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# Financing the Commercialisation of Green Innovation

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## Abstract

Innovation plays a large role in green growth. While it is a widely accepted view that, without innovation, it would be very difficult and costly to address major environmental issues, innovation itself tends to be constrained by limited access to eco-financing and is inherently risky, often requiring a long-term horizon.

Although global consensus is more or less established as to the urgency and necessity of accelerating green innovation, the quality and quantity of financing in this area is largely insufficient, with increasing funding gaps in many countries. A new financial mechanism is urgently needed in order to re-orient financial flow and enable innovators to overcome the valleys of death that occur throughout the innovation cycle.

A number of different modalities exist in financing the commercialisation of eco-innovation. Existing mechanisms have not been as successful as expected, revealing critical limits to furthering certain types of projects that are essential for economic and environmental progress. Experts' estimations have shown that the funding gap will widen in the coming years as demand for clean energy and green infrastructure rises, and as green technologies and innovation develop faster than the market for it can develop.

Against this backdrop, the main purpose of this research is threefold: to identify issues and problems regarding current means of funding for eco-innovation and green projects; to provide insight into securing long-term green financing by looking at European cases; and ultimately to suggest policy implications for designing and implementing eco-specific financial instruments, focusing on governments' roles in sustainable financing for eco-innovation.

This study analyses different models of financing mechanisms, a mix of public and private funds, in view of suggesting conditions for the sustainable financing of green projects, especially for large-scale high-risk projects. Based on the findings from the analyses of mechanisms and the shortcomings of the existing funding

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modalities, this study ultimately suggests policy implications for effectively supporting the commercialisation of eco-innovation.

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Keywords

Eco-innovation, eco-financing, double valley of death, commercialisation of green innovation

## 1. INTRODUCTION

### 1.1. Background to the Research

Ensuring sustainable growth and the progress of our society should be one of the most fundamental concerns of all governments and policy makers. However, the ‘sustainability’ of growth and progress can be guaranteed only if our economy ensures that ‘natural assets continue to provide the resources and services on which our well-being relies (OECD, 2011a, p.9),’ which underlines the urgency of decoupling in the context of environmental quality and economic production. The agenda of greening growth first emerged to address the series of questions around synergies and trade-offs between economic growth and the environment.

Since the late 2000s, green growth has been one of the most discussed topics in the area of global governance. It emerged as a core agenda item that is today perceived by many countries as a tool for advancing national and global economic growth. Having developed beyond conceptual debates, policy makers have reached a consensus on the importance of green growth and the urgency of implementing a green growth strategy. This consensus reflects the world’s growing concerns over climate issues, environmental degradation, energy insecurity, and a worsening economic downturn.

Green growth as a political programme, initiated by the Korean government, has gone on to be adopted and developed by other OECD (Organisation for Economic Cooperation and Development) members and has thus by increments earned full credentials as a legitimate policy option.<sup>1</sup> It evolved beyond its initial criticism of being a hollow political slogan and is now a national and international priority for industrialised and developing countries alike, even with the current unstable economic situation worldwide.

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<sup>1</sup> Although serious discussions of trade-offs and synergies between environment and economic growth date back to the 1970s, the term “green growth” was first said to be coined in the field of public policy by the Korean government and the UN ESCAP at the Seoul Initiative Follow-up Meeting in 2008. Meanwhile, the first official use of the term “low-carbon green growth” was by the then President Lee Myung-bak at the 60<sup>th</sup> Anniversary of Korean Independence on August 15, 2008.

Since 2009, green growth strategy has developed into a crosscutting issue, involving diverse directorates of major international governmental bodies—notably the OECD and the UNEP,<sup>2</sup> and more recently the G20 in Mexico—as well as that of many different government ministries in many countries. Such rapid expansion reflects an overall awareness of the serious pitfalls associated with current development patterns and a desire to find new sources of growth. It is believed that the implementation of a green growth strategy may help rebound economies from the slump, simultaneously improving environmental conditions or at least halting environmental degradation so as to meet internationally agreed climate-related targets.

Discourse on green growth increasingly dominates the two global governance tenets of today, “global growth governance” and “the environmental governance.” Green growth strategy largely consists of fostering green innovation through investment, and generating new markets and jobs in order to turn the current economic crisis into a new opportunity for economic growth while minimising environmental degradation.

Innovation plays a large role in green growth. Existing production technology and consumer behaviour can only be expected to produce positive outcomes up to a certain point of saturation, beyond which depleting natural capital has negative consequences for overall growth. Innovation can push this frontier forward by decoupling growth from natural capital depletion (OECD, 2011a, p. 10). While it is a widely accepted view that, without innovation, it would be very difficult and costly to address major environmental issues, innovation itself tends to be constrained by limited access to eco-financing and is inherently risky, often requiring a long-term horizon (OECD, 2011a, p. 51).

## 1.2. The Scope of the Research

This study analyses different models of financing mechanisms, a mix of public and private funds, in view of suggesting conditions for the sustainable financing of green projects, especially for large-scale high-risk projects. Based on the findings from the analyses of mechanisms and the shortcomings of the existing funding modalities, this study will suggest policy implications for effectively supporting the commercialisation of eco-innovation. The main focus of the research is on the different types and cases of government intervention designed to overcome financial market failure and mobilise private funds for green innovation. With a special emphasis on green financial instruments and institutions, policy suggestions will be made on the government’s integral approach extending to areas associated with the “double valley of death” in order to effectively finance green innovation while minimising the potential risks.

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<sup>2</sup>The UNEP(2012) advocates ‘green economy’ rather than green growth. Green economy is a pillar of the UN sustainable development agenda, which focuses more on developing countries’ adoption of the green agenda in their economies. The OECD’s green growth strategy has recently extended its scopes to include non-OECD countries as well. At the recent Rio+20 event, OECD representatives underlined that the purpose of a green growth strategy should not be to create a policy tool to replace sustainable development but to create one that accelerate sustainable development.

Sustainable financing is not the sole condition for achieving green innovation. Successful innovation policy may involve a wide range of instruments from research and development (R&D) at the laboratory to commercialisation in the market. However, this paper highlights the problems of financing in the later stages of green innovation since commercial-scale demonstration and wide adoption and deployment of green technologies and solutions are critically hindered by lack of funds at this particular stage.

Although global consensus is more or less established as to the urgency and necessity of accelerating green innovation, the quality and quantity of financing in this area is largely insufficient, with increasing funding gaps in many countries. A new financial mechanism is urgently needed in order to re-orient financial flow and enable innovators to overcome the valleys of death that occur throughout the innovation cycle.

A number of different modalities exist in financing the commercialisation of eco-innovation. Existing mechanisms have not been as successful as expected, revealing critical limits to furthering certain types of projects that are essential for economic and environmental progress. Experts' estimations have shown that the funding gap will widen in the coming years as demand for clean energy and green infrastructure rises, and as green technologies and innovation develop faster than the market for it can develop.

Against this backdrop, the main purpose of this research is threefold: to identify issues and problems regarding current means of funding for eco-innovation and green projects; to provide insight into securing long-term green financing by looking at European cases; and ultimately to suggest policy implications for designing and implementing eco-specific financial instruments, focusing on governments' roles in sustainable financing for eco-innovation.

By interlinking the two core issues of green growth innovation and investment in an eco-innovation context, this paper identifies the shortfalls of existing funding both in quality and quantity, using as primary sources a number of government documents and papers issued by relevant institutions that analyse the various features and drawbacks of different funding methods. Interviews with government officials and observations on related workshops and international meetings were used as supplementary sources in order to enrich the analysis.

