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**Renewable Electricity Generation Policy Mechanisms
for the New Zealand Energy Efficiency and Conservation Authority**

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1. Transmittal

This report was prepared at the request of Energy Efficiency and Conservation Authority. This report is an overview of mechanisms used worldwide to develop renewable generation of electricity. It is not a detailed analysis, nor a template for support mechanism design, though some elements of good design are mentioned. This report primarily examines support mechanisms for wind energy and solar photovoltaics (PV). The mechanisms discussed have also been used to develop biomass, low-head or small hydro, and geothermal generation.

For more comprehensive analysis or detailed policy design, contact:

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- Janet Sawin, Worldwatch Institute, jsawin@worldwatch.org, +1 202 452 1992.

This report makes several sweeping assumptions in order to focus specifically on support mechanisms themselves and not on the rationale for developing renewable energy. These assumptions are:

- Renewables are desirable,
- Diversity of technology is desirable,
- Diversity of ownership is desirable, and
- Geographical diversity is desirable.

Similarly, it was necessary to make several assumptions about how to evaluate the performance of support mechanisms. These assumptions are:

- Amount of renewables developed,
- Diversity of renewables developed,
- Diversity of market participants or maximum opportunity,
- Geographic distribution of renewables developed,

- Minimum administrative burden,
- Maximum transparency, and
- Maximum market stability (minimum of boom-and-bust cycles).

In the debate surrounding support mechanisms, these criteria are frequently used. The most often used criteria is simply the amount and diversity of renewables developed.

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2. Summary

Renewable Tariffs have proven the most successful mechanism for stimulating investment in renewable energy worldwide. Renewable Tariffs have resulted in more installed renewable generating capacity and more robust competition among manufacturers and have stimulated more renewable technology development than any other policy mechanism.

This can be illustrated by a comparison between the USA and continental Europe. The USA and continental Europe have equivalent populations and market economies of similar size. Total installed wind-generating capacity in the USA at the end of 2005 stood at about 9,000 MW. Less 1,000 MW installed in the early 1980s under an early Renewable Tariff program, there are 8,000 MW operating today. The majority of this capacity has been installed under various tendering systems, with the remainder under Renewable Portfolio Standards. In contrast, continental Europe (Germany, Spain, Denmark, and France) has installed approximately 32,000 MW under Renewable Tariffs or four times the amount installed in the USA. Most wind turbines and nearly all wind turbine designs are of continental European origin.

The situation with solar photovoltaics (PV) is more mixed. Japan has been successful with capital subsidies, whereas Germany has been equally successful with Renewable Tariffs. Currently the growth rate of Germany's photovoltaic industry exceeds that of Japan. Both dominate the world market. German manufacturers of PVs now compete with Japanese manufacturers.

Both Quota systems (Requests for Proposals and Renewable Portfolio Standards) and Renewable Tariff (Minimum Price) systems can be made to work effectively. Both can produce growth in the targeted renewable technology when properly designed. However, Quota systems favor large, vertically integrated generators and multinational electric utilities, and are more difficult to design and implement than Price systems. Only Renewable Tariffs have a consistent record of offering equitable opportunity to all willing participants in the market and stimulating rapid rates of growth.

New Zealand is rich in renewable energy resources. With an aggressive conservation program and implementation of Advanced Renewable Tariffs, New Zealand can produce 100% of its electricity with renewable resources by 2025.

3. Introduction

There is an extensive literature on the topic of renewable energy support mechanisms. There are several recent (2005-2006) reports and a new book that examine renewable policy options in more detail than possible here.

- Commission of the European Communities, The support of electricity from renewable energy sources,
- Volkmar Lauber, *Switching to Renewable Power: A Framework for the 21st Century,*
- ECN, Review of International Experience with Renewable Energy Obligation Support Mechanisms, and
- Janet Sawin, National Policy Instruments: Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies around the World.

These and the documents cited in the text offer insights into the advantages and disadvantages of each public policy measure and how such programs can best be designed. There is also an extensive collection of articles and commentary on feed laws (Renewable Tariffs) at http://www.wind-works.org/articles/feed_laws.html.

3.1 Terms

Discussions of renewable energy policy often include an alphabet soup of acronyms describing different agencies, political parties, and support mechanisms. Here are several used in this report.

ARTs (Advanced Renewable Tariffs): More sophisticated form of electricity feed laws as now used in Germany and France.

CDU/CSU (Christlich Demokratischen Union/Christlich Soziale Union): German Christian Democrats.

EEG (Erneuerbare Energien Gesetz): Germany's Renewable Energy Sources Act, an example of Advanced Renewable Tariffs (2000 and 2004).[1]

Feed-In Laws, or Feed Laws: Generic term for minimum price systems, also known as REFITs.

[1] Original (2000) version in English http://www.wind-works.org/FeedLaws/Germany/GermanEEG2000.pdf, visited January 7, 2006; current version (2004) http://www.wind-works.org/FeedLaws/Germany/EEG-New-English-final.pdf, visited January 7, 2006.

MPS (Minimum Price Systems): Generic term for feed laws. Encompasses both simple feed laws and more complex Advanced Renewable Tariffs.

Production-Based Incentives: American term for any incentive based on kilowatt-hours of generation. This is sometimes used as a politically neutral term for feed laws in the American context.

PTC (Production Tax Credit): American federal tax subsidy for wind energy based on the number of kilowatt-hours of electricity generated, as a credit against federal taxes.

REFITs (Renewable Energy Feed-In Tariffs): Generic Euro-English term for electricity feed laws used in the non-anglophone world.

RPS (Renewable Portfolio Standards): Renewable targets placed on electricity suppliers, often coupled with tradable certificates. Also known as quota systems. RPS are frequently synonymous in North America with targets and do not necessarily imply tradable certificates.

Renewable Tariffs: Generic term for electricity feed laws.

RECs/ROCs (Renewable Electricity or Obligation Certificates): Quota system using tradable Renewable Electricity Certificates. Here a Renewable Obligation System is synonymous with a Quota System that uses tradable certificates. This is distinct form a Renewable Portfolio Standard, which may or may not include tradable certificates.

SOC (Standard Offer Contract): North American term that, like feed law, embodies both connection and price. In the Canadian context SOCs encompass more than renewable energy and may include gas-fired cogeneration.

SPD (Sozialdemokratische Partei): German Social Democrats.

Stromeinspeisungsgesetz (StrEG): Germany's original electricity feed law (1991).[2]

Tariffs: Rates paid for electricity per kilowatt-hour consumed, or in this case, generated. The term is commonly used in electric utility rate-making in North America. The term is also commonly used in Europe.

TGC (Tradable Green Certificates): Also known as Tradable Renewable Electricity Certificates, Renewable Obligation Certificates, and Renewable Electricity Certificates.

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[2] Stromeinspeisungsgetz (StrEG) in English, http://www.wind-works.org/FeedLaws/Germany/ARTsDE.html, visited January 7, 2006.

TRECs: Tradable Renewable Electricity Certificates used with Renewable Portfolio Standards or Renewable Obligation systems, also known as Renewable Obligation Certificates (ROCs) in Britain, or Renewable Electricity Certificates (RECs) in Australia.

WPPI (Wind Power Production Incentive): Federal wind energy subsidy in Canada, based on a payment per kilowatt-hour of generation.

3.2 Effectiveness

For this report the principal measure of a policy mechanism's effectiveness is its ability to deliver results in actual generation or in total installed generating capacity.

3.3 Efficiency

Policy mechanism's ability to deliver generation at minimum overall costs to society. This may entail more than simply the lowest price to consumers and may include environmental and social costs or the inverse, social and environmental benefits. Some states have included industrial policy and national security as criteria.

3.4 Energy Security

Energy security has played a significant part in recent overt policy considerations in some countries, notably in Germany as it prepares itself for the end of cheap oil and gas. In other countries (such as the USA) security issues have been an important but unspoken—and officially denied—consideration for an aggressive foreign policy that seeks to extend its sphere of influence into oil-producing regions.

Recent moves by Russia and its state-owned gas utility GazProm to use the availability and price of natural gas—in mid winter—as a foreign policy tool and the not-so-veiled threats by Venezuela and Canada to increase sales of oil to China from within the USA's economic sphere, augur poorly for the stability of price and the availability of both oil and gas.

New Zealand is in a vulnerable position, with its dwindling supply of natural gas and increasing electricity consumption. Construction of a LNG terminal and increased dependence on gas for electricity generation could increase the country's vulnerability to supply interruptions and price volatility. Natural gas extraction is in decline in North America and this winter the spot market price briefly hit $15/MMBtu ($21.75 NZD/MMBtu or approximately $22/GJ).

3.5 Exchange Rates

The exchange rates used this report were those in early January 2006. See Table 3.1.

Table 3.1. Exchange Rate.

Exchange Rate		
	$NZD	Date
£1 GBP	$2.560	January 8, 2006
€ Euro	$1.758	January 7, 2006
$1 USD	$1.447	January 8, 2006
$1 CAD	$1.233	January 9, 2006

3.6 Summary of Support Mechanisms in EU-15

There have been a number of recent reports examining the support systems in the European Union. The chart in Figure 3.1 summarizes the support mechanisms among the EU-15 (the original EU members before expansion).

Figure 3.1. Summary of support mechanisms in EU-15.[3]

Country	Main electricity support schemes	Comments
Austria	Feed-in tariffs (now terminated) combined with regional investment incentives.	Feed-in tariffs have been guaranteed for 13 years. The instrument was only effective for new installations with permission until December 2004. The active period of the system has not been extended nor has the instrument been replaced by an alternative one.
Belgium	Quota obligation system / TGC[27] combined with minimum prices for electricity from RES.	The Federal government has set minimum prices for electricity from RES. Flanders and Wallonia have introduced a quota obligation system (based on TGCs) with the obligation on electricity suppliers. In Brussels no support scheme has been implemented yet. Wind offshore is supported at federal level.
Denmark	Premium feed-in tariffs (environmental adder) and tender schemes for wind offshore.	Settlement prices are valid for 10 years. The tariff level is generally rather low compared to the previously high feed-in tariffs.
Finland	Energy tax exemption combined with investment incentives.	Tax refund and investment incentives of up to 40% for wind, and up to 30% for electricity generation from other RES.
France	Feed-in tariffs.	For power plants < 12 MW feed-in tariffs are guaranteed for 15 years or 20 years (hydro and PV). For power plants > 12 MW a tendering scheme is in place.
Germany	Feed-in tariffs.	Feed-in tariffs are guaranteed for 20 years (Renewable Energy Act). Furthermore soft loans and tax incentives are available.
Greece	Feed-in tariffs combined with investment incentives.	Feed-in tariffs are guaranteed for 10 years. Investment incentives up to 40%.
Ireland	Tendering scheme. It has been announced that the tendering scheme will be replaced by a feed-in tariff scheme.	Tendering schemes with technology bands and price caps. Also tax incentives for investment in electricity from RES.
Italy	Quota obligation system / TGC. Anew feed-in tariff system for photovoltaic valid since 5th August 2005.	Obligation (based on TGCs) on electricity suppliers. Certificates are only issued for new RES-E capacity during the first eight years of operation.
Luxembourg	Feed-in tariffs.	Feed-in tariffs guaranteed for 10 years (for PV for 20 years). Investment incentives also available.
Netherlands	Feed-in tariffs.	Feed-in tariffs guaranteed for 10 years. Fiscal incentives for investment in RES are available. The energy tax exemption on electricity from RES ended on 1 January 2005.
Portugal	Feed-in tariffs combined with investment incentives.	Investment incentives up to 40%.
Spain	Feed-in tariffs.	Electricity producers can choose between a fixed feed-in tariff or a premium on top of the conventional electricity price, both are available over the entire lifetime of a RES power plant. Soft loans, tax incentives and regional investment incentives are available.
Sweden	Quota obligation system / TGC.	Obligation (based on TGCs) on electricity consumers. For wind energy, investment incentives and a small environmental bonus are available.
UK	Quota obligation system / TGC.	Obligation (based on TGCs) on electricity suppliers. Electricity companies which do not comply with the obligation have to pay a buy-out penalty. A tax exemption for electricity generated from RES is available (Levy Exemption Certificates which give exemption from the Climate Change Levy).

[3] Commission of the European Communities, The support of electricity from renewable energy sources, COM (2005) 627 final, Communication from the Commission, http://europa.eu.int/comm/energy/res/biomass_action_plan/doc/2005_12_07_comm_biomass_electricity_en.pdf, 07/12/2005, visited January 3, 2006.

4. Policy Support Mechanisms

All support mechanisms for renewable generation of electricity must, at a minimum, include measures for:

- Access to the grid (interconnection), and
- A price for the electricity produced that contributes to profitability or at least the prospect of profitability.

These elements are the two essential parts of the development equation. One without the other will not lead to significant development. All successful policies, whether European Feed Laws or Renewable Obligations, include these two elements.

For example in the US, PURPA (the Public Utility Regulatory Policy Act of 1978), provided access to the electricity network and specifically prohibited discrimination against “qualifying facilities”. PURPA also provide a mechanism for determining a price (avoided cost) that would be paid for generation, but it famously did not specify a price. At the time of PURPA there were also lucrative tax subsidies available in the US. Nonetheless, there was little development. Independent power producers did not have sufficient countervailing power to negotiate successfully with the entrenched electric utilities that operated state-sanctioned monopoly franchises.

It wasn’t until California forced the state’s investor-owned electric utilities in the early 1980s to offer standardized contracts that development of wind energy began. And it wasn’t until one contract, Standard Offer #4, provided specific prices (tariffs) for generation that development boomed.[4]

Germany’s groundbreaking *Stromeinspeisungsgesetz* (StrEG, 1991) is an example of a policy that provides both elements: access and price. Literally, the law on “feeding-in” electricity provides for access. For this reason, the law and subsequent revisions are commonly referred to as Feed-In laws. The StrEG also specifies how much the renewable generator will be paid.

Germany’s more recent *Erneuerbare Energien Gesetz* (EEG, 2000 and 2004), for example, clearly provides for access in its preamble by stating that its purpose is not only to permit but also to encourage interconnection with the network. Germany’s EEG is formally known as the “Act on granting priority to renewable energy sources” of electricity from qualifying generators. The EEG or Renewable Energy Sources Act as it is known in English then goes on to specify in great detail the prices that will be paid for renewable sources of generation.

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[4] For a discussion of this period, see Gipe, Paul, *Wind Energy Comes of Age*, (John Wiley & Sons: New York, 1995).

Britain's Renewable Obligation similarly permits access and payment for the electricity produced. In addition it provides a mechanism, tradable certificates, for determining a premium payment on top of the wholesale price paid for the electricity.

Corollaries to the elements of access and a means of payment are that access must be non-discriminatory, without resort to lengthy and costly regulatory proceedings, and that payment must be sufficient to drive development.

Revenues from tariffs, or from tariffs plus monetary support, must exceed the costs of generation by a sufficient margin for profitability, or development will not proceed, or will proceed at a tepid, insignificant pace. The degree to which revenues exceed generation costs determines the rate of deployment, everything else being equal.

Because renewable sources of generation are capital-intensive, they require long periods of time to return their investments and earn a profit.

Consequently, the prerequisites for policies that support renewable energy development must include:

- The political desire or demand for renewable sources of generation,
- The willingness to pay for renewable generation, and
- The stability of public policy to provide a return on investment.

Worldwatch Institute's Janet Sawin, an authority on national policy instruments for developing renewable energy, advises that any support mechanism must be:[5]

- Predictable, long-term and consistent, with clear government intent. These characteristics are critical to providing certainty in the market, to drawing investors into the industry, and to providing enough lead-time to allow industries and markets to adjust to change.

- Appropriate. The right types of support are needed—policies must match objectives and might vary by resource potentials, location, technology type, and timing. It is also important that the level of support not be too high or too low.

