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The Challenge of Institutional Investment in Renewable Energy

Climate Policy Initiative

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CPI Report

Descriptors

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About CPI

Climate Policy Initiative (CPI) is a policy effectiveness analysis and advisory organization whose mission is to assess, diagnose, and support the efforts of key governments around the world to achieve low-carbon growth.

CPI is headquartered in San Francisco and has offices around the world, which are affiliated with distinguished research institutions. Offices include: CPI Beijing affiliated with the School of Public Policy and Management at Tsinghua University; CPI Berlin; CPI Hyderabad, affiliated with the Indian School of Business; CPI Rio, affiliated with Pontifical Catholic University of Rio (PUC-Rio); and CPI Venice, affiliated with Fondazione Eni Enrico Mattei (FEEM). CPI is an independent, not-for-profit organization supported by a grant from the Open Society Foundations.

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The perspectives expressed here are CPI's own.

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Foreword

Climate change presents risks to the global economy and the assets of investors worldwide, but efforts to address climate change may create opportunities for investors to enhance the performance of their portfolios through investment in clean energy solutions. A move toward renewable energy sources will require significant long-term, low-cost investment. Policymakers, faced with fiscal constraints and a still-recovering financial system, have begun to look to institutional investors – principally pension funds and insurance companies – to provide the long-term, low-cost capital needed to meet this challenge. At the same time, investors are looking to policy makers to create greater investment certainty and improve the risk-adjusted returns available in the sector.

The investor groups that make up the Global Investor Coalition on Climate Change (GIC) and UNEP Finance Initiative (UNEP FI) together represent global institutional investors responsible for over $22 trillion in assets. We supported the Climate Policy Initiative (CPI) in this project, providing access to our membership and feedback on this research, as they investigated the barriers to institutional investment in renewable energy. We believe this report makes an important contribution to the efforts to facilitate increased investment in renewable energy projects.

CPI's research demonstrates the challenges and opportunities for institutional investment in renewable energy. The long-term investment horizons of many institutional investors may be well-matched to the profile of renewable energy assets, and by making these investments, institutions could enhance the performance of their portfolios, lower the cost of capital for renewable energy, or some mix of the two. However, institutional investment is constrained by climate, energy, fiscal and investment policies as well as the practices of investors themselves. These constraints limit the potential for institutional investors to meet renewable energy investment needs in full, or to set the terms for renewable energy project finance. While institutional investors may not be a panacea for renewable energy investment, there may be opportunities for institutional investors to make renewable energy a part of their portfolios while contributing to meeting policymaker goals to scale up renewable energy deployment.

CPI presents several ways forward which can encourage investment from institutions, including removing policy barriers to institutional investment in renewable energy, improving investment practices at the institutions themselves, developing pooled investment vehicles, and strengthening corporate investment in renewable energy.

These ways forward may be promising avenues for change. We welcome this report as an insightful input into our engagement with policymakers and our work with investors to address climate change risks and opportunities.

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Changing finance, financing change

Executive Summary

With national budgets tight, policymakers look to private capital as a key source for funding energy and climate change related infrastructure. The big prize is institutional investors — pension funds, insurance companies, and other long-term investors — whose $71 trillion in assets form one of the largest pools of private capital in the world, leading policy makers to ask whether institutional investors could help meet the climate change funding challenge. In this paper we explore a particularly interesting component of that challenge, that of institutional investment in renewable energy.

Our analysis shows that given enough attractive investment opportunities and reduced policy barriers, institutional investors could become a significant source of capital for renewable energy. However, our research also suggests that, for the developed world, there is not a shortage of potential investment in renewable energy; rather there may only be a shortage of opportunities at the price — and level of risk — that governments and energy consumers are willing to pay. Institutional investors, with their distinctive risk/return requirements and longer-term objectives, might invest in renewable energy projects at lower returns (and thus prices) than other investors seeking shorter-term gains. Thus, the question becomes whether institutional investors have the potential to bridge the financing gap more cost effectively, and what would be needed to make this happen.

To map this potential and identify the barriers to achieving it, we interviewed more than 25 pension funds and insurance companies across North America, Europe, and Australia, as well as their consultants, bankers, renewable project developers, analysts, and academics. We analyzed their investment portfolios along with global and national data on institutional investors to supplement our interviews. Our analysis compared potential investment from institutions to renewable energy investment needs over the next 25 years, as estimated by the International Energy Agency (IEA).

These discussions and analyses indicate that the potential impact of institutional investment is highly dependent on how the investment is made. We identify three channels for investment in renewable energy, each of which can come in different forms, such as equity/company shares or loans/bonds:

- **Investment in corporations** is the easiest investment path for most institutional investors, whether through equity shares or corporate bonds. Our analysis indicates that institutional investors could easily provide corporations with all of the corporate equity and debt that corporations would need to fund their share of renewable energy for the next 25 years. But corporations make investment decisions based on their own strategy and financial considerations. Thus, institutional investment in corporations with renewable energy in their portfolios may not encourage these companies to increase their share of renewable energy, unless the relative attractiveness of these renewable energy projects is superior to other potential investments from a corporation's point of view. Furthermore, there are relatively few pure-play renewable companies. Therefore, institutional investment in corporations will do very little to change the current renewable energy financing dynamics, and is unlikely to contribute to lower financing costs for renewable energy.
- **Direct investment** in renewable energy projects is the most difficult for institutional investors. The skills and expense required to make these investments are likely to limit direct investment to the largest 150 or so institutions, while the illiquidity of these investments — the ability to sell the asset at a minimum loss of value if unexpected cash needs arise — limits direct investment, even for those large investors who have developed direct investment capabilities. **We estimate that these institutions could provide, at most, roughly one quarter of the renewable energy project equity investment and one half of the related debt required between now and 2035.** That having been said, direct investment in renewable energy projects creates an opportunity for institutions to improve their risk-adjusted return, by taking advantage of their size, sophistication, longer-term investment horizon and in some cases an ability to accept some illiquidity, while potentially lowering the cost of capital for renewable energy.
- **Pooled investment vehicles or investment funds** vary in fit and accessibility for institutional investors. A large, publicly traded pooled

investment fund could eliminate both the liquidity and size constraints; however, like corporate investment, it could also reduce the connection to underlying project cash flows and therefore the potential cost of capital advantage for renewable energy. Other fund designs could offer a better connection to the underlying assets — for instance by offering a "buy and hold to maturity" strategy, where the fund agrees to hold an asset for its life in order to deliver predictable cash flows — but in so doing may sacrifice their ability to offer liquidity. So far, the experience with pooled investment vehicles has been mixed, with some institutions concerned about high fees and the uncertain cash flow profiles on offer.

Barriers to achieving investment potential

While direct investing has the greatest potential to lower financing costs, even the one-quarter to one-half potential will be very difficult to achieve. The reality is that a series of barriers, including energy policy, financial regulation, and investment practices within the institutional investors constrain their ability to invest in renewable energy, and may keep the investment potential from being reached.

The investment case for renewable energy almost always has a significant policy element, while the institutions are themselves subject to their own set of regulations. Three types of policy discourage institutional investors:

1. **Policies that encourage renewable energy, but in ways which discourage institutional investors;** for example, the use of tax credits as an incentive mechanism in the U.S. discourages investors like pension funds that are tax exempt and for whom the credits may have less value.
2. **Policies addressing unrelated policy objectives which unintentionally impede institutional investors from renewable energy investment;** for example, in Europe, policies intended to ensure the functioning of energy markets make investors choose between renewable energy generation and the transmission assets they may already own.
3. **Energy policy and renewable energy specific policy that is lukewarm, or inconsistent and creates perceived policy risk;** for example, retroactive tariff cuts in Spain or start-stop expiration of incentives in the U.S. create an aura of uncertainty that makes institutions ponder whether building a team to invest directly in renewable energy will make economic sense in the long-term.

Maintaining secure pension funds and insurance policies is an important limitation on direct investment. The primary objective of institutional investors is to provide services such as pensions and life insurance at reasonable costs, with a very high degree of certainty. These investors must maintain appropriate levels of liquidity, transparency, diversification, and risk to maintain this certainty. Financial regulation codifies these requirements, and in so doing may limit direct investment or in other ways impact the attractiveness of direct renewable energy investment.

Investment practices of all but a few of the institutional investors are only beginning to catch up with the opportunities available. Many pension funds will not invest directly in any illiquid assets, while many others have not built the specialist investment expertise to invest directly in renewable energy.

National pension policy varies widely between countries, so the funds available to invest in renewable energy are unevenly distributed. Ninety percent of the pension assets in the OECD are concentrated in just six countries, and even within these countries the size and style of the funds vary, leading to different investment potentials. Insurance assets are more evenly distributed across countries.

To provide one quarter to one half of required renewable energy project investment, institutional investors would need to rapidly expand the role of direct investment, build out direct investment teams (in large institutions), and be willing to allocate more of their capacity to accept illiquid investments — in exchange for higher returns — to renewable energy projects.

Five steps could help reach institutional investment potential

Based on our analysis, we identify five steps that could help to overcome these barriers and enable institutional investors to meet their potential to invest in renewable energy projects.

1. **Fix policy barriers that discourage institutional investors or investment funds.** However, many of the policy barriers exist to achieve important policy objectives outside of encouraging institutional investment. Thus fixes need to consider the value of increasing institutional investment versus the cost of implementing fixes. In some cases, appropriate exemptions or specific policies may encourage institutional investors.

2. **Improve institutional investor practices.** However, changing some practices, like increasing the tolerance for illiquidity and building direct investment teams, could impact both the risk profile of the institutions and the culture of their organization, which also requires careful consideration. We find that building this capacity may be difficult for institutions with less than $50 billion under management.

It is unclear whether these two steps would encourage enough institutional investment to lower renewable energy costs significantly. Thus, several additional actions could be taken to encourage renewable energy investment from institutions:

3. **Identify whether any regulatory constraints to renewable energy investment by institutional investors can be modified without negatively impacting investors' financial security, solvency or operating costs.** In some cases, the regulation of pension funds or insurance companies themselves constrains investment in renewable energy projects. Generally, this regulation is structured to ensure the solvency and security of the pension funds and insurance companies; therefore we see little room for major improvements. Any modification of these policies to encourage renewable energy investing must be carefully weighed against impacts they might have on the financial health of institutional investors.

4. **Develop better pooled investment vehicles** that create liquidity, increase diversification, and reduce transaction costs while maintaining the link to underlying cash flows from renewable energy projects; however the structuring and fee levels of such vehicles to date have limited the impact, so careful fund design will be essential.

5. **Encourage utilities and other corporate investors.** If the concern is raising enough finance rather than its cost, policy may need to be reoriented away from project finance toward corporate finance. Institutional investors are adept at investing in corporate securities, although funding renewable energy through corporate finance could limit the advantage that institutional investors may have in lowering the cost of finance for renewable energy.

This paper has highlighted concerns around each of these paths, but further research is necessary. Over the coming months and years CPI will continue to delve into each of these areas.

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1. Introduction

Pension funds and insurance companies invest money today to provide products like pensions and life insurance that help us protect our tomorrow; but providing pensions and insurance may not be the only way that these players help protect our future. Institutional investors, a group that includes pension funds and insurance companies, may also help avoid and adapt to future climate change by investing some of that money into long-term, low-carbon assets like renewable energy. They may even be able to improve their investment performance by doing so. Or so the theory goes.

This theory has grabbed the attention of policy makers, as they cannot miss the scale of assets managed by institutional investors when they face the daunting investment requirements associated with climate change. Policy makers observe that institutional investors look for long-term trends, like the global response to climate change, that can help their portfolios outperform in the long term. At the same time, many of the investment opportunities associated with climate change are precisely the long-term infrastructure assets that should appeal to institutional investors seeking attractive, low-risk, long-term investment performance. Thus, the relationship between institutional investors and climate change could be very important.

In this paper, we estimate the scale of potential institutional investment in one subset of climate change related investments — renewable energy — and identify both barriers and potential solutions for reaching this potential. But before we can adequately address the potential, barriers and solutions, we must clarify the scope along a number of dimensions:

- Who are these "institutional investors" and do differences within this group matter with respect to renewable energy?
- What types of renewable energy financial assets do we expect institutions to invest in and does the choice of asset matter to renewable energy goals?
- Does it matter how institutions invest, for instance whether they invest directly into projects or invest indirectly through intermediaries?

There are a range of possible answers for these questions, as described in table 1.1.

To explore these questions, we have interviewed over 25 institutional investors across Europe, Australia, and North America. We have also interviewed several of their investment consultants and advisors, bankers and investment managers, academics, analysts and ratings agencies. In addition to these interviews, we have mined relevant investment data and analyzed some of the policies and investment barriers to gain further insight.

In section 2 we define the set of institutional investors that could have an impact on renewable energy. In section 3, we scope the potential for their investment in renewable energy. As it turns out, the types of assets institutions invest in and the channels they use matter a great deal (see appendix 1), particularly if the primary objective is to reduce the cost of renewable energy while enhancing returns, rather than merely finding the required capital at any cost (see discussion in boxes 1 and 2). Meanwhile,

Table 1.1 – Key questions/dimensions for institutional investment and renewable energy

WHO ARE INSTITUTIONAL INVESTORS	TYPES OF INVESTMENT ASSETS	INVESTMENT CHANNELS
Pension funds • Defined benefit • Defined contribution Other pension assets • Pension reserve funds • IRAs, insurance contracts, etc. Insurance companies • Life, reinsurance • Property and casualty Sovereign wealth funds Foundations & endowments Investment managers	Corporate equity (Shares) Corporate debt (Bonds) Project equity • Levered • Unlevered (whole asset) Project debt	Direct investment • In corporate securities • In projects Through intermediaries • Investment managers • Private equity funds • Infrastructure funds • Other pooled investment vehicles

the ability to use different channels and invest in different types of assets varies significantly between investors.

In our scoping exercise we highlight differences between investors and the impact that these differences have on what they invest in and how. In particular, we focus on the distinction between direct investment in projects and investment in corporations (either directly or through intermediaries). In section 4 we contrast this potential, segmented by direct versus corporate investment, against forecasts for renewable energy capital needs.

Regardless of how institutional investors or investment assets and channels are defined, few policy makers or institutions would argue that the potential is being met. More controversial is the question of what is actually limiting institutional investment in renewables. Many institutions we spoke to cite a lack of good investment opportunities and unsupportive, unclear, or volatile policy. Some policy makers and industry observers suggest that it may just be the investment practices of the institutions themselves that prevent them from realizing the potential value. Still others ponder whether this may just be a temporary phenomenon, due to the immaturity of the renewable energy market, that will sort itself out once institutional investors become more comfortable with renewable energy. The remainder of this paper will investigate the limiting factors and develop a framework for developing solutions.

There are significant national differences between institutional investors, their regulations, objectives, and investment practices. Thus, in section 5 we highlight some key differences of these constraints by country and region.

In section 6 we investigate the constraints faced by institutional investors. First, as institutions manage these assets to meet obligations or future objectives of the institution, the risk of not meeting those obligations due to poor investment performance is a very important constraint. The difficulty and complexity of managing large investment portfolios adds further constraints. Policy — both energy policy and regulation of the institutions themselves — creates additional constraints which we discuss in this section.

In section 7 we outline options for increasing institutional investor involvement including: removing energy and renewable energy policy barriers; improving investment practices at the institutional investors; identifying potential improvements to financial regulation and national pension policy; developing third party pooled investment vehicles for renewable energy projects; and, strengthening the role of potential corporate investors in renewable energy. While the path forward for any of these options is not entirely clear, our discussion and analysis aims to provide a starting point for pursuing and selecting amongst these options.

Note that the issues associated with institutional investing in the developing world, including macro country risk, exchange rate risk, and policy risk, are significant, and merit their own, specific analysis. In order not to confuse the discussion here, in this report we focus on investments by developed world investors in developed world energy projects. Other CPI papers and analysis focus on developing world investment issues.[1]

1 See for instance CPI's recent work, "Meeting India's Renewable Energy Targets: The Financing Challenge," CPI (2012b), as well as CPI's annual "Global Landscape of Climate Finance" work, CPI (2012a).

Box 1 – Policy maker perspective – Why do institutional investors matter?

Our discussions with policy makers around the world have revealed considerable interest in understanding institutional investors and their perspectives on climate change and investing in renewable energy. But *should* these policy makers care? And, if so, why? The policy maker perspective is important because it will help define the objective for institutional investment in renewable energy and, in so doing, help frame our analysis.

We start with the policy maker objectives for renewable energy:

1. **Deploy renewable energy** to provide energy, diversify energy supply, improve energy security, provide environmental benefits, and meet renewable energy targets.
2. **Develop renewable energy technology and markets** to reduce technology costs and improve performance. Deployment is an important component of this objective, along with research and technology development.
3. **Achieve these objectives at a reasonable cost.**

Institutional investors could help achieve these objectives in two ways:

1. **Provide investment capital** for renewable energy deployment to make up for a shortage of potential investment available from other sources.
2. **Reduce the financing costs** by providing investment capital with terms, time horizons or different risk/return expectations than other market participants.

Regarding the relative importance of these two matters, if the objective is to make up for a shortfall, any investment channel will do, whether through corporations or projects, through loans/debt/bonds or through ownership/equity. In this case, the investment would match policy maker goals to raise awareness of renewable energy in general amongst institutions and to remove general barriers. If, on the other hand, the objective is to reduce financing costs, then how the institutions invest is important. Only if they can invest on different terms than other market participants will they have a marked impact on the financing costs of renewable energy.

Our discussions with renewable energy developers, investors, and bankers suggest that there is not currently a shortage of potential investment in renewable energy. Rather, as several investors stated, there is a shortage of good projects that offer the right combination of risk and return. Meanwhile, although the scale of investment in renewable energy required to meet targets may seem large (see section 4), we estimate that it represents only around 2% of the investible gross capital formation in the developed world between now and 2035. That figure is small compared against the 14% of global stock markets (based on MSCI ACWI ETF Holdings, iShares), and 10% of global bond markets (Bloomberg) currently accounted for by energy and utilities. In other words, with the right level of return and an appropriate risk profile, there could be plenty of investment from a variety of sources.

Therefore we believe that institutional investors are important because their size, sophistication, and long-term investment horizons might enable them to invest on terms and conditions that help reduce the financing costs of renewable energy.

Box 2 – Institutional investor perspective – Could renewable energy be attractive?

Renewable energy is a form of infrastructure whose investment characteristics can have most of the same attributes of more traditional infrastructure. The attractiveness of infrastructure investment to long-term institutional investors is well documented; see for instance Credit Suisse (2010), Beeferman (2008), Infrastructure Partnerships Australia, Probitas Partners (2011), Peng and Newell (2007), and Huibers (2012), who each discuss the value of infrastructure in an investment portfolio. To summarize the argument here, we contrast renewable energy with institutional investors:

Renewable energy is a capitally intensive investment. High initial costs, combined with low annual fixed and variable costs, can lead, depending on the regulation and incentive system, to a stream of reasonably steady, low-risk, long-term cash flows. In other words, with the appropriate policy, renewable energy is an infrastructure investment that can approximate a bond. Renewable energy project investments typically offer a premium return to compensate for their lower liquidity and higher transaction costs.

Institutional investors have long-term, reasonably predictable liabilities which they seek to balance through their investment portfolio. They often are "patient" capital, willing to accept a lower return in exchange for long duration, steadier cash flows and greater levels of certainty and security. Furthermore, the size of many institutional investors means that they can amortize transaction costs over larger scale investments and thus cover the transaction costs more efficiently. The profile of many institutional investors may create distinct advantages in investing in long-term, illiquid assets.

Institutional investors may derive more value than other investors from long-term, illiquid renewable energy project investments, because these assets may be a better match for their investment profile. This match creates a gap between the value of these investments to institutional investors and the value to the market in general. In practice, this value will be shared between the institutional investors and the buyers of the renewable energy. That is, some of this value may go to improve risk-adjusted returns for institutional investors, while some may go to lowering the financing costs or cost of capital to the projects, thus lowering the cost of the associated renewable energy. The split between investors and lower financing costs will depend upon the dynamics of the market. If institutional investors dominate the market, the premium they receive will fall to near zero as they compete with each other for projects, but if institutions represent only a small share of the market, the premium may remain high.

This paper finds that while institutional investors could contribute to the financing needs, they are unlikely to provide capital at sufficient scale to set the prevailing cost of capital. In other words, renewable energy project investing represents a big opportunity for institutional investors, particularly those with the scale to invest in large projects. Furthermore, there may be ways, through the development of institutional investor-friendly pooled investment vehicles, to make some of this premium available to smaller institutional investors and to reduce the cost of accessing this value.

2. Defining the institutional investor landscape

Institutional investors include insurance companies, pension funds, foundations, endowments, sovereign wealth funds, and investment managers. Together these total approximately $71 trillion in assets under management, of which $45 trillion are invested in service of long-term institutional obligations. Each class of investor has different objectives and faces different constraints, many of which affect their ability to invest in renewable energy, particularly regarding direct investment into projects.

Institutional investors are not homogenous. They have a wide range of investment objectives and approaches, structural factors that influence how they invest, and regulatory pressures. As noted by the World Economic Forum (2011) and other researchers, the idea of a classic, long-term institutional investor only holds true for a fraction of institutional investors. And for that fraction, renewable energy must compete against other investment opportunities that are often more appropriate and attractive. The landscape of institutional investors is summarized in many papers,[2] but there are certain categorizations that have a specific impact on the attractiveness of renewable investments to that investor.

We estimate that approximately $71 trillion of assets are managed by institutional investors in OECD countries.[3] This figure is composed of insurance companies, pension funds, foundations, endowments, sovereign wealth funds, investment managers (of which, a large proportion is institutional money), and pension assets that are not managed by a traditional pension fund. However, only $45 trillion of these assets meet the traditional definition of a long-term investor that invests to meet long-term institutional obligations,[4] and even within these groups, there are sub-segments that don't have a clear link between investment objectives and long-term obligations. These data are described in more detail in table 2.1.

Institutional investors segments vary in their investment objectives, structure of their markets, investment style, asset allocation, regulation, and ultimately their fit for long-term investment in assets like renewable energy. We highlight the main differences between key institutional investor groups in this section.

2 See for instance IMF (2011). Chapter 2 discusses long-term investors like investment managers, pension funds, and insurance companies. Inderst, Kaminker and Stewart (2012) also discusses the institutional investor landscape in the context of clean energy investment. World Economic Forum (2011) outlines investment issues for long-term investors, further refining the definition of institutional investors.

3 Our estimate of $71 trillion in assets for the OECD is in the ballpark of other work. IMF (2011) counts $60.3 trillion in institutional assets, but excludes pension assets that sit outside of pension funds. Kaminker and Stewart (2012) at the OECD count $71.1 trillion in assets. This figure for 2010 is the aggregate of the total assets managed by pension funds, insurance companies, investment funds and other forms of institutional savings including foundations and endowment funds, non-pension fund money managed by banks, private investment partnership and other forms of institutional investors. It does not include book reserved pension plans and does not adjust for potential double-counting that could stem from assets managed by pension funds and insurance companies invested in mutual funds. World Economic Forum (2011) counts $27 trillion in assets of long-term investors, a number which includes only life insurers, defined benefit pension funds, sovereign wealth funds, endowments, foundations, and family offices.

4 In this paper, we are differentiating between those investors that have predictable cash needs or objectives that extend beyond 5-10 years, and those investors that are driven by short-term cash needs or market performance. While some investment managers have "lock-up" periods on investment, these are typically driven by the illiquidity of underlying assets, rather than the need for cash over a long time horizon. The investment objectives of these managers will be determined by the demands of the market.

Table 2.1 – Institutional investor assets under management (figures in billions of 2010 USD)

INVESTOR GROUP	INVESTOR TYPE	GLOBAL AUM	OECD AUM	DRIVEN BY LONG-TERM OBLIGATIONS
INSURANCE COMPANIES	Life and Composite	-	17,360	Yes
	Non-Life	-	3,456	No
	Reinsurance	-	1,199	Yes
	Total	**24,600**	**22,015**	
PENSION FUNDS	Defined Benefit and Hybrid Funds	-	11,813	Yes
	Defined Contribution Funds	-	7,397	Yes
	Sovereign Pension Funds	2,699	2,127	Yes
	Total	**22,829**	**21,337**	
FOUNDATIONS AND ENDOWMENTS		1,500	1,500	Yes
SOVEREIGN WEALTH FUNDS		3,868	587	Yes
INVESTMENT MANAGERS		30,399	28,679	No
NON-FUND PENSION ASSETS	Social Security Reserves in Risk-Free Assets	-	2,721	No
	Book Reserves	-	237	No
	Insurance Contracts	-	3,497	No
	Other Assets (e.g. IRAs)	-	5,139	No
	Total	**11,594**	**11,594**	
ESTIMATED DOUBLE-COUNTING		15,000	15,000	
Total assets excluding double-counted assets		**79,789**	**70,713**	
Total assets driven by long-term institutional obligations		**52,796**	**45,439**	

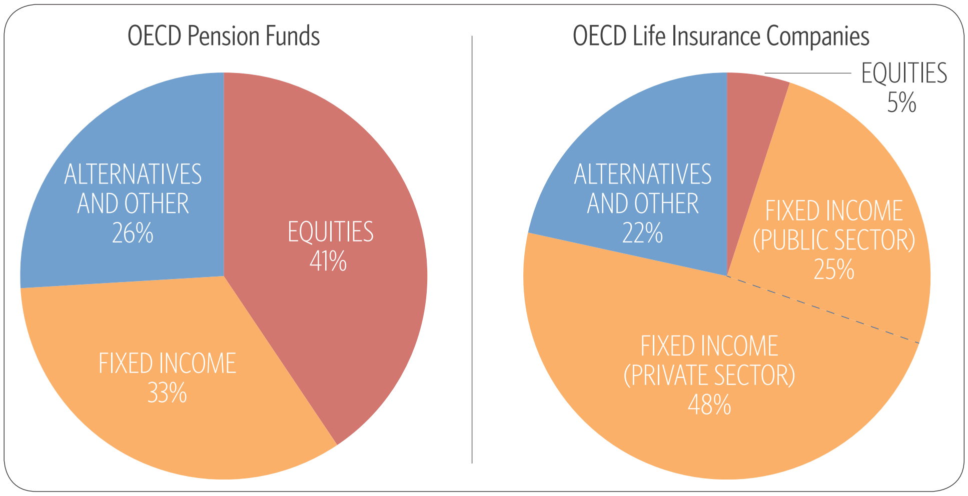
Sources: OECD.Stat Insurance Statistics, OECD.Stat Pension Statistics, TheCityUK (2011a and 2012a), Investment Company Institute, Sovereign Wealth Fund Institute, McKinsey Global Institute (2011).

Note: Estimated double-counting of $15tn, based on pension insurance contracts and pension assets potentially invested in mutual funds, ETFs, hedge funds and private equity funds. This estimate is based on an assumption that roughly $11.5 trillion in pension assets, both those managed by a fund and non-fund assets, are invested in third-party investment funds.

Insurance Companies

The insurance company segment is dominated by large, sophisticated investors, whose corporate performance may be, to a large extent, dependent upon the performance of their investment portfolio. The most significant difference is between life insurance companies and non-life companies. As shown in figure 2.1, the bulk of assets in the OECD are accounted for by a relatively small number of companies.

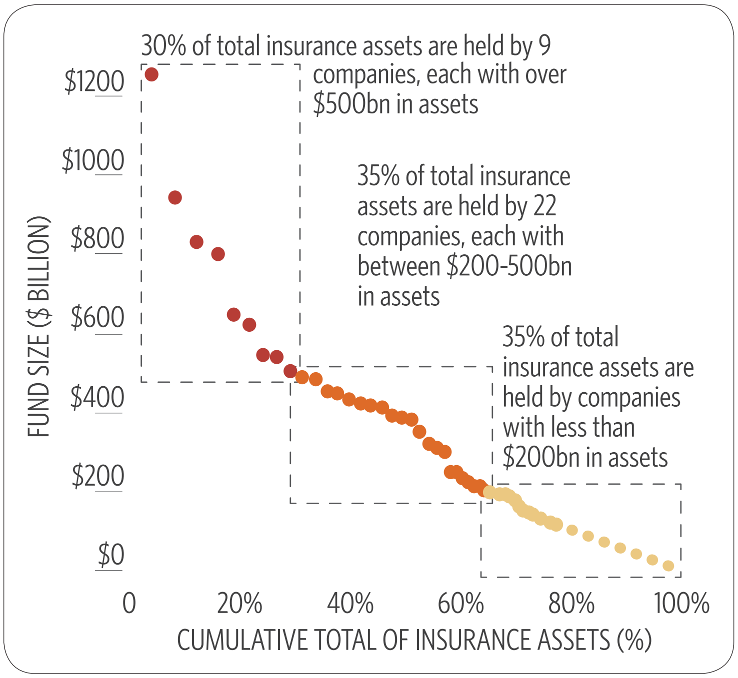
Figure 2.2 – Asset allocation of pension funds versus insurance companies in OECD



Sources: OECD (2011), OECD.Stat Pension Statistics, OECD.Stat Insurance Statistics. Excludes pension fund allocations to cash for comparability.

- ***Life Insurance Companies.*** To date, life insurance companies have been the most active participants in direct renewable energy project investing. The industry is dominated by large players with a strong incentive to optimize return within their relatively stringent risk management constraints, and as shown in figure 2.2, life insurers' asset allocation is heavily weighted toward debt. Furthermore, the liabilities associated with life insurance policies are long term and reasonably predictable, encouraging life insurance companies to invest in long-term assets like renewable energy projects. Among the various types of institutional investors, life insurance companies are the best suited and most capable investors in renewable energy projects, and many are active participants in the project finance market.

