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Towards a Green Investment Policy Framework: The Case of Low-Carbon, Climate-Resilient Infrastructure

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The Case of Low-Carbon, Climate-Resilient Infrastructure

Jan Corfee-Morlot, Virginie Marchal, Celine Kauffmann, Christopher Kennedy, Fiona Stewart, Christopher Kaminker and Geraldine Ang

Keywords: Infrastructure, climate change, development, private investment, finance, risk, policy

JEL Classification: G Financial Economics, O Economic Development, Technological Change, and Growth, Q Agricultural and Natural Resource Economics

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ABSTRACT

Achieving low-carbon, climate-resilient (LCR) development is a policy goal of many governments today, and investment in built-infrastructure – in the energy, transport, water and building sectors – is a central part of the challenge. In the face of growing infrastructure needs and fiscal constraints, such transformational change will require large-scale private sector engagement. However, there is little policy experience on how to integrate climate and other environmental policy goals into investment policy frameworks and infrastructure planning. While many studies focus on the role of environmental and climate change policies to support a transition to a low-carbon, climate-resilient (LCR) economy, this paper suggests that other factors play a critical role to achieve this transition. It starts from the premise that climate change policies and their effectiveness cannot be studied in isolation, but need to be considered in a broader national policy context, one that has the enabling environment for investment and development at its centre. This report aims to advise governments on how to create and improve domestic enabling conditions to shift and scale-up private sector investments in green infrastructure, to finance a transition to a LCR economy and greener growth.

This report advances a "green investment policy framework" taking infrastructure investment as a starting point and looking only at climate change mitigation and adaptation. It highlights the significant opportunities and many challenges that exist today in both developed and developing countries to transition to LCR development through investment in both renovated and in new infrastructure. The report suggests it is possible to generate multiple local development benefits from LCR infrastructure investment. It presents a five-point policy framework to guide domestic reforms that can steer use of limited public funds while also enabling and incentivising private investment to support a transition across relevant infrastructure sectors to simultaneously deliver climate change and local development goals.

Keywords: Infrastructure, climate change, development, private investment, finance, risk, policy

JEL Classification: G Financial Economics, O Economic Development, Technological Change, and Growth, Q Agricultural and Natural Resource Economics

RESUMÉ

La mise en œuvre d'un développement sobre en carbone et résilient au changement climatique constitue aujourd'hui l'un des objectifs de nombreux gouvernements, et les investissements consacrés aux infrastructures bâties – dans les secteurs de l'énergie, des transports, de l'eau et du bâtiment – représentent une part essentielle du défi à relever. Compte tenu de l'augmentation des besoins en infrastructures et des contraintes budgétaires, ces changements nécessiteront une mobilisation à grande échelle du secteur privé. Or les pouvoirs publics ne possèdent guère d'expérience sur la manière d'intégrer les objectifs climatiques ou relatifs à d'autres questions environnementales dans les cadres d'action pour l'investissement et la planification des infrastructures. Alors que de nombreuses études mettent en avant le rôle des politiques environnementales et climatiques dans la transition vers une économie sobre en carbone et résiliente au changement climatique, le présent document tend à démontrer que d'autres facteurs ont également un rôle décisif à jouer dans cette évolution. Il part du principe que les politiques climatiques et leur efficacité ne peuvent être étudiées isolément, mais doivent être envisagées dans un contexte de politique nationale plus large, en mettant l'accent sur les moyens de favoriser l'investissement et le développement. Ce rapport vise à conseiller les gouvernements sur la manière de créer ou d'améliorer les conditions permettant, au niveau national, d'orienter et d'accroître les investissements du secteur privé dans les infrastructures vertes, ainsi que de financer le passage à une économie sobre en carbone et résiliente au changement climatique et à une croissance plus verte.

Ce rapport propose un « cadre d'action pour l'investissement vert » à partir d'une réflexion sur l'investissement dans les infrastructures, considéré exclusivement du point de vue de l'atténuation du changement climatique et de l'adaptation à ses effets. Il met en évidence les opportunités notables et les nombreuses difficultés que suscite aujourd'hui, dans les pays développés et en développement, la mise en œuvre d'un développement sobre en carbone et résilient au changement climatique par le biais de l'investissement dans la rénovation ou la construction d'infrastructures. Ce rapport suggère qu'il est possible de dégager de multiples avantages, en termes de développement local, de l'investissement dans des infrastructures à bas carbone et résilientes au changement climatique (BRC). Il propose un cadre d'action en cinq points afin de contribuer à définir des réformes nationales susceptibles d'orienter l'utilisation de fonds publics limités tout en encourageant le secteur privé à soutenir la transition par des investissements dans les secteurs d'infrastructures appropriés, de façon à répondre simultanément aux objectifs climatiques et de développement local.

Mots-clés : infrastructures, changement climatique, développement, investissement privé, finance, risque, action publique

Classification JEL : G Économie financière, O Développement économique, avancées technologiques et croissance, Q Économie des ressources naturelles et de l'agriculture

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EXECUTIVE SUMMARY

1. Achieving low-carbon, climate-resilient (LCR) development is a policy goal of many governments today, and investment in built-infrastructure – in the energy, transport, water and building sectors – is a central part of the challenge. In the face of growing infrastructure needs and fiscal constraints, such transformational change will require large-scale private sector engagement. However, there is little policy experience on how to integrate climate and other environmental policy goals into investment policy frameworks and infrastructure planning. While many studies focus on the role of environmental and climate change policies to support a transition to a low-carbon, climate-resilient (LCR) economy, this paper suggests that other factors play a critical role to achieve this transition. It starts from the premise that climate change policies and their effectiveness cannot be studied in isolation, but need to be considered in a broader national policy context, one that has the enabling environment for investment and development at its centre. This report aims to advise governments on how to create and improve domestic enabling conditions to shift and scale-up private sector investments in green infrastructure, to finance a transition to a LCR economy and greener growth. As a starting point towards a "green" investment policy framework, the report focuses on infrastructure and climate change mitigation and adaptation. It highlights the significant opportunities and many challenges that exist today in both developed and developing countries to transition to LCR development through investment in both renovated and in new infrastructure. Beyond achievement of climate goals, the report builds on recent work showing it is possible to generate multiple local development benefits from LCR infrastructure investment. It presents a five-point policy framework to guide domestic reforms that can steer use of limited public funds while also enabling and incentivising private investment to support a transition across relevant infrastructure sectors to simultaneously deliver climate change and local development goals.

2. Successfully tackling climate change across developed and developing countries requires urgent policy action to bring about unprecedented economic, social and technological transformation. Global leaders have agreed to work together, with a view to limit global average temperature increase to 2 degrees Celsius compared to pre-industrial levels by the end of the century. With nationally appropriate mitigation actions and policies, leadership from developed countries and strengthened international co-operation now, it is still possible to bend unsustainable trends in a way that enhances economic development and prosperity. Yet the question is, how best to achieve this goal?

3. Infrastructure investment decisions will play an important role. Choices made today about types, features and location of new and renovated infrastructure will lock-in "commitments" to future levels of climate change and to vulnerability or climate-resilience. Infrastructure vulnerability and risk to inevitable climate change is driven by long operational lifetimes of these investments, making them sensitive not only to the climate existing at the time of their construction, but also to climate variations over the upcoming decades.

4. Infrastructure built or renovated today will be in use for decades to come. There is an opportunity to advance forward-looking infrastructure planning and development strategies across national and sub-national levels that integrate climate change considerations to achieve LCR development. Irrespective of climate change issues, investment in infrastructure in the coming years needs to be *scaled-up* significantly to support the broader development and economic growth agenda. In OECD countries, many infrastructure networks for water, electricity and transport have been in place for more than a century and are in need of replacement and upgrading. In developing countries, partly due to rapid urbanisation, a major part of the

infrastructure stock required to meet development goals is yet to be built. Without attention to climate change today, the rapid development of this infrastructure stock could lock-in climate change damages that threaten achievement of the basic development goals behind such investments.

5. While incremental investments for adaptation and mitigation might just be a fraction of the total investments required in a business as usual scenario, delivering climate adaptation and mitigation at scale will require unprecedented *shifts* in long-term investment and foresight to transform energy, transport, water and building infrastructure to become more resource -and energy-efficient (see definitions in Box ES-1).

6. The public sector does and will still play the leading role in commissioning green infrastructure projects and to guide and "jump start" investment when needed. But transformational change will ultimately require large-scale private sector engagement. Particularly, as government balance sheets have become increasingly strained and in the face of growing infrastructure needs, further recourse to private capital through corporate balance sheets and financial or banking assets will be required. While private investment in some LCR infrastructure sectors, such as clean energy, is rising quickly, it is far from being enough to fill the infrastructure investment gap or to deliver a transition to LCR development.

7. Domestic and international private investment in LCR infrastructure is still seriously constrained by market failures and specific investment barriers. Private investments in infrastructure projects have typically been constrained by high upfront capital costs, sometimes low-returns and long investment timelines. Country-specific barriers often limit the attractiveness of such investments, either in terms of the adequacy of returns or unmanageable risk. In addition to traditional infrastructure challenges, LCR infrastructure projects have to deal with specific barriers that limit engagement of the investment community. This includes weak or partial environmental policy backdrop that fails to sufficiently price pollution and that in turn distorts the competitiveness and cost of clean versus polluting infrastructure projects. Weak environmental policies introduce regulatory risk and this raises uncertainty for private investors. Other barriers to investment include lack of familiarity, limited information and knowledge, and limited expertise on green infrastructure. Finally there is also a lack of appropriately structured financing vehicles to provide the risk-adjusted return profile that the private investors expect.

Box ES-1. Definition of "low-carbon, climate-resilient" infrastructure investments

Choices of infrastructure or selected features of infrastructure will affect the greenhouse gas emission-intensity of service provision (*e.g.* water, electricity, mobility, shelter, goods exchange, sanitation services) as well as the exposure and vulnerability of businesses and people to climate change itself. In the context of this paper, green infrastructure or low-carbon, climate-resilient (LCR) infrastructure projects will either mitigate greenhouse gas emissions and/ or support adaptation to climate change in the area of transport, energy or buildings. While there are possible competing effects between adaptation and mitigation strategies in some infrastructure projects (i.e. air conditioning systems), important synergies exist, making the case for an integrated approach,

Despite the risk of lock-in into high emission and high vulnerability development pathways, infrastructure decisions are not irreversible, yet it can be costly to change them. Infrastructure investment typically has high capital expenditure requirements and altering infrastructure post-construction can be difficult and more costly than if it were designed to integrate climate change consideration from the start. As a result, greening infrastructure investment may be directed at renovation of physical infrastructure (also referred to as **"brownfield" investments**), such as retrofitting power plants or energy efficiency projects, or when building new infrastructure ("**greenfield" investments**), such as renewable energy projects or new public transport infrastructure systems. Investment to support green infrastructure may also be in the form of service sector activity (*e.g.* information provision, engineering or management advice).

Source: adapted from Kennedy and Corfee-Morlot 2012.

Towards a green investment policy framework

8. Governments have a central role to mobilise capital to LCR infrastructure in the establishment of reform agendas that deliver "investment grade policies". In most countries, climate and investment policies have to date functioned quite separately and sometimes at cross-purposes preventing or slowing investment in LCR infrastructure. Integrating climate and investment policies in a unique framework can help these different policy communities work together to achieve the common goal of low-carbon, climate-resilient (LCR) development and greener growth. Moving towards such a framework can usefully build on international tools and instruments that governments have developed to support investment design and implementation policy.[1] It is important however that these targeted financial policies and instruments be placed in a broad and coherent green investment policy framework that aims to deliver long term financial viability.

9. The proposed approach towards a green investment policy framework (see Figure ES-1 and Table ES-1) consists of five elements, notably:

(1) Goal setting and aligning policies across and within levels of government. This includes clear, long-term vision and targets for infrastructure and climate change; policy alignment and multilevel governance, including stakeholder engagement;

(2) Reforming policies to enable investment and strengthen market incentives for LCR infrastructure. This includes sound investment policies to create open and competitive markets; market based and regulatory policies to "put a price on carbon," remove harmful subsidies and correct market failures;

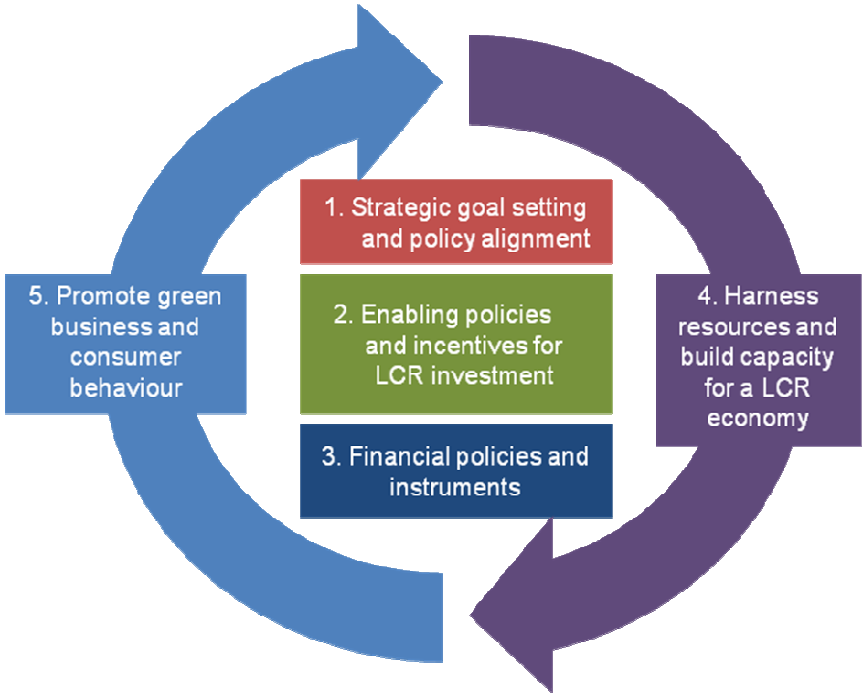
(3) Establishing specific financial policies, regulations, tools and instruments that provide transitional support for new green technologies; including financial reforms to support long-term investment and insurance markets; innovative financial mechanisms to reduce risk or increase market liquidity; transitional direct support for LCR investment.

(4) Harnessing resources and building capacity. This includes R&D for green technology; human and institutional capacity building to support LCR innovation; monitoring and enforcement; and climate risk and vulnerability assessment;

(5) Promoting green business and consumer behaviour. This includes information policies; corporate reporting and consumer awareness programmes; and public outreach.

[1] In particular, this report draws on the OECD Declaration on International Investment, which draws on a number of internationally recognised policy tools including the Guidelines for Multinational Enterprises; the Policy Framework for Investment, and the Principles for Private Participation in Infrastructure and its subsequent application to the water sector.

Figure ES-1. Towards a Policy Framework for Green Investment



10. From the perspective of the private sector, each of the five elements potentially influences three key investment conditions: i) the existence of investment opportunities; ii) the return on investment, including boosting returns and limiting the costs of investment; and iii) the risks faced by investors throughout the life of projects. Each element helps incentivise and shift private sector investment at scale to LCR infrastructure, while ensuring that the public services provided are affordable and accessible to a majority of the population as well as financially sustainable.

Sequencing the framework to specific sectors and countries' circumstances

11. Any policy framework should be seen as a dynamic, a tool that may be used to support decisions or a decision-making process rather than a prescription for policy. The elements of such a framework are interdependent and feedback loops exist between them. Although the elements of good practice for an integrated climate-investment policy framework are likely to be the same for all countries, country circumstances do matter and policy mixes and designs will need to be tailored to unique national contexts and to the needs of different sectors. As a result, applications of any policy framework or checklist will need to be sequenced and prioritised depending on the contexts. The proposed approach is sufficiently flexible to adapt to different priorities, and can be used in different ways depending upon the starting point of the country.

Table ES-1. Policy checklist for LCR investment

	Impact on attractiveness for private sector LCR investment			
	Create a market, boost opportunities	Increase return		Reduce risk
		Revenues	Reduce Costs	
1. Strategic goal setting and policy alignment				
• Goal-setting and strategic planning, including infrastructure planning	X			X
• Multilevel governance to align policies and engage stakeholders	X			
2. Enabling policies and incentives for LCR investment				
• Policies to enable and mobilise investment	X			X (*policy*)
• Open and competitive markets for green trade and investment	X			X
• Provide market incentives for low-carbon, climate-resilient investment			X	
• Regulatory and other policies to create markets and remove investment barriers	X	X	X	X *(regulatory, technology*)
3. Financial policies and instruments				
• Ensure a financial regulatory framework conducive to LCR investment	X			
• Innovative financial tools and instruments to reduce risk and increase market liquidity	X	X	X	X *(regulatory)*
• Transitional direct support for LCR investment	X	X	X	X (*financial)*
4. Harness resources and build capacity for a LCR economy				
• Foster innovation with R&D policies	X		X	X
• Training, education and human capacity	X		X	(*technology)*
• Administrative capacity for assessment, monitoring and enforcement	X		X	X(*operational*)
• Climate risk and vulnerability assessment	X		X	
5. Promote green business and consumer behaviour				
• Promote responsible business in support of a green economy	X		X	
• Information and public awareness policies	X			

I. INTRODUCTION

1.1 Why is low-carbon, climate-resilient infrastructure important?

12. Successfully tackling climate change across developed and developing countries requires urgent policy action to bring about unprecedented economic, social and technological transformation. Global leaders have agreed to work together, with a view to limit global average temperature increase to 2 degrees Celsius compared to pre-industrial levels by the end of the century. Yet the question is, how to do this? Infrastructure investment decisions will play an important role. Choices made today about types, features and location of new and renovated infrastructure will lock-in "commitments" to future levels of climate change and to vulnerability or climate-resilience for decades to come.

13. Without more ambitious action, global greenhouse gas emissions are projected by 2050 to increase by 50% (OECD, 2012a). This rapid rise in emissions is driven by rising living standards, a quadrupling of the world gross domestic product (GDP) and a global population that is expected to increase from 7 billion to over 9 billion by 2050. With stronger international cooperation and ambitious domestic policies, bending the emission trend is still feasible, but the window for achieving a sufficient emission reduction by 2050 is closing fast (IPCC, 2007; IEA, 2012). Delaying action and investments in low-carbon infrastructure would increase the required pace and scale of efforts after 2020 and raise the cost of mitigation action, partly due to premature scrapping or retrofitting of existing fossil energy infrastructure (OECD, 2012a).