- Flexible. It is essential to design policies such that adjustments (fine-tuning, but not wholesale changes or elimination of policies) can be made on a regular, pre-determined time schedule if circumstances change. Governments must be able to address existing barriers as they become apparent, and new

[5] Sawin, Janet, National Policy Instruments: Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies Around the World, in D. Aßmann, U. Laumanns, D. Uh (ed.), *Renewable Energy. A Global Review of Technologies, Policies and Markets,* (Earthscan, London, forthcoming 2006).

barriers as they arise. Policies also must be designed to allow developers/generators flexibility for meeting government mandates.

- Credible and enforceable. If policies are not credible, or are not enforceable (or enforced), there will be little incentive to abide by them.

- Clear and Simple. Policies must be easy to implement, understand, and comply with. Procedures of permission and administration, where necessary, must be as clear and simple as possible.

- Transparent. Transparency is important for suppliers and consumers of energy and is necessary to avoid abuse. It facilitates enforcement, maximises confidence in policies, and helps ensure that mechanisms are open and fair.

4.1 Classes of Support Mechanisms

There are two major classes of support mechanisms:

- Quota or amount systems, and
- Price systems.

Generally, support mechanisms will fall into one of these categories. Both provide a means for access to the grid: either by offering open access to all participants or by offering standard contracts. Both are politically determined. Both use market mechanisms to achieve their ends. It's how they do so that distinguishes one from the other.

In the Quota system, the amount of generation desired is politically determined and the market determines the price. In the Price system, the price is politically determined and the market sets the amount.

Quota or amount markets have been most successful with onshore wind energy, though in theory, bands for different technologies can be used to develop other renewable sources of generation.

Quota systems can be subdivided, based on how the market determines the price once the amount has been politically determined. In Renewable Obligation systems or Renewable Portfolio Standards, the price paid for generation is partially determined by trading in green certificates. In Tendering systems, the price is determined by the selection of winning bidders in a call for tenders, often on the basis of the lowest tendered price.

Price systems, or more correctly Minimum Price Systems (MPS) can also be subdivided, based on how they determine the price or tariff that will be paid and whether prices are differentiated by technology or location. Some systems (Spain) pay a percentage of the retail rate. The resulting tariff can be less than the retail rate, for example 90% of the retail rate (for wind energy in Spain), or more than the retail rate, for example 575% of the retail rate (for solar PV in Spain). Others simply state a price or tariff that will be paid, as in Germany and France. Because these systems specify the price or tariff that will be paid, they are also known as Renewable Tariff systems.

4.2 Net Metering

Net metering is a special case that includes elements of both a Quota system and Renewable Tariffs. Net metering allows access on the customer side of the meter. It also specifies how the generator will be paid.

Under net metering the renewable generator can feed excess generation (that which is not being used on the customer's side of the meter) into the grid and bank the electricity with the utility. When generation is less than consumption, the banked electricity is withdrawn from the grid. Thus, the price or tariff for generation is the retail price of electricity.

Most programs have total program caps and project size caps. Program caps are often very small, usually only a few megawatts. Project size caps are equally limited. In the US, for example, most programs limit wind turbines to 10 kW or less. Some permit up to 50 kW. A few go as far as permitting 100 kW (Canada's Prince Edward Island). An even smaller number permit wind turbines up to 500 kW (Ontario), and very rarely up to one megawatt (California).

Most programs only permit banking of electricity up to the customer's total annual consumption. No payment is made for any electricity generated above this amount. In other words, the customer gives any banked electricity at the end of the year to the network free of charge.

Net metering, by its definition, does not distinguish between different technologies, though it is most often applied to wind energy. Typically all technologies receive the same price for generation, the retail tariff.

Some programs are net metering in name only. By the addition of various fees or by reducing the tariff for generation delivered to the grid from that of the retail rate they don't provide true "net" metered rates. In some jurisdictions, for example, the so-called net-metered rate is only the wholesale rate and not the actual retail rate that the customer pays.

Net metering is mostly used in North America.[6] It is not widely used in Europe, where it is virtually unknown.

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[6] For a summary of US states with net metering (2004) see http://www.eere.energy.gov/greenpower/pdfs/metering_0604.pdf, for a summary of US State incentives (2006), see http://www.dsireusa.org/index.cfm?&CurrentPageID=3 .

4.3 Subsidies

Subsidies do not provide access to the grid. They only affect one side of the development equation: profitability. Subsidies alone are never a sufficient support mechanism.

Various direct and indirect subsidies have been used over the past 2-1/2 decades to promote various renewable technologies. Subsidies can be divided into categories based on both how they work and where the money comes from.

Subsidies are paid for either

- Capital investment, or
- Production.

4.3.1 Capital Subsidies

Many countries, states, and provinces have used direct subsidies from public treasuries to pay for a portion of the capital investment of a renewable technology, for example, in $/kW of installed capacity. This was an early tool. It is not widely used today except with solar PV in Japan and in California.

Unfortunately, subsidies on capital invested pay for hardware and not generation. With capital subsidies there is an incentive to install hardware with inflated costs. When the price for generation is low, as in net metering, there then is little incentive to ensure that the installed hardware actually generates electricity. As a result, there was widespread abuse of capital subsides in California during the early 1980s.

Following the abuses of the capital subsidies, the US began using a subsidy on the production or generation of electricity in kilowatt-hours (kWh). This is a more targeted subsidy as it pays only for the benefit desired: renewable generation in kilowatt-hours.

4.3.2 Production Subsidies

Production subsidies can be paid directly as a bonus payment per kWh or in the form of a tax credit or rebate.

The American Production Tax Credit (PTC) for wind energy is a credit against federal taxes due. As such it is worth its face value, in 2004 $0.018/kWh ($0.026 NZD/kWh). The PTC only is useable by those with a hefty appetite for federal taxes. It is not transferable and it is only for wind energy.

The Canadian Wind Power Production Incentive, the unfortunately named WPPI, is simply a payment from the federal government. WPPI was worth about $0.007

CAD/kWh in 2004 ($0.0086 NZD/kWh). Because WPPI is a payment and not a tax credit, it is not dependent on the tax status of the user. WPPI is more egalitarian than the PTC, but like the PTC is only for wind generation.

Neither the PTC or WPPI are sufficient on their own to stimulate development. A developer needs a contract with an electric utility or electricity buying authority that permits interconnection and pays a price sufficient for profitability when combined with the subsidy. The PTC and WPPI merely reduce the tariff, or the amount of payment per kilowatt-hour, needed for profitability.

Production payment subsidies have recently been implemented for solar PV in California (early 2005) and are pending for solar PV in Washington State. The California PV payment is the equivalent of its capital rebate program only in the form of a production payment.

4.3.3 Source of Subsidies

Subsidies are paid from either

- Public treasuries, or
- Funds created by System Benefits Charges (Public Goods Charges).

Most subsidies have been drawn from public treasuries. As such they are determined—and limited—by the public budgeting process. Since the introduction of electric utility restructuring, some subsidies have been drawn from charges on all electricity consumers to pay for public benefits or public goods.

Japan's PV capital subsidies are drawn from the public purse.

Subsidies under California's PV rebate program are drawn from a Systems Benefits Fund created after so-called deregulation in 1996.

4.3.4 Low-Interest Loans

Low-interest loans, like other monetary subsidies, only address one side of the development equation: profitability. As with subsidies, low-interest loans alone will not spur development. Low-interest loans can be an aid in development by providing a low-cost source of capital for project development, and they can be a useful tool for encouraging broader participation in a renewable development program.

Low-interest loans have been an important element in Germany's success with Renewable Tariffs, especially because they allow small firms, farmers, and even individuals to invest in renewable development. These loans are readily available, and open to all technologies that meet the lending bank's investment criteria. However, they in and of themselves have not directly produced

Germany's success with renewable energy development. They have been an aid to investment, but they have not caused the investment.

4.4 Quota Systems

As mentioned, Quota systems establish the amount of renewable generation desired. Quota systems use several mechanisms to determine who has access to the grid, and how those who have access will be paid.

4.4.1 Tendering

In Tendering or competitive bidding systems, a state, electricity purchasing authority, or electricity supplier issues a call for tender (Request for Proposals) to supply a certain amount of generation under a long-term contract or Power Purchase Agreement (PPA). An offer of or call for tenders often includes a price cap. There is a long history with Tendering for large public works and it has been used extensively for large-scale deployment of wind energy. Britain's Non Fossil Fuel Obligation (NFFO) is one example of Tendering, France's Eole program being another.

Tendering addresses both elements of development: access and price. By awarding a long-term contract, the offering institution provides access and payment based on the winning bid.

Tendering can specify technologies that are available to bid or they can be technology-neutral.

Much the nearly 700 MW of operating wind capacity in Canada has been awarded under calls for tender. Hydro Quebec in 2005 awarded 1,000 MW of wind contracts and in late 2005 announced plans for an additional tender for 2,000 MW.

Of the 9,000 MW of wind capacity operating in the United States, nearly 8,000 MW were awarded contracts through tendering. About 500 MW of wind energy was operating in Great Britain from tendered contracts, much less in France.

Tendering is also used to award contracts under Quota systems with tradable certificates, though it is not essential to do so.

4.4.2 Quota Obligations with Tradable Certificates

Quota obligations (mandates to Quota critics), set a renewable target for each electricity supplier. Each supplier is "obligated" or "mandated" to deliver a certain portion of their generation from renewables, say 10%, by a certain date. There often is a penalty for failure to meet the target.

In the United States, such Quota systems are called Renewable Portfolio Standards (RPS) because they set a standard for the amount of renewables in a utility's portfolio of generation. In Britain the same concept is called the Renewable Obligation. In Australia it is the Mandatory Renewable Energy Target (MRET).

In these systems, the environmental or renewable energy value of generation is separated or "unbundled" from the underlying electricity. This unbundled environmental value is then applied to "certificates" representing renewable generation. The certificates are then used to track compliance with the target and traded among electricity suppliers. Those suppliers who can't or who choose not to install their own renewable generation can meet their "obligation" by buying certificates from those with a surplus. The certificates are often simply entries in a ledger and are not a piece of paper. These entries can then be traded electronically without any documents changing hands.

If there is a demand for these Tradable Renewable Electricity Certificates (TREC) or Tradable Green Certificates (TGC), they then have a monetary value.

Under Britain's Renewable Obligation, access to the grid is open to all participants. There is no requirement for a purchase power agreement or contract, though this remains an option to participants.

In RPS systems in the United States, access can be open, but more often it is provided in the form of a contract. The contracts are most often awarded through tendering, though some participants have negotiated private bilateral agreements.

TRECs represent the benefits of renewable energy and separate the value of the benefits from the underlying value of the electricity itself. In Quota systems, this commodity (the certificates) can be banked, traded, and consumed by participants in the market. In some systems, such as that of Texas, the certificates remain bundled with the electricity.[7]

The price paid for renewable generation then is the sum of the value of the electricity and the value of the tradable certificate.

In Renewable Obligation markets, the value of Tradable Renewable Energy Certificates (TRECs) is primarily a function of the target, the schedule for meeting the target and the difficulty in obtaining the target's schedule.

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[7] van der Linden, N.H., and M.A. Uyterlinde, ECN; C. Vrolijk, IT Power; L.J. Nilsson, J. Khan, K. Åstrand and K. Ericsson, University of Lund; R. Wiser, Lawrence Berkeley National Laboratory, Review of International Experience with Renewable Energy Obligation Support Mechanisms, May 2005, http://eetd.lbl.gov/ea/emp/reports/57666.pdf, visited January 3, 2006.

Typically, Quota systems are technology neutral. They seek the least costly renewable resource to meet the target. Britain's Renewable Obligation and most RPS programs in the United States don't provide technology bands, though there's no inherent reason that a nation, state, or province can't choose to do so.

Italy and Sweden also use a Renewable Obligation, as do two regions in Belgium.

Britain's Renewable Obligation, in the absence of long-term contracts and with its ambitious targets, guarantees high certificate prices in the short-term. But the system design only guarantees high prices if there is a large gap between the renewables supply and the targets.[8]

Penalties can provide a floor price if the targets are not met. The penalty price in Britain's Renewable Obligation is £0.0316/kWh ($0.081 NZD/kWh) in 2004, but certificates were trading at £0.047/kWh ($0.12 NZD/kWh) in late 2004. Coupled with the wholesale or spot-market price of electricity (£ 0.017/kWh), total short-term payment for renewable generation in Great Britain were about £0.064/kWh ($0.164 NZD/kWh).

Italy's certificate prices under its RO were trading even higher than those in Britain in 2005.

4.4.2.1 RPS in USA

In the United States and elsewhere, the term "RPS" is often misapplied. For many renewable energy advocates and politicians, it means only "target". In this context "RPS" doesn't necessarily include the mechanism for awarding contracts nor for determining the price paid for renewable generation.

In the United States, 18 states (representing 40% of US electricity consumption) have implemented RPS policies in one form or another. Despite this, Lawrence Berkeley National Laboratory renewables specialist Ryan Wiser notes that actual field experience is limited. Most of the states are in still in the process of creating markets for tradable certificates that are an essential part of true RPS programs.[9]

Half of the new wind capacity installed in the US since 2001 is attributable RPS policies, say Wiser.[10] Still, this represents only 25% of the total installed wind capacity in the country, and even less in California, the birthplace of North American wind development. According to Wiser, through 2004 less than 200 MW of wind had been installed through California's RPS program. This represents only 10% of the state's 2,000 MW of wind capacity. (At least half of

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[8] van der Linden 2005, see Chapter 4 on Experience in the UK.
[9] van der Linden 2005, see Chapter 6 on Experience in the USA.
[10] van der Linden 2005, see Chapter 6 on Experience in the USA.

California's capacity is due to the state's Standard Offer Contract No. 4, a forerunner of today's Renewable Tariffs.)

Few states have successfully deployed the RPS. For example, Nevada has failed to bring its contracted projects online, leading to substantial under-compliance, notes Wiser. Nevertheless, Nevada's utility regulator has failed to enforce the RPS policy, calling into question the entire program.[11]

Wind is the dominant technology deployed under RPS programs in the United States because of the hefty tax subsidies represented by the PTC.[12] Wiser notes that federal tax subsidies have also played a large part in all wind development in the US whether under RPS programs or under Standard Offer Contracts.[13]

One-third of those states with RPS policies have technology bands that include solar PV. In New Jersey, certificates for solar PV are trading at $0.175 USD/kWh ($0.23 NZD/kWh).[14] This price may seem high relative to current electricity prices, but it is well below that necessary to make installation a profitable enterprise, even with a high price for the underlying electricity.[15] Markets such as New Jersey and California rely on "early adopters" to drive the programs; that is, those who are making the investment for social or environmental reasons.

Wiser argues that to maximize economic efficiency, Quota programs need to provide long-term contracts. These contracts, often 20 years in duration, provide the economic security needed to finance capital-intensive projects, such as renewables, at low cost. This has succeeded in Texas, but not elsewhere.

In Massachusetts, certificates are trading at $0.05 USD/kWh ($0.07 NZD/kWh), says Wiser, yet projects are not being built because of an absence of long-term contracting. In markets with long-term contracts, such as those in Texas, Minnesota, California, and Iowa, where the certificates are often bundled with the electricity, the overall cost of generation is low. In Texas, certificates are trading at about $0.015 USD/kWh ($0.022 NZD/kWh), considerably less than that in Britain or Italy.[16]

California requires long-term contracts under its RPS, and contracts are awarded through tender.

New York's state RPS is something of a misnomer. Initially the state will issue a massive call for tender and award long-term contracts to the winning bidders. As

[11] van der Linden 2005, see Chapter 6 on Experience in the USA.
[12] The PTC applies only to wind energy.
[13] van der Linden 2005, see Chapter 6 on Experience in the USA.
[14] van der Linden 2005, see Chapter 6 on Experience in the USA.
[15] Total payments for solar PV in New Jersey would range from $0.25-$0.35 USD/kWh ($0.40-$0.47 NZD/kWh), half of that needed for breakeven. Moreover, the certificate price is variable and may decrease as supply of solar PV increases.
[16] van der Linden 2005, see Chapter 6 on Experience in the USA.

such, the program is more properly a Quota system with tendering, like Britain's NFFO, the French Eole program, or Quebec's 1,000 MW tender.

