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Sources of Finance, Investment Policies and Plant Entry in the Renewable Energy Sector

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Christopher Kaminker,
Nick Johnstone

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SOURCES OF FINANCE, INVESTMENT POLICIES AND PLANT ENTRY IN THE RENEWABLE ENERGY SECTOR

By Margarita Kalamova, Christopher Kaminker and Nick Johnstone
OECD Environment Directorate

JEL classification: Q42, Q54, Q58, G24, G32, G38
Key words: Environmental Policy, Investment Policy, Renewable Energy Sources, Asset Finance, Financial Risk, Venture Capital, Climate Change

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ABSTRACT

This report looks specifically at the full array of public policies promoting investment in the renewable energy sector, and discusses their impact on plant entry into the market, with the support of case studies focusing on Germany, the U.S.A. and Australia. It examines differing risk/return expectations across stages of the investment continuum (from R&D through to mergers and acquisitions) and the financial structures that are employed at each stage. Although transparency, predictability and longevity of government programmes are necessary if investors are to initiate a project in clean energy, predictability should not be mistaken for permanence. In the case where policies target investment in physical capital, it is important to 'sunset' many of the policies discussed in this report. It is the nature of entrepreneurship that not all investments in new activities will pay off and not all promotion efforts will be successful. Against such a backdrop, public investment policy will also frequently meet with failure. Combining continuous assessment with policy predictability is a delicate balancing act. Clear criteria for policy evaluation are required, and ideally the criteria for success should depend on productivity.

JEL classification: Q42, Q54, Q58, G24, G32, G38

Key words: Environmental Policy, Investment Policy, Renewable Energy Sources, Asset Finance, Financial Risk, Venture Capital, Climate Change

RÉSUMÉ

Ce rapport s'intéresse plus particulièrement à l'éventail complet des politiques publiques encourageant l'investissement dans le secteur des énergies renouvelables, et analyse leurs effets sur l'entrée de nouvelles entreprises sur le marché, en s'appuyant sur des études de cas réalisées en Allemagne, aux États-Unis et en Australie. Il étudie les différentes attentes en termes de risque/rendement au cours des différentes phases du processus d'investissement (de la R-D jusqu'aux fusions-acquisitions), et les structures financières correspondantes. Bien que la transparence, la prévisibilité et la longévité des programmes publics soient nécessaires pour que les investisseurs se lancent dans les énergies propres, il ne faut pas confondre prévisibilité et permanence. Quand les politiques publiques ciblent l'investissement dans le capital physique, de nombreuses mesures examinées dans ce rapport doivent être mises de côté. Les entrepreneurs savent pertinemment que la totalité des investissements consacrés à de nouvelles activités, y compris les efforts de promotion, ne sont pas toujours fructueux. Dans ce contexte, les politiques d'investissement public se soldent souvent par un échec. Concilier évaluation continue et prévisibilité des politiques est un exercice d'équilibre délicat, qui doit reposer sur des critères d'évaluation clairement définis, dont le principal devrait idéalement être celui de productivité.

Classification JEL: Q42, Q54, Q58, G24, G32, G38

Mots-clés: Politique de l'environnement, politiques d'investissement, énergies renouvelables, financement d'actifs, risque en capital, capital risque, changement climatique

FOREWORD

This report is a contribution to the OECD Environmental Policy Committee (EPOC) and Investment Committee project on "Engaging the Private Sector in Support of a Low-Carbon Future”.

The report has been prepared by Margarita Kalamova, Christopher Kaminker and Nick Johnstone (all of the OECD Secretariat). The authors would like to thank OECD colleagues Jan Corfee-Morlot, Simon Upton, Helen Mountford, Celine Kauffmann, Andrew Prag and Shannon Wang, as well as Mark C. Lewis (Deutsche Bank) for their comments and review. And finally, the report also benefitted from comments received by delegates to the OECD’s Working Party on Climate, Investment and Development under the Environment Policy Committee as well as the Investment Committee.

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EXECUTIVE SUMMARY

While a number of studies have looked at the role of support for R&D or incentives at the output stage (e.g. feed-in tariffs), this study looks specifically at public policies promoting investment in renewable power plants, and discusses their impact on plant entry into the market. The report emphasises that investment policies are just one lever in the policy toolbox to support the development of renewable energy and need to be designed with the broader policy framework in mind.

The focus on policies which target the cost of investment in physical capital should not be interpreted as a supposition that they are the most important policy levers related to the investment decision. Indeed other measures which affect operational efficiency (such as R&D support) or revenue streams (such as feed-in tariffs) will have an important – and often much more important – effect on investment decisions at the project level. The focus of the report on policies which target investment costs directly is motivated by the relative dearth of literature in this area and the greater difficulty of justifying policy interventions.

It is argued that the immaturity of the renewable energy sector increases the difficulties associated with accurately pricing relative risk of investments in "clean" energy, making it more difficult for these technologies to obtain financing at reasonable costs than for fossil fuel technologies. Moreover, in some cases there can be important learning and demonstration effects which will not be realized in the absence of initial support.

Nonetheless, increased risk is not a justification for policy intervention to support investment. Is there a reason to believe that financial markets have more difficulty 'pricing' risk for renewables, thus leading to inefficient levels of finance? The information required by financial institutions to evaluate each potential investment opportunity may be somewhat greater for renewable energy projects than alternative uses of that capital, including investment in conventional forms of energy. This may be exacerbated by the smaller project scale of renewables which lead to disproportionately higher transaction costs and lower *gross* returns (although the *rates* of returns may still be well within attractive market standards). This is a complex area for investment and credit committees of banks to assess given that countries have differing support regimes, varying processes and legal standing for other issues such as awarding grid connections, generation licenses and securing off-take arrangements. Financiers may impose additional costs on generally under-capitalized project developers with limited track records, and have differing risk/return expectations across the stages of the investment continuum (from R&D through to mergers and acquisitions) which may make the various stages more or less attractive commercially. Against this backdrop 'investment' policies may be warranted.

However, it is clear that transparency, predictability and longevity of government programmes is necessary if investors are to initiate a project in clean energy. For instance, the degree of high uncertainty in American Production Tax Credits (PTC) was a contributing factor to investor exit from the wind power sector, in particular. The history of the stop-and-go implementation of the PTC in the US illustrates the importance for governments of ensuring that programmes are not subject to excessive policy uncertainty.

Predictability should not be mistaken for permanence. In the case of policies targeting investment in physical capital, it is important to 'sunset' many of the policies discussed in this report. With time the financial market will price risk efficiently (assuming policy regimes do not generate shocks continuously)

and learning benefits will be exhausted. While there will always be a case for taxing carbon, there will not always be a case for subsidizing investment in different mitigation technologies (including renewable energy).

An inevitable complication in any positive support policy relates to the ‘hazards’ associated with picking (or not picking) winners. While there may be a case for supporting investment in renewable energy on a temporary basis, the allocation of such support across different renewable energy types is a thorny policy issue.[1] In the presence of learning effects an ‘undifferentiated’ (or neutral) policy may not be optimal. Constant assessment of the returns for public investment support in different areas (offshore wind, solar photovoltaic, etc.) is required.

It is also important to ensure that incentives of generating firms, financiers and public agencies are properly aligned. For instance there is a strong case to be made for using tax credits rather than grants as a means of support, thus avoiding the dangers of overcompensation and adverse selection. A complicating factor may be that some potential beneficiaries (i.e. new entrants) do not pay taxes. In such cases it is important to ensure that support is conditioned in some way – i.e. on productivity change over time.

It is the nature of entrepreneurship that not all investments in new activities will pay off and not all promotion efforts will be successful. Against such a backdrop public investment policy will also frequently meet with failure. Combining continuous assessment with policy predictability is a delicate balancing act. Clear criteria for policy evaluation are required, and ideally the criteria for success should depend on productivity.

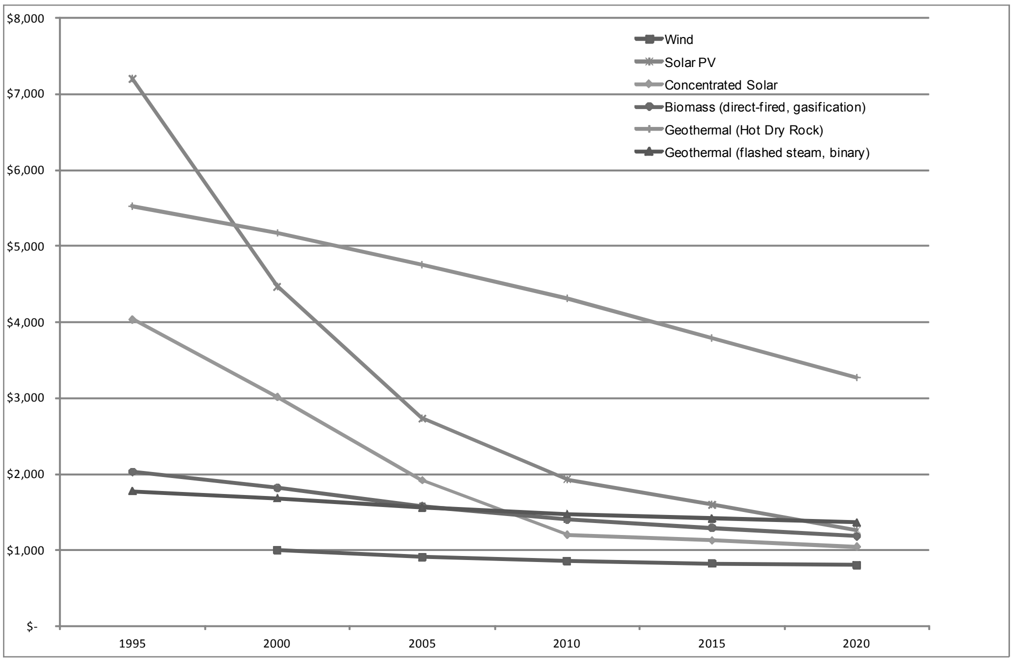
[1] The Environment Directorate assesses how this can be done in the context of R&D, see ENV/EPOC/GSP(2010)1

1. The Renewable Energy Sector

In the absence of policy interventions, free markets in energy services do not take into account social and environmental benefits and costs that might be associated with the generation of electricity. This leads to ongoing market inefficiency with respect to environmental protection and performance. In particular, the environmental impacts of fossil fuels often result in real costs to society, in terms of human health, infrastructure decay, biodiversity deterioration and the costs associated with climate change.

Globally, the IPCC (2011) finds that the levelised cost of energy[2] for most RE technologies has declined over the past 30 years and additional expected technical advances would result in further cost reductions. Examples of important areas of potential technological advancement include: new and improved feedstock production and supply systems, biofuels produced via new processes (also called next-generation or advanced biofuels, e.g., lignocellulosic) and advanced biorefining; advanced PV and CSP technologies and manufacturing processes; enhanced geothermal systems (EGS); multiple emerging ocean technologies; and foundation and turbine designs for offshore wind energy (IPCC, 2011). Figure 1 gives US data on total capital cost ($/kW) from 1995, forecast through to 2020. As RE technologies have matured over time their total capital costs ($/kW) have been falling across the board and are projected to continue to fall (U.S. EIA, 2010).

Figure 1. Total Capital Cost ($/kW) for a range of alternative energy technologies in the US in the period 1995-2020(estimated)



Source: U.S. EIA (2010)

For the most part, however, renewable energy remains more costly than conventional forms of electricity generation, particularly where subsidies to fossil fuels remain in place and the cost of carbon

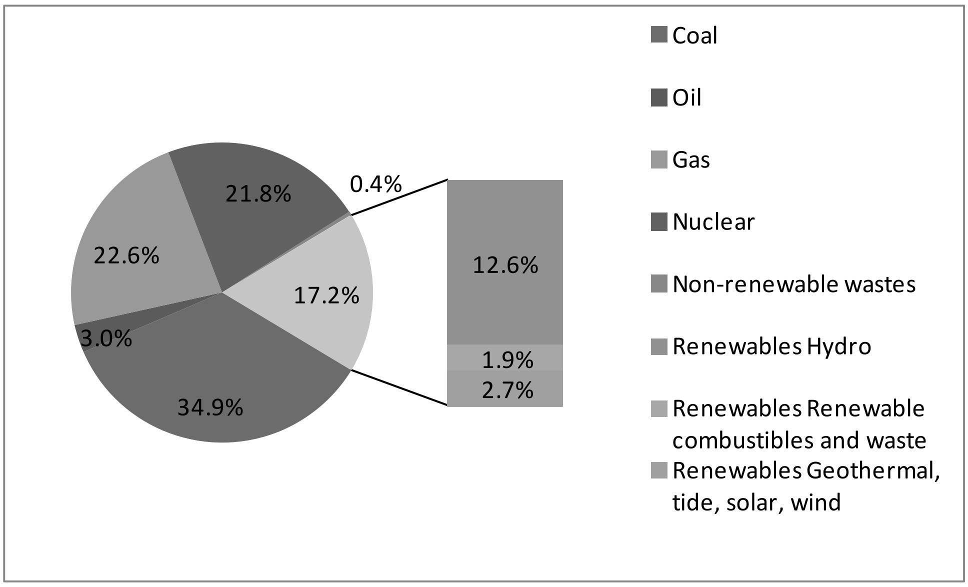
[2] The levelised cost of energy represents the cost of an energy generating system over its lifetime; it is calculated as the per-unit price at which energy must be generated from a specific source over its lifetime to break even. It usually includes all private costs that accrue upstream in the value chain, but does not include the downstream cost of delivery to the final customer; the cost of integration, or external environmental or other costs. Subsidies and tax credits are also not included.

pollution remain unpriced. Thus, in the absence of government intervention in the market, the share of renewable energy sources in the electricity mix will be less than that which is optimal. Indeed, according to some estimates when the externalities associated with different energy sources are fully reflected in policy incentives, some renewable energy sources, particularly wind power, are already as cost efficient as conventional energy sources. As many of these technologies are still in early phases of their respective development chains, further cost reductions are expected in the future, especially if these technologies are appropriately supported by research, development, demonstration and deployment programs (RDD&D).