14. Infrastructure is also key to the climate adaptation agenda. Long operational lifetimes make infrastructure investments potentially vulnerable not only to the climate existing at the time of construction, but also to climate variations over the many decades of its use (Table 1). Climate change is already altering global (and regional) mean temperatures, precipitation patterns and sea levels. When combined with business as usual development, it increases exposure and risk of infrastructure investments to heat waves, droughts and floods, including storm surge in coastal locations, which in turn leads to growing financial risk across these investments.

Table 1. Typical lifespan of selected infrastructure sectors (years)

Sector	Time scale
Water infrastructure (*e.g.* dams, reservoirs, sanitation facilities)	30–200 yr
Transportation infrastructure (*e.g.* port, bridges)	30–200 yr
Building and housing (*e.g.* insulation, windows)	30–150 yr
Land-use planning (*e.g.* in flood plain or coastal areas)	>100 yr
Urbanism (*e.g.* urban density, parks)	>100yr
Coastline and flood defences (*e.g.* dikes, sea walls)	>50 yr
Electricity generation facilities (*e.g.* coal-fired power plants)	50–60 yr

Source: Adapted from Hallegatte, 2009.

15. Today, the urgent need to *scale-up* infrastructure investments in developed and developing countries to support development creates a unique leapfrogging opportunity to *shift* those investments towards low-carbon and climate-resilient infrastructure. In more developed countries, many infrastructure networks for water, electricity and transport have been in place for more than a century and are in need of replacement and upgrading. In developing countries, a major part of the infrastructure stock required to meet development goals in the coming decades is still to be built, particularly in the face of rapid urbanisation. As the infrastructure built or renovated today will be in use for decades to come, there is an opportunity today to advance forward-looking development strategies that integrate for climate change to achieve sustainable development.

16. Public funding can and does play a critical role to "jump start" or guide LCR investment, but transformational change will inevitably require large-scale private sector engagement. Particularly as government balance sheets become more strained and in the face of growing infrastructure needs, further recourse to private capital will be required, through corporate balance sheets and financial or banking assets. To attract necessary capital, LCR infrastructure will need to be financially sustainable over the long-term, which in turns requires adequate risk-adjusted returns. Governments have a central role to mobilise capital to LCR infrastructure in the establishment of reform agendas that deliver "investment grade policies". And where donor climate finance flows are significant, there is an opportunity to connect this activity to domestic policy reforms that create commercial opportunities and achieve financial sustainability of LCR investments.

17. Achieving low-carbon, climate-resilient development is a policy goal of many governments today and investment in built-infrastructure – in the energy, transport, water and building sectors – is central to delivering this. Conversely, effectively responding to climate change is an important part of the challenge to inclusive green growth.[2] However, there is little policy experience on how to integrate climate and other environmental policy goals into investment policies and infrastructure planning.

1.2 Aim of the paper

18. This report aims to advise governments on how to create and to improve domestic enabling conditions to shift and scale-up private sector investments in green infrastructure, as part of their agenda to finance their transition to a low-carbon, climate-resilient economy. To do so, the report maintains a practical focus on climate change and infrastructure as a starting point,[3] recognising that it is only one key element of inclusive green growth or sustainable development. Box 2 outlines some of the central technical and environmental issues surrounding the definition of LCR infrastructure.

19. Though informed by investor and financier perspectives, the target audience is national policymakers and their advisors, in developed and developing countries, which are looking to increase private sector participation to finance a transition to LCR development. Country contexts matter, and policy mixes, policy design, and related institutions will need to be tailored to unique national characteristics and institutions. Yet regardless of the country context, the main elements for good practice are likely to remain the same. Even if the prioritisation and urgency placed on the various elements, and much of the detail of tailored policies, will inevitably differ.

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[2] World Bank 2012a, b; OECD, World Bank and UN, 2012, forthcoming; OECD 2011b.

[3] On climate change, the paper considers both mitigation and adaptation issues and how these intersect with infrastructure investment decisions. Mitigation refers to reductions in greenhouse gas (GHG) emissions below what they would otherwise be, and adaptation refers to how to limit the physical impacts of inevitable climate change by improving the resilience or the ability to limit the vulnerability of infrastructure to climate change over the lifetime of the investment.

20. Key policy questions include: How to facilitate the transition to LCR infrastructure while ensuring that the public services they provide are affordable and accessible to a majority as well as financially sustainable? More specifically, (how) can countries reform policies to boost opportunities and improve risk-adjusted return on investment for the private sector in LCR infrastructure, while also achieving public goals of infrastructure provisioning? What role can healthy markets play to boost LCR infrastructure investment?

21. This report notes the importance of the ultimate objective, principles and commitments enshrined in the United Nations Framework Convention on Climate Change (UNFCCC) (e.g. Articles 2, 3 and 4 - see Box 1). While recognising the international context, the focus of this report is on domestic rather than international or UN processes. In this way, the report targets a domestic policy maker audience, aiming to address those countries that are interested to pro-actively integrate climate change into broader economic development, investment and infrastructure planning and policy processes to achieve near-term and long-term development and sustainability benefits.

Box 1. Principles of the United Nations Framework Convention on Climate Change (UNFCCC)

Inter alia, these provisions state that "the Parties to this Convention should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof" (Art. 3.1). "The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties" (Art. 3.2).

Source: UNFCCC (1992).

1.3 Approach

22. The proposed elements of a green investment policy framework integrate two areas of research. First, stronger and more coherent policies attract and keep investment in any particular national context. This is an important part of the challenge of harnessing investment to support LCR infrastructure development. Unrelated to the issue of climate change, this challenge pertains to legal frameworks that create open and non-discriminatory market conditions for foreign and domestic investors alike, where protection of property rights and competition policy matter, and work alongside of government practices that encourage good corporate behaviour and enhance transparency. Moving towards such a framework builds on a range of international tools and instruments designed to support investment design and implementation policy.[4]

23. Second, this report builds as well on an emerging literature on how climate policies can be designed to attract private sector investment to combat climate change and achieve low-carbon development (Hamilton, 2009; UNEP-FI, 2009, 2012; WEF, 2011). Another stream of work identifies barriers to low-carbon investment, and analyses the potential for innovative financial instruments and tools

[4] These include the OECD Declaration on International Investment, which draws on a number of internationally recognised policy tools including the Guidelines for Multinational Enterprises (OECD 2011f; the Policy Framework for Investment (OECD 2006), and the Principles for Private Participation in Infrastructure (OECD 2007a) and a subsequent application to the water sector (OECD 2009b).

to use limited public funds to catalyse private investment in support of climate action (see for example AGF, 2010a; UNEP-FI, 2009; Maclean, *et al.,* 2008; Ward *et al*., 2009; Stadelmann *et al.,* 2011; Sierra, 2011).

24. Adaptation and resilience is also a policy priority for greening infrastructure, where evidence is showing financial risk also associated with the impact of climate change itself on capital investments (Agrawala *et al.,* 2011; IFC, 2010a, 2010b, 2011; Mercer, 2011). For example, in a world with more extreme flooding and temperatures, the ability of an electricity generation network to continue to operate under such conditions will affect the revenues and profitability of the system. However, there has been less attention in the climate finance literature to adaptation issues, making it an area ripe for further work. Planning ahead and managing the impacts of climate change over the operational lifetimes of new and existing infrastructure will be critical to increase the resilience to growing climate change accompanied by rising disaster risk. The long time lag between planning and implementation for infrastructure investment, and the complex system inter-relationships in the case of failure (*e.g.* between transport, power and water provision systems), warrants urgent policy attention today to adaptation and resilience in built infrastructure and land-use planning processes. An integrated approach can assist climate and investment policies to work more coherently together to achieve the common goal of LCR development and greener growth.

25. The report also builds on a growing literature in climate policy circles that focuses on finance and investment needs in developing countries. For example, several recent, high-profile international efforts have considered how to mobilise and scale-up sources of international public finance and the role of multilateral development banks (MDBs) as financial intermediaries to support developing countries to mitigate and adapt to climate change; these efforts also consider the role of private finance and investment to promote action (AGF, 2010; World Bank *et al.,* 2011). Other authors have considered investors' views and aim to educate policymakers about these to promote understanding and good practice (see Hamilton, 2010; Justice and Hamilton, 2009; BNEF, 2011a; Liebreich *et al.,* 2010; CMCI *et al.,* 2011).

26. This report differs from these initiatives by directly targeting a domestic policy audience and in its focus on how to guide domestic policy reforms. The report considers how domestic policies influence private finance and investment for LCR infrastructure, a role for policy that may become increasingly important in the context of severe fiscal constraints on public budgets. It aims to help countries to mainstream consideration of climate change in investment and infrastructure decision-making, across both public and private sector actors.

1.4 Defining low-carbon, climate-resilient infrastructure

Box 2. Definition of "low-carbon, climate-resilient" infrastructure investments

Infrastructure is the stock of fixed capital equipment in a country that affects human well-being and is considered a determinant of economic growth. In the investment context, it typically includes "economic infrastructure", in particular transport (e.g. ports, airports, roads, bridges, tunnels, parking); utilities (e.g. energy distribution networks, storage, power generation, water, sewage, waste); communication (e.g. transmission, cable networks, towers, satellites); and renewable energy; as well as "social infrastructure" such as schools and other education facilities; healthcare facilities, public buildings (Inderst, 2010).

Choices of infrastructure or selected features of infrastructure will affect the greenhouse gas emission-intensity of service provision (e.g. water, electricity, mobility, shelter, goods exchange, sanitation services) and also the exposure and vulnerability of businesses and people to climate change itself. In the context of this paper, LCR infrastructure refers to infrastructure projects that will either mitigate greenhouse gas emissions (*e.g.* low- or no-emission technologies compared to a business as usual scenario, including clean energy production and transformation, forest

Box 2 continued over page

Box 2 continued

and agriculture, fuel switching in energy-intensive end use sectors, methane capture or waste to energy investments, or improving energy efficiency of buildings) or those that will support adaptation to climate change (*e.g.* in the water, health, forestry, agriculture/livestock, urban development, or built infrastructure sectors).

Some investments can support both adaptation and mitigation (e.g. in forestry and land use, energy efficient buildings). For example, in the building sector, increased insulation and use of white (or, to a lesser extent, green) roofs may both save energy and make buildings more resilient to extreme temperatures or temporary losses of energy supply. Similar synergies may occur for water efficiency measures, water storage, distributed renewable energy supply and multi-modal transportation systems, but with details highly dependent on context. Adaptation and mitigation synergies can also emerge from radical improvements in energy and resource efficiency (IEA 2011, 2005; OECD 2012). Further, some adaptation strategies may be undesirable for mitigation, *e.g.* conventional air conditioning makes buildings liveable in extreme heat, but often with increased emissions. Desalination can be an important source of supply in water scarce regions, but requires substantial energy consumption. An opposite case is very high urban density, which supports the financial viability of sustainable modes of public transportation, but generally involves prevalence of impermeable surfaces, greater heat island effects5, and increased climate change risks through higher concentrations of people.

Despite the risk of lock-in to high emission and high vulnerability development pathways, infrastructure decisions are not irreversible. However it can be costly to change them. Infrastructure investment typically has high capital expenditure requirements and altering infrastructure post-construction can be difficult and more costly than if it were designed to integrate climate change consideration from the start. As a result, greening infrastructure investment may be directed at renovation of physical infrastructure (also referred to as "brownfield" investments) or at the building or extension of new infrastructure ("greenfield" investments). Investment to support green infrastructure may also be in the form of generating service sector activity (e.g. information provision, engineering or management advice).

Table 2. Examples of LCR infrastructure projects

	Projects with negative mitigation impacts (increase GHG)	**Projects with mitigation benefits (decrease GHG)**
Projects with negative adaptation impacts	New highways, roads and bridges without appropriate drainage systems	Small hydropower (where competing with scarce water supplies) Dense urban developments
Project with adaptation benefits (climate-resilient)	Water desalination plants Air-conditioning (conventional) in infrastructure	Waste to energy facilities Multi-modal transportation risk of flood Retrofitting power plants (e.g. to have higher thermal-efficiency) Energy efficiency (1) or demand-side management projects (2) Switching to less carbon or resource intensive building materials (e.g. sustainable wood products) Urban greenery

(1) For example, building insulation, distributed and centralised renewable energy systems
(2) Projects that lower the capacity and investment requirements for energy supply infrastructure

Source: adapted from Kennedy and Corfee-Morlot 2012.

[5] Where urban paved and built infrastructure absorb and re-radiates heat into the atmosphere, thus increasing the temperature change in urban areas that will be associated with a given global average temperature change. Depending upon the location, urban heat islands can lead to temperatures that are significantly higher than surrounding rural areas (*e.g.* Stewart 2011; Oke, 1995; Landsberg, 1981).

1.4 Outline of the paper

27. The remainder of the paper traces the arguments for the need for policy reforms and intervention to attract private sector engagement in LCR infrastructure. It considers the need for an integrated climate and investment policy approach.

28. Section II sets the scene of the challenges ahead for policy makers: it presents the infrastructure investment gap, highlights the need for mobilising private sector investment, and the key challenges and barriers to overcome. Section III then outlines elements of a policy framework that integrates current understanding of good practice in investment and climate policy to mobilise private sector investment. It consists of five elements, notably: (1) goal-setting and aligning policy goals across and within levels of government; (2) reforming policies to enable investment and strengthen market incentives for LCR infrastructure; and (3) financial regulations and specific financial mechanisms that provide transitional support for new green technologies. Two other elements provide resources and support for the other actions to occur and to be effective: (4) harnessing and scaling up resources (*e.g.* training and research and development, risk assessment tools); (5) establishing practices that promote green business and consumer behaviour, such as information policies and awareness raising campaigns.

II. CONTEXT FOR LOW-CARBON, CLIMATE-RESILIENT INFRASTRUCTURE INVESTMENT

29. Understanding why infrastructure matters to the achievement of climate policy goals and what needs to be done differently to "climate-proof" infrastructure is a first step to structuring policy reforms that will mobilise investment. Beyond this, private investors are looking for adequate risk-adjusted return on their investments. Presently, the scale of domestic and international private investment in climate-related activities is seriously constrained by country-specific as well as sector-specific barriers (Hamilton, 2009; UNEP-FI, 2009; Kennedy and Corfee-Morlot, 2012). Low-carbon infrastructure investments are particularly challenging, because they combine two types of barriers: those related to infrastructure projects on the one hand, and those related to climate change and LCR infrastructure on the other. Before discussing good practice in policy design and implementation, it is important first to define the scale and nature of the investments required, then to understand differing country contexts and finally to identify the types of barriers and risks that potentially restrict the flow of capital to infrastructure and particularly LCR infrastructure.

2.1 What is the scale of investment needs?

30. Addressing climate change cannot be done without addressing the infrastructure financing gap more generally. The OECD estimates global infrastructure requirements to 2030 on the order of USD 50 trillion to 2030, or an investment flow of roughly USD 2 trillion per year (OECD, 2008; WEF, 2012). The largest share of most estimates (typically more than 50%) is for developed countries to renovate out-dated and inadequate infrastructure (also referred to as "brownfield" investment). The remainder is estimated to be required in developing countries, where rapid economic growth and urbanisation drive demand for new "greenfield" investment (*e.g.* UNFCCC, 2008; Fay *et al*., 2010). A major part of the infrastructure stock required to meet development goals is still to be built in the fields of energy, water, urban development, transportation and agriculture (Satterthwaite *et al.,* 2008; WEF, 2012).

31. Investments in basic infrastructure systems have to be *scaled-up* significantly in the coming years to meet development goals. Today only roughly USD 1 trillion is estimated to be invested annually in infrastructure through domestic and foreign investments, public and private channels (WEF, 2012). In Africa, for example, of the USD 40.8 billion estimated to be needed annually to develop energy infrastructure by 2015, only USD 11.6 billion are being provided, representing a gap of a gap of 71% of the investment needs (UN-ECA, 2011; Foster and Briceño-Garmendia, 2010; Muzenda, 2009; Briceño-Garmendia, Smits and Foster, 2008).

32. Incremental investments for adaptation and mitigation might just be a fraction of the total investments required. A World Bank study (2012a) highlights the potential synergies between "building right" and "building more" infrastructure when the full long term costs are assessed (see Box 3). In addition, while greening infrastructure investment is often considered as an additional cost, recent work by the OECD suggests that limiting climate change to 2 degrees (*i.e.* low carbon development) could be achieved at relatively similar investment costs to those projected under business as usual, particularly if interactions between network infrastructure requirements are considered.

33. Using a combination of IEA and OECD studies for the period 2015 to 2020, Table 3 shows that the greatest incremental costs for low-carbon infrastructure will likely be for buildings and transportation

vehicles. Much of those costs are carried by the private sector, namely individual households. Although data are incomplete, the analysis shows that additional investment costs for LCR infrastructure in other sectors, such as power generation, could be offset by savings on port, road, airport, and oil and natural gas distribution infrastructure (Kennedy *et al.,* 2012).

Table 3. Comparative annual global infrastructure investments under business-as-usual and low carbon scenarios, 2015 to 2020 (USD Billion/ yr)

	Business-as-usual (6 deg C) scenario	Low-carbon (2 deg C) scenario	Incremental cost of low-carbon scenario	Notes on author's estimates
Power Generation [1]	320	380	60	
Electricity T&D[1]	270	260	-10	
*Buildings [1]	320	620	300	
Industry [1]	280	310	30	
Water	772 [2]	772[4]	0	
Telecoms	646 [2]	646[4]	0	
Road	245 [2]	< 245[4]	<0	Sequenced with transformation in vehicle technology
Transportation vehicles[1]	3,300	3,370	70	
Rail	120 [3]	120? [4]	0?	Decrease in demand for coal replaced by shifting of freight from road
Airports	120 [3]	< 120[4]	<0	
Ports	40 [3]	40? [4]	0?	Decrease in demand for oil and coal replaced by increased trade in green products
Oil & Gas distribution	155 [3]	< 155[4]	<0	Lower demand for oil and gas
Total	**6,590**	**~ 6500 to 7000**	**~ 0 to 400**	

Notes: 1: IEA (2012); 2: OECD (2006); 3: OECD (2012); 4: author's estimate; * IEA building cost estimates only cover energy-using equipment and retrofits to building envelopes; question marks denote cases where the direction of the change in cost between BAU and the low carbon case is uncertain; totals for low carbon and incremental columns are uncertain, so ranges have been given by summing upper and lower bounds of uncertain costs and rounding.

