Source: Proceedings of the Norwegian Association for Energy Economics (NAEE) Conference „Towards an Integrated European Energy Market", Bergen/Norway, 31 Aug – 2 Sep 2000.

FINANCIAL SUPPORT OF RENEWABLE ENERGY SYSTEMS: INVESTMENT VS OPERATING COST SUBSIDIES

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ABSTRACT

An increase in the share of renewable energy use has become an important energy policy target in most parts of the world. Even in cases where commercially available renewable technologies are technically and economically feasible, much investment in the energy sector is still directed towards conventional energy technologies, leading to market barriers and market failure faced by renewable energy technologies (RETs). The fact that today RETs account for only a modest proportion in meeting the world's total commercial energy demand means that there is a gap between the actual and the (economically and/or ecologically) optimal level of use. Apart from socio-economic aspects, particularly the financial barriers responsible for this gap need to be identified and tackled in order to design innovative energy policy approaches for the national and/or international financing of RETs. Capital markets are generally organised to provide large quantities of capital for energy projects at the scales common for conventional and often centralised energy technologies. However, many of the most promising technologies for meeting sustainable development goals require investments in small-scale energy production systems, or improvements in energy efficiency. Existing capital markets often discriminate against investments at such small scales. In order to avoid undesirable under-investment, it is essential that policies are implemented to develop a legal and regulatory framework that provides access to capital markets for small-scale renewable energy technologies investments. In this paper we critically contrast two of the most common approaches for renewable energy support: investment cost subsidies and operating cost subsidies. We highlight advantages and disadvantages of these public policy responses to private under-investment, analyse their interplay, and draw some conclusions for an economically efficient and environmentally less damaging promotion of renewable energy use.

Keywords: *Renewable energy; financing; energy subsidies; competitive energy markets.*

INTRODUCTION

A wide variety of market mechanisms are being employed to promote RETs. Countries like Germany, the Netherlands and Denmark, rank among the most environmentally conscious in the world; yet renewable energy could not establish itself without government intervention in these nations. Usually that intervention must take the form of a monetary mechanism.[i] Most of these countries provide higher payments for energy generated from renewable resources. Mechanisms through which RETs can be made economically more competitive include:[ii]

- *Investment subsidies.* Investment incentives are often used to reduce project developers' capital costs and thus provide incentives to developers to invest in renewable energy. Incentives are typically paid either by the government through the general tax base or by utility customers through a surcharge on their utility bills. They can take a wide variety of forms.

- *Fixed higher payments upon delivery.* These can be established through regulation or voluntary agreements. In Germany, for example, generators of renewable electricity receive fixed payments per kWh, depending on technology. Hence this approach tends to make it easier for small-scale developments to enter the market, as economies of scale are less relevant. This is a relatively simple, straightforward, and often highly effective (though not necessarily efficient!) mechanism. The impact of this incentive instrument on the development of renewable energy depends on the level of the feed-in tariff. In Germany, very favourable tariffs have triggered the very fast development of wind energy. A problem with this type of price instrument is the difficulty to forecast its quantitative effect: a very attractive tariff may attract a growing number of independent producers resulting in a rapidly increasing production of renewable energy with potentially exponential public expenditure. Another important drawback of this kind of price mechanisms is the limited incentive to decrease costs: independent power producers (IPPs) are not competing for renewable electricity production given the obligation imposed on the utilities to purchase all the electricity produced at a fixed price.

- *Competition.* There exist several examples of competitive systems. The non-fossil fuel obligation (NFFO) in England and Wales, for example, requires bidders to compete for contract awards within technology bands, and seems to have worked quite well (Fouquet, 1998; OFFER, 1998). Denmark's new renewables portfolio standard (RPS) is another example. It also represents the first case where a country has undertaken a transition from a fixed higher payment system to a competition-based system (Rader and Norgaard, 1996; Bernow et al., 1998; Awerbuch, 2000).

- *Green pricing/marketing.* Green electricity is a direct consequence of the introduction of competition between electric utilities and the possibility for consumers to select their supplier according to environmental quality criteria. With green electricity, consumers have the possibility to pay a premium for supporting the production of totally or partially renewable electricity. Green electricity is different from the other instruments in the sense that it is a voluntary marketing initiative from the electricity sector. It is not a real incentive scheme. But it creates a market niche which may favour technological learning and further development of renewable technologies. The question raised by green electricity is whether the niche is large enough to stimulate learning and to what extent non-competitive technologies (photovoltaics, for example) may also profit from these opportunities.

