the profitability of a project enjoying the median tariff results approximately 13% for Morocco,¹²² and 11.5% for India, both against the benchmark return of 15% (Kulichenko and Wirth, 2011), that would have underpinned the higher initial CSP reference tariff.

Second, in both cases the auction process helped to reduce final bids much further than the median bidding tariff, showing the ability of competitive tenders to push developers to reduce their costs (as in the case of Noor 1) and/or required returns (as in the case of SunTechnique) as much as possible and below the perceived average values in the market. The distance between the final and the median bid can be conceptualized as the “auction effect” (Figure 7), and results quite large in the case of Noor 1 CSP as the winning bid resulted more than 20% lower than all others bids that instead were clustered around the median level (MASEN, 2012).

Third, the effect of public finance terms is taken into consideration to arrive to the actual tariffs bid in the two auctions (“Concessional Finance” and “Public Long-Term Finance”): in the case of Morocco, the highly concessional financing reduces the tariff by almost 30% (by 80 USD/MWh); while, in the case of India, very expensive currency-hedging costs cancel out most of the benefits of the longer term public finance loans on the final tariff: a reduction of 53 USD/MWh is compensated by a cost increase of 30 USD/MWh.

Finally, the distance between this CSP tariff and the price on the power market indicates the size of the viability gap that policy needs to close.

¹²¹ Median tariffs have been calculated on the actual tariffs submitted to MASEN in the case of Noor 1 (PFM, 2012) and on the distribution of all discounts to the reference tariff provided to CERC in Phase 1 bidding (EVI, 2011). For Noor 1, equal concessional finance terms were offered to all bidders ahead of the auction. To allow comparison with the example in India, all tariffs submitted to the Noor 1 auction have then been grossed up to reflect more expensive commercial financing terms.

¹²² In the case of Morocco, this reduction has then been confirmed by the project developer and attributed to having the national agency for solar energy as equity partner (CSP Today, 2013).

The analysis shows that the combination of good policy and a tariff setting mechanism that prompts competition can significantly reduce the cost of the technology even for developing countries. However, a broader look at the two examples highlights areas of improvement for auctions. In the case of Morocco, it took more than two years to set up the process and negotiate terms, to award just 160MW in capacity. In the case of India - while the tender process awarded a total of 500MW to projects, competition drove prices so low that the financial profile of some projects is much weaker today than planned, and India's CSP program is likely to fall 300MW short of its deployment target (Stadelmann et al. 2014b).

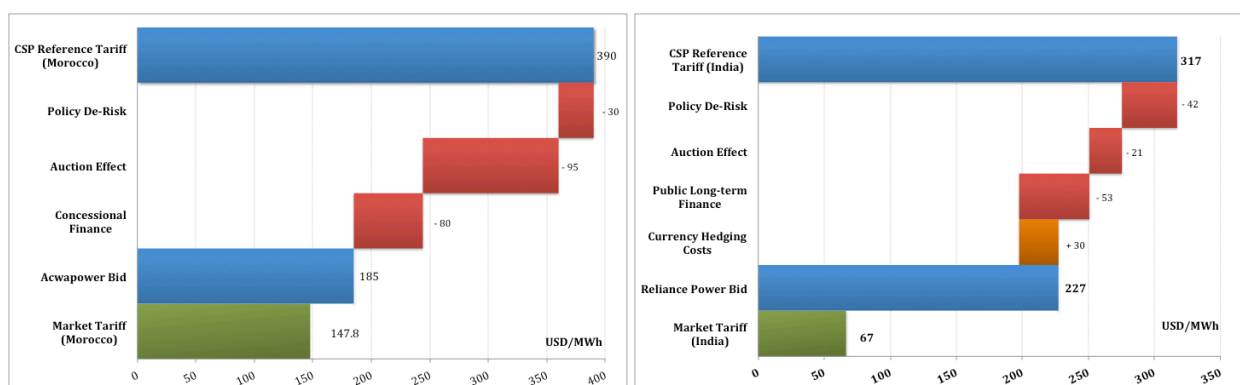


Figure 7: Policy and public finance impact on tariff for Noor 1, Morocco (left), and Rajasthan Sun Technique, India (right) - Source: Author

5. Conclusions

Despite the great potential for CSP to provide a substantial amount of stable and clean energy to several developing countries, its high cost and perceived risks represent significant barriers to deployment, calling upon public finance to improve projects' financial profile. So far national policymakers and international finance institutions have been the key drivers for CSP installations in emerging economies. National policymakers have been mostly responsible in covering incremental costs and in mitigating risks (e.g. solar resource, off-taker default), thereby making sure projects are financially viable and appealing for private investors. Public financial institutions have instead a significant role in reducing the weight of CSP support on public budgets by providing concessional loans in countries where private finance would be too expensive (e.g. Morocco) or extending

maturities in those markets in which commercial investors are present but poorly suited for project finance (e.g. India).

Finally, our analysis shows that public financial support can be a cost-effective tool to engage private investors in CSP when combined with competitive tariff setting mechanism (e.g. tenders and auctions) that align the level of financial support to the real technology costs. However setting competitive auctions can prove time consuming (eg for the case of Noor 1 in Morocco) and, if not managed properly, lead to bids that can result too low to make ensure projects are remunerated fairly and do not risk to be abandoned (as in the case of a few projects in the Phase 1 of the India NSM).

Still two main outstanding challenges remain and require innovative solutions to allow the needed scaled up investments: when international financial institutions provide their capital in a different currency from the domestic one, the cost of mitigating the risk of adverse currency fluctuations can be so high to cancel out most of the public finance's positive effects on the cost of energy. Second, given the limited amount of capital managed by these public institutions, a significant scale up of CSP investments will require the mobilization of more private investors alongside these public ones. To this end, the stability of these policy support systems and the alignment of public and private sector interest become key as perceived policy risk significantly increases investment costs and disincentives private investors from financing long-term projects.

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Chapter 4: Effectiveness of Risk Mitigation Instruments: the case of Bujagali Hydropower, Uganda¹²³

1.	Introduction	119
2.	Risk Mitigation Instruments for Climate Change: current trends and issues.....	120
3.	Bujagali Hydropower project, Uganda.....	121
3.1.	Uganda Energy and Financial Landscape at the Time of the Project	122
3.2.	Bujagali Project Financial and Risk Allocation Model.....	124
3.3.	Effectiveness of the Financing and Risk model.....	133
4.	Conclusions.....	141
	References	143

¹²³ This chapter draws its content from the research performed for the paper:

Frisari G. and Micale V. (*forthcoming*). **Risk Mitigation Instruments in practice – analysis of risk arrangements in the Bujagali Hydroelectric Project.** (*forthcoming*). Venice: Climate Policy Initiative.

Parts of this research have also appeared in the report:

Micale V., Frisari G. and Mazza F. (2013). **Mapping the World Bank Group Risk Mitigation Instruments for Climate Change.** September 2013. Venice: Climate Policy Initiative

1. Introduction

When planning an infrastructure investment, the careful analysis of all risks (actual and perceived), and their allocation to the parties most suited to bear them, is a necessary step for the private investor considering committing financial resources. The higher risk levels typically associated with low-carbon infrastructure assets (see section 2.1 in Chapter 1) make this phase of the analysis crucial for the policymaker whose goal is to increase the share of private capital in climate investments.

In traditional project finance, an investor can typically choose among three strategies to manage project's risks: retain the risk, allocate the risk to contractual counterparties in the project, and finally, transfer the risk to professional agents outside the project (Gatti, 2013). For low-carbon investments, not all these strategies are always available, leading to sub-optimal allocations of risks or *risk gaps* (see Section 2.3 in Chapter 1) that can discourage investors, or significantly increase their required remuneration, hence the costs of such investments.

Chapter 3 has shown how policymakers and development financial institutions can intervene to de-risk investments in immature clean technologies, such as concentrated solar power, in emerging economies (Morocco and India) where the political and financial framework are deemed investable by private financiers. The present chapter centers instead on the role that direct risk mitigation instruments provided by public institutions can have in supporting private renewable energy investments in high-risk environments (such as least developed countries). The analysis focuses on the instruments provided by members of the World Bank Group, given their overall scale and diffusion in high-risk environments, looking at their overall use (in Section 2), first, and then concentrating on the challenges and benefits of their application in practice (in Section 3). As in the previous chapters, the chosen research tool is a project finance model applied to a realized case study: the Bujagali Hydropower project in Uganda. Bujagali Hydropower is a 250MW hydroelectric plant build on the Victoria Nile River in Uganda and commissioned in 2011. Notably, when commissioned, the project was the largest renewable energy project developed by a private sponsor in Sub-Saharan Africa (Eberhard *et al.* 2011), also able to attract loans from commercial banks alongside development finance institutions (DFIs).