Source: Kennedy and Corfee-Morlot, 2012.

34. While incremental investments for adaptation and mitigation might just be a fraction of the total investments required in a business as usual scenario, delivering climate adaptation and mitigation at scale will require unprecedented *shifts* in long-term investments and foresight to transform energy, transport, water and building infrastructure to become more resource -and energy-efficient. Estimating the scale of investment already occurring today in LCR is challenging, as there is a significant gap in the data available, and no harmonisation of definition around what is "green" or "low carbon" (Clapp *et al.* 2012; Inderst *et al*., 2012). Although in the aggregate, it is estimated that public and private flows to climate change-related activities are nearing USD 100 billion in developing countries, it is unknown what share of these flows support LCR infrastructure. Private capital has already started to flow into LCR investments, notably to clean energy projects and programmes. Yet this is still far from the levels of investments required to achieve LCR transformation in the power sector and fill the green infrastructure investment gap.

35. There is hence a need to *scale up* infrastructure investment generally and, if we are to avoid lock-in dangerous climate change, to *shift* these towards low-carbon and climate-resilient infrastructure options, a change that may marginally add to these already high capital requirements when low-carbon options are more capital intensive than other alternatives.

Box 3. Assessing the full costs and benefits of greening infrastructure

Greening infrastructure investment is often considered as an additional cost, with potential tension between "building right" and "building more" infrastructure. However another view from a recent World Bank study (2012a) argues that "There will not always be trade-offs between 'building right' and 'building more', in particular when the full long-term costs and benefits are assessed" (OECD *et al.,* 2012). This view recognises potential for synergies between development and greening of infrastructure investment. For example demand-side policies limit the need for new, more costly supply side infrastructure investments. In the water infrastructure sector, tariff or pricing policies, or other policies requiring regulated utilities to promote and invest in conservation, can deliver demand-side efficiency improvements over time and improve system resilience to water stress, which is expected to be exacerbated with future climate change (OECD, 2009; see also section III.2). In another example, the World Bank estimates that making buildings more energy-efficient in China could reduce energy costs by more than 50% while increasing construction costs by only 10% (World Bank, 2012a). As for the transport sector, better public urban transport for instance reduces congestion and air pollution, with large economic and health impacts, and these policies also reduce greenhouse gas emissions (OECD, 2012a).

Designing policies to achieve multiple local development and climate change objectives can achieve net co-benefits when considering total additional costs and total benefits (including direct and indirect benefits) (Viguié and Hallegatte, 2012; Bollen *et al.,* 2009; McCollum *et al.,* 2011). If considered narrowly from a climate change perspective, health benefits from improved air quality are considered "ancillary benefits", along side of the direct benefits of lower greenhouse gas emissions and mitigating climate change. Yet these benefits may be among the most important to local communities as they are nearer term than are climate change benefits, which only accrue over the long-term. The opportunities to green infrastructure are particularly large in emerging economies and other developing countries where it is possible to leapfrog old technologies to adopt new ones. Developing distributed renewable energy and water infrastructure projects in remote areas also has potential to both improve access to energy in developing countries, while lowering emissions and improving environmental performance compared to conventional options. The challenge for policymakers is to build consideration of direct and indirect benefits of action into their decision-making, alongside of the cost of LCR infrastructure investment.

Source: Adapted from OECD, World Bank and UN, 2012.

2.2 What role for the private sector?

36. The public sector does and will still play the leading role in commissioning green infrastructure projects and in guiding and "jump starting" investment when needed (see Box 4). Indeed in some countries, the ownership structure of key infrastructure sectors is predominately public, for example through state-owned enterprises operating power generation or providing transportation services. But transformational change will ultimately require large-scale private sector engagement. Particularly as government balance sheets have become increasingly strained, and in the face of growing infrastructure needs, further recourse to private capital through corporate balance sheets and financial or banking assets will be required. In this context, recourse to private capital will be required to support necessary investment in basic infrastructure, even if in key parts of the banking sector provision of long-term financing has become tighter due to economic circumstances, financial turbulence and new financial regulation such as Basel III. While formidable, such investment levels are well within the capacity of capital markets if the appropriate risk-adjusted returns are available (Kaminker *et al.,* 2012).

37. The process of moving towards a "green investment policy framework" recognises that the public sector has a leading role to play in infrastructure provision. At a minimum, this includes promoting

and planning infrastructure investment and in some cases directly investing or financing infrastructure projects. Public engagement should aim to address key market failures and externalities as well as delivery of public goods, *e.g.* flood protection for the most vulnerable social groups, investment in power grids to enable the growth in new renewable energy sources. For example, in the case of power grids, an important question is who will pay for the expanded and modified network that is needed to accommodate new renewable energy generation. Network externalities associated with many infrastructure investments result from the presence of social benefits in infrastructure networks that cannot be fully appropriated by private stakeholders. These characteristics lead to a natural monopoly business model in some sectors and suggest an important, on-going role for public regulatory oversight (*e.g.* monopoly) and public investment over time (Foster 1992; OECD 2000; OECD *et al.,* 2012). An on-going role of public investment and strong regulatory oversight of private investment could be needed, particularly in the case where monopoly business models are allowed (Foster 1992).

38. Yet particularly under public budgetary constraints and tight bank lending conditions, new sources of private sector capital will also need to be tapped to support infrastructure investment at the scale necessary for sound development. Private sector participation can inject much-needed investment capital or bring other benefits, including end-user benefits of a more competitive environment, improve the often poor operational performance of publicly run utilities; this will occur in part through mobilisation of the private sector's technological expertise and managerial competences in the public interest (OECD, 2007; see Box 4).

Box 4. Private Sector Participation in Infrastructure

In a large number of OECD and other countries, private participation in infrastructure has increased in recent decades and helped boost both the coverage and efficiency of infrastructure services. Yet at the same time a number of failed public-private partnerships (PPPs) attest to the difficult challenges facing policy makers. Infrastructure investment involves contracting processes that are more complex and of longer duration than in most other parts of the economy, operated under the double imperative of ensuring financial sustainability while meeting user needs and public goals' provision. The challenges are even more acute when governments bring in international investors, especially sensitive to commercial risks involved in working in unfamiliar local environments and very exposed to public opinion and political scrutiny.

As a result, the choice between public and private provision and financing of infrastructure services should be guided by an objective assessment of what best serves the public interest. Factors to be taken into account include current levels of service delivery and the condition of assets, affordability to households and companies, coverage of networks, operational efficiency, long-term maintenance of assets as well as social and environmental sustainability. The decision also needs to be guided by the timeframe over which improvements are required and the sources of finance that are available in the market in question. In particular, the decision to involve the private sector has to be guided by an assessment of the relative long-term costs and benefits, and availability and reliability of private or public finance options. Ideally it will also take into account the pricing of risks transferred to the private operators and prudent fiscal treatment of risks remaining in the public domain.

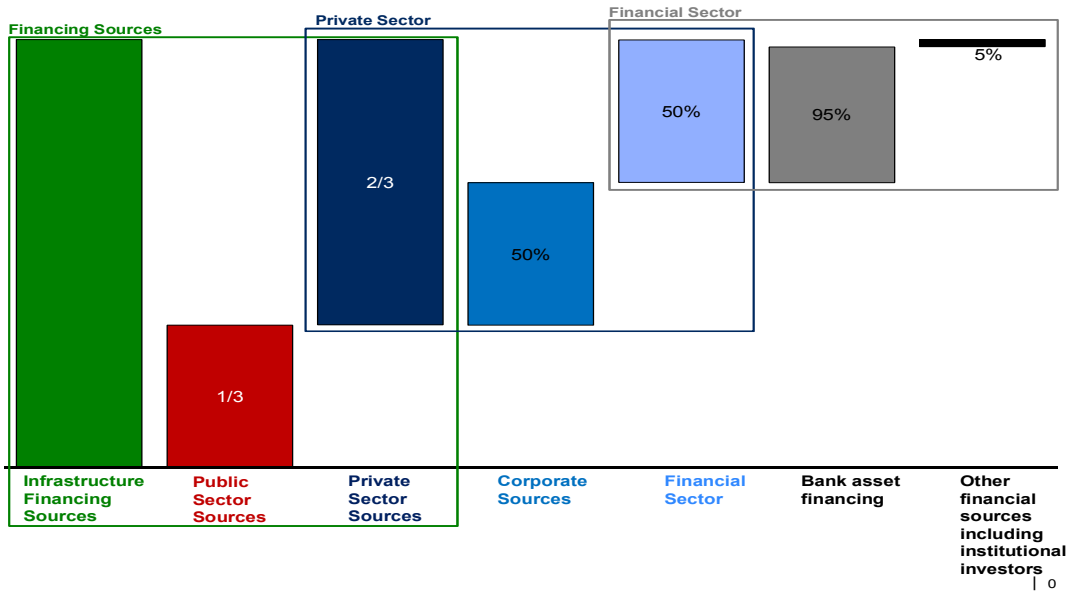
Source: adapted from OECD, 2007, Principles for Private Sector Participation in Infrastructure

Box 5. Sources of private sector investment in LCR infrastructure

By **private investment**, this paper refers to funding derived through different sources that aim to generate rates of return in excess of the opportunity cost of capital (Kaminker and Stewart, 2012). Private investment is supplied through different parts of the private financial system and aims to generate a profit. Sources of private capital include: 1) **corporate sources**, *e.g.* companies operating either multi-nationally or domestically, and 2) **financial sector**, including capital facilitators, such as banks, asset managers, brokers and advisors, or capital providers. The latter includes institutional investors, including pension funds, mutual funds, sovereign wealth funds insurance funds and hedge funds (see Figure 2).

The private sector is currently estimated to be the largest source of capital for infrastructure. For example, in December 2011, Bloomberg New Energy Finance (BNEF) recorded the trillionth dollar of cumulative investment in renewable energy, energy efficiency and smart energy technologies since 2004 (BNEF, 2012). The primary source of capital for investment in low-carbon power generation to date is the balance sheets of the electric power utilities[6] and developers.

Figure 2. Sources of Infrastructure Capital



Source: OECD illustrative estimates for developed countries in Kaminker and Stewart 2012, adapted from EIB, 2010.

One large potential source for infrastructure is the capital held by institutional investors. The main institutional investors (pension funds, insurance and mutual funds) in the OECD alone held over USD 71 trillion at the end of 2010; but institutional investors have played a minor role in directly financing infrastructure to date (Kaminker and Stewart, 2012). The OECD estimates that less than 1% of pension funds' assets globally are allocated *directly* to infrastructure investment, let alone to green projects.[7] The hesitancy of pension funds to invest at scale to date arises from multiple reasons including a lack of "investment grade" policy frameworks for achieving affordable green objectives (IIGCC, 2011).

[6] The relatively small market capitalisation of utilities may also be an issue given the scale of investments required.

[7] Excluding indirect investment in infrastructure via the equity and debt of listed utility companies and infrastructure companies. See Della Croce et al. 2011.

2.3 Barriers and opportunities for LCR infrastructure investment in different country contexts

39. Today, LCR infrastructure investments are characterised by inadequate returns or unmanageable risk. In turn, this limits the scale and the pace of LCR investments and challenges public and private sector actors to work together to overcome recognised barriers and limit the financial risk of such investments. Recent studies point to the "self-interest" of the private sector to invest in adaptation (Agrawala *et al*., 2011). However this assumes that private actors have sufficient information and incentives to prioritise investment in resilience, which may not always be the case. Investors also do not have sufficient or appropriate types of information to build their confidence and to help capital flow at affordable costs to new technologies (Kaminker and Stewart 2012). Overcoming such barriers will be necessary to fully engage the private sector to achieve long-term, transformative green growth.

40. Barriers to investment in LCR infrastructure can be clustered into two types (OECD, 2011a). First, barriers that relate to low overall economic returns to green investment. These often relate to inertia, for example due to incumbent network effects or to social norms and habits, and to low social returns (*e.g.* due to low human capacity or weak institutional support and governance). Second, barriers exist where there is low "*appropriability*"[8] of returns, which is driven by market and government failures that prevent firms and consumers from capturing the full value of improved environmental and efficiency of resource use (for example as in the case of network externalities, see Box 4).

41. The most prominent market failure associated with climate change is that its damage costs are not currently recognised in the market. Greenhouse gas emissions, which cause climate change, do not currently represent a cost of doing business unless governments act through policy to put a price on them. The costs of climate change will be greatest in locations that differ from where the largest sources of GHG emissions occur. Damage costs of climate change will also be incurred with a time lag, ranging from decades to centuries, from when the emissions occur. This climate change market "externality" leads to what Lord Stern has called "the greatest market failure of our time" (Stern, 2006).

42. Depending on the country characteristics and the sector considered by investors, the existence and importance of barriers will vary. Table 4 provides an overview of different country contexts – with country groupings organised by level of development – and the associated challenges and opportunities that may exist for LCR infrastructure investment. Additionally, investment barriers and opportunities differ across infrastructure sectors, particularly given the diversity of economic returns to green investment, market structures and policy environment of each sector.

[8] The factors that govern an innovator's ability to capture profits generated by an innovation.

Table 4. Challenges and opportunities for LCR infrastructure investment vary by national circumstances and institutional contexts

Category of country	Challenges	Opportunities
Developed countries	▪ Sometimes outdated or poorly maintained infrastructure requiring large investments for renovation ▪ Existing carbon-intensive infrastructure and carbon-intensive urban development patterns (though this varies widely by country) ▪ High greenhouse gas emissions per capitaBAU infrastructure development e.g. to build fossil fuel fired power plants ▪ Climate policies in place but sometimes fragmented and partial ▪ Some adaptation planning but limited policies and actions to adapt	▪ Strong institutional development, certainty and reliability of the investment environment ▪ High adaptive capacity, pockets of high vulnerability (*e.g.* urban slums or older urbanites) ▪ High capacity to govern climate change ▪ Routine renovation of aging infrastructure offers opportunities for upgrading to take climate change into account at relatively low-cost
Emerging economies (BASIC)[9]	▪ Typically low per capita greenhouse gas emissions but rising steeply, improving (but still low) energy efficiency ▪ Medium adaptive capacity, relatively high and increasing vulnerability (*e.g.* rapid urban growth and slum populations in high risk areas) ▪ Some adaptation planning (*e.g.* at local levels) but limited implementation ▪ Path dependent infrastructure development e.g. to build fossil fuel fired power plants to supply rapidly growing power demand	▪ Relatively sound investment conditions ▪ Strong economic growth and demographic pressure, rapid urbanisation, large investments in infrastructure occurring today ▪ Strengthening institutional capacity and policies to address climate change ▪ Rapid growth in new infrastructure build provides opportunity to "leapfrog" technologically and integrate climate concerns at design phase at relatively low-cost.
Medium-income developing countries	▪ Low energy efficiency, limited climate policy ▪ Rapid growth and urbanisation with associated infrastructure investment needs ▪ Limited adaptive capacity, some adaptation planning yet limited implementation ▪ Weak institutional capacity for policy reform, legal enforcement capacity	▪ Investment policy frameworks evolving, strengthening them is a governmental priority ▪ Industrialisation and increased energy and material consumption ▪ Growing donor support for low-carbon development and adaptation planning ▪ New infrastructure build provides opportunity to leapfrog technologically and integrate climate concerns at design phase at relatively low-cost
Low-income and least developed countries	▪ Weak enabling conditions for investment ▪ Lack of basic infrastructure (*e.g.* transport, energy and water) ▪ Sluggish economic growth, strong demographic growth putting pressure on existing infrastructure ▪ High dependence on natural resources (both renewable and non-renewable) ▪ High vulnerability to climate change and climate-related disasters ▪ Low adaptive capacity, some adaptation planning yet limited implementation or mainstreaming into development planning ▪ Insufficient financial and technical capacity in government	▪ Growing donor support for adaptation planning and implementation ▪ Opportunities to integrate climate change consideration into development planning and infrastructure planning, which is largely led by the public sector ▪ Provision of basic infrastructure provides opportunity for leapfrogging; also where growth is limited and rural decentralised infrastructure solutions may deliver low-cost, LCR services (*e.g.* off-grid electricity) along with other local development benefits.

Source: Adapted from OECD, 2011a (Green Growth Strategy).

[9] Refers to four large developing countries – Brazil, China, India, South Africa – which have formed a geopolitical bloc in the UN negotiations on climate change.

2.4 Risks related to LCR and infrastructure investment

43. Country-specific barriers often limit the attractiveness of such investments, either in terms of the adequacy of returns or unmanageable risk. In addition, private investments in infrastructure projects have typically been constrained by high upfront capital costs, sometimes low-returns and long investment timelines. These conditions, in turn, depend upon to what extent policies have internalised the cost of pollution and other environmental market externalities (e.g. by taxing pollution or charging for access to polluting activities such as use of roads by conventional vehicles). In addition to traditional infrastructure challenges, LCR infrastructure projects have to deal with specific risks that limit engagement of the investment community: regulatory risk and uncertainty for private investors linked to an unsupportive policy backdrop; lack of familiarity, information, knowledge and expertise with green infrastructure projects.

44. In any investment decision, investors will undertake a risk analysis of the project in question and of the investment conditions where the investment is being considered. When unabated or not compensated for, these risks present formidable barriers to investment. A typical risk assessment from an investor perspective includes review of several factors. These can be further distinguished between those pertaining to infrastructure generally and those pertaining to LCR infrastructure only:

- *Political, policy and regulatory risks.* These will vary by country and by particular policy context. Political risks include change in government, the risk of expropriation of assets, revolution, war or civil disturbance, and recently, terrorism. Policy and regulatory risk would include, for example, changes in tariff (or not being able to raise tariffs) and breach of contract. These risks are common to all infrastructure investment projects. At another level, there is a layer of policy risks that is specific to climate change policy (for example related to carbon pricing policy).

