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Getting the most from your green: An approach to using public money effectively through green banks and other low-carbon financing

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About CPI

Climate Policy Initiative is a team of analysts and advisors that works to improve the most important energy and land use policies around the world, with a particular focus on finance. An independent organization supported in part by a grant from the Open Society Foundations, CPI works in places that provide the most potential for policy impact including Brazil, China, Europe, India, Indonesia, and the United States.

Our work helps nations grow while addressing increasingly scarce resources and climate risk. This is a complex challenge in which policy plays a crucial role.

Contents

1. Overview

This document addresses the effective uses of public financial interventions for low carbon projects. It provides an overview of Climate Policy Initiative's (CPI's) approach to determining the most efficient ways in which green banking and other public financial interventions could support the transition to a low-carbon economy. To illustrate, it includes some findings from an application of this approach to the large-scale renewable energy sector in California. These findings are also provided in more detail in our July 2014 report, "Getting the most from your green: A case study for using public money effectively for large-scale renewable energy in California."

The transition to a low-carbon economy requires substantial up-front capital investment. As a result, the cost of financing this investment plays a significant role in determining the transition's cost to society. Public funds are increasingly becoming available that could be used to address these costs or other barriers. Institutions dedicated to using public resources to leverage private capital in service of low-carbon objectives have been set up in several states. Connecticut, New York, and Hawaii have all created such institutions, commonly referred to as "green banks". Due to the current level of interest in these institutions and the mechanisms they may employ, the time is right for rigorous analysis of how these funds can be most cost-effectively and efficiently deployed to accelerate the decarbonization of the economy.

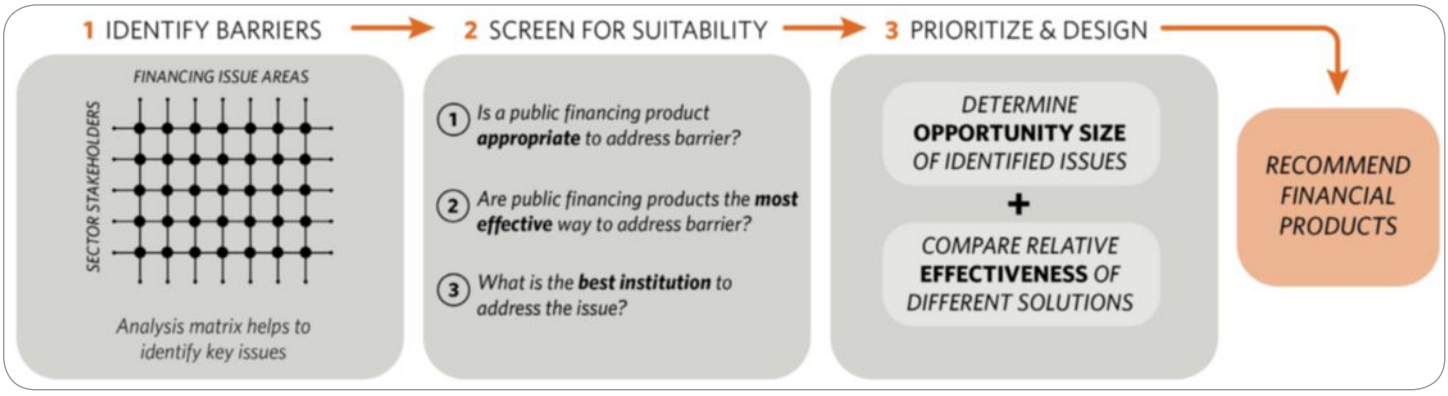
As illustrated by Figure 1, we provide a framework for critically assessing how and when public financial interventions could effectively address these barriers to a low-carbon economy – as well as when such instruments would be less effective than another approach, and when a dedicated implementing institution such as a green bank would be desirable. Our framework addresses three main questions**:**

- Should public financing and risk-bearing mechanisms be used to address identified financing issues?
- What type of financing or risk-bearing mechanism, if any, would be the best solution for each issue?
- Is a green bank the appropriate institution to implement the identified mechanisms?