Figure 2.1 – Insurance assets are highly concentrated in a limited number of companies



Sources: Relbanks, OECD.Stat Insurance Statistics.

- ***Non-Life Insurance Companies.*** Non-life insurance companies, predominantly property and casualty companies, face several constraints to direct project investing. The companies and their investment portfolios are generally smaller and there is greater uncertainty in claims in any given year; unlike life insurance, property and casualty policies are often renewed on an annual basis. Together these factors increase liquidity requirements — that is the amount that must be kept as cash or short-term instruments to meet unexpectedly high cash demands. Shorter investment horizons reduce the attractiveness of long term investments, while the smaller investment portfolios makes direct investment in renewable energy relatively more expensive compared to the additional potential return.

It is worth noting that many life insurance companies have non-life businesses. In interviews, we found that the large "composite" insurance companies often treat their non-life portfolio like life insurance portfolios, as their size allows for risk diversification.

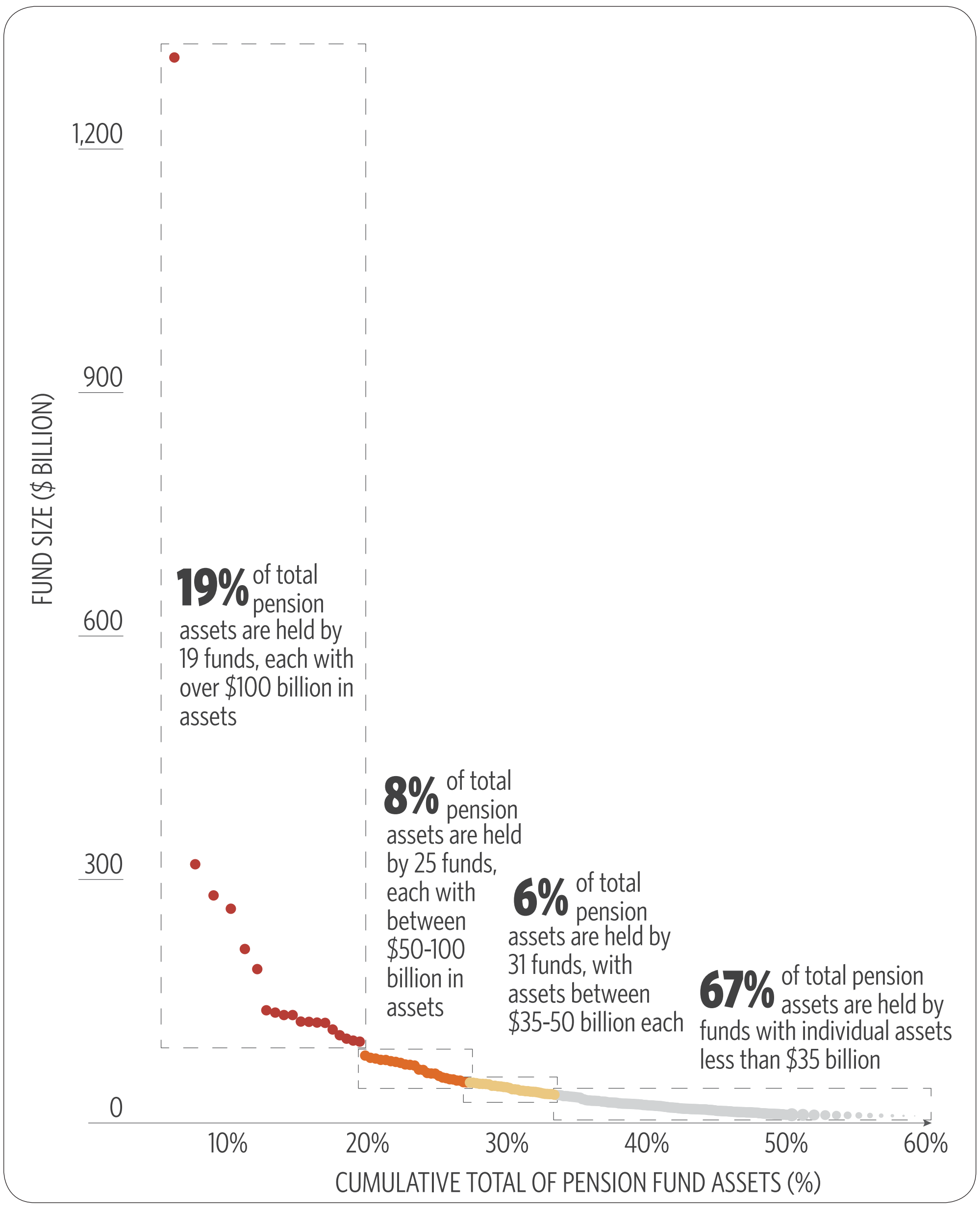
Re-insurance also deserves a special attention. Although their policies may be subject to annual renewal, reinsurers may view their liabilities as longer term and more predictable, similar to life insurers. More significantly, reinsurance companies and some large composite insurers have a very good grasp of the technology issues surrounding renewable energy, as the insurance arm of their business may be underwriting insurance for renewable energy projects. These companies use their underwriting arms to become more comfortable with the technology risks, and may also use their investment arms to improve their understanding of the technology. As one company said:

"We manage our renewable energy investment portfolio separately from our other assets with our insurance business because we understand the risks through the insurance side and that may make us better underwriters."

Pension Funds

Pension funds present a more diverse picture than insurance companies. Like insurance companies, there are several large players with significant assets under management, as shown in figure 2.3. But unlike the insurance industry, the majority of pension assets are managed by small funds. The size of a given fund, its ownership, the age of its members, and national differences all influence investment goals and policy. However, the biggest difference is whether the plan is defined benefit or defined contribution.

Figure 2.3 – Pension fund assets include a handful of large funds, but many small pension funds



Sources: Towers Watson (2011a), OECD.Stat Pension Statistics. Data for OECD countries only.

- ***Defined contribution plans.*** In defined contribution plans the risk of poor investment performance lies with the individual member (employee) rather than the plan or the sponsor, as the performance of the investments will determine how large a pension the member receives. Members usually are given more control over investment options, so that they can decide on the level of risk they are willing to accept, and the options they are given rely heavily on external investment managers and mutual funds. Members usually can switch investment managers, and may do so on the basis of short-term performance. Thus, defined contribution funds usually have a shorter investment horizon and sometimes only invest in liquid assets. As pension sponsors seek to reduce risk, they close defined benefit programs to new participants and contributions and move towards a defined contribution model (see figure

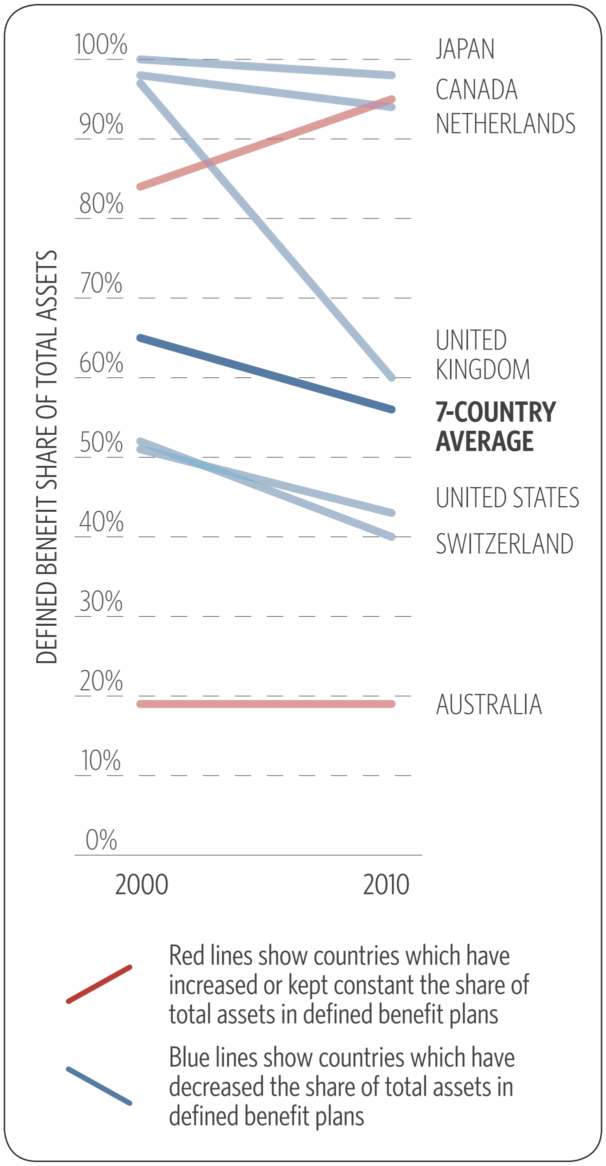
2.4). This could limit the more direct paths to renewable energy investing.

- ***Defined benefit plans.*** With defined benefit plans, the risk of poor performance remains with the plan sponsor and opportunities for members to switch out of a plan are limited. Thus the strategy and risk tolerance of the sponsor determines investment choices. Taking more risk can reduce the cost of providing a pension, but at the expense of greater uncertainty and volatility that could, in some cases, threaten the financial solvency of the plan sponsor. Depending on financial reporting requirements, pension fund volatility may need to be included in annual earnings reports, with highly volatile earnings reducing the value of the sponsor.

  Differences in reporting requirements and risk tolerance may explain some of the differences between plans sponsored by governments and corporate plans. Corporate plans, for instance, appear to be more conservative and, at the same time, are moving more rapidly towards defined contribution, or converting their pension asset to annuities, managed by life insurers.

- ***Defined Benefit – Other important factors.*** Beyond reporting requirements, other factors including age, funding level, and fund size each have a significant impact on investment philosophy. An older membership reduces the risk tolerance, as there is less time available to ride out market volatility before retirement. Well-funded pension funds with strong reserve positions tend to take on more risk since they have a cushion; however, underfunded pensions may be tempted to seek higher returns, and thus higher risk, to make up for the shortfall, if pension regulation does not intervene. As will be discussed in section 6, size is one of the most important factors, as larger funds will have more resources and incentive to develop their own investment capabilities and seek alternative investment opportunities. While nearly all pension funds use external investment managers for some of their assets, small- to medium-sized funds usually do so exclusively.

Figure 2.4 – Pension assets in the largest countries have moved from defined benefit towards defined contribution



Source: Towers Watson (2011b).

Foundations, Endowments, and Sovereign Wealth funds

Foundations and endowments are typically quite small, and, like smaller pension funds, rely heavily on external asset managers for their investments.

There are few sovereign wealth funds in the OECD, and almost all of the assets are managed by Norges Bank Investment Management (NBIM) in Norway. This fund manages much of its portfolio internally, but does not have an allocation to infrastructure, and does not invest directly in renewable energy projects.[5]

5 See Norges Bank Investment Management (2012).

Investment Managers

While other studies have included investment managers in their tallies of institutional assets (for example, IMF (2011) and Inderst, Kaminker and Stewart (2012)), we are excluding investment managers' assets. Investment managers manage significant amounts of pension fund and insurance money, but their clients are the principal decision-makers. Moreover, investment managers manage substantial assets for individual investors, but in this case must respond to market conditions and the needs of investors.

To a great extent investment managers are intermediaries rather than classic institutional investors. They manage assets either in co-mingled funds, such as mutual funds, or in segregated accounts. The advantage of segregated accounts is that the underlying assets can be assigned directly to the ultimate owner, such as the pension fund, and the manager can make adjustments to the portfolio to reflect special issues such as tax status.

Whether comingled or segregated, the objectives of their clients and the need to market to these clients often drives investment philosophy. But as investment managers are often under pressure to demonstrate top investment performance over the short and medium term, most offer liquidity — that is their investors can move their money any time they want — and therefore can invest only in liquid assets themselves, so they can sell these assets if and when their investors withdraw their money. Thus, most investment managers, including those managing pension assets, have liquid, relatively short-term portfolios. That is, they do not invest in project type assets that would be aligned with renewable energy.

The important exceptions are some private equity and infrastructure funds that specifically target direct investments in projects and require long-term lock-in periods. The lack of liquidity in the underlying investments makes it extremely difficult to offer segregated accounts, so these funds are typically co-mingled. An important result is that unless these funds target a specific group of institutional investors, the marketing and execution of these funds is unlikely to match the investment needs of any particular institution, especially considering how institutional investors' investment goals vary. We discuss these funds in more detail in section 3.

Other Institutional Investor Assets and Double Counting

Some pension related assets do not fit squarely into any of these categories. For instance, pension reserves are often for short-term liquidity purposes and can invest only in "risk-free" assets like treasuries. Others represent double counting, for instance insurance contracts are all also part of the insurance money, while investment retirement accounts (IRAs) are predominantly managed by investment managers.

The characteristics of the major types of institutional investor are summarized in table 2.2.

Table 2.2 – Characteristics of institutional investor types

INVESTOR TYPE	TOTAL OECD ASSETS ($BN)	INVESTMENT OBJECTIVE	TYPICAL SIZE OF FUND	INVESTMENT STYLE	ASSET ALLOCATION	REGULATORY ENVIRONMENT	FIT FOR INVESTMENT IN RENEWABLE ENERGY
Insurance Companies	22,015	Lowering cost and improving profits from insurance policies	Dominated by large firms - over half of assets in 20 largest insurance companies	Large insurance companies invest directly, and through subsidiaries - some investment through external asset managers	Dominated by fixed income, including large allocations to sovereign fixed income	Subject to significant financial regulation, including working capital requirements and accounting rules	Non-life insurance assets back short-term policies, requiring liquidity. Life insurers are active participants in renewable project finance markets.
Pension Funds	21,337	Providing pension benefits	Some large funds, many small funds - 20 largest pension funds (public, national and corporate) account for around 1/5 of total assets	Some large pension funds have direct investment teams, most funds rely on external asset managers	Allocation tilted towards equities	Corporate pension funds subject to corporate accounting requirements, public sector funds sometimes subject to less stringent accounting standards	In most defined contribution plans, pension beneficiaries can switch in an out of investment options, generating a need for liquidity. With several exceptions, only defined benefit funds are expected to invest directly in renewable energy projects.
Foundations and Endowments	1,500	Supporting activities of organization / institution over the long run	Small funds relative to other II types, largest are USD 30-40 bn	Largely reliant on external asset managers	Allocation tilted towards equities	Varies by geography and nature of institution	Time horizons and use of proceeds vary, but may be able to invest through third-party funds.
Sovereign Wealth Funds	587	Providing benefits to future residents, stabilizing national wealth from resource revenue	OECD figure dominated by NBIM, Norway's Sovereign Wealth Fund	Some direct investment, and some investment via external asset managers	Allocation tilted towards equities	Varies by geography and nature of institution	Time horizons vary, and would need to develop expertise in renewable energy, and make an allocation to renewable energy in order to invest.
Investment Managers	28,679	Track or exceed benchmark, objective varies by type of fund	Many funds, though several large asset managers with a variety of different funds under management	Direct investment consistent with fund objective	Mix reflects market demands	Listed funds subject to national financial regulation, explicit illiquidity limits, other rules	Mutual funds require significant liquidity to account for investment switching and market conditions Liquidity needs likely preclude investment in renewable energy.
Non-Fund Pension Assets	11,594	Various	N/A	Sovereign reserve funds invested in risk-free securities only, other asset types managed largely by external asset managers	Sovereign reserve funds invest in risk-free securities only. Asset allocation for others varies, determined by objective	Varies by geography and nature of assets	Personally-managed funds allow greater investment choice, and may require greater liquidity Sovereign reserve funds invested in liquid, risk-free assets to ensure stability of social security programs Assets backing pension insurance contracts (e.g. annuities) managed by insurance companies

3. The scope for potential institutional investment in renewable energy

In this section we analyze these investor classes and their constraints and estimate that, assuming there are no policy or investment practice barriers, they have a combined potential to invest approximately:

- $689 billion in renewable energy through corporate vehicles
- $257 billion in renewable energy projects
- Investment funds or pooled investment vehicles could fall anywhere within this range

3.1 The connection between investment vehicles and lower renewable energy finance costs

An institutional investor has three basic options for investing in renewable energy:

1. **Investing in corporations** — through equity shares, corporate bonds, or other related investment vehicles — that then use this capital to invest in renewable energy projects. These can be publicly traded or private investments, although we focus on publicly traded investments as their greater liquidity and visibility make them easier for institutions to invest in. These corporations can be either pure-play renewable energy companies or more general energy or utility companies that have renewable energy in their portfolio.
2. **Direct investing in renewable energy projects**, either through equity ownership in the project, loans, other private placement project debt instruments made directly to the project, or a host of other similar variations.
3. **Investing in pooled investment vehicles**, such as investment or infrastructure funds, that invest in renewable energy projects. Again, these can be either debt or equity funds or a combination of both, and may be renewable energy pure plays or general infrastructure funds.

From an institutional investor perspective, the differences in the financial and market characteristics of these three investment options have a profound effect on how the investments fit within the portfolio and how much of their portfolio they could dedicate to these investments. In this section we estimate the potential investment capacity by institutional investors in each of these categories. However, before we present these estimates, it is important to note that the differences between these investment options also lead to a significant difference in the impact that institutional investors might have on the financing costs of renewable energy through these investments. We summarize these differences in the following sections.

Corporate level investments

When institutional investors invest in a company, they not only invest in the series of assets that the company owns, they also invest in the management, experience, and skills of the company itself. A significant portion of many companies' value lies not in the assets, but in the expectations that the company will be able to use these skills to create additional value from developing new assets, entering new markets, and enhancing the value of the set of assets it owns.

From an institutional investor and renewable energy perspective, this means that investors take on a series of risks, and potential benefits, that are in addition to the underlying project characteristics and cash flows. These risks include:

- **Reinvestment and dividend policy.** Will the corporation decide to keep the project cash flows to reinvest in new projects rather than paying out the steady dividend stream that the investor was expecting? If so, the investor can no longer depend upon the project cash flows, but must trust the corporate dividend policy.
- **Corporate strategy.** Will the management decide to change markets or focus away from the institution's original expectations? Since few renewable energy pure plays exist, and many are tied to the

strategies of non-renewable parents,[6] the risk might entail moving away from renewable energy type investment profiles altogether.

- **General market risk.** The pricing for shares and bonds will move with market expectations. Although utility and renewable energy companies might be lower "beta" companies, that is they will exhibit less price movement with respect to general share prices than the market in general, market volatility will continue to have a significant effect. One of the benefits to institutional investors of direct investment in renewable energy projects, rather than investment through corporations, is that, if held through the life of the project, there should be close to no correlation of returns with the general market.

Of course, from an institutional investors' perspective, these effects are less pronounced with corporate debt than with equity, particularly if the corporate debt is held to maturity. However, the decisions that the corporation will make with respect to the required return of renewable energy projects and whether to invest in renewable energy or other projects will be based upon the market conditions and financial factors affecting their strategy, rather than that of the institutional investor. Therefore, even if investment in utilities or other corporations lowers the cost of capital for the company itself, it is unlikely to lower the cost of renewable energy so long as the corporation has a choice amongst a host of investment options.

Direct investment in renewable energy projects

As opposed to investment in corporations, direct investment in renewable energy projects creates an opportunity to structure the institution's investment to match the profile of the long-term institutional liabilities. But for this advantage to have an impact on the cost of capital for, and therefore the cost of energy from a renewable energy producer, two conditions will have to be met:

1. The institution typically needs to be actively involved in structuring the project, so that the cash flows they receive from the asset match the institution's long-term liabilities, and contribute to lowering their overall portfolio risk. If the asset is not structured in a way that lowers overall portfolio risk, it will not allow the institution to offer a lower cost of capital.
2. There must be enough competing potential investors with similarly low capital costs for institutions with structural advantages to share the benefits of their risk profile with the renewable energy asset in the form of a lower cost of capital. If institutions with low capital costs are accepting higher market returns set by other project finance investors, they might simply capture the whole premium available for taking on liquidity risk, and not contribute to lowering the cost of capital for renewable energy projects.

There are a number of factors that limit the ability of institutions to invest directly into projects. As we will discuss later, a key question will be whether there is enough potential investment to change the renewable energy landscape, or whether this may only serve as a more profitable investment opportunity for institutions.

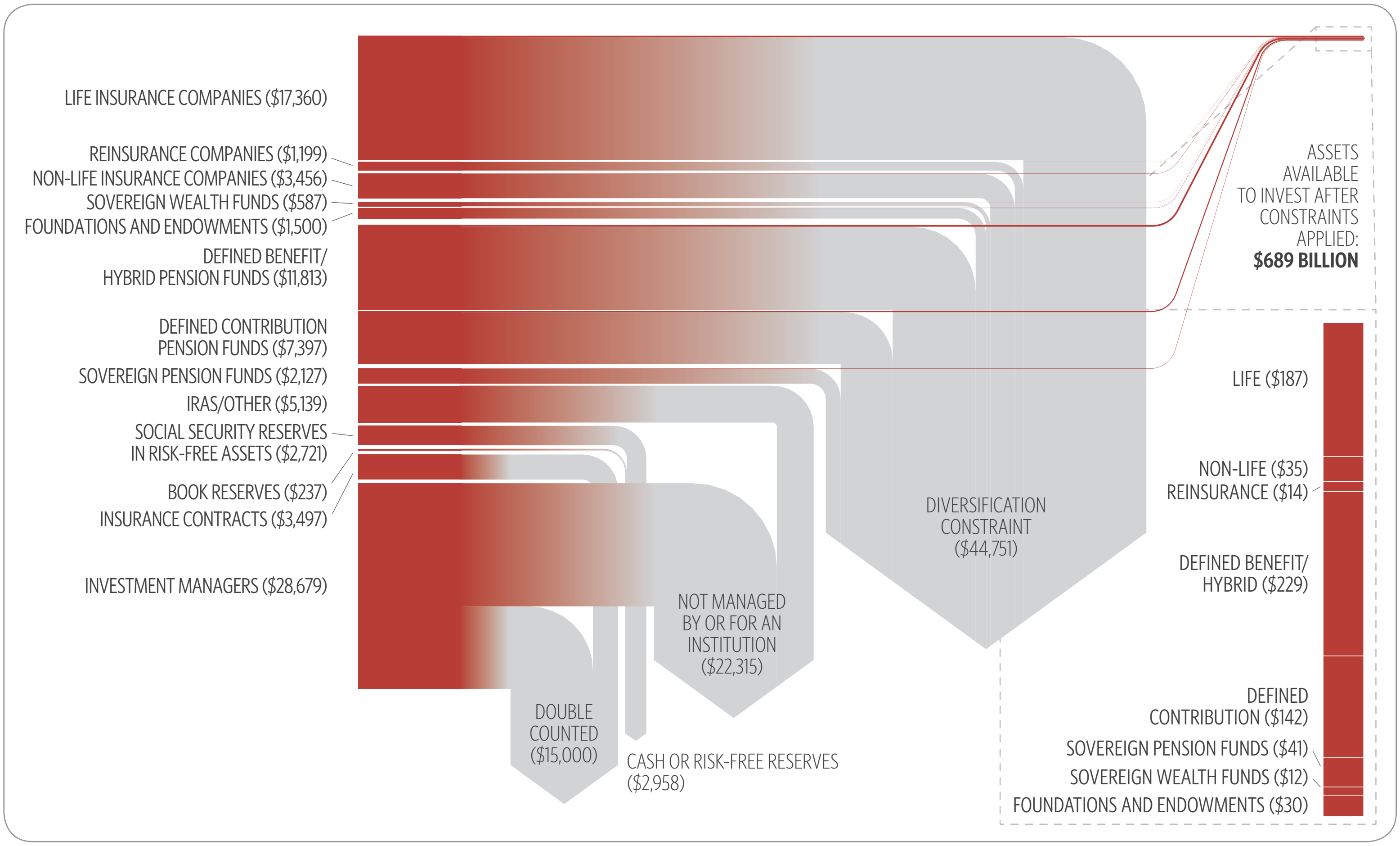
Pooled investment vehicles

Pooled investment vehicles can share many of the characteristics of either corporate or direct project investment. If an investment fund is large, well-researched, and traded over an exchange, the fund could eliminate both the liquidity and size constraints; however, in this case, like corporate investment, to trade over an exchange and offer liquidity, the fund will be unable to lock into project investments for long durations and will thus reduce the connection to underlying projects. Like corporate investment, this could undermine the potential cost advantage for renewable energy. Other fund designs could offer a better connection to the underlying assets — for instance by offering a "buy and hold to maturity" strategy, where the fund agrees to hold an asset for its life in order to deliver predictable cash flows — but in so doing might need to sacrifice their ability to offer liquidity. Further, while funds can be effective in increasing access to smaller pension funds and insurance companies by developing the teams, access to projects, and skills that might otherwise only make economic sense for very large funds to develop, developing these teams can be expensive and the fees that such funds might need to charge could erode much of the economic benefit to either institutional investors or renewable energy projects.

So far, the experience with pooled investment vehicles has been mixed. Some institutions that we spoke with expressed concern about high fees and the uncertain cash

6 For example, Iberdrola Renewables (subsidiary of Iberdrola) and NextEra (part of Florida Power and Light).

Figure 3.1 –Potential institutional investment in renewable energy through corporate securities (in billions of USD)



flow profiles on offer. These pooled investment vehicles are discussed in greater detail in section 7.4.

With this connection as background, we turn to estimating the potential scale of institutional investment in each of these investment vehicles. This analysis is designed to give an estimate for how much institutions could potentially invest, which we compare with investment needs in Section 4. However, we recognize that the results will be somewhat sensitive to the assumptions used. Appendix 2 details the key assumptions used in this analysis.

3.2 Potential institutional investment in corporate renewable energy assets

Institutional investors face relatively few constraints investing in corporate securities that could eventually feed investment in renewable energy. With relatively high liquidity and readily available research, investment in corporate securities is fairly straightforward. Furthermore, the abundance of investment managers investing in this space enables access even to the medium and small institutional investors that exclusively use external investment managers. In fact, through investment managers individual investors can also invest extensively alongside pension funds, sovereign wealth funds, and insurance companies. As in figure 3.1, the main constraint to investing in corporate securities is sector diversification. That is, the need to diversify the portfolio in order to reduce the risk of being overly exposed to any single trend or economic or political development. In our analysis we assume that renewable energy is equally attractive to other corporate securities and that investors set their weighting for renewable energy based on renewable energy's share of gross capital formation by investible sectors.[7] Going beyond these levels should be feasible, but

7 As explained in appendix 4, the IEA-estimated investment needs for renewable energy constitute roughly 2% of expected gross fixed capital formation from 2011-2035. We assume that institutions would not over-weight this sector unless they were convinced that the sector would consistently out-perform other sectors of the economy.

only if the incentive, and therefore the cost of renewable energy financing, were increased.

With sector diversification as the main constraint, we estimate that institutional investment could be $686 billion and could be even higher if the returns are attractive enough to encourage institutions to "overweight" the sector. On an annualized basis[8] these figures could correspond to $47.4 billion and $53.5 billion for project equity and project debt respectively. These figures exclude non-institutional money invested through investment managers. Adding this investment would add significantly to these numbers.

3.3 Potential direct institutional investment in renewable energy project assets

Direct investment in renewable energy projects faces many more challenges than corporate investment. For instance:

- Some institutional investors have short-term investment horizons that preclude them from entering into assets that may include a lockup period or otherwise require long-term investment horizons. This constraint eliminates many classes of institutional investors including most defined contribution pension funds, property and casualty insurance companies, and the money invested through external managers in mutual funds rather than segregated accounts.[9]
- There are factors that limit access to direct investment, or make direct investment uneconomic, for any but the largest institutions. These include the high transactions costs and large minimum deal sizes as well as the cost of developing and maintaining the requisite investment teams. Several interviews on the banking side suggested that small institutions, investing alongside larger investors, can constitute up to 20% of a deal's book. That is, smaller funds can tag-along with larger institutions by relying on the investment and due diligence capabilities of the larger player. We have included a 20% "tag-along" value to account for this activity.
- Even the largest funds with direct investment teams will only be able to dedicate a portion of their portfolio to direct investment in renewable energy or infrastructure, which is among the least liquid investment opportunities for these funds.
- Even within their illiquid investments, investors need to diversify across a range of sectors. This sector diversification will also limit direct project investments.
- Further detail on our analysis of the challenges facing direct investment is included in appendix 2.

Figure 3.2 demonstrates how each of these constraints impact potential investment in renewable energy projects, beginning with the short-term investment horizons and liquidity requirements of investment managers that prevent most of them from direct investing. Next we exclude double counted other assets and the lion's share of defined contribution and non-life insurance assets whose liquidity requirements prevent direct investing.[10] Then we exclude pension funds that are too small to direct invest (adjusted for tag-along investment from small funds as in section 2.1).

The remaining funds are large enough to direct invest and are willing to commit to less liquid investments in exchange for higher potential returns. However, our interviews show that even the most aggressive of these require the vast majority of their funds to be invested in liquid assets. We take only the portion of these funds that an aggressive market participant would be willing to invest in illiquid assets. From this point sector diversification requirements further limit investment.