- *Commercial and technical risks* which vary by technology or infrastructure sector in a given context. LCR infrastructure may be particularly susceptible to new technology risk where there may be little experience with a given mitigation or adaptation technology and thus there may be risk around its performance in different contexts.

- *Market risks* will vary by type of business. With respect to LCR infrastructure investments, these will be related to the exposure of the specific businesses to climate change liabilities (*e.g.,* from high emissions or high exposure to climate change risk) or reputational risks that are related to climate change responses and performance in these areas.

45. Such risks may be particularly challenging for private investors as they accumulate the market failures and the risks from two different "asset" categories: first, infrastructure and second, within that, a special subset of green infrastructure investments that help to achieve climate mitigation or adaptation goals (see Table 2). At the political or policy level, they can detract from the "ease of doing business"[10] in a given country, and limit the confidence of investors, whereas commercial, technical and market risks can also be tackled through local policies and capacity building. Ultimately, investors are not looking for a "risk free" environment, but rather an environment where risks can be understood, managed and anticipated (Hamilton, 2009). In the context of unattractive risk-returns profiles, multiple market failures, and an urgent policy agenda, an argument can be made for time-bound government intervention and public finance is critical to help unlock investments in green infrastructure. Policy can play a crucial role to

[10] For example, see "The Ease of Doing Business Index" which is created by the World Bank. Higher rankings indicate better, usually simpler, regulations for businesses and stronger *protections of property rights.* See *http://doingbusiness.org/rankings* for details on the methodology.

address investment risks and market barriers and to create stronger enabling environments for business and industry to respond to opportunities and challenges presented by climate change, but there will remain a need for public finance and innovative finance mechanisms.

Table 5. The double challenge of low-carbon, climate-resilient infrastructure projects: risk analysis

		Traditional risks linked to infrastructure projects	Additional risks linked to the climate change aspects of infrastructure projects
Political, policy and regulatory risks	*Policy and regulatory risk*	Lack of political commitment / policy certainty over the long term on infrastructure planning ; Tariffs regulations to increase fees with inflation fall behind schedule; High bidding costs involved in the procurement process of infrastructure projects (lack of clarity about administrative rules; risk of corrupt practices); Fragmentation of the market and lack of policy alignment among across different levels of government. (You could consider adding the other risks mentioned on the previous page)	Lack of long term low carbon development or adaptation strategies; Trade barriers (tariff and non-tariff barriers) on green technologies and/or their inputs; Lack of harmonized environmental regulations; Lack of political commitment / policy certainty over the stability of specific forms of support to green investment, such as feed- in tariffs. Instability on the price of carbon, such as weak or unstable environmental regulations; Existence of fossil fuels subsidies that make other investments more attractive to investors.
	Legal and ownership rights	Unknown future litigation possibilities, planning consents not granted, lease running out; risk to repatriation of earnings.	Uncertainty about the legal status and property rights of emissions permits.
	Political and social risk	Opposition from pressure groups; corruption; Short-termism of politicians, limiting infrastructure planning and investment.	Additional forms of opposition to specific LCR technologies or processes, such as carbon capture and storage or wind farms, sea walls.
	Currency risk	Long-term investment horizon for infrastructure and exchange rate fluctuations.	Long-term investment horizon for climate impacts and mitigation.
Commercial, and technical risks	*Technological risk*	Includes the risk of technology failure, obsolescence or under-performance relative to expectations.	Particularly high in the context of low carbon investments as they often involve new technologies. The level of risk will depend on the maturity of the technology and the track record of the technology provider.
	Construction risk	Covering delays in the completion of the project, the interface between the different contracts of subcontractors or stakeholders.	Lack of expertise in new climate mitigation and adaptation technologies.
	Operational risk	Once the project has been constructed linked to the ability of the management to operate the asset, and to the decommissioning of the project.	Lack of expertise and track records in new GHG mitigation and adaptation technologies.
	Environmental risk	Unforeseen environmental hazards linked to an infrastructure project; Climate risk, changing climate can damage the functioning of infrastructure; Risk related to the uncertainty of climate change in infrastructure for adaptation.	
Market risks	*Business risk*	More competitors entering; Change in consumer preferences and demand.	Technological advances; Lack of familiarity with new low-carbon or adaptation technologies.
	Reputation risk	Damage to a firm's reputation can result in lost revenue or destruction of shareholder value. Such damage may stem from local sensitivities and needs.	The climate policy context could address the reputational risk though some new technologies, such as wind, tide or CCS projects could face local stakeholder resistance.

Source: Authors drawing on Della Croce *et al.,* 2011; ODI, 2011; UN AGF, 2010; Ward *et al.,* 2009; Muzenda, 2009.

III. INTEGRATING CLIMATE AND INVESTMENT POLICIES

46. While many studies focus on the role of environmental and climate change policies to support a transition to an LCR economy, this paper suggests that other factors play a critical role to achieve this transition. It starts from the premise that climate change policies and their effectiveness cannot be studied in isolation, but need to be considered in a broader national policy context, one that has the enabling environment for investment at its centre.

47. An integrated framework for domestic investment and climate change policy could help catalyse investment in low-carbon, climate-resilient development. Such a framework may also be an important communication tool for working with different policy audiences, including across governmental departments and levels of government as well as with stakeholders. It can provide a checklist for strengthening policy performance when looking across the multiple goals of policy from development and investment, to infrastructure finance and climate change. This paper gives special consideration to the goal of engaging the private sector in financing and investing in LCR infrastructure.

48. Table 6 sketches the main elements of these two policy streams. The second column outlines the main elements of a conceptual framework for investment policy, drawing on OECD's investment instruments and tools.[11] The last column outlines main elements of climate policy framework, drawing on an empirical literature on good practice. [12] In most countries, these two policy arenas have to date functioned quite separately and sometimes at cross-purposes preventing or slowing investment in LCR infrastructure.

[11] In particular: Declaration on International Investment, which includes the Guidelines for Multinational Enterprises (OECD 2011f; the Policy Framework for Investment (OECD 2006), and the Principles for Private Participation in Infrastructure (OECD 2007a) and its subsequent application to the water sector (OECD 2009b).

[12] For a review of literature and elements of good practice see OECD, 2011b, 2009b, 2008a, 2007b.

Table 6. Investment and climate policy frameworks: parallel policy processes

	Investment framework	Climate framework
Policy objectives	Design policies to increase private investment flows so as to promote economic development, working along 3 main axes: 1. **Boost opportunities** for investment 2. **Reduce investment risks** 3. **Increase return on investment** (*i.e.* **increase revenues** and **reduce costs** of investments)	Preserve environmental integrity, protect the global atmosphere and limit long-term climate change to global mean temperature change of 2 °C or less. 1. **Mitigation** as needed to limit greenhouse emissions in a cost-effective manner to achieve agreed emission reduction targets 2. **Adaptation** as needed to an already changing climate in a manner that limits damage costs and provides acceptable levels of security to society
Principles and elements of good practice	1.Transparency 2. Property protection 3. Non-discrimination 4. Policy coherence	1. Predictability and stability 2. Cost effectiveness 3. Technologically neutral and flexible policies to foster innovation 4. Targeted mechanisms to address market barriers 5. Policy coherence 6. Mechanisms for learning[13] and feedback over time

49. Table 7 proposes elements of an integrated green policy framework to help governments facilitate the transition to LCR infrastructure while ensuring that the public services they provide are financially sustainable, affordable and accessible to a majority of stakeholders. Each of the elements of this framework is discussed in some depth below, drawing on the literature and experience across investment and climate policy domains. While this structure is relevant to green investment generally, the focus here is on LCR infrastructure investment.

It considers two key objectives of an integrated climate and investment policy approach with respect to infrastructure:

- **Provision of public goals**: ensure timely and cost-effective private sector investment in necessary infrastructure to support economic development and enhance human well-being, while protecting the global climate and limiting impacts of inevitable climate change.

- **Scaling-up private sector participation**: policy intervention to 1) boost opportunities, i.e. creating a market for green "investment grade" projects; and 2) levelling the playing field by limiting investment risks, managing costs and increasing returns on investments.

[13] Also known in the academic literature as principles of "adaptive management".

Table 7. Integrating climate and investment policies: elements of a green investment policy framework

	Elements of a green investment policy framework	
Investment Policies	**1. Strategic goal setting and policy alignment** Clear, long-term vision and targets for infrastructure and climate change; policy alignment and multilevel governance, including stakeholder engagement **2. Enabling policies and incentives for LCR investment** Sound investment policies to create open and competitive markets; market based and regulatory policies to "put a price on carbon", remove harmful subsidies and correct for environmental externalities **3. Financial policies and instruments** Financial reforms to support long-term investment and insurance markets; innovative financial mechanisms for risk-sharing such as green bonds; transitional direct support for LCR investment **4. Harness resources and build capacity for a LCR economy** R&D, human and institutional capacity building to support LCR innovation, monitoring and enforcement, climate risk and vulnerability assessment capacity **5. Promote green business and consumer behaviour** Corporate and consumer awareness programmes, corporate reporting on climate change, information policies, outreach	**Climate Policies**

Source: Authors.

3.1 Strategic goal setting and policy alignment

50. One of the key barriers to private sector engagement in LCR infrastructure is uncertainty about the policy and regulatory frameworks that directly affect business opportunities, costs, risk and returns on investment. The long time frames required for infrastructure project development render businesses and investors particularly vulnerable to policy or regulatory changes that might occur over the investment lifetime. In addition to traditional policy risks in infrastructure projects (changes in fees, concessions), any unexpected changes in climate policies pricing externalities could jeopardise the profitability of the investment (*e.g.* the abrupt removal of subsidies). On the other hand, policy makers look for flexibility in policy making to adapt to fast changing market conditions and scientific information about climate change. Governments will need to actively manage the trade-offs between predictability and flexibility – or ability to adjust policies based on new information (Hallegatte, 2009; World Bank, 2012a).

51. The investment community has called for long-term and predictable climate policies to align investment and policy timescale as much as possible.[14] What matters to investors is not so much the stringency of the goal or the level of government that sets it, but the stability, clarity and coherence of policy goals and action across regions in which they operate (IGCC 2011). Providing a clear and, if possible, legally-binding framework for achieving climate goals would build confidence in new markets for green technologies and infrastructure, by ensuring continuity of the investment framework regardless of political change. Engaging key stakeholders along the process is also critical to build confidence, salience and coherence on policy objectives. Flexibility and certainty in policies can co-exist provided that an active and transparent consultative review process exists (World Bank, 2012a).

[14] Either referred as "long, loud and legal" or "transparency, longevity, certainty" or "clear and stable". See CMCI, 2012; UNEP FI, 2012,2010, 2009; Chatham House *et al.,* 2009; Hamilton, 2010, 2009; IGCC, 2011; Deutsche Bank, 2011; 2009; WEF, 2011; Ward, 2010a, b.

Goal-setting and strategic planning, including infrastructure planning

52. Long-term development planning is an important tool to help overcome investment barriers and mitigate political and regulatory risk, taking into account disaster risk management strategies and low-emission development goals. Governments can achieve this through integrating clear, stringent and long-term mitigation objectives and identified adaptation strategies to the risk of inevitable climate change into national development or infrastructure plans, or by introducing specific infrastructure goals in national climate strategies.

53. At the UN Conference of the Parties to the Framework Convention on Climate Change in *Cancún* in 2010 (COP-16), global leaders called for industrialised countries to develop low-carbon development plans and strategies (UNFCCC, 2010). Developing countries were encouraged to do the same and today nearly 50 countries have already done so (World Bank, 2012a). Beyond plans, many countries have already developed national laws and strategies, some of which establishing legally binding economy wide emission constraints or goals (OECD 2012a; Townshend *et al.,* 2011). For instance the UK has a legally-binding absolute emissions reduction target in its Low Carbon Transition Plan (LCTP), introducing the concepts of five-year carbon budget with binding milestones. The recent adoption of the Climate Change Act (2012) in Mexico is an important step towards long-term, clear climate change policy goals in Mexico, as it will impose domestic binding emission reduction targets.

54. These targets, plans or strategies are essential within a policy framework to encourage and steer investment to low-carbon, climate-resilient outcomes (Clapp *et al.,* 2010; Buchner, 2007: Bowen and Rydge, 2011). Setting ambitious goals is however challenging, and governments should work with stakeholders to gather support for policy reforms that strengthen cross-cutting policies and the country's commitment to use private investment to stimulate green innovation and commercial opportunities (see Box 5).

55. Setting long-term national climate goals for emission reduction or adapting to climate change in specific infrastructure sector would create more opportunities in low-carbon infrastructure projects. The EU, the UK and now Mexico have legislated into law long-term GHG mitigation and renewabl energy targets where targets are now legally binding and long-term (i.e. in the 2020 to 2050 timeframe). Goal-setting can also usefully occur at the sector level to provide a clear vision of the future for investors. For instance, in the transport sector the European Union (EU) introduced a binding commitment to achieve a 10% reduction by 2020 compared to 2012, or the UK has a statutory commitment to abate transport GHG emissions by 50% in 2027 and by at least 80% by 2050 from 1990 levels. Domestic infrastructure investment plans can also be key tools to integrate low-carbon and climate-resilient priorities and to overcome the business as usual trend. A key opportunity is to incorporate climate risk planning within countries' infrastructure plans and national disaster risk management strategies. Examples include the United Kingdom (UK) National Infrastructure Plan (2010), which aims to create a LCR and green economy, including mainstreaming of the UK Adaptation Programme both for new and existing infrastructure (HM Government, 2011). *Building Canada* (2007) is a seven-year plan supporting public infrastructure projects that also contribute to cleaner air, water and land (OECD, World Bank and UN, 2012).

Box 6. Key challenges in setting ambitious climate goals for mitigation and adaptation

Climate change policies make important contributions to social welfare by protecting the natural resource base upon which economic production depends and by improving human security and health. A core challenge of climate policy-making is to manage the risk of non-linear or catastrophic change in the context of scientific uncertainty about such events (Weitzman, 2011). Another challenge is the lag in time and in space between when and where emissions occur versus when and where damages occur. Yet there are many political-economy concerns that prevent governments from setting such targets at a sufficiently stringent level. Scientific uncertainty and the tendency toward "short-termism" should not be allowed to delay timely mitigation goal setting or to hinder an adaptation strategy to address the inevitable risks to people and infrastructure due to unavoidable climate change. The risk of irreversible, possibly catastrophic damage from climate change justifies action through the use of cost-effective policies, even if the marginal costs exceed the marginal benefits today (Jamet and Corfee-Morlot, 2009; Weitzman, 2011).

Goal-setting for adaptation policy is fundamentally different than for mitigation policy, as it revolves around the provision of public goods to support a multitude of government and private decisions – at consumer and firm level and at different levels of government (Bowen and Rydge, 2011). Adaptation is also inevitably "local" in character. With respect to infrastructure, climate change impacts will vary widely by location (*i.e.* geography) and by the sensitivity of the sector or project in question to climate change risks (*e.g.* its water consumption requirements or its need to be located in a coastal zone such as for marine transport infrastructure). Investments to build climate resilience into infrastructure will be in the asset owner's best interest; however access to good information, tools for risk management and knowledge about climate risks may be lacking or not acted upon (Agrawala *et al.,* 2011; see below 4). An overarching goal of adaptation policy may be to support decisions that are robust across a range of possible outcomes and that assist with adaptation to today's climate hazards, often referred to as no- or low-regret strategies (Hallegatte *et al.,* 2011). Policy may also target as a priority decision processes and investors that have lasting impact on physical infrastructure (Bowen and Rydge, 2011; Hallegatte *et al.,* 2011). This might include, for example, integrating consideration of climate change risk into urban land-use and zoning decisions (*e.g.*, to avoid the sitting of infrastructure facilities in flood-prone areas) or into infrastructure planning more directly (*e.g.* water, sanitation or energy infrastructure).

A key in climate policy goal-setting with respect to infrastructure sectors will be to manage the interactions between long-term inertia and irreversibility on the one hand, and near-term economic returns on the other (World Bank, 2012a). A recent World Bank (2012a) review of these interactions suggests priority infrastructure areas for action in developing countries are land use planning, public urban transport, and large-scale water supply projects, since these are characterised by high inertia and risk of irreversibility and by high potential for local benefits for development, green growth and climate change.

Another challenge is to manage the political economy of reform, where there is a need to recognise distributional issues, and winners and losers including a multitude of competing business interests, some of which will be lobbying to maintain status quo (de Serre *et al.,* 2011). It is key for governments to address these political economy issues, including smoothing the transitional costs for businesses and workers that stand to lose from moving to low-carbon, climate resilient activities (i.e. by providing transitional support for labour market training, for "green" innovation and investment at firm level as well as public funding of R&D activities).

56. Long term financial planning is complementary to development planning as a means to help overcome investment barriers and create opportunities for private sector participation in infrastructure investment. Financial planning is essential in part because infrastructure investments are lumpy, requiring long time frames for project preparation and implementation, and commitments to long lifetimes once built. The delivery of public goals and private returns from any infrastructure investment will depend on a number of uncertain developments over the lifetime of the project, *e.g.* how future demand for services unfolds, regulations and policies that price those services as well as resource availability and pricing for inputs (*e.g.* for energy inputs, or water, or in the case of public transport the price of gasoline for individual vehicle travel) (Hall *et al.,* 2012). Infrastructure planning, including the use of scenarios to consider robust outcomes across a range of possible future developments, can help policymakers and investors alike to anticipate and take action to manage political, regulatory and policy risks associated with such investment (Ang and Marchal, 2012 forthcoming; Hall *et al.* 2012; see also III.4 below).