2. Risk Mitigation Instruments for Climate Change: current trends and issue

For several decades, DFIs activity in high-risk environments has mainly focused on the issuance of concessional loans to public institutions, as the use of most publicly-provided risks mitigation instruments began only in the late 1990s (Micale *et al.* 2013). These instruments have lately gathered more attention and support towards an analysis of their effectiveness, and a more streamlined and scaled-up use. Eberhard and Gratwick (2013) highlighted how partial risk guarantees provided by the World Bank Group (WBG) together with a few governments in Sub-Saharan Africa (SSA) have been one the cornerstone pieces of a few examples of successfully implemented independent power producers (IPP) regimes of the late 2000s, such as Kenya, Cote d'Ivoire and Uganda. At the same time, while confirming their effectiveness in facilitating the flow of private investments in high-risk sectors and countries, the Independent Evaluation Group at the World Bank concluded that the volume of guarantees provided by the World Bank Group had fallen short of reasonable expectations, recommending the WB management a strategic revision of the internal policies and organizational structure for the provision of guarantees (IEG, 2009). Finally, in 2012, a World Bank Group public consultation on the modernization of its operational policy framework on guarantees highlighted the significant value-added seen by private investors and lenders in these instruments, the complementarity of guarantees with direct financing instruments and the great interest of private investors for African assets at the improved terms typically allowed by the guarantees. However, investors reported a perceived high complexity in accessing the instruments, and under-exploited synergies when using instruments from different institutions of the World Bank Group (WB, 2012). Reacting to this evidence, the World Bank Group has approved several changes to its guarantees operational policies, increasing the scope of the instrument and its geographical application, integrating guarantee policies with those of loans and other financing instruments, and increasing the flexibility of the instrument's application allowing for the offering of some hybrid product when needed (WB, 2013).

A similar trend of under-utilization of risk mitigation instruments occurs for the financing of climate-related investments (including adaption, disaster risk management, and mitigation). Using single

project-level data from operations funded between 1990 and 2013, Micale *et al* (2013) show that World Bank Group has committed on average USD 2 billion per year to projects through risk mitigation instruments; climate related projects have however represented on average only 10% of this value (Figure 1). More importantly, the majority of projects dedicated on climate change mitigation involved energy efficiency (40%) and mature renewable energy technology (e.g. geothermal, 13.7%, and hydropower, 18.3%), with wind and other, less established renewables representing only 1% of the total (Figure 2).

Beyond the World Bank Group, Christianson *et al* (2013) detect very similar trends in the use of guarantees analyzing projects funded by OPIC and Exim Bank of the US.

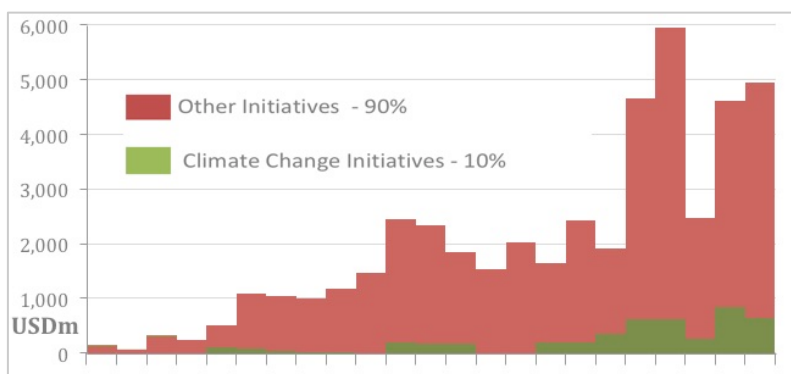


Figure 1: Share of Climate related commitments on total WBG portfolio, 1990- 2013 – Source: Micale *et al.* 2013

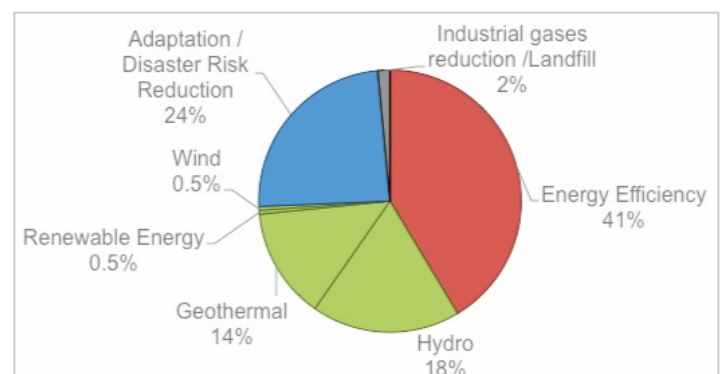


Figure 2: Total WBG risk commitments to climate change by technology – Source: Micale *et al.* 2013

3. Bujagali Hydropower project, Uganda

The Bujagali Hydropower project is a 250 MW dam on the Victoria Nile River in the Republic of Uganda financed in 2007, following a previous unsuccessful attempt to finance a very similar project in the early 2000s. Given its financial size compared to the Ugandan economy, the high level of political risk in the country, and the very limited presence of private investors in the country, the engagement of two private equity investors and two commercial banks would have not been possible without significant de-risking efforts from the national government and several development financial institutions (DFIs) via financing and risk mitigation instruments. It is then a very suitable testing ground to analyze in detail how risk mitigation tools work in practice, and what are the key risks they need to mitigate in order to mobilize commercial resources for such projects. The next paragraphs introduce the energy and financial landscape in which the project was financed, before illustrating in

detail the financial and risk allocation models adopted for the project financing and, finally, discussing the impact of de-risking instruments provided by the World Bank on the cost of the project, the risk of debt default and the expected returns of the equity investors.

3.1. Uganda Energy and Financial Landscape at the Time of the Project

The project's main objective was to eliminate power shortages and load shedding: the project had been identified as the least-cost sustainable power development alternative for the country, and would provide a stable power generation capacity at costs significantly lower than what the country was paying for the supply from thermal power plants running on imported fuel (WB and IFC, 2001; WB, MIGA and IFC, 2007)¹²⁴. In order to promote private sector ownership and management in the country's energy sector the project was designed as a public-private partnership between the government and a private producer – while, to support financial investments in the country, the financing package included a blend of public resources from development financial institutions and private investments from commercial banks. Planning and development activities for the project started in the late 1990s'; however, issues with the procurement process, delays in finalizing and approving the financial package and, finally, economic difficulties of the selected developer led to the cancellation of the project in 2003 (WB and IFC, 2005). The project was then re-launched in 2004, with a new competitive procurement process that led to the selection of a private consortium for the construction of the plant. Construction works for Bujagali Hydropower began in 2006, and the project reached commercial operation on August 2012, doubling Uganda's electricity supply and increasing the country's capacity by 44% (New Vision, 2012; Observer, 2013).

Investment climate in Uganda. In the few years leading to the project preparation, Uganda's economic performance had been robust, with an average growth rate of 6.4%– nevertheless it still was one of the poorest country in the world with a 31% poverty level, of which more than 90% was represented by rural poverty (WB, MIGA and IFC, 2007). Although the stock of Foreign Direct Investment (FDI) in the country had increased sharply from USD 800 million in 2000 to USD 2.3 billion in 2006 (UNCTAD, 2013), obtaining project finance, especially for large power projects, still remained a

¹²⁴ The project's outcome indicators are indeed (a) BEL'S electricity generated (GWh) from the proposed 250 MW power station; (b) Levelized cost of electricity (\$/kWh) from the plant; and (c) amount of unmet demand (GWh/month) (WB, IFC and MIGA, 2007).

barrier in Uganda (UNFCCC, 2011). There were both little interest from equity investors and developers, and no involvement of commercial banks as project lenders (IFC, 2011b) - in September 2012, the country ranked 99th globally in the Institutional Investors Country Credit Rating, based on survey of leading commercial banks (Institutional Investors, 2013). In particular, the quality and reliability of power were regarded as the most binding constraints to private investment in the economy (WB, MIGA and IFC, 2007).

Investment climate in the energy sector. Despite the reform and privatization of the energy sector in 1999¹²⁵ private power investment before the Bujagali Hydropower had been relatively contained, with the value of energy assets with private participation totaling only USD 170 million between 2003 and 2006 (WB, 2014a). Within this overall investment climate, private investments in the energy sector carried two additional risks: low levels of assets' recoverability for non movable installations and a high counterparty risk due to the reliance onto a government-owned sole power distribution company as designated purchaser of all power fed to the Ugandan grid (UNFCCC, 2011). In such context, relevant private investments occurring before Bujagali Hydropower project concerned only smaller thermal plants, installed, managed and operated by private companies on short-term (3–5 year) contracts with the grid operator (UNFCCC, 2011). Bigger projects like hydroelectric plants were seen as less attractive as they required both a strong technical and financial backing from the sponsors, entailed lengthy and complex negotiations with the local authorities and, finally, to be financially viable, would necessitate long-term debt (UNFCCC, 2011).