4.5 Renewable Tariffs

Renewable Tariffs are also known as electricity feed laws, Minimum Price Systems, Renewable Feed-In Tariffs (REFITs), fixed-price systems, and, in North America, as Standard Offer Contracts. They provide the two essential elements for a successful support mechanism: access to the grid and, by design, a price sufficient to drive profitable development.

Renewable Tariffs provide investment security, flexibility in program design, and development of both near-term (wind) and long-term (solar PV) technologies. Renewable Tariffs with sufficient price and terms can produce rapid growth, leading to volume manufacturing and technological innovation

The price or tariff for renewable generation is established politically in an open, public, and transparent manner. The price per kWh is derived from an analysis of industry data by various stakeholders, including academics (economists and engineers), and consultants. Tariffs are chosen that are expected to produce the desired pace of development.

Until recently, Renewable Tariffs were most well known in the non-anglophone world of continental Europe. This is ironic, because the first use of a Renewable Tariff was in California.

4.5.1 Standard Offer Contracts

Standard Offer Contracts for renewable power development were first introduced in California in the early 1980s in response to obstructionist behavior by the state's investor-owned utilities toward small power producers. California's Public Utility Commission ordered the utilities to offer standardized contracts and to offer one such contract, Standard Offer No.4 (SO4) with fixed prices. By the mid-1980s, private power producers had installed 1,200 MW of wind capacity in California. Much of this capacity is still in service. For two decades these wind turbines have delivered about 1% of the state's electricity.

4.5.2 Electricity Feed Law

In 1991 the German parliament introduced the Stromeinspeisungsgesetz (StrEG) or literally, the electricity in-feeding law. The StrEG was patterned after successful Danish policy that enabled access to the grid and stipulated the price that would be paid for renewable generation from wind, solar, hydro, and biomass. Like the earlier Danish system, the tariffs under the StrEG were presented as a percentage of the retail rate.

- Wind & Solar, 90%;
- Hydro & Biomass <500 kW, 75%;
- Hydro & Biomass >500 kW, 65%

The StrEG was more streamlined than the complex Danish system. In Denmark, wind generation was paid 85% of the retail rate. However, there were also several other payments that increased the final price paid to generators.

During the late 1990s the retail rate declined in Germany, affecting the profitability of projects already in the field. There were also regional imbalances of costs to consumers. Most wind development was taking place in the north of the country and consumers there were paying more for the program than consumers in the south.

It was also clear by this time that payments were far from sufficient to develop more costly solar PV. The German 1,000 roof and later 100,000 roof programs (direct capital subsidies from the public purse) had run their course, and German lawmakers felt it was time to put solar PV development on a firmer footing, rather than to depend on parliamentary approval of budget appropriations.

Principally for these reasons, the Bundestag approved a new feed law in 2000, the Erneuerbare Energien Gesetz (EEG). The EEG was amended in 2004 and is up for its regular review in 2007. The EEG was the first of what has been termed Advanced Renewable Tariffs (ARTs).[17]

4.5.3 Advanced Renewable Tariffs

Advanced Renewable Tariffs are the modern version of electricity feed laws. They are widely used in northern Europe. ARTs differ from feed laws in several ways. Feed laws set the price paid for renewable energy as a simple percentage of the retail tariff. ARTs, on the other hand, are more sophisticated than feed laws and can be tailored to different renewable technologies and to different regions of a country. There are often several tiers of tariffs depending upon the technology, its size, its application, where it’s located, and how long the generator has been in service.

All Advanced Renewable Tariff policies have similar characteristics:

- Differentiation by technology,
- Differentiation by size or application
- Differentiation by resource or site (for wind energy),
- Specific length of payments (15-20 years),

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[17] Two parliamentarians claim credit for the EEG: Hermann Scheer of the SPD, and Hans-Josef Fell of Die Grünen (The Green Party). At the time both parties were partners in the red-green coalition.

- Provision for periodic review, and
- Provision for balancing accounts to spread the program's cost.

Tariffs under these programs vary widely from one country to the next.

4.5.3.1 Technology Differentiation

Germany, France, and Spain provide tariffs for a host of different technologies. Typically, these include wind, solar PV, various forms of biomass, hydro, and geothermal.

4.5.3.2 Differentiation by size or application

Similarly, Germany and Spain provide tariffs by application and often for project size. For example, Germany provides specific tariffs for wind energy on shore and off. For solar PV, the German tariff structure is even more complex, with different tariffs for free-standing and roof-top applications, as well as on building facades. The PV tariffs are further broken down by size. See Table 4.1. This differentiation is similar in the French and Spanish programs, but to a lesser degree.

Table 4.1. Solar PV Tariffs in Germany.

Erneuerbare-Energien-Gesetz (EEG)					
		Tariff	1.38984	1.21054	1.758
	Years	€/kWh	CAD/kWh	USD/kWh	NZD/kWh
Solar Photovoltaic					
<30 kW rooftop	20	0.574	0.798	0.695	0.695
<100 kW rooftop	20	0.546	0.759	0.661	0.695
>100 kW rooftop	20	0.540	0.751	0.654	0.695
Freestanding	20	0.457	0.635	0.553	0.695
Facade cladding	20	0.500	0.695	0.605	0.695

4.5.3.3 Resource Differentiation

One of the continuing problems with wind energy has been the rush to windy sites. This was as true under the StrEG as it was under Britain's NFFO or its current Renewable Obligation. This "wind rush" creates two enduring problems: it uses the best sites first, often with the least developed technology, and it creates wind ghettoes—large concentrations of turbines in windy areas. The latter often results in a backlash against wind energy of the type, "Why should we have all the turbines here?"

In Germany, sites for wind turbines along the North Sea coast were being quickly exhausted in the mid-1990s. Consequently, the Germans wanted to encourage development in the less windy interior away from the coast. To do so they needed a policy instrument that made it possible to earn a profit from the less windy sites in the interior, the *binnenland*.

Their solution was simple enough: a two-tiered tariff system that paid more for wind energy where it was less windy. This has had a profound effect on wind development in Germany. More than half of all operating wind capacity and much of the new installations have taken place away from the coast.

The challenge then was how to determine the wind energy content of the site. Again, the solution was elegant: actual wind generation from turbines on the site. Thus, all wind turbines are paid the same tariff for the first five years: €0.084/kWh ($0.148 NZD/kWh).

After the first five years, a determination is made of the wind resource at the site by use of what the Germans call the Reference Yield Method (*Referenzertrag*). They average production over the five-year period and compare that of the same model of wind turbine with the projected generation at a hypothetical site with a wind speed of 5.5 m/s at a given height. This comparison is then used to determine how many years a wind generator will be paid the premium tariff. For an operator at a windy site at the end of the five-year period, the tariff falls to the second tier: €0.057/kWh ($0.10 NZD/kWh). The lower tariff is then paid for generation from years 6 through 20. For those at less windy sites, the premium payment is extended a number of months as function of the site's productivity. See Table 4.2.

Table 4.2. Wind Tariffs in Germany.

Erneuerbare-Energien-Gesetz (EEG)					
		Tariff	1.38984	1.21054	1.77273
	Years	€/kWh	CAD/kWh	USD/kWh	NZD/kWh
Wind on Land					
60% Reference Yield	20	0.084	0.116	0.101	0.141
70% Reference Yield	16.9	0.084	0.116	0.101	0.141
80% Reference Yield	15.4	0.084	0.116	0.101	0.141
90% Reference Yield	13.9	0.084	0.116	0.101	0.141
100% Reference Yield	12.4	0.084	0.116	0.101	0.141
110% Reference Yield	10.9	0.084	0.116	0.101	0.141
120% Reference Yield	9.4	0.084	0.116	0.101	0.141
130% Reference Yield	8	0.084	0.116	0.101	0.141
140% Reference Yield	6.5	0.084	0.116	0.101	0.141
150% Reference Yield	5	0.084	0.116	0.101	0.141
All	To Year 20	0.053	0.073	0.064	0.089

France uses a similar approach but handles the problem differently. As in the German system, all wind turbines are paid the same tariff for the first five years: €0.084/kWh ($0.148 NZD/kWh). At the end of five years, the highest and lowest production figures are discarded (to avoid gaming) and the remaining three years' production figures are used to find the average productivity of the site. This productivity is then used to determine the tariff on a sliding scale. Turbines at high wind sites will see their tariff reduced to €0.31/kWh ($0.053 NZD/kWh) for years 6 through 15. See Table 4.3.

Table 4.3. Wind Tariffs in France.

Advanced Renewable Tariffs in France							
		Full Load	Capacity	Tariff	1.38984	1.21054	1.773
	Years	Hours	Factor	€/kWh	CAD/kWh	USD/kWh	NZD/kWh
Wind Energy in Continental (Metropolitan) France							
	1-5			0.084	0.116	0.101	0.148
Low	6-15	2,000	0.23	0.084	0.116	0.101	0.148
		2,100	0.24	0.080	0.111	0.096	0.141
		2,200	0.25	0.076	0.105	0.091	0.134
		2,300	0.26	0.072	0.099	0.087	0.127
		2,400	0.27	0.068	0.094	0.082	0.120
		2,500	0.29	0.064	0.088	0.077	0.113
Medium	6-15	2,600	0.30	0.060	0.083	0.072	0.105
		2,700	0.31	0.057	0.079	0.069	0.100
		2,800	0.32	0.054	0.075	0.065	0.095
		2,900	0.33	0.051	0.071	0.061	0.090
		3,000	0.34	0.048	0.067	0.058	0.085
		3,100	0.35	0.045	0.063	0.054	0.080
		3,200	0.37	0.042	0.059	0.051	0.075
		3,300	0.38	0.039	0.054	0.047	0.069
		3,400	0.39	0.036	0.050	0.044	0.064
		3,500	0.40	0.033	0.046	0.040	0.059
High	6-15	3,600	0.41	0.031	0.042	0.037	0.054

Though shown here in separate bands, tariffs in the second tier both in Germany and France are on a continuum.

4.5.3.4 Term

The term of the original StrEG was indefinite; that is, as long as the wind turbine or hydro plant was in operation, the tariff would remain the same. Most ARTs programs specified a time limit on the payments: 20 years in Germany, 15 years in France. The limits in Spain are even longer than those in Germany and in many cases indefinite; that is, for the life of the facility. See Table 4.4.

Table 4.4. Typical Renewable Tariff Contract Length.

Typical Contract Term in Years for Renewable Tariffs				
Country, Province, or State	Wind	Photovoltaics	Hydro	Biomass
Austria	13			
Brazil	20		20	20
California		3		
California SO4 (old)*	10	10	10	10
Czech Republic	15			
France	15	20	20	20
Germany	20	20	15-30	20
Italy		29		
Minnesota	20			
Portugal	12	12	12	
Spain***	>15	>25	>25	>20
Turkey	7			
Washington State		9		
*Fixed-price portion 10 years. Total contract length 15-30 years.				
***Life of facility.				

4.5.3.5 Periodic Review

Both the French and German system provide for periodic review and revision of tariff pricing for new contracts. These reviews do not affect old contracts or those installed prior to the revisions taking affect. If the pace of development is too rapid, prices can be reduced. If there is insufficient development, prices can be raised. In this manner, the policy controls the pace of development. The Bundestag undertakes its review of the EEG every two years. The next review is in 2007.

4.5.3.6 Balancing Accounts

In all ARTs programs, costs are spread equally across all electricity consumers in the governing jurisdiction. In the case of Germany and France, this is nationwide.

4.5.3.7 Program Limits

Unlike Quota systems, which limit the size of the program or the amount of development, Renewable Tariffs are often open ended, that is, without specific limits. The programs will build as much capacity as the market will bear. Germany has the world's most aggressive program: there are no limits to the program's size. Germany's official "target" is 50% renewable energy (not just electricity) by 2050. Spain has also established a very high program limit: 20,000 MW of wind. See Table 4.5.

Table 4.5 Renewable Tariff Program Size.

Renewable Tariffs Program Size or Limit				
Country	Wind	Solar	Small Hydro	Biomass
Austria		15 MW		
Brazil	1,100 MW			
California**		3,000		
Denmark	20%			
France	1,500 MW*			
Germany	No Limit	No Limit	No Limit	No Limit
Italy		100		
Minnesota	200 MW			
South Korea		1,300		
Spain	20,000 MW	400 MW	2,400 MW	3,200 MW
*Original limit, no longer current.				
**Rebate or buy-down of $2.8/W. Not a tariff				

4.5.3.8 Justification of Tariffs

Germany's EEG is in part predicated on offsetting the environmental and social costs of conventional sources of electricity generation, as was the original StrEG.

Economist Olav Hohmeyer, best known for his work on external costs of conventional generation, explored whether external costs can serve as a justification for the premium payments under the EEG.[18]

Hohmeyer analyzed the net external costs (greenhouse gas emissions and health damage) and found that for all renewable energy technologies except solar PV, payments from the EEG were below the actual net external and internal costs (social costs) avoided. Due to the wide range of externality estimates possible, Hohmeyer uses a median value for external costs, not the highest cost.

For example, in the case of wind energy the median tariff paid at low wind sites for 20 years (€0.087/kWh) was significantly less than the actual net avoided external costs of €0.145/kWh ($0.25 NZD/kWh). Thus, if the true overall social cost avoided by the use of, for example wind energy, were incorporated into the EEG, payments would be higher than under the law.

The solar PV tariff, Hohmeyer argues, can be justified in two ways. First, solar PV can be considered a critical backup technology, one that is not subject to the price volatility of fossil fuels, and one that will play an important role in the future—if developed today. Second, the savings from the other technologies, relative to their true avoided costs, as in the case of wind, can be applied as

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[18] Hohmeyer, Olav, Vergleich externer Kosten der Stromerzeugung in Bezug auf das Erneuerbare Energien Gesetz (EEG), March, 2002, http://www.erneuerbare-energien.de/files/pdfs/allgemein/application/pdf/vergleich_kosten.pdf, visited January 3, 2006.

society's investment in a promising technology. By spurring massive deployment today, the technology can be brought more rapidly down the learning curve and future costs reduced.

4.5.3.9 Inflation Adjustment

There are sometimes provisions for adjusting Renewable Tariffs for inflation, however, the amount of adjustment varies widely.

Unlike the ARTs system used in France and Germany, Spain's system is based on a percentage of the retail price of electricity. For example, small home- or farm-sized solar photovoltaic systems are paid 575% of the retail rate for the first 25 years of operation.[19] Larger systems are paid less. As the retail price is adjusted annually, so to is the tariff paid for renewable generation. See Table 4.6.

Table 4.6. Inflation adjustments under Renewable Tariffs.

Renewable Tariff Adjustments for Inflation	
	Inflation Adjustment
Germany	0%
Ontario RFP	15%
Prince Edward Island	26%
France	60%
Spain	100%
California ISO4, EPO1	Fixed Forecasted 10-year Avoided Cost
California ISO4, EPO2	Fixed Forecasted Levelized 10-year Avoided Cost
California ISO4, EPO3	Fixed Forecasted Incremental Energy Rates
California FSO4	Ramped for Inflation
*ISO4: Interim Standard Offer Contract 4 (New Contracts Suspended 1985).	
**FSO4: Final Standard Offer Contract (Never Implemented).	

4.5.3.10 Degression

Germany's EEG reduces the tariffs for new projects each year. This "degression" rate varies with technology. The degression for wind is 2% per year, but for solar PV is 5% per year. The degression is intended to account for lower costs as production volumes increase and the technology moves down the learning curve. German developers feel the degression for wind is too steep. Since the degression was implemented, annual installation of wind capacity has decreased steadily by 30% per year from a high of 3,250 MW in 2002 to 1,800 MW in 2005.