Multilevel governance to align policies and engage stakeholders

57. The choice of an infrastructure strategy goes far beyond the climate agenda, and low-carbon, climate-resilient strategies should emphasize other social, economic and environmental benefits. Aligning policy goals and exploring synergies and co-benefits is fundamental to develop coherent and cost-efficient policies. For instance, the choice of transport infrastructure impacts GHG emissions, but also local air quality and health, congestion hence economic development, transport accessibility hence social equity, and road safety. Adequate LCR strategies need to be designed to account for the different policy criteria. Aligning climate change priorities with economic development, and infrastructure planning in particular, can help to advance national policy in a more coordinated, cohesive and strategic manner (see Box 3). Low-emission development strategies (LEDS) for instance provide an opportunity to integrate climate change into economic development (Clapp *et al.,* 2010).

58. Sector policies are also particularly important to shape infrastructure investment. A key goal is to systematically integrate concern about climate change into sector policies – such as for water, energy and transport – as well as into those concerned with urban development and infrastructure (Bowen and Rydge, 2011; OECD, 2010a; Kennedy and Corfee-Morlot 2012). A good example is transport infrastructure planning; to be effective in achieving public goals, it must be fully integrated with urban land use planning (Ang and Marchal, 2012 *forthcoming*).

59. An important part of the policy alignment is to ensure that policies and incentives are aligned as well across levels of government and between stakeholders. In the area of climate change, this includes not only looking at how national and sub-national policies align but also establishing opportunities for cooperation, networks and learning horizontally, *e.g.* amongst business with similar climate risk profiles (OECD, 2010a). Thus institutional models of integration include (i) horizontal integration of policy objectives across national (or local, sub-national) infrastructure authorities and other public authorities, where coordination between public and private stakeholders is also an essential activity – enhanced horizontal coordination and communication between the climate change and investment communities is particularly relevant across governmental levels; and (ii) vertical integration to increase the consistency between national, local/urban and regional policies (OECD, 2007c; OECD 2010).

60. Early engagement of key stakeholders in goal-setting and planning processes, at each level of government, will help to ensure relevance and widespread acceptance of the outcomes as well as stakeholder commitments to assist with implementation and increased effectiveness (CMCI, 2012; OECD, 2010a). Depending upon the level of decision-making, the relevant stakeholders may vary. At national levels it will include the largest of national corporations, financiers, development and environmental non-governmental organisations. At urban levels, by contrast, it will necessarily include neighbourhood and community organisations, local banks, business and environmental interest groups. Policy coherence and stakeholder engagement requires to take into account the specificities of institutional arrangements and social and cultural factors within each domestic context. However there are also trade-offs between the time and resources required to engage with stakeholder processes and design and implement strategies (Project Catalyst, 2009; Clapp *et al.,* 2010). Stakeholder consultations therefore need to be used judiciously and budgeted into policy processes from the start.

3.2 Enabling policies and incentives for LCR investment

61. In any risk analysis, the "ease of doing business" is among one of the first conditions that investors consider, particularly in the case of capital-intensive projects. The ability of investors to recover their investments in large infrastructure projects is constrained by weak investment policies, such as controls on repatriation of capital, and regulatory disincentives. Investors need a good general investment

climate, which includes coherent governance and regulatory structures, clear enforcement rules and property rights and a strong rule of law (OECD 2007; CMCI, 2012).

62. Governments have to address as well market failures deriving from climate change. This can be done by ensuring that market policies put a price on environmental "bads" and by reforming policies that directly or indirectly support mal-adaptation, or investment in polluting technologies (UNEP FI, 2012; OECD, 2012a).

Policies to enable and mobilise investment

63. Key principles of a strong investment framework are generic and not specific to environmental performance. They include: transparency, non-discrimination, property protection, and policy coherence. A critical determinant in investment decisions is *transparency* in how governments disclose information and implement rules and regulations dealing with investment, including the performance of these investments in climate change adaptation and mitigation. Transparency also helps to counter corruption in infrastructure projects and ensure the integrity of the procurement process. Governments are also expected to grant adequate *investment protection*. Investors need to be confidant that their ownership of, or right to use, property is legally recognised and protected. *Non-discrimination* among investors ensures that green infrastructure markets are open and accessible for all, including foreign investors. An *open investment* environment allows domestic and foreign firms to compete on an equal footing. Measures such as unbundling infrastructure networks, with horizontal or vertical separation of operations, can create increased opportunities for private investment than vertically integrated systems. Competition policy can help lower entry barriers for firms, for instance by revising the privileges of state-owned enterprises so that they are not given undue weight in the procurement process and stemming the growth of monopolies and cartels. Also, enhancing product variety and quality through innovation can in turn raise consumer welfare, for example by lowering prices for consumers (OECD, 2007a).

64. The protection of property rights over the long term is crucial to attracting investment and establishing incentives for innovation. It includes intellectual property rights but also other rules, such as proper rules to acquire land on which to build plants or install infrastructure. Green sectors, and other areas, are particularly conducive to a high degree of innovation. Intellectual property rights, in particular, give firms incentives to invest in product, technology and product research and development, which in turn is key for environmental performance. Intellectual property rights also give investors the confidence to share new technologies via joint ventures and licensing agreements, and this turn can also promote green business activity and further investment. Limited protection of intellectual property rights, on the other hand, constitutes a major disincentive for investment and trade in new green technologies and processes.

Open and competitive markets for green trade and investment

65. An open economy facilitates investment, including in green technologies and infrastructure. Reciprocally, trade barriers (tariff and non-tariff barriers) on green technologies, services and/or their inputs may hamper investment and the trans-boundary flow of innovation in this area and undermine the effectiveness of emission abatement policies. According to Kim and Steenblik (2009), there is room for lowering non-tariff barriers to green goods and services worldwide. It is likely though, as underlined by Doornbosch, Gilien and Koustaal (2008), that most trade and international investment barriers are generic (*i.e.* not specific to green technologies or services). Addressing these will help increase trade and investment, but not specifically in LCR or green technologies and processes.

66. An additional policy challenge pertains to the market structure in some sectors where the potential for LCR new investment is the highest, such as in the electricity sector. Yet in addition to the lack of a "level playing field", often legal and regulatory measures limit private sector participation in

renewable energy (UNEP FI, 2012). This is partly because the policy push for renewable energy is quite recent, coinciding with growing liberalisation in the electricity market, and it is not clear yet how the two trends will interact (OECD, 2010c). For example, production of renewable energy presents opportunities for new market entrants in power generation. However, incumbent companies could and may handle those investment opportunities through a diversification of their portfolio and if they benefit from state benefits, such as subsidised equipment, the incumbents could crowd out new market entrants. Yet evidence suggests that a large proportion of breakthrough innovations tend to come from new firms that challenge existing business models. Government measures to remove barriers to entry and to support growth of new firms may have an important part to play to stimulate investment in LCR technologies (OECD, 2010e).

67. In addition to increasing the penetration of renewable energy supply in power systems, the transition to smart grids may give rise to competition policy issues. These may concern access to the power grid and to distribution networks for these new sources of power, possibly generated by third parties, and the need for standards in metering services to facilitate market access. There are many different possible restrictions that may limit competition, for instance banning or limiting investment by foreign-controlled enterprises or barring foreign investment in some sectors; there are also exceptions to national treatment,[15] such as on the basis on national security. Conversely, granting tax breaks, lifting import duties and offering other investment incentives can facilitate investment in LCR infrastructure. These issues should be monitored closely to ensure that LCR and other environmental performance criteria are met along side of open access and competition amongst all qualified providers (both foreign and domestic), thus avoiding "green protectionism."

68. For infrastructure investments and markets, a key feature is the delivery of public goods in fixed network infrastructure, *e.g.* airports require regulated monopoly market structures (Foster, 1992).[16] Where one segment in the chain of production is network-based, such as distribution or transmission of energy or water, regulated monopolies or state-owned enterprises may be a preferred business model (Kennedy and Corfee-Morlot 2012; OECD 2012a). As noted in a recent G-20 report, in some cases "collective gains of extending the network is higher than the private returns to the network owner" (*e.g.* for electricity, water or public transport) (OECD, World Bank and UN, 2012). In this case, a strong regulatory framework or significant public investment, or both, may be warranted. However, direct state ownership may not be necessary to achieve regulatory aims.

Provide market incentives for low-carbon, climate-resilient investment

69. A strong and visible carbon price will improve the risk-adjusted return profile for climate-resilient investments. If a carbon price signal is broadly applied across all greenhouse gases and economic sectors, it will help to steer investments over time to least-cost mitigation options, also in the agricultural and land use sectors (with adaptation benefits) as well as industry or waste management. Further, carbon taxes or use of emission trading systems also trigger climate technology patenting and innovation (OECD, 2010e). In the United Kingdom for example, the Climate Change Levy on energy use in industrial, commercial, agriculture and public sectors, has been found to stimulate innovation, with a higher patenting activity of firms paying the full price of the levy than those benefiting from exemptions (OECD, 2012a; OECD, World Bank and UN, 2012). Emission trading systems to establish common carbon prices across firms at the domestic level include: the EU emission trading scheme (EU ETS), the world's largest and

[15] A concept of international law that declares if a state provides certain rights and privileges to its own citizens, it should also provide equivalent rights and privileges to foreigners who are currently in the country. "National treatment" is a privilege granted by nations in the context of international trade and investment. For example, it can be found in bilateral tax treaties and also in most World Trade Organization agreements.

[16] For a detailed literature review on "regulation for natural monopolies", see chapter 4 of the OECD Economic Outlook 2000 (OECD, 2000).

most advanced trading scheme, covering medium and large emitters, including electricity generators; the New Zealand emission trading scheme (in place since 2008); and the Australian carbon tax (2011) (Hood, 2010; OECD, 2012a). Yet today carbon prices – even where they exist – are not high enough to send a signal for transformational change (OECD, 2012a; Vivid Economics, 2011). Instead, today's low prices for carbon are driving investments away from riskier and newer alternatives, and towards fossil fuel options such as natural gas.

70. While essential for innovation and efficiency over the medium to longer term, carbon prices are not sufficient on their own to achieve ambitious climate goals. They will need to be complemented with a suite of other instruments that create markets for climate-resilient investment over the near- and medium-term (see 3.3.). In the transport infrastructure sector, for example, pricing policies have limited potential due to low price elasticity of transport demand for vehicles. Despite scope for influencing mobility choices through prices and taxes (*e.g.* vehicle and fuel taxes), market-based instruments need to be accompanied with policies such as land-use planning controls (OECD, 2012e).

71. One further step to integrating climate change externalities into markets and to "level the playing field" for LCR technologies is to identify and reform policies that may provide perverse incentives. For example, subsidies that encourage consumption of fossil fuels (see Box 7), investment promotion for commercial developments in high flood risk areas, or land-use policies that induce urban sprawl and dependence on high-emission passenger vehicle travel could all be categorised as perverse incentives that raise emissions, promote mal-adaptation or both. Similarly, water subsidies inducing more water use by industrial and agricultural water users remain common despite increasing water scarcity (see OECD, 2012a). Reforming environmentally harmful subsidies is essential if carbon pricing is to be effective and can also avoid mal-adaptation in some sectors.

Box 7. Reforming environmentally-harmful fossil fuel subsidies

An inventory of 24 OECD countries finds that fossil fuel production and use was supported by USD 45-75 billion per year between 2005 and 2011. Fossil fuel consumption subsidies in 37 developing and emerging economies amounted to an estimated USD 554 billion in 2008, USD 300 billion in 2009 and USD 409 billion in 2010. Importantly, phasing-out fossil fuel subsidies can be a foundational policy that can pave the way for carbon pricing policies. Yet subsidy reform is politically challenging, and can in some cases have negative impacts on low-income households. Such policy reforms must be implemented carefully to ensure that any negative impacts on household affordability are mitigated through appropriate measures (*e.g.* means-tested social safety net programmes). To achieve intended social benefits, it is preferable to target the support directly to those who most need it, rather than to maintain an across-the-board subsidy to all fuel users. Reforms should also be carefully sequenced and phased-in with advance notice to allow businesses and consumers to adapt to new market prices.

Source: OECD, 2012b; OECD, 2011d; IEA/OECD/OPEC/WB, 2011, 2010; IEA, 2011b.

72. A further deepening and extension of the carbon market creates the scope for substantial transfers of private funds from developed to developing countries (potentially generating revenues for green firms in developing countries). In the near term, the main channel for such transfers could be scaling-up existing crediting mechanisms, such as the Clean Development Mechanism (CDM) (World Bank *et al.,* 2011). In a rapidly urbanising world, domestic or international offset mechanisms can also be designed to stimulate investment in green urban infrastructure projects that mitigate GHG emissions (Clapp *et al.*, 2010). Finally, an important feature of market based instruments such as carbon taxes or cap and trade policies is that they also generate revenues to ease tight government budgets and potentially provide new sources of public funds, some of which may be used to support climate action (OECD, 2012a; World Bank *et al.,* 2011).

73. Ecosystem protection[17] is a key adaptation measure that can limit the impact of climate change on people and infrastructure by providing services such as natural flood buffering, water and soil conservation. Experience is growing with market-based instruments as a means to engage the private sector, for example by establishing policies that provide payments for ecosystem services (PES) (*e.g.* in the area of forest-based ecosystem services, or wetland conservation measures) (Karousakis and Corfee-Morlot, 2007; OECD, 2010f). In the case of markets for reducing emissions from forest degradation and deforestation (REDD+), there is the possibility to deliver both adaptation and mitigation benefits. As with demand-side management, investments to preserve ecosystems and their services can avoid the need for more costly investments in hard infrastructure (*e.g.* watershed preservation can be cheaper than investment in water sanitation facilities). The use of market-based instruments to deliver ecosystem services requires institutional capacity and monitoring and enforcement measures to ensure clear property rights and good data to allow services to be measured over time, as well as enforcement capacity (see III4 below). When these design features are in place, policies that establish PES can provide a steady revenue stream to investors and clear incentives to conserve rather than destroy critical ecosystems by internalising the value of these services into private land use decisions.

Regulatory and other policies to create markets and address LCR investment barriers

74. Regulations can help to create markets for green technologies by fostering demand for new, greener infrastructure, hence creating new business opportunities for private sector investments. As a necessary part of the environmental policy mix, regulations can be most appropriate in situations where markets cannot provide price signals that reflect the full costs of behaviour to individuals or organisations or where there are market failures that limit the effectiveness of price signals. This can be the case where, for example, pollution cannot be adequately monitored at the source or where there is no good proxy that could be subject to taxation or where behaviour is unresponsive to marginal price change (OECD, 2012a; Hood, 2011). Typical examples include vehicle fuel-efficiency standards and building codes that require use of insulation materials, low-emission performance or performance features that withstand stresses from foreseeable natural hazards (*e.g.* intense wind, heat or precipitation events). Regulatory approaches may also be more politically feasible in some jurisdictions, for example where constituencies are strongly against tax increases.

75. Standards and regulations can also clarify minimum environmental performance for investors and thus provide greater market certainty to companies and other investors. Such performance-based regulatory measures do provide technology-neutral (shadow) price incentives to companies. The design of environmental regulations is important to their efficiency and effectiveness: they should be closely targeted to the policy goal, stringent enough so that the benefits outweigh the costs, stable enough to give investors' confidence, broad-based while also flexible (*i.e.* technologically neutral) so as to foster genuinely novel solutions. Ideally they are also updated regularly to provide incentives for continuous innovation (OECD, 2012a). Another very effective form of regulation of LCR infrastructure is to mainstream climate mitigation and adaptation objectives in public procurement processes (see Box 8).

[17] In some policy circles, this is referred to as ecosystem preservation is referred to as "green infrastructure".

Box 8. Public procurement to build LCR infrastructure

As low-carbon, climate-resilient projects can be more expensive than alternatives, there is no incentive for private sector to include those dimensions in public bidding processes. One way to move towards LCR transformation would be to include specifications that lay out minimum LCR performance criteria for products, technologies and project (Ang and Marchal, 2012, forthcoming.)

Public procurement can help:

1. Support the diffusion of new LCR technologies by creating demand for these;
2. Mainstream climate-resilient practices into the procurement of greenfield and brownfield infrastructure projects; and
3. Encourage public-private partnerships (PPP), other risk-sharing and financing mechanisms to be geared towards LCR infrastructure alternatives.

In particular, PPP contracts – where in place and where there is sufficient administrative capacity to design and implement them -- could be adapted to provide regulatory incentives for investment and thus help to create markets for green technologies or infrastructure (Kennedy and Corfee-Morlot, 2012).

76. Regulations, often combined with information policies, can also be a key approach to deliver demand-side management (DSM) outcomes, for example in the energy, transport or water sectors. This has been shown to be the case in the energy and water sectors, where water conservation and energy efficiency policies for energy or water using equipment or products (*e.g.* energy or water demand management) can be used to alter demand and thus supply needs (World Bank, 2012b). As noted above, demand-side policies can limit the required investment in new physical capacity, leading to a more cost-effective provisioning of services overall. These policies complement supply-side policies focused on infrastructure provision. In road transport, congestion pricing has been shown to be an effective demand-side management tool (OECD & ITF, 2010). Labelling and information policies may also be useful to overcome information barriers to green investment and to promote good corporate and consumer behaviour (see III. 5 below).

77. Specifically, penalties and performance standards can be used to increase the resilience of infrastructure investment, for example in water and energy utilities. Regulatory instruments may be more effective than market-based instruments to increase climate resilience of infrastructure, particularly given the presence of network externalities and other market failures existing in some sectors. Despite direct and indirect local benefits to invest in climate-resilient infrastructure, those who carry the investment costs may not be the ones that appropriate the benefits (Agrawala *et al.,* 2011, Hallegatte *et al.,* 2011).

3.3 Financial policies and instruments

78. Financial policies and instruments can help scale up investments in LCR infrastructure in one of several ways, e.g. by increasing availability of financing sources, reducing the financial risk associated with the investment or increasing the returns. Tools such as public-private partnerships (PPPs) are one possible tool, provided that risks are appropriately allocated to the private sector to justify returns that they will appropriate. One of the key barriers to the development and deployment at scale of green infrastructure projects – and infrastructure projects in general – is the availability of traditional sources of public and private financing. Private financing for LCR projects such as clean energy have traditionally been provided mainly through corporate balance sheets and the banking sector (*e.g.* listed debt and equity instruments issued by utility companies and various forms of equity and debt financing by banks). However, the scale of the financing challenge for infrastructure will stretch these resources considerably, including for the project finance market. The financial sector (notably banks), is currently constrained as a source for long term financing due to extraordinarily difficult economic circumstances in Europe and the

US following the recent financial crisis, which in turn has led to deleveraging and impending financial regulations (such as Basel III). Institutional investors, including pension funds and insurance companies, could provide alternative sources of capital (Kaminker and Stewart, 2012). Yet given competition for funding, the relatively high risk and low return of green infrastructure investment projects will keep investors away without targeted financial policy interventions.