Power generation and energy access. Uganda's energy sector was characterized by three serious issues, which were both a consequence and a cause of inadequate energy infrastructure investments: very low energy access; severe power shortages; and production costs much higher than affordable tariffs, leading to a precarious financial health of the state-owned utility (UETCL). In 2011, before the plant was commissioned, only about nine percent of the population had access to grid-supplied

¹²⁵ Before 1999, power was a government monopoly implemented by the Uganda Electricity Board (UEB), funded by government equity, debt and accumulated reserves (World Bank and IFC, 2000). No private investments were allowed. The power sector was reformed when Parliament passed the new Electricity Act, which unbundled UEB into three companies, one each for generation, transmission and distribution (World Bank and IFC, 2001), leading to the concessioning of the Uganda Electricity Generation Company Ltd (UEGC) to Eskom of South Africa in 2002 (World Bank and IFC, 2005), with the privatization of Nalubaale and Kiira in 2003 (UNFCCC, 2011), and to the concessioning of Uganda Electricity Distribution Company (UEDCL, now UMEME) to a consortium of Globeleq (UK) and Eskom of South Africa, effective March 2005 (World Bank and IFC, 2005). The Uganda Electricity Transmission Company Limited (UETCL) remains owned and managed by the government, and covers all transmission assets operating above 33 kV (World Bank and IFC, 2001).

electricity, mostly concentrated in the three major urban cities of Jinja, Kampala and Entebbe, and much lower than the average access rate of 23% in Eastern Africa (WB and IFC, 2001; UNECA, 2013). Most of the power generated in the country derived from two hydropower plants on the Victoria Nile, built in the mid-1950s and then expanded in 2002 - Nalubaale Dam and Kiira Dam, respectively. The remainder was provided by a number of small hydropower plants and a biomass plant (up to 12 MW), as well as substantial thermal generation capacity (from three 50MW plants fuelled by diesel or heavy fuel oil) installed, as a temporary solution, from 2005 to address severe power shortages (UNFCCC, 2011). As the output from the two large hydroelectric plants significantly declined from the 380MW name-plate capacity to 120MW of actual generation in 2006, while demand for electricity grew at about 8% per annum (WB, MIGA and IFC, 2007), the emergency thermal plants produced up to 27% of grid-connected power between 2005 and 2007. While partially reducing the issue of power shortages, these thermal plants increased the cost of power generation by more than 50%, bringing the cost of producing electricity in Uganda to USDc 27/kWh in 2007 (WB, MIGA and IFC, 2007), a level much higher than the USDc 18/kWh average for the continent (AfDB, 2013a). This prompted the Government of Uganda (“GOU”) to highly subsidize electricity to make it affordable to end users: retail tariffs in Uganda indeed remained unchanged between January 1993 and June 2001 (WB and IFC, 2001), unaligned with real energy generation costs. In order to make the outstanding debt of the state-owned power off-taker more sustainable, in 2001 the Electricity Regulatory Authority (ERA) restructured the tariff system,¹²⁶ increasing the tariff by 40% from USDc5.6/kWh to USDc 7.8/kWh in 2002 (World Bank and IFC, 2001).

3.2 Bujagali Project Financial and Risk Allocation Model

Due to its financial size and relevance for the entire country’s economy,¹²⁷ the Bujagali Hydropower project required the participation of a large number of players and investors from both the private and the public sector. The public sector provided most of the financial resources, however the role of private investors (especially on the equity side) was substantial, especially when considering that the

¹²⁶ The Electricity Regulatory Authority (ERA) was created in 2000 as an autonomous entity to regulate the sector, protect consumers and investors, and to ensure that distribution and generation concessionaires comply with the terms of their operating licenses, including quality of service standards (WB and IFC, 2001).

¹²⁷ The Bujagali Project was three times the total FDI for the country (UNCTAD, 2007) and almost one tenth of the national GDP (in current dollars) in 2006 (IMF, 2013).

majority of the projects, similar in size, developed in the region that have been financed mostly with public resources only (see Section 3.3).

3.2.1 Project Costs

The hydropower station has been designed as a run of the river power plant with five vertical Kaplan turbine generators with 50 MW capacities each, and an adequate reservoir for daily storage. It is expected to produce 1,305 GWh/year using water coming from the upstream Kiira and Nalubaale hydro power plants (UNFCCC, 2011). The total cost for the project construction amounted to more than USD 900 million (New Vision, 2012), 13% higher than the USD 798.6 million estimated when project was re-launched in 2005, and 55% more from the EPC contract negotiated in the 2001 project (WB and IFC, 2001). Higher costs were mainly due to inflation, more expensive raw materials, and the low number of actors that could qualify as EPC contractors (WB, MIGA and IFC, 2007). The costs' increase over the tendered EPC was also due to higher than expected construction costs, as the type of ground and rock found underneath the surface proved different and more complex to treat than anticipated. As the government had decided to bear (a portion of) these geological risks to keep the bids low and accelerate the tender process, project developers were finally allowed to pass to the tariff the costs of longer and more complex construction, and higher interests during construction.

The project unit costs stand at USD 3,600/kW, roughly in the middle of the range estimated by IRENA for large hydropower projects (USD 1,050-7,650/kW) (IRENA, 2012), but much higher than the average costs for large run of rivers dams (with a capacity between 50 and 500MW) in developing countries (UNEP Risø Centre, 2013). Engineering Procurement and Construction (EPC) costs represent the majority of total costs and amount to 62% with the prevalence being civil construction and equipment costs. Of the balance, interest during construction and financing charges accounted for more than 10% of total costs. Figure 3 below shows the structure of the project financing with the sources of capital and its final uses during the construction phase (operation and interest costs are excluded as those are covered by project revenues during the operation phase):

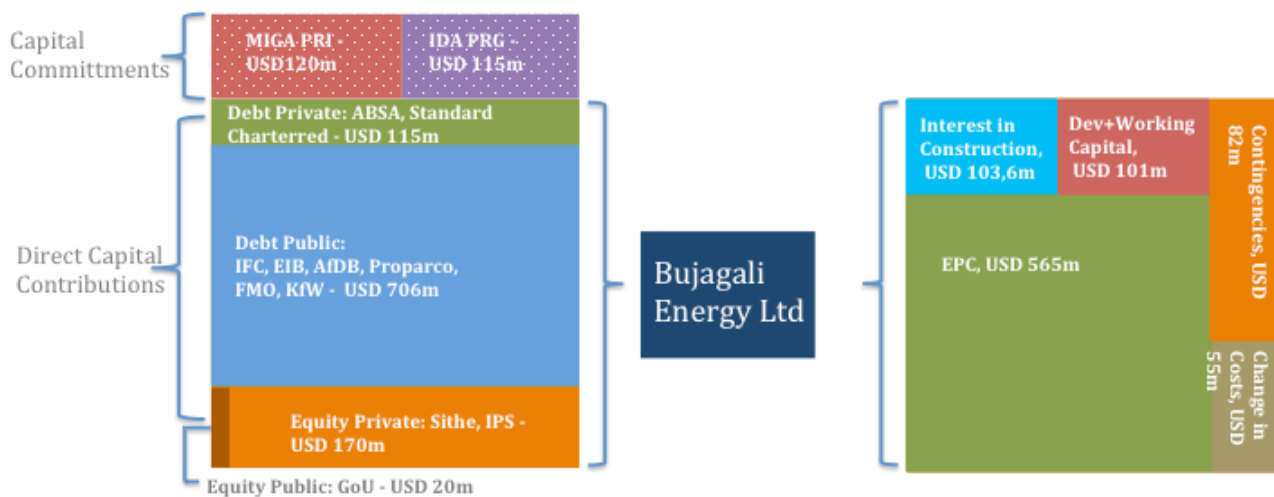


Figure 3: Bujagali Hydropower financing sources and final uses – Source: Author

3.2.1 Project Financial structure

Bujagali Hydrpower Plant is a **Public-Private Partnership (PPP)** between the Government of Uganda and two private developers (Industrial Promotion Services (IPS) from Kenya and Sithe Global Power from the US) that formed a special purpose vehicle, Bujagali Energy Limited (BEL). The Government of Uganda (GoU) has contributed upfront project assets (USD 20 million) in exchange of a minority interest in the project company, that won't carry management or voting rights and won't pay dividends (to minimize the project's impact on the final consumer bills) until all senior and junior loans have been fully repaid (WB, MIGA and IFC, 2007). The PPP structure has a term of 30 years during which BEL will construct and manage the asset under a Build-Own-Operate-Transfer basis. At the term's expiry, the ownership of the asset will be transferred to the government.

The debt financing has been provided as a limited recourse project finance transaction, with a debt to equity ratio of 80:20 (Table 1). High perceived country and sector risks and Uganda's limited track-record in attracting private capital for large infrastructure investments (Fernstrom, 2011) required a substantial involvement of multilateral and bilateral development agencies that provided loans for USD 590 million - approximately 65% of the project value - political risk insurance (PRI) for one equity holder, and partial risk guarantees (PRG) for the commercial lenders (WB, MIGA and IFC, 2007). Two commercial banks¹²⁸ (Standard Chartered Bank and ABSA Bank) jointly provided two senior loans of

¹²⁸ Subsequently, these two banks syndicated their position dividing it with Fortis and NedBank, as further proof of the risk perceived with such a project in the country.