- *Carbon tax.* A tax on the carbon contents of fossil fuels is an attempt to mitigate climate change. Carbon taxes help to level the economic playing field by compensating (at least partially) existing subsidies for coal, oil and, to a lesser degree, natural gas. To the extent that carbon taxes serve the end of climate change mitigation, they have public support, for example in the Netherlands and in Sweden.

- *Green certificates.* The idea of green certificates is to create two different markets with renewable electricity, one for physical (renewable) electricity and the other for renewable certificates. With such a system, renewable electricity is fed into the electricity grid and sold at market prices, but the renewable electricity producer also receives a certificate that is sold on the market for certificates and improves the competitiveness of the renewable production, because it has the effect of a subsidy. The importance of the subsidy obviously depends on the market price of the certificates and as such on supply and demand characteristics.

Many of the promotion mechanisms available can essentially be reduced to the basic instances of investment and operating cost subsidies. In this paper we critically contrast these two approaches for renewable energy support and point to some unintended consequences of these mechanisms to contribute to an economically efficient and effective promotion of renewable energy which is environmentally less damaging and can be justified on the grounds of market failure. Public sector support of RETs is needed in three categories: (a) to help establish innovative supply systems for RETs that are already both technically proven and fully cost-competitive in targeted markets; (b) to provide incentives designed to encourage fast progress along learning curves for RETs that are technically proven with good intrinsic prospects for cost reduction but still positioned early on the learning curve; (c) to provide support for technological demonstrations of RETs that are not yet technically proven but have good intrinsic prospects for being cost-competitive if successfully demonstrated and advanced along the learning curve. Mechanisms compatible with the market oriented structure of power markets have to take into account the different requirements of each category.

MOTIVATION FOR SUPPORTING RENEWABLE ENERGY

Many motivations for the public support of renewable energy can be found. They typically comprise many aspects relevant for a more sustainable development, like

- *Climate change.* Renewable energy use does not produce additional carbon dioxide and other greenhouse emissions that contribute to global warming (IEA, 1998; Schimmelpfennig, 1995).
- *Reduced air pollution.* RETs produce virtually none of the emissions associated with urban air pollution and acid deposition, without the need for costly additional controls (Serchuk, 2000).
- *Rural communities.* Production of renewable energy can provide economic development and employment opportunities especially in rural areas, that otherwise have limited opportunities for economic growth. Renewable energy can thus help reduce poverty in rural areas and reduce pressures for urban migration (Kaufman, 2000).
- *RET development and technology transfer to developing countries.* Financial support of RETs in developed countries also helps to transfer RETs to developing countries, allowing them to leapfrog to a more sustainable energy system (Able-Thomas, 1996; Forsyth, 1998).
- *Diversity/security of supply.* The penetration of various RETs increases the diversity of supply technologies, therefore making the energy supply system less vulnerable to monopoly / oligopoly price manipulation or unexpected disruptions of supply. Such diversity could also help to reduce energy price volatility.
- *Fossil/nuclear fuel subsidies.* Despite efforts to internalise external costs of energy use, there still exist many hidden and open subsidies to conventional energy sources (IEA, 1999). In this respect, subsidisation of RETs helps to level the playing field.
- *Other benefits.* Some renewable technologies can be sited in or near buildings where electricity is used. This practice, known as distributed generation (DG), can avoid costly expenditures on transmission and distribution equipment. DG can also improve power quality and system reliability (Madlener and Wohlgemuth, 1999).

Another motivation for supporting renewables comes from the ongoing changes in the electric power industry, which tend to make it more difficult for RETs to compete in the liberalised market environment. The most important elements of the global power market transition include (Pollitt, 1997):

- *Liberalisation*. The historically heavily regulated monopoly compact is being discarded, and the electricity industry opened to competition in generation and retail supply. These initiatives, although often leading an increased rather than a reduced need for regulation, will nonetheless provide numerous opportunities for new ventures to emerge and capture value (WEC, 1998).
- *New technologies*. Along with emergence of new entrants into the power sector, innovative forces will be unleashed, and many technological improvements will consequently result. As occurred in the telecommunications sector during the past 15 years, new technologies will transform the landscape of the electricity industry, in terms of the economics and choices that customers will face.
- *Increasing environmental pressures*. Environmental issues are likely to become more significant in the coming years, given the threat of global warming and increasing local air pollution problems (e.g., ozone concentrations in urban areas). As environmental concerns become

manifested by tighter emission restrictions, the economics of the power industry will be significantly altered.