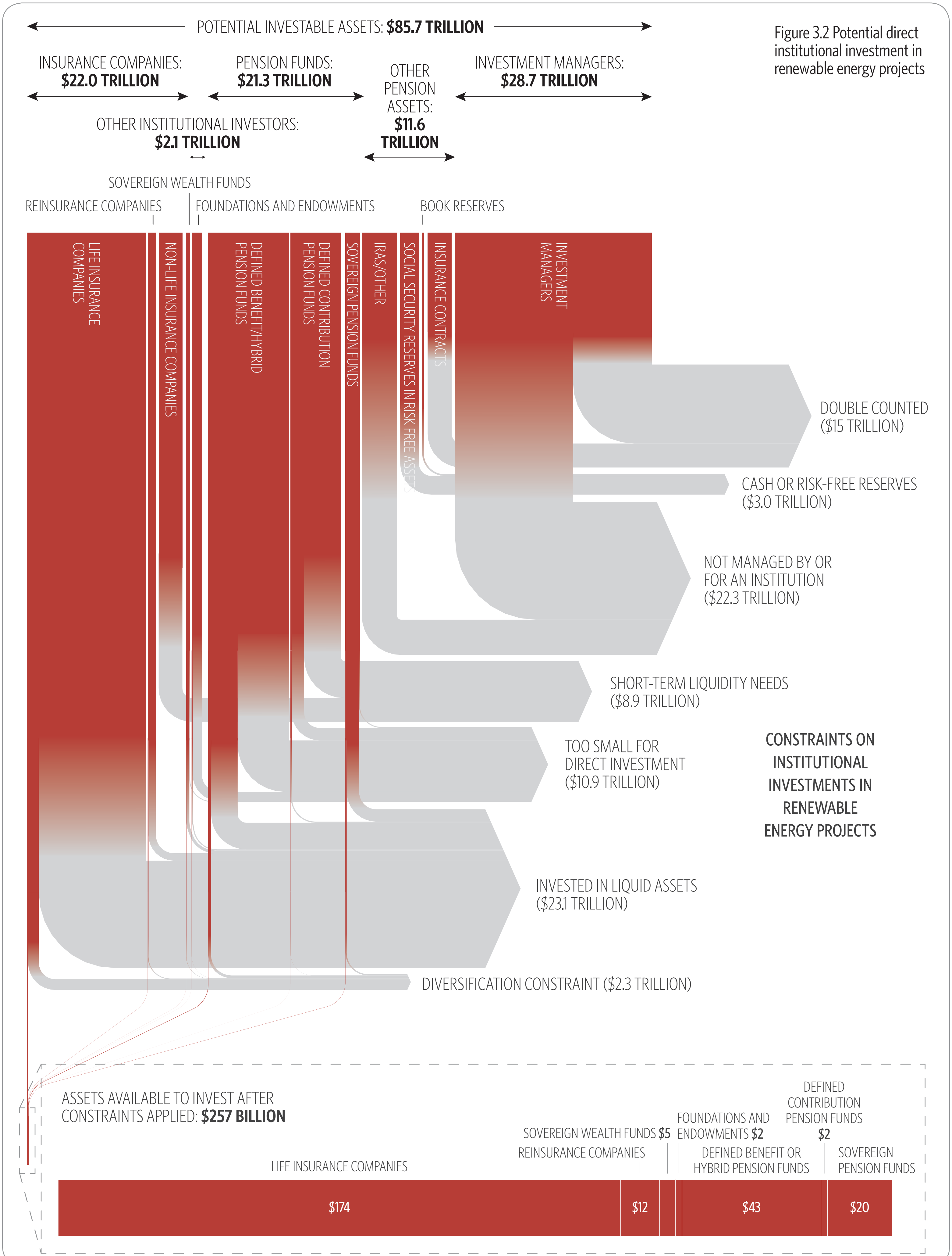
After each of these constraints, we estimate that $257 billion, less than one half of one percent of total assets under management, will be available for direct investment in renewable energy projects. Each of these investors will have different perspectives on whether debt of equity is more attractive. Using the average debt-to-equity mix for each type of investor, we estimate that $191 billion will

8 Again, see appendix 2 for further details

9 World Economic Forum (2011) describes the characteristics of long-term investors, including the liability profile, investment beliefs, risk appetite, and ability of an institution to develop and execute a long-term investment strategy. In some countries (notably Australia), defined contribution funds may meet these criteria, and do, in fact invest in long-term, illiquid assets. Likewise, some institutions are able to access these investments through private equity and infrastructure managers. However, this intermediated investment is not counted towards potential institutional investment directly into projects.

10 A few of these can direct invest. See appendix 2 for more detail.

Figure 3.2 Potential direct institutional investment in renewable energy projects



be available for project debt and $66 billion for project equity. On an annualized basis[11] these figures correspond to $8.8 billion and $30.5 billion for project equity and project debt respectively.

3.4 Potential institutional investment in pooled investment vehicles or investment funds

The potential for institutional investors to invest in renewable energy projects through infrastructure or renewable energy investment funds will depend entirely upon the structure of the funds on offer.

A fund that might offer the closest structure to direct investment, and therefore would offer the best chance to reduce renewable energy costs, could be designed to buy renewable energy projects (or their related debt) and hold these projects through to their maturity. These funds might need to group projects by their life span, in order to provide greater consistency and certainty for cash flows, and would be closed, with all cash from the projects returned to the funds' investors, rather than reinvested into new projects. However, such a fund would require some degree of lock in from investors and would likely be relatively illiquid even beyond the lock in. It is unclear whether such a fund could support a fee structure that would attract investment managers to develop and maintain such a fund.[12]

Moving away from such a structure, a fund could provide greater liquidity by increasing the size of the fund and trading the fund on an exchange.[13] However, such a fund would take on market risk and might need to buy and sell assets to create liquidity and enhance returns, to justify listing the fund on an exchange. In this case, the fund would, effectively, become like a renewable energy corporation.

11 See section 4.2 and appendix 2 for further details of this calculation.

12 The Real Assets Energy Fund is attempting to offer stable, long-term returns to institutional investors through buy-and-hold investments in renewable energy power plants. They will offer annual liquidity windows for their investors to address unexpected cash needs, but otherwise will require investment lock in over a 25-year period (RAEF 2012). A number of other closed-end renewable energy investment funds exist, but our interviews indicate that few, if any, offer a buy-and-hold strategy with limited liquidity to match institutional needs.

13 Brookfield Renewable Energy Partners, for example, is a listed fund that invests primarily in hydroelectric and wind power plants (Brookfield Renewable Energy Partners Website).

Table 3.1 – Potential total institutional investment by asset class (excluding investment managers)

	CORPORATE INVESTMENTS	PROJECT INVESTMENTS	POOLED INVESTMENTS
EQUITY	$354 bn	$66 bn	$136-272 bn
DEBT	$335 bn	$191 bn	$230-290 bn

So given this wide range of options, the question is how much could the various forms of these pooled funds attract in institutional investment and what would be the impact on renewable energy costs. To assess this, we look at the main constraints that the pooled investment vehicles could ease: size limitations and liquidity.

- **Institution size.** Pooled investment funds could make direct renewable project investment available to nearly all institutions, regardless of size. Relaxing the size constraint on direct investment could more than double potential investment in project equity, and raise potential investment in project debt by 20%. The smaller institutions that are excluded from direct investment are nearly all pension funds. Since pension funds are more disposed to invest in equity than debt, while insurance companies are more disposed to the debt markets, lowering size thresholds has a greater impact on equity.
- **Liquidity.** Creating liquidity could increase the share of the portfolio that institutions could dedicate to renewable energy. Relaxing the liquidity constraint could potentially double the amount of project equity available, but only raise potential investment in project debt by 11%. This difference is again due to insurance companies, where liquid renewable energy debt instruments would compete for an allocation of corporate debt, rather than an allocation of illiquid investments.
- **Liquidity and size.** Relaxing both constraints would have the greatest impact, more than quadrupling the amount of potential project equity, and increasing potential project debt investment by 52%.

Our sensitivity analysis suggests that pooled investment vehicles may have a greater impact on the equity portions and on pension funds. However, given that the potential for direct investment in project equity is less than one-third that of direct investment in project debt, this increase might be precisely what is needed.

Table 3.1 summarizes the potential investment from institutional investors, for each type of asset class.[14] In this case, the pooled investments represent a range, where the lower bound involves accessing institutions of all sizes, while the upper bound would involve addressing both the size and liquidity constraints.

14 Corporate, project and pooled investments are considered independently in our analyses, and our estimates for each of these channels cannot be combined into a total. For example, an institution's exposure to renewable energy assets through corporate or pooled investments may further constrain their ability to invest directly in projects.

4. Potential impact of institutional investors on renewable energy capital needs

Annual renewable energy investment requirements are forecasted to average $160 billion over the next 25 years. Comparing this requirement against the potential estimated in section 2 we find that plenty of investment is available for corporate investments, but that institutions can play only a smaller role in direct project investment. We estimate that if barriers are removed, institutions could meet approximately 24% and 49% of annual capital requirements for renewable project debt and equity respectively.

The previous section suggests that institutions could contribute $66 billion in equity and $191 billion in debt to renewable energy projects. But is this enough to make a difference for financing needs? To assess, we need to compare this figure against estimates for annual investment required.

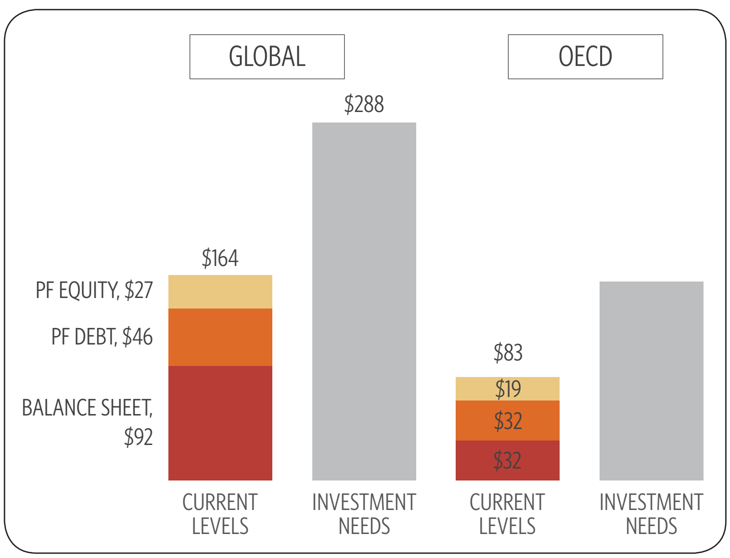
4.1 Annual renewable energy investment needs

The world's need for energy infrastructure investment in the coming decades has been well-documented. In the 2011 World Energy Outlook, the International Energy Agency (IEA) estimated that from 2011 to 2035, over $35.6 trillion will be invested in energy supply infrastructure in order to meet climate goals. However, as described in box 3, renewable energy is only one part of this large investment need. Based on the figures presented by the IEA, we estimate that $ 7.2 trillion will need to be invested worldwide in non-hydro renewable energy between 2011 and 2035, $ 4 trillion of which would be required in OECD countries.

In figure 4.1 we compare these investment needs (expressed as annual averages) to current levels of investment, derived from Bloomberg New Energy Finance data.

Both globally and within the OECD, we find that current levels of investment are between 50% and 60% of annual requirements.[15] On an aggregate level, we need to see a significant scale-up in investment.

Figure 4.1 – Mix of current renewable energy investment vs. annual investment needs, in billions of USD



Sources and Notes: IEA (2011), Bloomberg New Energy Finance (2012b), BNEF Database, CPI Analysis. Investment needs figures represent annual average of 2011-2035 cumulative investment needs for the IEA "450 Scenario," in 2010 dollars. To compare with New Energy Finance, this figure excludes estimate investment in hydroelectric power.

While the scale of needed investment is impressive, the mix of current levels of investment indicates that financing is likely to come in a variety of forms. In the OECD in 2011, 62% of new investment in renewable energy was provided through project finance (financial arrangements specific to individual projects, common for power and infrastructure investments in general) while the remaining 38% was invested by companies, using their balance sheets. Of project finance, roughly 63% of the finance came in the form of debt.[16] This debt includes loans from commercial and public banks, as well as debt finance provided for projects by institutional and public markets. These debt investments are accompanied by equity investments, from project developers, banks, asset managers, and others. However, Basel III regulations on European banks, intended to reduce the financial risk-tak-

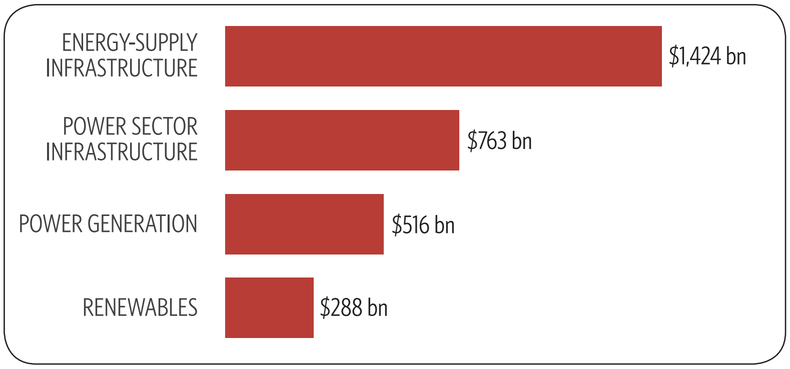
15 Figures for annual investment needs and current levels of investment both exclude rooftop solar photovoltaics. Distributed generation attracted $75.8 billion in investment in 2011 (BNEF 2012a and 2012b).

16 For projects where financial structure was disclosed in the BNEF database.

Box 3 – Investment needs for renewable energy and other energy infrastructure

The global need for investment in energy infrastructure, estimated by the IEA to be $35.5 trillion over 25 years, is by all measures massive, and renewable energy is only one component of this investment need.

Average annual global investment needs



Sources and Notes: IEA (2011); CPI Analysis. Investment needs figures represent annual average of 2011-2035 cumulative investment needs for the IEA "450 Scenario," in 2010 dollars. The figure for renewables excludes investment in hydroelectric power.

But from an investment perspective, there are some notable differences in these types of infrastructure. For instance, Credit Suisse (2010) points out that the drivers of renewable investment are "diversification of energy sources, abundance of natural resources, and 'green' importance," whereas traditional energy supply infrastructure is driven by "supply-demand imbalance, regulatory changes, and inadequate transmission capacity." Moreover, Kaminker and Stewart (2012) highlight that clean energy and low-carbon infrastructure bears some unique policy/regulatory, commercial, technical, and market risks, beyond those of typical infrastructure assets.

Even given the large investment needs required for renewable energy, an institutional investor would likely diversify across many types of infrastructure to diversify risks. Indeed, to address the climate challenge while meeting the world's growing demand for energy, there will be a wide variety of investment opportunities across the energy infrastructure space. Clearly, even within an institution's allocation to illiquid infrastructure investments, renewable energy will be but one of the areas of opportunity moving forward, highlighting the importance that renewable energy be able to compete with other infrastructure investments on the basis of risk-adjusted return.

ing of banks, have led some to withdraw from the project finance market. Those that remained have had to offer shorter tenors, and in some cases, higher cost of capital, compounding the challenges of financing renewable energy. The breakdown of current investments is compared with the annual need for renewable energy investments in figure 4.1.

If we assume that the mix of finance required form 2011 to 2035 is similar to the current mix of finance, future investment needs will be dominated by project finance debt. Of the USD 160 billion in needed investment, USD 61.8 billion will come from project finance debt, with roughly USD 36.8 billion provided by project finance equity. By the same logic, a fair amount of finance may flow through corporate entities. If the share of debt and equity the corporate entities must raise to finance these projects is similar to project finance, we estimate the need for corporate debt at around USD 38.6 billion, and corporate equity around USD 23.0 billion.

4.2 Potential institutional investment against renewable energy capital requirements

To compare the scale of investment potentially available from institutional investors with the investment needs, we first need to convert our estimate of assets into an expected flow of funds. The details of this calculation are in appendix 2, but table 4.1 summarizes the main steps. We adjust our estimate for expected GDP growth over the period of 2011-2035, convert to an annual average flow incorporating reinvestment, and add the additional flows

Table 4.1 – Calculation of investment flows ($2010 Billion)

ASSET CLASS	ASSETS AVAILABLE FOR RENEWABLE INVESTMENT (2010)	ADJUSTED FOR ASSET GROWTH	CONVERTED TO POTENTIAL ANNUAL INVESTMENT FLOW	CATCH UP INVESTMENT TO REACH STEADY STATE	TOTAL AVERAGE ANNUAL POTENTIAL INVESTMENT FLOWS
PROJECT EQUITY	66	86	6.2	2.6	8.8
PROJECT DEBT	191	252	22.9	7.6	30.5
CORPORATE EQUITY	354	466	33.3	14.1	47.4
CORPORATE DEBT	335	441	40.1	13.4	53.5

that would be needed to catch up to the full renewable energy allocation.

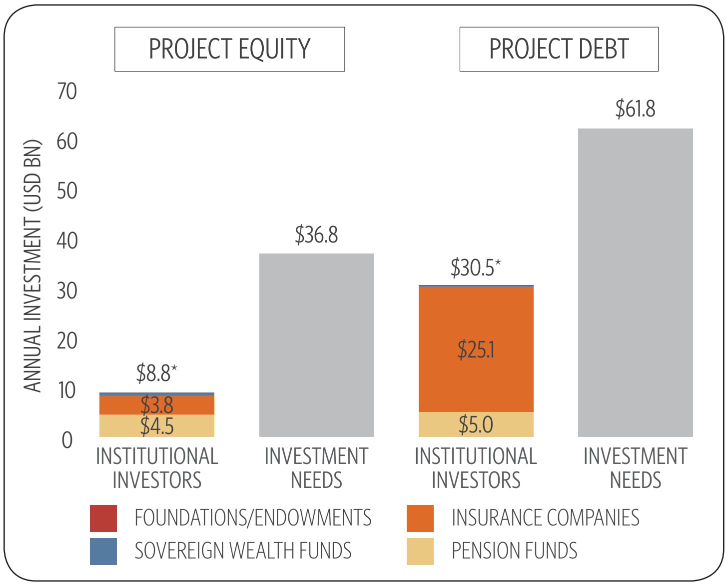
In figure 4.2 we set potential institutional investment against the needs, segmented by asset class for each.

The analysis suggests that under exceptionally good circumstances — that is no policy barriers and all institutional investors adopting aggressive investment strategies with respect to renewable energy and illiquid assets — institutional investors could meet only 24% of project equity investment needs, and 49% of project debt needs. From this perspective, we should highlight the role and potential for insurance companies to provide project debt to renewable projects.

The situation for corporate investment is quite different. While there are significant constraints on institutional investment in renewable energy projects, investment needs on the corporate side appear to be well covered by institutional investors. This investment can be provided by all types of institutional investors. Pension funds currently maintain large allocations to corporate, publicly traded equity, while insurance companies are heavily invested in corporate debt securities.

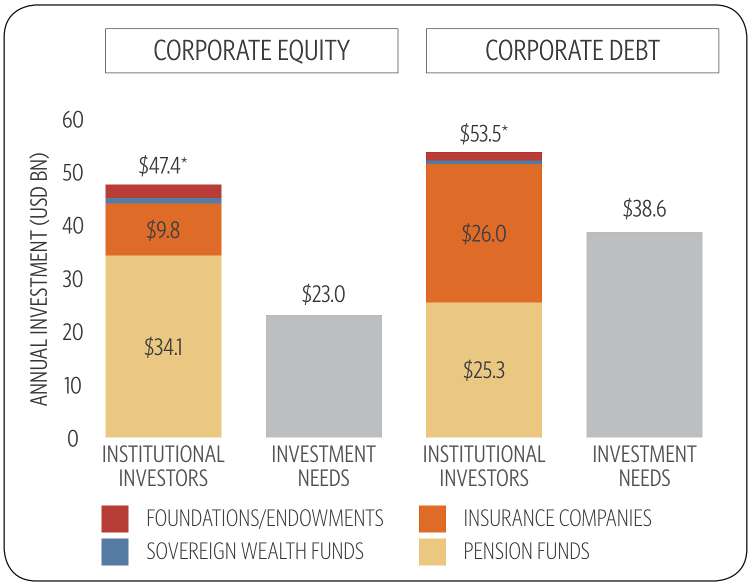
However, meeting the potential for corporate investment is not without its own challenges. Many institutions invest to match the performance of an index, and companies that are too small to be included in major indices can be overlooked. For corporate debt in particular, achieving an

Figure 4.2 – Potential annual pension funds and insurance company investment versus OECD project investment needs



Notes: Project Equity total includes $0.4 bn Foundations and $0.1Bn Sovereign Wealth funds; Debt includes $0.3bn and $0.1bd of each respectively.
Sources: IEA (2011), CPI Analysis described in appendix 2.

Figure 4.3 – Corporate investment needs are well-covered by institutional investors



Notes: *Project Equity total includes $2.5 bn Foundations and $1.0Bn Sovereign Wealth funds; Debt includes $1.6bn and $0.7bd of each respectively
Sources: IEA (2011), CPI Analysis described in appendix 2.

investment grade rating and being included in a major index is critical for accessing institutional investment, as we heard from several institutions.

In addition to institutional investors, there are many other potential investors in corporate securities. Retail investors and high-net-worth individuals can readily access the public markets. Mutual fund holdings are dominated by publicly traded equity and debt. Banks also invest in publicly traded securities on behalf of their clients and shareholders. So while institutional investors can likely cover needed investment in corporate investments, there are many additional sources of capital for companies via the public markets.

Table 4.2 summarizes the potential investment as a percentage of investment needs. Corporate investment needs could likely be more than fully covered by institutions, if there were sufficient corporate investment in renewable energy projects. However, project investment remains limited by a series of constraints, and in our estimate, institutions could only provide 24% of the equity and 49% of the debt for projects. Pooled investments may be able to cover most to all of project equity, and the majority of the debt, if they are able to sufficiently address the size and liquidity constraints of the institutions.

Table 4.2 – Investment potential against needs

	CORPORATE INVESTMENTS	PROJECT INVESTMENTS	POOLED INVESTMENTS
EQUITY	206%	24%	50-99%
DEBT	139%	49%	60-75%

5. National differences for institutions and their impact on renewable energy investing

The assets of institutional investors are concentrated in a handful of countries. National pension policies play a pivotal role in concentrating 90% of pension assets in just six countries, and through their impact on fund size and industry structure, influence how much of this money could potentially be invested in renewable energy assets. While insurance assets are distributed more evenly, only a few companies in each region control the majority of assets. These regional differences imply that most of the potential for renewable energy investment comes from a limited set of countries.

Faced with the enormity of the $45 trillion managed by OECD institutional investors, it is easy to miss the fact that the $25 trillion managed by investors large enough to invest directly in projects is managed by just 120-150 institutions.[17] It is also easy to miss the concentration of this investment in a few countries. Almost two-thirds of OECD-based insurance and pension fund assets reside in just the U.S., Japan, and the U.K. Figure 5.1 Compares assets managed by the largest 50 pension funds and 49 largest insurance companies in the OECD. This set represents 93% of the funds large enough to invest directly, the remaining 20-50 funds are medium-sized (but still large enough to direct invest) insurance companies where we do not have a precise breakout by country.

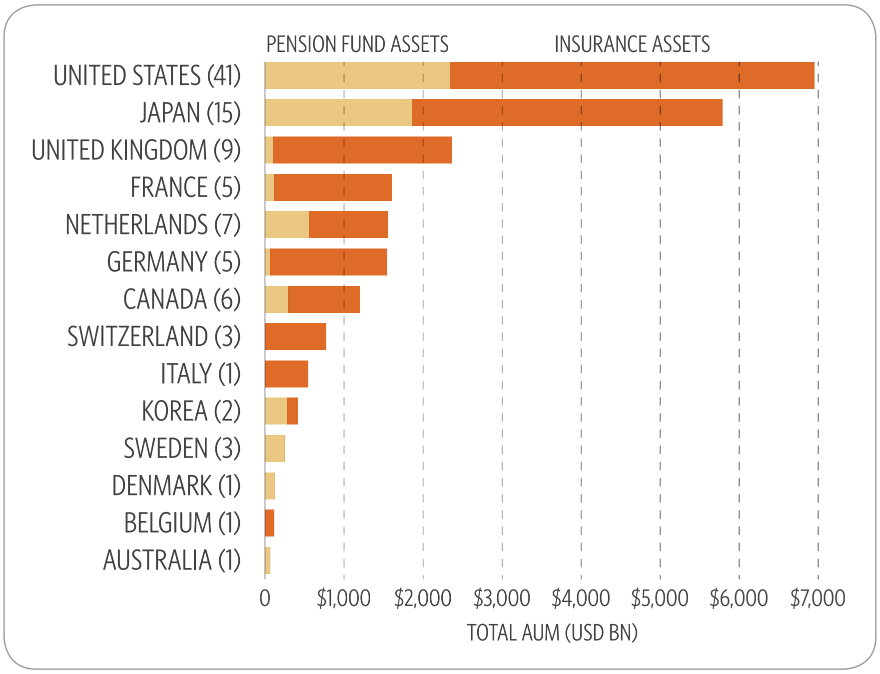
For insurance companies, this concentration is driven by the advantages of size including economies of scale in sales and marketing to consumers, diversification of risks in underwriting, and efficiencies in managing a larger investment portfolio. As a result, close to 50% of European based insurance assets are managed by 10 insurance companies. In North America the figure is 68%, while in Japan the figure reaches 98%.

On the pension side, national pension policy plays a pivotal role in concentrating assets in a few countries. For example, pension policies in Australia, Canada, and the Netherlands are responsible for these countries having a disproportionate role in global pension assets, while the United States, Japan, Canada, United Kingdom, Australia, and the Netherlands account for nearly 90% of OECD pension assets.

In other countries, a greater proportion of retirement benefits are provided through government budgets, rather than by independent investment funds. Figure 5.3 illustrates the divide between countries with fund-based pension systems, and countries whose pension systems are not backed by substantial assets.

The regional differences and the general concentration in a limited number of institutions have several implications:

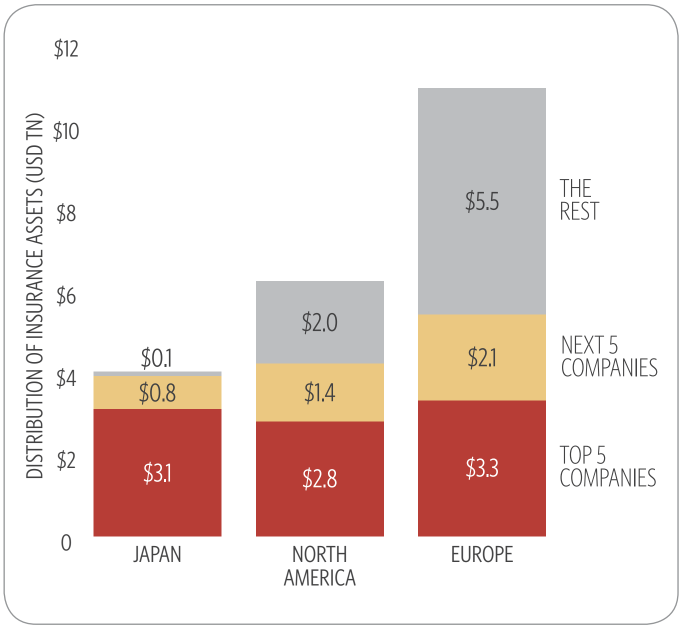
Figure 5.1 – Assets managed by the 50 largest pension funds and 50 largest insurance companies, by country



Note: Total number of funds and companies in parentheses.
Sources: Towers Watson (2011a), Relbanks data.

17 Estimate based on Towers Watson (2011a) and Relbanks data.

Figure 5.2 – Distribution of insurance assets ($tn)

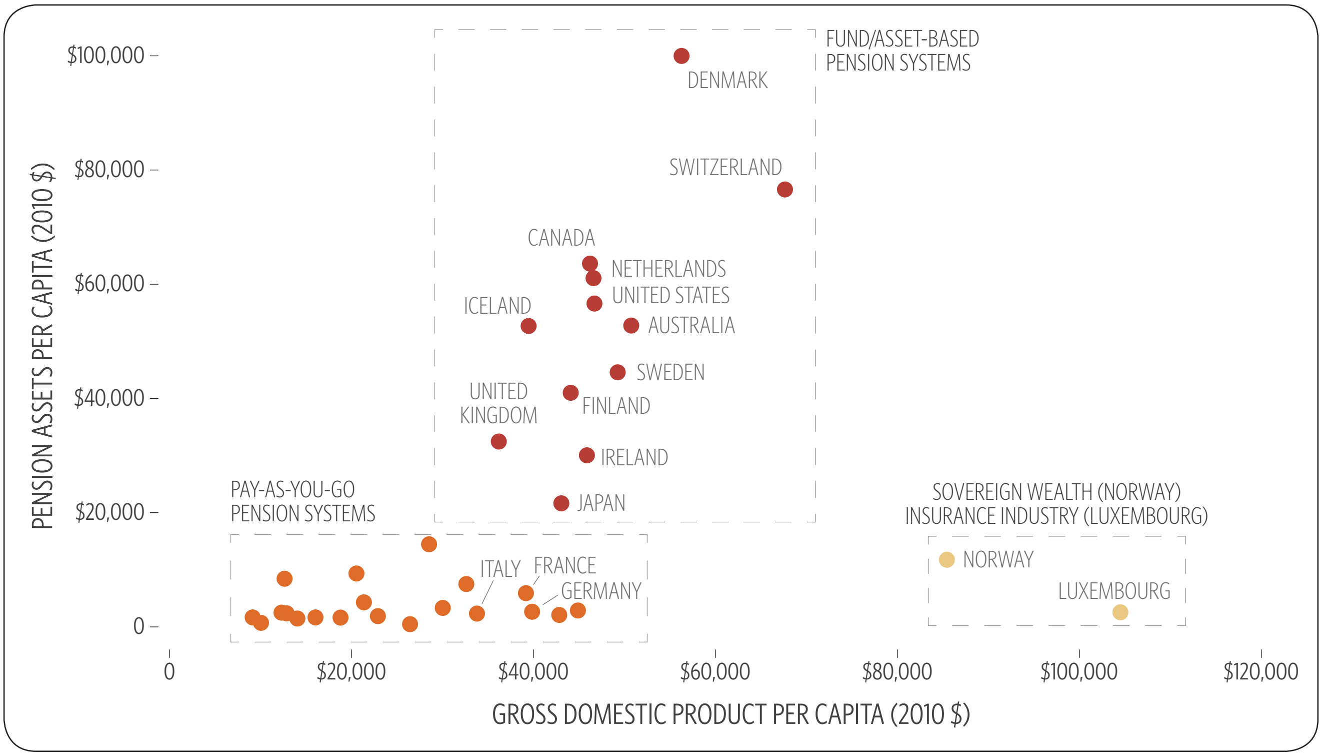


Sources: Relbanks data.