USD 57.5 million, importantly, with the same long-term maturity of the public loans (16 years). This long maturity compares with an average maturity from private lenders in the country of just two years and can be considered a positive outcome due to the provision of PRGs and the co-investments from DFIs (Fernstrom, 2011). Besides, **while financing terms have not been disclosed in detail, project insiders report that thanks to the risk mitigation instruments, private lenders were willing to offer their financing at interest rates below those of DFIs - even when considering the fees for the guarantees** (IFC, 2013a).

Table 1: Bujagali Hydroelectric Financial Structure – Source World Bank, MIGA and IFC (2007)

Investor	Financing Type	Amount (USD m)	Share
DEBT			78%
IFC	Senior/Sub Loans	130	14%
AfDB	Senior Loan	110	12%
EIB	Senior Loan	136	15%
ADB/FMO/KfW/Proparco	Senior/Sub Loans	216	24%
ABSA/Standard Chartered	Commercial Loan	115	13%
Equity			22%
IPS	Equity	60	7%
Sithe	Equity	116	13%
Government of Uganda	Equity	20	2%
Total Project Cost		903	
Risk Mitigation Instruments			
IDA	Partial Risk Guarantee	USD 115	
MIGA	Political Risk Insurance	USD 120*	
* Amount does not include an insurance coverage (classified as "proposed") of USD 18m to be awarded to commercial debt providers			

All senior loans had maturities of 16 years while subordinated loans (USD 68 millions) had maturities that extended up to 20 years. The long maturity of these loans allowed the national utility (and ultimately the Government) to spread financing costs over a number of years and made the power affordable for the country's budget (WB, MIGA and IFC, 2007).

The Political Risk Guarantee (PRG) was provided to private lenders for the entire amount and duration of their investment (USD 115 million for 16 years). It transferred certain types of risks (mostly political) from the private lenders to International Development Association, by covering debt payments in case the project defaulted due to the inability or unwillingness of the off-taker (or the

government via its guarantees) to honor payments to the project company. The PRG was also contractually linked to a sovereign guarantee from the Government to IDA; in case the PRG payments are triggered, any amount paid by IDA would be claimed back from the Government.

MIGA provided “Breach of contract coverage” for 90% of the equity investment made by Sithe Global – for a total value of USD 120 million and a maturity of 20 years. MIGA’s insurance covered the equity holder from the risk that either the off-taker (UETCL) or the government refusal to comply with their obligations arising from the PPA contract. As per the initial project appraisal reports, the involvement of MIGA was a precondition for the engagement of one of the two project equity sponsors (WB, MIGA and IFC, 2007), effectively mobilizing private equity capital.

3.2.3 Project Revenues and Returns

The project’s expected returns and yearly financial profile have been here simulated using a discounted cash-flow model as described in Section 3 of the introduction. The financial simulations’ main aim is to quantify the impact of the concessional loans and the risk mitigation instruments on the cost of the project and the final tariff that the national utility (and hence the public budget) pays to the project company. These reconstructed financial transactions are also the input to the analysis of the model effectiveness in Section 3.3 that aims to measure the financial resilience of the projects against adverse financial outcomes (e.g. instances of political risk).

The data has been largely provided by the lenders’ project appraisal document (AFD, 2011; DEG, 2010; FMO, 2012; WB, MIGA and IFC, 2007), the project’s submission to the Clean Development Mechanism (UNFCCC, 2011) and several interviews with the concessional lenders and the providers of the risk mitigation instruments (AFD, 2014; IFC, 2013a; Kimber, 2014; MIGA, 2013b; WB, 2013b; WB, 2013c).

Project revenues have been contractually established by a long-term Power Purchase Agreement (PPA) of 30 years between BEL and UETCL, the single off-taker of all the power generated by the plant, that has been tendered in a competitive auction. The project also benefits of additional revenues from the CDM carbon credits with the proceeds shared between the project company and the government (UNFCCC, 2011). As the CDM revenues only represent approximately 1% of total revenues, project financial viability relies entirely on the PPA revenues. For such reason, the Government provided the project company with a guarantee to back UETCL’s payment obligations under the PPA in case the

utility defaulted under its obligations. Payments are denominated in USD and linked to the nominal capacity of the plant, not the actual generation over time – they have been set to ensure the project can repay its debt, its operating costs and remunerate equity sponsors with a regulated annual rate of return of 19% (Kasigwa, 2009). Project’s returns seem high compared to many large infrastructure projects in developed countries (estimated in a range of 12-14% - Foran *et al.* 2010), but in line with other large hydropower projects in Far East Asia (e.g. 5 projects on the Mekong River between 2009 and 2020), whose equity return range has been reported between 9.2% and 20% (Foran *et al.* 2010).

Table 2 Bujagali Hydropower cost and output summary - Source: Author

Bujagali Hydropower Project (estimated values at financial closure)	Value
Annual Energy Generated	1,400 GWh (weighted average of low and high hydrology scenarios)
Total Annual Revenues	
- Power sold through PPA	USD 170-200 million (for 12 yrs) USD 70-90 million thereafter
- Sale of carbon credits (to project)	USD 1.7 million
- Sale of carbon credits (to GoU)	USD 2.6 million
Investment Costs	USD 905 million USD 3,600 /kW
Levelized Cost of Electricity (LCOE)	USD 95 /MWh
- CAPEX	86%
- OPEX	4%
- FINEX	10%
Internal Rate of Return (IRR)	Project 11-13% Equity 18-20%

From the public sector perspective, the project will require an annual payment from the national utility of an estimated average USD 180 mil¹²⁹ until project loans are repaid and around USD 90 mil thereafter until the PPA expires. The project will generate tax revenues for USD 35 million (on average) for the first 12 years of project operation and USD 15 million thereafter; and finally, during the first seven years of operation, carbon revenues accruing for 60% to the government, for an estimated value of USD 2.6 million per annum (ERA, 2014).

Current estimates of capacity payments imply a levelized cost of energy of USD 95 USD/MWh, whose main component is the value of capital expenditures; these costs are higher than the 67 USD/MWh average value for large hydropower plants, but remain well within the range of reported plants – 25-

¹²⁹ The annual capacity payment has increased from the initial appraisal of USD140-170mil to face higher than expected project costs (World Bank, MIGA and IFC, 2007)

180 USD/MWh¹³⁰ (IRENA, 2012). In the Ugandan power context, the 95 USD/MWh unit costs appear lower than both the average cost of electricity production (260 USD/MWh) and the cost to the economy of unserved electricity (i.e. the cost of severe load shedding) - USD 389 USD/MWh (WB, MIGA and IFC, 2007).

3.2.4 Risk allocation model

Table 3 maps the main risks identified in the project through several stakeholders' interviews and analysis of the key contracts and financial terms. The map also traces the allocation of each risk from its initial bearer to the final one, via different risk mitigation and transfer instruments. As defined in Chapter 1, **a risk allocation framework can be deemed effective when risk is transferred to actors better suited to carry it: that is, to actors with a better access to information, a greater carrying capacity, or a higher influence on the probability of the adverse event to occur.** Before discussed in details, risks have been here classified in three categories of magnitude combining stakeholders' perceptions about their probability of occurrence and the severity of their impact over the project's financial profile.

The financial size of the project, the low penetration of private investors in the market (IFC, 2011) and Uganda's high political risk¹³¹ meant that, in order to appeal to private investments, a substantial portion of project's risk had to be transferred from the project sponsors and commercial lenders, to public actors (the Government of Uganda and the DFIs).

DFIs have mitigated most financing risks by providing long maturity loans, otherwise not available for any infrastructure project in the country (Fernstrom, 2011), while also ensuring the viability of the project and the affordability of the power for the country. As the carrying capacity of these entities is larger than the country's budget and private lenders' risk appetite, they seem in a better position to carry project's financing risks. These institutions also mitigated the perceived political and regulatory risk both indirectly, through their engagement with the project, and directly via the partial risk guarantees and the political risk insurance. Their stronger influence over the government's compliance

¹³⁰ The width of this reported range signals how site-specific issues (geology of the site, river's hydrology etc) impact the final costs of a large hydropower project.

¹³¹ Uganda ranked amongst the riskiest countries in the OECD Country Risk Classification (OECD, 2014) in the years leading to the project with the OCED credit risk score of 7 (scale 0-7) between 2002-2007. Aon 2013 Political Risk Map highlights as main risk sovereign non-payment, political violence and interference, increased by instability in neighboring countries and weak infrastructure, energy in particular (AON, 2014).

compared to a private company lowers the probability of non-compliance (see Chapter 1, Section 3.1 for a more detailed treatment of DFIs enforcement ability); while, at the same time, their higher carrying capacity, reduces lenders' expectation of financial losses in case of default.