4.6 Bonus Systems

There are hybrid support mechanisms, such as the Danish Bonus System. Wind generators, for example, are paid the wholesale price for their generation. Then

[19] This is equivalent to Euro 0.421/kWh ($0.74 NZD/kWh) in 2005.

they are also paid a bonus, representing the environmental values. Often these bonus values are derived from the public treasury or from specific environmental taxes; a carbon tax, for example.

The Spanish also offer a bonus system in addition to the fixed tariff. Most of the larger wind projects are opting for the bonus system because in 2004-2005, total payments were greater than under the fixed tariff.

4.7 Trends

During the late 1990s and early 21st century it appeared that Quota systems would sweep aside Renewable Tariffs. However, attitudes have begun to change and it now appears that Renewable Tariffs may not only hold their own but may be advancing in Europe, North America, and Asia.

On December 22, 2004 Prince Edward Island, Canada’s smallest province, announced implementation of a renewable energy policy that among calling for the island to generate 100% of its electricity by 2015 from renewables, set a fixed renewable tariff of $0.0775/kWh ($0.099 NZD/kWh).

In early 2004, California introduced its Production-Based Incentive for solar PV as an alternative to the state’s cumbersome buy-down or rebate program. California has an RPS but uses a buy-down program to develop solar PV.

Though Italy uses a Quota system with tradable certificates, it introduced a complex renewable tariff for solar PV in 2005.

While the RPS continues to make headway in the United States, it has gained little traction in Canada. Ontario is currently considering an Advanced Renewable Tariff system to operate alongside a traditional Tendering program. Ontario’s ARTs program would be limited to projects under 10 MW connected at less than 50 kV. The Ontario Liberal Party, the current ruling party in the province, endorsed ARTs at its first-ever energy platform conference in November 2004.

China began its implementation of its Renewable Tariffs in January 2005.

The European Union, in its drive for regulatory “harmonization”, had considered abandoning Renewable Tariffs for Quota systems with tradable certificates as used in Britain and Italy. This struck fear into renewable advocates on the continent, especially those in Germany, France, Spain, and Austria where Renewable Tariffs were so popular. However, the high prices of the British and Italian RO, and the continuing success of the Renewable Tariffs in Germany and Spain has dampened desire within the EU toward “premature harmonization”.[20]

[20] See Lauber, Volkmar, REFIT and RPS: options for a harmonised Community framework, University of Salzburg, Energy Policy, 2004, http://www.sbg.ac.at/pol/ress/downloads/lauber_refit.pdf, visited January 3, 2006, and also

The CDU/CSU had campaigned in the recent German elections on making changes in the EEG. The FDP (the German neo-liberal party) had campaigned on switching the German program of Renewable Tariffs to a Quota system. The election was indecisive and the CDU/CSU and the SPD formed a coalition government without the FDP. The coalition agreement specifically protects the EEG until its mandatory review in 2007.

Tendering systems have continued in use throughout North America. Britain and the Republic of Ireland have abandoned their Tendering systems. France abandoned its Eole (Tendering) program but has continued using tenders for large wind projects alongside its Renewable Tariffs. The Irish have switched to a Renewable Tariff program in principle but in implementation it appears the program uses elements from both Tendering and Renewable Tariffs. See Table 4.7.

Table 4.7. Status of Renewable Tariffs worldwide.

Status of Renewable Tariffs by Country, State, or Province		
Existing	Regulations Pending	Proposed
Austria	Czech Republic	Oregon
Brazil	Ireland	Japan
California (PV)	Minnesota C-BED	
China	Ontario	
France	Turkey (Wind)	
Germany	Washington State	
Greece		
Italy (PV)		
PEI, Canada		
Portugal		
Spain		
The Netherlands		

http://www.wind-works.org/FeedLaws/Lauber%20-%20EU%20policy%20on%20support%20schemes%20for%20electricity%20from%20renewable%20energy%20sources%20-%20E&E%20-%2018%20Oct%2005.pdf, 2005.

5. Discussion

5.1 Overview

The European Renewable Energy Federation (EREF) argues that comparing the two systems (Quotas and Renewable Tariffs) is difficult because there's insufficient data to fairly judge Quota systems. EREF suggests that issues to consider in developing any policy mechanism are the price paid to renewable generation, the amount of generation produced, the financial security of investments in renewable generation, technological innovation that results, geographical distribution of generation, technological diversity, the ease of implementation, program flexibility, and prevention of windfall profits.[21]

The simplest and most effective measure of a policy's effectiveness is the policy's ability to deliver results in actual generation in MW of operating capacity or terawatt-hours of generation.

Another measure is a policy mechanism's ability to deliver generation at minimum overall cost to society. This may entail more than simply the lowest price to consumers and may include environmental and social costs. This may imply the inverse, as well: social and environmental benefits. Some nations (Germany) and some states and provinces (Quebec) include industrial policy as a criterion. Still others (Germany) include national security as a policy rationale.

Generation costs alone should not be used to evaluate effectiveness, simply because the costs of generation from renewables vary widely by technology and by region (by resource). New Zealand, for example, has some of the windiest sites in the world. Thus, the cost of wind generation in New Zealand will be much lower than comparable technology in Germany, particularly at inland German sites. As a consequence, generation costs are not easily compared from one region to another, and certainly not from one country to another.

EREF suggests that it may be more cost-effective in the long term to stimulate rapid development of renewable technologies by paying high prices today to bring technology quickly down the learning curve than by slowly introducing the technology with timid measures that pay lower prices.[22]

One measure of assessment that has been used by some economists is the gap or spread between the cost of generation and the amount paid for it. The greater the spread, the less "efficient" the support mechanism in promoting development at the least monetary cost. On the other hand, the spread is directly related to the pace of development. The greater the spread, the more rapid the pace of development. This gap can be a useful evaluation tool if the policy mechanism,

[21] EREF 2004.
[22] EREF 2004.

such as a Quota system, was designed to deliver renewables at the lowest monetary cost.

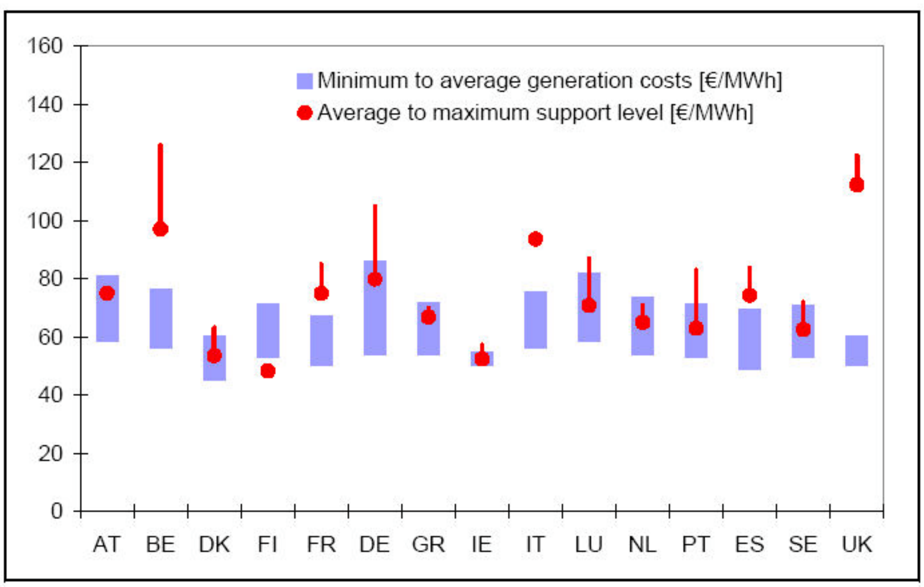
Other measures for evaluating a policy mechanism's success include the geographic distribution of development, and the distribution of opportunity among different players in the market.

Among the dozens of reports in the past few years evaluating different renewable policies is that of the European Union on renewable support programs. It is important because the EU must balance the different goals for renewables across the Union with the mechanisms used to achieve those goals.[23]

5.1.1 Wind Energy

As seen in the accompanying chart from the EU report, the support price of the countries using Renewable Tariffs (Austria-AT, Denmark-DK, France-FR, Germany-DE, and Spain-ES) in the EU-15 is closer to the estimated cost of generation than in those countries using Renewable Obligations (Belgian-BE, Italy (IT), and the United Kingdom-UK).[24] Note the good match between the support level and the estimated cost of generation in Austria (AT), Germany (DE), and Spain (ES). This is no accident and is a result of the tariff design in these countries. This contrasts markedly with the charge that Renewable Tariffs overpay for generation. It appears they do not. See Figure 5.1.

Figure 5.1. Wind generation costs and support levels in EU-15.

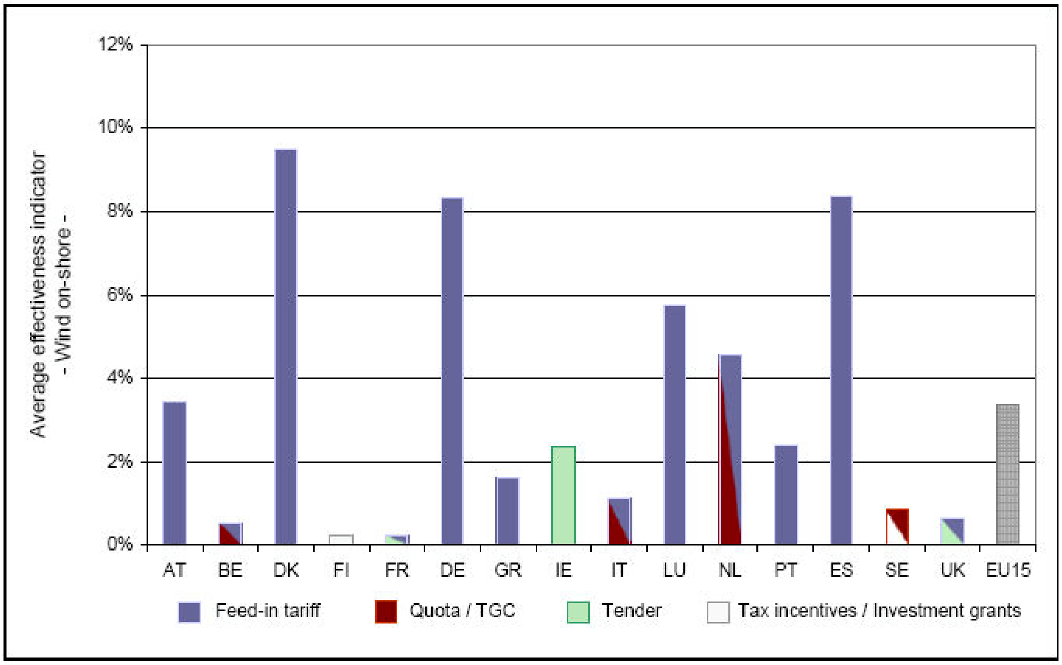


[23] Commission of the European Communities, The support of electricity from renewable energy sources, COM(2005) 627 final, Communication from the Commission, http://europa.eu.int/comm/energy/res/biomass_action_plan/doc/2005_12_07_comm_biomass_electricity_en.pdf, 07/12/2005, visited January 3, 2006.

[24] CEC 2005, 100 Euro/MWh = $0.176 NZD/kWh.

The European Commission defined effectiveness as the amount of electricity delivered relative to the country's potential for each technology. This definition is more specific than the more widely used one of simply which mechanism has delivered the most generation. Even by the EU's more restrictive definition, the three countries that were most effective developing onshore wind energy were Germany, Spain, and Denmark, as seen in the accompany chart. Each used Renewable Tariffs. See Figure 5.2.

Figure 5.2. Average effectiveness of wind energy support measures in EU-15.

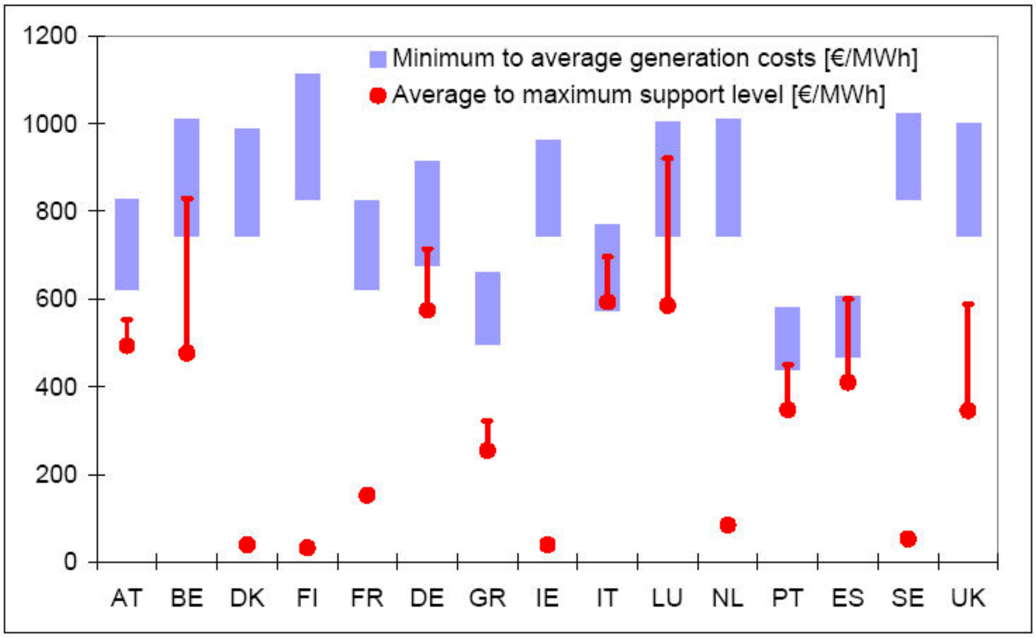


5.1.2 Solar Photovoltaic

The European Commission found that Quota systems provided little support for solar PV in the EU-15 as these systems are often not technology-specific and are designed to develop only the cheapest resource available.[25] As seen in the accompanying chart nearly all solar PV developed in the EU-15 were developed with Renewable Tariffs. Even in Germany, where the tariff for PV is the highest in Europe, the tariff is barely sufficient to provide profitability for projects using PV. Developers of PV in Germany, says the EC report, are certainly not getting rich or earning excessive profits. See Figure 5.3.

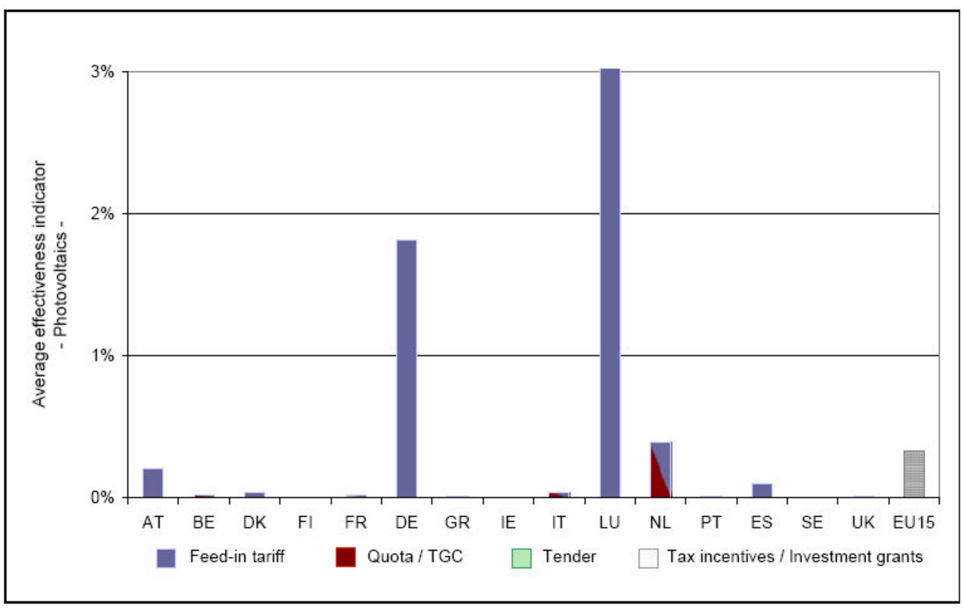
[25] CEC 2005.