- The potential impact of institutional investors will vary. While there is a significant flow of investment across borders, particularly within regions, investment by a fund in a home country is likely to be easier to assess, complete, and monitor.
- The impact of energy policies on institutional investment in renewable energy will also vary. For example, insurance companies generally will have a preference for debt investments, whereas pension funds may seek both debt and equity investments in renewable energy. Even within pension funds there are critical differences that affect the types of investments they want. These differences are driven by pension policy and regulation, as well as a number of other factors such as the age of members and the status of the plan sponsor.
- Pension policies and insurance regulation will also have a different impact in different regions.

While we have so far presented a view of potential institutional investment in aggregate across the OECD, there are meaningful national and regional differences in investment practice, industry structure, and regulation which have implications for potential renewable energy investment from institutional investors. This section describes some of the major differences between regions, with a focus on pension funds and insurance companies.

Figure 5.3 – Provision of pension benefits varies by country



Sources: OECD (2011), World Bank data.

5.1 Europe

Table 5.1 – Assets available for direct investment in renewable projects ($bn) - Europe

	TOTAL ASSETS	AVAILABLE FOR PROJECT EQUITY	AVAILABLE FOR PROJECT DEBT
PENSION ASSETS	5,956	5.0	6.9
INSURANCE COMPANIES	10,869	17.9	76.4
SOVEREIGN WEALTH FUNDS	499	3.1	1.6
FOUNDATIONS AND ENDOWMENTS	200	-	-

Note: Based on analysis described in appendix 2. Sovereign Wealth Funds include Norway and France funds.

European pension assets are very unevenly distributed. Of the approximately $5 trillion managed by pension funds in Europe, the United Kingdom has 40%, the Netherlands 20% and Switzerland 12%.

Defined benefit plans represent just over half of this figure and are slightly more uneven, with the UK representing 44% and the Netherlands 35%. Of the $1 trillion managed by pension funds larger than $50 billion in assets, which represent the primary target for direct investing, the three largest pension funds in the Netherlands manage over one half of the assets, while the UK and Denmark each have slightly more than 10%. These numbers exclude the sovereign wealth fund of Norway, which alone would account for more than 10% of European pension assets if it were defined as a pension fund.

The pension plans of other countries have fewer assets backing these plans, primarily due to the way that these plans are funded. Some are funded as pay as you go systems or funded out of national budgets, while some manage money through insurance contracts

It is beyond the scope of this paper to analyze the ins and outs of particular national pension systems, except to note that these very basic decisions on how to set up a national pension system obviously overwhelm any other policy. The Dutch system, where most pension assets are managed by designated pension providers that are regulated by the Dutch Central Bank, provides a particularly interesting example. By pooling pension provision, these funds have developed the scale to justify building larger and more sophisticated investment teams than elsewhere. These funds have already developed teams to look at potential direct investing in renewable energy infrastructure. In contrast, there are fewer large players in the UK pension system, so direct investing is more rare and difficult, although the UK funds do have more of an appetite for direct investing than equivalent-sized US funds.

In contrast, insurance industry investors are based in a wider range of countries. The UK and France both have just less than a quarter of the $10.9 trillion assets managed by insurance companies, while Germany has less than 15%. The UK, France, Germany, the Netherlands, and Switzerland all have multiple large investors, while Italy also has one. Since the distribution of these investors is more closely (although far from exactly) aligned to the size of the relevant economy, the assets of insurance companies are more closely aligned, geographically speaking, with energy and infrastructure needs. That having been said, the large insurance companies tend to operate across Europe, so investment could be well matched.

A number of significant policy concerns complicate the picture. First, unbundling of gas and electricity markets prevents investors from owning a controlling stake in both transmission and generation, including renewable energy. Given the attractiveness of transmission and pipeline type infrastructure assets, this regulation could preclude a large proportion of institutions from investing in renewables. Second, regulation designed to maintain the financial stability of insurance companies has the potential to make direct investing significantly less attractive. These policy issues are discussed in more detail in section 6 and Appendix 3.

Implications – European pension funds and insurance companies

From the perspective of potential to mobilize capital, the British and the Dutch pension systems are the most significant. From the perspective of accessing large investors that could invest directly into projects, the Dutch system becomes the most significant target. However, the Nordic pension funds in Denmark and Sweden have taken particular missions to invest in renewable energy, even if they are below the size that we might normally expect to enter this realm.

While the smaller size of UK pension funds limit their impact on direct investing, the scale of assets invested by medium-sized funds could create a significant opportunity for either corporate investments or pooled investment vehicles, if a suitable structure can be created.

Insurance companies are busy looking for investment opportunities in renewable energy and should provide a continued source of new investment, if the policy does not create significant barriers.

5.2 North America

The United States accounts for 57% of all OECD pension assets, and one-quarter of OECD insurance assets, while Canada adds an additional 7% of pension assets and 3% of insurance assets. In addition, a large share of foundation and endowment money and other asset managers are located in North America. However, these markets are structured very differently. Pension funds in North America vary significantly in size, structure, and regulation, while insurance companies are dominated by a few very large firms.

The U.S. and Canadian governments both have government-run social security systems, but these only provide a portion of pension benefits, and are largely funded on a pay-as-you-go basis through government budgets.[18] Pension funds, and to some extent other forms of pension assets like individual retirement accounts (IRAs) and annuity contracts managed by life insurance companies, constitute an important part of the pension system. The U.S. and Canada have many large pension funds; of the 51 pension funds globally with over $50 billion in assets, 23 are in the U.S. and three are in Canada. But these funds only represent 25% of the assets managed by pension funds in the U.S., and 17% of the pension fund assets in Canada. In both countries, the pension fund landscape is characterized by some big players, and many small, diverse funds.

These funds differ in their structure, regulation, and management. Many of the largest funds are publicly funded to provide benefits to state employees, while a number of large corporations also run substantial pension funds. There are large differences between these fund types. State funds invest to meet a target rate of return, and as academic literature points out, sometimes use their target rate of return as a discount rate when assessing their long-term pension liabilities. This may encourage more risk-taking among public pension funds, driving them into a more equity-focused investment strategy.[19] State pension funds are subject to scrutiny by their boards, state politicians, and taxpayers. Their salaries for investment professionals are generally well below those offered in the private sector. One state pension fund that we interviewed indicated that it would take an inordinate push by management to hire top investment managers for direct investing in infrastructure, given prevailing salaries in the profession. These types of constraints drive many state funds to rely heavily on external asset managers, and create large barriers to direct investing.

Corporate funds, on the other hand, face very different issues and constraints. Corporate pension liabilities show up on the balance sheet of companies, and can impact their financial position. Accounting standards, such as IFRS and US GAAP, have driven many corporate pension funds towards mark-to-market accounting for their pension investments. Moreover, an increasing number of corporate pension funds in the U.S. have been closing their defined-benefit funds to new contributions and participants, moving from defined benefit to defined contribution, or moving their pension liabilities off their balance sheet through the purchase of annuity contracts with insurance companies. These trends have implications for their potential for direct project investments in renewable energy, by creating barriers to investing in long-term, illiquid assets.

On the insurance side, the industry is dominated by large life insurance companies. Half of U.S. insurance assets are accounted for by four companies: MetLife, Prudential, AIG, and TIAA CREF.[20] In Canada, the majority of assets in the insurance industry are managed by Manulife Financial. Each of these firms manages over $400 billion

18 The U.S. has a $2.6 trillion social security reserve fund, invested solely in U.S. sovereign securities, which our numbers exclude, while Canada has a $136 billion investment fund to support the viability of future pensions, which has a broader investment mandate and we count as a pension fund (data from OECD 2011).

19 See Andonov, Bauer and Cremers (2012) for a detailed discussion of how pension funds assess their liabilities, and the implications these methodological choices have for investment risk profiles.

20 AIG failed in 2008, during the financial crises, and was rescued by the U.S. government. As a result, there may be more scrutiny on the financial solvency, level of illiquidity, and other aspects of the financial health of U.S. insurers.

Table 5.2 – Assets available for direct investment in renewable projects ($bn) – North America

	TOTAL ASSETS	AVAILABLE FOR PROJECT EQUITY	AVAILABLE FOR PROJECT DEBT
PENSION ASSETS	19,524	21.5	8.2
INSURANCE COMPANIES	6,168	5.3	41.6
SOVEREIGN WEALTH FUNDS	52	-	-
FOUNDATIONS AND ENDOWMENTS	1,100	1.0	0.6

Note: Based on analysis described in appendix 2. Includes both Canada and United States. Sovereign Wealth Funds include U.S. state investment funds.

in assets. These large, sophisticated investors are currently among the top institutional participants in the energy project finance market.

Implications – North American pension funds

Given the size of the industry, it is not surprising that pension funds have considerable potential to invest in the equity of renewable energy projects. Despite this potential, their involvement is currently very limited. In general, we found the investment teams to be less willing to invest directly in projects and infrastructure of any type, particularly compared to their European counterparts. Investment through external managers is much more the norm.

The reluctance to invest in infrastructure and, particularly, renewable energy projects may also be due to policy. The use of tax credits to incentivize renewable development has created a tranche of “tax equity investors” that sit between the high risk/high return of the developer’s equity and the low risk/returns of the debt holders. While the tax-exempt status of pension funds may make tax equity investment unattractive, the space it occupies is precisely where many pension funds would like to invest, avoiding some of the development and construction risks, but still taking on some of the equity returns.

The large number of small- to medium-sized pension funds would provide a big opportunity for “tag-along” investment that could increase the role of the pension funds in renewable equity, if there were big funds to invest along with, but failing this, that potential goes unrealized. Alternatively, the role for pooled investment vehicles, if structured to meet pension fund needs, presents a large opportunity.

Implications – North American insurance companies

Insurance companies have the potential to provide a significant amount of project debt. Indeed, our analysis and interviews demonstrate that the insurance companies are already very actively involved in this space and have substantial portfolios already invested in renewable energy project debt. On an interesting note, this investment appears to have been greatly accelerated by the use of cash grants in lieu of tax credits in the U.S. The use of tax equity, it seems, crowds out not just the mezzanine type equity that pensions seek, but also the debt that insurance companies might offer. We heard from insurance companies and bankers alike about the difficulty in arranging and negotiating project debt to go alongside the tax equity, and concerns regarding the degree of subordination of project debt to tax equity.

5.3 Australia

Table 5.3 – Assets available for direct investment in renewable projects ($bn) - Australia

	TOTAL ASSETS	AVAILABLE FOR PROJECT EQUITY	AVAILABLE FOR PROJECT DEBT
PENSION ASSETS	1,166	0.5	0.2
INSURANCE COMPANIES	308	0.8	1.4
SOVEREIGN WEALTH FUNDS	-	-	-
FOUNDATIONS AND ENDOWMENTS	N.E.	-	-

Note: Based on analysis described in appendix 2.

Australia's institutional investor landscape is dominated by the country's superannuation funds. With $1.1 trillion in assets under management, Australia represents roughly 5% of OECD pension assets. The country also has a small insurance sector, with roughly $300 billion in assets, which lacks the very large life insurance companies that characterize the insurance markets in the U.S., Europe, and Japan.

Australia's superannuation system is driven by the requirement that employers pay a share (currently 9%, rising to 12% by 2020) of their employees' salary into a superannuation fund. Superannuation funds tend to be small relative to other regions' pension funds. Future Fund, the country's largest at $98 billion, is funded through the government budget to support public employee pensions. AustralianSuper manages nearly $50 billion[21] and many of the remaining funds are less than half this size. As a consequence of small fund size, very few superannuation funds have direct investment capacity, choosing instead to invest through external managers.

Superannuation in Australia is largely dominated by defined contribution funds, which present an array of investment options from which to choose. A report on superannuation fund investment in infrastructure by Ernst and Young points out that "under a defined contribution model, most assets are on call and there is a need for a balance between liquidity and long-term investments. A defined benefit model is much more conducive to long-term investments such as infrastructure." However, several superannuation funds we spoke with had 25-40% of their portfolio in illiquid assets. One superannuation fund indicated that most employees stay with the same fund throughout their working life, and 97% of workers leave their assets in the default option. Another fund also indicated that workers exhibited a "high level of disengagement" with their superannuation fund.

Australian superannuation funds have among the highest allocations to infrastructure of any country, with an average allocation of roughly 10% among major funds.[22] But these assets tend to be managed by external investment managers, through infrastructure funds. Direct infrastructure investment is rare, as few funds have the size to justify a direct investing team. In table 5.3, we present assets available for direct investment in renewable energy projects. Importantly, our estimate of pension assets available for direct investment excludes funds smaller than $50 million in assets, a large share of Australia's superannuation industry. However, we note that smaller funds have occasionally been involved in direct investment (often co-investing with fund managers). Moreover, given a strong interest from superannuation funds and the presence of many established infrastructure fund managers, the potential for investment through pooled investment vehicles is particularly pertinent in Australia.

Implications – Australian pension funds

In Australia there is only a limited potential for direct investment in projects. However, the willingness of the superannuation funds to search for alternative investments and accept some illiquidity, and especially the Australian experience of infrastructure funds, could provide an important basis from which to explored the needs and design parameters for pooled investment vehicles.

21 At the end of 2012 (Future Fund Website, AustralianSuper Website). However, in the last year full data was available for analysis, 2010, Future Fund managed only $66 billion in assets, and other funds were much smaller (Towers Watson 2011a).

22 Infrastructure Partnerships Australia.

5.4 Japan

Japan is the second-largest country in term of pension assets, with roughly 9% of OECD pension assets under management. Japan also has a large insurance industry, its $4 trillion in assets account for 18% of the OECD total. Though our research did not cover Japan in great detail, there are a few observations we can offer about the Japanese institutional investor market. Most of the pension assets in Japan are in a handful of public and corporate pension funds, however, a full half of the pension assets are in Japan's government employee pension fund, which invests entirely in liquid stocks and bonds. The insurance market in Japan, like other regions, is dominated by just several firms, and the top five firms account for 78% of assets. The largest insurance company in Japan, Japan Post Insurance, is almost a third of the total.

Table 5.4 – Assets available for direct investment in renewable projects ($bn) - Japan

	TOTAL ASSETS	AVAILABLE FOR PROJECT EQUITY	AVAILABLE FOR PROJECT DEBT
PENSION ASSETS	2,698	5.4	14.3
INSURANCE COMPANIES	4,018	3.6	33.2
SOVEREIGN WEALTH FUNDS	-	-	-
FOUNDATIONS AND ENDOWMENTS	N.E.	-	-

Note: Based on analysis described in appendix 2.

Implications – Japanese pension funds and insurance companies

In our research, we did not examine Japan in great detail, and the opportunity for Japanese institutions to invest in renewable energy remains a topic worth looking at in future work. The presence of several large pension funds and insurance companies may present an opportunity for renewable energy investment. However, the largest funds currently have little exposure to asset classes beyond liquid stocks and bonds, and may be unlikely to be direct investors in renewable energy projects.

6. Constraints and barriers to institutional investment in renewable energy

Our estimates of the potential to invest in renewable energy reflect a series of constraints faced by institutional investors in managing their portfolio. The most important of these include:

1. **Managing liquidity issues:** Limitations on investing in illiquid assets
2. **Institutional investor scale and direct project investment:** The scale required to invest directly in renewable energy projects
3. **Diversification and limiting exposure to an industry or investment theme:** Sector limits required to manage overall portfolio risk

In addition to these constraints, other barriers limit the ability of institutions to achieve even the potential outlined here. These barriers include:

4. **Policy barriers to renewable energy investing:** Both renewable energy policy and regulation of the institutional investors
5. **Investment practices of institutional investors:** Practices that affect how institutions make investment decisions

In this section we will address the structure and causes behind each one of these constraints and barriers in turn. In Section 7, we discuss potential ways forward in addressing these barriers and constraints.

6.1 Managing liquidity issues

> Maintaining liquidity of an investment portfolio — that is, ensuring that across all potential time periods there will be enough cash available to meet the institution's needs — is critical to the success of an investment team. Valuing the cost of illiquidity is difficult and uncertain. Most institutional investors err on the side of caution; many avoid all investments they deem illiquid. The result is that institutional investors often limit or avoid direct investments in projects and smaller companies, even if the risk adjusted returns seem more attractive, reducing the overall potential for institutional investors in the renewable energy space.

At any given time, institutional investors must have access to at least a minimum level of cash in their investment portfolio. Typically, these minimum levels can be defined in terms of how much cash could be made available within a certain time frame; for instance, how much cash could be made available in one day, one month, or one year. These cash needs can be met either through maintaining cash balances in the investment portfolio, or by maintaining investment securities that can be in the required timeframe with a minimum of delay and relatively low transaction costs or loss of value. Generally, this requirement is called liquidity.

Within a portfolio, the most liquid assets are cash, followed by publicly traded stocks and bonds with clear market prices where securities trade hands frequently, often over an exchange. Investors can increase their liquidity by holding smaller proportions of the outstanding share of any given security, as it would be easier to sell a smaller stake in a short period of time without moving the market price (and thus losing value). Less liquid assets include smaller, privately held companies with few shareholders, real estate, and investment funds with long lock-in periods. Direct investment in physical assets, where transactions costs are highest, the effective lock-in periods are the longest (through the physical life of the asset), and where, unlike real estate, the limited number of transactions increases the uncertainty around the ability to sell the asset if it is absolutely necessary, are the least liquid assets.

World Economic Forum (2011) estimates an allocation to illiquid assets among long-term investors. They find that defined benefit pension funds hold roughly 9% of assets in illiquid investments, while life insurers may hold as low as 4%. Sovereign wealth funds, foundations, and endowments may have somewhat higher allocations to illiquid investments, in the 10-20% range.

The illiquidity of direct infrastructure investments is well-documented. Beeferman (2008) and Infrastructure Partnerships Australia qualitatively describe the liquidity of infrastructure, institutional bonds, institutional real estate, and private equity, finding that unlisted infrastructure is the least liquid type of asset among these asset classes. Similarly, in their report on long-term investing, the World Economic Forum (2011) shows infrastructure to be among the least-liquid and longest-term asset classes available, as shown in figure 6.1.

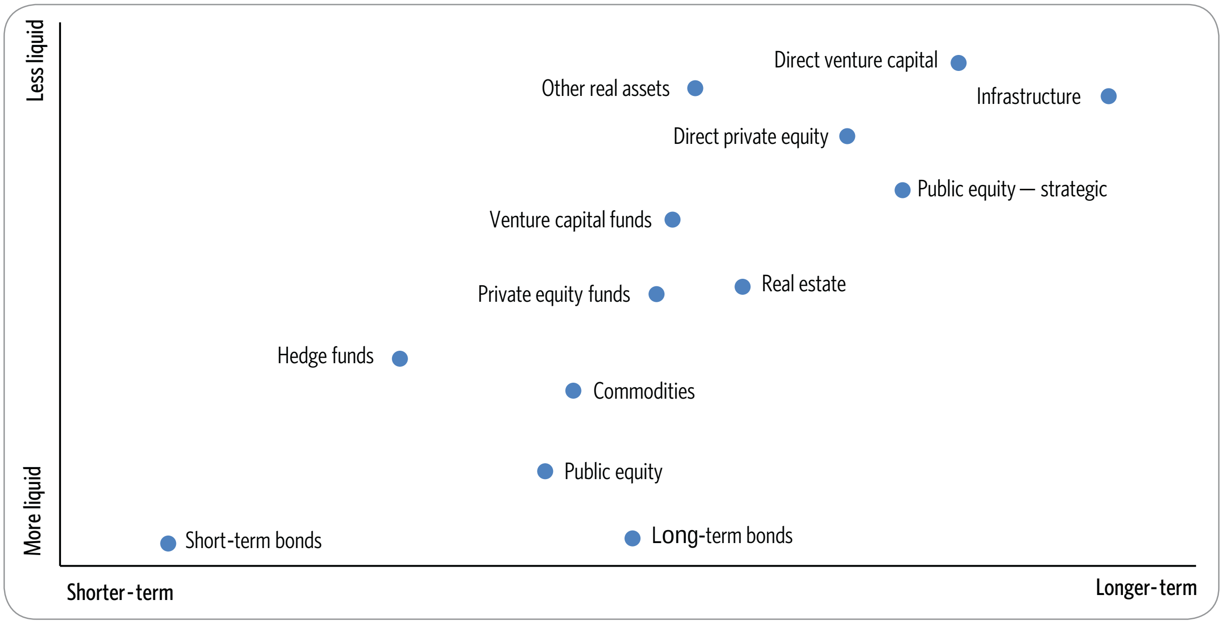
Institutional investors require liquidity for at least five reasons:

1. If members or clients have the option to switch funds, liquidity is required to provide funds to these members without hurting remaining clients
2. If cash demands are unexpectedly high — for example, due to higher than expected death or retirement rates — liquidity is needed to meet these unexpected demands
3. To increase the ability to alter investment strategy as new trends and opportunities arise, which should, theoretically, increase fund performance
4. To meet liquidity requirements set by regulation to protect clients and members
5. To adapt to changes in business circumstances

The most liquid asset, cash, has the lowest expected returns. Illiquid assets usually offer higher returns for commensurate levels of risk (outside of the liquidity risk). Thus, investors will evaluate the need for liquidity to meet the five needs above and determine how much illiquid assets they can invest in without endangering the solvency and return of the portfolio as a whole.

Large portfolios and relatively predictable cash needs can give institutional investors a tremendous potential advantage. If an institutional investor is willing to accept the illiquidity and buy and hold an investment through to its maturity it can capture all of the premium that the market offers for taking on the illiquidity. The incremental return

Figure 6.1 – Asset class liquidity vs. time horizon (adapted from World Economic Forum 2011)



can be high, if the investor is willing to bear the liquidity risk.

The pension funds and insurance companies we interviewed agreed that it is difficult to estimate a liquidity premium, but in general, these investors suggested that they have seen liquidity premiums between 100 and 300 basis points (one to three percentage points) for project finance debt, and potentially greater for riskier equity investments.

The smaller the investor, the greater the potential cost of illiquidity and, probably, the lower incremental return available for taking on more liquidity risk. But larger, more sophisticated investors may have many options to meet liquidity needs over different time horizons; for instance by holding more cash and fewer bonds, or by investing more in large cap stocks than in small cap. In each case, the investor gets an expected premium for accepting lower liquidity.

Many uncertainties cloud an institutional investor's valuation of liquidity:

- The need for liquidity; that is the potential for unexpectedly high cash demands, is likely to be driven by anomalous and unpredictable events; thus the level of protection needed is highly uncertain, and therefore the value of the protection is also uncertain
- The cost of illiquidity varies from asset to asset as the cost of selling an "illiquid asset" depends on many things including the potential buyers, potential brokers, the remaining life of the asset, and the quality of financial information available
- As these transactions are often unique, there is little data to estimate the discount required to sell the asset and the time required to sell it

In a paper on measuring liquidity in financial markets, Sarr and Lybek (2002) point out that there are many dimensions to liquidity, and the importance of these dimension changes over time:

> *"For instance, during periods of stability, the perception of an asset's liquidity may primarily reflect transaction costs. During periods of stress and significantly changing fundamentals, prompt price discovery and adjustment to a new equilibrium becomes much more important."*

Moreover, as the World Economic Forum (2011) describes, even if illiquid assets can earn a premium, there are a range of factors that impact investors' abilities to realize that premium. Everything from fundamental investment beliefs (e.g. whether the premium justifies the costs and risks of illiquid assets), to investment experience, access to the market, and market timing can impact whether an investor can actually capture this illiquidity premium. These issues certainly come into play as investors consider the value of illiquid assets.

Liquidity implications for renewable energy

At the least liquid end, such as direct project investment, the investor may consider whether the additional return available for accepting illiquidity is worth the cost of compensating adjustments elsewhere in the portfolio. For investors with plenty of liquidity, the calculation becomes how to maximize the total premium available from taking on illiquid investments. One way or another, the share that any institutional investor can dedicate to illiquid renewable energy project debt or equity assets will be limited.

Meanwhile, financial regulation is increasing liquidity requirements and increasing the cost associated with investing in illiquid assets. Thus, illiquidity is likely to continue to be a major stumbling block to getting institutional investors to invest in project debt or equity.[23] Furthermore, we have found that liquidity issues are likely to compound the problems associated with the scale required to invest directly in projects (Section 6.2), and the problems of siloing direct investment capabilities (Section 6.6.4), which tend to restrict direct investment in renewable energy project debt from pension funds, may restrict investment in renewable project equity from some insurance companies and, together, reduce the overall potential for institutional investors in the renewable energy space.

23 However, we note the growth of project acquisitions, as documented by BNEF (2012a), and a recent wave of secondary renewable energy project transactions in the U.S. However, without additional analysis, it is unclear whether this trend is simply keeping up with investment growth, or providing additional liquidity to the market.

6.2 Institutional investor scale and direct project investment

> Direct investment into renewable energy projects has higher transaction costs and requires a significantly greater level of effort and specialization on the part of the investor. Building this capability can be costly. While direct investment can offer higher returns, investors need to have a large direct investment portfolio to cover the fixed costs of developing and maintaining a direct investment capability. Thus, only the largest funds can justify direct investment in renewable energy projects.

According to several direct investors in renewable energy, the key ingredient differentiating institutions that can invest directly in renewable energy project debt or equity and those that cannot is the ability to develop and maintain a team with experience in direct investing and current knowledge of the sector. But what drives the decision to develop the specialist team in the first place?

It turns out that much of relates to size. Making direct investments in projects is expensive. Since these deals are bespoke and not traded on public markets, the potential investor has to do much of the investment appraisal, analysis, and due diligence itself. If the team makes a mistake, the fund can be stuck with a poor investment for many years. Beyond developing and maintaining the direct investing team, there are transactions costs, legal fees, consultants, and deal sourcing. While direct investments should have higher risk-adjusted returns than investments in publicly traded shares or bonds, the additional return must be high enough to justify both the higher transactions costs and the possible illiquidity of the investment.

The result is that these investments must be large enough and lucrative enough to justify the costs. Box 4 explains two potential approaches for determining a minimum portfolio size to justify direct investment in renewable energy projects. Both approaches yield a minimum size of $40 to $50 billion under management. Among the funds we spoke with, only a few of this size were directly investing in projects, and many much larger funds also lacked direct investment teams.[24] Furthermore, we heard from some investors around that limit that the cost of developing and hiring a team with the specialist, and expensive skills to do direct investing were not consistent with the makeup and organization of the team. In other words, internal organization considerations may push the minimum limit up even further.

There is one exception to this story: In some deals, smaller funds can invest alongside a larger institution, relying, at least in part, on the larger institution's due diligence and deal structuring capabilities. From the banking side we have heard that up to 10-20% of a deal's book can be filled by these smaller institutions investing alongside a major player. The involvement of at least one large institutional investor with a dedicated direct investment team is probably necessary to structure a deal that could be acceptable to institutional investors in general. However, we have also heard from smaller institutions that getting involved as a minority player in these deals is difficult and risky and that the best parts of the deal are often taken by the larger players. That is, the smaller players often feel squeezed out of the deal as it progresses.

Investor scale implications for direct investing in renewable energy

The result is that there are probably about 45 pension funds and 70-100 insurance companies worldwide that are large enough for direct investing. Nevertheless, these 120-150 investors represent about $25 trillion in assets under management or 56% of the total institutional investment assets under management. With smaller players investing alongside, this number could rise to 67% of the total.

24 As mentioned in section 5.3, several Australian superannuation funds under this size threshold have been involved in direct investment, often co-investing with fund managers.

Box 4 – Minimum size for direct investment

There are two potential approaches to determine the minimum size of an institutional investor to participate in direct project investing.

The first relies on the fact that project finance deals themselves have a minimum size to be considered economic, and when combined with the need for a diversified portfolio, investors will need to have a certain number of assets under management for a dedicated investment team to make sense. The institutions we interviewed suggested a minimum project finance deal size of at least $100 million. Requiring diversification, an investor would need to manage five to 10 separate project investments, resulting in a project portfolio of $500 million to $1 billion. But direct investments in projects are unlikely to make up more than 1% of an investor's total portfolio, given liquidity constraints and the need to diversify among classes of illiquid investments. Thus, a portfolio of $50 billion, if not $100 billion is likely to be required for direct investing.