79. The demise of AAA-rated mono-line insurance companies[18] has frozen current capital markets for infrastructure, depriving the infrastructure market of a limited but valuable source of financing and credit enhancement for infrastructure bonds (by 2010, only one mono-line insurer was issuing new policies and none had retained a AAA credit rating).[19] This gap has been partially filled by multilateral lending institutions increasing their support to the infrastructure sector during the crisis, however by themselves they cannot offer a solution to the "infrastructure gap" more broadly or all the funds required for clean energy projects more specifically. Consequently, public resources will need to be used strategically to leverage and attract private capital.

80. Public efforts can catalyse private investment, emphasising the importance of increasing public funds to partner with private investors to green infrastructure investment, support a positive investment climate and the development of local capacity (e.g. in the commercial banking sector) (UNDP, 2011). The public sector, international finance and other development finance institutions (DFIs) as well as bilateral donors often provide funds for project preparation and concessional elements for pioneer investments. Such support can go a long way toward changing risk-return profiles and giving investors more confidence in the long-term viability of their projects.

81. Development finance support can also come in the form of non-concessional financial tools to help mitigate investment risk (and risk perception) of green infrastructure. For example, the Climate Public Private Partnership (CP3) Fund is a £3 billion fund launched by the UK (2012) in partnership with the International Finance Corporation and the Asian Development Bank. With the aim to unlock barriers to low-carbon investment in developing countries, the CP3 Fund is providing early stage equity, as well as management support, technical assistance and financial sector capacity building (Brown and Jacobs, 2011). The Fund is scheduled to run as an investment platform, on a commercial basis. Its goal is to use the AAA credit risk rating of key donor partners both to leverage private equity and to provide longer term loans at lower cost than would otherwise be the case for low-carbon infrastructure projects (Brown and Jacobs, 2011). Building on such project-based activity, there is also an opportunity to partner development finance support with country-led policy reforms that can help to make such projects commercially viable and financially sustainable over time.

82. Market imperfections in financial markets typically include a lack of capacity in local financial markets this limits access to private capital to fund infrastructure development. Tackling these barriers can be achieved through direct support to the development of a local financial sector, where necessary. In particular, many developing countries have a poor supply of long-term financing. To complement financial sector regulations (below), a set of financial tools and instruments will need to be tailored to specific local contexts (*i.e.* to the maturity of the local financial sector), market barriers (perception of risk, transaction costs) and market segments (SMEs or large developers). A critical step in the interim, as local capacity is built in the financial sector, is to provide transitional incentives and subsidies to improve the risk-return value proposition of green infrastructure assets.

[18] Mono-lines are specialised insurance companies that provide guarantees and thereby credit enhancement to bond issuers.

[19] See HSBC and Climate Bonds Initiative (2012, forthcoming).

Ensure a financial regulatory framework conducive to LCR infrastructure investment

83. Access to well-functioning capital markets is a pre-requisite to LCR infrastructure investment, as for any other infrastructure investment. Countries with well functioning domestic capital markets find it both easier and cheaper to involve private enterprises – particularly international operators – in their infrastructure sectors (OECD, 2007c). In open financial markets with convertible exchange rates, infrastructure operators fund their operations at competitive international rates. In countries with limited access to repatriation of profits and investments, investors find it difficult to mitigate their exchange rate risk and often face a strong incentive to fund their investments locally. In these cases, the success of infrastructure projects can be bolstered by strong local capital markets and by giving investors full access to these.

84. Well intended and important global and regional financial regulations also have the potential to negatively impact the conditions for capital market transactions and flows that are particular to the sector; this includes, for example, long-run infrastructure-backed debt investment, essential to drive project finance towards transport infrastructure projects. Financial institutions and policymakers need to understand, monitor and discuss the impact of new financial regulations to avoid undermining other policy efforts to attract capital to green infrastructure (Box 9).

Box 9. Potential implications of new financial regulations on the availability of long-term finance

New international accounting rules have brought greater transparency and consistency in financial statements. However, a number of well-intended and important regulations may also be inadvertently discouraging institutional investors from investing in longer-term, illiquid or riskier assets such as infrastructure projects. These include potential unintended consequences from international accounting, risk-based funding and solvency rules. New requirements will force banks to hold more equity on their balance sheets for higher risk lending and it is predicted that the long-term capital commitments associated with green infrastructure projects could become too expensive for banks to finance. Some of the finance community have stressed that there is a need for detailed appraisal of the implications of Basel III for banks ability to provide long-term project finance; and further consideration of whether there are ways for this impact to be ameliorated. Indeed, following the financial crisis, some of the banks most active in the infrastructure financing sector more broadly have largely withdrawn from the market, essentially due to liquidity and deleveraging issues and the fact that these loans consume a lot of capital but are relatively low in profits.[20] Current expectations are that conditions for bank loans and refinancing will likely become much less favourable and more expensive (OECD, 2012f). In addition, the Dodd Frank Wall Street Reform and Consumer Protection Act passed by the US Congress in 2010 could potentially restrict investment in private equity and venture capital firms and other types of privately offered funds which may have an impact on US banks' ability to fund the development of clean tech companies (OECD, 2012f).[21]

Risk-based funding and solvency regulations are envisaged in the Solvency II framework for European insurers. Solvency II, commonly referred to as "Basel for insurers", is due to come in to effect 1 January 2014 and aims to reduce the risk exposure of European insurance companies through more stringent capital standards. Amongst other aspects, such regulations apply a different capital charge to different investments depending on their perceived riskiness – and again there is a concern that this could discourage investment in sectors such as infrastructure.

For a full discussion of the impacts of accounting and solvency rules on long-term investing see OECD 2012 forthcoming "*The Effect of Solvency Regulations and Accounting Standards on Long-term Investing".*

Source: Kaminker and Stewart, 2012*;* OECD, 2012f forthcoming.

Innovative financial tools and instruments to reduce risk and increase market liquidity

85. Financial tools can help scale up investments in LCR infrastructure either by reducing the perception of risk, actually reducing financial risk or by increasing returns. Improved contract design of

[20] In the current environment, the 15-year project finance debt market from European banks is virtually nonexistent (having moved to 7-10 year structure as funding beyond this period is prohibitively expensive), although some Asian banks and some export credit agencies are still active (HgCapital).

[21] For further details see Standard & Poor's (2011).

public-private partnerships (see Box 13) are one possible tool, provided that risks are appropriately allocated to the private sector since the private sector is best positioned to mitigate or manage such risks at least cost. Other tools and guarantee mechanisms can address the uncertainty about return on infrastructure investment, which is increased by unanticipated regulatory changes and in particular by governments' inability to commit to long-term climate policies. Institutional investors require specific attention to such risks as they have fiduciary responsibilities and are looking for long-term, lower risk, inflation-linked returns.

86. The types of finance potentially available for the development, commercialisation and deployment of an LCR technology or project will depend on the nature of the investment, the underlying technology and on what stage it is at, *e.g.* early development or fully commercial. A paramount issue for policymakers is to understand how different sources of capital interact and how the risk appetites and return requirements associated with each differ; policies and the suite of financial instruments and incentives will need to be adapted accordingly.

Table 8. Financing mechanisms for clean energy need to be tailored to the maturity of local financial sector

	Level of Financial Sector Development		
	Low	**Medium**	**High**
	Low Income Countries	Middle Income Countries	Upper Middle Income and High Income Countries
Banking Services	Basic Banks	Full Range Banks	Universal Banks
Non-Bank Financial Services	None	Government Bonds Equity	Government and Corporate Bonds Equity Alternatives (Private equity, venture capital)
Interest Rate	Administrative Setting	Largely Market Based	Fully Market Based
Access to Finance for SMEs	Limited	Partial	Readily Available
Availability of Long-Term Funding	Limited (up to 1 year)	Partial (up to 7 years)	Full (up to 15 years)
Risk Management	Weak	Adequate	Robust
Clean Energy Financing Instruments	Lines of Credit (liquidity support) Concessional Financing Dedicated Debt Funds	Lines of Credit (demonstration) Partial Risk Guarantee	Lines of Credit (demonstration) Partial Risk Guarantee Equity Funds Consumer Financing

Source: World Bank, 2012c.

87. Governments can draw on a number of approaches to ensure that suitably risk-adjusted, long-term income opportunities are associated with green infrastructure in capital markets today (see Table 8). Examples of relevant approaches include creating vehicles specialising in early-stage projects and public sector finance either investing alongside the private sector and institutional investors or taking subordinated equity positions in funds. Such initiatives may be particularly relevant in developing economies where infrastructure investment is a pressing issue to deliver essential public services to large numbers of people. Issuing green bonds can also help to improve the liquidity in these markets and thereby their depth and development (see Della Croce *et al.,* 2011 and Box 10).

Box 10. Green bonds

Green bonds are broadly defined here[22] as fixed-income securities issued (by governments, multi-national banks, financial institutions or corporations) in order to raise the necessary capital for a project that contributes to a low carbon, climate resilient economy. Green bonds involve the issuing entity guaranteeing to repay the bond over a certain period of time, usually with either a fixed or variable coupon payment. They can be asset backed securities[23] (ABS) tied to specific green infrastructure projects or plain vanilla "treasury-style" bonds issued to raise capital that will be allocated across a portfolio of green projects (such as the World Bank's issuances).[24]

Green bonds or other asset back securities have the potential to attract new sources of capital to green infrastructure investment, including institutional investors. Today institutional investors are only beginning to make direct investments, and fixed income instruments remain the dominant asset class in portfolio allocations of pension funds and insurance companies across OECD countries. For instance, in the EU, structured assets, which allow investors to access secondary markets, account for less than 3%[25] of green financing. Green bonds, or the most senior asset classes in structured funds targeting institutional investors, can take assets off bank and corporate balance sheets, and in turn lower the cost of capital, and allow recycling of funds into new investments. Bonds align well with the high capital expenditure and low running cost of green infrastructure projects can provide the long-term, low-cost capital needed for corporate expansion or to free up capital for new developments. They also fit within the asset allocations of institutional investor portfolios. Governments and development finance institutions are already using financial risk mitigation and credit enhancement tools (*e.g.* the European Project Bond Initiative) to ensure that institutional investors gain access to financial vehicles with the appropriate risk-return profile. In addition to these governmental initiatives, adequately rated asset-backed securities (including covered bonds) issued by banks or the corporate sector have potential to attract institutional investor capital sources to green infrastructure, if backed by public sector or corporate balance sheets.

Despite the longer term potential, today's market for green bonds is currently a small and nascent one. Using a conservative definition, the OECD estimate pure green bond issuance at around USD 16 billion in 2010. Using a broader definition, Bloomberg estimates USD 200 billion of bonds as 'green' investment related bonds (including ABS and corporate debt issued by companies that operate in green sectors). Nonetheless, issuance so far remains a tiny share of the total global bond market estimated at a value in 2010 of USD 95 trillion.

A number of policy responses by governments are possible and may boost the issuance of green bonds to support LCR infrastructure investment. These include: supporting the market directly through preferential tax treatment, or through the provision of partial guarantees, insurance and other financial risk mitigation products; robust and transparent rules for debt aggregation; and using standards to verify environmental benefits of bond investments (such as the Climate Bonds Standard). Currently a range of (broad and narrow) definitions is in use in the financial marketplace. Yet general consensus on a particular concept may be difficult to obtain. Market participants find there is a trade-off between a very narrow definition (at high cost and small scale) and a too broad a definition (that makes 'green-washing' all too easy). With supportive policy in place, green bonds could become an instrument of choice, for example by "green banks" or other development finance institutions, along with other vehicles for using public finances to work with and leverage private capital and through securitization/asset backed issuance.

Sources: Kaminker and Stewart, 2012, Inderst, *et al.,* 2012, Della Croce *et al.,* 2011.

[22] See Della Croce *et al.,* 2011.

[23] Asset backed or securitized bonds are similar to ordinary bonds but have specific assets whose revenues pay the interest and principal. An ordinary bond's payments are generally guaranteed by the company that issues them. In asset backed or securitized bonds a set of revenue generating assets are put into a special purpose company and these assets pay the bond holder their interest and principal.

[24] http://treasury.worldbank.org/cmd/htm/WorldBankGreenBonds.html

[25] Financing of low-carbon technology projects in EU-25 between 2004 and 2009 (Accenture and Barclays, 2011).

88. Well-designed public finance mechanisms can help to mobilize private investments. In the case of renewable energy and energy efficiency, the following tend to have the greatest leverage[26] (World Bank, 2012b):

- Credit lines or loan guarantee instruments to engage private banks. For instance the International Finance Corporation provided some USD 65 million in concessional funding, primarily for risk-sharing facilities, and generated USD 680 million in sustainable energy finance investments.
- "Fund of funds" under which the government invests a relatively small amount of long term capital in a range of private, professionally managed funds that then invest in clean energy or energy efficiency.
- Public funds to reduce interest rates for consumer financing, typically through financial institutions or utilities.

Box 11. Policy reforms and development finance to address specific challenges of developing countries

Investment challenges specific to LCR infrastructure in developing countries (see Table 4 section II) require tailoring policy instruments to developing countries' specific national circumstances and contexts. Beyond incremental LCR infrastructure investment needs, the lack of existing infrastructure or the presence of poorly maintained infrastructure requires to tackling LCR and development policy goals together, as the adaptation and mitigation gaps represent a fraction of the overall infrastructure development gap (EIB, 2010; Kennedy and Corfee-Morlot, 2012 forthcoming).

Other investment challenges are particularly high in developing countries, including regulatory impediments for infrastructure, and policy and capacity building are needed to target these. According to Muzenda (2009), these "involve the lack of independent or impartial regulators in some countries; lack of competition or open access to transmission and distribution networks; one-off power purchase agreements (PPAs) rather than standard PPAs; weak procurement laws; inefficient or non-transparent tendering processes that result in cancelled, postponed or disputed tenders; poor contract laws; and tariffs that are set by the government with no provision for inflation or changes in cost." Integrating environmental performance criteria into already weak regulatory systems will be ineffective unless government regulatory and administrative capacity is strengthened in parallel to overseeing infrastructure investment and operation (see also III.4).

In addition to strengthening the enabling investment environment, donor agencies and development finance institutions (DFIs) can make appropriate use of financial instruments to leverage private sector investment towards infrastructure projects in least developed countries (LDCs) and other developing countries. Beyond traditional instruments such as grants and direct loans, mechanisms such as blended instruments,[27] credit guarantees, political risk insurance, export credit instruments as well as investment funds, can be particularly useful to help DFIs mobilise private investment towards infrastructure projects in LCDs, particularly in Africa, by mitigating the risks in bankable projects (Miyamoto and Muzenda, 2012). Political risk insurance for instance can help attract private financing in infrastructure projects located in LDCs by covering losses as a result of expropriation, political instability, currency risk and breach of contract; the Initiative for Risk Mitigation in Africa (IRMA) for instance, launched in 2009/2010 by the African Development Bank (AfDB) and the Italian Government, aims at facilitating private capital mobilisation by transferring some of the investment risk from project financiers to third-party guarantors and insurers (Miyamoto and Muzenda, 2012). Development finance can also be instrumental in providing an infusion of funding to build capacity in order to strengthen and undertake domestic policy reforms (*e.g.* to strengthen and green tax policies) and to monitor performance in order to learn over time and adjust policies as needed to achieve agreed goals.

[26] In addition, energy service companies (ESCOs), which provide clients with energy auditing, propose energy-savings measures, and financing can help consolidate multiple small transactions. ESCOs as an industry often require public support to establish: in China it took more than a decade of support by the government and the World Bank before the ESCOs grew to a USD1 billion industry in 2007 (World Bank, 2010c).

[27] This refers to combining concessionary financing - from grants or loans with a grant element – with debt finance from IFIs or market-based sources; Miyamoto and Muzenda (2012).

89. The establishment of green investment banks or green infrastructure funds by governments is to offer transitional support investment in state-of-the-art green infrastructure. A green bank can have a mandate to tackle risk that markets currently cannot handle, thereby acting as a catalyst for further private sector investment. Green investment bank initiatives are being developed in a number of countries, for example in the UK, the US and Australia (Kaminker and Stewart, 2012 forthcoming; OECD *et al.,* 2012). In addition, a number of multi-national development banks already perform similar functions to a green investment bank. However as investment and environmental policies become more stable and well-integrated, and as markets for new green technologies mature, the targets for such transitional support will need to continue to shift over time to ensure it is well targeted to technologies that are not yet fully competitive and to avoid ongoing, inefficient subsidies. Thus sunset clauses and careful monitoring and evaluation practices are essential to guide decisions on how to allocate and prioritise limited public support that might be available through green banking channels (de Serres *et al,.* 2011; Kalamova *et al.*, 2010).

Box 12. The role of KfW Bankengruppe to support private investment in energy efficiency and renewable energy in Germany

KfW Bankengruppe, Germany's national development bank, has put in place a programme supporting private sector investment in building and renovation towards energy-efficient housing, energy efficiency in SMEs, and renewable energy. It is a key pillar of Germany's policy framework for low-carbon infrastructure investment.

KfW offers subsidised loans for energy efficiency. Its business model consists of an "on-lending-system", enabling KfW to support promotional loans working through the network of German commercial banks. The programme is designed to ensure that commercial banks pass attractive interest rates to private investors. To do so, KfW's stipulates a compulsory maximum interest rate that on-lending commercial banks are allowed to charge, which is based on its own an attractive refinancing rate and a margin for the commercial bank partner.. KfW itself benefits from its AAA-credit rating and refinancing capacity via capital markets, to minimize the financial costs of these interest subsidies.