Figure 5.3. Solar PV generation costs in EU-15.



Surprisingly, the European Commission found that despite the seemingly high tariffs for solar PV generation, the cost of generation often still exceeds the tariff, as seen in the accompanying chart.[26] Still the tariffs have been sufficiently high in Germany to produce spectacular growth.

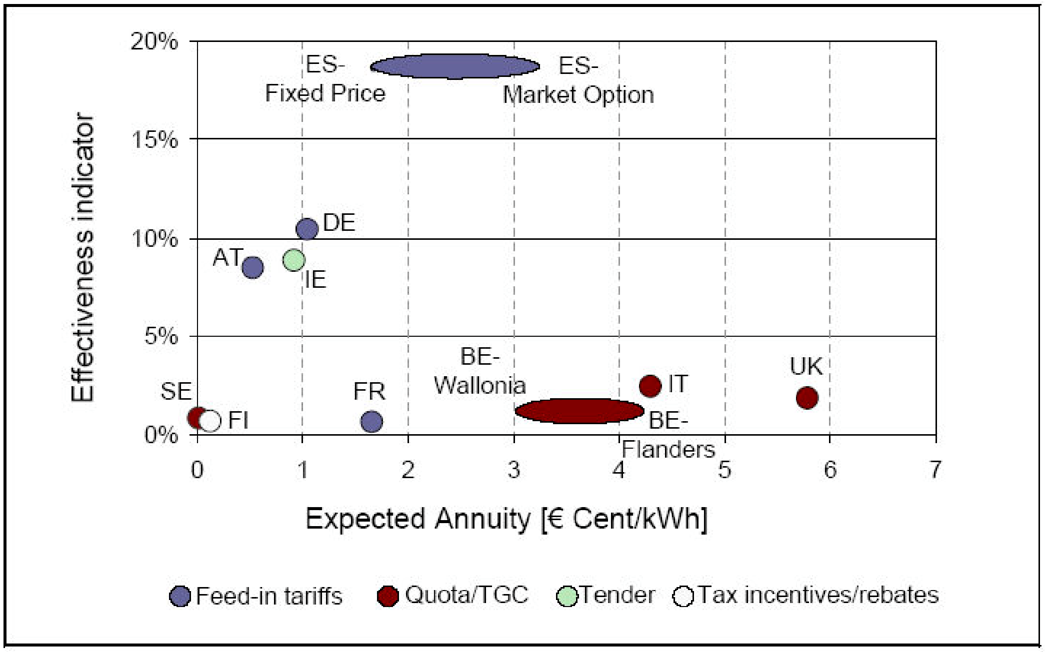
Figure 5.4. Effectiveness of support measures for solar PV in EU-15.



[26] CEC 2005.

The European Commission used a novel approach to evaluate the effectiveness of support mechanisms in spurring investment relative to a country's wind resource in the EU-15. Interestingly, the most effective mechanisms were Renewable Tariffs (Spain-ES, Germany-DE, and Austria-AT), despite the higher annuity than Quota systems with tradable certificates (Britain-UK and Italy-IT). See Figure 5.5

Figure 5.5. Monetary effectiveness of support mechanisms in EU-15.



One major advantage of Quota systems to policymakers is that total program costs can be capped either by the penalty price in systems with tradable certificates or by price caps on tenders.

While proponents of Quota systems like to point to the efficient functioning of the market as the best means for promoting renewable technology, observers of such systems in practice have characterized them as "blunt instruments" in comparison to more targeted mechanisms.[27]

5.2 Net Metering

Net metering can be a useful transition tool to more full-featured and robust support programs. It can also be useful politically as a stop-gap measure when more substantive programs require a longer preparatory period or need to pass through lengthy and tortuous legislative channels.

[27] van der Linden 2005, see Chapter 5 on Experience in Sweden.

Net metering alone is almost nowhere a support mechanism sufficient to drive renewable development of wind or solar. Net metering may be helpful with larger farm-based biogas or biomass plants. Even then, in most places where net metering could be used, retail prices are so low that they are insufficient for farmers to take the technological risk. Farm-based biodigesters and biogas plants have been most successful in countries (Germany and Austria) with Renewable Tariffs.

Of the states with net metering, only a few permit the use of any size wind turbine the customer chooses. Consequently, this limits the consumer to using wind turbines of less than the optimum size, economically, for their conditions.

Caps on wind turbine size and total program size protect utility markets. Utilities accept net-metering programs with low caps because the programs pose no serious threat to their market share.

Utilities have little to fear. Net metering is self-limiting. Only those whose consumption can absorb all the production from a large turbine will choose to net meter. Customers such as Iowa's Schaefer Systems and Spirit Lake School will opt for larger turbines, because it makes economic sense to offset as much of their load as possible. Those for whom a 10-kW turbine is a closer match to their needs will choose a 10-kW machine. Artificial limits are unnecessary.

In the end though, net metering can’t deliver significant renewable development. Nowhere net metering has been used is there a significant contribution from wind or solar energy.

In most cases, the retail price offset alone is insufficient to drive renewable development. Subsidies are needed to make net metering work (California) and subsidy programs have had a checkered history. Most subsidy programs have led to widespread abuses that have ultimately hurt the renewables industry and its supporters. Even today, most subsidy programs have no requirement for metering actual generation, one of the fundamental means for monitoring the success or failure of renewable programs.

In California, net metering only provides access to the grid. The retail tariff, among the highest in North America, is insufficient to justify installing rooftop PV or a small wind turbine. The California program only works because of the subsidy from the state’s System Benefits Charge.

5.3 Subsidies

In general, subsidies have failed to promote widespread deployment of renewables. Most unsuccessful are capital subsidies that eliminate any incentive for the owner to ensure performance of the systems once the technology has been installed.

Targeted subsidies, carefully implemented, can work. Subsidies for solar PV, in the form of a fixed amount per unit of capacity (e.g. $/W) as rebates on the purchase price, have been successful in Japan (the world's second largest PV market) and in California (the world's third largest market). Policymakers have chosen this mechanism over specifying the subsidy as a percent of installed cost. It is believed that consumers will then choose the most cost-effective system rather than trying to maximize its cost and, hence, the subsidy.

5.4 Quota (Amount) Systems

Both forms of Quota systems (Tendering and Quotas with tradable certificates) have delivered varying amounts of renewable capacity, mostly wind, worldwide. Both have been used enough to gain some understandings of the strengths and weaknesses of each. When done well, both can deliver the amount of wind capacity desired. However, neither system has demonstrated any propensity for providing geographical diversity, technological diversity, or the ability to elicit the participation of small investors. Their record on delivering capacity for the least monetary cost remains mixed.

5.4.1 Tendering or Bidding

While Tendering systems theoretically provide optimum economic efficiency in providing the lowest-cost generation, this is not always true in practice. Moreover, Tendering leads to stop-and-go development cycles not conducive to stable growth or dynamic markets. Emphasis on low cost results in a greater risk that winning bids may not be built, as seen in Britain's NFFO and France's Eole programs. A significant amount of capacity was awarded contracts in Britain, California, and France, but was never built.[28]

In a study comparing different support mechanisms by Cambridge University and the Massachusetts Institute of Technology, researchers found that only 30% of contracted capacity under Britain's NFFO system was actually installed. Of the 3,270 MW awarded under NFFO only 960 MW had been installed by 2003.[29]

The results are quite similar to those of France's Eole program, where only 70 MW were built of the 300 MW contracted. Of that, only 30 MW are operating

[28] Lauber, Volkmar, ed. Switching to Renewable Power: A Framework for the 21st Century, (Earthscan: London, 2005), see Chapter 8, The Design and Impacts of the Texas Renewables Porfolio Standard by Ole Langniss and Ryan Wiser.

[29] Butler, Lucy, and Neuhoff, Karsten, Comparison of Feed in Tariff, Quota and Auction Mechanisms to Support Wind Power Development, Cambridge University, CWPE 0503, and Massachusetts Institute of Technology, CMI Working Paper 70, http://www.econ.cam.ac.uk/electricity/publications/wp/ep70.pdf, visited January 3, 2006.

under the original contract.[30] The remainder have switched their contracts to Renewable Tariffs. The poor performance of the Eole program is the principal reason France switched to Advanced Renewable Tariffs for projects less than 12 MW.[31]

Much has been made of the low prices bid in Britain's NFFO, but the price bid under such tendering systems may not be representative of the true costs of generation if so little of the contracted capacity is built. "It is thus questionable whether a competitive tendering process, which places such emphasis on reductions on the price paid for wind energy, is the most appropriate means of encouraging an expansion in capacity", say the authors of the Cambridge-MIT study.[32]

The study concludes that the oft-stated reason for Britain's poor installation rate of wind energy, planning hurdles, was incorrect and that to the contrary, the reason was an insufficient price paid to produce profitable projects.[33] Projects were bid at low prices to win contracts; then, when it was realized they were not sufficiently profitable, many bidders walked away.

The risk that bidders will walk away from winning bids can be mitigated by careful design of the Request for Proposals and the inclusion of substantial penalties for non-fulfillment of the contract. To avoid this and other risks from bidders gaming large Tenders, bids have grown increasingly complex.[34] As the complexity of Tendering has grown, so too have the costs to administer Tenders as well as the cost to bid into a Tender.

Tendering has been little used to develop renewable technologies other than wind. There is limited experience with tendering for solar PV, the exception being the Sacramento Utility District in California. As theory would predict, the prices for PV under SMUD's program were among the lowest in the industry at the time. However, several years into operation, a number of the units are being replaced or scrapped due to changes in ownership of the host site or to quality problems due to the low-bid supplier. It's unlikely that SMUD will repeat the Tendering experiment with PV.

All support mechanisms are a function of their political environment, whether it was Germany's CDU/CSU supporting their conservative Bavarian constituents, or Britain's Conservative Party supporting the nuclear industry with the NFFO. Catherine Mitchell of the Warwick Business School comments that the NFFO could have been more successful if the penalties for non-fulfillment of the

[30] Chabot, Bernard, ADEME (Agence de l'Environnement et de la Maitrise de l'Energie), personal communication, 2004.
[31] France has lifted the 12 MW cap on project size in 2005.
[32] Butler 2004.
[33] Butler 2004.
[34] The qualification to bid document in Ontario's first wind RFP in 2004 was 120 pages long.

contracts or the price caps had been higher. But, writes Mitchell, the Department of Trade and Industry was "more interested in showing that their competitive renewables policy had 'worked' in principle (rather) than in practice."[35] The implication was that the program was designed to satisfy ideological criteria and not necessarily to result in successful deployment of renewable technology.

EREF finds that there is evidence that the much-touted low prices for wind energy of Britain's NFFO were due to technological innovation and price reductions in the country, Denmark, that supplied the wind turbines.[36] Denmark was using a form of Renewable Tariffs at the time.

While "in theory," tendering produces competition among developers, especially with near-term technologies such as wind energy, it has been less than successful in promoting the rapid growth of renewables in comparison with Renewable Tariffs. This is due partly to the intermittency of the tenders and the uncertainty this produces, partly to the complex and costly bidding process, and partly to unrealistically low prices bid to win contracts which result in some projects not being built.[37]

Tendering demands complex and costly bid documents, and responding to a call for tenders is equally costly and complex. Preparing the bid documents has spawned an industry of consultants, such as Navigant, that specialize in providing this service to governments and utilities.

The boom and bust typical of the US wind energy market is not unique to North America. Nor is it unique to wind energy. Tendering systems often lead to boom and bust cycles or--in more elegant words—to lumpy development. This was true of Britain's NFFO and is characteristic of the tendering systems in Quebec and most Canadian provinces. It's also been true of solar PV development in California, which uses subsidies that must be periodically refunded by action of the legislature.

Canadian provinces have long experience with Tendering systems for large hydro development. Canadians argue that with their experience and the complex Tenders that result, they will deliver the wind capacity contracted. Wind development in Canada is too recent to judge whether this will be true or not.

Britain's NFFO at least included technology bands for technologies other than onshore wind, whereas the current British Renewables Obligation does not.

5.4.2 Quota Obligation with Tradable Certificates

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[35] Catherine Mitchell, Peter Connor, Renewable Energy Policy in the UK 1990-2003, University of Warwick, http://users.wbs.warwick.ac.uk/cms_attachment_handler.cfm?f=fa052a3f-4f54-4e7b-ab2b-8c74d591b288&t=renewable.pdf, visited January 3, 2006.
[36] EREF 2004.
[37] van der Linden 2005.

Several observers have noted that though "in theory" a Quota system with tradable certificates is an effective policy tool, the results are mixed. The results are tentative at best. Most Quota advocates argue that it is too early to tell if Quotas will achieve their objectives at the low monetary cost promised.

Proponents note that Quotas with tradable certificates perform best when there are:

- Realistic targets,
- Steadily increasing targets over time, and the
- Availability of long-term contracts.

If well designed, that is if penalties are both sufficient and enforced, the targets (the Quotas) are reasonably obtainable, a Quota system with tradable certificates can efficiently meet the program's objectives. Like Renewable Tariffs, the total cost of the Quota system can not be determined in advance. In theory, competition among providers of certificates will ensure that the least expensive projects will be developed first.[38]

It is clear that such systems are complex and will only function well when carefully designed.[39] Worldwatch's Sawin writes that Quota systems are more difficult to design correctly than Renewable Tariffs.[40]

5.4.2.1 Meeting Targets

In theory, the gap between the supply of certificates and the target determines the price of certificates. Currently Britain's Renewable Obligation is 50% short of its targets. This has resulted in some of the highest support prices in Europe—if not the world—for wind energy. But the price is volatile, so banks demand a hefty risk premium for investing in renewable projects in Great Britain. Larger developers, such as multinational electric utilities, can finance development through their balance sheets. Smaller developers cannot.

In Britain's Renewable Obligation, the system only acts as an effective support mechanism if the targets are not met. While this is not overtly stated, it is now understood by all participants, including policy makers, say researchers.[41] It is in the interests of the system's participants that the targets never be met or the value of their certificates will drop to zero. Thus there is pressure to manipulate the market where possible. This is an intuitive outcome of the Quota system with tradable certificates and it's surprising that the Renewable Obligation's designers and Quota proponents didn't anticipate this.

[38] van der Linden 2005.
[39] van der Linden 2005.
[40] Sawin 2006.
[41] van der Linden 2005, see Chapter 4 on Experience in the UK.

5.4.2.2 Cost of Generation

The purpose of using tradable certificates is to use the market in certificates to reward the lowest-cost producers. However, EREF, says Quota systems do not necessarily result in lower prices to consumers.[42]

Under Renewable Obligation systems like those practiced in Great Britain, certificate prices are highly unstable. In the British system this is often coupled with the fluctuating spot market, or wholesale, price of electricity. Developers must pay higher risk premiums from banks and investors as a result, says EREF.[43]

Lawrence Berkeley Laboratory's Ryan Wiser finds that because Quota policies depend upon short-term trading of electricity and certificates, the costs will be higher than those using long-term contracts. This certainly is the case in Great Britain.

In North American Quota systems with tendered or privately negotiated long-term contracts, the sum of certificates and the underlying electricity are much lower in cost than in Britain. Unfortunately, these contracts are not transparent, nor are they open to all participants.