These changes affect renewable electricity generation particularly directly. Concern that the new structure of the power industry may prove hostile to RETs is also often mentioned as a justification for market intervention to promote environmentally friendly technologies. Introduction of competition does not automatically favour renewable energy as energy prices are expected to decrease, short term investment decisions are preferred because of uncertain market environment, etc. In a context where utilities do not have long term guarantees regarding the evolution of the market, economic characteristics with up-front capital investment and low running costs do not favour renewables. Without mechanisms to provide support for renewables, market reform will not contribute to any increase of theses sources of energy. However, market reform may also have some positive impacts on the development of RETs. It facilitates independent power production compared to the situation of public monopoly. It may also result in lower subsidies allowed to some forms of fossil fuels or to some consumers. Finally, some specific characteristics of renewable energy (shorter construction lead time, easier adaptation to uncertain evolution of demand, decentralised investments) may have greater value in a competitive environment than under a monopoly market structure.

INVESTMENT VS OPERATING COST SUBSIDIES

In this section we contrast the most common approaches for supporting renewable energy generation: investment and operating incentives, and we point out their major advantages and disadvantages. The most common variations of investment and operating subsidies include:

Investment Incentives

Investment Subsidies

Direct capital investment subsidies can be provided per kW of rated capacity or as a percentage of total investment cost. Such direct subsidies are the most straightforward incentive and are attractive for their simplicity, but they must be strictly monitored against abuse and to ensure that project costs are not artificially inflated. A vigilant regulator is thus essential in order for subsidy funds to be efficiently allocated. Countries such as Sweden and the Netherlands provided such subsidies in the past but have since been phasing them out.

Investment Tax Credits

Investment tax credits are similar to investment subsidies and serve to lower capital costs by allowing developers to reduce their taxes by the amount invested in qualifying projects. They can be useful in enticing profitable enterprises or high income individuals to enter the renewable energy market to reduce their tax liabilities, but they can be inefficient if investors are more interested in maximising their tax shelter than in achieving actual electricity production. Investment tax credits are less transparent than direct investment subsidies, which may increase their complexity and reduce their effectiveness. The most famous and notorious use of investment tax credits was in California to stimulate wind energy development in the 1980s (Wiser et al., 1998; Righter, 1996).[iii] The strategy played a major role in the creation of the modern wind energy industry but also suffered widespread abuse and created a political backlash. Another drawback of tax credits is that small project developers may not have sufficient pre-tax income to fully absorb the tax, thus limiting the range of investors who can benefit from such policies.

Other Investment Incentives

A wide variety of other investment incentives exist. For example, import duty exemptions or reductions have been used in developing countries such as India and China to lower the cost of imported equipment. Other tax incentives include accelerated equipment depreciation, property tax reductions, and value-added tax rebates. Such mechanisms can be used to lower projects' capital costs, though, like with all investment incentives, there is a danger that some of the incentive will be captured by equipment vendors through higher prices. Again, tax incentives can be politically expedient, as it is usually easier for governments to avoid collecting taxes through tax credits than to collect the taxes and then disburse them as explicit subsidies. But from a public policy standpoint, such expediency must be carefully balanced against the complexity and distortions inherent in manipulating the tax system.

Operating Incentives

Reliable power purchase contracts/agreements are perhaps the single most critical requirement of a successful renewable energy project. The vast majority of renewable energy projects have been implemented by IPPs. The only possibility for such facilities to sell their power is to have access to the utility's transmission and distribution grid and to obtain a contract to sell the power either to the utility or to a third party by wheeling through the utility grid. Because renewable energy projects are generally considered risky by financial institutions (Delphi International, 1997), a reliable, stable and hence credible long-term revenue stream is extremely important for obtaining finance at a reasonable cost. Creation of reliable power markets for independent producers has thus been the cornerstone of essentially every successful renewable energy strategy. The most famous example of this may be the 1978 Public Utilities Regulatory Policies Act (PURPA) in the United States which mandated that utilities purchase all independently generated power at their avoided cost.