### **1.3. Defining Eco-innovation**

"Eco-innovation is a phenomenon with two types of positive externalities, technical and environmental, that occur at various levels (OECD, 2012b, p. 6)." Eco-innovation is considered essential for opening the door to sustainable development and green growth (OECD, 2012b, p. 8). According to the OECD *Oslo Manual*, "innovation comprises technologically new or significantly improved products or processes." Eco-innovation can also be identified by its favourable impact on the environment, although judging this impact is somewhat difficult (OECD, 2011b, pp. 29-30).

The EU's "Eco-innovation Action Plan" defines eco-innovation as follows:

(...)any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resistance to environmental pressures, or achieving a more efficient and responsible use of natural resources. (OECD, 2012d, p. 8)

Similarly, the EU's *Eco-Innovation Observatory* defines it as:

(...)the introduction of any new or significantly improved product (good or service), process, organisational change or marketing solution that reduce the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle (OECD, 2012b, p. 8).

Definitions of eco-innovation can be as varied as the definitions of innovation are abundant. As seen from the above-cited definitions, some emphasise innovation's impact on the environment, and others focus more on the process of innovation. For a simpler but more generic definition, Cooke (2011) defines eco-innovation as "new combinations of knowledge commercialised to minimise human-centred ecological degradation (As cited in OECD, 2012c, p. 8)." As a working definition, this paper takes eco-innovation to mean new technologies and solutions that may substantially reduce negative impact on the environment or improve environmental conditions while producing economic value in the market. This paper is particularly concerned with innovations in large-scale enabling technologies that are highly complex and risky in implementation and potentially significant in their environmental impact. The 'commercialisation' of innovation in this paper includes the stages of marketising innovative technologies that are environmentally beneficial. Green innovation and eco-innovation are used interchangeably depending on the context since green and eco(logical) would both imply positive impact on the environment.

#### **1.4. Outline of the Paper**

The following sections deal firstly with green financing practices in detail. Case studies follow, focusing on three financial instruments, namely Germany's Kreditanstalt für Wiederaufbau (KfW), the European Union's Global Energy Efficiency and Renewable Energy Fund (GEEREF), and the UK's Green Investment Bank (GIB). The section on case studies will be devoted to discussions on major eco-specific financial mechanisms. These discussions will illustrate innovative ways of funding where governments have taken initiative and play key roles in maintaining sustainable funding by mobilising private funds. A framework for green financing can then be drawn from this analysis and comparison of the three instruments. The final section summarises the main findings and policy implications both in general and in the context of further implementation of green growth in Korea. The aforementioned cases were chosen based on the rationale of selecting cases where the primary purpose of government-led green-specific financial mechanisms was to attract private funds. Although the Korean case is not dealt with in the same context, some of the financial mechanisms used for fostering green growth in Korea are introduced in order to provide domestic implications. Finally, this paper argues that the role of government in financing eco-innovation is now crucial due to the particular nature of the market for eco-innovative products and services. Financial institu-

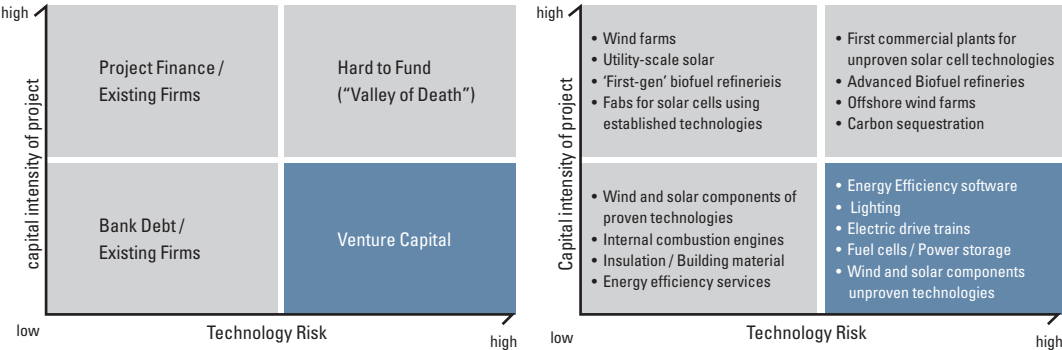
tions in general are well established in most developed countries, and what is required is a redirection of the flow of investments into green innovation so that green project developers and innovators have increased access to funds.

**2. THE DOUBLE VALLEY OF DEATH**

It is well known that the commercialisation of innovation may face a critical financial problem, the so-called “valley of death,” mainly due to a lack of track record and the high risk of failure. Where debt financiers avoid risk that might mean limited returns on their investment, venture capitals (VCs) play a substantial role as a critical source of risk capital for the innovative projects of start-up companies.

However, many eco-innovation projects with high capital concentration commonly face a much more severe funding gap. Due to the nature of investment,<sup>3</sup> VCs have only a limited role in financing such projects. Gosh and Nanda(2010) explain that the financial market failure in this area, addressing a specific case of investment in clean energy projects. The figure below illustrates four different groups of clean energy technologies with different levels of risks and various financing needs.

FIGURE 1. Risk Profiles and Financing Needs



Source: (Ghosh & Nanda, 2010)

<sup>3</sup> Usually VCs preferences are for less capital-intensive projects, which means investing at the early stages of project development when capital needs are relatively small. Venture capitalists do not know for certain which of their investments will turn out to be winners and losers. As a consequence, it is difficult to invest in capital-intensive projects without any further risk aversion schemes (Ghosh and Nanda, 2010).

The bottom-left box highlights technologies that are neither risky nor capital-intensive. They have relatively easy access to finance through bank loans. In the case of large-scale projects, financial access is also relatively easy if they are based on mature technologies such as utility-scale solar power plants or wind farms as shown in the top-left box. Technologies categorised on the right-hand side are too risky to attract debt finance, and are thus mostly dependent on VC investments. While relatively small-scale projects in the bottom-right box can be financed through VCs, high-risk technologies with high capital intensity that are listed in the top-right box (such as first commercial plants for unproven solar technologies) are likely to experience a massive funding gap (Ghosh & Nanda, 2010).

Investment in these projects requires proven commercial viability since the amount of funding may reach several hundred million dollars over a five to ten year period. Such investment is too capital-intensive for VCs, which usually invests no more than tens of millions in any projects. VC investment has decreased in the cases of capital-intensive and radically innovative technologies, with focus shifting to relatively low-risk projects including those for energy efficiency, energy storage and transportation. This is because the pattern of VC investment functions in a similar way to traditional investment in terms of their capital intensity, exit requirements and business models (Ghosh & Nanda, 2010).

With regards to funding barriers faced by large-scale eco-innovation projects, it is often argued that there exists a “double valley of death”<sup>4</sup> during the innovation process. The first valley of death refers to an early stage of innovation during which ideas require further research or pilot studies, and the second valley of death refers to a later stage of large-scale commercialisation. Investment in the second valley, where companies seek financing to scale up and demonstrate their technologies at a commercial level and to secure the necessary equipment for mass production, are too risky for debt financiers and too capital-intensive for VCs.

While the first valley has been identified by many innovation studies and numerous policy efforts, the second valley is not so well addressed. The problems of the second valley are fundamentally linked with shortcomings in market creation that the private sector alone cannot resolve. Even in the cases of small-size projects, efforts to commercialise and deploy eco-innovation are often met with a series of financing difficulties. This is partly because the existing financial institutions are not necessarily familiar with new green technologies and are not sufficiently equipped with the expertise to screen and evaluate such projects. In many countries, notably in Germany, despite a strong guaranteed payment system, it usually takes a long time for financial institutions to familiarise themselves with solar PV projects.

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<sup>4</sup> However, according to empirical research conducted by CEG (Clean Energy Group) and BNEF (Bloomberg New Energy Finance), pre-assumptions about where financing gaps exist have become less useful. It has been discovered that there could be several valleys of death at any stage of innovation whenever ‘entrepreneurs face high cash demands and a significant scarcity of capital’ (BNEF, 2010: section 4). Where and how many valleys of deaths could be met may vary depending on the particular project in question.