The second approach involves the cost of hiring a team to manage a portfolio of direct investments. Macintosh and Scheibelhut (2012) indicate that for every $401 million in internally-managed infrastructure and natural resources assets, pension funds on average have one full-time-equivalent internal manager. The same study suggests that the cost of internal active management of real estate and private equity, which also require specialized skills and unique transactions, are 21 and 25 basis points respectively. Together these numbers imply that starting up an investment team of one person could cost $1 million, and if this team's $400 million in assets were 1% of the investor's total portfolio, that investor would need at least $40 billion in assets for direct investing. However, with large minimum deal sizes and the need for a diversified portfolio of assets, the minimum size is likely to be even larger, as described above.

6.3 Diversification and limiting exposure to an industry or investment theme

Investors diversify their investment portfolios in order to minimize the risk and exposure to any single risk. As a result, investors tend to keep their portfolios close to benchmarks, unless they have a high conviction that a particular sector will outperform. Outperformance could be achieved by offering high expected performance, but this would entail offering above market returns and high incentives. Thus, investors are likely to stay near renewable energy sector weights unless incentives, and therefore the cost, of renewable energy increases compared to other sectors.

At the board level, institutional investors manage risk by setting the balance between asset classes (i.e. shares versus bonds). At the portfolio management level, managers address other types of systematic risks. One such risk is an over exposure to any single sector, theme, or trend. To the extent that they hire outside managers to manage a share of money, these managers often have maximum sector overweights, or other limits, within their remits. To the extent that share, bond, or direct investments are managed internally, the manager is likely to have either explicit or implicit sector limits.

Whether these limits are explicit or implicit, more conservative investors will often manage their portfolios to weight any given sector near that sector's share of a standard benchmark unless they have a high degree of conviction as to the likely outperformance (or underperformance) for a sector in the medium term. Managing sector exposure is somewhat more difficult outside of the publicly traded share and bond markets, as there may not be an established benchmark, but portfolio managers will attempt to diversify the portfolio to avoid over exposure to any sectoral risks. Often these risks are only managed within each group; that is, within the equity remit or debt remit, but there also is the potential to weigh sector weights to balance overweights in one mandate versus another.

Diversification implications for renewable energy

Investment in corporate equities or debt is likely, on average, to follow the benchmark for whatever sector renewable energy is grouped with, unless the renewable energy investment proposition is made extremely attractive relative to other sectors.

Power generation projects, including renewable energy, represent a much larger share of project finance type investments than of financial markets in general. Therefore, we would expect these investments to comprise a reasonable share of direct investment portfolios. However, an investor using more general benchmarks could feel uncomfortable with the "overweight" in renewable energy and either limit investment in the sector or reduce renewable or power/utility type investments elsewhere in the portfolio.

6.4 Policy barriers to renewable energy investing

The investment case for renewable energy almost always has a significant policy element, while the institutions are themselves subject to their own set of regulations. We have identified three types of policy barriers affecting institutional investment in renewable energy.

1. Policies designed to encourage renewable energy, but implemented using mechanisms or incentives that either discourage institutional investors or favor other types of investors;
2. Policies addressing unrelated policy objectives — for instance, the security of financial markets — that are structured in ways that have severe unintended consequences on the ability of institutional investors to invest in renewable energy;
3. Energy policy and renewable energy specific policy that is lukewarm, inconsistent, or in other ways reflects an ambivalence of policymakers towards support for renewable energy investment and development.

In the renewable energy world, policy is a fact of life. Until renewable energy options become among the lowest-cost form of providing energy, continued development and deployment of renewable energy will require policy-based incentives. Nearly every investor in this space identifies policy risk as the single biggest concern to investing in renewable energy.

Nevertheless, driving down the costs of renewable energy by encouraging institutional investment is hardly a singular focus of policy. Renewable energy deployment and the cost effectiveness of this deployment exist amongst a myriad of other policy objectives, from making sure that the lights stay on to ensuring that pensions and insurance policies are affordable and do not fail. Other policy priorities often take precedence over institutional investment in renewable energy; at times barriers to renewable energy investment are just an unintended casualty of unrelated policy objectives. For example, regulation to ensure electricity reliability can increase the cost of renewable energy by forcing producers to pay for backup systems, while the same rules that prevent pension managers from betting all of a fund on pork belly futures also prevent them from putting too much of a fund in renewable energy.

From the perspective of policy attractiveness, it is useful to start with the characteristics that distinguish institutional investor goals and constraints in investing in renewable energy projects:

1. They would like a premium return to compensate them for the transaction costs in making the investment and any risks they take on due to illiquidity of the investment or, possibly, reduced diversification of their portfolio.
2. They seek investments that offer some protection from general market volatility; in finance parlance, investments with low, zero or negative beta.[25] In other words, steady, predictable returns whether the general market is up or down.
3. They want enough control of the asset to avoid a minority squeeze; that is, they want to prevent other shareholders from changing the profile of an investment to their detriment. For example, by reinvesting cash that a project generates rather than paying dividends and thus increasing uncertainty and risk.
4. The institutions must be able to invest on a competitive basis with other potential investors. For example, managing the risk of an investment cannot be dependent upon a deep knowledge of daily events, or a risk trading portfolio, that might be available only to an industry insider such as the incumbent utilities.
5. Many institutions, particularly pension funds, are tax exempt or have other tax related idiosyncrasies that could affect an investment case.

With this as background, policy barriers facing institutions fall generally into three categories:

1. Policies designed to encourage renewable energy, but are implemented using mechanisms or incentives that

25 Many investors seek to improve the efficiency of their portfolio by lowering their exposure to systemic market risks, while maintaining their overall level of return. Beta is one measurement often used to assess the level of market risk in an asset.

either discourage institutional investors or favor other types of investors;

2. Policies addressing unrelated policy objectives — for instance, the security of financial markets — that are structured in ways that have severe unintended consequences on the ability of institutional investors to invest in renewable energy;
3. Energy policy and renewable specific policy that is lukewarm, inconsistent, or in other ways reflects an ambivalence of policymakers towards support for renewable energy investment and development.

6.4.1 Renewable energy policies that discourage institutional investors

So what renewable policy could discourage institutional investors? The most obvious starting point involves tax policy. As tax-exempt investors, the use of tax credits as an incentive policy, such as U.S. federal wind and solar tax incentives, can discourage pension funds. In the best case, renewable energy projects will need to find a partner to monetize the tax credits at a transaction cost (and transfer of value to the tax investor) that could represent as much as 30% of the total value of the incentive.[26] In other cases, tax investors could take the place of the mezzanine or debt finance and reduce the investing opportunities that could attract institutions. In the worst case, institutions could be excluded from investing.

As one investment banker put it: *"Tax equity is definitely a big problem for getting institutions involved"*

A second issue comes when policy support offers attractive economics, but creates more market risk than the investors seek. One example is short duration of support which induces market volatility and re-investment risk when the investors get back the investment. For instance, previous CPI analysis suggested that reducing the length of policy support by 10 years raised the cost of projects by 11-15%.[27]

A third set of issues surface when incentive mechanisms are either complex or create risks that are more easily borne by other types of investors such as banks or utilities. A classic example is a switch in incentives from a feed-in tariff (FiT) that offers a fixed price for output from a project, to a feed-in premium (FiP) that offers a premium to the wholesale electricity market price. While the expected value of the FiT and FiP plus market price could be the same, revenues from a FiP will have more volatility. Utilities with large customer bases, energy trading businesses, and energy supply contracts will be in a better position to mitigate this risk than the institutional investor. Similarly, any incentive — such as renewable energy credit markets — that creates some volatility or market risk will, at the very least, require the typical institutional investor to enter into a contract to eliminate this risk, possibly giving away some incentive value in the process.

The role government plays in providing these forms of support is also a hotly debated one. We heard from institutional investors that they would like governments to provide institutionally tailored support, but they become quite anxious when these forms of support come with increased government involvement in the governance, operations, and management of particular investments or investment practices.

6.4.2 Policies unrelated to renewable energy that discourage institutional investing in renewables

Pension funds and insurance companies are often highly regulated. Their capital represents a large portion of society's safety net, and a broad range of government regulations impact them in both direct and tangential ways.

At the same time, access to secure and reliable energy and electricity is needed to ensure the proper functioning of a modern developed economy. So electricity markets are highly regulated as well.

Concerned with maintaining the sanctity of the security net and the reliability of the energy supply system, policymakers can be forgiven for overlooking the impact of their regulation on the ability of these investors to invest in energy supply. Nevertheless, by doing so, they could be making both tasks more difficult and expensive to achieve. Examples of both energy market and financial regulation impact are plentiful. A few of the more topical ones include:

Energy Market – European electricity and gas market unbundling

The European Union's third energy package prohibits

26 See CPI (2012d), "Supporting Renewables While Saving Government Money."
27 See CPI (2011), "The Impacts of Policy on the Financing of Renewable Projects: A Case Study Analysis."

owners of a controlling interest of gas or electricity transmission assets from having a controlling interest in electricity generation or natural gas production. The policy is intended to prevent owners of transmission networks from operating and expanding their networks in a way that favors their own generation or production and thus distorts the EU energy market. However, as one pension fund stated:

> *"Electricity and gas unbundling regulation is the single biggest impediment to us investing more in energy infrastructure."*

While the policy has been developed to avoid the very real possibility of market distortions, institutional investment in renewable energy projects may be collateral damage. Many institutional investors in projects require a degree of control of the assets, so this regulation essentially forces them to choose between owning transmission or generation including renewables. Many already own some small transmission or pipeline assets and thus are excluded from investing in renewable energy projects anywhere in Europe. Further, as several investors said:

> *"..We prefer transmission assets because the investment case is more straightforward, without the resource (wind or solar), technology, or even commodity price risk that might be associated with renewable energy."*

and

> *"…we regard transmission assets as core infrastructure assets… renewable energy is non-core, it would be nice to have, but it will never be the dominant part of our infrastructure portfolio and we will pursue it more once we have our core assets in place…"*

Our research suggests that while owning both transmission and generation assets does not always present a conflict of interest, investors are wary of the legal risks, and will generally avoid areas with this level of uncertainty. Details continue to be worked out, and the long-term impact is unclear, but the uncertainty generated highlights the need to consider investors when developing energy policy.

Financial regulation – Solvency II

New capital adequacy rules, similar to Basel III directed at banks, are intended to insure that European insurance companies have adequate financial reserves to account for the riskiness of their investment portfolios. The objective is to ensure the financial security of these companies. The rule sets reserve requirements for different asset classes, which as structured could make project investment in renewable energy — particularly project debt — considerably more expensive by requiring companies to hold more reserves against these projects. Interestingly, uncertainty around the eventual application of these rules seems to hamper pension funds more than insurance companies, even though insurance companies are the main target of the rules.

As Bloomberg New Energy Finance (2013) describes:

> *"Solvency II regulations governing the need for insurance companies to hold capital in supposedly liquid and/or low-risk instruments like public equities and government bonds will reduce their appetite for long-term investments for which there is no public market, even though such investments have well-understood yield characteristics and a well-developed private market."*

One insurance company said:

> *"We are not worried about the impact of Solvency II on our renewable investments because we have sophisticated modeling that we can use to show how its lower risk reduces the riskiness of the portfolio, and we will be able to use that to make our case."*

Meanwhile several European Pension funds highlighted their own concerns about potential regulations that may apply to them:

> *"Solvency II does not necessarily affect us, but the uncertainty about whether it will or whether future related regulation may be applied to us, makes us very concerned about the cost of having private placement debt in our portfolio."*

Financial regulation – Accounting rules

A recent trend in accounting has been the introduction of mark-to-market accounting for investments to increase transparency. In broad strokes, mark-to-market accounting has driven pension funds in some countries towards higher allocations to fixed income securities, and encouraged greater used of liability-driven investing to immunize plan sponsors from large swings in funding status.[28] However, mark-to-market accounting can be difficult to apply to illiquid investments with long holding periods. Countries vary in the time frame that changes in market

28 See Stone and Sweeting (2005).

value need to be accounted for, but in some cases, there can be large differences in the short-term market value of an illiquid long-term asset and the expected value of the asset over its full life. These issues can be mitigated by allowing long-term investments to be valued in ways that reflect their true long-term economic value.[29]

Environmental protection – planning rules

Ironically, given that an important goal for renewable energy is protection of the global environment, protection of the local environment through difficult, expensive, and sometimes arbitrary planning processes can be an impediment to institutional investment. Delays by the process can be costly and uncertainty around the result — particularly if there is a risk of overturning a decision — can also be expensive.

Economic stimulus – bonus depreciation

Bonus depreciation, where companies could offset large shares of investment against taxes when the investment was made rather than depreciating them across the life of the asset, has been used as a way to stimulate investment during financial crises and thus accelerate recovery. However, in the case of renewable energy that has been incentivized through tax credits, the result has been to reduce the taxes owed by many companies, and thus reduce the appetite for the tax credits generated from renewable energy projects. This decline in tax appetite may have increased the transaction costs associated with monetizing tax credits and made the incentives less attractive.

In Appendix 3 we provide more detail of specific instances where energy and financial regulation interfere with institutional investment in renewable projects. If investment by institutions in renewable energy is a true priority, policymakers must integrate this policy goal across a broad range of regulations. As we have seen throughout this paper, there are enough impediments to renewable energy gaining traction without unintended policy implications adding to the barriers.

6.4.3 Inconsistent or lukewarm policy

The best-designed, most well-intentioned support by governments has little impact if that support is perceived to be short-term and/or ambiguous. To encourage long-term investors to make long-duration investments requires unambiguous support by governments. As investors around the world highlighted to us, the risk of funding disappearing or policies being reversed has a chilling impact on the market.

Investor after investor stated that policy uncertainty is the biggest impediment to investing in renewable energy, whether directly or through corporations. Typical quotes include:

> *"Our board feels that they need a greater level of policy certainty".*

Or

> *"Policy certainty is our biggest concern."*

We do not intend to over-dramatize this observation, but it is important to note that past reversals by governments have taken a toll on institutional investors. Most institutional investors have limited personnel, few asset classes, small allocations to illiquidity, and limited upside for pursuing new forms of investment. Many institutional investors see the time and energy to consider new government programs when funding may be cut off or policies may be reversed as an illogical allocation of sparse resources.

Inconsistent or lukewarm policy is a concept that needs further analysis and CPI is looking into this topic for developing world countries in other work.

29 See Crowell Moring (2008).

6.5 Investment practices of institutional investors

External factors, such as policy constraints and external barriers, are not the only factors limiting institutional investors. Internal factors, such as the way that institutional investors respond to these barriers, and the way that they organize themselves to manage the portfolio have further impact. In this section we examine these internal issues:

Investor response to external barriers and constraints

- 6.5.1 Investor response to liquidity
- 6.5.2 Decisions to build direct investment teams
- 6.5.3 Sector diversification
- 6.5.4 Evaluation of policy risk

Management practices that may further limit investment

- 6.5.5 Setting overall portfolio investment objectives
- 6.5.6 Subdividing the portfolio into distinct, more manageable mandates
- 6.5.7 Managing the distinct mandates or investment "silos"

6.5.1 Investor response to illiquidity

Many investors deem the risk of illiquidity in itself to be too high and refuse to invest any of their portfolios in illiquid assets. Clearly, such investors would not be able to invest directly in any project type investments.

In general, we found that institutional investors have a difficult time analyzing and managing illiquidity in their portfolios. Given the problems with performing sophisticated liquidity calculations and the lack of trust that such calculations would have in the current market even if they were made, we found that even those funds that have decided to seek the additional premium are doing so cautiously.

6.5.2 Decisions to build direct investment teams

While there may be higher returns available for direct investment into projects, this type of investment requires a set of skills and business processes that many pension funds do not possess. Many pension funds manage most of their money through external managers. Thus, they have become adept at evaluating the relative quality of different investment managers, but will feel less in their comfort zone when evaluating particular project investments. In all likelihood they would need to hire different personnel, acquire transaction expertise, and change the organizational structure of their fund to support direct investment in projects. Doing all this can be quite daunting, and may be beyond the reach of many funds and their boards who may not see or believe the incremental value that may be created. The decision to build such a team, therefore, is very difficult and cannot be taken lightly.

Insurance companies, on the other hand, are generally larger and have a history of making direct private placement loans and other investments. Therefore, this step is much less daunting, which is reflected in their greater presence in this space.

6.5.3 Sector diversification

Institutional investors and their external managers seldom break down sector limits to levels that would include renewable energy as a distinct category. Instead, they group these investments to reflect benchmarks or include industry classifications such as energy or utilities. The amount that can be invested in renewable energy can depend upon the sector grouping. For example, we have found instances of investors unwilling to invest more in renewable energy because they already had a portfolio replete with conventional power generation investments. Thus, grouping renewable energy with power generation, utilities, or energy could limit investment. Furthermore, a decision to overweight renewable energy, because it could appear attractive, could be complicated by the sector grouping and portfolio tracking methodology employed.

6.5.4 Evaluation of policy risk

Policy risks are continually changing. The problems of inconsistent or lukewarm renewable energy policies are discussed in section 6.4.3. However, investor practices and perceptions of policy uncertainty may compound the impact of these issues on investment. Evaluation of these risks is difficult, particularly for investors for whom renewable energy, and the related policy, may be only a small share of the overall portfolio. The result is that investors do not have enough time to get comfortable with political and policy risk and may, therefore, not even consider investing in the sector.

The largest investors, however, may have teams and investors dedicated to specific sectors for whom understanding policy changes is one of their main tasks. These investors, therefore, are often more comfortable with risks. One result is that medium-sized funds, who might otherwise invest directly, may find it even more difficult to compete with their larger, better resourced, counterparts.

6.5.5 Setting overall portfolio investment objectives

Typical pension fund: *"Our major objective is to deliver an affordable pension."*

The central problem for institutional investors is maximizing expected returns from their investment portfolio, while minimizing the risk that the cash available from the portfolio is insufficient to meet liabilities at any given time; in other words, lowering the cost of providing a pension or insurance for a given level of risk.

At the broadest level, this problem is often called asset/liability matching or ALM (See Appendix 5). ALM can be a complicated and analytically challenging task, employing sophisticated mathematical models, but even so, ALM is more of an art than a science. Crucially, the design of ALM modeling, and the input assumptions made, can dramatically alter the investment portfolio suggested by the ALM model. The number of asset classes and their definition in the model, the return and risk characteristics ascribed to each of these asset classes and the estimated covariance between these asset classes, can have a profound impact on the ability of an institutional investor to invest in renewable energy and, possibly, take advantage of the specific investment characteristics that could provide more value to that investor. The output of the ALM exercise will usually suggest how much a fund will invest in corporate equities versus bonds, private equity, real estate, and so forth.

ALM modeling is a data driven tool to help investors understand an effective way of meeting investment objectives within their set of constraints. But every fund may have a different view of both its objectives and its constraints, even if the potential liabilities were identical. Therefore, the output of the ALM exercise can be very different for seemingly similar institutions depending on:

- The level of risk that is acceptable
- Limits to the acceptable cost of pensions or insurance
- Who takes the risk of fund shortfall (members, shareholders, government, clients)
- Time horizon for analysis and liability matching
- Reporting requirements and regulation

From this perspective we highlight a few issues that create general differences between insurance companies and pension funds in table 6.1.

A few quotes from the pension funds and insurance companies we interviewed highlight the diversity of institutional investor attitudes and outcomes from this modeling exercise.

> *"Given our liabilities and the risk/return characteristics, our models would ask for 100% of our portfolio to be invested in infrastructure if the investment opportunities were there. We would not be comfortable with this concentration, so we must constrain our model to more realistic levels."*
>
> *"We have to force fixed income into our ALM output, because our modeling would ask for 100% equity if left unconstrained."*
>
> *"We have significant reserves in our fund, so we can afford to invest more in return seeking equities or private equity"*
>
> *"We want to minimize expected pension cost, so we invest more in high-return investments."*
>
> *"We have an older membership, so we need to be more conservative and invest in more fixed income."*
>
> *"On average our members are young, so we have plenty of time to ride out market cycles; therefore we feel more comfortable with more return seeking investments."*

Table 6.1– Key differences between pension fund and insurance company investment restrictions

	INSURANCE COMPANIES	PENSION FUNDS
DURATION	Life insurers have long duration liabilities leading to long investment horizons property and casualty policies are renewed annually	Funds with older members have less time to bear investment performance downturns, so focus on conservative strategies (e.g., fixed income)
FUNDING / RESERVE LEVELS	Companies with larger reserves can take more risk or expand business offerings Uncertainty can be met through reinsurance or investment policy	Well-funded funds can take more risk utilizing reserves Under-funded funds take on risk to make up for gaps, if regulation permits
REGULATION	Heavy regulation requires insurers to maintain adequate coverage of mismatches between investments and liabilities (often limiting illiquidity)	Corporate pension funds are often more regulated than government pension funds and may be subject to greater reporting requirements Some, particularly corporate pension funds, are required to mark shortfalls to market. Increased performance volatility may make fund managers more conservative (or shift to defined contribution)
RESULT	Life insurers tend to be conservative investors (heavily liability driven) with sophisticated ALM processes	Pension funds tend to seek higher risk/return but face a wider range of objectives and perspectives. Regulatory changes push many towards Liability Driven Investing or defined contribution and pension outsourcing

Implications of objective setting on renewable energy

For potential renewable energy investment, the implications are significant. While ALM will say nothing specifically about renewable energy, it will impact the relative attractiveness of different asset classes within renewable energy and it may impact the team that the fund hires and whether or not it chooses to develop certain capabilities that would be required to invest in specific types of renewable energy investment. Thus, due to the more limited set of asset classes generally found in large pensions funds:

- Since ALM modeling will always include public equities, investments in renewable energy corporate equity will be easy to make, as long as the corporation in question is large enough to be listed on an exchange, and, hopefully, be included in a stock market index. As we discuss in section 3, institutional investment in corporations is unlikely to impact the cost of capital for renewable energy, or offer distinct risk-reduction advantages for the institutional investor.
- Corporate debt is also relatively easy, but perhaps slightly more difficult than equity. First, some funds concentrate their fixed income portfolio on sovereign debt, though low yields are driving more into corporate debt. Second, having a rating and being part of an index is more important for debt than for equity. Thus, smaller companies will find raising debt from institutional investors more challenging, as they are not always included in indices and may be discouraged by high costs of obtaining ratings. Note that many of the renewable energy pure play companies in Europe have been owned by utilities and have chosen to raise debt at the utility parent level rather than the renewable energy pure play.
- Project investments in either debt or equity are more difficult, as the ALM modeling may not specify by asset class. For instance, all direct investments in renewable energy, whether debt, equity, or a mix of the two, may all be lumped in a single category of private equity or infrastructure.

Smaller pension funds typically use consultants for the asset allocation modeling. The consultants may offer more investment categories, but these categories generally refer to specific mandates to be given to external managers, rather than larger categories that can then be allocated to different managers (including internal managers). Thus smaller funds generally can only invest in listed equity or bonds. As several pension funds suggested:

> *"Investment consultants only understand listed companies."*

and

> *"Direct investment has a problem with benchmarks."*

The largest insurance companies, meanwhile, appear to have the most granular decision making at the ALM level, possibly due to regulation and the very large scale of their investment operations. The result is that from a strategic and ALM perspective they appear to be much more able to invest in renewable energy projects, and particularly the debt, while investing less in corporate equities. They also are major players in the corporate debt arena.

6.5.6 Subdividing the portfolio into distinct, more manageable mandates

There are many different investment options and asset classes that can, in some way, fund capital investment in renewable energy. However, as we have argued, in the current regulatory and financial structure, the potential impact of institutional investors could be greatest in making project level investments. At the ALM level the analysis and modeling does not delve much into decisions such as whether to invest in renewable energy, information technology, or consumer goods, rather it focuses on asset class issues and the general split between equity, debt, and maybe real estate, private equity, or infrastructure.

Institutional investors limit the number of asset classes — pension funds typically have three to six classes at this level, insurance companies may have more — because the data required grows exponentially as more asset classes are added, even while, some feel, the robustness and insight may diminish.

Typical quotes:

> *"We struggle with more (than 4) asset classes"*

and

> *"We had mezzanine as a class, but then we wanted real estate as a class and the board asked us, what about mezzanine in real estate? In the end, more asset classes got too confusing so we had to trim."*

For asset classes such as unlisted, private placement debt, or where there is no readily available index or historical pricing information, calculating the expected performance relative to the general market is difficult, if not impossible.[30] At least one insurance company we interviewed resolved this issue by including private placement debt in the model with a beta of zero, that is, with the assumption that there is no correlation between project debt (when held to maturity) and the equity markets in general.

The insurance company example notwithstanding, the more typical response is to limit the number of asset classes as much as possible. We heard, for example, about a lack of confidence in the robustness of data that models mezzanine financing, particularly because there are so many potential variations and questions about how to deal with debt or equity that might be within a real estate or infrastructure class. Mainly we heard about the diminished transparency and insight that was caused by creating too many asset classes and thus obscuring the higher level conclusions.

Implications of investment mandates for renewable energy

The debate between more or fewer investment classes is basically about whether more complex and detailed analysis can actually yield better returns and lower risk, while still providing the transparency that allows effective oversight. This debate is further clouded by perceived weakness or unreliability of the data. Since the incremental value of renewable energy project investments to institutional investors lies in the details of sector risks and cash flows, this value can only be garnered with ALM modeling that identifies and credits the investment for these unique characteristics. In other words, more granular ALM modeling is difficult and often met with skepticism by boards and trustees. These challenges may make it impossible for many institutions to evaluate the full additional value of renewable energy project investing.

30 While the data is scarce, there are efforts ongoing to improve the quality of data, particularly by the ratings agencies. Moody's (2012) evaluates the default and recovery rates for project finance bank loans from 1983 to 2010, and S&P (2009 and 2010) has conducted similar studies of the projects they have rated.

6.5.7 Managing of the distinct mandates or investment "silos"

While only the largest institutional investors can justify building direct investment teams, the good news is that many are busily doing so. Insurance companies have long been building deep and sophisticated direct investment teams and many have impressive portfolios of both equity and debt investments in projects including in renewable energy. The larger pension funds are somewhat later in the game, but a few are now beginning to build teams and investing directly into projects and infrastructure.

Yet direct investing does not necessarily translate into direct investing in renewable energy, nor does it necessarily translate into investing as needed across the debt/equity spectrum. Unsurprisingly, the investment criteria and skill set required to invest in the equity of a project is somewhat different than those required to lend to the same project. The same goes for investing in renewable energy versus, say, telecommunications. Unless motivated by specific strategic decisions at the plan sponsor level,[31] only the largest of the large funds can justify having a specific team dedicated to power generation debt, or clean technology equity. More typically, one team may handle all private equity type direct investments or all of infrastructure. While there are usually specializations within the team, the overall investment objectives of the team may not reflect the special characteristics of specific types of renewable energy investments. Generally, we observed two effects:

1. **For pension funds project equity is often favored to the exclusion of project debt.** With all direct investing taking place in one team, we found a number of cases where the organization of the investment team favored project equity almost to the exclusion of project debt. In these cases, the direct investment team was given a target return rate that was typically higher than could be expected from debt investments. At the same time, the team was given risk tolerances or expectations that were high enough to fit good equity projects. A typical quote:

   "We invest only in equity because we need to meet a certain threshold"

   The result is that, within this mandate, there would be no benefit of investing in lower risk, lower return debt. Such an investment would lower average returns from the portfolio, but because the direct investment team had enough risk capacity, it would not increase the risk they could take elsewhere, or otherwise allow the team to capture any of the benefits of lowering the overall risk of the portfolio. Further, without a connection between these characteristics of these assets and the ALM modeling, it is unclear whether the fund would be able to use the risk capacity to seek higher returns anywhere else in the portfolio.

   In one case we note that a pension fund involved in direct investing was able to make the tradeoff between debt and equity by investing in unlevered assets; that is, projects without debt, which is effectively investing in both the debt and equity of a single project.

   Yet in other cases, we observed funds leveraging up direct equity investments with debt in order to meet internal team return hurdles, but not offering the project's debt which may provide better risk adjusted returns than the corporate debt in other parts of the portfolio, to the same funds' debt teams. Debt managers at these funds were unable to assess the investment opportunity, because they did not have the appropriate mandate, direct investing skills, or specific knowledge of renewable energy.

   The reason for this: *"Our fixed income guys are too narrow and do not have enough time to look at something different. They invest only in publicly traded bonds and usually need these bonds to be in the benchmark."*

   These examples demonstrate in a tangible way how the criteria set in the individual team mandates affects the relative attractiveness of different types of investments.

2. **Renewable energy may be at a disadvantage relative to other private equity or infrastructure assets.** A private equity portfolio is likely to have aggressive return targets, while depending on the regulation, renewable energy is likely to offer a more stable and less risky investment return. As we heard from teams where renewable energy was handled within the private equity team, a team with private equity type

31 One notable fund to make a significant strategic move towards renewable energy is PensionDanmark, who has quickly become one of the leading funds for renewable energy investment. See CPI's forthcoming San Giorgio Group case study on the Jädraås onshore wind farm, 2013.

targets may find it difficult to dedicate a significant portion of the portfolio to renewable energy and may not value renewable energy for its stable cash flow profile.

Another common option is to place direct investment in renewable energy within the infrastructure team. Here the objective is to have extremely steady, and potentially indexed linked, returns. While renewable energy definitely fits within this portfolio, we heard from more than one institution that renewable energy, because it may have policy, energy price, performance, or resource risk, would be a secondary objective for infrastructure investing compared to more pure infrastructure projects such as regulated transmission lines, water companies, or even airports.

The result is that for the current potential investment categories, renewable energy may not be a perfect fit and thus take only a secondary share of the investment.