According to the IEA (2010) gross electricity production in the OECD area from renewable energy sources (including hydro, tide, geothermal, wind, solar, solid biomass, liquid biomass, gas from biomass, and renewable municipal waste) increased from 1,310 TWh to 1,741 TWh between 1990 and 2008. Since 1990, renewable energy generation has been growing only at an annual rate of 1.6%, which is lower than the growth rate of total electricity generation (1.9%). Thus, while in 1990, 17.3% of total electricity was produced from renewable sources, this share has declined to estimated 17.2% in 2009, most of which (12.6%) was generated from hydro plants.

Figure 2 gives the share of renewables in total electricity production amongst OECD countries for the year 2009, compared with the shares of the conventional energy sources. Obviously, more than 80% of produced electricity comes from coal, natural gas and nuclear power plants, while renewable energy sources rank fourth.

Figure 2. Renewable energy share in OECD electricity production in 2009(estimated)



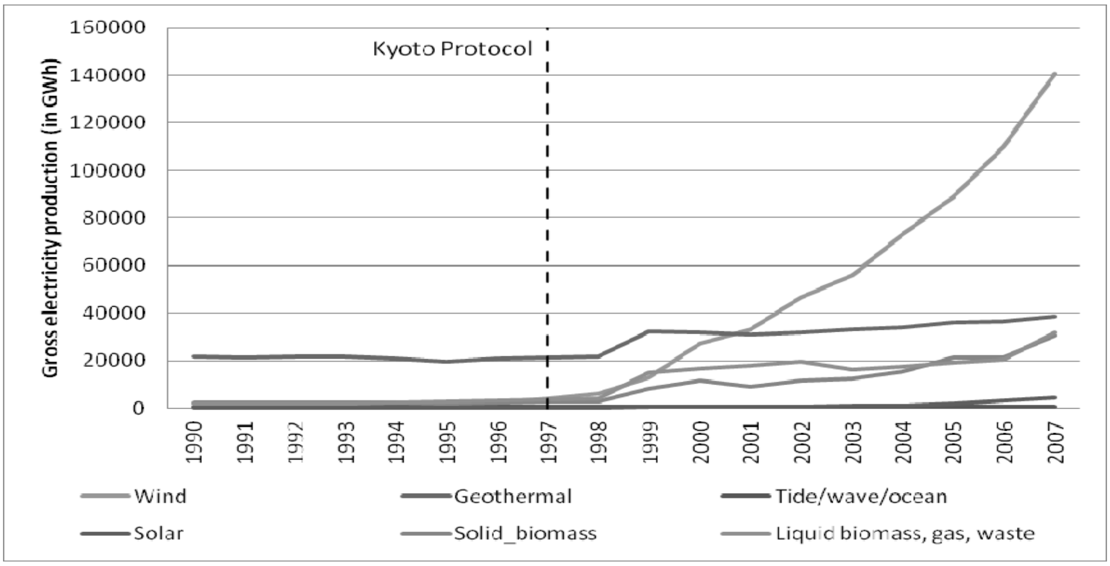
Source: IEA (2010)

Moreover, Figure 3 shows the development of gross electricity production by renewable product over the period 1990-2007 (as measured by GWh). By excluding hydro[3], wind appears to have recently the highest percentage in RES electricity production followed by biomass and geothermal. Since signing of the Kyoto protocol (in December 1997) all renewable products were gaining in importance; however, wind has had the highest annual growth rate amongst RES since then. Solar and tide energy play still a very

[3] We exclude the hydro power sector from the analysis, since no governmental policies have been introduced targeting hydro in the recent decades and the size of the hydro sector, as compared to other renewables and total electricity generation, has been steadily decreasing.

marginal role in the electricity market. Despite the growth rates, the contribution of wind, solar, tide, gas from biomass, renewable municipal waste and liquid biomass to total energy supply is still minor (only 1.2%).

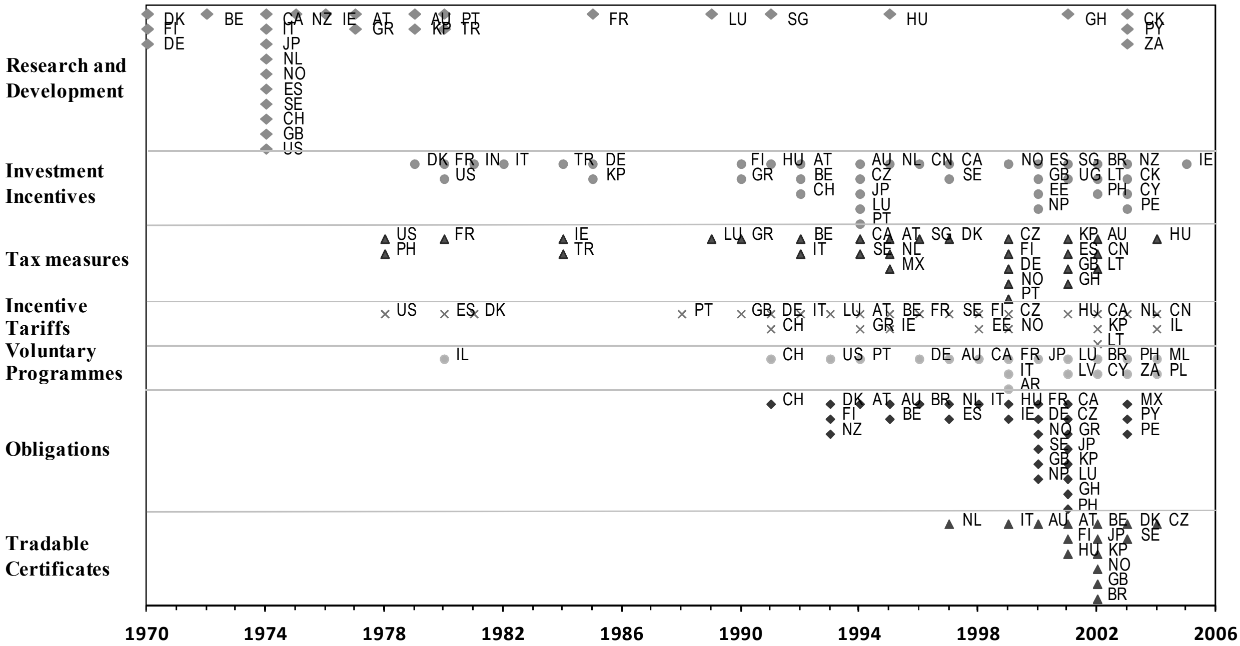
Figure 3. OECD electricity production from 1990 to 2007 by renewable energy source (excluding hydro)



Source: IEA Electricity and Heat Generation: Renewables Database, Edition 2009

In recent years OECD governments have intervened in energy markets with a variety of policies in order to achieve environmental objectives. Policies to promote renewable energy through support for research and development were implemented in some OECD countries in the 1970s, but began to emerge in many more countries in the 1980s, and particularly since the Kyoto Protocol was signed in 1997. Figure 4 indicates clearly that different policy types have been introduced in the OECD countries with some temporal regularity. In the 1970s, many countries introduced support for research and development (R&D), which was followed by investment incentives (capital grants, loan guarantees and low-interest rate loans), taxes (accelerated depreciation, tax credits, tax exemptions and rebates), and price-based policies (feed-in tariffs). Recently, quantity obligations, often followed by certificates in which the obligations are tradable, and net metering have been introduced in the OECD area. According to the Renewable Energy Policy Network for the 21st Century (REN21), the number of countries globally with some kind of renewable energy target and/or deployment policy related to RE almost doubled from an estimated 55 in early 2005 to more than 100 in early 2010 (REN21, 2010).

Figure 4. Renewable energy policies by type in OECD countries in the period 1970-2006



Source: IEA (2004), updated until 2006 by staff of the Renewable Energy Division at the IEA

Considerable work has been undertaken on the effect of policy incentives targeting R&D and large-scale deployment/electricity output (e.g. feed-in tariffs). However, relatively little work has been done on policies related directly to the cost of investment in physical capital (like investment incentives and tax measures). This paper reviews the case for financing of investment in renewable energy plants and the role of government policy in the investment process. In particular, it highlights the important investment needs in electricity generation and points out financing as a major bottleneck in further uptake of renewable energy.

However, the focus on policies which target the cost of investment in physical capital should not be interpreted as a supposition that they are the most important policy levers related to the investment decision. Indeed other measures which affect operational efficiency (such as R&D support) or revenue streams (such as feed-in tariffs) will have an important – and often much more important – effect on investment decisions at the project level. The focus on policies which target investment costs directly is motivated by the relative dearth of literature in this area and the greater difficulty of justifying policy interventions.

Policies targeted at different points in the product life-cycle are often used in conjunction. For instance, a glance at Figure 4 indicates that many countries have introduced a policy package involving a mix of R&D incentives, physical investment incentives, and feed-in tariffs. To the authors' knowledge there are no empirical studies which have assessed the combined impact of such measures on market penetration of renewable energy sources. However, in order for such an approach to be efficient it is important that their roles be complementary, addressing distinct market failures and barriers.

In the next section, we discuss the nature of renewable energy in terms of financing and the importance of different sources of finance for RE plants. Section 3 presents a range of government policies designed to motivate RE supply and, in particular, the establishment of energy plants. In section 4, we use the UDI Database of electricity plants for a descriptive analysis of entry activity in the market of renewable energies for selected OECD countries and look for a relationship between the introduction of government policies and new installed electricity generating capacity. Section 5 concludes.

2. Financing of Renewable Energy Financing

In the event that capital markets did not distinguish between the risks associated with investment in fossil fuel generating plants and renewable energy generating plants there would be little justification for the use of targeted investment policies. For this reason it is important to understand how investment risks in the sector are assessed and priced, an issue addressed in this section. However, before proceeding to discussion of investment risks, the types and sources of finance commonly used in the sector will be summarized, along with trends in financial flows and performance.

2.1. Types and Sources of Finance

In this section, we present the common knowledge from the finance literature about how energy projects can be financed, including those which involve the exploitation of renewable energy sources. In general, there are three forms of finance that can be used to develop projects: investment grants (subsidy), loans (debt), and equity. Mezzanine finance is a combination of debt and equity. (See Box 1.) In the rest of the document we adhere to these definitions, a practice also adopted by UNEP (2007) in their report on financing of renewable energy.

Box 1. Types of finance

Grants are typically provided by governmental organizations. They are, in general, provided to projects that are commercially marginal, and they do not need to be repaid under the condition that the stated purpose of the grant funding is achieved. However, in some cases grants may be convertible to loans or equity if the project achieves commercial success.

Equity is capital raised from shareholders that receive returns through dividends (distributions of cash from after-tax profits) or from the sale of shares. Shareholders have only a residual claim to the assets of the project company. This type of finance represents the highest level of risk, and the expected returns for equity holders are accordingly higher than for lenders. From the project developer's point of view, equity has the advantage of not having to be paid back, thereby freeing up cash flow, which is often particularly important during the early years of a project. Typically, equity providers will only cover part of a project's total cost, as the rate of return on equity can be increased ('geared' up or 'leveraged') by increasing the amount of debt in the project finance structure. Equity can come from many different sources, including venture capital funds, private equity funds, tax equity investors, and public equity capital markets (share issue, i.e. IPO).

Debt is an amount of money provided by a third party to a project that must be repaid either during or at the end of its agreed term. Interest has to be paid over the period of the borrowing. The majority of loans are provided by banks, but also persons and organizations can act as lenders. Loans can take many different forms. The main forms include senior debt, junior or subordinate debt, low-interest loans, lease finance or up-front payments.

Mezzanine finance is a hybrid product from bank debt and equity. As such, it can be seen as 'middle-risk – middle-return' financing. A mezzanine investment can be structured in various forms. Although typically a subordinated loan, it may also comprise preference shares or convertible bonds.

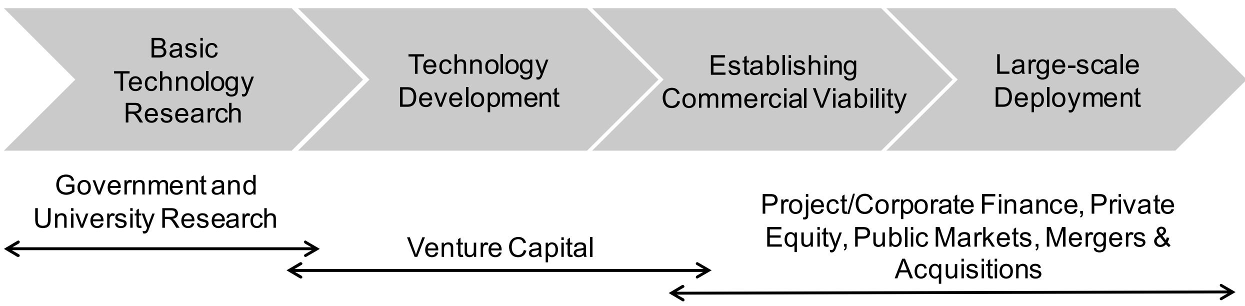
The shares of debt, equity and subsidies covering the project costs depend strongly on the renewable energy source. For example, solar power plants receive a high amount of investment subsidies in the form of up-front payments and tax incentives and much less debt. In some circumstances, especially, for conventionally project financing structures the highest levels of debt that can be supported by the capital structure will be used for associated tax-shield benefits. In the next section, we will illustrate the different financing sources that can be used to finance an investment project in renewable energy, such as project and corporate finance, private equity and venture capital, public markets and the government sector.

Access to financing is a key distinction between traditional fossil fuels and renewable energy projects. Figure 5 shows the flow of activities and financing sources along the life cycle of the development of the renewable energy sector. While this paper is primarily concerned with the right-hand side of the chain (commercialization and deployment), it is important to understand financing needs across the whole value chain or 'investment continuum'.

The first stage - "Basic Technology Research" - poses a particular challenge for emerging technologies. Public support via national or laboratory funding and additional grants are very often available and well-proven sources of finance in this phase. Since 2000, worldwide public investment in RE R&D it has steadily risen to close to USD 2 billion as of 2008 (IEA, 2010). "Technology Development" refers to the demonstration and pre-commercial stage of the technology's life cycle and is generally financed by venture capital[4] (VC) investments. VCs often focus early in the stage of the firm's life cycle, where the capital needs are smaller. Once commercial viability has been established, they often seek to recover their investment either through a sale to established companies in the sector or through the public equity markets (Ghosh and Nanda 2010).