In the housing sector, KfW's Energy Efficient Construction and Rehabilitation (EECR) programme provides subsidised lending as well as grants for new buildings and rehabilitation of existing building stock. The interest rate subsidy is set according to the level of energy efficiency achieved. The "KfW-Efficiency House" new building performance standard, which was defined according to the German 2009 Energy Savings Ordinance (EnEV), serves as a reference. From 2001 until 2010, KfW promoted 1.8 million housing units under the EECR programme, and committed about 630,000 loans worth a total of 40 billion Euros.

The EECR programme has contributed to improving energy efficiency in the housing sector. Several key success factors include: the focus on loans and grants, which provide capital and financial incentives for private investors to increase energy efficiency; the "KfW-Efficiency House" standard, which has become a brand for energy efficiency in Germany; and KfW on-lending-system, which provides a broad distributional network; the reliance on local commercial banks to stimulate private sector engagement and learning about this important category of "green" investment.

KfW is active in promoting other forms of green investment through several other programmes with strong results to date. For example, it offers energy financing schemes for SMEs, through the Environmental and Energy Efficiency Programme of the 2009 European Recovery Plan (ERP), in addition to providing an expert-platform for energy efficiency advice to SMEs. It also has a strong renewable energy financing programme.

KfW actively monitors the results of its programmes through regular ex-post assessment and reporting to the government on the costs and the benefits of its domestic "green" financing programmes in energy sector.

Source: Adapted from Pfliegner, Schuberth and Gumb 2012.

90. Finally, public-private partnerships (PPPs) offer risk-sharing opportunities for LCR infrastructure provision between public entities and the private sector. PPPs can be attractive for bankable LCR infrastructure projects under certain conditions, including the presence of sufficient institutional capacity, stable regulatory and legislative environment, and well-designed PPP contracts – in order to ensure appropriate risk sharing and flexibility (OECD, 2008b). Environmental performance criteria can also be built into PPPs, thus providing a tool to green infrastructure investment and operations (Box 13).

Box 13. Financing Green Infrastructure using Public-Private Partnerships (PPPs)

PPPs involve private sector participation in the development, financing, construction, operation, maintenance and transfer, deconstruction or re-designation of public infrastructure. Despite a wide range of PPP types and scale of private sector participation, PPPs typically differ from traditional relationships in two ways:

1) The private sector bears some of the investment risks that would otherwise fall on the public sector. As a result the private sector partners will be motivated to perform effectively and efficiently in order to recover investments certainly if payments are related to performance.

2) Contracts have an integral nature: they can combine development, construction, operation and/or maintenance, while in traditional contracts these activities are often contracted separately by the public sector. This encourages contractors to manage interfaces and look for optimisations in design. These optimisations involve innovations regarding the building of physical infrastructure and the processes of design, construction, operation, maintenance and transfer/deconstruction/re-designation.

Although they can be a complex way of delivering public services, PPPs are sometimes chosen as a financing mechanism to mobilise large-scale investment in infrastructure. Infrastructure often requires public subsidy or other public financial support, and LCR infrastructure may justify more financial support. Yet the choice of business models (public, private or mixed) for the provision of LCR infrastructure should be driven by efficiency, as in traditional infrastructure projects, to ensure 1) that PPPs yield most value for money (VfM) (*i.e.* that the procurement method optimise outputs compared to costs) and 2) that the public benefits exceed the costs.

Several provisions and policy tools can encourage the efficient use of PPPs, such as: *ex ante* estimation of projects' affordability; establishment of competitive bidding process in tendering procedures; full disclosure of conditions in bidding stages; pricing regulations to secure revenue flows; and creation of PPP units – as government PPP units have developed the capacity and skills to effectively manage often complex infrastructure projects, then this may make them the ideal administrative units for managing the additionally complex issues of green infrastructure. The tendering and negotiation processes used in PPPs can be particularly helpful to ensure governments make more efficient use of public funds. This argument might not hold for smaller projects, as there may be relatively high administrative cost to the PPP process that might not be justified.

From a LCR perspective, PPPs may be particularly risky for new technologies. A key would be to ensure that public and private sector partners appropriately share the risks for investments in promising yet riskier new technologies. If PPPs are chosen for LCR infrastructure investments and operate over the full project life cycle, they might be designed in a way that incentivises LCR performance over time. In this case, contractors could be provided with an incentive to invest in various ways of optimisation during the design and operation phases that improve the contribution of the infrastructure to LCR objectives.

Sources: OECD, 2008b; Koppenjan, 2012; Kennedy and Corfee-Morlot, 2012.

Transitional direct support for LCR investment

91. To achieve LCR transformation, green infrastructure technologies at different stages of development will require different types and levels of public support to reach cost competitiveness with high carbon alternatives. While the least mature technologies may require public support for research, development and demonstration, technologies that are technically proven, but still more expensive than existing alternatives may require support to lower capital costs.

92. High capital cost is a key barrier to private investment in low carbon infrastructure. Many countries have opted to provide tax- and other financial incentives to directly lower capital costs of low-carbon investment options. These typically include exemptions from taxes or import duties, tax credits, loan guarantees, insurance or export-credits (Kalamova *et al.,* 2011). Policies that bring down initial capital costs will usefully address traditional infrastructure project barriers and complement others that affect upstream innovation (*e.g.* R&D policies – see section 4.1.) or that provide steady revenue streams (*e.g.*

feed-in tariffs for electricity production from renewable sources, differentiated purchase taxes on automobile based on fuel economies, grants, loans and guarantees for mitigation projects).

Box 14. Feed-in tariffs

Feed-in tariffs (FiTs) have emerged in many countries as a means to support renewable energy investment; they increase revenues and "bankability" of projects, as they also increase the predictability of revenues over the lifetime of the project (*e.g.* Deutsche Bank, 2010). According to BNEF, 59% of global wind capacity and 87% of global solar PV capacity have been deployed in FiT markets (BNEF, 2011b).

The policy certainty around feed-in tariffs has helped to deliver large changes in investments when designed appropriately, as for instance with the German feed-in tariff for electricity generated from renewable energy sources. However, governments inherently lack information to set the price properly as is evidenced from experience with FiT in Sri Lanka (Meier, 2012; Wijayatunga, 2011) and in Europe. In the case of Europe, Spain and the UK had to radically alter programmes mid-stream to keep them affordable, which in turn has created uncertainty and additional financial vulnerability for clean energy projects and investors (CMCI, 2012). To overcome this information gap problem, some countries have developed auctioning mechanisms to establish contracts for capacity at a given price, in particular Brazil, China and India as well as some of the US states (BNEF, 2012). However, even where a competitive process enables the government to establish a benchmark price for a new green technology, it can create concern for developers since prices may seem too low to be financially viable; this appears to have been the case for wind power in China (Maurer and Barroso, 2011).

93. Key lessons on how to design investment support include the need for clear eligibility criteria and a pre-announced timeline, including for the phasing out of the measure (Kalamova *et al.*, 2011). Predictability of government programmes is necessary if investors are to initiate a project in clean energy; however, predictability should not be mistaken for permanence. "Sunset" clauses are needed for policies that support investment directly, since over time the financial markets will price risk efficiently and learning benefits will be exhausted. Another important feature of policy design is to incorporate monitoring and evaluation of the effects of the public support and to allow for those *ex post* analyses to be considered if and when the policy incentives are considered for extension (OECD, 2012b forthcoming).

94. The coherence and consistency of different subsidy schemes used should also be regularly checked (Kalamova *et al.*, 2011). Even if each individual incentive granted may make sense at the time, the cumulative effect of all the incentives, with time, may become unaffordable or counter-productive, by "crowding out" private investment or giving investors an incentive to delay investments until they can obtain concessions. Authorities offering support to attract investment should periodically evaluate their relevance, appropriateness and economic, social and environmental benefits against their budgetary and other costs, including the long-term impact on resource allocation. Government support policies should be based on assessment of *expected* costs and *expected* benefits, taking any interaction between instruments into account (OECD, 2008a).

95. Beyond technology support policies, other factors play a key role for innovation and diffusion, and attracting private sector finance: competition policies, regulatory regimes, education policies, stringency of environmental goals, as well as predictability and flexibility of regulatory regimes. Government may be tempted to "pick winners", but it may be more efficient to support general infrastructure or technologies that support a wide range of applications, such as improved energy storage and grid management (Johnstone *et al.,* 2011).

Box 15. Insurance mechanisms for adaptation and disaster risk management

Insurance markets can play a unique role in supporting adaptation for infrastructure, directly reducing the damage costs that go beyond the financial by sending market signals to individuals, households and firms about the nature of climate change risks and how to better manage them (Fankhauser *et al.*, 2008; Mills, 2007; Ranger *et al.,* 2009). Innovative insurance mechanisms are being explored and may support adaptation and disaster risk management on a sub-national, national or regional scale in the future (Brugmann, 2012). One example is the Caribbean Catastrophe Risk Insurance Facility (CCRIF), operating across the Caribbean as a risk management mechanism (Harmeling, 2009). While insurance pools are designed to give governments quick access to funds should a disaster strike, a shortcoming is that they do not provide funds for actual reconstruction (OECD, 2011f; Cummins and Mahul, 2009; World Bank, 2010a; Da Silva, 2010). Catastrophe bonds are another mechanism that could be used to finance disaster responses, as for instance with Mexico's catastrophe bond (2006), with potential to use the proceeds of the bond as a "positive" source of funding to reduce hazard exposure and risk. More research is needed on the role of different funding solutions for infrastructure risk management.

Insurance however is not a panacea for adaptation and disaster risk reduction. Where risk levels exceed certain thresholds, insurers will abandon coverage or charge excessive amounts for coverage (Da Silva, 2010). This is a particularly challenging for reinsurance firms, exposed to climate change risk, since they provide disaster insurance coverage to insurance companies for natural catastrophes such as hurricanes or windstorms (De Forges, Bibas and Hallegatte, 2011). This challenge can threaten the ability of reinsurance companies to absorb large disasters without charging a high reinsurance cost, which would limit the efficiency of the reinsurance system (De Forges, Bibas and Hallegatte, 2011). Further private investment or standard insurance markets will not protect low-income populations where risks are high (as they are in most informal settlements) and capacity to pay low, and where there is no money to be made (Hallegatte *et al.,* 2010).

3.4 Harness resources and build capacity for a LCR economy

96. Governments and companies often lack the technical capacity or the resources to advance on their own low-carbon, climate-resilient infrastructure projects. Capacity building, information provision and technical assistance, institutions for monitoring and assessment (including enforcement of regulatory policies) and human resources development are critical to unlock green investment opportunities.

Foster innovation with R&D policies

97. Technological innovation is an essential part of any transition to a LCR economy. Barriers to innovation are particularly important for infrastructure innovation because of market structure: infrastructure markets are traditionally monopolistic, with very high entry barriers, creating a lack of incentive for incumbents to embrace new technologies (Aghion *et al.,* 2002). Government support for research and development (R&D) in low-carbon and climate-resilient technologies not only helps to bring forward innovation and technology breakthroughs thus lowering the cost of responding to climate change, but also reduces the costs and the risks of private sector investment in new technologies (Carraro *et al.,* 2009). Further, publicly funded R&D can help to build confidence among private sector actors, particularly when combined with policies that "put a price on carbon".

98. Public investment in R&D for green technology and innovation is justified by a number of well-known market failures that lead firms to under-invest in research and development (OECD, 2010b, 2011c). First, it is difficult for firms to appropriate the returns on their research investments as new technologies or ideas emerge and knowledge about these spread (often referred as the "knowledge spillover"). Second, specific barriers to entry exist for new technologies and competitors, due to the dominance of incumbent technologies and designs, for example in energy and transport markets (OECD, 2010b). Beyond this, network externalities often mean that energy or transport systems are locked-in because supporting and/or network infrastructure does not exist for new systems (*e.g.* a shift from gasoline to electric vehicles will depend upon the availability of recharging infrastructure and battery technology breakthroughs) (OECD,

2011c; World Bank *et al.,* 2011). Importantly, R&D timeframes for green innovation are long-term and R&D policies will require sustained commitment beyond the typical political cycles of government administrations.

99. Given the need for transformational technology change to address climate change, an argument can be made to support what are potentially "breakthrough" technologies (*e.g.* hybrid and electric vehicles may be one such example, see OECD, 2011c). However, where possible, analysis shows cost-effectiveness is highest when support goes to "enabling" technologies; for example energy storage and grid management is an enabling technology that can in turn provide support for a wide range of renewable energy supply technologies as they become mature (Johnstone *et al.,* 2011). Such a strategy has high returns in part because the invest benefits a wide range of possible renewable energy technologies, rather than attempting to pick "winner" technologies (something which governments are notoriously bad at doing).

100. Additionally, government can support pilot projects for innovative technologies, notably to help identify the appropriate and most effective technologies for climate-resilient infrastructure. More generally, "national innovation systems" can be actively developed through a variety of national and local policies that work to support the co-localisation of education, research and business organisations in innovation clusters; incentivise creation of skilled jobs and hiring of highly qualified graduates by businesses; making data on technological innovations available online and easily accessible (OECD, 2002).

Training, education and human capacity

101. Education and training is necessary to provide the workforce for a low-carbon, climate-resilient economy. As part of a more general greening growth process, climate policies will see new green sectors and activities develop and new skills required of workers in both new jobs and existing jobs that are re-engineered to support new green infrastructure practices (*e.g.* energy efficient building practices, or water-efficient land use planning and landscaping).

102. Labour market and skills development policies can make an important contribution to greener growth by reducing investment costs for companies. By minimising skill bottlenecks and preventing a rise in structural unemployment, these policies can make the transition to green growth quicker and more beneficial. An increasing number of studies put forward the potential for net job creation associated with the restructuring of the energy sector towards a cleaner energy-mix (OECD, 2011a; UNEP/ILO/IOE/ITUC 2008). Even if there is no net job creation, there is an inevitable need for a shift in skills and competence in the workforce to support green growth. Key areas of focus are R&D skills for development of low-carbon, climate-resilient technologies, as well as the skills necessary to construct, manufacture, install and maintain these (e.g. see Klein, 2012 on the case of Germany) .

103. The lack of familiarity of long-term investors with infrastructure projects and climate projects is a key barrier to scaling up pension funds and institutional investors' direct investments in projects (Kaminker and Stewart 2012). Institutional investors traditionally invest in infrastructure assets through indirect vehicles, i.e. through listed companies and fixed-income instruments. As a result, they have no experience in assessing infrastructure projects, which are characterised by high up-front costs and large scale, and by a set of risks that are not familiar to investors, including: legal and regulatory risks, construction, technology and operational risks, and contractual risk linked to the complexity of public-private partnership agreements. Investors lack this type of expertise, and it can take years to build it particularly for small funds. Another related issue is the lack of available information on infrastructure investment, which makes it difficult for investor to build a hedging strategy, as they do not have information on the correlation between this asset class and other types of investments (Pfliegner et al., 2012; Kaminker and Stewart, 2012).

Administrative capacity for assessment, monitoring and enforcement

104. Climate policies need to be predictable, but they also need to be flexible, as the science around climate change is constantly improving. The solution to combine flexibility and predictability goes through the implementation of strong monitoring and evaluation (M&E) systems, as well as governance mechanisms that allow feed-back loops between M&E systems and policy goal setting. Transparency and clarity in the indicators of policy evaluation, and clear rules on how this would change the policy environment is critical to avoid uncertainty in the market and drive investors away from low-carbon alternatives.

105. The multi-dimensional and cross-sector nature of climate change and other environmental concerns requires strong coherence across policy areas and between government levels and agencies. This in turn requires the existence of strategic planning and a multi-agency approach, to ensure support and align policies and programmes across jurisdictional areas and levels of government (OECD, 2010).

106. Domestic capacity for policy and regulatory development and implementation in the public sector is also critical. Sufficient resources are necessary to ensure that institutions are credible in the eyes of investors and to establish a level playing field. This includes resources for monitoring and assessment both to deliver compliance and enforcement and to provide critical feedback on policy performance over time. As knowledge about climate change and climate policy is evolving rapidly, designing monitoring and assessment into implementation plans provides a means to refine policies over time in order to improve performance. In countries where human and financial resources for policy implementation are limited, it will be less costly to mainstream climate change considerations, including establishing policies for LCR investment, through relevant existing line ministries and public authorities than to build new institutions for climate change alone.

107. Monitoring and evaluation of policies and their performance has to be done at various levels. It will be valuable to look across national and sub-national levels and at sector, programme and project levels (OECD, 2012d). M&E should also take into account achievement of public goals as well as, importantly, success to attract and maintain private investment in the sector or infrastructure programme of interest.

108. Regulatory reform and review may be a key M&E pathway to improving performance over time. On the side of public goals, it will need to consider the cost-effectiveness of the policy mix and of overlapping instruments to advise the government on how to fine-tune the policy mix to improve performance (OECD, 2008a; Bowen and Rydge, 2011). With respect to private investment incentives, periodic reviews of regulatory policies can assist with streamlining of procedures for approvals, forms and other administrative requirements that can simplify and strengthen the effectiveness, and lower the cost, of the administrative process without necessarily harming the original intent of regulations.

109. Overall monitoring and evaluation processes will need to be structured to be transparent and participatory as far as possible with one key goal being to develop and publicly share consistent data and indicators on policy performance over time. Another key goal of monitoring and evaluation processes will be to provide a foundation to enforce regulatory policies with the rule of law. Finally it should also provide information to inform the ongoing policy process, to assist with improvement of policies over time.

110. Beyond systematic M&E, is the need also to develop and use capacity to project forward, taking into account the full range of possible drivers of change, to use for example a modelling capacity to foresee different possible futures and to consider policies that are robust across a range of possible outcomes. Developing and using such an analytical capacity within government can assist with foresight exercises, policy assessment and stakeholder engagement processes that support goal-setting and policy making. There is often opportunity for research collaboration or partnerships where governments fund competent

research organisations to develop assessment and other analytical capacity, and ongoing provision of information, to support public and private decision making, for example for infrastructure planning (Corfee-Morlot *et al.,* 2011).

Climate risk and vulnerability assessment

111. For adaptation, government policy to support adaptation decision making will need to focus on the provision of public goods (Bowen and Rydge, 2011; Lamhauge *et al.,* 2011). This includes provision of: i) robust, local information about climate change, in particular about past climate trends and projected climate change and risks (including vulnerability or risk mapping, taking into account different socio-economic development scenarios); ii) risk management tools that target different types of investor or decision maker (*e.g.* corporate versus households); and iii) consistent frameworks and metrics for monitoring progress.