This brief focuses on locating the most effective financial mechanisms that a public financing institution could employ. There are many other challenges involved in implementing public financial mechanisms for low-carbon projects. For example, legislation, staffing, and negotiation with existing institutions may be required. Such functions are outside the scope of this document.

This brief follows the sequence laid out in Figure 1. We begin, in **section 2**, by identifying significant financial barriers to a low-carbon economy. **In section 3**, we then assess the suitability of public financing interventions to address these barriers and consider whether a green bank or other public financial institution is the most sensible institution to intervene. Finally, we identify the most effective form of policy intervention as outlined in **section 4**. Appendix 1 provides more detail on the matrix that forms the basis of section 2.

Figure 1: CPI's analysis framework for evaluating green banking and other financial interventions for low-carbon projects.



2. Identifying Potential Opportunities for Public Financial Intervention

We begin with a survey of key barriers to low-carbon investment potential opportunities for a green bank or other public financial institution to accelerate climate mitigation. This section corresponds to the first box of Figure 1. We perform our analysis on a sector-by-sector basis.

There are a number of common issues that financing and risk-bearing interventions may be well suited to address, such as high costs of capital, poor risk allocation, and credit availability.

In order to present an inclusive picture of the many ways in which financing and market conditions may be hindering low-carbon activities, we utilize an analytical framework that focuses on whether such financial needs are met for each of the major stakeholders in a given sector. The framework identifies stakeholders and potential barriers for those stakeholders where a public financial institution might be able to intervene.

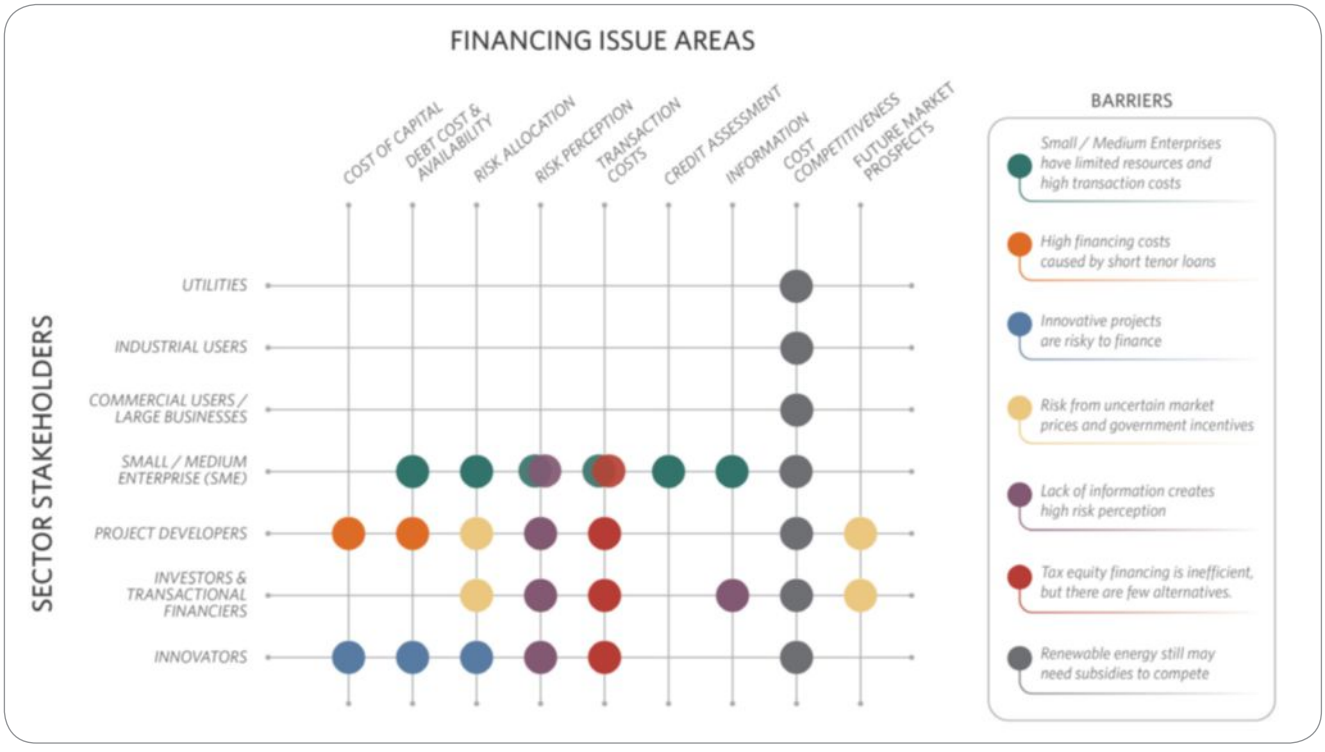
We provided an example of this framework as applied to California large-scale renewable generation in Figure 2, in the form of a matrix. The California example shows a slightly different set of stakeholders and issues than described below, because it has been adapted to fit the needs of the large-scale renewables sector.