Technology prizes are sometimes used to foster technology development. While the R&D risk lands on the shoulders of the competitors, they have freedom in the way they approach innovation and the competition process is sometimes easier than applying for public grants (contracting, reporting, control). Newell and Wilson (2005) focus on inducement prizes in the US targeted at the middle stages of the technological change process: applied research, development, and demonstration and present considerable evidence that technology prizes have a role to play in the portfolio of inducement mechanisms available to spur climate change–related technological advances. They find that the economics of technology prizes reveal conceptual advantages that support increasing their role in certain cases citing almost 300 years of evidence on their successful implementation and they examine compelling reasons specifically related to climate change. Once again however, their theories and historic evidence cited suggests that getting the design of prizes correct is critical.

Figure 5. Stages of technology development and sources of finance in the renewable energy sectors



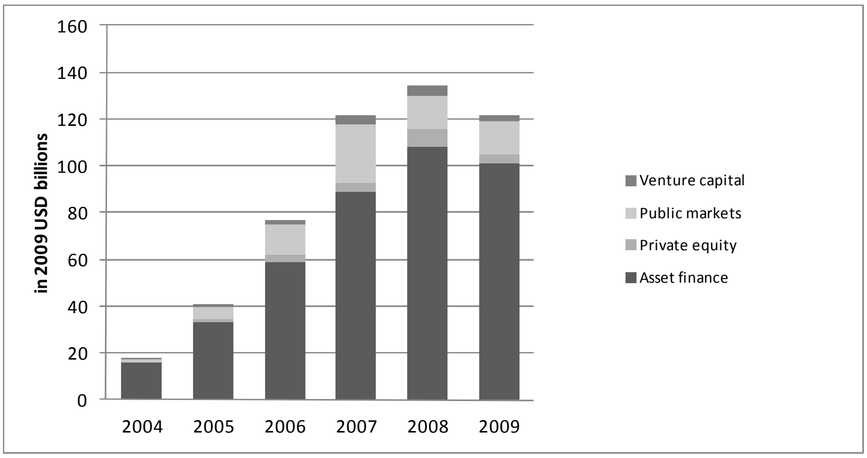
[4] Venture capital is a type of private equity capital typically provided for high-potential technology companies in the early market deployment phase in the interest of generating a return on investment through a trade sale of the company or an eventual listing on a public stock exchange.

The last two stages in the life cycle, "Establishing Commercial Viability" and "Large-scale Deployment", involve the capital needed to set up manufacturing and sales facilities and are financed predominantly by project and corporate finance, via private equity and public markets. The "valley of death" is the distinguishing mark of the "commercialization" stage: the phase between late-stage venture capital financing and full-scale commercial roll-out. BNEF (2010) notes that "banks will always be the first in line to finance your second project", but bank lenders and project finance funders are often unwilling to invest large sums of money in new projects before technologies have been tried and tested over a period of few years. The problems posed at this stage represent fundamental, structural market shortcomings, which cannot always be resolved by the private sector acting on its own. In some cases, it is only with the public sector's help that the "valley of death" can be bridged. The means by which this can be done is discussed in Section 3.

Financing the construction of RE generating facilities involves a mix of equity investment from project owners and loans from banks ('private debt') or capital markets ('public debt' raised through bond offerings). Both types of finance are combined into the term 'asset finance', which represents all forms of financing secured for RE projects (whether from internal funds, debt finance or equity finance) (IPCC, 2011). The refinancing and sale of companies is the last stage of the 'investment continuum'. Mergers and acquisitions (M&A) transactions in the RE sector usually involve the sale of generating assets or project pipelines, or sale of companies that develop or manufacture technologies and services.

Figure 6 gives an overview of the investment flows to renewable energy markets in the period 2004-2009. Renewable energy markets have been growing robustly until the outbreak of the global financial crisis in 2008. However, despite the world economic downturn, 2009 total investments in clean energy declined by only 6.6 % from the year before, reaching 162 USD billions globally (Pew 2010). Moreover, the trend set in 2008, when the clean energy sector investment outperformed investment in fossil-fuel technologies for the first time, persisted through 2009. In comparison, according to the World Energy Outlook 2009 (IEA 2009a), the global oil and gas industry had investment declines of 19 percent in 2009.

Figure 6. Global sustainable energy investment by type of private sector's investment

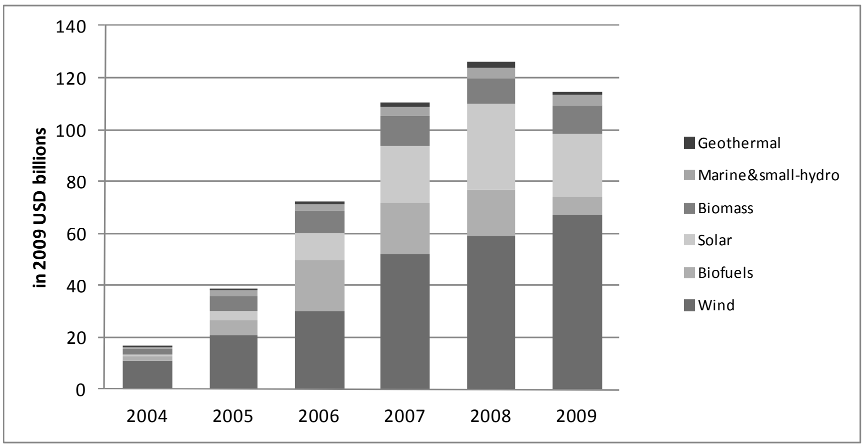


Source: Bloomberg New Energy Finance data from the report of UNEP and BNEF (2010)

Asset finance represents the highest share (more than 70%) of private sector's finance for the clean energy industry (including electricity generation by renewable sources, energy efficiency and bio-fuels). Venture capital and private equity financing have been contributing least (7% in the period 2004-2009) to investment in renewable energy, followed by the public equity markets (14%).

Throughout the last decade, the wind energy sector has been the primary recipient of clean energy investment, which reflects its mature status as a large-scale generation source. In 2009, wind energy accounted for 56%of global clean energy investment. Investment in solar energy follows wind's leading position and is poised to expand as a result of declining solar energy prices and the potential of new, thin-film technologies as noted by Pew (2010). New investment in biomass, geothermal and small hydro seems to play a marginal role in the total market (see Figure 7).

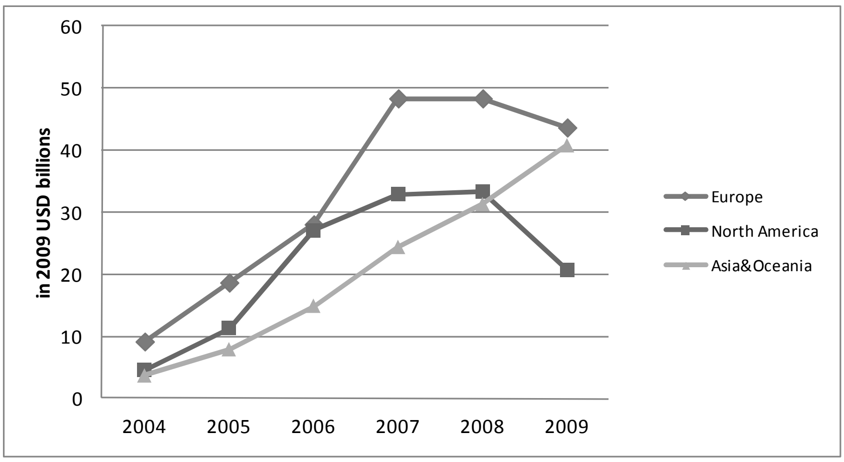
Figure 7. Financial sector new investment (incl. VC, PE, asset finance and public markets) by type of renewable energy



Source: Bloomberg New Energy Finance data from the report of UNEP and BNEF (2010)

Until recently, European countries have dominated the most important markets for new investment. This investment has been underpinned by government policies supporting new clean energy projects. Since 2009 the increased role of Asia, and in particular China, is changing the landscape of the sector. China took the first place for total clean energy finance in 2009, ranking ahead of the United States, whose clean energy investment fell 40%%that year. China's investments are a response to ambitious renewable energy targets and are expected to greatly increase with China's *12th Five Year Plan,* which runs from 2011 to 2015. Below, we discuss and give evidence on each source of finance separately.

Figure 8. Financial investment (incl. VC, PE, asset finance and public markets) by region

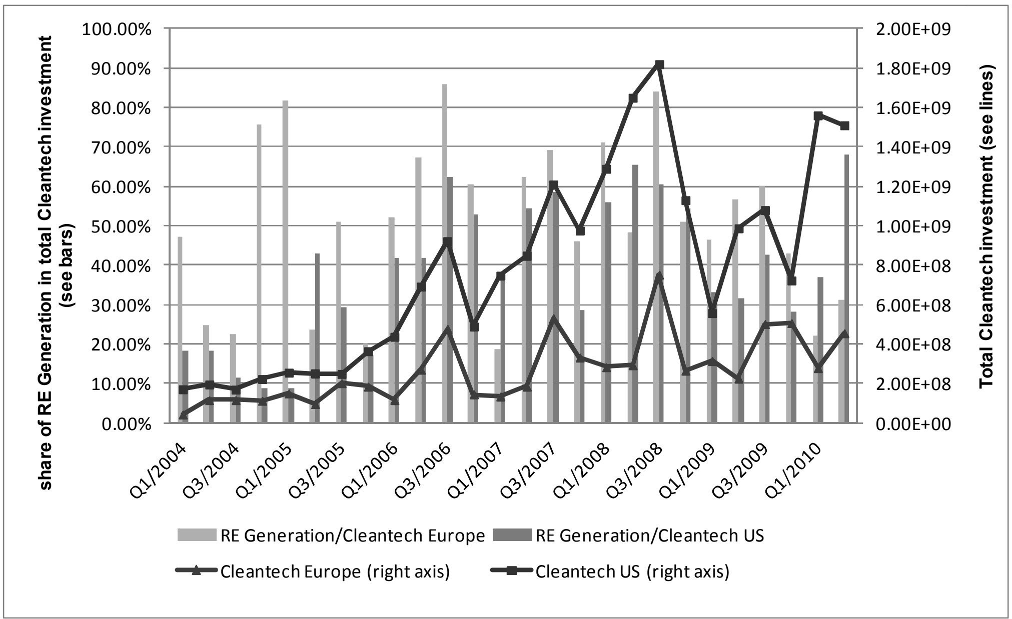


Source: Bloomberg New Energy Finance data from the report of UNEP and BNEF (2010)

Let us consider first financing of renewable energy expansion through venture capital (VC), which is a major source of finance for companies at the "Technology Development" stage. VC investment in clean energy has increased steadily over the last decade until the onset of the crisis in 2008. And while the total amount of VC investment has risen sharply since early 2009 (as evident from Figure 9), the number of investors contributing to this growth has remained relatively flat (Cleantech, 2010). The figure shows additionally that the share of investments in RE generation is falling as compared to pre-crisis levels. This highlights the fact that VCs have begun moving their focus away from full-scale energy producers.

Ghosh and Nanda (2010) consider the risk associated with scaling up to be the main force behind this trend. In general, demonstration and initial commercial plants for energy production are very capital intensive. They can reach several hundred millions of dollars over a 5-10 year period, compared to the tens of millions that are typically associated with VC investment in any given start-up. Moreover, VCs are hindered from exiting the investment in time[5], because these start-ups are still too risky for project and corporate finance investors to fund their demonstration and first commercial plants. As a result, VC investors are changing their focus towards less capital intensive ventures, such as RE component manufacturers, whose profile more closely matches their investment approach.

Figure 9. Venture capital investment in Cleantech industries in Europe and US (2004-q2/2010)

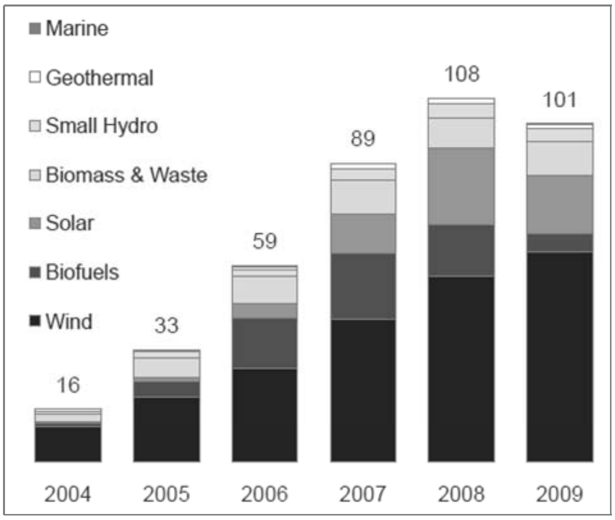


Source: www.cleantech.com

Second, we consider asset finance – including project finance and corporate finance – which characterises the majority of investment projects in renewable products (see Figure 6). As mentioned above, it is the major source of finance used in the construction phase of RE investment projects. Figure 10 provides an overview of the amount of investment financed via asset finance which went to the different renewable energy sources in the period 2004-2009. Because of the financial crisis, global asset financing in 2009 fell by 6 % from 2008. Still, a drop in investment in US and European projects was offset by a continued growth in China. The top sector for investment globally was wind, followed by solar and biomass energy. The next paragraphs differentiate between project and corporate finance.

[5] VC funds are generally structured to have a life of 10 years.