It is important to note that for the largest insurance companies, these effects were not apparent. With more assets under management, a greater focus on fixed income investments, and a business requirement to invest in fixed income with above benchmark returns, insurance companies tend to have more teams dedicated to specific industry groups and asset classes. Thus, insurance companies often have specific teams with resources and experience to invest in power generation or energy markets, usually with a strong bias towards project finance debt. Further, given the strong growth in renewable energy project investment compared to conventional fossil fuel investment, we found that these teams have had very large proportions of their recent investments specifically in renewable energy project debt. For instance, nearly one half of the power project finance portfolio of one large insurance company is invested in non-hydro renewables, and another fifth in hydroelectric projects.

7. Five steps could help reach institutional investment potential

Based on our analysis, we identify five steps that could help to overcome these barriers and enable institutional investors to meet their potential to invest in renewable energy projects.

1. Fix policy barriers that discourage institutional investors or investment funds.
2. Improve institutional investor practices.

It is unclear whether these first two steps would encourage enough institutional investment to lower renewable energy costs significantly. Thus, several additional actions could be taken to encourage renewable energy investment from institutions:

3. Identify possible impact of the regulation of institutional investors on direct investment in renewable energy.
4. Develop better pooled investment vehicles.
5. Encourage utilities and other corporate investors.

With policy and investment practices properly aligned, pension funds and insurance companies could supply about a quarter of the equity and half the debt for renewable energy projects and all of the corporate equity and debt that would feed into renewable energy. But simply meeting this potential will involve overcoming specific barriers in policy and investor practices, and may require investigating regulatory constraints, developing better pooled investment vehicles, or encouraging corporate investment in renewable energy.

In this section we address each of these issues in turn in order to set a path for exploring the potential ways forward.

7.1 Fix policy barriers that discourage institutional investors or investment funds

Policy barriers are not necessarily mistakes or bad policy; often they merely reflect a set of priorities distinct from encouraging renewable energy investment from institutional investors. However, while institutional investment in renewable energy may not be the primary goal of any energy policy, this investment could be an important contributor to meeting these goals. For that reason, policymakers should consider the impact on institutional investors when developing and structuring their policies.

In particular, there are three issues that they should address:

- The tradeoffs between other policy objectives and the benefits of institutional investment
- The potential value of carve outs or exemptions for institutional investors
- The design of specific policy elements to encourage institutional investors

Where the involvement of institutional investors is important, policy makers need to evaluate a series of questions, as in tables 7.1 and 7.2.

An alternative to restructuring entire policies would be to create exemptions that might facilitate institutional investment while still addressing the overall policy objectives. EU unbundling regulation, where institutional investment is a potential casualty of regulation designed to ensure the competitiveness of European energy markets, shows an example of how exemptions or a minor exemption could facilitate EU objectives, while enabling institutional investment.

We plan to conduct more quantitative analysis on the impact of policy barriers to institutional investors and the impact of these barriers on policy maker objectives. A cornerstone of future CPI work in the institutional investor

Table 7.1 – Evaluating tradeoffs between other policy objectives and institutional investor participation

QUESTION	EXAMPLE POLICY – U.S. TAX INCENTIVES
Does the policy discourage institutional investor involvement? If so, how and how much?	Pension funds cannot make use of tax credits, and bank-provided tax equity may crowd out insurance companies that could provide project finance debt.
What impact does a reduced role for institutional investors have? Does it lead to a shortage of investment? Higher investment costs?	Crowding out low-cost institutional debt could raise the cost of capital for projects. The extent of the increased cost will depend upon the availability of alternative investors in projects and their return requirements. For example, the recent financial crisis reduced the number of investors with tax liabilities seeking to take advantage of tax credits and therefore could have increased the importance of institutional investors.
Are there alternatives to achieving the desired policy objective? What do these cost? Or what other consequences are there?	Providing cash incentives rather than tax credit based incentives could eliminate the relative disadvantage of tax exempt investors in this space. According to CPI's 2012 paper, "Supporting Renewables While Saving Taxpayer Money," the cash based incentives could maintain the overall profitability of renewable energy projects, but at a 40% lower cost to government.
How do the costs of alternative policy compare to the benefits of institutional investor involvement?	In this case, increased access to renewable energy investments could come at a lower cost to the government. Furthermore, we would expect the expanded investor base to lower financing costs even further. On the negative side would be the political cost of moving from a tax based incentive and, potentially, some minor transition costs.

space will be a focus on this type of cost benefit analysis of specific polices.

So far we have discussed barriers that arise from policy. However, there is also the opportunity to take proactive policy options that could encourage institutions to invest. Many of these can correct some of the biases above, others can specifically target the needs of institutions.

Inflation indexation

The liabilities of many pension funds and insurance companies are inflation linked. Thus inflation is a significant risk to their asset liability match. Several of the institutions we spoke with discussed the advantages of inflation linked infrastructure investments in de-risking their portfolio. Thus, one option is to offer power purchase contracts of feed in tariffs that are indexed to inflation.[32] For this security, investors with inflation linked liabilities seem to be willing to accept lower expected returns.

However, there are a number of potential problems that need to be addressed. First, it is unclear whether there are enough inflation sensitive investors to make this market viable. It could be, as noted in some geographies, that a scarcity of inflation linked assets discourages investors from seeking them, creating a self-fulfilling circle. Beyond that, inflation linked assets are difficult to leverage,[33] so returns are more difficult to enhance. Finally, governments, regulators, or ratepayers would need to take the other side of the inflation risk and may not be willing to do so. Nevertheless, it does represent an option that deserves further study.

Debt or risk guarantees

Debt guarantees can boost institutional investor interest in renewable projects in a couple of ways. A partial guarantee can provide the financial flexibility needed to engineer debt tranches which can be tailored to meet the needs of specific institutional investors. A full guarantee can shift technology and construction risk, which institutional investors are not well suited to assess and bear, to government, allowing institutional investors to provide capital for more innovative renewable projects. [34]

32 Inflation-linked revenues for a specific project may be valuable to institutional investors. We note that renewable energy support policies may be able to offer this value and provide a mechanism for adjusting prices for new projects as technology costs improve and market conditions change.

33 Primarily because inflation-linked debt is typically hard to raise from investors, as it makes up only a small part of many investment portfolios. In addition, structuring debt to capture inflation risks presents additional challenges and complexity.

34 We note that in the past, monoline insurance companies provided full "credit wraps" for infrastructure projects. However, in the wake of the recent financial crisis, this type of insurance product is less readily available. Monoline insurance for renewable energy projects may help pension funds and other institutional investors to gain comfort with investment risks. As one Financial Times (2012) article points out, the monoline insurance industry is beginning to once again be active, particularly for American municipalities seeking to

Table 7.2 – Evaluating potential policy carve outs

QUESTION	EXAMPLE POLICY – EU UNBUNDLING
Does the policy discourage institutional investor involvement? If so, how and how much?	Institutional investors with controlling interests in transmission or pipeline assets will be banned from owning controlling interests in renewable energy projects
What impact does a reduced role for institutional investors have? Does it lead to a shortage of investment? Higher investment costs?	Several institutional investors own, or would like to own, transmission assets in their portfolio. Since several institutions declared a preference for transmission over generation, a large share of institutions could be excluded. The outstanding question is how much potential investment will be excluded and the impact that that will have on meeting investment needs or on the required investment return of remaining investors.
Are there alternatives to achieving the desired policy objective? What do these cost? Or what other consequences are there?	A de minimus exemption, which excludes investors whose transmission assets are not substantial enough to enable significant market control, could enable institutional investment with little impact on EU energy market goals
How do the costs of alternative policy compare to the benefits of institutional investor involvement?	Further analysis of specific propositions is needed, but will depend on the level of exemption and the amount of institutional investment that is excluded

Another area gaining visibility is the concept of offering policy insurance. Since institutional investors identify policy risk as the biggest concern, can products be developed to mitigate this risk? Once again, the answer is not simple. Might policy risk insurance make it easier for countries to change policy, by modifying the consequences of policy change? How much would this insurance cost and could the cost eat up all of the advantage? And which policy risks get included, as "policy risk" is really a generic term covering many potential (and unknown) ills. Finally, if a country can change policy retroactively, why would they honor an insurance contract?

7.2 Improve institutional investor practices

The counterpoint to improving the policy landscape for institutional investors is the question of whether these institutions are prepared to take advantage of these opportunities even if the policy landscape were improved. In section 6.5 we outlined a number of areas where investment practices could slow the effort to get institutional involvement. In many ways, these barriers are transitional. That is, the opportunities available for investors in renewable energy are only just beginning to reach a magnitude that should interest a large set of institutional investors. Throughout our discussions we found evidence of investors, particularly the largest ones, building up skills and teams to enable direct investment in renewable projects. Speeding up this transition, combined with improved policy, would be critical to reaching the levels of investment identified in sections 3 and 4. We identify a number of paths to increasing this investment.

Getting investors of sufficient size to invest directly into projects

Our analysis estimates that funds with over $50 billion in assets under management may be large enough to support a team for direct investing into renewable energy projects. This size is required to cover the cost of an investment team, given the incremental yield of illiquid project investments, minimum investment sizes, and requirements for diversification across several investments.

However, several pension funds that we interviewed were large enough, but did not have internal teams for direct investment. Reasons for this included the optics of hiring highly-paid investment professionals for a lower-return part of the portfolio, as well as the lack of a mandate where this direct investment team would reside.

As one medium-sized pension fund said: "*we have a small team and it wouldn't look right for us to build and pay the sort of team necessary to direct invest in projects.*"

And even if the medium-sized players did so, it is unclear whether they would be successful. As another medium-sized fund put it:

> *"We have tried to direct invest, but we are too small to take a big share of an asset. We have tried to invest alongside the big guys, but we find that we keep getting squeezed out of the best bits…"*

Overcoming these barriers and getting most or all large funds to build capacity for direct investing in renewable

borrow money to finance infrastructure.

energy is one critical path to achieving our estimated level of potential investment from institutional investors.

Getting more investors to make allocations to infrastructure and renewable energy

While some institutional investors are making significant commitments to infrastructure and renewable energy, many are not. A 2010 paper indicates that globally, roughly 0.5% of pension fund assets are invested in infrastructure.[35] In this light, getting institutional investors to invest 10% of their assets in highly illiquid assets like infrastructure and to dedicate 10% of this share to renewable energy projects may seem like quite a challenge. However, the last several years have seen a number of institutional investors making significant allocations to infrastructure investing.

As more institutional investors allocate a portion of their portfolios to infrastructure, we may expect an increase in renewable energy project investment, provided that policies make renewable energy as attractive as other core infrastructure investments like toll roads, airports, gas pipelines, and electricity transmission. However, there will likely need to be a sea change in investment practice among institutional investors for a full 1% of assets under management to be available for renewable energy project investing.

Increasing use of liability-driven investment

A growing number of pension funds, particularly occupational funds for public employees, are looking into tying their investment strategy more directly to their institutional liabilities. Depending on how this liability-driven investment approach is implemented, it may provide an opportunity for pension funds to capture the value of long-term cash flows that match the duration and profile of their liabilities, an area where direct investment in renewable energy shines. However, as Bloomberg New Energy Finance (2013) notes, "rules on the matching of assets and liabilities tend to push trustees towards taking a highly conservative approach to asset allocation." Our research suggests that the impact of liability-driven investment will vary depending on its implementation, but will generally drive portfolios towards fixed-income, liability-matching investments.

Increasing the sophistication of their asset liability management modeling

Beyond liability-driven investment, renewable energy investment might further benefit from a more granular approach to asset allocation modeling; that is, one that could distinguish the specific benefits of private placement debt versus equity, or be able to capture how exposure to energy prices may offset inflation risks in institutional liabilities. Furthermore, more sophisticated asset liability management modeling imposes data needs, but data on unlisted infrastructure and renewable energy assets may not be readily available. In general, we found that the large life insurance companies, by nature of their size and governance structure, were able to employ more sophisticated investment modeling and granular investment management organizations to capture more benefits.

Getting to investment potential faster

A number of investors, particularly insurance companies, already own substantial portfolios of renewable energy project debt and equity. Despite these examples, current investment is certainly only a small fraction of the potential we have identified here. The speed with which institutions move towards reaching this potential will have a big impact on how much of an impact they have on renewable energy as a whole. In our analysis we assumed the institutions could reach their potential immediately, since we were calculating potential, rather than actual, investment. But if investors take the full 25 years to reach their potential, their average investment over that period would decline 25-50%, reducing their ability to meet the investment needs over that period. Thus, it is clear that accelerating their involvement is important to fulfilling their potential.

35 See Inderst (2010).

7.3 Identify possible impact of the regulation of institutional investors on direct investment in renewable energy

Access to investment opportunities (driven by fund size), the ability to absorb illiquid investments, and the need for diversification among sectors are the major factors that limit insurance company and pension fund investment in renewable energy projects. Rational and secure investment management practices are the main underlying consideration driving these limitations, but to some extent, financial regulation of these investors — which is itself designed to ensure rational and secure investment practices — can affect the significance of any of these constraints. Given recent experience with a failure of lax financial regulation, it would be unwise to suggest that financial regulation should be modified just to increase institutional investment in renewable energy, and we have not conducted an analysis of appropriate levels of reserves for illiquid assets. However, there a number of ways that financial regulation can affect renewable energy investment, which should be considered in any design of policy to encourage institutional investment in renewable energy.

7.3.1 National pension policies

We identify five pension policy considerations that impact project investing. Many of these involve pension system reform. With a range of considerations involved, taking any actions on pension policy purely for the sake of increasing renewable or infrastructure investment would be a significant stretch. However, policymakers would be well advised to consider the consequences that future pension reforms might have on the attractiveness of renewable energy investing.

- **Asset liability matching requirements.** Funds that require closer matching of their investment assets to their pension liabilities, possibly through liability-driven investment, have significantly more conservative investment portfolios. These funds, like insurance companies, tend to focus more on debt than equity and are better placed to recognize the value of reduced risk from the steady long-term cash flows associated with renewable energy projects.
- **Mutualization or increasing average pension funds size.** The relatively small size of most pension funds is a significant barrier to project investment. An interesting example here is the Dutch pension system or, possibly, TIAA-CREF where corporations and institutions outsource their pension provision to a few pension specific firms that invest money to provide that service. Three firms dominate the market in the Netherlands and the result is that the three Dutch pension companies are large enough to build specialist direct investing teams that include expertise in renewable energy. Encouraging the role of these larger providers could have the added benefit of facilitating project level investment.
- **Defined benefit plans versus defined contribution.** There is a slow but steady trend towards transferring the risk associated with pension plan underperformance to the members (who might respond to pension volatility by saving more or less, or by working longer) by moving to defined contribution funds. While the risk benefits are important, we do note that this trend has a significantly negative impact on renewable energy project level investment.
- **Asset supported pensions versus pay as you go systems** – In many countries, many pension funds are either set up as pay as you go systems, such as the U.S. social security system, or are, in others ways, backed up by assets and revenue streams outside of dedicated funds. Thus, as in section 5, we note that there is a very wide divergence between countries as to the share of national assets invested in pension funds. While this is purely a matter of pension policy and organization, we note the impact on increasing investment potential.

7.3.2 Financial regulations

Another policy consideration could be the financial regulation of the institutional investors themselves. Once again, these options involve considerations that reach well beyond the provision of capital for infrastructure and renewable energy:

- **Liquidity requirements.** Particularly since the 2008 financial crisis, regulators, rating agencies, and investors have been heavily focused on the liquidity of investment portfolios. This focus has taken different forms depending on the jurisdiction and the nature of the institution, but it is prevalent globally. While the focus on liquidity is certainly understandable, a swing of the pendulum in the other direction may lead institutions to leave potential returns on the table and to pass on investment opportunities that may generate significant benefits. Rather than shunning illiquid investments altogether, careful analysis of the acceptable illiquidity risks and proper accounting of options to hedge this risk could encourage more investment. Furthermore, several policy mechanisms could reduce the cost of illiquidity by offering liquidity reserves to back up these investments or by enabling clearing-houses that could improve the liquidity of these project investments.

- **Solvency II.** As described in section 6.1, Solvency II directs European insurance companies to have adequate financial reserves to account for the riskiness of their portfolio. This rule is intended to ensure the financial stability of these companies. A number of institutional investors, in particular pension funds, have expressed concern that Solvency II rules will decrease the amount they can invest in renewable energy projects, especially private placement debt. As Basel III rules have for European banks, this may reduce institutional investors' allocation to illiquid investments in general, and reduce the tenors that they can offer to renewable energy projects.
- **Accounting regulations.** Section 6.1 also discusses accounting rules that force some actors to mark the value of their investments to market. Moreover, there are varying accounting requirements for public sector and private sector actors. Our research suggests that the more stringent accounting requirements placed on listed companies drives these companies towards a more liability-driven investment strategy and conservative portfolio allocation.
- **Markets for illiquid assets.** Finally, we note the potential to create new, more liquid markets for illiquid investments in renewable energy. As in other asset classes (such as real estate) when multiple illiquid investments are aggregated and traded on exchanges, the most illiquid securities can be traded easily. Bankers are exploring the possibility for Real Estate Investment Trust (REIT) and/or Master-Limited Partnership (MLP) securities related to renewable energy investments, and these will go a long way towards providing institutional investors with liquidity. But the tax treatment of these financial instruments may determine their success with institutional investors, as tax-exempt investors like pension funds may still face barriers to investing in these innovative financial products.

7.4 Develop better pooled investment vehicles

Throughout this paper we have highlighted the potential advantages to renewable energy financing of direct investment in projects — versus investment in companies that develop renewable projects. We have also discussed a series of barriers that limit the potential to invest directly. But if there is value to be garnered — either through lower financing costs for renewable projects or higher risk adjusted returns for institutional investors — in bridging the gap between direct investment and investment through corporations, then surely financial markets should adapt and create markets to bridge this gap.

Indeed, two potential instruments stand out, project bonds and pooled investment funds. Some of the investors we interviewed have highlighted significant issues with both. This area represents a potentially fruitful area for further development and analysis; one which will be taken on by CPI and others. In this section we lay out some of the preliminary reasons why attempts so far have not been as successful from an institutional investor perspective as they might be, and the major considerations that need to be addressed to make these pooled investment vehicles create value for either institutions, renewable energy objectives, or both.

The main issue with project bonds has been size. Investment bankers we spoke with suggested that the transactions, ratings, legal, and listing costs associated with project bonds outweigh the benefit of the greater liquidity of these instruments unless the issuance size is somewhere between $350 and $700 million. Even then, unless the bond is large enough to be included in indices, many institutions will not be able to invest. As a result, most single renewable projects are likely to be too small to justify the expense.[36]

The logical next step is to consolidate project bonds — and equity — into investment funds. A number of funds have sprung up to exploit this market, and numerous institutional investors have entrusted a portion of their portfolio with these funds. Nevertheless, the fund structure, returns, and style have yet to translate into the benefits to either renewable energy or institutional investors that we have discussed above. Indeed, we have heard from a number of institutional investors that, while they invested in early infrastructure and renewable energy funds that they were more reticent at this point as the returns and cash flows of these funds were not precisely what they had anticipated and needed.

A typical quote: *"we tried infrastructure funds, but the fees were too high for the returns and they didn't give us what we wanted, so we decided to internalize more and focus on direct investing."*

Or another: *"Why should we pay 2 and 20 (referring to a fee structure normally used for hedge funds) to get infrastructure type return?"*

Some of the pension funds that expressed this view have developed their own direct investment teams instead, but many of the medium-sized and smaller investors may not have that option.

In particular, we found that pooled investment funds designed to invest in renewable energy equity may distort the economics of these projects for an institutional investor by:

- Leveraging projects to improve returns, but by doing so also increasing risk and volatility
- Hedging out inflation risk — often to enable leverage — and thus eliminating the inflation indexation that could have been very attractive for institutional investors focused on liability hedging
- Churning the portfolio — that is trying to buy projects when they are cheap and sell when they are expensive — enhancing returns, but also increasing risk and distorting the underlying cashflows
- Managing the time frame of the vehicle, which is often not the optimal time frame for the underlying projects
- Re-investing cash flows into new projects rather than providing dividends, creating re-investment risk beyond control of the institutional investor
- Demanding high fees and fee structures that

36 The Bloomberg database of all public issuances of debt includes only a handful of renewable energy project bonds. The most notable transaction of this type was the $850 million bond offering for MidAmerican Energy's Topaz Solar Farm. The offering, the first debt financing for the 550 MW solar farm, was quickly subscribed and may be followed up by an additional offering. However, this bond issuance was only possible because of the massive scale of the project, and the strength of the sponsor, a business unit of Berkshire Hathaway (Bloomberg 2012).

increase the financing cost and reduce attractiveness to institutional investors

As a result of the packaging and design, increasing leverage, and reinvesting dividends, the pooled investment vehicles no longer offer risk/return and cash flow profiles adequate for liability matching, and as such become return seeking.

In our discussions with institutional investors and fund managers we identified several potential explanations for the design of investment funds not being fully tailored to institutional investors. First, there may not be enough institutional investors interested for the investment manager to rely on them as the sole source of funds. This argument could be circular if there is not enough interest because of the design of the fund. Alternatively, institutional investors have a diversity of perspectives and requirements, therefore funds need to be designed to the lowest common denominator. However, simply structured, plain vanilla investment funds cannot justify the fees required to support the fund management team and transaction cost structure, leading fund managers to enhance returns in order to create a product that is attractive to both themselves and the market. Another point of view suggested that clean tech fund developers *"typically come from investment banking environments and may not understand institutional investor requirements sufficiently"*. The likelihood is that all of these perspectives hold some, but not all, of the truth.[37]

The problems associated with the project equity funds are potentially even greater for a pooled debt vehicle. The margins are smaller and thus may make it more difficult for a fund manager to create a business model that makes sense. The greater difficulty for debt funds to buy and sell loans, because transaction costs may be higher and the market thinner, and lever to increase portfolio returns is both good news and bad. On one hand, the funds may more closely reflect institutional investor needs. On the other hand, there will be significantly less opportunity for fund managers to make an attractive margin. Insurance companies, which are the larger target for debt funds, are also the most advanced in pursuing direct investment in project debt.

37 Some superannuation funds in Australia pointed to the structure of Industry Funds Management (IFM) as a potential solution to these issues. IFM is owned by 30 Australian pension funds, who are also investors in IFM's funds, potentially leading to a better alignment between investor needs and fund management. (IFM Website, 2013).

Designing investment funds for institutional investors

All of this leads us to the question of whether it is possible to structure funds that could narrow the gap and be used to increase institutional participation. For example, whether the costs of operating such a fund would eat up the benefit, or whether a fund that could be attractive to a potential fund manager could provide a product that was attractive to an institution. While this is a question for further analysis, we define some of the key characteristics that such a fund must have:

- **Deal flow.** An important impediment to medium-sized institutions is getting on the list for potential deals. The funds must be large enough and noteworthy enough to attract interest from project developers and bankers.
- **Expertise.** Similarly, the funds must maintain expertise in the sector to improve investment performance and lower risk.
- **Low transaction costs.** The fund will need enough deals to streamline its searching and transaction costs to reduce the overall fund costs.
- **Monitoring.** The fund will monitor investments over their life, replacing what could be an onerous task for a medium-sized institution with limited investment personnel. Note that a fund structure is likely to include holding many securities to the maturity of the investment, so this monitoring may be somewhat different than current funds.
- **Liquidity.** The most difficult problem may be to take the illiquid assets and increase the liquidity by enabling secondary transactions of the fund. Further analysis will be required to see what tradeoff between liquidity and investment certainty will be appropriate for investors. A range of liquidity options is possible.
- **Liability matching, control, and predictability.** Institutional liabilities are reasonably predictable and long-term, and these liabilities could be well-matched through long-term illiquid assets. But the tradeoff between liability-matching and liquidity needs further analysis.

In our view, all of these considerations imply that a successful fund is likely to be larger than average or sit within an institution that develops segregated funds based on shared capabilities. The fund(s) is (are) likely to have a buy and hold to maturity mentality, and may offer different maturity profiles to fit with different investors. A low transaction cost and "plain vanilla" approach to investing is also important. We have heard of at least one attempt to start a family of funds along these lines. However, the question remains as to what might be the best way to encourage such an investment class and whether the economics will work out (for both the investor and policy).

7.5 Encourage utilities and other corporate investors

Throughout this paper we have discussed the extent to which institutional investors find it easier to invest in corporate securities such as shares or bonds. Good liquidity, low transaction costs, readily available investment research, established benchmarks, and historical data series that allow for robust quantitative evaluation for asset liability match modeling all provide a platform for institutional investment.

Furthermore, as in Figure 3.1, pension funds and insurance companies could, themselves, meet all of the demand for capital that corporations need to raise to meet their share of the renewable investment under the IEA's 450ppm scenario. Beyond pension funds and insurance companies other investors such as mutual funds and individuals face the same liquidity, size, and resource constraints that make it easier for them to invest in corporate securities rather than projects. We estimate that utilities and energy companies place between $200 and $300 billion of new corporate bonds each year. The retained earnings — that is the amount of profit that corporations choose to reinvest in new assets rather than return to shareholders as dividends — from publicly listed energy companies and utilities exceeds $60 billion annually in the U.S. alone. This figure does not include new equity issuances, private companies ,or potential corporate renewable energy investors from other sectors. In other words, corporations should find it easy to raise the capital that they need to fund renewable energy investment needs.

So why should we even worry about institutional investment in renewable energy projects? Here we return to the discussion in section 2 that:

> *The long term investment horizons and patient investment practices of institutional investors are a good fit with renewable energy investments; attracting investment from institutional investors could reduce the financing cost of renewable energy by taking advantage of this fit.*

That is, increasing the share of corporate balance sheet investing by reorienting policy towards investment by companies such as utilities could make it easier to meet the investment requirements, but also misses an opportunity to lower the cost of financing renewable energy and possibly a way of improving investment returns for institutions.

Increasing corporate investment in renewable energy is not without its challenges. Many analysts comment on the attractiveness of renewable energy to incumbent utilities and energy companies and others, so there is no need to discuss the challenges in detail here except to highlight potential issues such as a company's desire for diversification (partly due to policy and technology risk), concerns about the impact on the existing conventional portfolio, and limited balance sheet capacity of utilities all limiting or slowing renewable energy deployment. Overcoming some of these concerns could require higher returns or more risk guarantees, all of which could raise the cost of renewable energy further. In addition, there could also be concerns about stifling innovation if renewable energy becomes the purview of only the large corporations.

Thus, while the corporate investment route remains an option, analysis of the various options should probably consider it as a fall back or baseline against which to evaluate the cost and consequences of policies that could strengthen project type renewable energy investment.

8. Conclusions and next steps

Institutional investors have the potential to play a significant role in providing capital for renewable energy. The match between renewable energy investments and the long-term investment needs of many institutions further offers the possibility that, by making these investments, institutions could enhance their own risk adjusted returns, lower the cost of financing renewable energy, or both.

However, institutional investors are heterogeneous and their impact cannot be assessed as a group. Differences between pension funds and insurance companies, large companies and small, and a host of other distinctions determine what is possible. Furthermore, differences between debt markets and equity markets, direct investments, investment through project or infrastructure funds, or investment through stocks and bonds all have a profound effect on the potential impact of institutional investors.

Our research suggests that while there are many paths through which institutions can invest in renewable energy, only for a limited set of these paths will institutional investors differ markedly from the financial markets in general and so contribute to lowering the cost of renewable energy financing. These paths are different for different investors.

The largest 150 or so institutional investors have the biggest opportunity to affect the cost of financing renewable energy by directly investing in project equity or debt. Accounting for portfolio and risk management constraints, these investors could provide up to one quarter of the project equity and half of the project debt required to meet the developed world's renewable energy goals. Pension funds have greater potential for investment in project equity, while life insurance companies' potential is more focused on project debt. In fact, many insurance companies are active providers of renewable energy project debt. While these institutions can help meet renewable energy investment needs, they are unlikely to become the dominant source of project finance. They may have some impact on the cost of capital for renewable energy, but the institutions themselves will likely capture additional value in the form of better risk adjusted returns.. Policy barriers and a slow uptake of these opportunities by institutional investors further limits the extent to which institutional investment in renewable energy projects could be game changing with respect to financing costs for the sector as a whole.

Infrastructure funds or other pooled investment vehicles provide an avenue to increase the flow of institutional money into renewable energy projects. Depending on their structure, these funds could increase the number of institutional investors with access to renewable energy projects and also increase their allocations. However, the costs of managing these funds, fees charged and the structure of the fund investments could erode a substantial portion of the potential benefit to reducing renewable energy financing costs. From both the perspective of the economics of the investment funds themselves and the demand from institutional investors, we believe that there is greater potential on the equity or mixed equity/debt funds than on the pure debt funds side. But in any case, careful structuring of these funds will be required to achieve any financial benefit for renewable energy.

Perhaps most importantly, our research suggests that policymakers need to consider the specific role of different types of institutional investors in designing their policies. Institutional investors have a great capacity for investment in liquid investments in corporate equity and debt, and if policymakers are primarily concerned about achieving enough investment, rather than lower the financing costs of that investment, they might consider policies that encourage utilities and other companies to finance renewable energy on their balance sheets, rather than relying on project finance to meet investment needs. The challenges in encouraging corporate investment, as well as the implications and tradeoffs of changing market structures, encouraging innovation, and improving regulation are certainly a topic deserving of further study.