### ***Global Demand for Eco-financing***

Experts have estimated that the coming twenty or thirty years will see the most sizeable infrastructure investment in world history after the post-World Wars period of reconstruction, due to the urgent necessity of investment in new green infrastructure. However, because of intrinsic limits to balancing demand and supply in funding, sustainable financing will remain the biggest challenge in furthering eco-innovation. These intrinsic limits include a relatively immature market for eco-innovation. In addition, due to the fixed cost of developing new infrastructure, the current energy and transportation infrastructure market often acts as an entry barrier for new technology.

Quantitative estimation of the funding gap between the cost of green innovation and the availability of funding vary from country to country and depend on individual cases. Countries set different goals for achieving green transformation, and the levels of development in green technology and innovation also vary from one country another. Moreover, research institutes employ different methodologies in specific areas of green technology. An accurate funding gap would be difficult to grasp in quantifiable terms, but nevertheless some figures provide indicative ideas of the future needs of investment in eco-innovation. Addressing climate change issues, the BNEF for example estimates that “at least USD 500 billion will have to be invested in new, low-carbon energy technologies each year starting in 2020,” which represents a tripling of the investment made in the sector in 2009.

At the moment over 85% of investment in renewable energy within the EU are provided by the European Investment Bank (EIB), which is far less than what is actually needed, and the gap is still widening. According to the International Panel on Climate Change (IPCC) simulation on development of renewable energy, it is estimated that between 2012 and 2030, investment in renewable energy sources (RES) for electricity generation alone would require USD 7.18 trillion around the world. Indeed the world market for renewable energy technology is expected to expand fourfold between 2007 and 2030, from USD 165 billion to USD 738 billion.

A recent OECD/IEA study estimates that achieving a low carbon energy sector would require a total investment of USD 104~140 trillion by 2050. This represents at the minimum an average of USD 1 trillion in additional investments each year between 2010 and 2050, or the equivalent of an extra USD 130 per person, or 1% of GDP each year worldwide. With regards to infrastructure investment over the next decade, an estimated USD 2 trillion would need to be invested annually in the power, transport, and energy intensive industry and building sectors, adding additional investments in related low-carbon technologies which would amount to nearly USD 5 trillion (OECD & IEA, 2012, p. 135).

## **3. THE ROLES OF GOVERNMENT AND EFFECTIVE INTERVENTION**

### **3.1. Providers of Public Finance**

The BIS (2011, p. 13-16) summarises five aspects of green financing regarding this complex and



critical funding gap. These factors implicitly indicate a rationale for government intervention in green investments:

- *Imperfect information and information asymmetries*: The lack of a track record in terms of the performance of eco-innovation projects, uncertainty over projects costs, technology risks, and policy risks are predominant in the field of green innovation.
- *High financing transaction costs*: Eco-innovation projects are often high in number but small in size, which raises the costs for assessment, monitoring and organising other sources of finances.
- *Reliance on long-term policy*: Many green investments rely heavily on policy interventions to make them economically viable. Projects often only generate an acceptable return only when policies remain unchanged up to ten years or longer.
- *Novelty of technology*: Eco-innovation often involves the application of new technologies (such as deepwater wind projects or marine power), leading to a limited track record and reduced project evaluation capability.
- *Capital intensity*: Eco-innovation projects are often more capital intensive, requiring a larger number of investors and a greater amount of investments.

There are various methods of government participation in eco-funding. It may provide equity, loan or grants to eco-innovation projects, and employ various types of instruments that can produce synergistic effects while maximising the leverage of public financing to ensure the sustainable mobilisation of private investment. There could be various combinations in the ways that governments provide financing, largely depending on two factors, the providers of public finance and the types of finance (OECD, 2012).

Public finance providers include government agency, government-affiliated organisations, government-owned banks, and government-backed funds. Private sector management can be applied to government-owned banks or government-backed funds, which helps makes their structure more self-sustaining. The government provides an initial capital contribution or commitment to the public financiers and the capital is replenished over time from repayments, commissions or other revenue from their investments.

Public financing can also be provided through private financial institutions such as VCs, commercial banks, or private funds. The benefits of such indirect financing methods can be broadly summarised as follows. Firstly, the government can take advantage of private sector management with its expertise on risk analysis and finance structuring; secondly, the government can exercise a better funding method with the help of the private sector's performance-based evaluation structures and professional risk management skills; thirdly, the presence of government funding *per se* can help to raise additional investment from private financiers; and finally, the returns on investment can be re-

invested into new projects.

### 3.2. Types of Finance

Three broad types of financial support can be considered, namely equity, loans, and grants. Equity is typically provided indirectly through investment funds or other instruments that are fully or partially funded by the government. This is due to the high risk that the government has to bear when an ownership or control situation could be generated vis-à-vis the beneficiaries. Some smaller and riskier projects could be funded entirely with equity, but in many cases equity is applied in conjunction with other instruments, notably with debt financing. Loans or grants could effectively increase total available capital at a lower cost than equity. However, debt financing and grants can be exposed to excess risk with limited return. This may hamper financial sustainability, at times causing moral hazards.

### 3.3. Risk Sharing Scheme

In addition to the provision of public financing, government can offer various incentives to attract private investment and larger quantities of conventional debt capital. These incentives include accepting lower returns on its investment as a means of guaranteeing higher returns for private financiers, accepting longer investment or repayment timeframes, or undertaking a lower position in the capital structure through subordinated debt or first loss equity in order to maximise the protection of private investments.

Furthermore, the government may provide risk aversion mechanisms such as loan guarantees or insurance-like products as well as tax incentives to private investors looking to invest in eco-innovation. In the case of loan guarantees, a risk-based fee that compensates for the risks in question can be imposed on each project while keeping borrowing rates reasonable. Similar to other government financing, these guarantees also provide upside sharing for financial sustainability.

In addition, governments can encourage eco-funding through non-financial measures. For example, governments can help develop and facilitate a private financing network. Table 1 below shows a typology of the government's support based on different approaches in mobilising private financiers.

TABLE 1. Financial Support by Government for Eco-innovation

Type	Instruments
Financial measures	The government may provide equity, loans or grants to enterprises directly or indirectly: - Through public financiers: government agencies, government-owned banks, government-acknowledged funds, etc.; - Through private financiers: venture capitals (VCs), investment banks, private equity funds (PEFs), etc.
Non-financial measures for effective funding	To address the network failure and information problem: - Help develop and facilitate private financing network - Introduce green certification programmes to help financiers identify prominent eco-innovation projects for funding
Additional incentives	To attract private investors, the government may provide various incentives additionally: - Investor protection measures - Risk aversion measures - Tax incentives

Innovative funding mechanisms are necessary to induce private funds in a sustainable manner, along with a certain level of expertise to inform investors of the associated risks and help fill the information gaps when investing in green technology and projects. This is particularly required in the case of large-scale projects involving high risks. In developing countries, the situation would be even more precarious due to these same risks having a detrimental effect on the ability to mobilise private funding. In many developing countries, relevant information is scarce, and existing financial institutions may not have the appropriate infrastructure in place to provide appropriate services. Government's involvement in funding may entail some risk of selecting unnecessary activities due to the difficulties involved in identifying the potential hazards associated with a project, and due to a lack of insight into market mechanisms. This is one of the reasons why public and private partnerships are often considered an effective way of funding eco-innovation. In this context, the Korean case provides a good basis for consideration.