112. Investing in climate-resilient infrastructure (including retrofitting existing assets) requires establishing the institutional capacity to assess, implement and monitor climate-resilient infrastructure (ADB, 2011; OECD, 2012d). Whether at the project or programmatic levels, climate-risk assessment is rarely conducted, despite development of national climate-resilient assessment plans. Government, foreign donors and MDBs can support vulnerability and climate risk assessment by: setting self-assessment policies at the national, regional and local levels that take into account LCR objectives; developing climate risk-screening and risk-assessment tools, climate projections and guidelines; encouraging greater transparency and disclosure of climate risk and adaptive measures by private companies and investors, and climate risk incorporation within firms' due diligence assessment processes; setting an example through public procurement processes and financing criteria (DEFRA, 2011; OECD, 2012d); and through integrating disaster risk management and planning approaches with infrastructure planning (World Bank 2012a). Examples of climate risk screening tools include: the UK ORCHID Programme and the Department for International Development's Climate Risk Impacts on Sectors and Programmes; the Climate quick scans by the Netherlands' Ministry of Foreign Affairs; and the German Climate Check, by German International Cooperation.[28] Planning adaptation in all cases around the worst-case scenario can be excessively expensive; decision-making can therefore also be aided by consultative stakeholder processes to manage uncertainty in a robust manner that is accepted by those most affected without excessive costs (World Bank 2012a).

3.5 Promote green business and consumer behaviour

113. When combined with some market-based and regulatory tools, "soft" policy instruments such as information instruments or voluntary approaches can enhance the effectiveness of policy packages (OECD, 2007b,Braathen 2011) and help address information barriers in LCR projects.

Promote responsible business conduct

114. Companies are facing increasing pressure to address climate change. While government and business roles need to remain distinct – each assuming its own responsibilities – policies in support of climate-friendly business practices can be important levers to enhance companies' contributions to addressing climate change and to improve the policy framework for investment.

115. For an increasing number of companies, addressing climate change has become part of business practice (OECD, 2010g). As a first step in managing emissions, companies *measure and disclose GHG*

[28] See also Hammill and Tanner, 2011 for a review and analysis of tools used in the field of development cooperation for climate risk screening.

emissions. This helps them assess their impacts on the climate and the associated risks and costs of mitigation, and design cost-effective emissions reduction plans. Requesting that companies measure and disclose emission-related information is also an important tool for policy makers. At present however, there are no internationally agreed standards for reporting and corporate climate change-related information. Addressing these concerns will require greater cooperation across governments to improve the consistency of GHG reporting methodologies. In addition, companies are increasingly assessing and reporting on their vulnerability to climate change, and on adaptation measures being taken to address these risks (Agrawala *et al.,* 2011).

116. Increased transparency of corporate emissions can incentivise companies to reduce emissions, and manage their climate risks and liabilities, including through infrastructure investment choices. This, in turn, helps policy makers design and fine-tune climate change policies and monitor their progress. For commercial partners, financial institutions, investors in general and the public at large, information on corporate emissions and climate change risk to its investments is necessary to understand the company's climate change performance and evaluate the related risks and the company's capacity to manage them. As of today, most of the largest companies (four out of five of the Global 500) measure and disclose their GHG emissions (OECD 2010g), and a growing number are reporting on climate change risks (Agrawala *et al.,* 2011). Examples of disclosure guidelines include the US Climate Change Disclosure guidance by the US Securities and Exchange Commission (SEC); it outlines information that publicly traded companies facing significant material effects from climate change must disclose. Reporting companies have mostly focused so far on regulatory risk rather than actual climate risk (DEFRA, 2011; Riedel, 2012; SEC, 2010). Despite an increasing volume of company reporting, governments may want to mandate integrated reporting on climate change risks and liabilities alongside of other environmental information to further ensure corporate and investor recognition of climate change in investment decision making (Generation Investment Management, 2012).

117. The second area of corporate action is to set corporate climate targets and *reduce emissions and/or take adaptation decisions*. For many companies, it starts with reducing energy consumption, which has both environmental and economic benefits. Other emission reduction measures include reducing waste generation, adopting low-carbon technologies, optimising logistics and shifting to renewable energies. Depending on the size, sector and location of the company, these measures may be costlier and have a longer return on investment. Companies are thus taking very different approaches in implementing them.

118. The new frontier of corporate action is extending low-carbon strategies *beyond the company's borders* (OECD, 2010g). The bulk of GHG emissions are often produced outside companies' boundaries, throughout the supply chain and the use and disposal of intermediary or final products. Leading companies have therefore started involving their suppliers and engaging with consumers to lower their overall carbon footprint. Governments are also increasingly seeking to leverage companies' knowledge of their supply chains to spread good emission management practices. These actions will have indirect effects on the infrastructure choices that supplier companies make.

119. OECD (2010g) shows that companies look to governments to clarify their expectations in terms of corporate emission reductions and engagements of suppliers. Governments also have a leading role to play in raising consumer awareness (OECD, 2011e), sending signals to shape consumer demand and to increase trust in companies, through for instance certification and labelling schemes.

120. In addition to encouraging the private sector to consider climate resilience in investment decisions, governments can promote business opportunities arising from climate change. Indeed, the private sector is increasingly looking for new commercial and investment opportunities, including new products and services such as financial and consulting services, logistics and transport, or water management technologies (OECD, 2012d). In particular, as governments strengthen policy frameworks,

business opportunities will grow for provision of independent investment advisory services for sustainable asset management (Generation Investment Management, 2012) as a complement to technical engineering and management advisory services.

Information and public awareness policies

121. Part of the cost associated with low-carbon, climate-resilient projects derive from a lack of knowledge and awareness among the private sector actors, including consumers. Information programmes and public awareness campaigns can encourage corporate and investor as well as consumer behavioural changes by informing decisions and shifting markets to influence climate change outcomes. Relevant policy instruments include product labelling that indicates the energy and emissions profile for appliances and automobiles, requiring audits for buildings and plants, and the identification of dissemination of best practices to businesses and consumers. Many energy efficiency improvements, such as the phasing-out of incandescent lamps, are estimated to cost little or nothing to implement and bring potentially large, near-term emission reduction benefits and possibly financial savings, but people need to be aware of such options and be persuaded to voluntarily take them up. There is often an opportunity cost where financial returns are higher elsewhere or the challenge of split-incentives (e.g. owner tenant issues). However, if they are taken up on a large scale, such actions to improve the efficiency with which resources are used can lead to significant shifts in the demand for services and in, in turn, limit the need for new infrastructure investment (OECD et al., 2012). Beyond this, the new frontier of corporate low-carbon strategies is to work beyond corporate boundaries, where leading companies are managing their corporate carbon footprint by monitoring emissions and practices throughout their supply chains and also by influencing consumer behaviour (OECD 2010h).

122. Similarly, for adaptation, government and corporate information policies can encourage the uptake of precautionary measures or "good practices" that avoid or limit climate change impacts, e.g. from extreme events. For example, in the event of extreme heat, they can raise awareness for households and businesses to keep their homes and office spaces shuttered to limit overheating and unhealthy indoor temperatures, and the need for people to drink large amounts of water to avoid dehydration. Businesses may also want to build resilience by planning adaptation measures that are triggered exception by the onset of extreme weather conditions, such as giving employees the option to adapt working hours to cooler parts of the day or allowing tele- or home-working. Governments can also partner with business and local non-governmental organisations to put in place early warning information systems and to plan for quick evacuate people and mobile assets from locations particularly vulnerable to flooding (e.g. urban areas in coastal zones) thus avoiding the worst of possible consequences from such extreme weather events (Hanson et al. 2011; Corfee-Morlot et al. 2011). Governments and businesses have a role to work together to help develop and implement such "soft" policy or other information measures that raise awareness, improve preparedness and help to shift norms of consumers and firms to address climate change risks in day-to-day decisions.

123. Beyond this, integrating information about climate change into school curricula across all levels, from primary to professional adult or even management education programmes, can help to raise awareness and create a culture of change to support LCR innovation over time.

IV. CONCLUSIONS

124. Investment in infrastructure needs to be scaled-up significantly in the coming decades to meet both development and climate change policy goals. While public finance will remain a key ingredient in many infrastructure sectors, fiscal constraints and the magnitude of the investment challenge suggest that transformative change requires private sector engagement and the creation of enabling conditions for business to "go green." Filling the infrastructure investment gap – in part through private sector engagement -- provides an opportunity to integrate consideration of climate change along side of other sustainability criteria in infrastructure planning. Yet mobilising private investment to support climate action in infrastructure sectors will necessarily require unprecedented shifts in policy, in engineering practice and in investor behaviour.

125. This report reviews and summarises understanding of good practice across investment and climate policy arenas. It is a first attempt to identify elements of an integrated policy framework and advise governments on how to reform policies to incentivise and shift private investment at scale to LCR infrastructure. With respect to private sector engagement, such a green investment policy framework could potentially influence three key investment conditions: i) the existence of investment opportunities; ii) the return on investment, including boosting returns and limiting the costs of investment; and iii) the risks faced by investors throughout the life of projects. The emerging policy framework for green investment provides an initial checklist for action (see Table 9).

126. Any policy framework should been seen as a dynamic schematic that may be used as a decision support tool rather than a prescription for policy. The elements of a framework are interdependent and feedback loops exist between them. For instance, strategic goal setting, policy alignment and sound investment policies may be prerequisites in terms of sequencing to optimising other policies that can incentivise or otherwise support private sector investment. Such policies need to create certainty, but they also need to be flexible enough to "learn" from monitoring and evaluation information, as well as to take into account evolving understanding from climate change risk assessment; and views and perspectives over time from key stakeholders. Regulations and procurement methods such as public-private partnerships (PPPs) need to be supported both by a sound regulatory framework and by programmes to build administrative capacity. Integrated pricing and public revenue raising strategies can be a major driver for improving the public acceptance of pricing instruments, and in securing long-term public financing for green infrastructure. For example using green taxation or other market instruments for climate policy (*e.g.* GHG emission trading, carbon taxes) can provide new revenue sources which can both assist with fiscal consolidation and help to scale up public sector support to fund green infrastructure. Beyond this, putting a price on carbon to attract private investment will have a very different impact depending on whether the targets for greening of infrastructure are consumer- or firm-level decisions and behaviour, such as in the case of buildings, industrial innovation or building of new infrastructure systems across urban areas. Thus policy instruments also need to be packaged and coordinated within the mix to increase their effectiveness, and tailored to tackle specific investment and infrastructure market barriers of different market segments.

127. Although the elements of good practice for an integrated climate-investment policy framework are likely to be similar for all countries, country contexts do matter and policy mixes and designs will need to be tailored to the needs of different sectors and to unique national contexts. As a result, use of such a policy checklist needs to be sequenced and prioritised depending upon the sector- and country-specific context. The proposed approach is sufficiently flexible to adapt to different priorities, as well as to be used in different ways depending upon the starting point of the country.

Table 9. Policy checklist for LCR investment

	Impact on attractiveness for private sector LCR investment			
	Create a market, boost opportunities	Increase return		Reduce risk
		Revenues	Reduce Costs	
2. Strategic goal setting and policy alignment				
• Goal-setting and strategic planning, including infrastructure planning	X			X
• Multilevel governance to align policies and engage stakeholders	X			
2. Enabling policies and incentives for LCR investment				
• Policies to enable and mobilise investment	X			X (*policy*)
• Open and competitive markets for green trade and investment	X		X	X
• Provide market incentives for low-carbon, climate-resilient investment	X	X	X	X *(regulatory, technology*)
• Regulatory and other policies to create markets and address LCR investment barriers				
4. Financial policies and instruments				
• Ensure a financial regulatory framework conducive to LCR investment	X			
• Innovative financial tools and instruments to reduce risk and increase market liquidity	X	X	X	X *(regulatory)*
• Transitional direct support for LCR investment	X	X	X	X (*financial)*
5. Harness resources and build capacity for a LCR economy				
• Foster innovation with R&D policies	X		X	X
• Training, education and human capacity	X		X	(*technology)*
• Administrative capacity for assessment, monitoring and enforcement	X		X	X(*operational*)
• Climate risk and vulnerability assessment	X		X	
6. Promote green business and consumer behaviour	X		X	
• Promote responsible business in support of a green economy	X			
• Information and public awareness policies				

128. Other OECD work is applying the elements of the proposed framework to sustainable transport to consider these issues from a sector perspective (see Ang and Marchal 2012 *forthcoming*). In other related work the OECD is investigating specific investment needs and financing challenges of green infrastructure and the possible role of different sources of capital, such as institutional investors, to fill the green infrastructure financing gap (Kaminker and Stewart, 2012 *forthcoming* and Kennedy and Corfee-Morlot, 2012 forthcoming). The findings of this paper are also being tested through a number of specific country case studies – in Germany, India, Mexico and South Africa; these case studies are designed to investigate how these policy issues play out in different sectors in their specific country context (Pfliegner et al. , 2012, forthcoming; EMBARQ, 2012, forthcoming; Francke *et al.,* 2012 forthcoming; Calland and Naidoo, 2012 forthcoming). The case studies are considering how policy reforms have (or may) work to boost the pace and the scale of LCR infrastructure investment, and how public policy or funding affects participation of the private sector in these projects or programmes. Some of the case studies are also considering the interaction between international climate finance and domestic policy reforms to create sustainable financing conditions for green infrastructure programmes. Combined this work should provide empirical evidence to expand our understanding of the interface between domestic policy reform – across climate change and investment arenas – and the challenge of scaling up and accelerating the pace of LCR infrastructure investment in different national contexts.

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ANNEX I. CMCI PRINCIPLES FOR "INVESTMENT GRADE" POLICY AND PROJECTS

The UK Capital Markets Climate Initiative (CMCI) (CMCI *et al.,* 2012) has developed five principles to advise policy makers from developed and developing countries on how to use public policy and funding to help developing "investment grade" policy and projects, in order to leverage climate-friendly private sector investment:

Principle 1: An early and ongoing managed dialogue with institutional investors and local and international private sector should be set up, with transparent objectives, critical stakeholders engaged and a review process in place.

Principle 2: A clear, long-term and coherent policy and regulatory framework should be implemented, including: a good investment climate, a predictable and long term framework, the integration of resilience in key economic sectors and the implementation of a measurement, reporting and verification (MRV) system.

Principle 3: Price signals in the market should support the deployment of low-carbon alternatives ensuring that any social costs associated with a transition are well managed, including putting in place subsidies for technologies not yet cost-competitive, a plan for fossil fuel subsidy phase-out and a plan for supporting a price on carbon.

Principle 4: Underpinning economic drivers should be realigned to support sustainable growth, with general regulation and standards to support green growth, low-carbon energy, land, water, waste and transportation strategy, R&D and education priorities for green sectors, and financial regulations' support to long-term investments.

Principle 5: National governments should have active programmes of public (climate) finance to support, underpin and develop investment grade projects that mobilise private capital.

ANNEX II. GLOSSARY

Note: The definitions below are for the purpose of the paper, and do not necessarily reflect the general views of the OECD.

Mitigation: In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere (UNFCCC, 2012).

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Adaptation not only covers actions undertaken to reduce the adverse consequences of climate change, but also those harnessing the beneficial opportunities it generates. In terms of corporate activities, adaptation covers company actions to adapt to the direct physical impacts of climate change, but it does not include mitigation measures by companies in response to climate policies. The stronger mitigation actions are and the earlier they are undertaken, the smaller the costs from adaptation are likely to be. Yet even strong and immediate mitigation does not obviate the need to adapt to changing climate conditions triggered by emissions that have already occurred or cannot be stopped immediately (UNFCCC, 2012).

Private investment: Funding derived through different sources that aim to generate rates of return in excess of the opportunity cost of capital (Kaminker and Stewart, 2012). Private investment is supplied through different parts of the private financial system and aims to generate a profit. Sources of private capital include: 1) corporate sources, *e.g.* companies operating either multi-nationally or domestically, and 2) financial sector, including capital facilitators, such as banks, asset managers, brokers and advisors, or capital providers. The latter includes institutional investors, including pension funds, mutual funds, sovereign wealth funds insurance funds and hedge funds (see Figure 2).

Finance: The process of raising funds or capital for any kind of expenditure. Consumers, business firms, and governments often do not have the funds available to make expenditures, pay their debts, or complete other transactions and must borrow or sell equity to obtain the money they need to conduct their operations. Savers and investors, on the other hand, accumulate funds which could earn interest or dividends if put to productive use. These savings may accumulate in the form of savings deposits, savings and loan shares, or pension and insurance claims; when loaned out at interest or invested in equity shares, they provide a source of investment funds. Finance is the process of channelling these funds in the form of credit, loans, or invested capital to those economic entities that most need them or can put them to the most productive use.

Infrastructure: It is the stock of fixed capital equipment in a country that affects human well-being and is considered a determinant of economic growth. In the investment context, it typically includes "economic infrastructure", in particular transport (e.g. ports, airports, roads, bridges, tunnels, parking); utilities (e.g. energy distribution networks, storage, power generation, water, sewage and waste); communication (e.g. transmission, cable networks, towers, satellites); and renewable energy; as well as "social infrastructure" such as schools and other education facilities; healthcare facilities, public buildings (Inderst, 2010).

Choices of infrastructure or selected features of infrastructure will affect the greenhouse gas emission-intensity of service provision (*e.g.* water, electricity, mobility, shelter, goods exchange, sanitation services) and also the exposure and vulnerability of businesses and people to climate change itself (Kennedy and Corfee-Morlot, 2012)

Low-carbon, climate-resilient (LCR) infrastructure: refers to infrastructure projects that will either mitigate greenhouse gas emissions (e.g. low- or no-emission technologies compared to a business as usual scenario, including clean energy production and transformation, forest and agriculture, fuel switching in energy-intensive end use sectors, methane capture or waste to energy investments, or improving energy efficiency of buildings) or those that will support adaptation to climate change (e.g. in the water, health, forestry, agriculture/livestock, urban development or built infrastructure sectors) (Kennedy and Corfee-Morlot, 2012).