Each intersection of this matrix represents a point of evaluation: are this market actor's needs met in this area of the financing environment? See Appendix 1 for a lengthier description of why each category was included.

2.1 Issues for Public Financial Intervention

The issues for potential public financial intervention, represented in the columns of our matrix (Figure 2), were chosen for their impact on financing cost and financing arrangements. They cover the range of potential financial barriers that could be hindering stakeholders. Here we provide a brief overview of these categories; see Appendix 1 for more detail.

Figure 2: The analysis matrix, as modified for large-scale renewables in California.



This figure represents the practical application of the basic framework described in Section 2 and further Appendix 1. Stakeholders and issues have been modified from the basic framework to fit the landscape of this sector. Where a stakeholder has an unmet need in a certain financing issue area, the relevant intersection is shaded. Unshaded intersections represent that a stakeholder's needs are well satisfied in this area or that the issue is not applicable. Related issues that extend across stakeholders or issue areas share a common coloring,

The first four columns of our framework — debt cost and availability, cost of capital, perceived risk and risk allocation — play the primary roles in determining the cost and availability of financing for a project. **Debt cost and availability** is the problem in situations where financiers will not provide the actor with financing at a cost commensurate with the level of risk involved. Often, this can result from macroeconomic conditions such as high interest rates, banking regulation, or immature capital markets.

Even if financing is available, the **cost of the equity**– the interest rate or required equity returns – may be prohibitive; public programs can address this issue through cost-based or risk-based support mechanisms.

Risk allocation is a significant issue for projects with many stakeholders, as some of the actors may be better suited than others to bear certain risks due to their resources, expertise, or control over the risk.

Perceived riskiness of a given project can be out of line with actual risk; this misperception can drive up cost, especially if the project financiers have this misperception. See the box on this page for an example of how this issue is being addressed.

We have chosen to split out information and credit assessment from transaction costs because these two categories are especially significant issues for some smaller actors. Larger investors also may not have sufficient information about a technology to feel comfortable investing in it.

Cost competitiveness, although based on the economics of the project and not the cost of financing, is important to examine for two reasons. First, it heavily influences the cost of financing; and, second, it is often a key factor for low-carbon technologies, since these technologies tend to be newer and costlier than their high-carbon counterparts, and thus have increased difficulty competing on cost.

Split incentives refer to situations where the entity benefiting from an action is separate from the entity paying for that action. Novel financing arrangements can mitigate or eliminate such split incentives in certain situations.

Future market prospects is also included in our analysis because the assurance of continued demand and revenue, or lack thereof, has a major impact on the cost of financing.

2.2 Financial Stakeholders

The rows of this analysis framework were chosen to show the range of stakeholders who can influence and be influenced by financing policy. In theory, if the needs of all of these actors are adequately met, inexpensive financing should be accessible to the projects that need it. See Appendix 1 for more detail on each category.

We have broken out **end users** from the rest of the stakeholders in our basic framework (Figure 2); this distinction does not apply in all sectors but is useful to consider in some sectors.

Industrial users are distinct in that they may be running heavy machinery and large factories, and energy usage may be a large fraction of their costs. Energy use is likely not as large a part of business costs or decisions for **large commercial users** like large stores and offices, but their usage may be significant.