Table 3: Bujagali Hydropower risk allocation – Source: Author

	Risks	Original Bearer	Final Bearer	Risk Instrument	Risk Effectiveness criterion
High-Risk Event	Financing	Sponsor	DFIs / Lenders	DFIs loans	Carrying capacity
	Hydrology	Sponsor	Government	Historical Data/ PPA	Influence
	Political	Sponsor/Lenders	DFIs / MIGA	PRG/MIGA	Influence
	Offtaker	Sponsor/Lenders	Government/ DFIs	PRG / Sov Guarantee	Carrying capacity / Influence
	FX	Sponsor	Government	PPA	Influence
Medium-Risk Event	Construction	Sponsor	Sponsor/Contractor	EPC	Information / Influence
	Geology	Sponsor	Sponsor/Government	PPA	Carrying capacity
	Social Resistance	Sponsor	Sponsor/Government / DFIs	DFIs loans/ Sov Guarantee	Carrying capacity / Influence
	Environmental/ Social Impacts	Government	Sponsor/Government/ DFIs	DFIs loans	Information / Influence
Low-Risk Event	Local Content	Government	Sponsor	DFIs loans	Influence
	Performance	Sponsor	Sponsor	PPA	Information / Influence

The government backstops the project's off-taker financial ability to honor the monthly capacity payments, however leading to a higher perception of political risk, mitigated then by DFIs.

Interestingly, capacity payments in the PPA completely transfer hydrology risk – the risk of insufficient amount of water flowing through the dam - onto the off-taker (hence on the government). The rationale for this risk allocation lies on the fact that the amount of water flowing through Bujagali's turbines depends not only on meteorological conditions but also on decisions about water abstraction at the two upstream publicly-owned hydro power plants (Kiira and Nalubaale), on which the project company has no control. To mitigate hydrology risk that, however, remains significant, the project appraisal has been based on more than 100 years of historical data on meteorological conditions and

evaporation levels in the lake. The risk is also linked to climate variability and climate change impact on precipitations patterns (on which UETCL has no control) and could prove very hard to manage for its bearer. The risk has been assessed and deemed minimal during the project lifetime, but should be re-assessed in case the life of the assets is prolonged beyond the PPA term.¹³² The Government has also agreed to bear the **currency risk** as PPA capacity payments are denominated in USD. Evidence from projects in other emerging countries (such as the CSP project in India in Chapter 3) suggests that public entities could be considered in a better position than a private company¹³³ to control their currency, manage its fluctuations or pay for risk instruments that mitigate the risk. However, the impact of this risk on the project's costs (as seen by the government) could be substantial and affect the affordability of the power generated by the plant, suggesting this could be an area of improvement of the risk allocation framework.

Project sponsors and private partners bear almost entirely the **risk of construction delays** due to the penalty charges and damages set in the PPA agreement – the risk is then spread among private sector actors through the EPC contract and other service agreement, aligning the interests between the commitment of each phase of the work and the contractor. Construction and commissioning risks are mostly driven by the large size of the project in a land-locked country and increased by the complexity of the geology of the territory. Given the potential excess costs and delays due to uncertainties on the actual rock formation on the site, the government agreed to share part of the geological risks and allowed the project company to pass-through to the tariff a portion of eventual higher construction costs due to the geology of the site. Higher costs or delays and outages due to technical issues or sub-optimal operation of the assets (technical risks) are instead excluded from the tariff and allocated to the project company via performance thresholds (95% minimum level of the agreed plant efficiency) set by the PPA (WB, MIGA and IFC, 2007).

Finally, all stakeholders share the risk of **Social Resistance**, especially due to the controversial history of the project, its scale and the large footprint on the local environment. Social resistance and adverse

¹³² The World Bank Group project appraisal document states “The risk of climate change on the hydrology of Lake Victoria was taken into consideration: the conclusion of both the economic study and the Strategic/Sectoral, Social and Environmental Assessment (February 2007) under the Nile Basin Initiative, is that there will be no adverse effect on water release due to climate change during the life of the proposed project” (WB, MIGA and IFC, 2007).

¹³³ Especially in a country with undeveloped capital markets and very limited possibility to use financial instruments to hedge currency risks.

impacts on the local context could create disruption of construction and operation, leading to a longer and more expensive construction or the impossibility of operating the asset. As the risk already manifested in the first attempt to build this project, leading, rightfully, to a series of events that contributed to the cancellation of the project, in the second attempt to the project, the risk was preemptively managed via a rigid due-diligence by all concessional lenders on the application of their economic, social and environmental safeguards (EIB, 2012; World Bank, 2008; IBRD-IDA, 2008; CAO 2013) but also by a focused and open communication campaign by all project stakeholders and the project company in particular (IFC, 2011a).

3.3 Effectiveness of the Financing and Risk model

The following section focuses on the effectiveness of the financing package and risk mitigation instruments provided by DFIs in mobilizing more private resources and reducing perceived risks and project costs. The analysis first quantifies the impact of these instruments over Bujagali Hydropower's investment costs and financial profile, then compares these results with prevalent financial models of other hydropower projects in Africa, commissioned approximately during the same period.

3.3.1 Impact of De-Risking Instruments over Project's Financial Profile

Setting aside the institutional support and capacity building that were necessary to help national institutions to drive the process through its numerous challenges, DFIs provided three key financial instruments to reduce risks and project's costs: *long maturity concessional loans, a partial risk guarantee (PRG) provided by IDA and the political risk insurance (PRI) provided by MIGA.*

Concessional loans assumed the bulk of the project financing risk and, with their 20 years maturity and 4 years grace period, ensured the viability of the project and, ultimately, the affordability of the power for the country. Data on financing terms for commercial banks' lending to infrastructure and power projects in Africa at the time of Bujagali Hydropower financial closure is scant, however Fernstrom (2011) suggested a typical term of 2 years for commercial lending in Uganda, while Eberhard *et al* (2011) reports maximum maturities varying from 5 to 20 years but with interest charges going up to 20% for certain countries. Building a scenario in which the project is fully

financed with debt from commercial banks at commercial terms and assuming an unchanged equity returns of 19% and debt service ratio at 1.4; the tariff resulting from the simulated financial model (for the initial years until debt is repaid) would need to be several times larger the one estimated for the project (Figure 4). For example, reducing all loans' maturities from 20 years to 10 years would require a tariff 50% higher to cover the debt service of the loans, while with maturities of 7 years, the tariff would have needed to be almost three times than the agreed one. The effect due to lower interest charges is less remarkable but still considerable, an average interest charge close to 10% or 15% would have demanded a higher tariff in the PPA by, respectively, 10% and 25%.

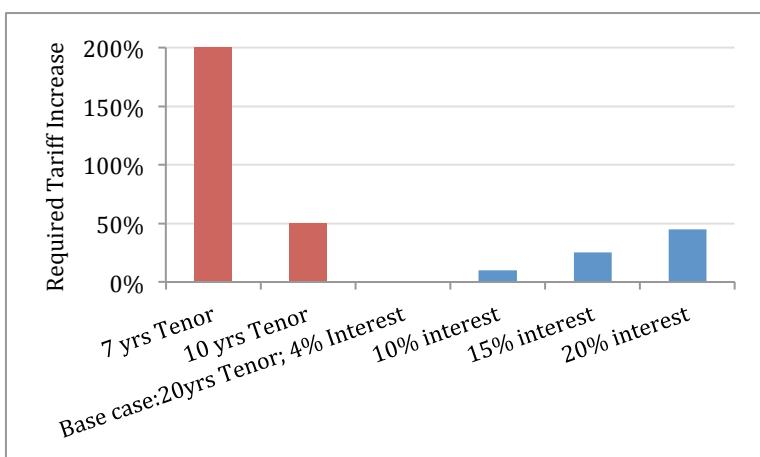


Figure 4: Concessional Loan Impact: Tariff Increase required in the hypothesis of full commercial financing – Source: Author

Risk mitigation instruments, in turn, contributed to the financing of the project in two ways: they mobilized both equity and debt private capital; and reduced investors' perceived political and regulatory risks, and the losses that would follow from a negative event.

PRGs, in particular, managed to mobilize loans from commercial banks at a maturity and interest rates comparable to the concessional ones: these terms allowed a reduction of the required initial tariff between 7% and 60%, depending of the assumption considered for the commercial lending terms – e.g. had commercial banks provided their loans at 20% interest rate and 7 years maturity, the initial tariff required to keep the equity remuneration at 19% IRR and the debt service at 1.4 would have needed to be 60% higher than the one agreed for the project (Table 4).

Table 4: PRG Impact: Initial Tariff Required with Commercial Loans provided at Commercial Terms – Source: Author

Commercial Interest Rates	10% Interest	15% Interest	20% Interest
Commercial Maturities			
7 yrs Tenor	50%	55%	60%
10 yrs Tenor	18%	25%	28%
15yrs Tenor	7%	12%	18%

Both **PRG and PRI also reduced investors’ perceptions of political risks and improved project’s financial resilience in case a negative event occurs.** Through Monte Carlo simulations, the analysis assesses the impact of a renegotiation of the PPA payments (e.g. the government defaulting on its obligations) on the project financial profile and its ability to remunerate debt (hence on the probability it would default) and equity investors (hence on the rate of return, or the net present value of the investment). Under different assumptions for the (ex-ante) probability of such renegotiation to occur, and the final amount of the renegotiated PPA, the simulations compare the results of four risk management strategies available to project sponsors: the use of project company’s internal resources; the use of only one risk mitigation instrument; the combined use of both PRG and PRI. The simulations model the chain of events triggered by a political risk event and the risk management process, considering not only the probability of the adverse event occurring but also the probability of risk mitigation strategies to succeed in avoiding losses or compensating for damages.