The Korean government pursues various approaches in supplying funds to eco-innovation projects. Bank loans to green industries amounted to 2% of corporate lending during the first half of the Five-Year Plan (2009-13), with state-owned banks providing three-quarters of the loans. Such lending was encouraged through large credit guarantees provided by public institutions. Meanwhile, investment in green industries through venture capital nearly doubled between 2009 and 2011, rising to around half of total venture capital investment. Public funds were provided to eighty-three venture businesses. At the same time, the OECD recommended Korea to engage in providing more private funds. Korea's Five-Year Plan features around 600 projects and has a total budget of 108.7 trillion won (10% of 2009 GDP). Public R&D accounts for 11% of the total, which could help in addressing market failures related to the high degree of uncertainty and long-term horizons in green innovation.<sup>5</sup>

The next section further discusses the innovative modalities of public intervention, focusing on the functions and funding of emerging eco-specific financial mechanisms. The latter illustrates innovative ways of funding where governments play a significant role in sustainable financing through the mobilisation of private funds. By analysing and comparing three cases, a framework for eco-funding can be delineated, which may help other countries in designing and operating a financially efficient and environmentally beneficial eco-funding mechanism.

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<sup>5</sup> However, government support may also hinder more active private-sector participation in eco-funding. In 2009, private firms in Korea were involved in nearly two-thirds of the 4,732 R&D projects in the Five-Year Plan, but their financial contributions amounted to only 8%. Thus, greater involvement by business enterprises is needed to advance green research and private sector-driven innovation. Government intervention should be implemented more cautiously in order to avoid the risk of 'picking winners' which often results in locking into inferior technologies. (OECD, 2012a, p. 19)

## 4. MAJOR CASES IN EUROPE AND COMPARATIVE ANALYSES

### 4.1. The Emergence of Eco-specific Financial Institutions

As discussed in the previous sections, risk-averse private funds are less likely to support large-scale long-term eco-projects. Even small-scale eco-projects at times face difficulties in securing private funds, commonly due to investors' lack of expertise and lack of familiarity with the nature of projects. Governments are usually in an advantageous position to initiate, guide and monitor the funding exercises in this field, and the three examples below demonstrate a common thread in what governments can do to secure sustainable eco-funding.

The recently established GEEREF is a green energy-focused fund, with a particular interest in developing countries. The KfW was established in 1948 as a state-owned commercial bank with increasing emphasis on environmental infrastructure investments. The GIB was launched in October 2012, having final approval of state aid from the European Commission.<sup>6</sup> The institution is unprecedented in its form as a green-specific independent bank that was first initiated and funded by the UK government and has since been transformed into an independent financial institution with a public role.

The GEEREF is an indirect provision of public financing using a well-designed public-private partnership to leverage public funds to mobilise private funds. The KfW can be described as a public financing mechanism that utilizes existing institutionalised funding methods to focus on eco-innovation projects. The GIB is a new institution combining direct and indirect funding provisions, and exclusively focuses on eco-innovation projects.

All three are risk takers in how they cover eco-innovation project investments of all scales and risky technologies that are usually avoided by private financiers. In addition, investments in developing and transitional economies where there is a lack of government involvement may add particular risks that would again normally be avoided by private investors. Many other financial institutions operate with similar funding mechanisms but the three cases mentioned above are, albeit to differing degrees, eco-innovation-focused and government-led. They are also willing to invest in riskier projects without excluding investments in less stable economies in the developing world, and thus fulfill a substantial gap in the market.

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<sup>6</sup> The GIB was launched in October 2012, having secured state aid approval from the European Commission. State aid is a principle under EU law to ensure that EU nations' government interventions do not distort competition and trade inside the EU. However, there are a number of policy objectives that are considered exceptions to this principle. The GIB received European Commission approval as being compatible within the exceptions for EU state aid. (This information is based on email exchanges with a Policy Officer of Economics, Climate, Energy Team, the UK Permanent Delegation to the OECD/British Embassy Paris.)

TABLE 2. Comparisons of the Main Features Between the Eco-financing Institutions

	<b>KfW</b>	<b>GEEREF</b>	<b>GIB</b>
<i>Core features</i>	Existing state-owned bank; fund for domestic and international projects for development aid purposes	Energy-focused; funding projects in developing countries (ACP-focused) outside EU	Environment-specific hybrid (mixture of public and private) fund (to be transformed to a bank); international investment
<i>Establishment</i>	German government initiative	EU, Germany, and Norway-initiative guided by the WSSD 2002 & JREC 2003	The UK government initiative ( <i>at the final stage of preparation, to be launched later 2012</i> )
<i>Initial purpose of establishment</i>	Post-war restoration, environmental protection and supporting SMEs	Searching for triple objectives of people (access to energy), planet (fight against climate change) and profit (financial stability)	Private investment bank focusing on environmentally beneficial technology, innovation, and infrastructure
<i>Funding mechanism</i>	State owned promotional bank; global loans function focusing on CO2 reduction and energy efficiency	Fund of funds (indirect) providing global risk capital	Fund turned to an independent bank
<i>Area of focus</i>	Supporting SMEs, environmental projects, climate change, international development aid	Energy efficiency & renewable energy projects	Offshore wind, energy from waste, and domestic energy efficiency
<i>Strengths</i>	Well established with accumulation of know-how to deal with risks	Developing countries-specific; role of re-directing existing funds to a common goal	Exclusively focused on environmental innovation; leveraging private funds

## 4.2. Kreditanstalt für Wiederaufbau, Germany

### 4.2.1. Establishment

Germany has been re-invigorating the KfW, a state-owned bank, as a means of financing eco-innovation. As a leading promotional bank with over 70 locations, the KfW plays an increasing role in the eco-innovation field and in development aid. The KfW was first established in 1948 for post-war restoration. As early as the 1950s however, the KfW started investing in projects related to environmental protection and SMEs, which still remains one of its core tasks today. As Germany began to take a greater responsibility in international development, the KfW was legally mandated to perform development cooperation and commercial project financing in 1961. The KfW did undergo a period of refocusing on domestic promotion primarily due to the two oil crises (1972–1974 and 1978–1980) and high interest rates that caused economic upheaval. In the 1990s, during the period of German reunification, Aufbau Ost (reconstruction of the East) became its main focus in the form of a joint effort between the KfW and Deutsche Ausgleichsbank (DtA).

In the 2000s, the KfW has shifted its focus to green projects. It made a commitment of EUR 20 billion worldwide for climate protection and other environmental projects in 2009 for which EUR 8.1 billion was spent on energy efficiency programmes and EUR 5.3 billion for renewable energy promotion. It has also supported the Carbon Disclosure Project since 2007. Total investment in 2009 has grown by 31 per cent compared to 2008. In 2011, a EUR 5 billion loan programme was set up, and indirect low interest loans dedicated to renewable energy projects are increasing. Most of the funded projects are consistent with the German government's "Integrated Energy and Climate

Change Programme.” In this way, the KfW gradually recreated itself as Germany's largest environmental and climate bank.

Unlike the GIB or the GEEREF, the KfW’s focus is not limited to eco-innovation projects, yet the KfW avoids financing any projects that are likely to have unacceptable ecological or social impact. Consequently all KfW bonds are called green bonds. Its investments increasingly concentrate on green infrastructure, starting with a reliable energy supply, data networks and roads, railways and ports. The KfW is active in more than 100 countries, helping develop infrastructure on a sustainable basis. (KfW , 2012; Vivid Economics, 2011, p. 45)

#### ***4.2.2. Funding Mechanism and Practice***

As a conventional promotional bank, the KfW’s general functions include domestic promotion, export and project finance, development finance, and special tasks to support the federal government in the performance of global loans and ELENA (European Local Energy Assistance).<sup>7</sup> The bank’s eco-relevant feature is well represented in its “global loans” function. The bank grants loans to banks in partner countries within Europe for investment loans offered to SMEs and eco-construction projects for private housing construction. Much of the global loans currently concentrate on CO2 reduction and energy efficiency through collaboration with local promotional and commercial banks in other European countries.