We have broken out **small and medium businesses** (SMBs) because their smaller size can influence the decision-making process, both due to limited resources

Example: Current Policy Addressing Perceived Riskiness

Perceived riskiness influences capital availability and cost, and refers to the financiers' perception of the risk level of the project; this perception can be out of line with actual risk, especially in emerging markets. This aversion to perceived risk is precisely the target of the **UK's Green Investment Bank**, which seeks to remedy "information asymmetries and risk aversion" among potential investors through co-investment with private institutions (UK Green Investment Bank). The private investment they encourage in new markets should result in better-informed financiers who have a more accurate picture of the risks involved.

and to the higher relative impact of transaction costs for these businesses. See the box below for an example of how current policy aids these actors. **Residential users** share several of the issues that plague SMBs, including limited resources, the impact of transaction costs, and limited access to information.

Utilities are the principal customers for large-scale projects, the rate-setters and gatekeepers for distributed projects, and the administrators of many energy efficiency and distributed energy lending and rebate programs. Especially for investor-owned utilities, attractive project finances are vital to drive a low-carbon project forward. Since selling energy cheaply benefits investors, intervention may be required to promote energy conservation or more costly low-carbon generation.

Third party service providers and project developers, such as energy services companies, solar leasing companies, or project developers for large renewable generation are crucial for the execution of many projects and often intermediaries to sources of capital. The costs of financing their projects and the risks they bear can have a major impact on project viability.

The distinction between **long-term investors** and **transactional financers** does not apply in all situations, but is useful for many large projects and pools of loans. The first-order financier may sell their stake in the project to a long-term holder, through a security or another market.

Manufacturers may be able to effectively re-allocate risk and drive down the costs of financing through the warranties and product guarantees they can provide. Additionally, they may be important targets of policy seeking to promote innovation or create local hubs of expertise.

Finally, **innovators** receive special treatment in our matrix because the key barriers confronting new technologies are often vastly different from those experienced by older technologies. Crucially, they may have a significantly more difficulty accessing capital because of their risk profile.

2.3 Using Our Framework for Public Financing Interventions

For each combination of stakeholder and type of potential barrier, we assess whether the issue is sufficiently addressed, not applicable, or potentially requires public intervention. To complete this exercise for a given sector, we draw on the following resources:

- Review of literature on barriers and the state of financing in the sector
- Examination of the current policies and how they apply to the variety of stakeholders within the sector
- Discussions with sector experts and other stakeholders
- Lessons learned from previous CPI work, notably including our financial modeling (Climate Policy Initiative 2012, for example).
- Analytical examination of available data.

This survey identifies an array of issues potentially ripe for policy intervention via a public financial institution. We next assess whether public financing and risk-bearing mechanisms, such as those employed by a green bank, could be the most effective solution for any of the identified barriers.

Example: Small & Medium Businesses Struggle to Obtain Financing

Small and medium businesses' smaller size can often result in a significantly different decision-making process. In addition to the barriers imposed by their more limited resources for assessing their clean-energy options, credit assessment costs can be preventatively high for small businesses, making loans very expensive or impossible to obtain. Connecticut's C-PACE (Commercial Property-Assessed Clean Energy) program addresses the latter issue by circumventing the credit assessment barrier for commercial properties. It ties the loan payments to property taxes, which persist through foreclosure, providing enough security that financiers are willing to back such loans (Copithorne 2014).

3. Narrowing in on significant opportunities

This section corresponds to the second box of Figure 1, in which we filter the barriers we identified in the previous step. We determine which of those needs and barriers have a large impact and could be effectively addressed by public financing and risk bearing mechanisms.

To narrow in on this subset of issues, we ask the three questions set forth in Figure 1:

1. Is a public financing mechanism appropriate to address the barrier?
2. Is a public financing mechanism the most effective way to address the barrier?
3. What is the best institution to address the issue?

After applying these three 'filters,' we are left with a set of promising opportunities for public financial intervention.