For the PRG, consistently with the instruments’ terms of reference (WB, MIGA and IFC, 2007), the simulations assume the PRG is triggered only once the project has exhausted its internal resources to service the debt; for the PRI they use instead historical values from MIGA’s track record for the time needed for negotiations with the government to attempt to revert the change (between 2 and 26 months¹³⁴) and their success rate of 93.7% in negotiations (MIGA, 2011a); and for the time and amount of the MIGA’s compensation in case the claim is finally accepted (6-13 months¹³⁵).

Figure 5 presents a summary of the simulations’ results after 1000 random generated scenarios have been created for each risk management strategy under different probability (the horizontal axis) and amount regimes (the vertical axis) for retroactive PPA reductions: the four charts on the left present

¹³⁴ It has historically taken between 2 months (Kenya Kibo’s sugar) and 26 months (East Java Pwr Corp. In Indonesia, Himal Power in Nepal) for trying to settle things with the governments before submission of claim request (MIGA, 2012b).

¹³⁵ MIGA aims to provide compensation within 6-13 months following the date of claim submission (MIGA, 2011b)

the average frequency of project defaults in the simulations; the charts on the right the average project net present value (NPV) for the equity sponsor. The green areas in the figures indicate the most favorable outcomes for investors: no occurrence of debt default on the left, and the highest NPV on the right. Conversely, the red areas represent an almost certainty of project defaulting on its debt obligations (on the left) and a NPV of zero or negative (on the right).

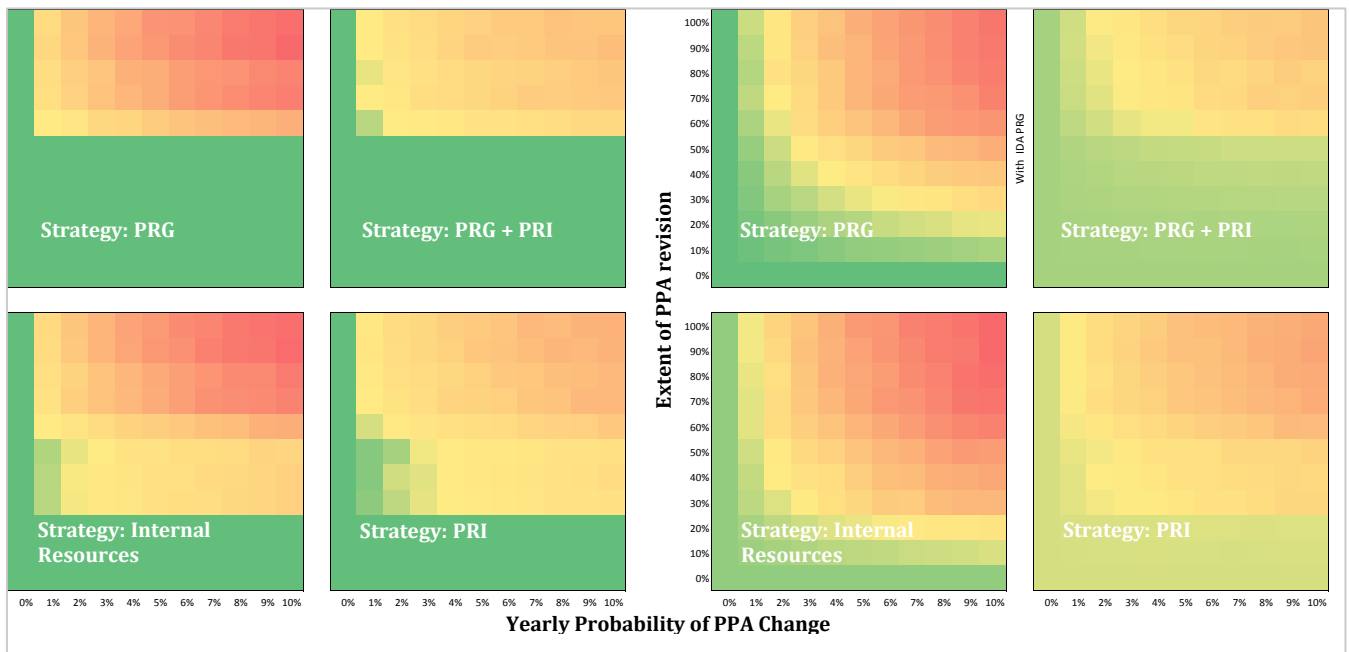


Figure 5: Default frequency (left) and NPV changes (right) for different levels of PPA revisions probabilities and amount, under for risk mitigation strategies - Author

Impact of IDA PRG: Despite formally restricted to the coverage of assets provided by commercial lenders, PRG’s ability to enable longer debt tenors mitigates the impacts of political risk on both the project debt’s performance, and shareholders’ returns. Against debt defaults, the high level of PPA tariff is certainly the first level of protection, as it guarantees an after-taxes project cash flow almost twice than the debt payments. This provides a very effective first buffer for the project, whose high cost is however covered by local public money. As seen above, by facilitating commercial loans at longer maturities, the PRG allows a better coverage of the debt payments, hence making the tariff even a better cushion able to withstand PPA changes up to 50% of the tariff amount. Above such threshold, however, the guarantee is ineffective in mitigating the risk of debt default, as changes become large enough to jeopardize debt payments.

Impact of MIGA PRI: The PRI is particularly suitable for high-risk contexts, as higher risk perceptions justify the instrument's cost for equity holders. MIGA PRI increases the project's expected NPV by 18.1%, compared to a strategy which excludes the use of WBG risk mitigation instruments, but its performance is not uniform and gradually increases with the probability of a PPA change: from 1-5% for low risk scenarios to 50-60% for high risk scenarios.¹³⁶ Given its relatively expensive annual premium of around 1/1.25% – entirely borne by equity holder Sithe Global – in these simulations MIGA seems economically beneficial when probabilities of PPA revision are higher than 2%, per annum or magnitudes of PPA revisions are above 10%.¹³⁷ Furthermore, while covering only a portion of equity assets, MIGA negotiation capabilities are able to enhance the entire project, including its credit performance. The high rate of success in negotiations (90-95% as reported by experts (Kimber, 2014) and confirmed by the six claims have been paid by MIGA against 90 successfully resolved disputes (MIGA, 2011a)) significantly impacts the credit profile of the project, whose chances of default are reduced by a half with the involvement of MIGA. However, in the event of a substantial PPA change, the provision of MIGA PRI might not sufficient in improving project credit performance as the occurrence of default depends on the project's ability of temporarily compensate revenues shortfalls until negotiations are ongoing. As the time needed by MIGA for negotiation may require (at times) more than 2 years, this is certainly a potential area of improvement, and here DFIs could play a crucial role. The simulation exercise assumes the Bujagali Hydroproject can deal with temporary inability to pay back debt using corporate equity, or using a reserve fund dedicated to prevent debt default, but not all companies may be large enough to source this financing internally.

The combined effect of PRG and MIGA allows synergies by lowering transaction costs and further improving expected returns for loan and equity providers. The possibility by the World Bank to leverage on skills available across its multiple agencies ensures economies of cooperation have already been achieved in the case of Bujagali Hydropower in terms of reduced transaction costs: coordination aspects, centralized financial assessment of the project, centralized environmental and social impact assessment. In addition, simulations' results indicate that a coordinated use of the instruments is also

¹³⁶ Low risk scenario: levels of probability of PPA change (below 5% per year), or magnitude of PPA revision (below 50%); High-risk scenario: levels of probability of PPA change (over 5% per year), or magnitude of PPA revision (over 50%).

¹³⁷ In general if the PPA change involves minor changes, and if the project is still remunerative for the developer, the client would refrain anyway from contacting MIGA and going into arbitration to avoid clashes with the government (Kimber, 2014).

able to achieve financial synergies, relative to what the instruments could achieve separately, with lowering a further 7.4% the average frequency of project debt default, especially for significant changes of the PPA - and increasing by 12.7% the expected returns for the equity holder.

Finally, and not surprisingly, notwithstanding which risk mitigation strategy is implemented, the expected probability of a PPA revision has a large effect on the project's financial profile, especially on the equity returns, as the project NPV significantly deteriorates when moving towards the right side of each chart. The expected probability is also the lever on which these risk instruments' can have their highest influence, as proved by the fact that PRGs have never been called since their inception, while MIGA has successfully solved 94% of the disputes negotiated with governments. The financial ties between the World Bank Group and the host country can greatly improve the perceived risk profile of the project for both lenders and investors, as it would be fair to assume that when adopting a strategy that includes PRGs and PRIs the expected probability of PPA revision can be significantly reduced. In graphical terms, this change of risk perception would translate in moving horizontally towards the left of the charts in Figure 5, with both expected NPV changes and frequency of defaults improving for both investors and lenders.