The success of Texas' RPS in building new wind capacity at low cost has much to do with the availability of substantial federal tax subsidies, more than one-third the total cost of generation at windy sites in West Texas.[44] Moreover, the initial low cost of wind energy in the United States from RPS and Tendering systems will be offset as the best sites near transmission capacity are exhausted. As the industry moves to less windy sites with smaller project size, costs will increase, not decrease. This "cream skimming" or "cherry picking" can send misleading signals to policymakers about the true cost of renewable generation.

The high price for steel, the tight supply of wind turbines, and the lag in turbine supply has resulted in increasing project costs. Even before these costs had worked their way through the system in 2005, some Canadian developers who have actual experience building and operating projects were publicly complaining that their costs were rising.[45]

Quota systems without long-term contracts, such as Britain's Renewable Obligation, overpay for lower-cost renewables (onshore wind energy and

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[42] EREF 2004.
[43] EREF 2004.
[44] Lauber 2005, see Chapter 8 Wiser and Langniss.
[45] Presentations by Jason Edworthy, VisionQuest Windelectric (a division of TransAlta), Canadian Wind Energy Association annual conference, Montreal (2004), and Toronto (2005).

biomass waste-to-power) because they don't differentiate technologies or resources, says Worldwatch's Sawin.[46]

For wind energy in the EU-15, there is a significant spread between the cost of generation at windy sites in Great Britain and the total payment under Britain's Renewable Obligation system. The European Commission suggests that the reasons for this may be found in the higher investment risk in Quota systems using tradable certificates like Britain's, or that the British market, despite its positive press, is "immature".[47]

Thus, despite the favorable press, the monetary efficiency of the Renewable Obligations programs in Europe is poor according to a report by ECN, the Dutch National Laboratory. In US states, where long-term contracts are available, monetary efficiency is satisfactory. But in US states where long-term contracts are not the norm, certificate prices are driven more by penalty prices than by supply and demand—contrary to theory. Significantly, ECN found that "If TRECs are delivered under long-term agreements, the TRECs are effectively withdrawn from the market and the price may not be known publicly. This hampers liquidity and transparency of the short-term TREC market . . ."[48]

5.4.2.2 Market Dominance

This lack of liquidity or transparency has led some observers of the British Renewable Obligation to suggest that the dominant players are manipulating the market, or certainly have the power to do so, to maximize profits.[49] Of course, this would negate the purpose of using Quotas with tradable certificates: monetary efficiency.

5.4.2.3 Long-Term Contracts

LBL's Wiser, a contractor to many US states, as well as to the US Department of Energy, recommends using long-term contracts when designing a Quota system with tradable certificates. California's RPS and those of several other states require long-term contracts where the TRECs are bundled with the electricity. In Texas, which offers long-term contracts with its RPS system, the price for certificates is a fraction of that in Britain. The Texas contracts are offered either through a tender or through private, non-transparent, two-party negotiations.

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[46] Sawin 2006.
[47] CEC 2005
[48] van der Linden 2005.
[49] van der Linden 2005. See chapter 4 on experience in the United Kingdom. See also Commission of the European Communities, The support of electricity from renewable energy sources, COM(2005) 627 final, Communication from the Commission, http://europa.eu.int/comm/energy/res/biomass_action_plan/doc/2005_12_07_comm_biomass_electricity_en.pdf, 07/12/2005, visited January 3, 2006.

While this precludes small players from participation, it has resulted in low prices for wind generation.

If there is political uncertainty about continuing support of ever-increasing targets, then obligated suppliers will avoid long-term contracts, leading to short-term trading in certificates.[50]

While bilateral, long-term contracts are possible under Britain's Renewable Obligation, few have opted to use them. One reason is the risk-sharing terms demanded by the electricity suppliers that diminish the value of the certificates to the project developer.[51]

To obtain a long-term contract in Great Britain, the developer must give up substantial value of the TRECs to the supplier. Without contracts, developers must budget for price fluctuations in the wholesale price of electricity as well as the price of the TRECs. This uncertainty demands a substantial risk premium and partly explains the high price of TRECs on the British market.

Interestingly, in the British context, long-term contracts are only 5-10 years in length. Contracts under Germany's Renewable Tariffs are 20 years in length; those in France, 15 years.

Under a Quota system without long-term contracts, as in Britain's Renewable Obligation, the price of certificates is at the mercy of new entrants.[52] If sufficient new projects come onto the market and suppliers near their obligations, the price will fall. This risk, the price volatility of the tradable certificates, is reflected in the steep discount for certificates that suppliers demand for long-term contracts in Britain.

5.4.2.4 Flexibility

It appears that Renewable Obligation systems are less flexible than necessary, and this rigidity may reduce the options of policymakers once the program is implemented. Government reviews of the performance or cost of the Renewable Obligation increase uncertainty in the certificate market. Changes in the obligation, for example by reducing the targets, will lower the demand for certificates and, hence, their price. Such an action will reduce the revenues of existing operators who are dependent on the certificate price for profitability—the objective of the program, after all.[53] In contrast, changes to prices under the German and French Renewable Tariffs affect only new projects, not existing ones.

[50] van der Linden 2005.
[51] van der Linden 2005, see Chapter 4 on Experience in the UK.
[52] Sawin 2006.
[53] van der Linden 2005.

Observers of the British Renewable Obligation find that the system is difficult to modify once it is in place. Therefore, it's best to design the program right the first time.[54]

5.4.2.5 Technology Differentiation

Quota systems without technology bands claim to be technology-neutral (there is no "picking of winners"), yet by their emphasis on the least cost among competing renewable technologies, only certain technologies will be selected, wind energy for example. Other technologies, which may have significant long-term potential, for example solar PV, are effectively excluded because of its current high cost. Yet the cost of solar PV will never drop miraculously if it is not deployed today.

5.4.2.6 Distributed Generation

Quota systems are cost-driven and tend to limit geographic distribution. Quota systems, therefore, have not been used to differentiate development by the availability of the renewable resource. Consequently, Quota systems invariably have led to geographic concentration of development.

In the case of wind energy, Quota systems force development onto those areas with the highest winds. This was an early criticism of Britain's NFFO: the tendering system pitted one developer against another for the windiest site. The windiest sites in Britain are often those near Areas of Outstanding Natural Beauty, near National Parks, or near cherished landscapes in the uplands of Wales and the Pennines of England.

Quota systems typically don't lead to distributed generation but to the addition of renewables, wind generation mostly, to a centralized system of generation. Large wind projects are interconnected at transmission voltages. In this regard, they are no different from any large central station. Thus, most Quota systems can't take advantage of all the attributes that renewables offer: most obviously, the ability of renewables to be used in distributed applications embedded in the network.

5.4.2.7 Distribution of Ownership

Small developers fare poorly under the British Renewable Obligation. They are offered long-term contracts at only £0.045/kWh ($0.115 NZD/kWh) for bundled electricity and certificates.[55] This may reflect the market power of the large developers that are vertically integrated and the poor countervailing power of the small developers against that of the obligated supplier. Quota systems, because of their inherent risks and high transaction costs, have led to a concentration of renewable ownership in the hands of multinational electric utilities.

[54] van der Linden 2005, see Chapter 4 on Experience in the UK.
[55] van der Linden 2005, see Chapter 4 on Experience in the UK.

5.4.2.7 International Trading of Certificates

There currently is little or no international trading in renewable certificates. The Dutch scrapped their TREC system after discovering that three-fourths of the certificates, along with their Dutch renewable subsidies, went outside the country.[56] The Dutch then switched to a modified Renewable Tariff that draws payment for the premium above the wholesale price of electricity from the national budget. While not as elegant or as successful as the programs in France, Germany, and Spain, it is functioning better than the previous Quota system.

5.5 Renewable Tariffs

Renewable Tariffs in and of themselves are no panacea. They too must be well designed to operate effectively. However, countries with Renewable Tariffs have consistently met (Denmark) or surpassed their renewable targets.[57] In a recent report, EREF concluded that Minimum Price Systems produce large-scale development of renewable energy more quickly and more cheaply than Quota systems.[58]

Renewable Tariffs, when well designed, can stimulate development without resort to a host of other mechanisms or subsidies. The seemingly costly premium prices of Renewable Tariffs are justified by their advocates on the grounds that they compensate for the external costs of conventional generation.[59]

All countries in the EU-15 with a higher than average effectiveness developing wind energy have used Renewable Tariffs, says the European Commission. The Commission found that the single most effective mechanism for developing wind energy had been the Renewable Tariffs used in Germany, Spain, and Denmark.[60]

Critics claim that those with the most to gain from Renewable Tariffs (manufacturers and developers) are those who provide the cost data for determining the tariffs and, thus, have no incentive for accurately reporting their

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[56] Lauber, REFIT and RPS.

[57] Janet Sawin, National Policy Instruments: Policy Lessons for the Advancement & Diffusion of Renewable Energy Technologies Around the World, in D. Aßmann, U. Laumanns, D. Uh (ed.), *Renewable Energy. A Global Review of Technologies, Policies and Markets*; Earthscan, London, forthcoming 2006. Note that these are typically targets, and often minimum targets, not limits (except in the case of Denmark) or obligations as in Renewable Obligations or Renewable Portfolio Standards.

[58] European Renewable Energies Federation, 2004-RES-E EU Frameworks & Prices (Euro/MWh), http://www.eref-europe.org/downloads/pdf/2004/pricereport2004.pdf, visited January 4, 2006.

[59] Sawin 2006.

[60] CEC 2005

costs. The result is a tendency to set the tariff higher than necessary, say critics.[61] However, this hasn't been as much a problem in practice as feared, especially in the dynamic and competitive German market where wind turbine and tower prices, for example, are published publicly. In no other market in the world are wind turbine and tower prices published annually as they are in Germany.[62]

5.5.1 Technology Differentiation

Only in countries with Advanced Renewable Tariffs are a full spectrum of renewable tariffs being deployed in significant amounts, most notably in Germany. One need only drive down the road in Germany to see the effects of its tariff for PV: solar systems on houses, apartment buildings, offices, factories, and farm buildings. Through its EEG, Germany has become an industrial powerhouse of renewable technologies. Germany now leads the world in wind turbine and PV technology. Similarly, Germany and Austria are world leaders in the technology for on-farm biogas generation.

5.5.2 Resource Differentiation

The Advanced Renewable Tariffs used in Germany and France have had the effect intended by their multi-tiered pricing for wind energy. These different tiers have succeeded in spreading wind development to areas other than the windiest regions. In Germany much of the new growth in wind energy is occurring in the interior, the *binnenland*, and this is only possible because of the extended period of premium prices for qualifying wind projects.

Similarly, in France the tiered tariffs have produced robust growth in several regions of the country: Languedoc-Roussillon, Bretagne (Brittany), and Nord-Pas-de-Calais. One 30 MW project was recently completed in Lorraine, in northeastern France, an area not previously noteworthy for its wind resource.

5.5.3 Equity

The German market is unusual in that ownership of renewables is primarily in the hands of small investors. As in Denmark, Germany's system of Renewable Tariffs has enabled broad ownership of wind turbines across society. Ads in German trade magazines seek investors for cooperative wind and solar projects—sometimes combined in the same project. It's not uncommon in Germany for farmers to own one or several commercial wind turbines themselves.

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[61] van der Linden 2005.

[62] See Marktübersicht: "Windenergie 2005", Bundesverband WindEnergie, Osnabrück, Gemany, http://www.wind-energie.de/.

Much of the staggering growth in solar PV in Germany has been through purchases by individual homeowners and farmers.

Likewise, the bulk of biogas and biomass development in Germany has been thanks to individual farmers or cooperatives of farmers.

5.5.4 Energy Security

One purpose explicitly stated in the revisions to the EEG (2004) is the need to avoid resource conflicts over fossil fuels.

"Article 1, Purpose
(1) The purpose of this act is to facilitate a sustainable development of energy supply, particularly for the sake of protecting our climate, nature and the environment, to reduce the costs of energy supply to the national economy, also by incorporating long-term external effects, to protect nature and the environment, to contribute to avoiding conflicts over fossil fuels and to promote the further development of technologies for the generation of electricity from renewable energy sources."[63]

5.6 Bonus Systems

A concept related to Renewable Tariffs is a fixed-premium system where a bonus is paid above the wholesale or spot market price.

Denmark abandoned its successful Renewable Tariff system in 2000 when a new conservative government took power. The new government, citing neo-liberal philosophy, charged that Renewable Tariffs violated market principles and instead opted for a Quota system relying on tradable certificates. However, the market for the certificates never materialized. The Danes implemented their bonus system when it became apparent that a tradable certificate model was not likely to succeed. Since these actions, the Danish domestic market for wind turbines has collapsed and currently only one wind turbine manufacturer, Vestas, is still operating in Denmark. The only other remaining manufacturer, Bonus, was bought by the German company, Siemens.

In contrast to the sorry performance in Denmark, the Spanish have been very successful with their bonus system. Many, if not all the larger wind projects built in recent years have been built under the bonus system, which currently pays slightly more than the fixed-price systems.

5.7 Conformance with Neo-liberal Markets

[63] EEG (Renewable Energy Sources Act), 2004, http://www.wind-works.org/FeedLaws/Germany/EEG-New-English-final.pdf, visited January 7, 2006.

Both Quota and Price systems conform to the prevailing neo-liberal philosophy of using markets to obtain social objectives. This is intuitive with Quota systems that use either Renewable Obligations or Tendering, and is the principle reason that these systems have been used. How Renewable Tariffs conform to a market system is less obvious. This has led to confusion and unfounded criticism of Renewable Tariffs as not being “market based.” See Figure 5.6.

Figure 5.6. Summary of Price-Quantity Markets.[64]

	“Political price-/amount market” model	“Political amount-/certificate price market” model
(a) Is it a market model?	The price is political, the amount is decided upon a market.	The amount is political, the price is partly decided upon a market, partly politically set.
(b) Does it further competition between equipment producers?	The equipment producers as a group can expand sales and profit by lowering production costs.	The equipment producers face a 6-8 year politically set annual production quota. They can expand profit by lowering costs and especially by increasing sales prices.
(c) Can it differentiate the price between good and bad “politically desired” wind sites?	Yes, as happens in the German model.	No. In this “mono-price” model, the same price is paid to the very good coastal sites as to the good inland sites.
(d) Can it price-differentiate between the first years and the last years of the production of a given RE plant?	Yes, as happens in the German model.	No. The same price has to be paid during the whole lifetime of an RE plant.
(e) Can it lower the price in parallel with RE productivity improvements?	Yes, as happens in the German model. 2002 wind turbines are getting 1.5% lower kWh prices than 2001 wind turbines.	No. The quota has to be set for a 6-8 years period and new improved wind turbines are getting the same certificate price as less efficient wind turbines built at an initial stage of development.
(f) Does it support neighbour and local investors?	Yes. The foreseeable prices make it possible for local groups to borrow from local banks.	No. The very fluctuating and possibly manipulated prices make it too risky to invest and difficult to borrow from local banks.
(g) Does it put a cost pressure on equipment producers?	Yes. Almost the same cost pressure is put on investors at good wind sites as on investors at inland wind sites.	In general, no. The mono-price system gives very high profits to owners of good coastal sites. This increases site prices and weakens the cost pressure on equipment producers.
(h) Does it support investor groups independent of uranium and fossil fuel interests?	Due to the above (f), yes.	Due to the above (f), no.

Table 3: A comparison of the “political price-/amount market” model with the “political amount-/certificate price market” model.

Economist Frede Hvelplund, in a book-length treatment, argues that Renewable Tariffs create market conditions where the private sector can achieve public policy objectives in a dynamic manner. Moreover, Hvelplund contends that Price systems encourage numerous private parties to participate in the market and in doing so reduce the concentration of ownership and the resulting market power found in Quota systems. Hvelplund finds that Price systems are especially good

[64] Hvelplund, Frede, Political Prices or Political Quantities? A Comparison of Renewable Energy Support Systems, New Energie, 5/2001, p. 21.

stimulating competition among product manufacturers, whereas Quota systems encourage competition primarily among project developers.[65]

5.8 Equity & Acceptance

Renewable Tariffs enable broader participation in renewable energy development and thus are potentially more politically palatable when everyone who wants to participate can do so. This has the important carry-on effect of increasing acceptance when local residents can participate in nearby projects. Local communities bear the environmental and social costs of, for example, nearby wind development. With local participation, residents of such communities can also share directly in the benefits that Renewable Tariffs make possible.