Figure 10. Asset finance (incl. project and corporate financing) by renewable energy sector



Source: UNEP and BNEF (2010)

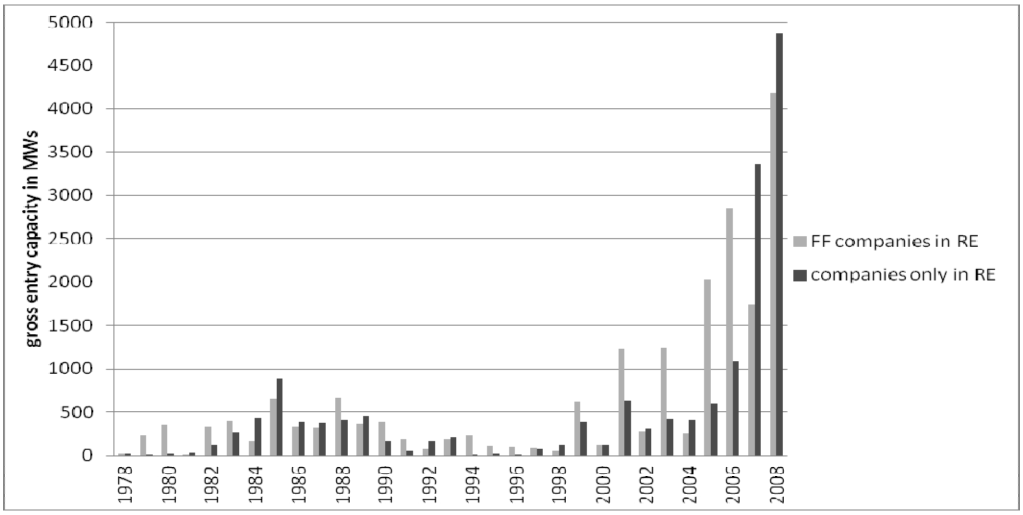
In the case of project finance the cash flow of the project itself determines the structure of the financing model and its key financial parameters. Loans are either non- or limited recourse to the parent company and therefore either have negligible or no impact on the company's balance sheet or creditworthiness. As a result, small- and medium-sized developers are free to pursue several projects simultaneously without large negative company-wide impacts. Project finance structures involve thus simple debt and equity and have been most popular in Europe, where government fiscal incentives have often reduced the associated risk. The principal advantages of the project finance structure are the developer's ability to raise large amounts of debt, and limited recourse to assets of project sponsors. UNEP (2007) reports that a typical project finance structure in an OECD country consists of 10-30% equity, 60-90% senior debt, and 0-15% junior debt. Depending on the source of renewable energy, grants may also cover a large share of the project costs.

The main characteristic of corporate finance is that the financing of the project is based on the risk profile of the company as a whole. This implies that utilities and multinational companies can use their access to cheap capital, as a result of their low risk profile, to invest in RE technologies. As such, their activity levels can be considered as one of the key indicators of the health and growth of the market for clean energy. Cleantech (2010) reports a 325 % increase in corporate investment in the first two quarters of 2010 as compared to the same period of 2009. To make use of corporate finance, an electricity provider (including developer and project investor) should have a track record in the market. This condition applies mainly to firms that have unrestricted access to capital markets for raising funds, such as utility-like companies operating in the market for renewables and other firms in the rather mature renewables sectors (on-shore wind, geothermal or biomass).

Figure 11 compares the entry of new plants owned and operated by renewable energy companies (excluding hydro) with entry of plants owned and operated by utility-like companies. Until 2007 many of the renewable energy plants in the US and Canada were developed by companies operating as fossil-fuel utilities, while in 2007 and 2008 there is more plant entry from renewable-only firms (analysis is based on the data availability in the UDI Platts database). However, larger power companies and utilities in Canada continue to be strong players in the RE sector through merger and acquisitions, by launching their own projects and participating in various competitive procurement processes at the provincial level. Cleantech

(2010) reports that utilities are accelerating the adoption of wind and solar, in particular. The reduced cost of these energy sources and the increased government support are considered to be the main incentives for utilities to increase their RE investments. Examples include the recent 700 MW wind project of the AES Corporation as well as Dow Chemical's investment in solar PV, among others.[6]

Figure 11. Ownership of new renewable energy plants (measured in MW) in North America: renewable-only companies versus conventional energy companies



Source: UDI Platts

Evidence shows that very often building a new power plant in the renewable sector is supported by not just one financing source, such as project or corporate finance, but that hybrid financing structures can be utilized. Harper et al. (2007) identify seven different sources of finance for the wind sector in the US, which feature varying combinations of equity capital from project developers, third party tax-oriented investors (both strategic and institutional investors), and commercial debt. Their origins stem from variations in the financial capacity and strength, as well as the business objectives, of wind project developers. We are not going to discuss these specific financing models, but present the classification developed by Harper et al. (2007) in Table 1.

[6] However, Ghosh and Nanda (2010) raise an important concern that many fossil-fuel utilities invest in renewable technologies for effective marketing reasons rather than for long-term energy generation from renewable sources. And very often it is the solar and wind energy companies, which have themselves reached the utility stage, that become active investors in their respective sub-sectors.

Table 1. Financing structures in the US wind power sector

Financing Structure	Project Capital Structure	Likely Equity Investors	Brief Description of Structure Mechanics
Corporate	All equity	Developer (corporate entity)	Corporate entity develops project and finances all costs. No other investor or lender capital is involved. Corporate entity is able to utilize Tax Benefits (no flip).
Strategic Investor Flip	All equity	Developer and Strategic Investor	Strategic Investor contributes almost all of the equity and receives a *pro rata* percentage of the cash & Tax Benefits prior to a return-based flip in the allocations.
Institutional Investor Flip	All equity	Developer and Institutional Investor	and receives *all* of the Tax Benefits and, after the developer has recouped its investment, *all* of the cash benefits, until a return-based flip in the allocations.
Pay-As-You-Go ("PAYGO")	All equity	Developer and Institutional Investor	Institutional Investor finances much of the project, injecting some equity up-front and additional equity over time as the PTCs are generated. Includes a return-based flip in the allocations.
Cash Leveraged	Equity and debt	Developer and Institutional Investor	Based on the Strategic Investor Flip structure, but adds debt financing. Likely involves Institutional Investors, rather than Strategic Investors. Loan size/amortization based on the amount of cash flow
Cash & PTC Leveraged	Equity and debt	Developer and Institutional Investor	Similar to the Cash Leveraged structure, but the loan size and amortization profile are based on the cash flowfrom power sales *plus* a monetization of the projected PTCs from the project.
Back Leveraged	All equity (but developer uses debt outside of project)	Developer and Institutional Investor	Virtually identical to the Institutional Investor Flip, but with the developer leveraging its equity stake in the project using debt financing.

Source: Harper et al. (2007)

Last, we consider public equity market financing. Typically, it enables companies to raise capital for expansion and growth, especially, through initial public offerings. Private equity, which is a source for raising growth capital in relatively mature companies that are not publically traded, will not be discussed here. In Figure 12 we compare the development of the World Alternative Energy Index (WAEX) with the S&P 500 and the S&P GSCI Energy Index (a benchmark for investment in the energy-commodity markets and a measure of commodity performance over time)[7]. The clean energy market reached its peak in 2007. While at the end of 2008 the Commodity Index declined by 100 percentage points, the WAEX dropped by 200 percentage points.

Pew (2010) notes several reasons for this development. One of the reasons is investor demand, which collapsed during the financial crisis, thus lowering stock prices and slowing market investment in the sector. A second reason is tight credit markets in which established companies are struggling to raise capital to strengthen their balance sheets rather than to fund growth plans. Nevertheless, Cleantech (2010) reports that while Europe's and North American IPO activity is still well below its peak in 2007, China's market has been clearly recovering and recently reached its highest values on record, by amount raised and number of transactions.

[7] The WAEX index includes the 20 largest stocks involved in 1) renewable energy (solar, wind and biomass); 2) energy efficiency (better use of energy generation, which involves industries such as energy meters and supraconductors), and 3) decentralized energy supply (power generation in close proximity to the consumer, involving microturbines and fuel cells). WAEX is an equally weighted benchmark, i.e. the weight of each member is set at 5% on quarterly basis.

Figure 12. SGI World Alternative Energy Index as compared to S&P 500 Index and S&P GSCI Energy Index

Source: Bloomberg

2.2. Market, Technology and Regulatory Risk in the Renewable Energy Sector

All projects are subject to risk. In this section we review the main characteristics of the risks associated with renewable energy projects. In at least some respects risks may differ from those associated with 'substitute' projects (i.e. fossil fuel plants), and we discuss instances in which this is the case.

Irreversibility characterizes most major capital investments in the electricity generating sector. Investment is partially or totally irreversible when some or all of its costs are sunk. What makes investment expenditure in a power plant a sunk cost? In general, a power plant is industry specific, thus it can only be used to produce electricity and cannot be converted to other uses. On the one hand, if one power generating firm suffers an idiosyncratic negative shock, it can sell its plant to another firm and get fairly good value for it, in which case irreversibility is less severe. On the other hand, if the whole industry suffers a negative shock, then the resale value of the plant is small and the irreversibility is large.

Although the high sunk costs associated with irreversible investments are a barrier common to both fossil fuels and renewables, there are other factors which have different effects on the financing costs for renewable energy relative to fossil fuels, and which help to explain the slow transition from a sector reliant on fossil fuels to one in which renewables have a more important share. These factors include resource-based and geographic conditions, the relative maturity of the sector, capital cost and size of the investment projects, lack of institutional track record and the role of government policies.

The geographic and resource-based conditions for renewable energy sources differ widely across the world and the OECD area, in particular. For example, the countries with the best wind conditions in Europe are France, UK, and Ireland (with Denmark and Germany being the largest wind power producers). Austria, Finland, Sweden, and Italy are among those with good conditions concerning hydro energy generation (Reiche and Bechberger 2004). While fossil fuel plants, for example, can be established almost anywhere, renewable energy plants have to be built where the energy source is available. Most importantly, renewable energy sources are fundamentally non-tradable in contrast to fossil fuels (excluding coal).

Even though lower fuel and operating costs may make renewable energy cost-competitive on a life cycle basis, higher initial capital costs can mean that renewables provide less generation capacity per initial dollar invested than conventional energy sources. Thus, RE investments generally require higher amounts of financing that must be amortized over the life of the project for the same capacity. Depending on the circumstances, capital markets may demand a premium in lending rates for financing renewable energy projects due to the higher up-front capital risk associated with investment in renewables than with conventional energy projects and the legislative/political risk at the operational stage (Mendonca 2007).

Furthermore, most renewable energy projects using solar energy, in particular, are small compared to coal, nuclear, and natural gas facilities. Symeonidis (1996) shows that positive linkage between concentration/size and investment activity can occur when high sunk costs dominate individual projects, and economies of scale and scope in the production of innovation rents are available. Many financing institutions are not interested in small transactions. Even if financing is available, the transaction costs per megawatt are much higher for smaller projects because many of the same financing and development steps must be followed regardless of facility size. Furthermore, as the IPCC (2011) discusses, this smaller project scale may lead to disproportionately higher transaction costs and lower *gross* returns (although the *rates* of returns may still be well within attractive market standards). Beside the small size of many companies entering the renewables market, banks and investors are reluctant to support projects also because of the lack of institutional track record.[8] Therefore, big incumbent companies with proven track record (RWE or E.ON, for instance) will have a clear advantage over new small firms and households entering the market.

Perceived technological risks may also be greater for at least some types of renewable energy. Due to the relative 'immaturity' of the renewable energy sector most financial institutions do not have significant experience in evaluating renewable energy resource risks. Furthermore, the lack of visible installation and familiarity with RE technologies can lead to perceptions of greater technical risk than for conventional energy sources. Many renewable energy technologies are also perceived as unproven, with large performance risks. Institutional memory of past project failures makes raising capital difficult and costly for many renewables developers. These real and perceived risks generally result in financing that is more costly than that which is available to more traditional generation sources.[9] As the IPCC (2011) points out, to operate effectively, markets rely on timely, appropriate and truthful information. But energy markets are far from perfect; and this is especially true of markets in technological and structural transition, such as the RE market. Thus, as a result of insufficient information, underlying project risk can tend to be overrated and transaction costs can increase as compared to conventional fossil fuel technologies.

In addition to the market and technological risks noted, it was pointed out that some form of fiscal support is usually necessary for RE projects to be attractive to equity investors and lenders. Often, the viability of a specific investment is dependent upon a particular policy regime remaining in place, and this is a major risk that equity and debt (banks) investors will need to evaluate before deciding on the financing parameters for the project. This is significant since it can take more than five years to develop, permit and construct a new renewable energy plant.

Therefore, developers must absorb significant risk during the development of a project if there is some uncertainty that a particular policy will apply to their project when it comes on-line. Even where policies survive attempts at legislative intervention, agency and/or court rulings can significantly alter a policy's applicability and implementation. To the extent that unpredictability in these policies provides

[8] However, banks in some OECD countries including Germany and France, among others, have a financing history for renewables dating back twenty five years.

[9] Note, however, that some 'advanced' fossil fuel technologies will face a premium due to technological uncertainties,

some uncertainty to the underlying economics of renewable energy technologies, financiers will be reluctant to invest. [10]

2.3. Pricing of Risk

Taken together, the factors presented above increase the relative risk of renewables and thus make it more difficult for those technologies to obtain financing at reasonable costs than for more mainstream generation technologies (including gas, coal, and oil). Table 2 (adapted from Szabó et al., 2010) presents an assessment of technology, market and regulatory risks for different energy sources.

Table 2. Qualitative risk levels and risk dimensions of different electricity technologies

Technology/Risk type	Technology risk	Market risk	Regulatory policy risk
PV	Low	Medium	Low
Concentrated solar	Medium/High	Medium	Low
Wind	Low	Medium	Low
Bioenergy	Low	Medium	Low
Fossil/Nuclear	Low/Medium	Low	Medium

Source: Szabó et al. (2010)

How does this translate into financing costs? The table above gives qualitative indication for some risk dimensions. At the final stage in the risk assessment, the risk scores in the various risk dimensions have to be translated to a single number: the expected return value. For instance, the regulatory risk premium of a PV technology is below zero (e.g. -3%), but its technology premium is 3% instead. At the same time, we can observe the opposite figures for fossil-based technologies (-3 to +3% regulatory risk and 0% technology risk). The expected return rates add up to a required return on investment between 9% and 30%, the main factor for the large range being the maturity of the technology. Depending on its cash-flow, different technologies can obtain 50-80% of its investment needs from a bank at an interest rate of 6-9%, while the rest has to be filled by equity financing, which for these kinds of investment will typically require a return of between 15% and 30%. This results in a weighted average cost of capital of 8-20%. The major factors in what cost level the different technology market can achieve depend on, besides the discussed risk levels, the level of debt financing from the financial institutions, the level of equity financing, the interest rate and the required return on equity (Szabó 2010).