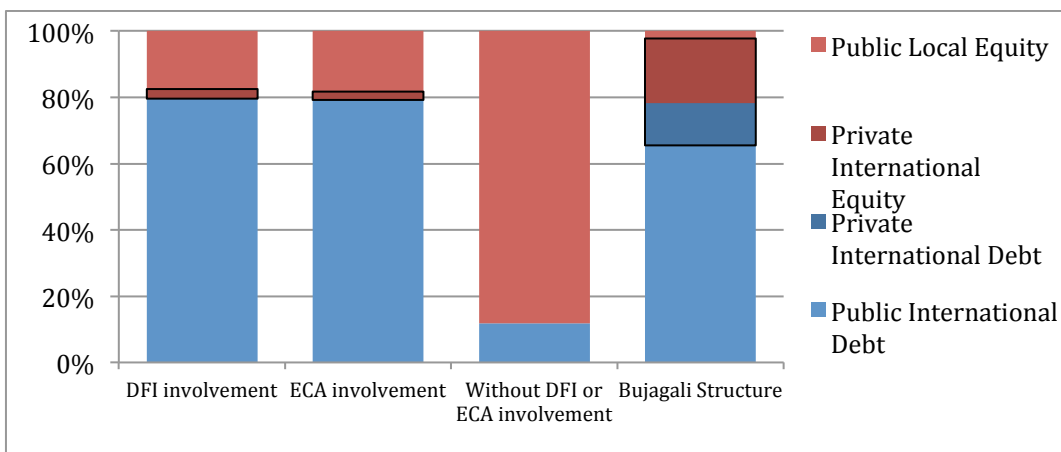
3.3.2 Bujagali's financial model in the hydropower landscape

To assess the effectiveness of Bujagali's financial model - in terms of private capital mobilized and time to financial closure - its financial structure and performance has been compared with 10 large-scale hydro power projects financed in Africa between 2005 and 2013, including both greenfield and expansion projects with a capacity larger than 50 MW. In this instance, the effectiveness is measured by the overall amount of financing mobilized beyond national governments budgets, the share of private resources mobilized and the time required to complete the financing package.

Three main models have financed hydropower in Africa and can be compared with the financing of Bujagali: two models combining private investors with development financial institutions (DFIs), or export credit agencies (ECAs), and a more traditional model anchored on local public financing commissioning the plant to private contractors.

This cross-sectional comparison offers the following three insights:

First, the participation of DFIs to hydropower projects facilitates the acquisition of higher shares of debt capital in the projects with respect to traditional equity-intensive forms of financing (adopted particularly in the past in Africa), managing to cover on average 80% of the investment costs. The amount of debt in Bujagali, in particular, is considered “unprecedented” for Sub-Saharan Africa’s Projects (Eberhard *et al.* 2011). Similar debt on equity ratios can as well be achieved by involving ECAs, as these agencies can usually finance up to 85% of the investment, at the condition that developers come or purchases technology from the same country. A significant number of such combinations have involved Chinese government-backed institutions as debt and technology provider, with the China Exim Bank, subsidized by the foreign aid budget of the Ministry of Commerce, providing a package of commercial and concessional loans (Hensengerth, 2011). Compared to the model with ECAs, however, the participation of multilateral banks has usually increased the level of transparency and accountability of the projects, in particular on the systems adopted to mitigate risks and their environmental and social impacts (Hensengerth, 2011; Eberhard *et al.* 2011).



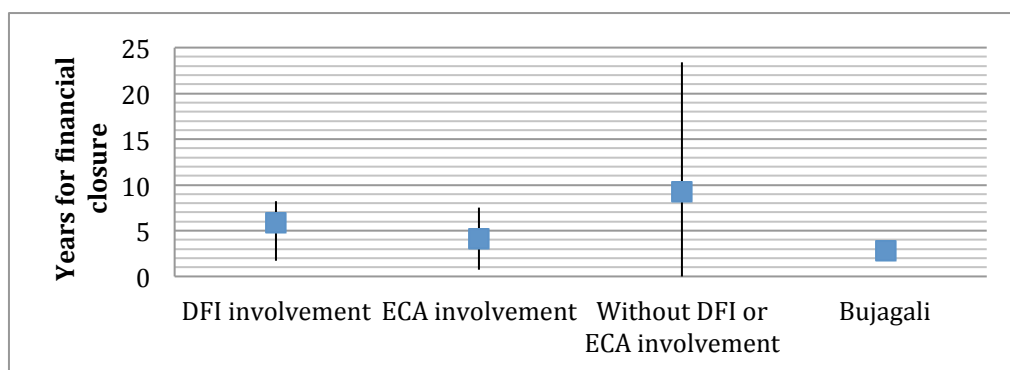
NOTE: Figures for hydro projects with DFI involvement do not include Bujagali.

Figure 6: Private sector leverage in financing hydropower in Africa – Source: Author

Second, the combination of DFIs financing and risk mitigation tools in Bujagali has allowed the largest mobilization of private resources: the project is one of the few ones financed with the help of the **private sector**, achieving the **highest leverage since 2005**, (almost USD 1 of private capital investment for each USD 2 of public financing). Despite hydro being a consolidated technology, in general it is difficult to do a project without the financial engagement of the public sector, either as national public equity investor or as international/governmental foreign debt provider (Figure 6).

Overall the Bujagali hydropower plant represents the most important private initiative in the Ugandan energy sector, totaling 67% of such investments in the period 2003-2012 (WB, 2014). Besides the use of de-risking tools, the mobilization of private resources is achieved more frequently when the projects are formally structured as public-private partnership, as in the case of Bujagali. In this case, importantly, private capital enters in the riskiest part of the investment as well.

Finally, despite expectations of long transactions associated to the deployment of DFIs instruments as in the case of Bujagali, comparison with existing hydro projects (see Figure 7) shows that Bujagali needed less than the average time required to reach financial closure.



NOTES: Time needed for financial closure is defined as the difference between the approval of the project, i.e. the identification of project developer via bid/tender, and the signature of the last financial agreement (signature of the PPA, or of the loan agreement). Figures for hydro projects with DFI involvement do not include Bujagali.

Figure 7: Time to financial closure for large hydropower projects in Africa – source: Author

The evidence from the other projects in the data sets suggests that delays have been very common for a large number of the hydropower projects operating since 2005, often related to a variety of factors, like changes in laws affecting the PPAs (the Itezhi Tezhi Hydro Power project in Zambia¹³⁸); institutional, governance, social and environmental concerns impacting on the participation of key actors in the project (Sundu Miriu Hydro Power Project in Kenya¹³⁹); contractor performance (Kiira Power Station in Uganda¹⁴⁰), and local funding shortages or war events (Capanda project in Angola¹⁴¹).

¹³⁸ In Zambia, a statutory instrument stating that all deals between Zambian entities should be priced in local currency stalled negotiations determining a delay in the signing of the PPA for the Itezhi Tezhi Hydro Power project. Deal became possible after the PPA was no longer categorized as domestic transaction (Project Finance, 2013).

¹³⁹ In the Sundu Miriu Hydro Power Project in Kenya, due to institutional and governance concerns raised by financiers and by Africa Water Network and Climate Network Africa related to habitat loss due to the construction of the tunnel, and effects on health of the local residents, the Export Credit Agency JBIC initially withdrew from the funding. However, social and environmental concerns have been mitigated, and JBIC resumed financing in 2004 (UNFCCC, 2007).

¹⁴⁰ In the case of the Kiira Power Station in Uganda, defects noted during commissioning tests delayed commercial operation of the units by about 2.5 years (WB, 2009).

4. Conclusions

Risk mitigation instruments have proved very effective in mobilizing private capital towards investments in several high-risk environments, nonetheless they seem to have been under-used so far, especially for climate change related investments. Most of the barriers to their utilizations concern lack of knowledge about their performance, the perceived complexity of necessary processes and the high level of costs compared to their contribution. The detailed analysis of the financing model underpinning the Bujagali Hydropower has shown in practice the contribution of both partial risk guarantees provided by the WB and MIGA political risk insurance to the project financing of a large-scale project in a high-risk and financially weak environment. The effectiveness of the financing model has then been evaluated in terms of the impact on the final project costs for the country, and in terms of the project financial resilience against adverse events of political risks.

The analysis has allowed the following insights:

Despite the very low penetration of private investments in the country and the high risks perceived due to the energy sector's poor financial health, **risk mitigation instruments have been able to mobilize private capital in both the equity and debt part of the capital structure.** Furthermore, the private debt mobilized has been provided with the same long maturities and low interests than concessional financing, helping to ensure the affordability of the power produced by the plant.

The direct compensation offered in the case of a risk event improves the project financial performance on average, and especially in high-risk scenarios, where perceived probability and the expected magnitude of a risk event are high. More importantly, **the combination of the two de-risking tools also lowers the probability of the occurrence of political and policy risk** (defined here as a default on their obligations by the government or the state-owned utility) proven by the history of successful negotiations for MIGA and by the fact that the PRGs have never been called. Finally, despite the higher complexity and transaction costs perceived with the involvement of these risks instruments, **the time required for the financial closure of Bujagali Hydropower doesn't seem to exceed the average time required for other large size and complex hydro plants in Africa.**

¹⁴¹ The Capanda project in Angola was supposed to start generating power in December 1993. However, the dam was attacked, occupied and damaged by rebels twice (1992-1994, and 1999-2000). Rehabilitation started in 1999 and construction was finally resumed in 2000 (International Rivers. 2010).