Further, opportunity and participation build a constituency for renewable energy and with it, the political support needed for policy development.

This support can transcend the political spectrum. It was conservative Bavarian farmers who pushed the ruling conservative parties (CDU/CSU) and the neo-liberal party (FDP) to support Germany's first feed law in 1991. The farmers and their supporters argued that the feed law compensated for the external costs of conventional generation.[66]

5.9 Excess Profits

One paradox that has arisen in the debate over European policy involving renewable electricity generation is why multinational electric utilities don't dominate the German market as they do the British market. If Renewable Tariffs produce the excess profits that their critics charge, why then are not EoN (formerly Preussen Elektra) and EdF (Electricite de France) more active in Germany's wind and solar industry. The answer may rest in the actual profitability of wind energy under Germany's relatively low wind conditions, compared to those of windy Great Britain, and in the lower prices offered under Germany's EEG compared to those under Britain's Renewable Obligation. Political supporters of the EEG in the SPD and Green Party and among user groups such as the German Wind Turbine Owners' Association (BWE), argue that the multinationals can simply earn more money more quickly under Britain's Renewable Obligation than they can under the EEG. This is in part because

[65] Hvelplund, Frede, Renewable Energy Governance Systems: A comparison of the "political price-/amount market" model with the "political quota-/certificate price market" system (The German and Danish cases), Aalborg University, July, 2001, http://www.i4.auc.dk/environmentalmanagement/Institutions%20and%20Organisations/Renewable%20Energy.pdf, visited January 3, 2006.

[66] Lauber, REFIT and RPS.

profits are limited under the EEG by design, say its defenders, such as the law's principal authors Hermann Sheer (SPD) and Hans-Josef Fell (Die Grünen).[67]

5.10 RPS and Renewable Tariffs Hybrid

Where the RPS is simply a target, the mechanism for reaching the target may not be specified. The mechanism used to support development could be tradable certificates with tendered contracts, tendering on its own, or Renewable Tariffs. Some critics of California's RPS have suggested that renewables advocates abandon their attempts to establish a certificate trading system and instead implement Renewable Tariffs as the support mechanism.[68] These advocates argue that Renewable Tariffs have a proven track record as a mechanism that delivers renewable generation quickly, while their experience with Quota systems, like those in California, has been unsatisfactory.

5.11 Manufacturing

According to Lewis and Wiser in a paper for the US Department of Energy, a prerequisite for developing a national manufacturing industry requires a sizable and stable local market, independent of what support mechanism is used.[69] This has been demonstrated in wind turbine manufacture in Denmark and Germany. The pattern has also been repeated with solar PV in Germany. Germany is now the world's largest market for PV, surpassing Japan. Spain has also developed a dynamic indigenous wind industry, not only because of a stable and growing market, but also in part because of local content requirements. All three countries have used Renewable Tariffs, and the stability and financial security provided by the tariffs, along with their consistent political support, have contributed to dynamic growth.

Considering that their work was partially funded by the US Department of Energy, Lewis and Wiser surprisingly conclude that "A stable feed-in tariff has clearly proven to be one of the most successful mechanisms to date for promoting a large-scale wind energy market that offers the stability necessary to attract local manufacturing.[70]

[67] Bundesverband WindEnergie (German Wind Energy Association or more correctly, the German Wind Turbine Owners Association), http://www.wind-energie.de/ ; Bundesverband Erneuerbare Energie (BEE or German Renewable Energy Federation), http://www.bee-ev.de/ ; Hermann Scheer MdB, http://www.hermann-scheer.de/welcome.php ; Hans-Josef Fell, MdB, www.hans-josef-fell.de .

[68] Rich Ferguson, Coalition for Energy Efficiency and Renewable Technology, Sacramento, California, private communication. At the time, Ferguson was chair of the Sierra Club's California Energy Committee.

[69] Lewis, J. and R. Wiser, Fostering a Renewable Energy Technology Industry: An International Comparison of Wind Industry Policy Support Mechanisms, LBNL-59116, November 2005, http://eetd.lbl.gov/ea/emp/reports/59116.pdf, 07/12/2005, visited January 3, 2006.

[70] Lewis and Wiser 2005. The US Department of Energy, through its Wind Powering America initiative, supports Quotas with tradable certificates and is openly hostile to Renewable Tariffs.

Renewable Tariffs are no guarantee of developing domestic technology or a domestic manufacturing plant (France). This is especially true in a nation the size of New Zealand with its limited industrial base.

Lewis and Wiser nevertheless state that whether or not new wind turbine manufacturers succeed depends largely on the use of their products in their own domestic markets.[71] This has relevance to the demand for WindFlow turbines in New Zealand.

Quebec, in a 1,000 MW tender, is trying to use local content requirements to spur manufacturing of wind turbines in the province, notably on the Gaspé peninsula where there is high unemployment. Quebec has stipulated that the bids be built out in stages over several years, thus artificially creating a stable market. Development was awarded to General Electric.

5.12 Political Impact

Quotas run directly into the opposition of the entities required to meet the target or obligation, similar to the opposition to carbon taxes by large emitters. In contrast, Renewable Tariffs are an incentive to generators, not an obligation. In this sense, Quotas are a market push policy and Renewable Tariffs are a market pull policy.

Renewable Tariffs only require the right to connect and the ability to pass costs on to ratepayers. Distribution utilities should remain whole, with direct or “shallow” interconnection costs borne by the renewable generator. The cost of purchasing the renewable generation and any administrative charges are simply passed through to consumers.

Distribution utilities are not “obligated” to meet any political target. It’s the responsibility of the government to meet its self-imposed target by setting a price sufficient to drive development. It’s not the responsibility of the distribution utilities.

Lauber notes that political support for renewables can cross party lines. The vote in favor of the StrEG in the Bundestag was nearly unanimous.[72] At the same time Lauber, in recounting the American experience in the 1980s and 1990s, shows that support for renewables can be politicized and identified with one ideology or political party. Lauber’s description of the origin of the RPS in the political milieu of the day is the most succinct one available. The RPS was, as he says, a “concession to the spirit of the times,” a way of moving renewables forward in a hostile political environment both on the national and state level.

5.13 Conclusion

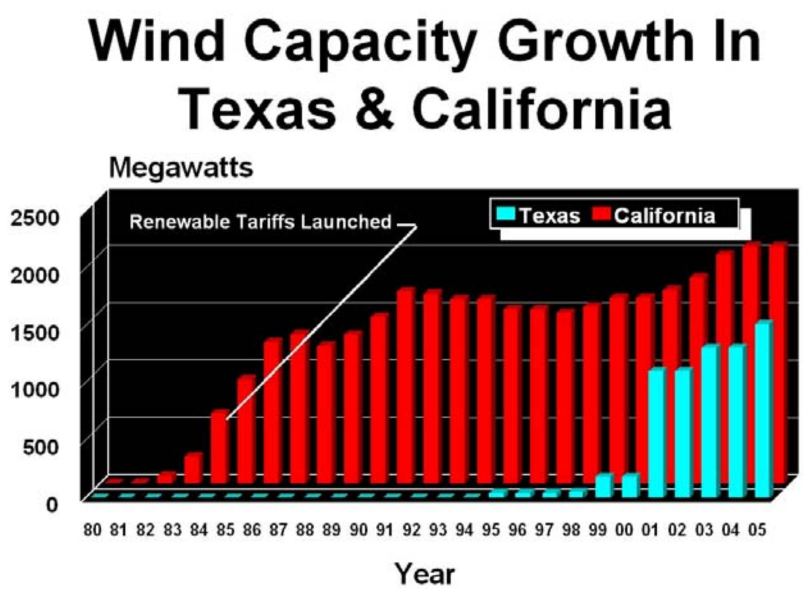
[71] Lewis and Wiser 2005.
[72] Lauber 2003.

LBL's Wiser concludes that design of RPS or Quota policies is complex and that if long-term contracts are not an integral feature of the mechanism and short-term trade of certificates dominates, these policies are a costly and unstable means of developing renewable energy. Nevertheless, he goes on to write, well designed RPS programs will result in "significant—though not massive—renewable development.[73]

This is a most interesting observation. If the objective is limited or timid renewable development, RPS policies are a good choice. But if massive renewable development is desired, as in Germany and Spain, then this mechanism may not be the best choice. Coming as it does from a contractor to the US Department of Energy and one of the most senior renewable energy policy analysts in the United States, this statement is all the more remarkable.

Texas' RPS is often used as an example of how a Quota system can be successfully implemented. Indeed, installation of 1,100 MW of new renewable capacity is an accomplishment. Nevertheless, it is often overlooked that California, using an early Renewable Tariff (Standard Offer No. 4) installed an equivalent amount of wind capacity—20 years ago! Both the Texas RPS and California's SO4 contracts depended upon lucrative subsidies to drive development. See Figure 5.8.

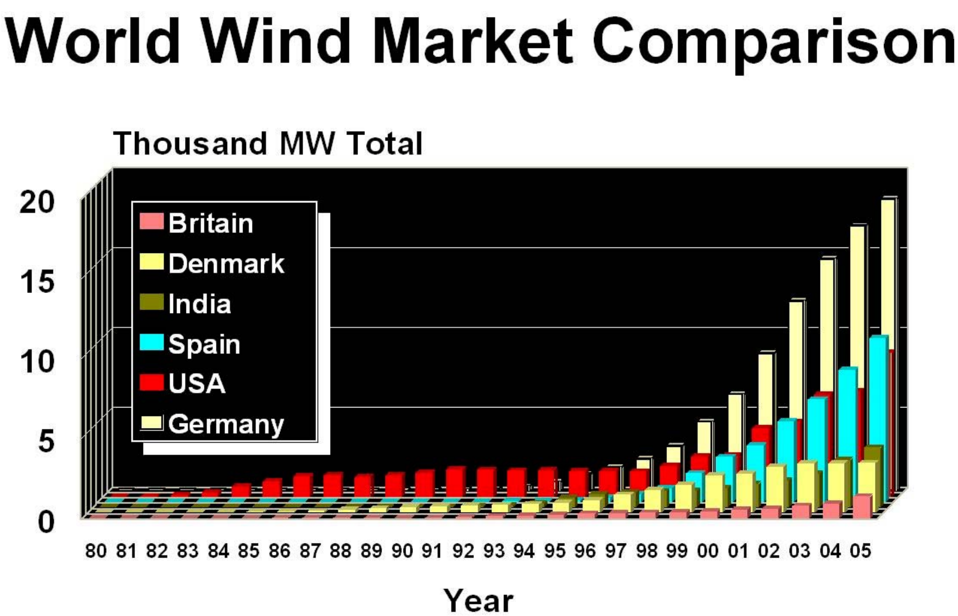
Figure 5.8. Wind development from the Texas RPS and California's SOC.



[73] van der Linden 2005, see Chapter 6 on Experience in the USA.

Regardless of the success of the Texas RPS, and regardless of the growing market for wind energy in Britain from its Renewable Obligation, the fact remains that renewable development is booming on the European continent. This growth is driven primarily by Renewable Tariffs. Of the countries with the largest installed wind capacity (Denmark, Spain, and Germany), all have or are now using Renewable Tariffs. Britain has been a perennial laggard and only now is the British market beginning to grow. Growth in the United States has been and will remain sporadic because of the PTC's on again-off again approval by Congress. See Figure 5.9.

Figure 5.9. World wind market comparison.

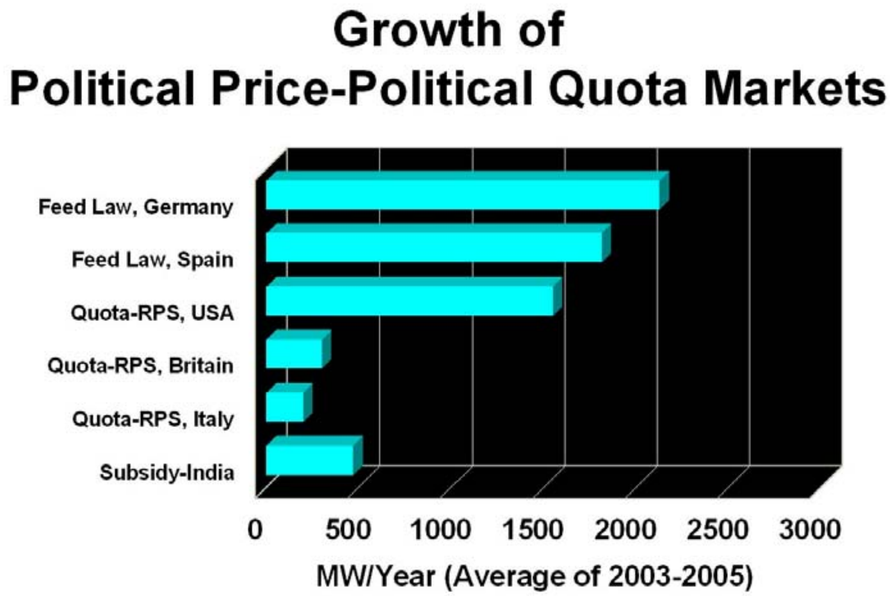


Altogether Denmark (3,100 MW), Spain (10,250 MW), and Germany (18,400 MW) operate nearly 32,000 MW of wind generation capacity and nearly all of this has been installed under Renewable Tariffs of one form or another.

How can continental Europeans be so successful? How can Europeans have installed so much generating capacity that the Danes produce 20% of their electricity with wind, the Germans 10% with wind, solar, hydro, and biomass, and the Spaniards 6% with wind?

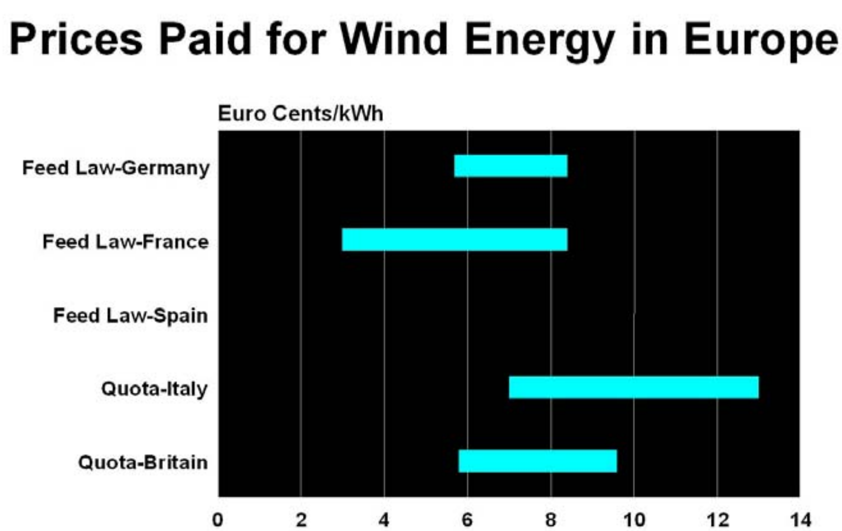
The answer is surprisingly simple: they pay for it. They pay for renewables by setting a price per kWh for wind, for solar PV, for hydro, and for biomass. They set a price high enough to ensure that they get the kind of renewables they want. The results speak for themselves. See Figure 5.10.

Figure 5.10. Growth of political-price and political-amount markets for wind energy.



Further, there are no tax-payer subsidies involved. Electricity consumers pay for the program. Those who use more electricity than the average, pay more for renewable generation than others. See Figure 5.11.

Figure 5.11. Prices paid for wind energy in Europe.