Institutional investors alone will not solve the challenge of renewable energy investment, and scaling up investment from institutional investors will be a difficult task. The ways forward — from improving policy and regulation, to creating effective pooled investment vehicles and encouraging corporate investors — each deserve the attention of policymakers. However, the prize is substantial. Any comprehensive solution that reduces the financing costs of renewable energy or bridges the financing gap will require consideration and engagement of institutional investors.

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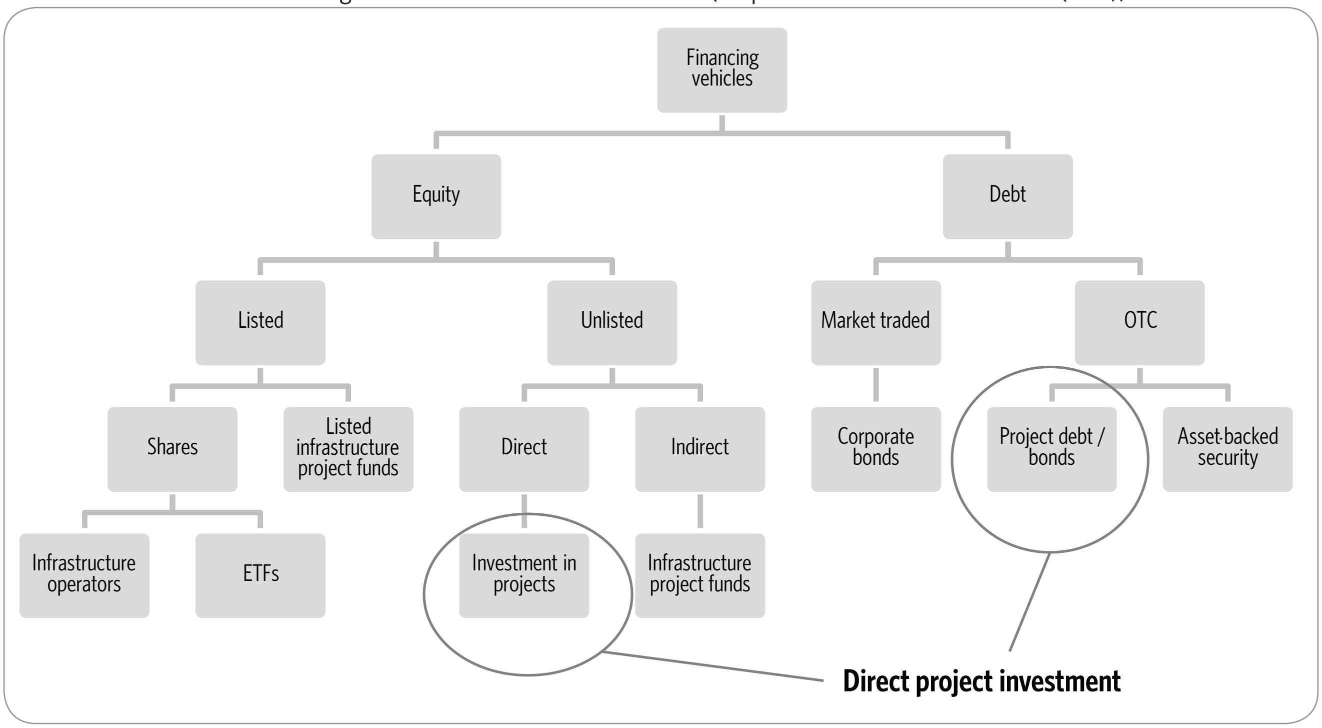
Appendix 1. Asset classes and investment vehicles

Institutional investors allocate their portfolios across a wide range of asset classes, each with a distinct set of risk factors, return expectations, and correlations with other kinds of assets. In general, infrastructure as an asset class is considered long-term (particularly true for unlisted infrastructure investments), exhibiting a low correlation to equity and debt markets, and sometimes linked with inflation.[38] However, even within infrastructure there are differences, and renewable energy assets with long-term power purchase contracts show little correlation to other asset classes, although data on the performance of these assets is thin.[39] In our interviews with institutional investors, bankers and other financiers, many suggest that renewable energy assets may have little exposure to broad equity market conditions, commodity prices, or other common risk factors.

For infrastructure more broadly, and renewable energy in particular, the various types of investment vehicles have been summarized by Kaminker and Stewart (2012) in the figure below.

Our work distinguishes between asset classes along two dimensions. The first is debt or fixed-income, versus equity or return-seeking investments, versus investment in whole assets (essentially capturing both the debt and equity characteristics). The second dimension is investment directly in projects, versus investment through investment funds, versus investment in corporations. Each of these dimensions has implications for the availability and cost of capital from institutional investors.

Main institutional investors' financing vehicles for infrastructure investment (adapted from Kaminker and Stewart (2012))



38 RARE (2009) describes the correlation between the MSCI Global equity index and infrastructure investments between 2002 and 2008. Listed infrastructure has a correlation of 0.65, while unlisted infrastructure has a correlation of 0.23. Colonial First State Global Asset Management (2010) measures the correlation between infrastructure and other asset classes for the 10 years ending 2010. Listed infrastructure was shown to have a 0.45 correlation with equities, while unlisted infrastructure had a correlation of 0.10.

39 One insurance company that we interviewed noted that renewable energy project investments were included in their asset-liability matching with a beta of zero.

Debt versus equity investments

	DEBT INVESTMENTS	EQUITY INVESTMENTS	WHOLE UNLEVERED ASSET
INVESTMENT CHARACTERISTICS	Most secure tranche of investment, often guarantees a certain level of yield with limited upside Investment risk is primarily default risk	High risk, high reward tranche of investment for investors seeking greater returns Greater return, but greater concentration of risk with leverage	Mix of debt and equity cash flows Higher risk and return than debt, but lower than equity
IMPORTANT INVESTMENT CRITERIA	Yield, credit rating, duration / tenor, inclusion in standard index	Valuation, cash flow profile, growth potential	Mix of debt and equity criteria
INSTITUTIONAL INVESTOR PERCEPTION	Typically low risk and low return Can be a good match for predictable liability profile While rare, inflation linkage can help hedge inflation risk in institutional liabilities Low correlation with other asset classes when held to maturity	High risk and return Can be the "alpha" (excess return) generator of the portfolio Not typically a match for institutional liabilities, but can outperform debt in the long-term (with greater volatility) Varying level of correlation with other asset classes	Mix of debt and equity elements

Project, investment fund, or corporate investments: Matching investment profiles to institutional investor needs

In practice, the link between steady, low-risk renewable energy asset cash flows and institutional liabilities is complex. Cash flows to investors are generated by projects, companies or funds that issue a host of investment products, creating an array of renewable energy asset classes. Investors will each use different criteria, strategy and objectives to evaluate these different asset classes, as outlined in section 6.5 and appendix 5.

For simplification, we highlight the contrast between investments in corporations that own renewable energy (such as utilities or renewable energy companies), direct investment into renewable energy projects, and pooled investment vehicles. Corporate investments seek returns from businesses that may have multiple sources of revenues and expenses, and assets and liabilities.

	PROJECT INVESTMENTS	FUND / POOLED INVESTMENTS	CORPORATE INVESTMENTS
INVESTMENT CHARACTERISTICS	Complex deal structures that require extensive due diligence Project assets are illiquid, and often carry a premium for illiquidity risk Can be tailored to meet specific investor needs and requirements	Investments in projects intermediated through an investment manager Manager takes a fee, typically tied to performance Introduces principal-agent problems, where decisions are made by the manager, while the risks fall on the investor Varying levels of liquidity, depending on fund structures Varying levels of leverage, reinvestment, and other elements that impact cash flow profile relative to projects	Most accessible asset class Research by financial analysts readily available Liquid assets often traded on an exchange Asset risk and return profile will depend on corporate strategy, leverage, dividend policy, and many other factors Cash flow link to underlying projects (owned by a corporation) can be minimal
IMPACT ON COST OF CAPITAL	Institutions may be able to structure investments to manage risk in institutional liabilities – some institutions may have a structural advantage when it comes to providing capital at lower cost If there are enough low cost-of-capital market participants, projects may see cheaper capital If there are not enough low cost-of-capital market participants, advantaged institutions may simply capture risk premiums while lowering overall institutional risk, for better risk-adjusted returns	Deals are generally structured by an investment manager, with an incentive to enhance returns Many funds do not access institutional advantages in managing long-term liquidity risk, and may not be able to lower the cost of capital from institutions	Cost of capital for corporations set by many market participants, and institutional investors do not have any distinct advantage Cost of capital for projects will be determined by the corporations' ability to manage project risks appropriately

Appendix 2. Sizing renewable energy investment potential

Our analysis estimates the potential for institutional investment in renewable energy assets, both project-level assets and corporate securities. This analysis is not designed to produce an exact figure, but rather an indication of the scale of potential investment, given realistic constraints. This appendix describes our methodology, assumptions and data sources used in developing an estimate of potential institutional investment.

Description of methodology

Our method can be broken into a series of calculations, reflecting the constraints to investing identified in our research. This calculation differs for project-level investments and corporate investments, because the constraints that face investors in each realm are quite distinct.

2.1 Method for project investments

For our estimate of potential institutional investment in projects, our calculation follows the following six steps:

1. **Data on assets under management (AUM)**

   We developed our initial estimates of AUM for institutional investors based on a variety of industry, academic, and other sources. These data represent AUM as of 2010, the last year where we have complete data for all of our institutional investor categories. Our starting estimate includes five broad categories of institutional investor: insurance companies, pension funds, sovereign wealth funds, foundations and endowments. These are the investor categories that manage a pool of money to meet future organizational or institutional obligations, as discussed in section 2 of the paper, and highlighted in table 2.1.

   As a result of this data collection and parsing exercise, we identify roughly $45 trillion in assets in the OECD that we considered institutional investors.

2. **Exclude investor types that require significant short-term liquidity, or have narrow investment mandates**

   While the screen applied in step one has eliminated entire asset pools that do not meet our definition of institutional investors, there are several sub-categories of investors that are simply not the kinds of long-term investors that would take on a long-term, illiquid investment in

Project investments – Key constraints applied and assets remaining ($ bn)

CONSTRAINT	PENSION FUNDS	INSURANCE COMPANIES	SOVEREIGN WEALTH FUNDS	FOUNDATIONS AND ENDOWMENTS	TOTAL
BEGINNING AUM	21,337	22,015	587	1,500	45,439
LONG-DURATION INVESTORS	15,938	18,560	587	1,500	34,459
LARGE ENOUGH FOR DIRECT INVESTING	6,478	18,560	471	160	25,669
LIQUIDITY	647.8	1,856	47.1	16.0	2,567
DIVERSIFICATION	64.78	185.60	4.71	1.60	257
ASSET ALLOCATION	Debt: 31.57 Equity: 33.19	Debt: 157.34 Equity: 28.26	Debt: 1.65 Equity: 3.06	Debt: 0.57 Equity: 1.04	Debt: 191 Equity: 66

INVESTOR GROUPS INCLUDED	INVESTOR GROUPS EXCLUDED
Insurance companies • Life, non-life, reinsurance Pension funds • Defined benefit, defined contribution, sovereign Sovereign wealth funds Foundations Endowments	Non-fund pension assets • Social security liquidity reserves (needed for liquidity purposes, invested in risk-free assets) • Book reserve (needed for liquidity purposes) • Insurance contracts (double-counted with insurance companies) • Other assets (dominated by U.S. individual retirement accounts (IRAs), controlled by individuals) Investment managers • Mutual funds, private equity, hedge funds, exchange-traded funds (partially double-counted with institutional money, other assets not managed for long-term institutional clients)

a renewable energy project. These include most defined contribution pension funds and most non-life insurance companies.

Defined contribution pension funds often require liquidity in the short term, because in most schemes, investors have the option to move their money among investments, or move their money to a different defined contribution fund altogether. However, our interviews highlighted that defined contribution plans in some countries may have little exposure to this need for liquidity. For instance, Australia's large mandatory defined contribution system experiences very little switching between funds and investment options. Based on a cursory review of defined contribution plans, we chose to exclude all defined contribution assets, except for those in Australia, Chile, Denmark, Mexico, Netherlands and Switzerland, pension systems in which defined contributions funds have characteristics that may reduce the need for short-term liquidity.

We consider life insurance companies (as well as "composite" life and non-life insurance companies) in our analysis, while we exclude non-life insurers (e.g. property and casualty insurers). While life insurers are the classic institutional investor, non-life insurance assets generally require significant liquidity. Property and casualty insurance premiums are renewed every year, and can fluctuate for a given firm as market dynamics and regulations change. Most property and casualty insurance companies invest heavily in short-term liquid debt, particularly high-quality corporate or sovereign debt. While we exclude all exclusively non-life insurance assets, some large insurance companies offer both life and non-life insurance, and pool their investments. Our interviews indicate that these large "composite" insurance companies manage their portfolios much like life insurers do, and we count their assets in our analysis.

After eliminating these investors, we are left with approximately $34 trillion in assets that have long-term investment objectives and minimal short-term needs for liquidity.

3. **Exclude funds of insufficient size to employ direct investing**

Our research, analysis and interviews suggest that only funds of sufficient size will be able to build a team with the capabilities for direct investing. As shown in box 4 in the paper, we estimate that it may be difficult for funds with less than $50 billion in assets to build the capacity for direct investment, due to the size of direct project transactions, the need for diversification across projects, and the cost of maintaining a team. We note that there will be exceptions where smaller funds invest directly, and larger funds do not, but we expect this rule to hold in aggregate.

For pension funds, we use Towers Watson (2011a) data on the top 300 pension funds worldwide to calculate the assets, country by country, in funds large enough for direct investment. However, our interviews revealed that up to 20% of a deal's book can be filled with smaller institutions, which are relying on a larger institution to structure the terms of the deal. From the funds that are large enough for direct investing, we assume that 20% more assets will accompany this investment from smaller funds. Finally, because of discrepancies between OECD country-level data and Towers Watson fund-level data, we cap assets in a given country to the level indicated in OECD data.

For insurance companies, we note that the vast majority of assets are managed by very large companies. Due to lack of data on insurance companies with less than roughly $100 billion in assets,[40] we assume that all of the assets are managed by companies that are large enough to invest directly in renewable energy, although we recognize that this may slightly overstate the investment potential.

There is only one sovereign wealth fund in the OECD with over $50 billion in assets – Norges Bank Investment Management – and only that one fund is counted in our figures. We note that this one fund does not currently invest directly in renewable energy projects (NBIM Website).

While all foundations and endowments are below the $50 billion threshold, we find that some of these organizations may be driving to investment in renewable energy as part of their organizational mission, or in the case of endowments, potentially student pressure. While this may overstate the potential, we assume that foundations and endowments with over $10 billion in AUM can invest directly in renewable energy. We note that the vast majority of foundation and endowment money is the United States, as are the large foundations and endowments.

Overall, almost $9 trillion in assets are excluded due to insufficient size, leaving a total of approximately $26 trillion remaining.

4. **Apply a limit on illiquid investments**

While we have already excluded those investors where most of their assets are potentially on call for liquidity reasons, even the long-term investors will have constraints on the amount of their portfolio that can be invested in illiquid assets like renewable energy projects. These constraints stem from both regulation and investment practices.

As discussed in section 6.1, liquidity can mean very different things to different investors, and the elements of liquidity that matter the most can change over time. The overall illiquidity of an asset is a combination of transaction costs involved in a sale of the asset, whether a resale market exists for the asset, or the loss in value that may be incurred if the asset needs to be sold quickly. Moreover, the quality and reliability of financial information and other relevant data can impact an asset's liquidity.

The World Economic Forum (2011) presents data on an estimated allocation to illiquid investments, presented below.

	ESTIMATED ALLOCATION TO ILLIQUID INVESTMENTS
LIFE INSURERS	4%
DEFINED BENEFIT PENSION FUNDS	9%
SOVEREIGN WEALTH FUNDS	10%
ENDOWMENTS AND FOUNDATIONS	20%

In our interviews, we have observed a wide range of levels of allocation to illiquidity, but in our analysis, we make the simplifying assumption that on average, 10% of the portfolios of these investors can be allocated to illiquid investments. However, this number, like those reported by the World Economic Forum (2011), applies to a range of assets types with differences in their level of liquidity (essentially everything other than publicly-traded shares and bonds). As indicated by figure 6.1 in the paper, direct infrastructure investments are among the least liquid asset classes, and often require substantial long-term lockups. Our 10% limit on illiquid assets may overstate the potential for direct investment, particularly from life insurance companies, relative to current levels.

This liquidity limit reduces the assets available for investment to $2.6 trillion.

5. **Apply a limit on renewables as a share of illiquid investments**

We also recognize that within an institution's allocation to illiquid investments, there will be a range of asset types that attract institutional investors. Private equity investments, property, and other types of infrastructure (e.g. tolls roads, airports, electricity and gas transmission) all compete for an investor's illiquid investment allocation. Our interviews suggested, time after time, that renewable energy would only ever

40 Data from Relbanks and AM Best (2012) cover only the largest 55 and 25 insurance companies (respectively) all of which have assets over $100 billion.

receive a small portion of this allocation, if any. While generous, we assume that 10% of an institution's allocation to illiquid investments can be invested in renewable energy. We expect more traditional illiquid investments, like property and private equity, to make up most of an institution's allocation to illiquidity.

This diversification requirement further limits available assets to $257 billion.

6. **Break estimate into debt and equity portions**

Finally, we break our final estimate of $257 billion into debt and equity, based on the estimated portfolio allocation of the investors themselves. For pension funds and insurance companies, our estimates come from country-by-country data from the OECD (OECD.Stat Pension Statistics, OECD.Stat Insurance Statistics), which we have aggregated into return-seeking versus fixed-income assets. For sovereign wealth funds, we use the specific asset allocation of Norges Bank Investment Management (NBIM Website). For foundations and endowments, we have observed that where data on specific funds is available, they invest in a manner similar to pension funds, and therefore use the weighted average for pension funds for the asset allocation of these funds.

The end result is that our estimate of $257 billion is split into $191 billion for project debt, and $66 billion in project equity. Since a large part of the potential investment comes from insurance companies, their debt-heavy asset allocation drives the allocation of available investment.

2.2 Method for Corporate Investments

Corporate investments – Key constraints applied and assets remaining ($ billion)

CONSTRAINT	PENSION FUNDS	INSURANCE COMPANIES	SOVEREIGN WEALTH FUNDS	FOUNDATIONS AND ENDOWMENTS	TOTAL
BEGINNING AUM	21,337	22,015	587	1,500	45,439
SECTOR LIMITS	412.34	235.58	11.66	28.96	689
ASSET ALLOCATION	Debt: 158.10 Equity: 254.24	Debt: 162.51 Equity: 73.07	Debt: 4.09 Equity: 7.57	Debt: 10.21 Equity: 18.75	Debt: 335 Equity: 354

To estimate potential institutional investment in renewable energy backed corporate securities (which we assume the corporations will then invest in renewable energy projects), our calculation follows three steps:

1. **Develop data on assets under management (AUM)**

   For comparability, the data developed for this step is identical to the data used for our estimate of potential investments in renewable energy projects. However we note that many different investor types have access to corporate investments, including individuals, investment managers, banks and other corporations. Thus, our estimate of institutional investor potential for investment in corporations is likely only one piece of the large potential investment for this space.

2. **Apply a sector limit to limit investors' maximum exposure to renewable energy assets**

   Institutions will require diversification of their investment in corporations, across companies and sectors. In fact, the institutions that we interviewed largely relied on common, diversified indices of corporate equity and debt as benchmarks for their portfolio performance. Thus, we expect that on average, these institutions would give renewable energy no greater weight than the overall market does, unless these assets offer superior risk-adjusted returns.

   But what is an appropriate market weight for renewable energy? While there are a number of ways to estimate this number, we chose an approach based on the investment needs for renewable energy. We calculated the expected gross fixed capital formation in the OECD, based on projected economic growth (based on OECD 2012b, World Bank Data Bank). We then removed the one third of gross fixed capital formation accounted for by vehicles and dwellings, which are largely owned by individuals, not investors. Using IEA's estimates of renewable energy investment needs, we estimate that roughly 2% of OECD "investable" gross fixed capital formation will need to be channeled to renewable energy assets, and so we use 2% as our assumed limit to renewable energy exposure in a corporate debt or equity portfolio. Our total estimate is slightly lower than 2% of the entire AUM, however, since we assume that the sector limit applies only to insurance companies' corporate holdings, leaving allocations to public sector debt untouched.[41] This calculation is described in more detail in appendix 4.

   Our estimate assumes that renewable energy assets earn comparable risk-adjusted returns to the rest of the market. In most cases, the returns available to investors in renewable energy projects are determined, in part, by policy support. One might expect that investors would overweight the sector if the risk-adjusted return of renewable energy investments was made more attractive. However, a greater return is the same as a higher cost of capital, and while offering investors greater return would likely increase investment, it also raises the cost of deploying renewable energy.

   This sector limit takes us from $45 trillion in assets down to $689 billion in assets available for corporate renewable energy investments.

3. **Break estimate into debt and equity portions**

41 However, we did not have sufficiently granular data to exclude public sector debt for pension funds.

Finally, as we did for project investments, we break our estimate into debt and equity portions. We use the same data and methodology as above for this calculation, but the overall split is slightly different because non-life insurers and defined contribution pension funds are now included.

The end result is that our estimate of $689 billion is split into $335 billion for corporate debt, and $354 billion in corporate equity.

2.3 Sensitivities for pooled investment vehicles

We conducted several sensitivity analyses, to establish a range for potential investment in renewable energy investment instruments that overcome the investor size and liquidity barriers. These sensitivities relied on the methods for estimating potential project investment, but changed the constraints. We tested three scenarios: 1) a pooled investment vehicle allows small funds to access the market, but does not address liquidity constraints, 2) a pooled investment vehicle provides the liquidity of corporate securities to the market, but does not make investments accessible to small investors, and 3) a pooled investment vehicle makes investment accessible to funds of all sizes, and provides the liquidity of corporate securities. In removing the liquidity constraint, we applied the corporate sector limit, as described above, in its place. But we left in place the constraint that investors have a long time horizon, the primary difference between liquid pooled investment vehicles and corporate vehicles being the time horizon.

2.4 Converting assets to flows

We convert our estimate of available assets to annual flows to compare our figures with the IEA estimate of required investment. For this conversion we make two adjustments to account for: 1) expected growth in the asset base of institutional investors, 2) the fact that cash flows generated from renewable energy investments may be reinvested into additional renewable projects over the 25 year period represented by the IEA estimates, and 3) "catch up flows" where institutions invest above the steady state replacement rate to reach "full" allocations.

Growth in institutional assets

The IEA estimates of investment needs for renewable energy account for expected growth in economic output and energy demand between 2011 and 2035, while our estimates represent institutional investor assets available in 2010. Thus, to make an appropriate comparison, we must account for potential growth in institutional assets over the period of comparison.

EXPECTED REAL GROWTH RATES IN OECD COUNTRIES			
2011	2012-2017	2018-2030	2031-2035
1.5%	2.0%	2.2%	1.9%

Source: OECD (2012b), World Bank Data Bank

Growth in institutional assets will depend on a range of factors; for example, country economic growth, demographic trends, and regulation. While long-term economic projection is beyond the scope of this work, we observe

Sensitivities – Assets available by scenario ($ billion)

	DIRECT PROJECT INVESTING	SIZE CONSTRAINT ELIMINATED	LIQUIDITY CONSTRAINT ELIMINATED	SIZE AND LIQUIDITY CONSTRAINTS ELIMINATED
PENSION FUNDS	64.8	159.4	129.6	318.8
INSURANCE COMPANIES	185.6	185.6	200.7	200.7
SOVEREIGN WEALTH FUNDS	4.7	5.9	9.4	11.7
FOUNDATIONS AND ENDOWMENTS	1.6	15.0	3.2	30.0
TOTAL	**256.7**	**365.8**	**342.9**	**561.2**
TOTAL DEBT	*191.1*	*230.1*	*211.8*	*289.7*
TOTAL EQUITY	*65.5*	*135.8*	*131.1*	*271.5*

that growth in institutional assets is roughly equivalent to broad economic growth, and in fact savings can be a driver of economic growth. We therefore gross up our estimate of total assets by estimated real GDP growth in OECD countries, for each year between 2011 and 2035.[42] As our estimate of investment needs is an average across 2011 to 2035, we must average our estimate of grossed-up institutional assets across this same period, rather than simply take the value at the end of the period. When averaged across the period, this results in a 32% increase in assets.

Conversion of assets to flows

As an investment in renewable energy matures, it will generate cash flows in the form of profits, interest payments, depreciation, and/or debt repayments. At the same time the book value of the investment will decline as it is depreciated. In our comparison with investment needs, we have assumed that investors maintain a portfolio that grows with inflation. To do so, an investor will need to reinvest the depreciation or debt principal repayments and a share of the profits or interest payments to cover inflation. In other words, the stock of investment that we started with may be reinvested more than once of the 25 year horizon of our analysis.

ASSUMED REINVESTMENT RATE CALCULATION			
Asset class	Life (depreciation or amortization)	Inflation	Reinvestment rate (annual)
Equity	20 years / 5%	2%	7%
Debt	14 years / 7.1%	2%	9.1%

To estimate this reinvestment rate, we assume that equity investments are depreciated over a 20-year economic life, meaning that 5% of the initial value is paid back each year. Likewise, we assume that the principal in debt investments is paid back over 14 years, which means that 7.1% of the principal is paid back each year. In both cases, we assume annual inflation is 2%, consistent with IMF and OECD long-term inflation projections for the U.S. and Europe. As a result we assume that 7% of equity and 9.1% of debt is reinvested in renewable energy to maintain a steady, inflation-adjusted portfolio. In other words, equity investments are fully recycled into new projects approximately every 14 years and debt every 11 years.

Finally, institutions will have to invest at rates above their steady state reinvestment potential to expand their portfolios. Our analysis assumes that investors start with a negligible amount of investment and reach targets and expand to their full estimated potential immediately, thus we average the full potential investment over the 25-year period. However, this may not be a realistic assumption, and our calculations indicate that if investors take the full 25 years to reach their potential, their average investment over that period would decline 25-50% (because of a reduced capacity for reinvesting capital into the sector), reducing their ability to meet the investment needs over that period. Thus, it is clear that accelerating their involvement is important to fulfilling their potential.

Calculation of investment flows ($ billion)

ASSET CLASS	ASSETS AVAILABLE FOR RENEWABLE INVESTMENT (2010)	ADJUSTED FOR ASSET GROWTH	CONVERTED TO POTENTIAL ANNUAL INVESTMENT FLOW	CATCH UP INVESTMENT TO REACH STEADY STATE	TOTAL AVERAGE ANNUAL POTENTIAL INVESTMENT FLOWS
PROJECT EQUITY	66	86	6.2	2.6	8.8
PROJECT DEBT	191	252	22.9	7.6	30.5
CORPORATE EQUITY	354	466	33.3	14.1	47.4
CORPORATE DEBT	335	441	40.1	13.4	53.5

42 See OECD (2012b). World Bank Data Bank used to calculate actual real growth in GDP in 2011.

Data Sources

	PENSION FUNDS	INSURANCE COMPANIES	SOVEREIGN WEALTH FUNDS	FOUNDATIONS	ENDOWMENTS
TOTAL ASSETS UNDER MANAGEMENT	OECD.Stat Pension Statistics; OECD (2011) "Pension Markets in Focus," Issue 8; Towers Watson (2011b) "Global Pension Asset Study," Presentation.	OECD.Stat Insurance Statistics.	Sovereign Wealth Fund Institute, "Fund Rankings," As of September 2010.	McKinsey Global Institute (2011)	McKinsey Global Institute (2011)
ASSET ALLOCATION	OECD.Stat Pension Statistics; OECD (2011) "Pension Markets in Focus," Issue 8.	OECD.Stat Insurance Statistics.	Norges Bank Investment Management, "Investment Strategy," Accessed December 2012.	Based on Weighted Average Pension Mix	Based on Weighted Average Pension Mix
CONSTRAINTS FOR DIRECT INVESTMENT					
LONG-TERM INVESTORS CLASSIFICATION	Interviews, literature review	Interviews, literature review	Interviews, literature review	Interviews, literature review	Interviews, literature review
FUND SIZE	Towers Watson (2011a) "P&I / TW Top 300 Pension Funds: Analysis as at 2010 Year End," Presentation.	Assumption, based on data from Relbanks.	Sovereign Wealth Fund Institute, "Fund Rankings," As of September 2010.	Foundation Center (2012) "Top 100 U.S. Foundations by Asset Size."	Boston College (2011). "Top 50 Educational Endowments."
MAXIMUM ALLOCATION TO ILLIQUID INVESTMENTS	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews
RENEWABLES SHARE OF ILLIQUID INVESTMENTS	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews	Assumption, based on interviews
CONSTRAINTS FOR CORPORATE INVESTMENT					
SECTOR LIMITS	Assumption, based on investment needs as a share of projected investable gross fixed capital formation (OECD (2012b); World Bank, World Data Bank; IEA (2011))	Assumption, based on investment needs as a share of projected gross fixed capital formation (OECD (2012b); World Bank, World Data Bank; IEA (2011))	Assumption, based on investment needs as a share of projected gross fixed capital formation (OECD (2012b); World Bank, World Data Bank; IEA (2011))	Assumption, based on investment needs as a share of projected gross fixed capital formation (OECD (2012b); World Bank, World Data Bank; IEA (2011))	Assumption, based on investment needs as a share of projected gross fixed capital formation (OECD (2012b); World Bank, World Data Bank; IEA (2011))
OTHER DATA					
ASSET GROWTH	Assumed to grow with real GDP (OECD (2012b); World Bank, World Data Bank)	Assumed to grow with real GDP (OECD (2012b); World Bank, World Data Bank)	Assumed to grow with real GDP (OECD (2012b); World Bank, World Data Bank)	Assumed to grow with real GDP (OECD (2012b); World Bank, World Data Bank)	Assumed to grow with real GDP (OECD (2012b); World Bank, World Data Bank)
REINVESTMENT	Assumed equity return of capital in 20 years, debt in 14 years	Assumed equity return of capital in 20 years, debt in 14 years	Assumed equity return of capital in 20 years, debt in 14 years	Assumed equity return of capital in 20 years, debt in 14 years	Assumed equity return of capital in 20 years, debt in 14 years

Appendix 3. Important policy issues

This section lays out some of the specific concerns about policies – both general policy concerns and specific policies – that we heard in our interviews. Several of these issues CPI has done analytical work to address, while others are areas that deserve further analysis.