Significant room for improvement remains: the mitigation potential of the instruments could be highly enhanced if, the instruments could provide some financial compensation to the project company and help it service costs and debts while not receiving the contractually stated revenues, given the average time needed for negotiations with the government. Latest changes in the offering of the PRGs, that now can be provided via letters of credit of commercial banks for payments shortfalls (WB, 2013), as well as the partial expropriation clause covering business income losses offered by OPIC (see Chapter 1) seem to go in the right direction and should be welcomed by project sponsors and investors. Finally, the amount of counterparties involved and, especially in a PRG the need of the government counter-guarantee, increases both complexity and transactions so that the instrument becomes economical only for very large-scale projects, usually much larger than the typical renewable energy installation. On this regard, the recently introduced, but still unproven, project series guarantees of the WB could address this barrier and find application in renewable energy programs where smaller scale projects can be aggregated under a single risk mitigation package. Their effectiveness and impact on transaction costs should be assessed once they'll begin to be deployed.

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Final Remarks

Fighting climate change is at the same time a key financial challenge of our times and a remarkable investment opportunity towards a more sustainable economic growth. The transition from a high-carbon to a low-carbon economic system requires the mobilization of financial resources that has only a few precedents in history. In the global economy these resources are, however, already available: the crux of the challenge is not an issue of shortage of capital, but one of a drastic redirection of investment flows out of conventional usages into new, low-carbon and climate-resilient assets.

Investments are already flowing towards this opportunity, yet overall financial flows toward low-carbon assets fall short of what is needed, as knowledge gaps, regulatory uncertainties and market failures make these investments perceived, often unduly, as high-risk. Policymakers and international public finance can play a decisive role in controlling, alleviating and mitigating these risk perceptions in order to facilitate the mobilization of private investments, while at the same time lowering the cost of the investments. However, not all investment risks need mitigation from the public side: investors are generally willing to take certain types or certain amounts of risk, and allocate others to better-placed market counterparties; furthermore, the public sector might not always be the actor best suited to take certain risks.

This work aims to contribute to the literature and to policymaking in two ways: in improving the understanding of which risks are acting as the main barrier to private investments and should be addressed with priority by policymakers; and, second, by providing evidence of how risk allocation frameworks supported by national policies and international public finance can be effective in lowering the cost of low-carbon technologies and engaging private investments at scale, especially in emerging economies and high-risk environments, where the investment needs are actually the largest.

Chapter 1 has answered the question: *“What risks matter the most in low-carbon investments and which ones need mitigation by the public sector?”* Evidence from investment patterns and direct engagement with asset owners and financial intermediaries has shown that, in both developed and developing countries, *regulatory and financial risks act as the main barriers to private sector*

engagement in low-carbon investments. Many of the risks perceived by investors for low-carbon assets are not very different from commonplace risks that investors face in traditional infrastructure investments. However, certain specific characteristics of green investments increase risks perception or limit the amount of risk mitigation instruments provided by the market, hence creating *Risk Gaps*, instances of demand for risk coverage unmet by an adequate supply of risk mitigation instruments. Low-carbon investments frequent reliance on public support to ensure assets' financial viability (due to higher technology costs than conventional alternatives) increases the perception of policy and regulatory risks, leading to a demand of risk coverage that often remains unmet in the market as the private sector might not be well suited to cover risks that are originated by governments defaulting on their obligations. Besides, for more pioneering technologies (e.g. concentrated solar power), their novelty and lack of robust performance track records increase the perception of physical and technical risks from investors, but also limit the supply of risk mitigation instruments in the market as their providers do not have the necessary loss histories to correctly price the risk at levels they feel comfortable with. Finally, in high-risk environments such as least developed countries, several risks (political, physical, financial) compounded by underdeveloped financial markets can completely prevent private investments in low-carbon infrastructure or increase their financing cost to levels that severely preclude their affordability for the countries.

Chapter 2 has tried to quantify the cost of this *regulatory risk gap* in terms of increased investors' risk aversion and increased financing costs in countries with unstable regulatory regimes or that have experienced retroactive policy changes. By focusing on the experience in Spain with support policies for concentrated solar power, the analysis has showed that policy instability and risks can completely halt private investments in these technologies, and lead to an increase of financing costs that can compromise the appeal of these investments even in presence of significant technology cost reductions. In particular, evidence from project financing in the Spanish CSP sector indicates that, following several regulatory changes since 2009, retroactive policy changes have translated into prospective policy risk and significantly increased risk aversion of both equity sponsors and commercial lenders: as of today, fewer sponsors would be willing to commit resources for this

technology in the country, while available lending packages would be more expensive, of shorter maturities and cover smaller shares of the overall investment costs. With such financing structures, even assuming significant (approximately 30%) technology cost reductions as indicated by the latest CSP installations in other countries, levelized power production costs (as measured by a plant *LCOE*) have increased and projects would ultimately require more than a 20% increase from the former 2007 feed-in tariff to see the profitability of a Spanish CSP plant in line with both the Spanish market and CSP investments in other countries.

The analysis indicates that, in presence of high policy instability and regulatory *risk gaps*, establishing a transparent and stable support framework that can combat policy uncertainty should be a higher policymakers' priority over setting a different level for the support or a new feed-in tariff.

Starting from the evidence of *risk gaps* occurring for the less developed clean technologies, **Chapter 3** answered the question "*How can policymakers and international public finance provide effective de-risking tools for promising but yet not commercially competitive clean technologies in developing markets?*" Investment risk perceptions can be substantially higher for promising renewable technologies, such as concentrated solar power, whose costs prevent them to compete with other more established renewable technologies or conventional solutions, and whose novelty and lack of established performance track records discourage market players to provide necessary risk mitigation instruments. When considering the deployment of these technologies in emerging economies – to harness their great generation potential and large system benefits - investment risks compound with developing market risks making these investment opportunities unsuitable for the private sector. *The cooperation between national policymakers and international finance can however effectively de-risk these investments and successfully attract private investments.* Detailed analysis of the financial structures of the large-scale CSP plants in Ouarzazate (Morocco) and Rajasthan (India) has proved that a suitable regulatory framework that covers the technology viability gap in a way that is perceived sustainable by the market can attract private investors in partnership with the public sectors or as independent power producers, as in the case of Morocco and India, respectively. In such contexts, international public finance can play a crucial role in reducing the weight of the support on public

budgets by providing concessional loans in countries where private finance would be too expensive (e.g. Morocco) or extending maturities in those markets in which commercial investors are present but poorly suited for project finance (e.g. India). Both examples also show that, if well executed, policies can be successful in delivering technology deployment while fostering competition and drive down technology costs. Nevertheless, there is still much room for improvement: when international financial institutions provide their capital in a currency different from the domestic one, the cost of mitigating the risk of adverse currency fluctuations can be so high to cancel out most of the public finance's positive effects on the cost of energy – in the case of the CSP plant in Rajasthan, excessive currency hedging costs offset more than half of the benefits due to the long-maturity public finance loans. Finally, **Chapter 4** has provided an empirical answer to the question “*how publicly-backed risk mitigation instruments can effectively mobilize investments in high-risk environments?*” The analysis of the financial structure of the Bujagali Hydropower project in Uganda has highlighted how publicly-backed risk mitigation instruments can effectively reduce perception and impact of risk on investments in environments with minimum private capital penetration and severely underdeveloped financial systems and institutions. The simulation of project's financial transactions and cash-flows has demonstrated how partial risks guarantees and political risk insurance effectively improve the expected financial resilience of the project against negative outcomes while, at the same time, mobilizing private capital at more favorable terms, improving the affordability of the power generated by the project for the host country. Interestingly, despite the number of actors and the complexity of the transactions involved, these risk mitigation instruments do not seem to increase the time needed for the project financing, when compared with similar transactions in the same region. The analysis of the Bujagali Hydropower has shown that synergies between different instruments exist, and a combined provision of several instruments can realize economies of cooperation and reduce transaction costs. However, the analysis also shows that instruments' effectiveness could be further improved, as several implementation challenges and high transaction costs greatly limit both the demand and the supply of these instruments, so that their current deployment in renewable investments appears much below what would be needed.

Recognizing both the potential and the challenges of a scaled-up implementation of these instruments, international financial institutions are modernizing their offering, improving the effectiveness of existing instruments and proposing new ones that could fill the gaps currently perceived by investors and succeed in mobilizing the, still large, portions of the investment community that shy away from low-carbon and climate resilient investments. The recently introduced World Bank PRGs provided via letters of credit of commercial banks for payments shortfalls, those issued against series of projects and investment programs, as well as the partial expropriation clause covering business income losses offered by the political risk insurance from OPIC, seem steps in the right direction, whose effectiveness and impact on transaction costs should be assessed once they'll begin to be deployed.