What is the evidence on risk premiums for renewable energy relative to conventional energy projects? There is considerable variation in the rates that banks charge, depending on the location, the size of the project and the technology used. Onshore wind projects, for example, will enjoy a smaller spread over LIBOR[11] than offshore projects and solar PV a smaller spread than solar thermal. Before the financial crisis, renewable energy project debt was reported to be at a premium of approximately 200-300 basis points (Chadbourne and Parke, 2009) above a public financial indicator, such as LIBOR. For example, an

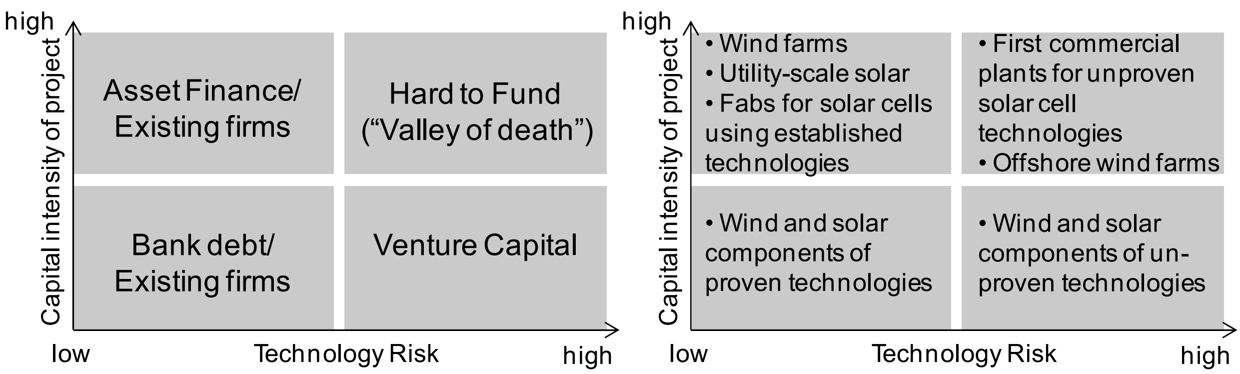
[10] Note that investors also face uncertainty with respect to existing policies which support fossil fuels. For instance, large public subsidies for all energy forms distort investment cost decisions. The World Bank and International Energy Agency estimate global annual subsidies for fossil fuels to be still very significant ranging between US$100-200 billion. This represents a significant barrier to the penetration of renewable energy in the electricity generating sector.

[11] LIBOR is a daily reference rate based on the interest rates at which banks borrow unsecured funds from other banks in the interbank market.

operational UK wind farm generating revenue under a long term power contract could have borrowed money at a rate of LIBOR + 110 basis points in the first half of 2008 (even less in 2007), expected to pay in the order of LIBOR + 350 basis points for the same loan by mid 2009. In July of 2010, the premium for bank debt for RE projects in the US was reported to be 225 to 300 basis points above LIBOR and about 50 basis points higher in the capital markets (Chadbourne and Parke, 2010). [12]

Figure 13 positions RE technologies and different financing sources in terms of technology risk and capital cost. The two left-hand boxes outline the deployment of more mature energy generation technologies. They are characterized by relatively low technology risk as a result of successful commercialization. The upper left box contains projects, such as wind farms or utility-like solar, which are expensive to finance. However, since the underlying technologies have been tried and tested over a few years, debt investors are willing to invest large sums, and public markets and private equity will support the growth of such companies. The lower left box is typically financed by corporate finance, because projects there are less capital intensive and often undertaken by existing companies. In contrast, technologies in the two right-hand boxes have high technology risk and cannot attract asset finance because of that. The lower box covers projects such as the development of wind and solar components of unproven technologies, which are not very capital intensive. As such they fit well to the investment approach of venture capital companies. The problematic box, however, is the upper right-hand one. First commercial plants of unproven technologies are a common example in this box. Because of their high risk and capital intensity, they can hardly attract private finance for their investment projects and are thus trapped in the "valley of death", we presented above.

Figure 13. Focus of different sources of finance with respect to technology risk and capital intensity



Source: Adapted from Ghosh and Nanda (2010)

However, increased risk is not a justification for policy intervention to support investment. Is there a reason to believe that financial markets have more difficulty 'pricing' risk for renewable, thus leading to inefficient levels of finance. The information required by financial institutions to evaluate each potential investment opportunity may be somewhat greater for renewable energy projects than alternative uses of that capital, including investment in conventional forms of energy. This is a complex area for credit committees of investment banks to assess given that countries have differing support regimes and varying

[12] At the same time, premiums for the average US conventional coal fired plant ranged from 140 to 250 basis points above LIBOR (Chadbourne & Parke, 2010), while conventional plants may face a risk premium due to policy uncertainty concerning future climate change policies. This latter point is reflected in the AEO 2010 Reference case of the U.S. EIA (2010) which assumes a 300 basis point premium for the cost of capital for new coal-fired capacity. Because nuclear and renewable power plants (including wind plants) do not emit GHGs, however, their costs are not directly affected by regulatory uncertainty in this area.

process and legal standing for other issues such as awarding grid connections, generation licenses and securing off-take arrangements. Against this backdrop 'investment' policies may be warranted.

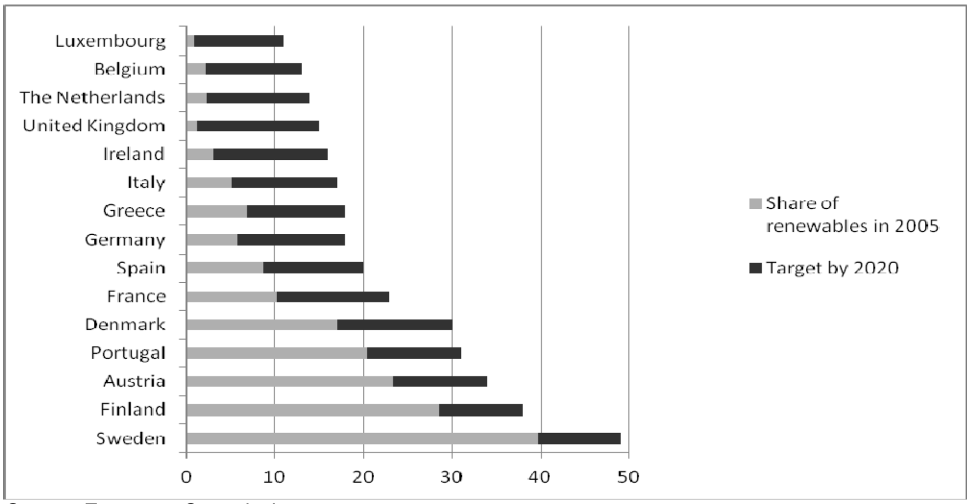
3. Government Policies for Renewables

3.1 Public Support for Renewables

Government policies can promote investment in renewable energy when they are bound to clear policy targets which guarantee stability and commitment. Policy targets for renewable energy exist in at least 85 countries. Most national targets are for shares of renewable energy supply in total electricity production, typically 5-30%, but ranging all the way from 2 to 90% (REN21 2010). For instance, the European Union Directive of 2008, which succeeds the one from 2001, requires member states to increase their shares of renewable energies to meet a 20% overall energy target by 2020. The directive set a series of interim targets, known as 'indicative trajectories', in order to ensure steady progress towards the 2020 targets. EU countries are free to decide their own mix of renewables, allowing them to account for their different potentials, while Brussels reserves the right to enact infringement proceedings if states do not take appropriate measures towards their targets. Figure 14 gives the 2020 national targets for renewable use in EU-15 as compared to the 2005 share of renewables in total energy supply. Another example is Canada, whose government is committed to reducing Canada's total greenhouse gas emissions by 17% % from 2005 levels by 2020. The government also intends to implement regulations which will require an amount of renewable fuels equal to 5% of the volume of the gasoline pool by 2010 and 2% renewable content in diesel and heating oil by 2012 upon successful demonstration of renewable diesel fuel use under the range of Canadian conditions.

At least 83 countries have some type of policy to encourage renewable power generation (REN21 2010). In all these countries government policies have been designed to specifically target different stages of the industrial process, ranging from the research and development (R&D), through the investment in physical capital (plants and equipment) up to the production and sale/consumption of energy. While abundant literature documents the design and efficiency of policies supporting R&D and providing direct price incentives, there is no evidence on whether and how government policy directly influences investment in renewable energies. This section discusses the government role in promoting renewable energy investment and, particularly, in the establishment of renewable energy power plants, and exemplifies the practice in OECD countries to date.

Figure 14. EU15 renewable energy targets: Share in final energy by 2020 as compared to share of renewables in 2005



Source: European Commission

Renewable energy is a blend of multiple technologies at different stages of maturity, and stimulating investment in these will require different types of policy instruments. Supporting investment in RE can be achieved in multiple ways: by modifying the rules of the energy markets and trade; by promoting equity or debt investment through direct financial transfers; by means of tax rules; or by direct government provision of energy-related services. The choice of mechanism depends on local political and economic conditions. Table 3 gives an overview of the most common public policy mechanisms (according to OECD (1998) definition of subsidies) to encourage investment in the market for renewable energy; these are organized according to the different stages of technology development, including R&D, capital investment and large-scale deployment.

Table 3. Types of renewable energy promotion policies along the stages of technology development

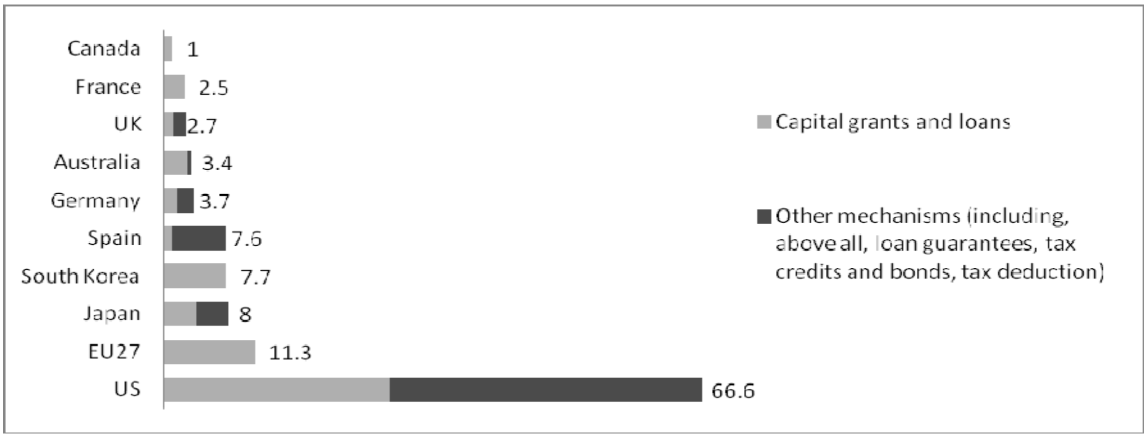
		Stage of technology development		
Classification	*Policy examples*	Research and Development	**Capital investment**	Large-scale Deployment
Energy market regulations	Feed-in tariff	Indirect impact	Indirect impact	YES
Direct financial transfer	**Capital grants**	YES	**YES**	
	Low-interest loan and loan guarantees	YES	**YES**	
	Government-funded/run venture capital funds	YES	**YES**	
Preferential tax treatment	**Accelerated depreciation**		**YES**	
	Investment tax credit		**YES**	
	R&D tax credit	YES	Indirect impact	
	Production tax credit		Indirect impact	YES
	Sales tax, energy tax, excise tax, VAT reduction			YES
Trade restrictions	Renewable portfolio standards (quotas)			YES
	Tradable renewable energy certificates			YES
Services provided by government at less than full cost	Public investment in infrastructure		Indirect impact	YES
	Government research and development	YES	Indirect impact	

A wide range of public policy mechanisms exist to promote renewable energy, however, many of those do not target investment directly. Yet, they may have important indirect effects on incentives to make such investments. For instance, by increasing the competitiveness of electricity from renewable energy, feed-in-tariffs should have a positive effect on the ease with which investors can obtain financing for their projects. Similarly, support for R&D should result in more efficient generation of electricity from renewable sources, driving down the cost of generation, and with similar implications for the ease and cost of financing new plants. Furthermore, government investment in infrastructure stimulates the development of the renewables sector by warranting access for new plants to the electricity grid. In the following we describe and give evidence of the policy mechanisms which directly support investment in renewable energy plants (see highlighted cells in Table 3).

3.2 Types of Investment Policy for Renewable Energy

Capital grants are used extensively in OECD countries to support early-stage technologies, and to stimulate commercialization of new technologies. They can help reduce risk and capital cost for building a new energy plant as they are paid in advance, based on installed capacity. Support levels depend either on the technology and site of an average project or on the cash flow analysis for individual projects (the last applies to Norway). Grants have successfully been used, for instance, in developing the Japanese solar photovoltaic sector. Moreover, in response to the recent financial crisis, most governments have agreed on green stimuli packages, the largest share of which will be distributed to the energy sector as capital grants and loans (see Figure 15).

Figure 15. 2009 Clean energy stimuli by country, in USD billions



Source: UNEP and NEF (2009)

Low-interest rates and loan guarantees have a major impact on the overall cost of RE projects. We noted above that developers of renewable energy projects often do not have a proven track record, as well as some of the new technologies they are investing in have not reached a mature state yet. As a result, these investors are struggling for capital and for access to commercial loans at reasonable conditions. By offering low-interest loans with long repayment periods or loan guarantees, governments can increase the commercialization of such projects. Such loans can be issued directly through state-owned banks (e.g. Germany) or through subsidies to commercial banks. On the other hand, loan guarantees by the government warrant debt repayment to the lending bank in case the project fails. This policy measure reduces risk and hence interest rate, debt term and debt service conditions of the loan (IEA 2009b, among others).