General policy concerns

- 3.1 – Longer policy support duration reduces financing costs and could improve attractiveness to institutional investors
- 3.2 – Structure of renewable support mechanism affects financing costs and attractiveness
- 3.3 – Uncertain policy is the most frequently mentioned impediment to renewable energy investment by institutions

Impacts of specific policies

- 3.4 – Electricity and gas unbundling legislation could severely hamper direct investment in renewable energy projects in the E.U.
- 3.5 – Solvency II regulations may make investing in renewable project debt less attractive to most European institutions
- 3.6 – U.S. tax credits/grants reduce appeal of solar and wind projects for direct investment by some institutional investors
- 3.7 – Inflation linked tariff structures could make renewable projects more attractive to many institutional investors
- 3.8 – Loan guarantees and insurance could provide protections and flexibility needed to attract institutional investment

3.1 Longer policy support duration reduces financing costs and could improve attractiveness to institutional investors

GEOGRAPHICAL IMPACT	All
POLICY	Policies provide revenue support (above the prevailing price of electricity) to renewable energy projects, either through direct government incentives or private contracts backed by policy. Some of these policies lead to revenue support over a shorter length of time, while others provide support over the economic life of the project.
INTENT / OBJECTIVE	Short-duration policies are intended to reduce government's long-term liabilities. Long-duration policies are intended to allow for long-term economic viability of projects.
ISSUES	The tenor of debt available to projects is typically linked with the duration of revenue support Shorter policy duration reduces the amount of a project that can be financed with low-cost debt Previous CPI analysis of six renewable energy projects suggested that reducing the length of policy support by 10 years raised the cost of projects by 11-15% by reducing leverage
IMPACT	Impacts investments in projects, particularly project debt Institutions investing in project debt may be less able to offer long tenors, and cash flow profiles may reduce the size of the debt, making it less attractive Institutions investing in project equity may be required to put in greater up-front investment, and hold the asset for a longer period of time to earn a sufficient return
RESULT	Could further bias institutions away from participating in the project debt market, and may reduce the attractiveness of equity cash flow profiles

3.2 Structure of renewable support mechanism affects financing costs and attractiveness

GEOGRAPHICAL IMPACT	All
POLICY	Policies provide revenue support to renewable energy projects through a range of mechanisms, including: • Feed-in tariffs (FiT – fixed price incentive for electricity generated from renewables) • Feed-in premium (fixed payment, on top of electricity market revenue) • Reverse auctions (contract based on bidding process to provide renewables at lowest costs) • Power purchase agreements (private contracts for renewable electricity, driven by regulatory requirements) • Renewable energy credits / renewable obligation credits (tradable credits generated by renewable energy producers, driven by regulatory requirements) These mechanisms each imply a different level of certainty or variability in project revenues.
INTENT / OBJECTIVE	Mechanisms are structured to achieve a variety of goals. These include supporting the economic viability of projects, using markets to meet goals cost-effectively, and supporting the deployment of specific technologies.
ISSUES	1. Less predictable revenue streams are more difficult to finance – in particular, debt investors require more coverage when revenues are less certain 2. Previous CPI analysis of six renewable energy projects indicated that a shift from fixed electricity prices (through a feed-in tariff or PPA) to variable electricity prices (through a feed-in premium) increases the cost of the projects by 4-11% 3. Policies that support emerging technologies using fixed-price incentives need to be managed carefully, and respond to changes in technology costs – unmanaged, these mechanisms can create risks for governments providing those incentives
IMPACT	1. Impacts investments in projects, primarily debt 2. Institutions investing in project debt are likely to require higher coverage ratios for more variable revenue sources 3. Corporate investments may be impacted if poor mechanism design reduces long-term market viability
RESULT	Institutions could invest more debt in markets where incentive structure provides stable cash flows, and less where cash flows are more uncertain.

3.3 Uncertain policy is the most frequently mentioned impediment to renewable energy investment by institutions

GEOGRAPHICAL IMPACT	All
POLICY	The issue most frequently mentioned as an impediment to renewable energy investing by institutional investors is the uncertainty and volatility of renewable policy.
INTENT / OBJECTIVE	Tradeoff between the benefit of reacting to changes in market conditions, costs, and needs versus the stability and predictability of policy and incentives that reduces financing costs and increases the pool of potential investors.
ISSUES	1. Policy needs to: 1) react to changing market conditions or potentially face political problems by giving investors high rents, and 2) control unexpected budget or cost implications 2. However, the threat of changing regulation increases risk for investors 3. Two types of uncertainty: 1) about how policies might be changed due to changing conditions and 2) about how adjustment mechanisms, designed to have policy react automatically, will work in practice 4. Significant difference between policy changes that affect potential new investments and those that retroactively affect the economics of investments that have already been made 5. Renewable energy regulation is new and evolving in many countries 6. Regulatory trends cross borders, so changes to policy regimes in one country will affect risk perceptions around the world; thus, retroactive tariff cuts in Spain have been cited in most countries as an indication of heightened regulatory risk
IMPACT	1. Analyzing renewable energy policy risk becomes more difficult, raising the cost of investing in the sector 2. To protect against these risks and the higher costs, some investors increase margins, others lower sector weights and still others avoid the sector entirely 3. It is unclear how much the costs are real or just perceived, but perceptions matter
RESULT	Policy uncertainty reduces investor pools and increases financing costs.

3.4 Electricity and gas unbundling legislation could severely hamper direct investment in renewable energy projects in the E.U.

GEOGRAPHICAL IMPACT	European Union
POLICY	The European Union's third energy package, which was to take full effect in March 2012, prohibits owners of a controlling interest of gas or electricity transmission assets from having a controlling interest in electricity generation or natural gas production.
INTENT / OBJECTIVE	The policy is intended to prevent owners of transmission networks from operating and expanding their networks in a way that favors their own generation or production and thus distorts the E.U. energy market.
ISSUES	1. Definition of "control" – what constitutes a controlling interest in an asset? 2. E.U. wide scope – owning transmission in Finland prevents renewable ownership in Portugal 3. Cross-sector scope – owning any gas pipelines prohibits renewable electricity ownership 4. Exemption for pre-September 2009 vertically integrated utilities 5. Subsidiarity – The policy is left to the member states to enact, leading to a diverse set of regulatory solutions 6. De minimus exemptions – are possible, but it is unclear which states will have them and how they will interact across borders
IMPACT	1. Impacts only direct investments in projects (either equity or debt) 2. Many institutions that invest directly in projects want controlling interests to 1) structure projects to meet their cash flow and risk/return needs, and 2) avoid potential minorities squeeze 3. Unbundling policy effectively requires direct investors to choose either transmission or generation 4. Most institutions prefer transmission type assets as they have a more classic infrastructure type steady, low risk cash flow 5. Many direct financial investors already have transmission assets in the portfolio and thus would be disqualified from investing in renewable energy projects 6. Uncertainty about the impact of the policy, and the diverse set of national regulations complicates investment in renewable energy projects and therefore significantly increases the transactions costs associated with making these investments
RESULT	Could discourage many of the largest institutional investors from investing directly in renewable projects.

3.5 Solvency II regulations may make investing in renewable project debt less attractive to most European institutions

GEOGRAPHICAL IMPACT	European Union, but similar concerns in other regions
POLICY	New capital adequacy rules for insurance companies.
INTENT / OBJECTIVE	The policy, similar to Basel III directed at banks, is intended to insure that European insurance companies have adequate financial reserves to account for the riskiness of their investment portfolio.
ISSUES	1. Reserve requirements differentiated by asset classes which influence the relative effective cost of investing in these different types of assets 2. Favors shorter term loans and bonds 3. Favors liquid bonds 4. Categorization of different assets – in particular, where would private debt placements for renewable energy fall 5. Currently, private placement debt could fall into "other" or "private equity" class raising reserve requirements 6. Uncertainty about who this will be applied to and whether pension funds will be subject to similar regulation
IMPACT	1. Shorter duration debt significantly increases the cost of financing and could increase project cost by 10-15% 2. Favors bonds over project level debt, but most renewable projects are too small to justify the cost of issuing a bond and having it rated 3. Even if project bonds are issued, they are likely to be lower rated than many corporates, Solvency II will likely increase the spread that institutional investors will require to invest in lower rated bonds 4. Further, these bonds are unlikely to be large enough to be in a standard index, further increasing required spread 5. Categorizing private placement debt in the "other" or "private equity" category makes it unattractive as the reserve requirements implicitly require private equity type returns to justify the investment 6. The largest insurance companies may be able to satisfy regulators of solvency levels and avoid some of the additional reserve requirement through the use of sophisticated ALM modeling; impact on smaller insurance companies could be greater 7. Pension funds, that are not the subject of this regulation, nevertheless appear concerned because they fear that these rules will soon be applied to them and that they cannot justify the sophisticated ALM modeling
RESULT	The pool of potential investors in renewable energy project debt could be sharply curtailed.

3.6 U.S. tax credits/grants reduce appeal of solar and wind projects for direct investment by some institutional investors

GEOGRAPHICAL IMPACT	United States
POLICY	A 30% investment tax credit (ITC) is available for solar facilities installed by the end of 2016, while a $22/MWh production tax credit (PTC) is available for wind producers through 2013. This credit may only be claimed by facilities owned by taxable entities or pass-through entities fully owned by taxable entities or individuals.
INTENT / OBJECTIVE	Provide support for innovative energy technologies to enable long term cost reductions from commercialization and deployment at scale
ISSUES	1. Tax status of public pension funds mean they cannot benefit from these tax credits 2. 5-year claw-back period for tax credit means that even transfer of such a facility to a public pension fund must wait at least 5 years 3. The up-front incentive for grants is not particularly well matched with the long-term, predictable revenues of interest to most institutional investors 4. Difficulty structuring tax equity with project-level senior debt – tax equity investors require forbearance agreements and a significant premium if they enter into such arrangements at all
IMPACT	1. Public pension funds will not provide equity for new renewable facilities which are generally not profitable without the ITC/PTC 2. Equity investment by public pension funds in existing assets is not possible until after the first 6 years (beyond the realization of ITC/PTC claw-back and accelerated depreciation) of operation. 3. Tax equity financing therefore effectively crowds out senior debt financing (either through public debt markets or via project financing) which might be of interest to institutional investors 4. Tax equity also crowds out other varieties of mezzanine financing which might have tenors / risk / return profiles of interest to a broader range of institutional investors
RESULT	Investment tax credits do not enhance the appeal of new solar projects for direct investment by institutional investors, and result in barriers for existing facility refinancing by public pension funds for the first five years of project operation.

3.7 Inflation linked tariff structures could make renewable projects more attractive to many institutional investors

GEOGRAPHICAL IMPACT	All
POLICY	Some regulated energy/infrastructure projects have tariffs, or power purchase contracts, indexed to inflation.
INTENT / OBJECTIVE	Intent can be either to reflect the economics of the projects, its replacement costs, or attract different pools of investors .
ISSUES	1. Renewable energy projects typically have high fixed costs and therefore their costs are not linked to inflation 2. Institutional investors desire for inflation indexation depends on extent to which their liabilities are inflation linked 3. May not be enough investors who want inflation indexation to fund large number of projects 4. Or, may not be enough inflation linked assets for investors to look or plan for them 5. Can be more difficult to leverage projects with inflation linkage because of mismatch with debt markets; although investors may not need to leverage the project
IMPACT	1. Institutional investors with inflation linked liabilities might be willing to accept lower rates of return in order to hedge inflation risk
RESULT	Could lower financing cost, but could also limit the investment pool. Analysis is needed to determine which factor is more important.

3.8 Loan guarantees and insurance could provide protections and flexibility needed to attract institutional investment

GEOGRAPHICAL IMPACT	United States
POLICY	Innovative energy projects have been eligible to apply for guarantees made by the Department of Energy of part (up to 80%) or all (implemented as a direct loan through the Federal Financing Bank) of their project-level debt (with a cap of 80% leverage). Budget authority to cover the subsidy cost of these guarantees has expired.
INTENT / OBJECTIVE	Provide support for innovative energy technologies to enable long term cost reductions from commercialization and deployment at scale
ISSUES	1. Partial loan guarantees provide greater latitude for the creation of investment debt tranches with terms / risk profiles / returns of interest to a broader range of investor classes 2. Loan guarantees transfer significant project risks to the public sector which may not be capable either of appropriately assessing or bearing those risks – for direct loans, this may be inefficient in that it provides both a significant monetary benefit to the project while creating moral hazard 3. Loan guarantees are subject to political risks, both in the politicization of the loan application or approval process and in the political difficulties associated with any defaults
IMPACT	1. Loan guarantees may provide the financial flexibility needed to engineer debt tranches which may be of interest to a broad range of institutional investors 2. Loan guarantees could be used to transfer risks which institutional investors may be unwilling to bear to the public sector, thereby allowing for greater equity investment from institutional investors. 3. However, loan guarantees create significant burdens – informational, political – for government which must be addressed. Direct loans, in particular, could even crowd out private investment if they are perceived as too readily available.
RESULT	Loan guarantees may provide the protections and flexibility needed to bring institutional investors into the renewable space, but can involve implementation challenges.

Appendix 4. Renewable energy capital needs

To compare our estimates of potential investment from institutional investors to investment needs, we relied primarily upon the International Energy Agency (IEA) estimate for investment needs, as published in the IEA's 2011 World Energy Outlook (WEO). This appendix describes how we calculated average annual investment needs for renewable energy from the data published in the 2011 WEO. Further, we used these figures to estimate a reasonable sector limit, and describe that calculation in this appendix as well.

4.1 Estimating renewable energy investment needs

In the 2011 World Energy Outlook, the IEA presents expected investment under several scenarios. The "New Policies Scenario" incorporates broad policy commitments and announced plans for energy and climate policies. The "450 Scenario" sets out an energy pathway consistent with a 50% chance of meeting the goal of limiting global warming to 2 degrees Celsius.[43] We have chosen to compare our estimates to investment needs consistent with meeting climate objectives, not just policy commitments, so we use the 450 Scenario. While the IEA presents ample detail on expected investment in the New Policies Scenario, the data presented on expected investment in the 450 Scenario is less granular, which leads us to make a few key assumptions to get to an appropriate estimate of investment needs for renewable energy generation in the OECD.[44] The table below shows our calculations of renewable energy investment needs, using data from the 2011 WEO.

	2011-2035 CUMULATIVE INVESTMENT ($ BILLION)	2011 WEO SOURCE
NEW POLICIES SCENARIO		
Total global investment in energy supply infrastructure	37,900	Page 97
Total global power sector investment	16,900	Page 97
Total global investment in power plants	9,791	Table 5.5, p. 194
Global investment in non-renewables and large hydro	5,319	Table 5.5, p. 194
Global investment in renewable power plants	4,472	Calculated
Non-OECD renewables investment	1,981	Table 5.5, p. 194
Investment in renewable power plants (OECD only)	**2,491**	**Calculated**
450 SCENARIO		
Total global investment in energy supply infrastructure	35,600	Page 224
Net additional investment in the power transmission and distribution	-930	Page 225
Net additional investment in the power sector	3,100	Page 225
Proportion of total investment into renewables (approximately two-thirds)	66.7%	Page 225, includes hydro
Global investment in renewable power plants including hydro	8,594	Calculated
Investment in hydro (assuming same level of hydro investment as New Policies Scenario)	1,406	Table 5.5, p. 194
Global investment in renewable power plants excluding hydro	7,188	Calculated
Non-OECD renewables investment (assuming same share of renewables investment as New Policies Scenario)	3,184	Calculated
Investment in renewable power plants (OECD only)	**4,004**	**Calculated**
Investment in renewable power plants (OECD only, per year)	**160**	**Calculated**

Assumptions:
1. The amount of investment in hydro is the same between the "New Policies" and "450" scenarios.
2. The proportion of non-hydro renewables investment in Non-OECD is the same between the two scenarios

43 IEA (2011), p. 55.

44 While the 2012 World Energy Outlook provides similar data, investment in the 450 Scenario was not presented with enough granularity to calculate investment needs in this manner. For this reason, we chose to use the figures from the 2011 WEO.

Our estimate of investment needs - $160 billion per year from 2011-2035 – can be further broken down into various asset classes using recent data on actual renewable energy financing. The table below calculates the share of balance sheet versus project financing, as well as debt versus equity investments using data from Bloomberg New Energy Finance.

	OECD, 2011, $ BILLION	SOURCE
Balance sheet	32.1	[1,2]
Project finance	46.8	[1,2]
Bond/other	4.5	[1]
Distributed generation investment (structure not available)	68.8	[1,2]
Project finance leverage	62.2%	[3]
Bond / other leverage	68.2%	[3]
Balance sheet	32.1	[1,2]
Project finance debt	32.1	[4]
Project finance equity	19.1	[4]
Distributed generation investment	68.8	[1,2]
Balance sheet (% of total excluding distributed generation)	38.5%	[4]
Project finance (% of total excluding distributed generation)	61.5%	[4]
Debt (% of project finance)	62.7%	[4]
Equity (% of project finance)	37.3%	[4]

[1] Data from BNEF (2012b).

[2] BNEF Database, includes BNEF estimates for undisclosed deals (totals may differ slightly from Global Trends Report)

[3] BNEF Database, based only on deals with disclosed debt and equity mix - all figures based on at least 10 data points

[4] Calculated

These shares are then used to divide the IEA investment needs estimate of $160 billion per year into corporate and project investment (using the share of investment on balance sheet as a proxy for corporate investment needs), and within each category between debt and equity (using the respective shares for project finance, assuming that corporate investments in renewable energy will ultimately require the same mix of debt and equity as project finance). This calculation yields the table below.

	CORPORATE INVESTMENTS	PROJECT INVESTMENTS
EQUITY	$23.0 billion	$36.8 billion
DEBT	$38.6 billion	$61.8 billion

4.2 Calculating a sector limit for renewable energy

We also use this estimate of investment needs to determine an appropriate sector weight for renewable energy, for the purposes of corporate investment. We calculated this sector weight in several steps:

1. **Estimate gross fixed capital formation (GFCF) from 2011-2035.** We started with OECD estimates of long-term GDP growth for OECD countries (OECD 2012b), and applied these estimates to OECD-wide GDP data from the World Bank to estimate OECD-wide GDP through 2035. Further, we used all available historical data on OECD-wide GDP and GFCF (1960-2010) to calculate the average ratio of GFCF to GDP. We used this average to estimate GFCF through 2035 for the OECD.
2. **Adjust for portions of GFCF that institutions or corporations are unlikely to invest in.** Because households are a source for a large part of investment in dwellings and vehicles, we chose to remove these two components of GFCF from our estimates. These components amount to 34% of GFCF, according to OECD (2012a).
3. **Sum total gross fixed capital formation (excluding dwellings and vehicles) and compare with renewable energy investment needs.** This calculation suggests that over 2011-2035, 2.17% of gross fixed capital formation in the OECD will need to be invested in renewable energy. We have rounded this figure and used 2% as our sector limit for renewable energy investing.

Appendix 5. Asset-liability matching

A pension fund or insurance company entrusts its investment arm and the chief investment officer (CIO) with a sum of money to invest to meet some or all of the institution's liabilities. The CIO then manages an investment team knowing that the higher a return this team gets, the lower the cost of meeting those liabilities and, by extension, the lower the cost of providing pensions or insurance.

But there is significant uncertainty in an institution's liability profile and potential investment performance. Even with good modeling, this team doesn't know exactly when the institution's liabilities will occur and how large they will be. At the same time, the team has a dizzying range of potential investment opportunities, but cannot know with certainty how much any of these investments will grow, how much they will be worth at any given time, or even if money from the investments will be fully available when the parent or sponsor needs money.

Then there are tradeoffs: a riskier portfolio may offer the highest expected return, but may also have higher volatility and uncertainty and therefore increase the probability that the fund will be unable to meet its liabilities at some point in the future.

Renewable energy investments are a minor factor in these types of decisions, that is, even if renewable energy factors in at all. If renewable energy represents 2% of potential investment opportunities (either directly, through pooled vehicles, or through companies that invest in renewable energy) then the investment team could have 49 other options that are just as important, or a handful that are much more important.

Thus, despite some important exceptions, most institutions are unlikely to make board level decisions that pertain specifically to renewable energy. Nevertheless, other strategic decisions that the institutional investors do make have a very significant impact on the amount that they can and do invest in renewable energy. These decisions will affect the type of team the institutional investors build, what types of investments they can make, what return they require and whether their involvement can reduce the overall cost of capital available to renewable energy projects, as discussed in section 6 of this paper.

What is asset-liability matching?

Suppose an individual pension fund member could retire in either 2020 or 2030 and then draw a pension until 2035 or 2055. The pension fund would need to plan against all possible contingencies including payouts beginning in 2020 and lasting for 35 years, or contributions continuing through 2030 with payouts lasting only 5 years. By aggregating all of the members of the plan into a single fund and applying actuarial analysis, the fund can estimate the range of net cash flows that might be required in any year.

To meet these potential cash outflows, the pension fund will invest in financial assets with a range of return expectations, cash flow profiles and expected volatilities. The fund's objective is to maximize the return of the fund, and thus minimize the cost of providing the pension, while assuring that, in the worst case (within limits), enough cash and liquid investments will be available to provide cash outflows needed to service member pensions.

There is a tension between guaranteeing that there is enough cash available to cover the pensions under the most trying of circumstances and achieving greater returns to lower the cost of the pension. Equity investments have higher expected returns over the long term, but higher volatility and greater uncertainty. Thus, with a higher percentage of equity investment in a portfolio, the likelihood of breaching the minimum levels becomes higher. Other investment classes, such as private equity or infrastructure, may be illiquid, that is, the investment could be tied up for 5 or 15 years. If cash needs are unexpectedly high, or investment returns in other parts of the portfolio are unexpectedly low, having money tied up in illiquid funds could cause damage to returns or even insolvency of the fund, and illiquidity becomes another important risk for the investment team to manage.

Armed with the actuarial analysis of the range of potential yearly pension outflows and inflows, the asset-liability matching (ALM) modeling exercise will optimize the mix of "return seeking" investments, such as shares and private equity, and "liability matching" investments such as sovereign debt, corporate bonds and other fixed income, given a set of assumptions about the performance, risk, and correlation between different types of asset classes. Real estate and infrastructure are other asset classes that contain elements of liability matching and return seeking, and are often classified separately in ALM modeling.

There are many different investment options and asset classes that can, in some way, fund capital investment in renewable energy. These include project level investments (whether these investments are debt, equity, unlevered equity, or mezzanine type investments such as preferred equity or convertible debt), investments through fund managers and pooled investment vehicles, or investment in the shares or debt of corporations. ALM analysis and modeling does not delve much into decisions such as whether to invest in renewable energy, information technology or consumer goods, rather it focuses on the high-level asset classes and the general split between equity, debt, and maybe real estate, private equity or infrastructure.

How asset-liability matching can affect renewable energy investing

There are three ALM-related questions that affect the attractiveness of different types of renewable energy investments:

1. How closely do assets and liabilities need to be matched? Should the responsibility for a mismatch between investments and liabilities, if it occurs, rest with the parent or the plan's sponsor?
2. What parameters and assumptions feed the ALM process? For example, what are the regulatory requirements, return objectives, benchmarks employed, risk metrics and limits, and investment time horizons assumed for each asset class, and for the portfolio as a whole?
3. How granular can the ALM (and its related modeling) be? How reliable (and granular) are the data that are used to drive ALM?

How closely do assets and liabilities need to be matched?

In our interviews, we observed a range of practices regarding how closely assets and liabilities are matched. Often, these differences were due to regulation and financial accounting rules. As described in sections 5.2 and 6.4.2 of this paper, many publicly-traded companies are subject to strict accounting rules. In some cases, accounting regulations place specific requirements around the discount rates that can be used in assessing pension or insurance liabilities, often based on the interest rate of high-quality corporate debt. These rules drive many insurance companies and corporate pension funds to select investment practices that very closely match liabilities with less uncertainty.

However, as mentioned in section 5.2, some public-sector pension funds (particularly in the United States) are not subject to the same rules, and instead use a discount rate based on their expected portfolio return, reducing the apparent cost of providing pensions, while increasing the risk of underfunding. Andonov, Bauer and Cremers (2012) provide a detailed discussion of how pension funds assess their liabilities, and the implications these methodological choices have for investment risk profiles.

What parameters and assumptions feed the ALM process?

For some funds, concerns about matching investment performance and cash flow with liabilities remain with the fund's sponsor or parent corporation. In these cases, return, risk and tracking error targets may be set outside of the purview of the fund itself. In other funds, decisions about return targets, risk tolerance and tracking error are made by trustees, a board, or the investment team themselves. Regardless of how these parameters are set, they are critical in the asset liability matching analysis. The importance of these parameters is discussed in detail in section 6.5.5.

How granular can ALM be?

The output of the ALM exercise will usually suggest how much a fund will invest in corporate equities versus bonds, private equity, real estate and so forth. For most investment teams, the next step is strategic asset allocation (SAA), where each of these general asset classes can be divided into separate mandates, for instance, emerging market equities versus US, Australian or European equities. However, we should note that the division between ALM and SAA is less clear than implied here. Some funds or companies skip straight to SAA; that is, their asset allocation model goes directly to defining specific mandates that are then, typically, given to investment managers.

Institutional investors tend to limit the number of asset classes – pension funds typically have 3-6 classes in their ALM analysis, while insurance companies may have more – because the data required grows exponentially as more asset classes are added, while some feel that the robustness and insight gained through extra granularity may diminish.

As some pension funds that we spoke with noted:

> *"We struggle with more (than 4) asset classes"*

and

> *"We had mezzanine as a class, but then we wanted real estate as a class and the board asked us, what about mezzanine in real estate? In the end, more asset classes got to confusing so we had to trim."*

The data needs for ALM modeling can be significant. For example, the models need not only data about the range and probability of returns over various time horizons for each asset class, but also the co-variance, or relationship, between each of the asset classes. For asset classes such as unlisted, private placement debt or private infrastructure equity, where consistent, reliable indices and historical pricing information are hard to come by, calculating the expected performance relative to the general market is difficult, if not impossible. At least one insurance company we interviewed resolved this issue by including private placement debt in the model with a beta of zero, that is, with the assumption that there is no correlation between project debt and the equity markets in general. As mentioned in section 6.5.6, while the data is scarce, there are efforts ongoing to improve the quality of data, particularly by the ratings agencies. Moody's (2012) evaluates the default and recovery rates for project finance bank loans from 1983 to 2010, and S&P (2009 and 2010) has conducted similar studies of the projects they have rated.

But the example of the insurance company that included private placement project debt in their ALM modeling may be an exception. The more typical response we heard involved pressure to limit the number of asset classes as much as possible. Our interviews highlighted a lack of confidence in the robustness of data modeling mezzanine financing, particularly because there are so many potential variations; or questions about how to deal with debt or equity that might be within a real estate or infrastructure class. Many of the investors we interviewed highlighted the diminished transparency and insight that was caused by involving too many asset classes in the ALM modeling.

Impact of ALM on Renewable Energy Investing

The argument for asset-liability matching (also sometimes referred to as liability-driven investing (LDI)) is that if the investment arm understands the constraints and objectives embodied in the likely cash flow needs, then the investment arm will be able to fine tune its investment strategy to these needs and, as a result, create a more efficient portfolio within the constraints of the sponsor's risk and return requirements.

There are several potential counterarguments to this proposition:

- The sponsor may have other ways to absorb or mitigate the investment risk that cannot be translated to the investment arm's objective set or ALM analysis;
- The sponsor's ultimate backers – for instance shareholders or taxpayers – may be willing to bear the additional risk in exchange for lower expected costs;
- The range of potential liabilities and alternative risk mitigation options may be too difficult and subtle to translate into the ALM exercise.

Despite the counterarguments, the trend among institutional investors is clearly moving towards ALM and LDI. Insurance companies, by regulatory requirements, have sophisticated ALM modeling capabilities. Corporate pensions are rapidly moving in the same direction, driven by changes in accounting principles designed to make the costs and risks of pension funds more transparent to shareholders. The same changes in accounting principles are also driving more corporate pension funds to defined contribution pensions, where the risk of investment performance and volatility is transferred to the pension holders. State-sponsored funds are also moving in the direction of ALM or LDI, albeit at a slower pace, perhaps due to the lack of relevant accounting principles or the potential for taxpayers to absorb some of the risk of investment underperformance.

The result of the move towards LDI has been a gradual decrease in the riskiness of portfolios, an increase in fixed income or liability hedging investments, and a decrease in the expected return for the portfolio as a whole. For renewable energy, where the need for debt investment is higher than the need for equity, this trend could be favorable, but only if the other major constraints addressed by this paper can be appropriately addressed.