Like capital investment incentives, operating incentives are subsidies to reduce the cost of producing electricity from renewable sources. As with investment incentives, operating incentives can be paid from the general tax base or through a surcharge on customer utility bills. However, unlike investment incentives, which are paid on the basis of initial capital costs, operating incentives are paid per kWh of electricity generated. Operating incentives can be superior to investment incentives by eliminating the temptation to inflate initial project costs and by encouraging developers to build reliable facilities which maximise energy production. The shift from investment incentives to operating incentives in the United States was clearly influenced by this concern and the abuses encountered by early investment incentive schemes.[iv] Renewables policies should be designed such that subsidy levels are not simply linked to capital investment only, but also to project performance, as measured by the actual amount of electricity produced. However, if the conditions required for the creation of a long-term, predictable revenue stream cannot be met, policy-makers may want to consider cash investment subsidies rather than production subsidies. Investment subsidies can either be provided up-front or spread over several years, contingent upon reaching performance or design objectives.

However, operating incentives also suffer from one clear disadvantage compared to investment incentives. Because operating incentives are paid per kWh of electricity generated, project developers and funders must rely on the assumption that the incentives will continue to be available in future years. Elimination of operating incentives due to policy changes, government budget cutbacks, or political whim can have devastating financial impacts on renewable energy projects. By contrast, investment incentives which are paid up-front are not subject to changing political forces once the incentive is paid. On the other hand, investment subsidies can also be subject to political uncertainty at the time of construction, as evidenced by the United States' year-to-year extension of its investment tax credit, subject to yearly Congressional approval (Sissine, 1999). Nevertheless, for developers, investment incentives are generally much safer against political risk than operating incentives.

Operating subsidies per kWh

Operating incentives can take different forms, the simplest being the direct cash subsidy, paid per kWh of electricity produced. Countries using such subsidies include the UK, Spain and Germany. However, the level of subsidy can be determined in a variety of ways. In the UK, the level is determined through a competitive auction, while in Germany the level is administratively set. In California, under its new electric utility industry restructuring law, the enacted Assembly Bill 1890, existing renewable electricity projects are paid an administratively determined operating incentive, while new projects must competitively bid for the per-kWh incentive (CEC, 2000).

Production Tax Credit per kWh

As with capital investment incentives discussed above, operating incentives can also be provided as tax credits rather than as direct subsidies. This has been the strategy employed by the United States since 1992, for example, in promoting wind and biomass energy.[v] Production tax incentives are subject to the same advantages and disadvantages compared to operating subsidies as were described above for investment incentives. The advantages appear to be primarily those of political expediency, while disadvantages include complexity and lack of ability of certain parties to fully absorb the tax credit. Furthermore, Kahn (1996) has argued that tax credits' usefulness is limited because, in order to take full advantage of tax credits, projects must be financed with a greater proportion of high cost equity and lower proportion of low cost debt than would otherwise be the case.

PREFERENTIAL FINANCING FOR RENEWABLES

The cost of raising capital is a major factor in all investment projects. This is particularly the case for infrastructure projects like power generation which often involve large up-front costs, and long construction lead times and operating lifetimes. Thus, improved financing terms such as lowered interest rates or longer repayment horizons can significantly reduce project costs. Governments such as Germany and India have created special funding agencies to provide loans for renewable energy projects at below-market interest rates. Furthermore, development organisations including the World Bank provide loan guarantees which reduce risks for commercial lenders and thus lower interest rates.

Financing terms are particularly important to RETs because renewables are often capital intensive, and therefore require a greater degree of up-front debt and equity than power plants with lower capital costs. A number of additional factors make it more difficult for renewables to obtain financing at reasonable costs than for more mainstream generation technologies: Many RETs are perceived by the financial community to have high resource and technology risks (Wiser, 1997). Most financial institutions do not have significant experience evaluating renewable energy resource risks (Wohlgemuth, 2000). Many RETs 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 available to more traditional generation sources. Wiser and Kahn (1996), for example, estimate that if wind developers received financing terms and costs similar to gas-fired IPPs, the nominal levelised cost of wind power might decrease by 25%.