National and state-run venture capital funds have also been used around the world as a solution to perceived equity gaps. Examples include UK's Carbon Trust Investments, Sitra Finland, Massachusetts Green Energy Fund or ITI Energy Scotland. However, these funds have not performed well, in general, due to difficulties in attracting high investing talent and maintaining investment discipline. As a consequence, publicly-funded venture capital is becoming more popular among governments than directly creating publicly-run venture capital operations (WEF 2010). For example, the Australian government launched in 1999 the Renewable Energy Equity Fund (REEF) which provides venture capital for small innovative renewable energy companies, including companies commercializing or producing renewable energy technologies and services. Investments are managed by an independent management unit CVC REEF Investment Managers, which invests according to the guidelines set by the government (IEA 2009b). The Danish Investment Fund is another example of a government-sponsored investment fund. It provides seed and start-up financing to small innovative firms on commercial terms using equity or state-guaranteed loans.

Accelerated depreciation schemes grant the right to depreciate certain types of clean energy equipment over an accelerated time-frame, thereby lowering effective tax rates in the early years of an investment. This way, the tax benefit of depreciation can be maximized by the equity provider, on the condition that they have a net income which is large enough to completely absorb the tax deduction. In general, an accelerated depreciation scheme produces a higher overall net present value of the project (De Jager and Rathmann 2008). The 5 year depreciation for RE in the US (following the Modified Accelerated Cost Recovery System) is an example of an accelerated depreciation with significant cost reductions as a consequence. Other examples include California (solar), Europe (offshore wind) and Netherlands (IEA 2009b). Furthermore, the availability of tax loss carry-back or –forward can be used to harvest the tax benefit of spreading negative earnings before tax (EBT) over years with positive EBT, which will reduce taxable corporate income.

Investment tax credits (ITC) permit RE developers to deduct a specified percentage of their project investment from their tax liability in addition to the normal allowances for depreciation. It is linked to installed production capacity. ITC is similar to accelerated depreciation because it allows faster write-off of investment in the early years of a project. However, it differs by offering a percentage deduction at the time a plant is built/purchased. In effect, the credit is a subsidy for investment (Wiser and Pickle 1998). For instance, ITC is the main support mechanism for large-scale solar in the USA, while production tax credit (PTC), based on the amount of energy generation, is associated with wind energy development in the states (the case for ITC and PTC will be discussed in more detail in Section 4). Since tax credits apply to taxpaying entities only, Canada has enabled also not yet taxpaying companies to profit from tax preferential agreements through a "flow-through share". It is important to note that the Canadian Renewable and Conservation Expenses (CRCE) can be used as a financing tool for small start-ups companies, as CRCE can be transferred to investors using flow-though share agreements. This is when the company cannot deduct these expenses in full in the year incurred or does not want to carry them forward indefinitely for period when the stream of revenue would allow tax deduction of their own.

3.3 Choosing the Right Measure

The description of policy measures targeting investment reveals that there are hazards for the government, and particularly in the case of direct financial transfers. The government does not have preferential access information relative to private agents. In this regard, the government is concerned with two main issues: A) how can it reliably distinguish between firms in order to maximize the return on public investments?; and, B) how can it be sure that a firm will use the financing granted to behave in a manner that it would not have otherwise behaved in the absence of such support? These two problems principally relate to misallocation and overcompensation due to adverse selection and moral hazard.

Adverse selection and moral hazard are likely to be most important in the case of grants since the absence of a counterparty makes it difficult to align incentives between the private sector and the government. However, they can also affect other policy measures. In the case of direct loans on preferential terms, Li (1998) argues that government support may encourage cash-poor firms with good projects to carry out their projects. On the other hand, they create an incentive for subsidized entrepreneurs to overinvest beyond the desired investment level. Furthermore, they can create a disincentive for all agents to save ('crowd out' private investment) and a disincentive for unsubsidized firms to enter the market.

The case of loan guarantees differs somewhat. Intuitively, given that a fixed proportion of a loan is guaranteed in the event of a failure, those who borrow more and/or have a higher probability of failure will benefit more from loan guarantees. The effect of loan guarantees on a firm with a 'good' project is a function of two factors. On the one hand, having a good project may mean borrowing more and hence being able to enjoy the benefits of large loan guarantees in the event of failure; on the other hand, a good project means a lower probability of failure and therefore less need for a loan guarantee. Thus, poor entrepreneurs with mediocre projects benefit more than others from loan guarantees. In contrast, in the case of government grants, all entrepreneurs benefit equally from the subsidies regardless of their asset holdings and project quality.

As mentioned in the previous sub-section, a significant shortcoming of fiscal incentives can be their perceived instability. Many studies argue that uncertainty is the major barrier for the breakthrough of renewable energy technologies (e.g. Foxon et al. 2005, Jacobsson and Bergek 2004, Meijer et al. 2007). These policies are often unpredictable and subject to manipulation over time as government leadership changes. Thus, changes to RE subsidies tend to be abrupt, and are therefore disruptive to developers and investors. They usually rely on government budgets and are thus subject to frequent political negotiations and annual budget constraints.

The effect of such policy unpredictability is likely to be less pernicious at the level of the individual project for one-off grants for capital investments. However, it may influence firm entry into the market. Moreover, in the case of measures where the benefits at the project level are accrued over a number of years, the effects are likely to be even more important. Fiscal incentives should be announced and guaranteed for a couple of years in advance. They could theoretically be financed through a surcharge on energy consumption, which adjusts automatically to the amount of support paid. These measures are likely to increase stability and reduce regulatory risk.

The observation that public policy can have a negative impact on private-sector RE investment is not new.[13] For instance, Barradale (2008) shows that the volatility of investment in wind power plants associated with the production tax credit (PTC) in the US is due to the dynamics of power purchase agreement (PPA) negotiations in the face of uncertainty. These negotiation dynamics, when coupled with PTC uncertainty, will lead to a volatile investment pattern no matter how strong other motivations for investing in wind may be. These motivations can include state and local policy incentives for wind investment, demand for wind power from green consumer programs, and exceptionally profitable project development opportunities. Since most wind is financed through PPAs, the dynamics of contract negotiations have an effect on the entire industry.

This is not to say that policies should be 'set in stone'. It is important to assess policies on a continuous basis in order to ensure that the level of compensation is optimal, and that the portfolio of projects which benefit from such support is optimal. In order to reduce moral hazard and adverse selection the task of the government is as much about eliciting information on the response of the private sector to different incentives, as it is about implementing appropriate policies from the outset. The government agencies carrying out promotion must maintain channels of communication with the private sector. Ongoing contacts and communication are important so as to allow public officials to have a good information base on business realities, without which sound decision-making would be impossible (Rodrik 2004).

4. Power plant entry

In this section we review plant entry in the renewable energy market for selected regions in the OECD, and assess in a descriptive manner the relationship between the introduction of government policies and new installed electricity generating capacity. To illustrate entry into the market for the different energy types we use the UDI database (June 2009 Version). This database includes electric power plants worldwide (except Sub-Saharan Africa and Latin America) for both conventional and renewable energy types. Power plant data are obtained from direct surveys, vendor reference lists, power company financial and statistical reports, and the trade and business press. Primary sources such as surveys and materials directly produced by owners, operators, and suppliers are used preferentially.

[13] See Johnstone et al. (2010) for a discussion of the effects of policy uncertainty on investment in innovation.

There is data for operating, projected, deactivated, retired, and cancelled generating units. For the conventional energy plants, including coal, oil, natural gas, nuclear, the data go back as far as the end of the 19th century. In our descriptive analysis of the renewable energy sector, however, we consider a shorter time period (from 1978 or later to 2008).

Global coverage is comprehensive for medium- and large plants of all types. The advent of widely-dispersed wind turbines and, especially, photovoltaic (PV) systems has become an issue due to the very small generating capacity of individual installations and the increasing rate of deployment worldwide. Therefore, data base coverage for wind turbines, diesel and gas engines, photovoltaic solar systems and fuel cells is considered representative, but not exhaustive in many countries. Many facilities of less than 1MW are listed, but generating units of less than 1kW are not included in the data base. The reported capacity value is preferentially gross megawatts electric.

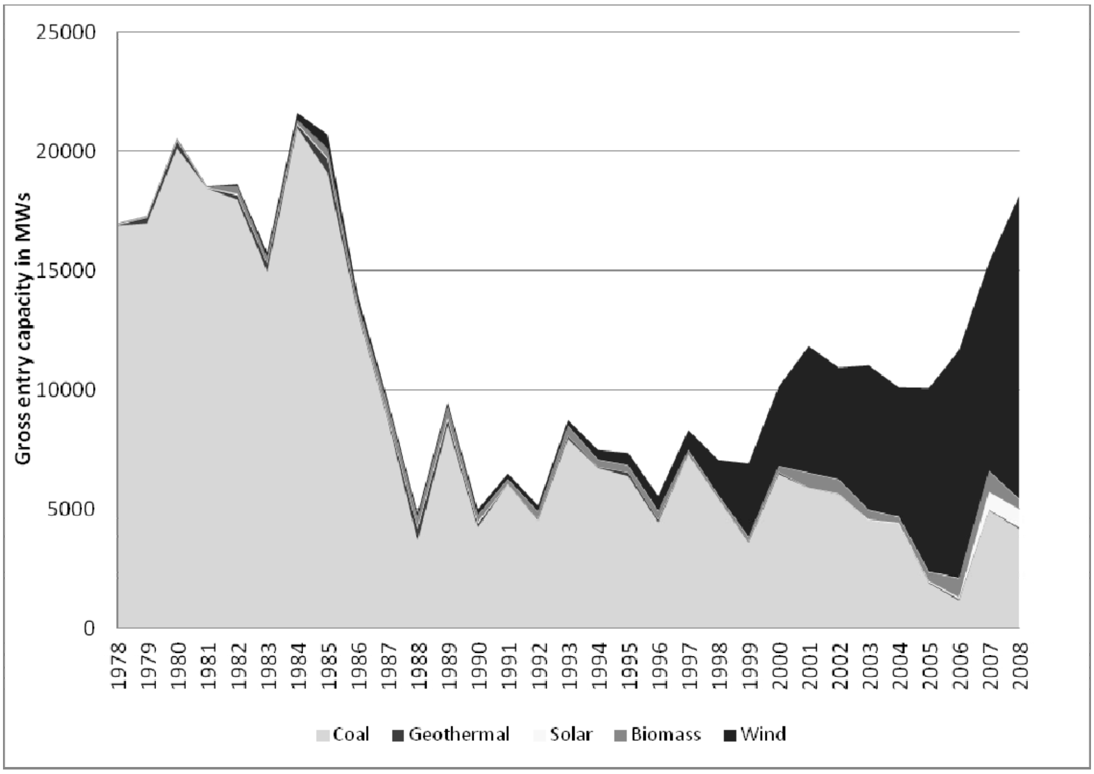
Many wind turbines have been installed by individuals, municipalities or local associations and cooperatives of various kinds. In the data base we use, these are included into plant-level operating entities. Furthermore, residential-scale photovoltaic plants are not usually listed, although larger-size housing development PV installations are included in aggregate where data are available. The same is valid for blocks of PV capacity itemized by local power companies.

We measure plant entry in a country/region by newly established gross capacity (measured in MWs) for a certain year. The year considered for each plant is its first year of commercial operation. Cancelled, deferred, delayed, planned plants and those under construction are excluded from the analysis, as well as plants for which the year-in-service is not available and cannot be calculated. Gross entry capacity has been calculated for twenty important OECD member states which produce a large ratio of world's electricity. They include the EU-15 countries, the USA and Canada and the Pacific region represented by Australia, Japan and South Korea.

Figure 16 gives an overview of the total entry capacities (measured in megawatts electric) for four different renewable energy sources – wind, solar, biomass and geothermal – and compares them to the coal energy sector in the period 1978-2008. Although there was a drop in the establishment of new coal plants in the 1980s, the level of investment in these facilities remains relatively high. Wind is the renewable energy source with the fastest-growing rate of entry, followed by solar and biomass, while the relevance of geothermal has been declining since the seventies (these trends are confirmed also by IEA data, see above).

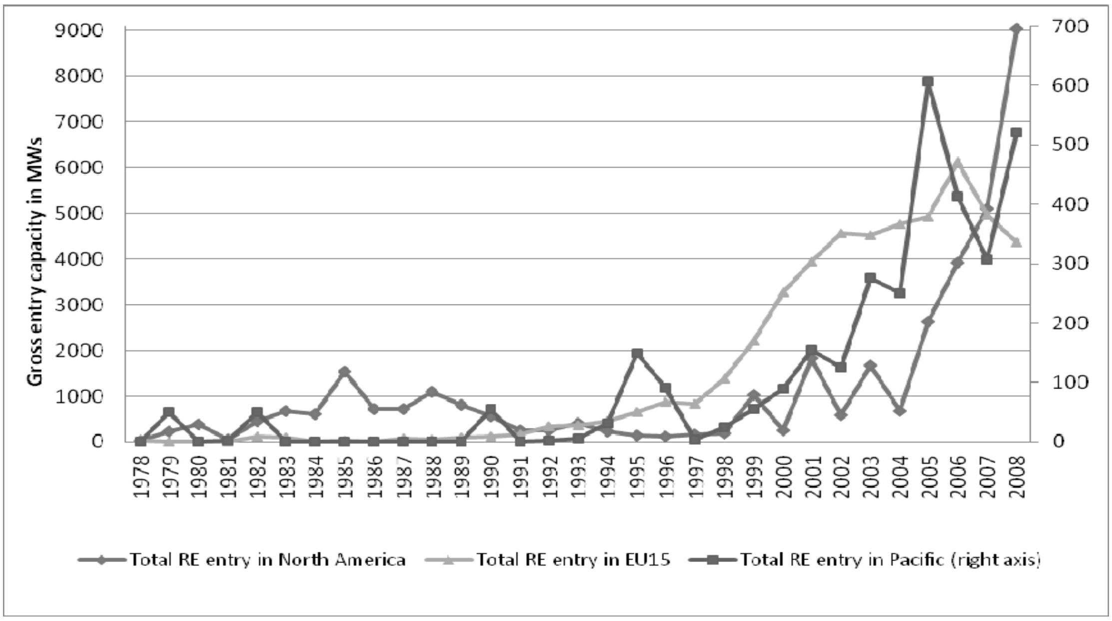
By comparing the renewable power plants installations over time in three different regions in Figure 17 – North America (including US and Canada), Pacific (Australia, Japan and South Korea) and the EU-15 countries – we identify an increasing trend for investment in RE power facilities in all regions since 1997 and until 2008. North American activity has been more volatile than in Europe, perhaps resulting from the uncertainty of public policy in promoting RE investment in the US. However, North America was the forerunner in renewable electricity with new entering capacity in the 1980s which exceeded even the current entering capacity in the Pacific region.