The KfW in particular has been implementing financing facilities in Central and Eastern Europe in cooperation with the EC and the Council of Europe Development Bank (CEB) since 2000. This scheme combines global loans with grants from the EU Commission. The project was further augmented by the development of an energy efficiency programme in 2007, primarily designed to finance investment in efficient energy use and CO2 reduction, and was used so far in Bulgaria, Croatia, and Romania.

#### ***4.2.3. Evaluation***

The KfW was a stable and established financial agent well before expanding its role in investing in projects on green infrastructure and development aid. This is a main strength of the KfW in contrast to newly established eco-specific banks in other countries. Another advantage is its flexible adaptation to the social and political milieu and its influence on the financial sector both at the national and international level. As seen in its institutional history, the bank successfully moved its focus from post-war reconstruction to sustainable development in accordance with changes in demands both internally and externally. The bank’s accumulated know-how adds stability and reduces risks in its funding activities for large-scale infrastructures and for marketising relatively unfamiliar technolo-

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<sup>7</sup> ELENA is a facility within the framework of the IEE II programme (Intelligent Energy Europe), supporting local and regional authorities in contributing to the EU’s 20-20-20 initiative. The 20-20-20 initiative represents EU’s goal of reducing greenhouse gas emissions by at least 20%, and/or increasing the share of renewable energies in energy consumption to at least 20% and/or improving energy efficiency by at least 20 %, all by 2020. Also available at [http://www.kfw.de/kfw/en/KfW\\_Group/About\\_KfW/Mission/Special\\_Tasks/index.jsp#ELENA-EuropeanLocalENergyAssistance](http://www.kfw.de/kfw/en/KfW_Group/About_KfW/Mission/Special_Tasks/index.jsp#ELENA-EuropeanLocalENergyAssistance) (KfW, August 13, 2012).

gies. As pointed out in the OECD report *Towards Green Growth* (2011), the sound financial system of a country is an important precondition for eco-funding, and Germany's KfW is an institution that meets this condition.

## 5. GLOBAL ENERGY EFFICIENCY AND RENEWABLE ENERGY FUND, EU

### 5.1. Features and Financing Mechanism

The European Commission introduced an innovative funding method that allows for the continuous mobilisation of private money by means of public fund leverage. The EC-founded GEEREF features a “fund of funds,” an indirect funding mechanism that provides global risk capital to energy efficiency and renewable energy projects in developing countries. The GEEREF was initiated by the Directorate General for Environment and Directorate General for Europe Aid Co-operation Office (AIDCO) of the European Commission, with the European Commission, Germany, and Norway as founding investors, and the European Investment Bank and the European Investment Fund as advisors (GEEREF, 2012).

The GEEREF invests in private equity funds that specialise in providing equity finance to small and medium-size project developers and enterprises, focusing on projects and technologies related to renewable energy and energy efficiency. A notable example includes the GEEREF's commitment to Barefoot Power, an Australian small enterprise. Barefoot Power's aim is to fight poverty and climate change in developing countries by distributing household solar light equipment and off-grid power solutions to poor populations that still rely on kerosene. The GEEREF provided Barefoot Power with EUR 1 million in the form of a technical support facility (UNEP, 2012).

In terms of the scope of its support to developing countries, the GEEREF embodies the guidance and discussions made at the 2002 Johannesburg World Summit on Sustainable Development and the 2003 Brussels International High-level Johannesburg Renewable Energy Coalition (JREC). The GEEREF accordingly invests mostly in emerging markets outside the EU with particular focus on ACP countries (a group of 79 African, Caribbean and Pacific countries) in addition to Latin America, Asia and neighbouring EU states with the exception of Candidate Countries. To date, *inter alia*, the GEEREF has invested in East Africa by participating in the New Danish Energy & Carbon Fund and by providing a partial fund to the Di Frontier Market Energy and Carbon Fund (European commission, 2009).

The GEEREF's investments broadly focuses on renewable energy areas such as hydro, solar, wind, biomass, and geothermal, and projects addressing energy efficiency such as waste heat recovery, energy management in buildings, cogeneration of heat and power, energy storage and smart grids. The GEEREF's primary aim is “to accelerate the transfer, development, use, and enforcement of environmentally sound technologies for the world's poorer regions (GEEREF, 2012).”



## 5.2. Funding Mechanism and Practice

The funding mechanism of the GEEREF was designed based on the 2004 EU launched PCI (Patient Capital Initiative), which functioned as a preliminary agreement. Over several occasions in 2006, member countries reached further accord on the urgency and necessity of innovative and flexible funding mechanisms.

The agreed current funding modality of the GEEREF is that the EC establishes a mixture of private risk capital and grants that are managed by professional finance mediators as patient capital. A typical example would be the EUR 0.5 million grants awarded to the German Canopus foundation for the “Solar for All Initiative” towards creating a new fund for an equity facility of the initiative. Other experienced organisations are also working jointly with the GEEREF, namely the Artemisia Foundation, Avina Stiftung, the Deutsche Bank Americas Foundation, the Elea Foundation, the Fraunhofer Institute for Solar energy Systems (ISE), the Lemelson Foundation, and the Woodcock Foundation.<sup>8</sup>

The GEEREF’s decision to participate in the Investment Fund in Africa in September 2011 also demonstrates the unique way of its “fund of funds” operation. A professional investment team called Frontier Investment Management manages the fund, which in turn is based in Denmark with offices in East Africa. The Confederation of Danish Industry provided support through a loan of EUR 7.5 million. In collaboration with a Danish experts group which includes PFA Pension, Pension Denmark, Tryg Insurance and the Danish Government's Investment Fund for Developing Countries (IFU), the GEEREF participates as a member of the expert group at the international level along with the UK development finance institution CDC Group plc and Fabvest from South Africa. The fund’s operations are supported by the EU with a grant of EUR 1.2 million and USD 1 million from the Seed Capital Assistance Facility funded by GEF and the UN foundation, and implemented by the UNEP in partnership with AfDB and Frankfurt School - the UNEP Collaborating Centre for Climate & Sustainable Energy Finance (Climate Funds Update, 2013; UNEP, 2012).

The GEEREF typically invests 25 to 30% of its fund in medium and high level risk sub-funds, and 15~20% in low-risk sub-funds. It also invests in renewable energy and energy efficiency projects with less than EUR 5 to 10 million risk capital, at the same time continuing to provide funds for capacity building projects that use up to 10 to 20% of total GEEREF support.<sup>9</sup> As seen in the Barefoot Power Company case, the GEEREF’s grant was provided at a critical stage when the company was expanding its capacity for commercialising low carbon technologies and an abrupt supply gap was found due to demand from villages in 30 countries throughout Africa that surpassed investors’