3.1 Is a public financing mechanism appropriate to address the barrier?

Our initial survey gives us a well-defined set of issues where public policy could be helpful for the sector. It may become clear at this point that some identified opportunities for intervention should not be addressed via a green bank or other public financial institution, though they may be very important. For example, the difficulty in obtaining information on various types of low-carbon technologies is not a financing or risk problem. However, information or transaction cost issues that relate directly to financing may be included in our scope (see our related work on targeting of California's Proposition 39 revenues (Climate Policy Initiative 2013b)). Many successful energy efficiency financing programs have a strong outreach component, informing consumers of their financing options.

3.2 Is a public financing mechanism the most effective way to address the barrier?

The result of our analysis thus far is a set of opportunities where public financing and risk-bearing mechanisms could plausibly accelerate climate mitigation in a significant way. Now we must assess whether such mechanisms would be the *most* effective approach to address these opportunities. While public financing and risk-bearing methods may be capable of addressing the issue, it is possible that other forms of policy intervention may be more effective.

Our assessment relies on evaluating the effectiveness of current and potential financing and risk-bearing policy mechanisms. We judge policies to be effective if they:

- **Are cost-effective on a risk-adjusted basis** – they reduce costs to society relative to other policy options, and allocate risks appropriately
- **Accelerate the transition to low-carbon technologies** by addressing market barriers to developing and deploying clean technologies in a demonstrably additional way
- **Enable significant progress towards applicable policy goals**
- **Avoid providing public support where private financing already does the job**
- **Use public finance mechanisms where they are appropriate and efficient**, rather than to address problems that may be better addressed through policy or regulatory changes
- **Are appropriately funded relative to demand**
- **Improve access to low-carbon technologies,** particularly in disadvantaged communities.

Other existing policy goals and priorities may modify this list. The method of applying this filter will vary based on the data environment, but will consider all the issues above for each opportunity.

3.3 What is the best institution to address the issues?

In considering whether any of the identified barriers should be addressed through public financing and risk-bearing policy, we must consider the best institution to implement the relevant policy mechanisms. There is increased interest in dedicated institutions for green financing like green banks, on both the national and subnational level. Table 1 lists several examples of public green infrastructure banks within the OECD, all developed within the last few years. However, other institutions may be better suited to implement low-carbon financing policies. Public financing and risk-bearing mechanisms could be implemented through a number of existing

institutions in many jurisdictions, instead of creating a new institution. This is an important question for two principal reasons:

- A green bank or other new insitution must offer significant advantages to justify the additional organizational costs a new institution would require. Additionally, current institutional barriers and political context may render a green bank unable to address certain problems.
- Green banks could implement a broad range of interventions in unrelated sectors. Mechanisms could range from commercial lending to infrastructural investment, venture capital, subsidies and concessional lending, and may not benefit from being housed in the same institution.

There are three primary reasons why an institution dedicated exclusively to low-carbon financing, like a green bank could be advantageous:

- The impact of the various policies implemented by a green bank may be higher if they are co-housed because a green bank could nimbly adjust the relative funding levels of each, shifting funds out of less-effective mechanisms and into more effective or in-demand mechanisms. This flexibility could enable more experimentation and rapid learning, ultimately resulting in more effective financing.
- The consolidation of these policies could make it easier for consumers to identify the programs that they are interested in, particularly if the green bank embraces a public awareness and informational role.
- Housing all the policies addressing low-carbon technologies and investments together could create a 'brain trust' of substantial expertise in these technologies and business models, which could inform a range of financing and risk-bearing policies. This is because, although the types of financing a green bank may engage in could vary widely, the types of projects that it would invest in have many similarities.

In order to justify the creation of a green bank, the advantages outlined above must outweigh the economic, political and institutional costs of creating a new institution.

Table 1: Examples of Public Green Infrastructure Banks in the OECD.