Policies may have unintended negative impacts on the financing process and on financing costs, reducing the overall effectiveness of these policies (Wiser and Pickle, 1998). An example provides the production tax credit on the renewables project capital structure currently granted by the United States federal government in the form of a 10-year, 1.5¢/kWh production tax credit to qualified wind power and biomass facilities (Sissine, 1999). Although this incentive is capable to stimulate the development of renewable energy projects, it inadvertently raises financing costs because of its impact on the capital structure (i.e., the mix of debt and equity used to finance a particular project) of renewable energy projects. This secondary impact has reduced its effectiveness moderately. Although, by providing a return to equity investors, the production tax credit allows a reduction in the wind power sales price, unless the capital structure changes, an energy price reduction can result in a violation of the minimum debt service coverage requirement (i.e., operating income is not sufficiently high to service the full debt payments). To combat this problem, the project developer must increase the fraction of higher-cost equity in the capital structure, therefore also increasing the contract price from what it would be under an equivalent cash incentive (which can be used to service debt).

THE CALIFORNIA EXPERIENCE

In terms of renewable energy, there has been significant concern that, without some form of continued government-mandated funding, the entire established California renewable energy industry may not survive in the competitive market. As a result, a new renewables support mechanism has been adopted to collect a total of US$540 million from electricity customers between 1998 and 2002 to support existing, new, and emerging RETs for electricity generation. These funds are to be collected by the utilities through a non-bypassable charge on distribution service ("system benefits charge"). Allocation of these funds to individual projects has been made the responsibility of the California Energy Commission (CEC).

The CEC has divided the funds into four primary categories: existing technologies (i.e., projects operational before Sep. 23, 1996), new technologies, emerging technologies, and consumer credits. The allocation of funds to these four categories has been established as follows (CEC, 2000):

- *Existing Technologies.* The existing technology funds provide support to already existing projects which continue to require financial support to remain operational. The existing technologies are further divided into three tiers, in which Tier 1 (currently least cost-effective technologies) includes biomass and solar thermal projects, Tier 2 includes wind, and Tier 3 (currently most cost-effective) includes geothermal, small hydro, digester gas, landfill gas, and municipal solid waste. For the existing technologies, incentives are paid *on a per-kWh production basis*, and the amount is determined by the lesser of (a) the administratively determined target price minus the market clearing price, or (b) available funds divided by generation; or (c) specified production incentive caps. The target price is set highest for Tier 1 (5 cents/kWh in 1998 declining to 3.5 cents/kWh in 2001), while the Tier 2 and 3 target prices are 3.5 cents/kWh and 3.0 cents/kWh, respectively. Furthermore, the production incentive cap for all tiers is 1.0 cent/kWh except for Tier 1 in 1998-1999, for which the cap is 1.5 cents/kWh.

- *New Technologies.* For new technologies (i.e., projects operational on or after Sep. 23, 1996), all technologies will be treated within the same category, and funds are to be allocated *on a simple auction basis*, with funds allocated to those projects requiring the least support. In other words, higher cost technologies like solar or biomass do not receive any preferential treatment over cheaper technologies like digester gas in the case of new technologies. Investors are thus expected to invest in the most cost-effective technologies as dictated by the market, with no technological preference indicated by the state. Production incentives are subject to a maximum cap of 1.5 cents/kWh and will be awarded to the lowest cost bidders until funds are exhausted. For projects awarded incentives, these incentives are to paid out over a 5 year period subsequent to project commissioning.

- *Emerging Technologies.* The $54 million in the Emerging Renewable Resources Account is used to fund the "Buydown Program", a multi-year programme of payments to buyers, sellers, lessors or lessees of eligible electricity generating systems that are powered by emerging renewable resources. (CEC, 2000) Emerging technologies eligible to participate include photovoltaics, solar thermal electric, fuel cell technologies that utilise renewable fuels, and small wind systems of not more than 10 kW. Payments from the Buydown Program are intended to substantially reduce the net cost of generating equipment using emerging technologies and thereby stimulate substantial sales of such systems. Increased sales of generating equipment are expected to encourage manufacturers, sellers, and installers to expand their operations and reduce their costs (Wene, 2000). To ensure that the costs of these systems decrease over time, the level of buydown payment declines in five steps, from US$3 to US$1 per watt, during the course of the programme. Besides encouraging the sales of emerging renewable technology systems, another goal of the Buydown Program is to encourage the siting of small, reliable generating systems throughout California in locations where the electricity produced is needed and consumed.

- *Consumer Credits.* Consumer credits are meant to help stimulate an active retail market in which consumers choose to purchase electricity from renewable energy suppliers. Consumers who choose such green power can receive an incentive applied to their electricity bills which is determined by the lesser of (a) available funds divided by eligible renewable generation, or (b) a 1.5 cent/kWh incentive cap.