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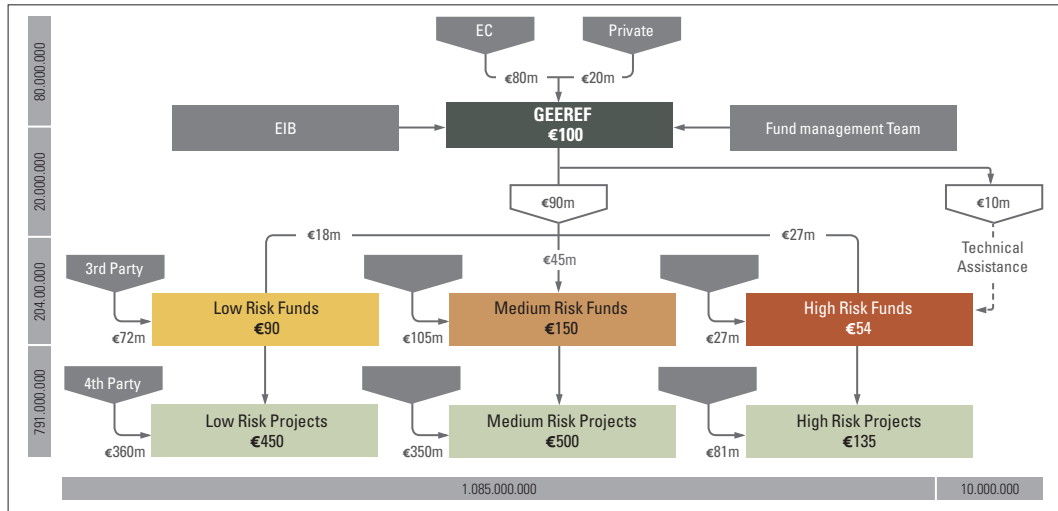
<sup>8</sup> For detailed descriptions and updates on the funding mechanism, the features, and the scope of the GEEREF, see (Climate Funds Update, 2013)

<sup>9</sup> High risk means small projects in least developing countries, where the GEEREF may cover untested markets and need to take an active role in the creation and governance of the sub-funds. Medium risk refers to focus on medium and large-scale projects in middle-income developing countries. Low risk would mean taking strategic position in newly created or existing funds targeting medium and large-scale projects in emerging economies or economies in transition.



confidence. At the point of growing at 25 to 50% per month, the company had almost exhausted its capital base. The GEEREF's timely EUR 1 million support via technical support decisively bridged Barefoot Power's double valley of death.<sup>10</sup>

FIGURE 2. Overview of GEEREF Structure



Source: (European Commission, 2006, p. 17)

### 5.3. Evaluation

With a target of raising EUR 200 to 250 million, the GEEREF successfully mobilised a total of EUR 108 million between 2008 and 2009. However, it is expected that up to EUR 1 billion could be mobilised through funds in which the GEEREF participates as well as the projects in which those funds are invested.

The funding mechanism of GEEREF overcomes the fundamental drawbacks of traditional grant programmes or loan programmes. Grant programmes are normally operated by the EC or its agencies, which select proposals and provide grant subsidies at a certain ratio of the project cost. As administrative costs are high due to the nature of the grant itself, this method has proven to be less cost effective. In the case of loans, the general mechanism is unsustainable because of how its basic operational method is to furnish government subsidies by lowering interest rates to private investors through institutions such as the EIB.

<sup>10</sup> A GEEREF grant has been provided to support the Company's development from early venture mode to growth mode as it seeks further financing to expand its shipping of product containers to developing countries (e.g. India and Indonesia), to strengthen its organisational structure and open up new markets as required, to achieve economies of scale and ramp up its positive environmental impact. (KfW, 2012)

Apart from certain difficulties associated with the GEEREF's funding mechanism and eco-thematic investment, the GEEREF's main strength is in its efforts in greening poorer countries. Developing countries face far more difficulty in financing environmental projects, particularly in encouraging private investment and altering priorities for eco-innovation. Higher risks are involved in eco-financing for numerous reasons. They are mainly derived from higher cost, lower returns, longer repayment periods, unsatisfactory political and commercial conditions, unstable interest rates, and relatively higher transaction costs due to the smaller size of capital.

The GEEREF's investments to date have produced tangible results. By dint of critical support from the GEEREF, Barefoot Power's operation reached 50,000 households in many African countries, notably in Uganda and Kenya. Another 50,000 were reached in over 30 countries including Papua New Guinea, Vanuatu, Haiti, India, Tanzania and Ghana. In these countries, by replacing kerosene with the ten-year lifespan of the solar panel, 95% reduction in expenditure was achieved. This model is expected to grow over ten years while expenditures are invested into larger energy systems that generate more power (GEEREF, 2012).

## **6. THE GREEN INVESTMENT BANK, UK**

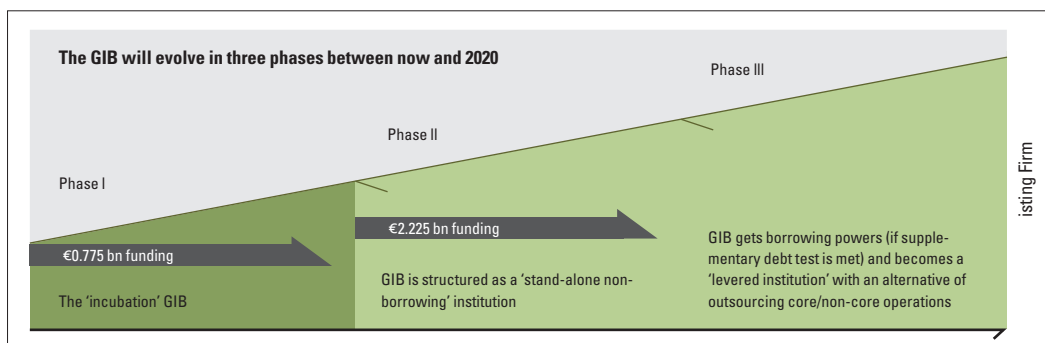
### **6.1. Rationale**

The United Kingdom declared the green economy as one of its most important national agendas for the coming years. It is estimated that the transition to a green economy in the UK will cost a total of GBP 220 to 330 billion in the next decade. Yet funding for such a transition has not been satisfactory in terms of both size and pace. By 2020, a minimum of a GBP 200 billion in investment will be required in the energy field alone, with additional amounts required for core green projects including transportation, waste, water, and floods control. Like other countries, the UK also suffers from a lack of funding, particularly in the field of offshore wind projects. The UK has been a leading country in offshore wind power production, while being slightly behind in terms of overall renewable energy power production compared to other OECD countries. 20% of total power generation should be composed of wind sources, according to the country's objectives. Thus, re-consolidation and expansion of the grid system is their most urgent task. The additional cost for the grid project alone will amount to GBP 4.7 billion in order to achieve this 20% goal by 2020. Another GBP 10 billion investment will be needed to connect the offshore wind power projects (OECD & IEA, 2012, p. 111).

Against this background, the UK government initiated the GIB which was launched in October 2012. The UK Department for Business, Innovation and Skills (BIS) is handling its establishment and developing the bank's road map. The purpose of the GIB is to accelerate private green investment in view of enhancing green impact and fully enjoying the economic benefits of investing in green proj-

ects<sup>11</sup> above and beyond the scope of domestic projects. As indicated in a government-released document, “the UK’s green economy goals are part of an EU-wide (and increasingly global) ambition for green growth and sustainable development (Vivideconomics, 2011, p. 47).” With GBP 3 billion of capital funding and the goal of leveraging a further GBP 15 billion in private investments, the GIB is expected to gain an independent status as an enduring institution with a key public role.

FIGURE 3. GIB Evolution Plan



Source: (UK government, 2011, p. 25)

## 6.2. Funding Mechanism and Practice

With an initial fund of GBP 3 billion, the UK government is ready to start direct investment in green infrastructure according to the GIB investment roadmap. Once these investments have begun, the investment function will be transferred to the GIB as a part of the legalising process.

The GIB will be empowered as a bank once it is endowed with lending powers from the capital markets and after a transitory period of having public fund status. The GIB should be endowed with lending power from around the year 2015 or 2016 since the UK Treasury has decided to delay until the target for a reduction in national debt has been met. Allowing the bank to lend on a commercial basis would give it the ability to raise a further GBP 18 billion from capital markets which could then leverage GBP 90 billion in private investment, or the equivalent of nearly half the amount needed to de-carbonise the UK energy system over the next decade.