BANK NAME & LOCATION	CAPITALIZATION	SOURCE OF CAPITALIZATION	YEAR OF CREATION	TARGET RATE OF RETURN	SCOPE	INSTRUMENTS USED
Australia – Clean Energy Finance Corporation	$10 Bn (1,7)	Government budget appropriation	2013	Commercial-level returns (13)	Renewable energy, energy efficiency (7)	Direct debt/equity investment and indirect (pooled) investment (7)
UK Green Investment Bank	$3.8 Bn (9)	Government appropriation (9)	2012	Sufficient to offset losses, and create profit (9)	Offshore wind, waste, non-domestic energy efficiency, with goal of market transformation (9)	Direct debt and equity investment; indirect, fund-led investment (9)
Korea Export - Import Bank (Kexim) Green Bonds	$500 Mn (2)	Bond issuance	2014	None provided	Low carbon and climate resilient growth, including clean energy, energy efficiency, emissions reduction, and waste filtering. (2,3)	Direct debt investment
**Canada – Ontario Financing Authority Green Bonds	<$500 Mn, planned (5)	Bond issuance	2014 – 2015 planned	None provided	Environmentally friendly infrastructure including transit (12)	Not specified
Canada Export Development Corp. Green Bonds	$300 Mn (4)	Bond issuance	2014	Sufficient to generate "modest profit to finance growth" (11)	Projects "aimed at the preservation, protection or remediation of air, water or soil or the mitigation of climate change." (8)	Direct debt investment (6)
USA – New York State Green Bank	$218.5 Mn (8)	Utility bill surcharge, auction proceeds. (8)	2013	Sufficient to offset losses (8)	Commercially proven clean energy and energy efficiency (8)	Credit enhancements, joint or pooled debt investment, loan warehousing (8)
USA - Green Energy Market Securitization (GEMS)	$100 Mn anticipated (1)	Bond issuance (1)	2014 planned	Not a key concern	Distributed solar, energy efficiency (1, 10)	On-bill financing, securitization (proposed) (1)

See bibliography for sources.

4. Identifying Specific Policy Solutions

The analysis thus far identifies a set of issues that a green bank or similar public financial institution could be well-positioned to take on. However, it does not specify the exact form that intervention should take, or which of these issues are higher priority than others. In this section, corresponding to box 3 of Figure 1 in the overview, we discuss how we can assess the relative opportunity size of the identified issues, and compare the effectiveness of different specific solutions. Completing these final steps creates recommendations for a potential green bank or other such institution.

Government resources are limited, and ought to be focused on issues that have the largest potential for accelerating decarbonization and reducing climate change impacts. The metrics and methods for quantifying the magnitude of the potential vary to suit the type of issue at hand and available data, including measures like GHG emissions avoided, number of affected consumers or businesses, and volume of financing demand.

Once we have identified the most important issues, we must identify the most effective policy solution to each issue, where effectiveness is defined as in section 3.2. To identify these solutions, we draw on a number of sources. In addition to utilizing best practices elsewhere, the relevant literature, and stakeholders' suggestions, we will also draw on our own substantial resources for and background in financial modeling and policy analysis.

CPI has done similar policy effectiveness analysis before, which we can draw on. For example, in "Supporting Renewables While Saving Taxpayers' Money," we compared a number of substitutes for the current tax credits for wind and solar energy in the US, and identified an alternate policy which could almost halve the cost to government (Climate Policy Initiative, 2012). Other examples of our relevant work include "The Impacts of Policy on the Financing of Renewable Projects: A Case Study Analysis," "Improving Solar Policy: Lessons from the solar leasing boom in California," and "Targeting Proposition 39 to help California's Schools Save Energy and Money" (Climate Policy Initiative 2011, 2013a, 2013b).

The solutions that we ultimately identify for each issue may ultimately bear on the institutional question: we may identify reasons why a green bank is or is not the ideal implementing institution for these particular mechanisms.

At the end of this assessment, we provide a set of policy solutions to the most pressing financial barriers to a low-carbon economy in a given sector and jurisdiction, as well as insight into the most appropriate implementing institution for these issues.

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Appendix 1. Reasoning Behind Analysis Matrix

Our search for significant financial barriers within a low-carbon sector starts by examining the status of a number of potential financial issues for each significant stakeholder in the sector. The intersection of these two categories creates a matrix of spaces where we might identify potential issues, an example of which is given in Figure 2. This matrix represents the starting point for our survey of barriers that public financing and risk bearing mechanisms would most effectively address, which we conduct on a sector-by-sector basis. Each intersection of a stakeholder and an intervention area represents a point of evaluation — are the financial needs of this stakeholder in this sector sufficiently met?