Figure 16. New plant entry by type of renewable energy (measured in MWs) as compared to coal in North America, Pacific and EU-15



Source: UDI Platts

Figure 17. New renewable plant entry by a geographic region

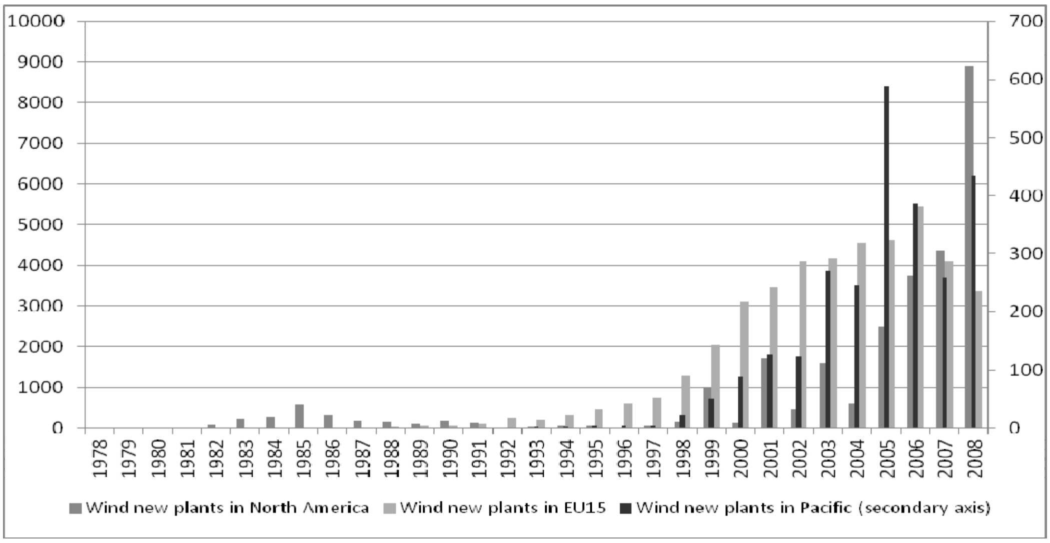


Source: UDI Platts

We can look separately at each renewable energy type in the three regions (Figures 18-21). Until 2006 European countries were the leading site of new wind power plant installations, but this changed somewhat after Canada implemented its Wind Power Production Incentive and the US introduced a number of financial incentives and legislation (including the 1978 Public Utilities Regulation Policy Act which was the basic law promoting greater use of renewable energy).[14] In addition, as a result of the 1981 Economic Recovery Act in the US, the American solar sector was attractive for new entrants in the 1980s and only recently again after the Solar America Initiative and new tax credits were implemented in the US in 2006 and 2005, respectively. Moreover, numerous federal and state programmes in Canada (ecoEnergy for Renewable Power in 2007 at the federal level, and standard offer and feed-in tariff programmes in Ontario) boosted entry of solar plants. European solar energy had its boom in 2008 mostly due to the introduction of Spanish feed-in-tariffs in the sector. Japan has successfully developed several subsidy programmes for solar installations since 1993. However, the 2008 peak in the Pacific region might be a result of recent tax incentives coming in to force in South Korea. The total gross capacity entering the market in the three Pacific countries is rather low compared to Europe and North America. At a later stage, we will present three case studies on wind and solar, including the US, Germany, and Australia, and will discuss the impact of certain types of policy mechanisms.

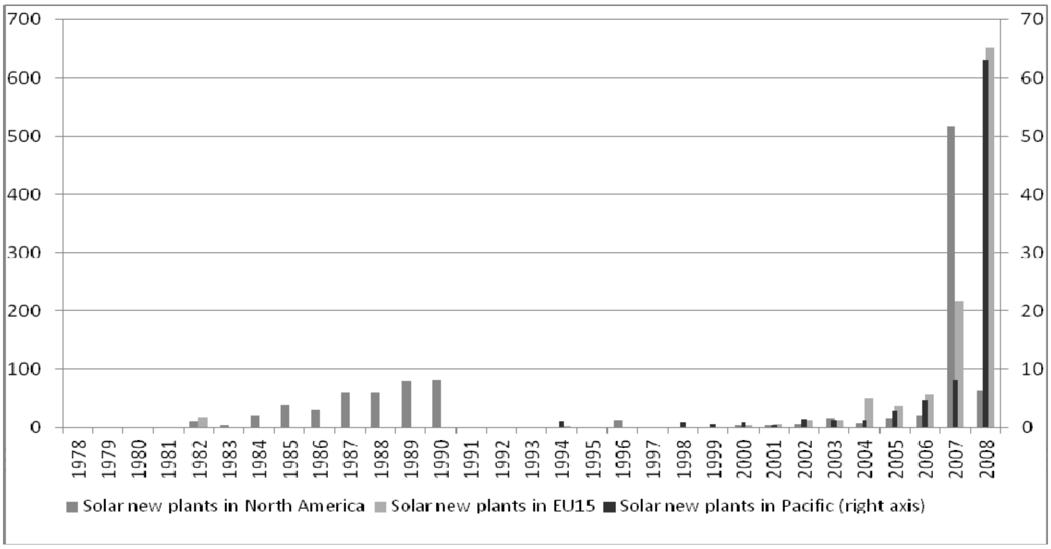
[14] The case of the US will be discussed more explicitly at a later stage in this section.

Figure 18. Wind power plant entry by geographic region



Source: UDI Platts

Figure 19. Solar power plant entry by geographic region

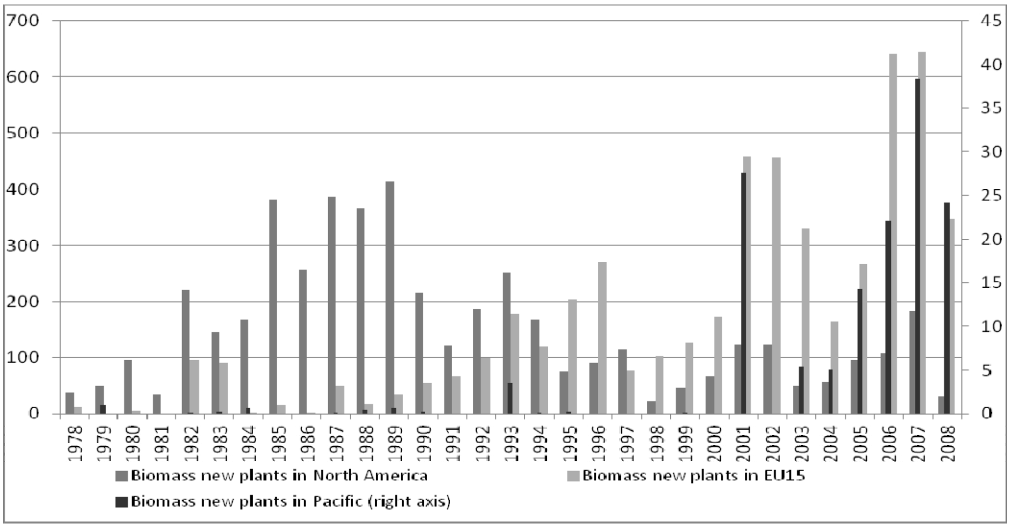


Source: UDI Platts

Beginning with the Energy Tax Act of 1978 many tax policies supporting geothermal development and installation were implemented in the US through the 1980s. The most important electricity sector incentive was the 1978 creation of a 10% business energy tax credit for investments in various renewable energy options (including biomass) in addition to the standard 10% investment tax credit, which was available for all types of equipment. The next most important reforms for geothermal was the 1981 Economy Recovery Act, which allowed for an Accelerated Cost Recovery System (ACRS) for geothermal and other renewable products, followed by the Modified ACRS in 1986 and the 1992 Investment tax credit reform. From Figures 20 and 21 it is evident that the 1990s were the high-point of the American biomass and geothermal electricity sector due principally to the policies implemented. During the period 1999-2009, the biomass generating capacity in Canada increased by 20% from 1,390 MW to 1,671 MW.

A large part of Europe does not have the ecological conditions for the development of geothermal (hydrothermal) clean energy[15]. On the other hand, some of the EU-15 countries are extensively supporting their **biomass** electricity sector. Sweden is a good example with its numerous tax incentive programmes for biomass energy and direct grants to the investors in the sector from the national and sub-national governments. Beside the feed-in-tariff, the French government also provides direct support for bioenergy through preferential loans and tax credits.

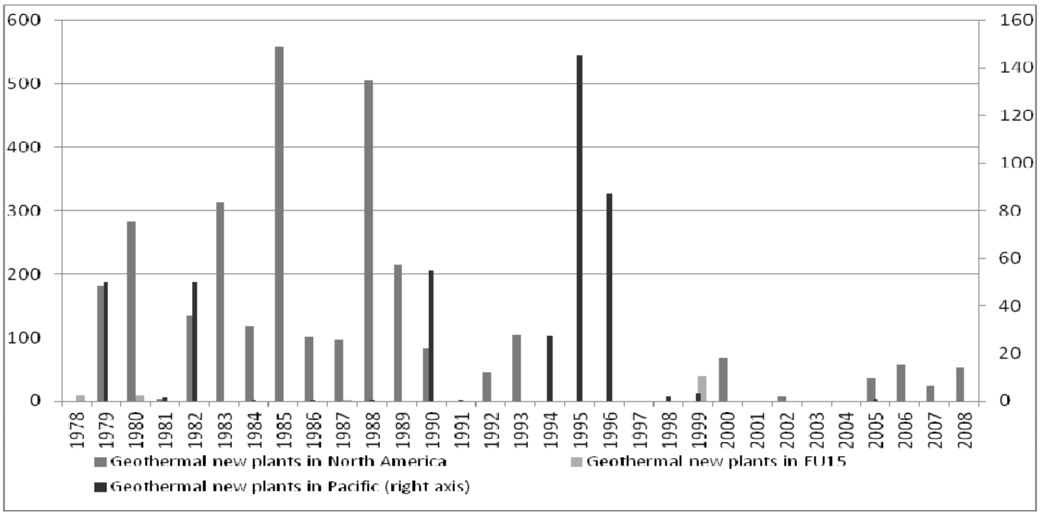
Figure 20. Biomass power plant entry by geographic region



Source: UDI Platts

[15] However, Italy, Switzerland and Germany operate geothermal power plants, engineered geothermal systems (EGS) or Hot Dry Rock technology excluded

Figure 21. Geothermal power plant entry by geographic region



Source: UDI Platts

In a next step, we consider three countries (Germany, US, Australia) in three different geographic regions more closely. While discussing each country's general policy framework and its impact on plant entry we concentrate on the five policy mechanisms – capital grants, venture and equity funds, low-interest loans, accelerated depreciation, and tax credits – which directly target investment in new plant establishment. It is important to bear in mind that other policy measures such as renewable energy quotas, feed-in tariffs, R&D support, etc. which do not relate directly to investments costs are not represented in the Figures.

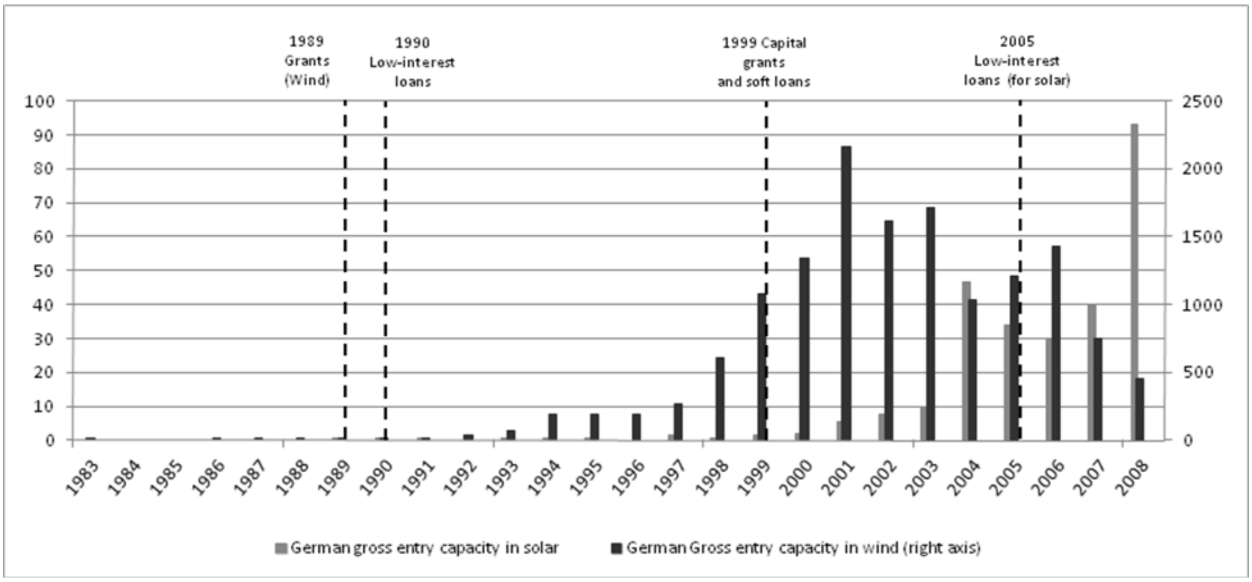
Germany's most important mechanism for financing renewable electricity projects is the feed-in-tariff (FiT) scheme. Germany has continuously utilized a feed-in-tariff scheme for nearly 20 years. From 1991-2000, the first feed-in-tariff law (*Stromeinspeisegesetz*) provided one single fixed feed-in-tariff for all renewable energy technologies. It mainly supported the development of wind energy, since this source is closest to being competitive with fossil fuels. Further stimulus was provided by the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz*), enacted in 2000 and amended later. It grants renewable energy project developers privileged access to the nearest grid connection point, which minimizes the risk of unforeseen grid costs for the investor. The investment certainty based upon the feed-in-tariff is complemented by low-interest loans and grants from the state-owned KfW bank.