SUMMARY AND CONCLUSIONS

Many motivations for the public support of renewable energy can be found. Generally, they comprise aspects of sustainable development and challenges that arise by the institutional changes in the electricity industry. Ideally, policy design should match the desired policy goals with the incentive mechanisms employed – subject to technical, market, and financial constraints. This criterion, however, cannot always be met, and in practice political considerations often dominate policy design and implementation approaches.

One the one hand, electricity sector reform may facilitate the access to the market for independent producers but on the other hand this may also put renewable electricity production at a competitive disadvantage. Consequently, specific incentive mechanisms are necessary but they should be compatible with the introduction of competition in electricity markets. Some of the existing schemes have proved very effective for stimulating the development of renewable sources, but they should evolve to become more compatible with competition. Some newer instruments appear to be more suitable in that respect but their effectiveness still has to be demonstrated.

Direct subsidies to investment which has largely been used during the 1980s for increasing renewable production may not be the best solution. Feed-in tariffs have proved to be very effective in different European countries for stimulating renewable production and industrial development, but they may be costly and do not, in general, stimulate market forces. Also, policies to promote emerging energy technologies based on uneconomically high mandated feed-in tariffs may lead to short-term gains but serious risks of long-term handicaps, as can for example be seen from the experience with wind energy promotion in California during the 1980s. Competitive bidding or tradable green certificates are alternative incentive schemes which rely to a greater extent on competition and may be more appropriate to the new conditions resulting from power market reform.

In most circumstances, renewables policies should be designed so that subsidy levels are tied to project performance, not capital investment. However, if the conditions necessary for creating a long-term, predictable revenue stream cannot be met, policy-makers may want to consider distributing funds as cash investment subsidies rather than production incentives or above-market contracts. Investment subsidies could be provided up-front or could be spread over several years contingent upon reaching performance or design objectives. An investment subsidy does not entail a long-term policy commitment to any individual project, however, therefore reducing one of the key risks of production incentives and above-market contract payment policies. Investment subsidies may also be helpful to projects that use new technologies and/or have particularly high performance risks. Capital support can partially protect investors from these performance risks because the subsidy level is not directly tied to uncertain electricity production.

A reason that RET policies are not more effective is that project development and financing processes are frequently ignored, or misunderstood, when designing and implementing renewable energy policies. Renewables policies that are carefully designed can reduce renewable energy costs dramatically by providing revenue certainty that will, in turn, reduce financing risk premiums. At a time when the emphasis appears to be on short-termism and market orientation, highlighting the financing implications of policy design is more essential than it has been in the past.

Renewable energy policies can have secondary impacts on the financing structures of renewables projects. Tax credits can push the optimal mix of debt and equity in the capital structure toward higher-cost equity, and therefore reduce the value of the credit. Secondary impacts should be considered during policy selection and design.

A programme of financial assistance must remain stable for some time, and combinations of policies are likely to be far more effective than any single renewables policy. Quite dissimilar renewable energy programs have succeeded in, for example, California, Denmark, Germany, and the United Kingdom. However, they share in common the qualities of predictability and stability.

Experience indicates that the need for subsidies declines as technologies mature. This experience include, for example, the steady decline of bids for the technologies covered under the NFFO system in the United Kingdom. Long term objective of any policy to promote the market penetration of RETs should be to make them fully competitive and thus eliminating the need for (financial) assistance.

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i Apart from monetary instruments, other classes of mechanisms can be used to promote the research and development and market introduction of renewable energy technologies (RETs). These mechanisms include regulatory instruments, information and education campaigns, and accompanying measures.

ii See Piscitello and Bogach (1997), IEA (1997), Derrick (1998), Drillisch and Kreuzberg (1995); World Bank (1998) and Gutermuth (1998), among others.

iii In California, the available tax incentives for renewables included a 25% energy investment tax credit which was available up until 1995, was reduced to 15% in 1996, and expired at the end of 1996.

iv With many projects (particularly wind) being developed primarily for tax shelter purposes, project performance in terms of electricity generation was often far below expectations. It was to avoid such abuses that tax incentives were changed from capital cost-based tax credits to production-based credits in 1992.

v US Energy Policy Act (EPAct) of 1992 created a production tax credit of 1.5cent/kWh available for 10 years to promote certain renewable energy technologies, including wind turbines.