In this appendix, we provide a more detailed explanation of what the various categories in our matrix mean, and provide examples of how current policy is addressing these issues. Within each sector we expect to modify the potential issues and stakeholders considered slightly, based on which are relevant in that sector. An illustration of this can be seen in the adaptation of the initial list, as described below, to the analysis of large-scale renewable generation in California, as described in the companion brief "A case study for using public money effectively".

Issues for Public Financial Intervention

On the first order, debt cost and availability, the cost of capital, and the risk perception and allocation of an investment play the primary roles in determining the cost and availability of financing for project. **Debt cost & availability** is the problem in situations where financiers will not provide the actor with debt at a reasonable price. High perceived riskiness of a loan, existing liens on a property, and a number of other issues can create this problem. For example, Hawaii's planned Green Energy Market Securitization (GEMS) initiative addresses the debt availability problem facing low- and middle-income residents who are unable to qualify for financing for solar panels, even though they may be able to pay their utility bills and a solar panel could be revenue-neutral or -positive; GEMS will offer these residents low-cost loans that are paid for by the savings generated by the installed panels (Hawaii State Energy Office). Additionally, public programs that provide interest rate buy-downs or below-market-rate loans address this issue, such as numerous utility loan programs that finance energy efficiency projects which would often otherwise be financed with costly unsecured loans (Brown & Braithwaite 2011).

Even if financing is available, the **cost of the capital** – the interest rate or required equity returns – may be unnecessarily high. For example, tax equity financing is frequently used in the United States in order to take advantage of federal tax credits, but these arrangements have high transaction costs and, according to CPI's analysis, only allow project developers to realize two-thirds of the incentive's value (Climate Policy Initiative 2012). Public programs can address this issue through mechanisms that bear a part of the costs, like interest rate buy-downs and concessional loans, and mechanisms that bear risk like loan loss reserves and loan guarantees.

Risk allocation is a significant issue for projects with many stakeholders, as some of the actors may be better suited to bear certain risks than others. For example, a manufacturer, contractor, or energy services company may be better suited to bear the risks of equipment underperformance or malfunction, since they have the most control over this risk; it would likely be more costly for another actor, such as a project developer or financier, to bear this risk. Contractual arrangements like power purchase agreements, warranties, service agreements, insurance, or energy performance contracting can enable this risk transfer. Rational risk allocation can reduce financing costs significantly.

Perceived riskiness influences capital availability and cost, and refers to the financiers' perception of the risk level of the project; this perception can be out of line with actual risk, especially in emerging markets. This aversion to perceived risk is precisely the target of the UK's Green Investment Bank, which seeks to remedy "information asymmetries and risk aversion" among potential investors through co-investment with private institutions (UK Green Investment Bank).

We have chosen to split out **information** and **credit assessment** from **transaction costs** because these two categories are especially hindering issues in certain areas; credit assessment costs can be preventatively high for small businesses, for example. Connecticut's C-PACE program circumvents the credit assessment barrier for commercial properties by linking payments to property taxes which persist through foreclosure, providing enough security that financiers are willing to back such loans

(Copithorne 2014).

Information provision is also a significant issue for small businesses, as well as homeowners and even financiers. Investors may not have sufficient information about a technology to feel comfortable investing in it. Small businesses and individual consumers may not know about the financing options available to them, or the work required to locate and secure inexpensive financing may be prohibitive. Marketing and informational campaigns addressing these gaps can make a real difference. Efficiency Maine, a home retrofit program coordinating incentives, low-cost loans, and contractor training, doubled participation in one month through aggressive outreach and sales training (MEEA 2011a, 2011b).

Cost competitiveness, although it is based on the economics of the project and not the cost of financing, is important to examine because it both heavily influences the cost of financing and is often a key factor for low-carbon technologies. These technologies tend to be newer and costlier than their high-carbon counterparts, so cost competitiveness is frequently a major issue that our analysis would be lacking without. A large variety of policies address this issue, such as the Production Tax Credit in the US, or rebates for green measures like energy efficiency installations.