The UK government recently appointed additional fund managers to begin working on plans for the

<sup>11</sup> For explanations on the GIB mandate in (Vivideconomics, 2011, p. 47) The major environmental NGOs (E3G, Friends of the Earth, Green Alliance, Greenpeace UK and WWF UK) in the UK have expressed deep concern about the current GIB rule, which would delay until 2016/17 the GIB’s borrowing power until the coalition has met its deficit reduction target. The NGOs contest the plan arguing that the government’s difficulties in reducing the deficit could mean the bank is denied the ability to borrow indefinitely, and such restrictions would undermine the bank’s ability to drive green growth and to qualify as a bank. (James Murray, “Green Groups write to Prime Minister to again call for GIB borrowing restrictions to be relaxed.” Business Green online newsletter <http://www.businessgreen.com/bg/news/2197469/ngos-warn-green-investment-bank-fails-to-qualify-as-a-bank>, accessed 10 August 2012.)

bank to invest up to GBP 100 million in non-domestic energy efficiency initiatives.<sup>12</sup> The government plans to invest directly in a few green projects on behalf of the bank, and announced priority areas. At least 80% of funds will be spent in the areas of offshore wind, non-domestic energy efficiency, waste and recycling, energy from waste, and the Green Deal scheme, and the rest, less than 20% of funds, will be used to support other green infrastructure investments (Bridge, 2012).

The GIB will eventually seek to co-invest using commercial terms alongside the private sector. The fund is expected to support a range of energy efficiency projects in the public and private sector, and could also be used to accelerate the emergence of so-called energy performance contracts that apply a “pay-as-you-save” model to allow businesses to undertake energy efficiency improvements at no upfront costs. Despite some concerns regarding a lack of clarity at this stage on the precise nature of the GIB’s new fund on where the fund will be invested or on when the first funding initiatives will be set in motion, the bank is expected to continue to play a major role in promoting sustainable investment in the areas of offshore wind, energy from waste, and domestic energy efficiency.

### **6.3. Evaluation**

The GIB makes up only a part of the UK’s goals of addressing climate change and transformation to a greener economy. Alongside other initiatives, the GIB is expected to play an unprecedented role in accelerating the achievement of these goals.

The GIB’s roles will include identifying and addressing market failures that limit private investment in carbon reduction activities, providing coherence to public efforts to support innovation in relation to climate change by rationalising existing government-established bodies and funds, and offering advice on financing issues in central and local government policy making (BIS, 2011).

A recent interview response<sup>13</sup> confirms the GIB’s legal status, missions, and final aims:

The UK Green Investment Bank will operate like an investment bank, channeled to a green purpose. As an enduring institution, it will operate at arm’s length from ministers, making loans and investments in the expectation of earning a return and reinvesting the proceeds from its investments. It is crucial to the Bank’s success that it operates as an independent commercial institution. The Secretary of State (UK minister) has, as the Bank’s shareholder, given an undertaking to respect its operational and commercial independence. The legislation requires the Secretary of State to lay this undertaking before Parliament as a condition of designation. Any change to this undertaking must also be laid before Parliament, to enable members of both Houses to monitor it. A key com-

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<sup>12</sup> In early 2012, during the preparation for launching the GIB, the government had initially appointed two fund managers and in an attempt to accelerate the pace of investment in the green economy, announced an investment of up to GBP 80 million in waste projects.

<sup>13</sup> From an email interview with R. Cook

ponent of the UK's transition to a green economy, the Bank's mission will be to provide financial solutions to accelerate private sector investment in the green economy. Funded with GBP 3 billion, it will be uniquely placed to facilitate this progression by addressing the market failures affecting green infrastructure projects in order to stimulate a step up in private investment. It will build the necessary deep expertise in financial markets and green investments, working towards a 'double bottom line' of both achieving significant green impact and making financial returns.

Although it is too early to evaluate the GIB without observing its actual funding activities, the government's main role and the effect of government's intervention in the course of establishing and managing the GIB thus far are threefold. Firstly, the government presented risk mitigation products with more attractive risk profiles to a wider range of investors. Secondly, through the GIB, innovative finance mechanisms led by the government were introduced so as to overcome the high transaction costs of investment and share risks. Thirdly, the government effectively arranged capital provisions via either equity or debt where shortage of capital remain, particularly in the areas where market failure is prominent, namely offshore wind, non-domestic energy efficiency, and waste, which have become priorities for the GIB.

## **7. FINDINGS AND POLICY IMPLICATIONS FOR FURTHER IMPLEMENTATION OF GREEN GROWTH**

As hitherto explained, government intervention in funding is essential in securing sustainable and effective green financing depending on the nature of the project and the stage of commercialisation. However, public funds alone are inadequate in addressing increasing financial discrepancies despite the comparative advantages of public funds that effectively supplement private funding. First of all, venture capital, while more likely to support risky projects, is not in fact a sustainable enough source for it tends to withdraw before reaching the final stage of commercialisation. Bank loans could potentially favour large-scale project funding, but banks are inherently risk-averse.

The common perception of the private investment market on the risks associated with eco-innovation projects and technologies often stems from a lack of knowledge and understanding of the relevant areas. Thus, their judgment of the commercial value of green projects and technologies might reflect their lack of confidence in future industrial trends and their distrust of fluctuating government policies. All these problems are far worse in developing countries than in the industrialised world. In this regard, various governmental bodies engaging in eco-funding both at national and international levels could ultimately encourage private investors to add value to green technologies with their better understanding of and confidence in the market.

It would be premature to attempt a full evaluation of the three instruments' performance and impact on the environment and energy security, given that the history of their eco-specific activities is relatively short. Nevertheless, the three organisations have in common their focus on the promotion of eco-innovative green projects including large-scale clean energy projects, which are mostly high-

risk capital intensive. The valleys of death or the funding gaps, occurring in the course of commercialisation of green innovation and technologies, will gradually diminish through governments' efforts to secure more private funding in a sustainable way. This will ultimately offer countries a greater chance of achieving greener growth.

### **7.1. Policy implications: Government's Role in Financing Eco-innovation**

As demonstrated in the KfW case, eco-financing through existing financial institutions would be the most practical way of gaining access to alternative funding. It would maximise the benefits, which include taking full advantage of established networks and accumulated risk-management skills. In fact, utilising a well-established existing financial institute would be particularly effective if the eco-investments are exercised more in favour of innovation projects of existing firms. Nonetheless, securing highly skilled experts in the field of eco-innovation would be crucial for the sustainability of managing eco-investments.

The GEEREF, as a typical model of "fund of funds," offers proof of how effective a relatively small amount of public money can be, targeting EUR 220~250 million in funding through the mobilisation of private funds. This model could well be the most cost-effective way of making the most of a pool of professional sub-fund operators' expertise. Yet a careful approach is required when employing a series of risk-aversion mechanisms for private fund mobilisation, such as the first-come-last-out rule, which may cause a moral hazard. At the same time, a reasonable balance should be kept between private sector interests and public goals, lest private investors concentrate their support on low-risk high-return projects in search of financial benefits.

The most significant trait of the GIB is the fact that it is the first green financing theme-focused financial institute in the world. As an independent financial entity, the bank will effectively facilitate eco-investment experts, systematically accumulate expertise, ensure a good balance between public goals and private interests, and enable strategic investments in radical eco-innovation fields that have long been avoided by private investors. As a new institution, the GIB may face several hurdles in securing its position within the existing financial structure, for example the high cost of starting-up, the possible overlap in function with existing financial institutes, the trials and errors in banking service and so on. Addressing these challenges will be essential for the GIB's soft-landing as a sound and sustainable financing mechanism.

As demonstrated through the major cases illustrated above, it could be argued that structural financial barriers in the later stages of eco-innovation could be overcome through appropriate government action. However, there are a number of issues that policy makers need to take into account when designing and implementing financial instruments supporting the commercialisation of eco-innovation.