Figure 22 depicts the German market for wind and solar electricity plant installations, beginning with the year 1983 when the first wind plant in Germany was established. We inserted a marker for each policy tool implemented, which is considered to support investment in physical capital directly. The "100 MW Wind Programme" was initiated in June 1989 and extended to "250MW" in 1991. It provided capital grants of EUR102/kW, up to a ceiling of EUR 51,300 for facilities larger than 1 MW. Grants up to 60% of the total investment to a maximum of EUR 46,000 were provided.

Furthermore, in 1990, at the same time as the feed-in-tariff law came into force, the KfW bank began providing low-interest loans to private companies until 2008, when the programme was superseded. It financed a maximum of 75% of investment costs, up to a maximum volume of EUR 10 million. Typically loans were given for a period of 10 years. Interest rates depended on the capital market and were at the lower end of capital market rates. An accompanying programme by KfW provided loans to freelancers and small companies at similar conditions. The German success story of wind power installations in the recent two decades, experiencing its peak in 2001, is based on the policy stability of the feed-in-tariff law and the reduction in the investment costs resulting from the grants and low-interest loans by the KfW bank. However, the separate effect of each of these policy mechanisms cannot be disentangled in a descriptive analysis.

The soft loans by KfW granted for solar power generation in 1999 together with the recent 2005 programme focused on photovoltaic systems clearly created the main incentives for companies entering the solar sector in Germany. In particular, the 2005 KfW-Programme Producing Solar Power offered low-interest loans for small investments in solar generation until the end of 2008. Private investors were the main beneficiaries as only projects with an overall investment up to EUR 50,000 were supported. 100% of the investment cost could be financed at interest rates between 3.6% and 4.15% p.a. in addition to a redemption-free initial phase of two to three years.

Figure 22. Relationship between investment policies and entry in the solar and wind electricity sectors in Germany

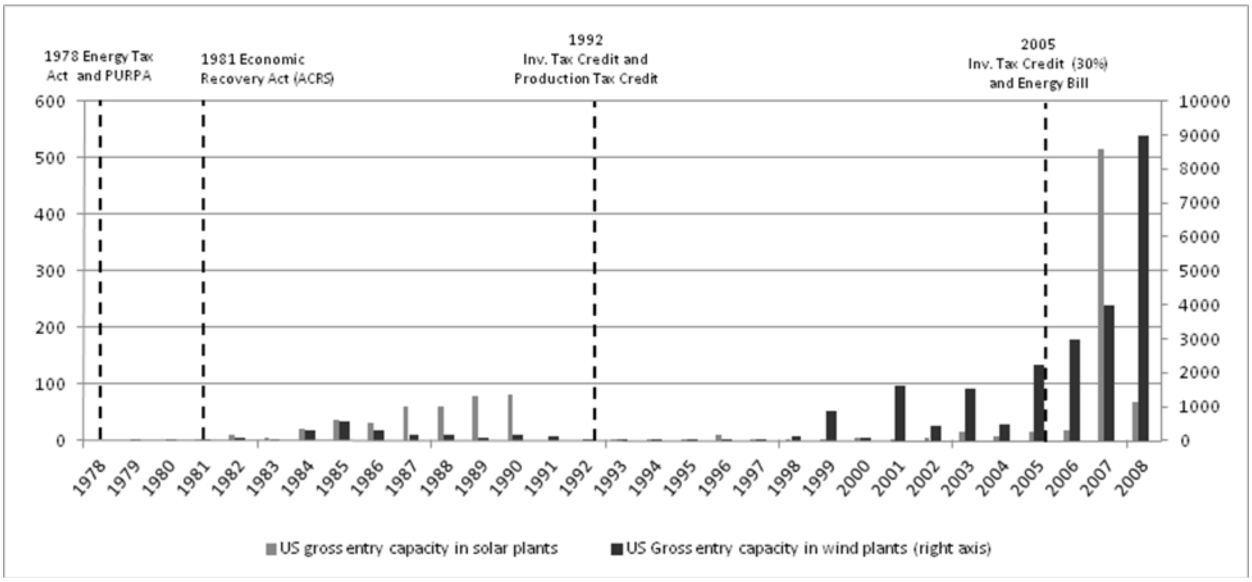


Source: UDI Platts and IEA (2009b)

While the German public sector uses mostly direct financial transfers (in addition to the feed-in-tariff scheme) in the form of capital grants and low-interest loans to support renewables plant installations, the United States government relies on tax credits and investment funds (excluding the PURPA law introduced in 1978). In Figure 23 we focus on the American market for wind and solar installations and examine the relationship between point of implementation of government investment policies and solar and wind plant entry. The first major policy was the Energy Tax Act enforced in 1978 and superseded by other acts in 1992 and 2005.

The 1978 law introduced a 10% business energy tax credit for investments in various renewable energy options. This credit was in addition to the standard 10% investment tax credit, which was available on all types of equipment. In addition, in 1981 the Economic Recovery Act allowed for an accelerated cost recovery system (ACRS) by which businesses can recover investments in solar, wind and geothermal plants through depreciation deductions. The ACRS establishes the time over which various types of capital investment may be depreciated (5-50 years). In 1986 the accelerated depreciation for renewable energy property was further liberalised (from 150% to 200% declining balance method). These measures created important impulses for initial investments in renewables in the US.

Figure 23. Relationship between investment policies and entry in the solar and wind electricity sectors in US



Source: UDI Platts and IEA (2009b)

However, despite the tax incentives, mentioned above, Figure 23 does not reveal any clear investment trend in renewables in the US since the late 1970s. Even the effects of the 1992 production and investment tax credit reform, under which companies can take a tax credit of up to 10% of their investments for purchase and installation of solar property, is not evident. However, the 2005 investment tax credit of 30% for solar installations accompanied by the loan guarantees of the Energy Bill may have changed the trend in solar installations. Furthermore, the capital grants for wind power plants provided under the latter act of 2005 can explain partly the permanent growth in wind electricity capacity since then.

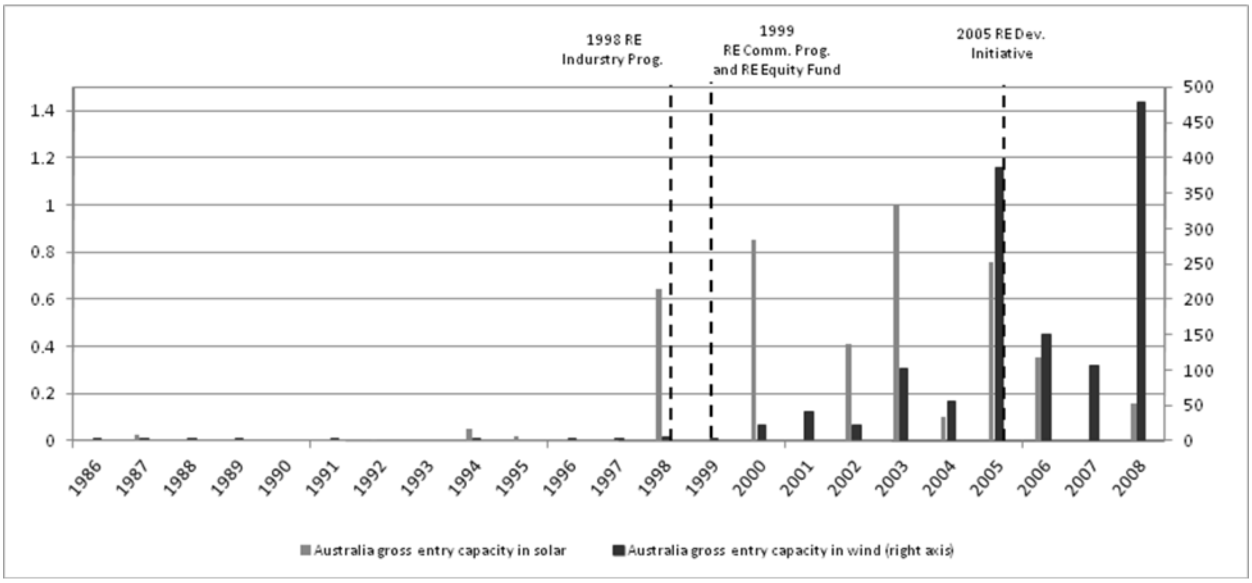
The evidence indicates that neither the accelerated depreciation nor the investment tax credit (ITC) mechanisms have played a role in encouraging entry of wind plants, and nor has the production tax credit (PTC) of the year 1992. The PTC was created along with ITC and provides an inflation-adjusted tax credit of USD 15 /MWh (inflation-adjusted) for electricity genherated from qualifying renewable energy projects, in particular, wind. Indeed, the most rapid growth did not happen until after 1999. While the PTC could have played a key role in the business case for new renewable power plants, there were intermittent interruptions of the PTC – which occurred when Congress delayed in reauthorising the Act. This added to uncertainty, and the interruptions coincide with dramatic drops in renewables investment in the US (see drops in installed capacity in 2000, 2002, and 2004 in Figure 23; for an elaborate study of the case see Barradale 2008).

The main characteristic of PTC is that it applies only to established tax paying entities. Thus, to make use of this privilieged tax regime, RE developers have to cooperate/merge with large established companies, which provide the tax liability against which the PTC can be claimed. This results in more complicated structures for project financing and increased intial transaction costs for renewable energy investors in terms of the time needed to find a potential partner and negotiate an agreement, as well as administrative and legal costs (see Table 1 for an overview of the existing financial structures for wind energy). Concerning solar energy, the most significant obstacle to large-scale deployment in this sector, particularly, in California is the expensive connection between new major renewable resource areas and often distant high-voltage power grids operated by utility companies, as noted by de Jager and Rathmann (2008).

In the case of Australia (Figure 24), most of the government subsidies are awarded to ‘Clean Coal Technology’ (more than 80%) and the rest goes to renewable energy grants. During the last decade three major policies have been implemented which we consider to support directly investment in physical capital. The 1998 Renewable Energy Industry Programme was the first major programm supporting renewable energy. It provided capital grants for the development of the sector in Australia in the total amount of AUD 2.2 million. In 1999 the Renewable Energy Equity Fund was implemented and is in force until nowadays.

As discussed in Section 2, the fund provides venture capital to small, innovative companies for the development of renewable energy technologies. AUD 17.7 million have been allocated to the fund, which amount is matched by private equity on a 2:1 basis, amounting to a total of AUD 26.6 million over ten years. The identification and management of investments is undertaken by an independent fund manager, who seeks to maximise return on capital for the REEF. Eligible companies may receive a maximum investment of AUD 3 million or 10% of the initial capital. Solar energy has not been developed in Australia. However, the policies have clearly motivated development and entry into the wind power market, with newly installed capacity in 2008 of nearly 500MW. The RE Development Initiative of 2005 has provided additional AUD 100 million to the clean energy sector in Australia.

Figure 24. Relationship between investment policies and entry in the solar and wind electricity sectors in Australia



Source: UDI Platts and IEA (2009b)

5. Concluding remarks

This paper describes the recent trends in renewable energy investment and finance and gives an overview of the government policy mechanisms directly supporting the development of renewable energy in the OECD area. While a number of studies have looked at the role of support for R&D or incentives at the output stage (e.g. feed-in tariffs), we look specifically at public policies promoting investment in renewable power plants, and discuss their impact on plant entry into the market.

However, it is important to emphasise that investment policies are just one lever in the policy toolbox to support the development of renewable energy. Internalising the negative environmental externalities associated with carbon emissions (i.e. through a tax or tradable permit system) and ensuring that rents are captured for the positive knowledge spillovers associated with research are necessary conditions for the development of the sector. Investment policy is an adjunct, and one which needs to be designed with the broader policy framework in mind. Indeed, with respect to investment market access policies may be even more important, an area not addressed in this paper.[16]

The immaturity of the renewable energy sector increases the difficulties associated with accurately pricing relative risk of investments in "clean" energy, making it more difficult for these technologies to obtain financing at reasonable costs than for fossil fuel technologies. Moreover, in some cases there can be important learning and demonstration effects which will not be realized in the absence of initial support. As a consequence in most countries, investment in renewables is underpinned by government incentives.

However, the predictability of government programmes is necessary if investors are to initiate a project in clean energy. For instance, the degree of high uncertainty in American PTC was a contributing factor in exit from the wind power sector, in particular. The history of the stop-and-go implementation of the PTC in the US illustrates the importance for governments of ensuring that programmes are not subject to excessive policy uncertainty.

Predictability should not be mistaken for permanence. It is important to 'sunset' many of the policies which have been discussed in this report. With time the financial market will price risk efficiently (assuming policy regimes do not generate shocks continuously) and learning benefits will be exhausted. While there will always be a case for taxing carbon, there will not always be a case for subsidizing investment in different mitigation technologies (including renewable energy).

An inevitable complication in any positive support policy relates to the 'hazards' associated with picking (or not picking) winners. While there may be a case for supporting investment in renewable energy on a temporary basis, the allocation of such support across different renewable energy types is a thorny policy issue.[17] In the presence of learning effects an 'undifferentiated' (or neutral) policy may not be optimal. Constant assessment of the returns for public investment support in different areas (offshore wind, solar photovoltaic, etc.) is required.

It is also important to ensure that incentives of generating firms, financiers and public agencies are properly aligned. For instance there is a strong case to be made for using tax credits rather than grants as a means of support, thus avoiding the dangers of overcompensation and adverse selection. A complicating factor may be that some potential beneficiaries (i.e. new entrants) do not pay taxes. In such cases it is important to ensure that support is conditioned in some way – i.e. on productivity change over time.

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[16] See Ferrey (2009) for a recent discussion.

[17] On-going work at the Environment Directorate is assessing how this can be done in the context of R&D.

It is the nature of entrepreneurship that not all investments in new activities will pay off and not all promotion efforts will be successful. Against such a backdrop public investment policy will also frequently meet with failure. Combining continuous assessment with policy predictability is a delicate balancing act. Clear criteria for policy evaluation are required, and ideally the criteria for success should depend on productivity. Depending upon implementation, the scheduled biennial review process which was added to the Renewable Energy Act in Germany might be considered an effort to get this balance right.

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