Split incentives refer to situations where the entity benefiting from an action is separate from the entity paying for that action. An oft-cited example is the tenant-landlord problem, wherein the landlord would be responsible for paying for energy efficiency improvements but the tenant would reap the benefits. This issue is relevant to our investigation because novel financing arrangements can mitigate or eliminate such split incentives; examples include Property Assessed Clean Energy, which could allow the costs of upgrades to the property to be passed through to tenants via the assessed property tax (Managan 2013).

Future market prospects are also included in our analysis because the assurance of continued demand and revenue has a major impact on the cost of financing. For example**,** California's Renewable Portfolio Standard has ensured significant demand for renewable energy on a long-term basis, allowing financiers to offer more favorable rates because demand, and hence revenue, is assured. However, now that utilities are near their procurement goals for renewable energy, it is becoming more difficult for renewable energy projects to secure the financing they need because long term revenue and demand are less certain.

Financial Stakeholders

The rows of this analysis framework were chosen to show the range of stakeholders who can influence and be influenced by financing policy. In theory, if the needs of all of these actors are adequately met, inexpensive financing should be accessible to the projects that need it.

We have broken out **end users** from the rest of the ecosystem; this distinction does not apply in all sectors but is useful, for example, in distributed generation, where 'commercial' could refer to a commercial vendor of energy efficiency products or a commercial operation utilizing those products.

Industrial users and **commercial users** are distinct in that industrial users may be running heavy machinery and large factories, and energy usage may be a large fraction of their costs. Commercial users includes large stores, office complexes, and the like; energy use is likely not as large a part of their costs or decisions, and so they may require extra incentive to act.

We have broken out **small and medium businesses** (SMBs) because their smaller size can often result in a significantly different decision-making process, both due to limited resources and to the higher relative impact of transaction costs for these businesses. For example, while a larger business may have a dedicated building manager who would be responsible for energy efficiency investments, smaller businesses may not have such expertise and resources available. **Residential users** share several of the issues that plague SMBs, including limited resources to devote to energy efficiency decisions, the higher impact of transaction costs, and limited access to information.

Utilities play an important role in renewable energy sectors as the principal customers for large-scale projects and the rate-setters and gatekeepers for distributed projects. Especially for investor-owned utilities, the financial incentives associated with any investment, from large renewable energy projects to energy efficiency incentives, are vital to drive a low-carbon project forward; since selling energy cheaply benefits investors, intervention may be required to promote energy conservation or more costly low-carbon generation.

These considerations make some policies like the Risk-Reward Incentive Mechanism, which rewards utilities for encouraging consumers to reduce their energy use, necessary to drive low-carbon investments in some low-carbon sectors (Climate Policy Initiative, 2014).

Third party service providers and project developers, such as solar leasing companies or developers of bigger projects such as large renewable generation and other major infrastructure, are a major part of the financing ecosystem. The costs of financing their projects and the large risks they bear can have a major impact on their viability. For example, Renewable Portfolio Standards requiring long-term Power Purchase Agreements, like California's, spur developers of large renewable generation because they mitigate electricity price risks and allow developers to access lower-cost capital (Climate Policy Initiative, 2011).

The distinction between **long-term investors and transactional financers** likewise does not apply in all situations, but is useful for many large projects and pools of loans. The first-order financier may sell their stake in the project to a long-term holder, through a security or another market. The growing wave of securitizations of low-carbon technologies, including SolarCity's securitization of solar leases and NYSERDA's offering of energy-efficiency loan-backed securities, make this distinction salient (Wesoff, 2014; NYSERDA 2013).

Manufacturers are also important to include in this list because the warranties and product guarantees they can provide may be able to effectively re-allocate risk and drive down the costs of financing. Additionally, they may be important targets of policy that seeks to promote innovation and/or create local hubs of expertise.

Finally, **innovators** receive special treatment in our matrix because the key barriers confronting new technologies are often vastly different from those experienced by older technologies. They may have a significantly more difficult time accessing capital because they are more risky, necessitating interventions like the DOE's 1703 Loan Guarantee Program for innovative projects, which supports investment in innovation by mitigating the risk to developers and their investors.