Attracting private financiers has proven to be important. As shown in the case of the GEEREF, by using public funds, governments can mobilise private funds for commercialising eco-innovation. However, government intervention needs to prioritise high-risk technologies and solutions that are typically avoided by private investors. Also, a portfolio approach would be useful through diversi-

fyng the tools of investments across sources.

With respect to management, adopting the mechanisms used by private financial entities may reduce the overall risks associated with management skills. Doing so would help to ensure a better public financing performance and would draw on the private sector's expertise in credit analysis and risk management. Independent operation of the programme would be essential so as to respond quickly to changing market conditions. The GIB has relative advantages in this aspect. Securing the independence, transparency and accountability of the programme are the ultimate determinants of the success of the government's financial interventions.

In terms of policy support, it may be necessary to use other demand-side instruments as effective leveraging. Well-designed policies accompanying government's financial interventions will foster market demand. Improved market certainty and strong demand will in turn lower the cost of financial transactions and facilitate private investment in eco-innovation. In addition, it is important to harmonise the objectives among related policies so as to keep the policy instruments sustainable and coherent with the initial investment goals.

## **7.2. Lessons for Korea**

All three cases in Europe offer important lessons for eco-financing policy in Korea. Indeed, they highlight the need for a transition to a more proactive and sweeping policy beyond the traditional reliance on indirect market instruments. Indirect policy instruments such as green certification or the development of models for the evaluation of green technologies have certain limitations due to the financial market's current mechanisms where risks are borne entirely by the investors. Even if a system were in place where a third party certifies or assists in the evaluation, the nature of this risk would not change. While the Technology Credit Guarantee Fund may have appeared to be a more or less effective solution, a limited amount of support for the Fund proved to be a barrier in backing innovation projects.

Accordingly, in view of further promoting green growth in Korea and revitalising green finance, the following options might be considered: firstly, similar to the mechanism of the KfW, an existing financial institution could be transformed into one that plays a major role in green-specialised financing. Considering the example of the GEEREF, another option would be to create various types of large-scale green finance-concentrated programmes such as public-private funds, loans, investments, trust funds, and so forth. A more radical option would be to establish an independent financial institute exclusively dedicated to green investment as in the case of the GIB in the UK.

The Industrial Bank of Korea or the Technology Credit Guarantee Fund could be considered as candidates under the first option. However, due to the potential impact on the financial market and the administrative costs that would be incurred in the course of transition, the feasibility of such a transition is rather low. The second or third options may be more feasible, although in both cases a period of trial and error would be necessary. These latter options involve extremely time-consuming exercises since the establishment of pre-conditions (e.g. expert pools or green financing methods)

is far from being a straightforward task. The degree of success in implementing such options would largely depend on how all of these practical barriers are managed.

Innovation cannot be realised without large-scale financial support. In order to promote green technology and commercialisation, it is extremely important that the appropriate financial infrastructure be in place. This is particularly the case in Korea, where the country is a leader in green growth, is equipped with well-established green growth governance mechanisms and has enormous technological potential, but is far behind overall in environmental performance compared to other developed countries.

## **8. CONCLUDING REMARKS**

Problems resulting from the quantity of funds dedicated to green innovation could largely be resolved by improving the quality of funding, for example re-prioritising funding for projects and technologies with more emphasis on greener ones and by creating more innovative ways of funding. An overall lack of funding often stems from limited access to funds due to faulty priority setting and institutional inefficiency.

Government intervention can play an effective role in filling the gap by offering further financing to eco-innovation while assuming public benefits obligations associated with the mandated risk-tolerance for investments in this area. In general, government intervention can facilitate the function of private financial markets and thus stimulate green innovation through various financial and non-financial measures. Government participation particularly helps with regards to private financiers who gain confidence in and find legitimacy for green financing, especially in the cases of large-scale, capital-intensive, high-risk, and public good projects. By addressing the issues around green financing, a country can take one more step forward in achieving environmental goals, economic growth, and energy security in the future.

Countries could consider adopting various means of eco-funding based on the existing available models. Notable examples include the KfW, the GEEREF, and the GIB as presented in this paper. Although the three mechanisms encompass certain challenges and limits, each provide useful insight into the current situation of eco-funding where the discrepancy between required and available sources is widening. Insomuch as environment-friendly innovation is imminent in many fields, resolving the problems around bottlenecks to financing is an indispensable task for all governments, including those in the developing world. To this end, efforts to establish innovative funding systems in pursuit of new technologies and solutions that are environmentally beneficial and commercially viable need to be encouraged in a relatively short time span since most large-scale environmentally sensitive projects can be expected to bring enormous benefits for all upon condition of their timely commercialisation. Otherwise, the consequences could be detrimental and potentially irreversible or at least very costly to reverse.



## REFERENCES

- Bloomberg New Energy Finance. (2010). *Crossing the valley of death: Solutions to the next generation clean energy project financing gap*. London, UK: BNEF.
- Bridge, N. (2012, November). *Update on UK green growth initiatives* presented by UK ambassador and permanent representative to the OECD. At the 9th friends of green growth meeting organised by the Korean permanent delegation to the OECD. Paris, France.
- Climate Funds Update (2013). Retrieved in May, 2013 from <http://www.climatefundsupdate.org/listing/geeref#TOC-Relationship-with-Official-Development-Assistance>
- COWI (2009). *Bridging the Valley of Death: Public support for commercialisation of eco-innovation* (Final report to DG Environment). Kogens Lyngby, Denmark: COWI.
- Department for Business, Innovation and Skills (BIS) United Kingdom (2011). *Update on the design of the green investment bank*. London: HM Government.
- European Commission. (2009). *GEEREF channels €22 million into African and Asian energy projects*. Retrieved in March, 2009 from [http://ec.europa.eu/environment/ecoap/about-eco-innovation/business-fundings/eu/359\\_en.htm](http://ec.europa.eu/environment/ecoap/about-eco-innovation/business-fundings/eu/359_en.htm)
- The European Commission. (2006b). *Impact assessment of the mobilising public and private finance towards global access to climate-friendly, affordable and secure energy services: The global energy efficiency and renewable energy fund*. (Commission staff working document). Brussels, Belgium: EC.
- Ghosh, S. & R. Nanda (2010). *Venture capital investment in the clean energy sector* (Harvard business school working paper 11-020). Cambridge, MA: HBS.
- The Organisation for Economic Co-operation and Development. (2012). *Driving eco-innovation: The role of demand side policy* (unpublished report). Paris: OECD/DSTI.
- \_\_\_\_\_. OECD. (2012a). *Economic survey, Korea*. Paris: OECD.
- \_\_\_\_\_. OECD (2012b) *Aligning national and sub-national initiatives to support eco-innovation. (Unpublished meeting document)*. Paris: OECD.
- \_\_\_\_\_. OECD. (2011) *Towards a green investment policy framework: The case of low-carbon, climate-resilient infrastructure* (unpublished meeting document). Paris: OECD.
- \_\_\_\_\_. OECD. (2011a). *Towards green growth*. Paris: OECD.
- \_\_\_\_\_. OECD. (2011b). *Better policies to support eco-innovation*. Paris: OECD.
- \_\_\_\_\_. and International Energy Agency, IEA. (2012). *Mid-term renewable energy market perspectives*. Paris: OECD.
- \_\_\_\_\_. OECD/IEA. (2011). *Energy policy review UK*. Paris: OECD.
- United Nations Environment Programme, UNEP (August, 2012). *Global energy efficiency and renewable energy fund*. Retrieved from Climate finance options. <http://climatefinanceoptions.org/cfo/node/192>
- UK Government (2011). *Update on the design of the green investment bank*. London, UK: HM Government.
- Vivid Economics (2011). *The green investment bank: Policy and finance context* (Final report). London, UK: Vivid Economics.