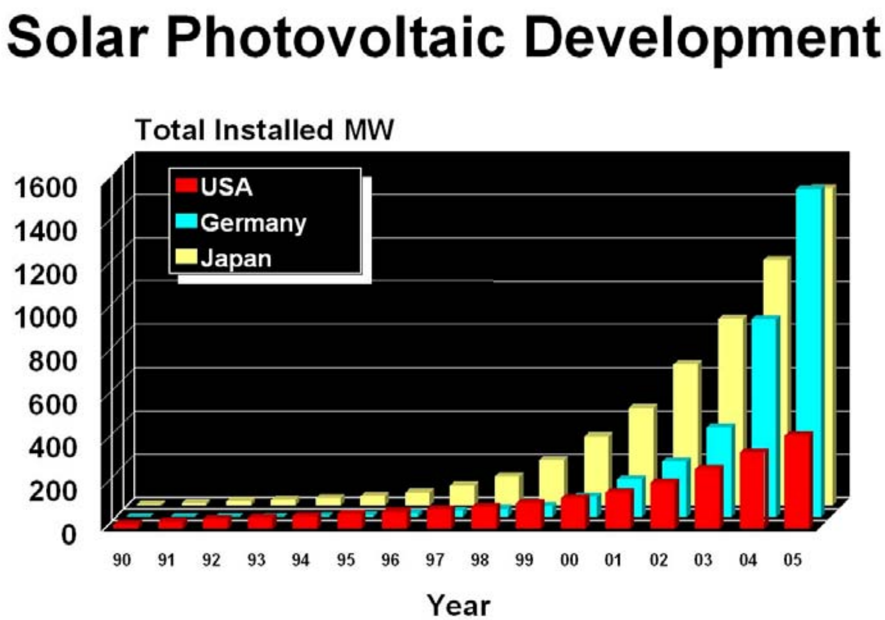


Nevertheless, the “premium” prices paid under the various feed laws are less than the short-term prices paid under Britain’s Renewable Obligation and Italy’s Quota system with tradable credits. Germany and Spain are doing more with renewable development at less cost than the presumably more market-oriented Quota systems of Italy and Britain.

Europe’s success is not limited to wind energy. The growth of solar PV in Germany has been truly remarkable. See Figure 5.12. Within a few years Germany has become a world leader in the PV industry. Currently the major markets for PV are

- Germany (500 MW/yr),
- Japan (350 MW/yr), and
- USA (80 MW/yr), mostly in California.

Figure 5.12. Solar PV development worldwide.

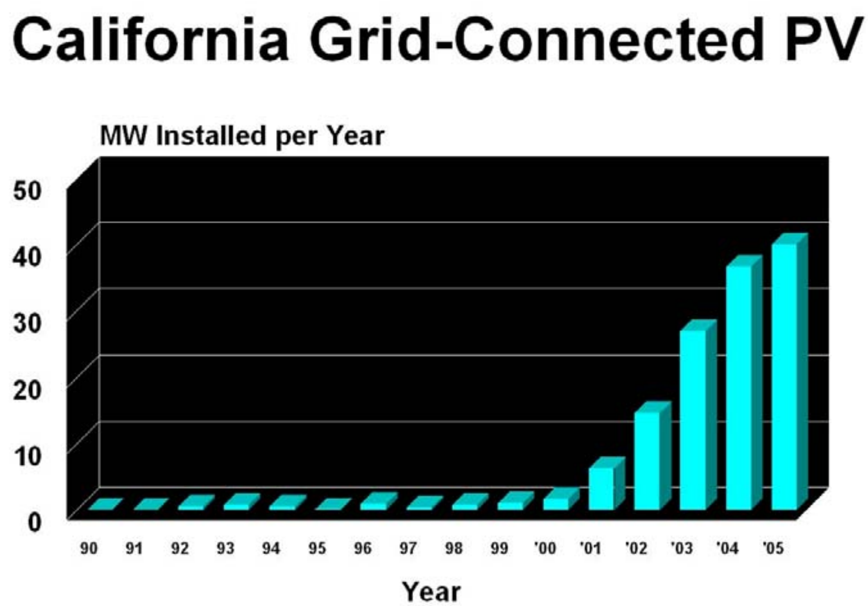


The California PV market, about one-half of the total US market, is driven by capital subsidies from the California buy-down or rebate program. The rebates are not particularly lucrative and the market is dependent on the size of the “early adopters” market. Growth is modest by German standards and costs are high. Despite constant reduction in the rebate by the legislature, PV systems are 10-20% more expensive in California than in Germany.

This cost differential flies in the face of conventional wisdom that it is more costly to do business in Germany than in the United States and that Germany’s premium tariff for PV should lead to more costly installations. That the opposite is true is another example that the competition among equipment suppliers and installers is fierce in Germany. The Renewable Tariff for PV puts the premium in the pocket of the purchaser (the homeowner or farmer) and not in the pocket of the installer. The installers must compete among each other for the purchasers business and the purchaser, who only receives payment from the PV tariff for actual generation, wants to spend as little up front as possible.

In contrast, California's rebate program puts the subsidy in the pocket of the installer. The purchaser is less concerned about the payment for generation (net metering) as the are in maximizing their subsidy payment. As a result, there's pressure to keep installed costs high rather than pressure to push them down. See Figure 5.13.

Figure 5.13. California grid-connected PV development.



Germany followed a traditional subsidy route for PVs until the expiration of the 100,000 solar roofs program in 1999. It was in part to prevent a collapse in the PV market that the EEG was passed in 2000 with substantial tariffs for PV. See Figure 5.14.

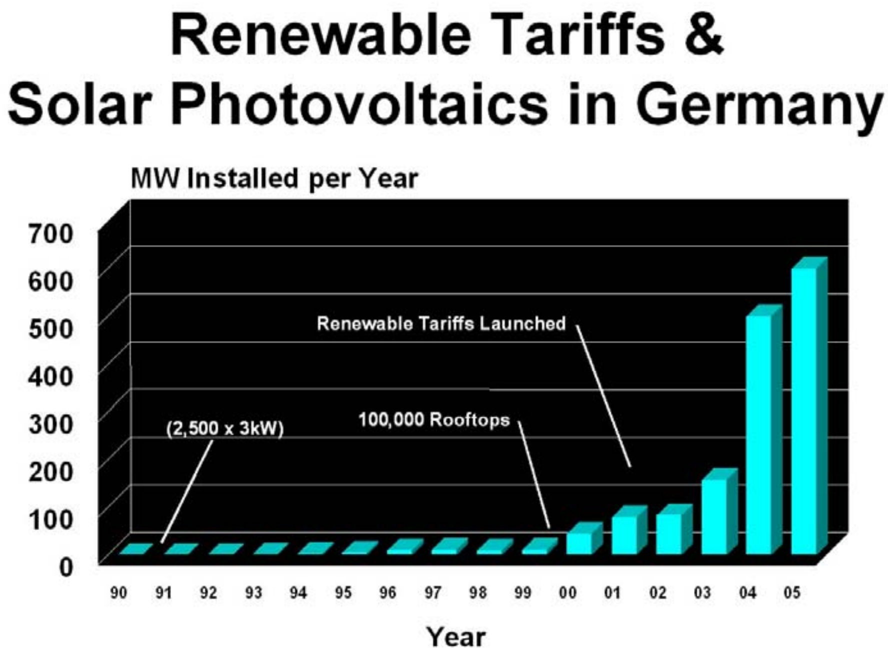
Tariffs for PV were again raised in 2004 amendments to the EEG. Though the degression (5%) is steep, PV development has taken off. By yearend 2005, Germany surpassed Japan as the world's largest PV market.

For a sense of the size of the solar PV market in Germany consider that

- 70,000 new systems were installed in 2004,
- 600 MW of new systems were installed in 2005,

- A total of 1,500 MW were operating by year-end 2005, and
- Costs have dropped 25% since 1999.

Figure 5.14. Annual installations of solar PV in Germany using Advanced Renewable Tariffs.



German farmers alone were expected to install 200 MW of PV in 2005, typically 30 kW systems on barn rooftops. Total installed operating PV in Germany by year-end 2005 was approximately 1,500 MW or six times the total installed wind capacity in New Zealand.

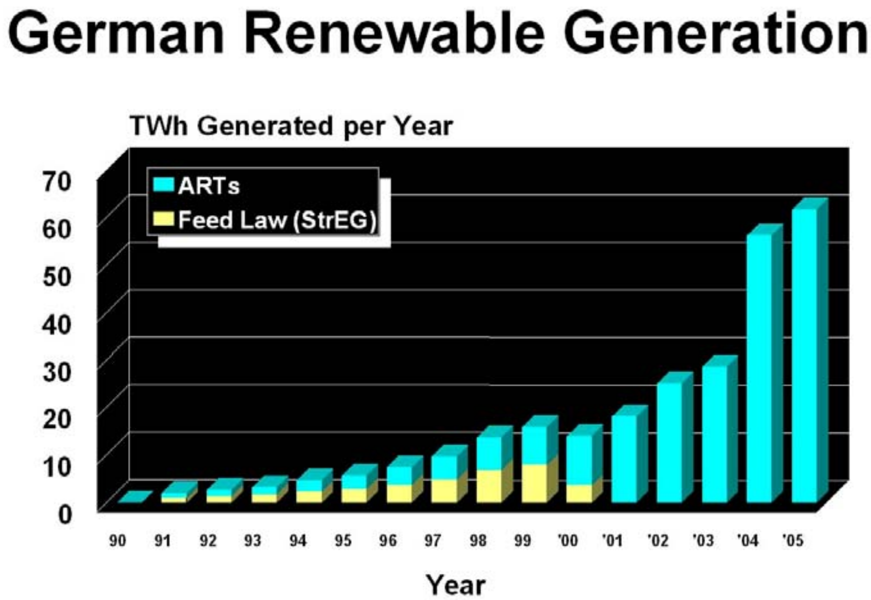
The scale of the German achievement is truly staggering. There are

- 200,000 PV installations,
- 2,000 biomass plants,
- 550 MW of farm biogas,
- 6,000 hydro plants,
- 18,000 wind turbines, and
- Altogether 226,000 new renewable installations operating in Germany.

Today renewables in Germany provide

- About 10% of supply (55 TWh/yr),
- 45,000 direct and indirect jobs in wind energy,
- 30,000 jobs in the PV industry, and
- Overall 150,000 jobs in renewable energy.

Figure 5.15. German renewable generation was about 10% of supply in 2005.



Once unthinkable in the North American context, the concept of Renewable Tariffs is beginning to gain momentum. In 2005 Minnesota passed its C-BED (Community-Based Energy Development) proposal, Washington State signed it's solar PV program into law that could pay as much as $0.54 USD/kWh ($0.78 NZD/kWh) for electricity produced by panels built in the state. California even launched a modest PV tariff of $0.419 USD/kWh ($0.61 NZD/kWh) in 2005 as well.

And the list of those using Renewable Tariffs is continuing to grow as more countries, and more states and provinces weigh the advantages of what Europeans prosaically call Electricity Feed Laws.

6. Conclusion and Recommendations

New Zealand could become the world's first nation with a sustainable electricity supply based on renewable resources, though it may be in a race with Sweden to do so.[74]

6.1 Renewable-Rich New Zealand

As the late Keith Dawber of the University of Otago in Dunedin would explain to anyone who would listen, New Zealand is in the enviable position of being rich in renewable sources of energy. New Zealand has an abundance of both variable forms of renewable energy, such as the winds that power the wind farms on the North Island, and steady base load forms, like hydro power that can be used when the winds are not at gale strength. The future for New Zealand was not in burning ever more natural gas in power plants, Dawber said, but in integrating wind-generated electricity with the renewable resources characteristic of each island.

Dawber envisioned integrating wind energy with the geothermal power plants on the North Island and with the hydro system on the South Island. In this way, he said, New Zealand could construct the world's first sustainable energy system, using only the renewable resources that fall on, blow across, or rise up from New Zealand's soil. Initially, natural gas would be set aside for transportation until it, too, would eventually be replaced by various forms of solar energy in the form of biomass-derived fuels.

While Professor Dawber was certainly a visionary, he was no dreamer. Like hydropower before it, wind energy has become a global enterprise. Wind is now the world's fastest-growing source of energy. For the past five years, growth has averaged 20%-40% per year. Denmark, New Zealand's Northern Hemisphere twin, meets 20% of its electricity needs with wind turbines alone.

The development of solar PV and biomass is now following the same trajectory as that of wind energy.

Professor Dawber often liked to point out that New Zealand has far more abundant renewable energy resources than tiny Denmark. New Zealand has some of the most powerful winds on earth. The wind turbines on the North Island are among the most productive in the world.

There is tremendous power in Keith Dawber's vision, one that can mobilize a nation’s people if seized upon.

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[74] Vidal, John, Sweden plans to be world's first oil-free economy, Guardian (UK), Wednesday February 8, 2006, http://business.guardian.co.uk/story/0,,1705315,00.html, visited February 13, 2006.

6.2 Renewables' Declining Share of Generation

New Zealand is fortunate that so much of its current generating capacity is renewable. See Table 6.1.

Table 6.1 New Zealand's Electricity Supply.

New Zealand Electricity Supply*	
Hydro	62%
Gas	24%
Geothermal	7%
Coal	4.5%
Other	3%
*40 TWh/yr.	

Some 69% of current supply is renewable. However, as late as 1990 four-fifths of New Zealand's electricity was generated renewably. Worse, consumption is increasing at an unsustainable rate of 1-2% per year. This trend is forcing New Zealand to increasingly rely on the declining Maui gas field for new generation.

If New Zealand opts for importing large quantities of LNG to meet increasing demand from gas-fired generation, the country will become dangerously vulnerable to supply interruptions and natural gas price volatility. Reliance on imports of LNG could endanger New Zealand's economy and the well-being of its citizens.

New Zealand should take action to insulate itself from international energy markets, over which it has no control and very little influence, by reversing the decline in the portion of electricity generation from renewable sources.

6.3 Growth Quickens in New Markets

Fortunately, renewable generating capacity can be added incrementally, and quickly. As the technology has advanced and more experience has been gained with both the technology and the policies necessary for rapid deployment, new generation can be brought on line quickly. Each new market finds that it can add generation more quickly than the markets that have gone before. See Table 6.2.

Table 6.2 Growth of Wind Energy Quickens in New Markets.

Wind Energy Growth Quickens in New Markets				
	Years to Reach MW			
	2,000	4,000	8,000	16,000
Denmark	16			
Germany*	7	2	2	2.5
Spain	5	1.5	2	
* Germany installed 3,250 MW in 2002.				

Denmark took 16 years to reach 2,000 MW of wind generating capacity. Germany, which followed Denmark, took only 7 years to install 2,000 MW. Spain took only 5 years. Germany and Spain doubled their first 2,000 MW in only 2 years, and doubled their wind capacity again, installing an additional 4,000 MW, in only 2 more years. Germany doubled its operating capacity yet again to 16,000 MW in only 2.5 years. At its peak, Germany installed more than 3,000 MW in one year alone.

This pattern is being repeated in the rapid growth of solar PV, both in Germany and Japan. See Table 6.3.

Table 6.3. Solar PV Growth Quickens in New Markets.

Solar PV Growth Quickens in New Markets			
	Years to Reach MW		
	100	500	1,000
Japan	7.5	5	3
Germany*	10	4	1.5
* Germany installed 600 MW in 2005.			

Both Japan and Germany took nearly a decade to install their first 100 MW of solar PV. Yet it took only 4-5 years to install 400 MW more. And it required only 2-3 years more to double installed capacity to 1,000 MW.

6.4 New Zealand Renewable Targets

6.4.1 Conservation Targets

No renewables policy is complete without an aggressive conservation program. At a minimum there should be zero growth in consumption. It will require a major effort for New Zealand to confront the decline of the Maui gas field and the loss of existing gas-fired generation, even without trying to tackle ever increasing consumption.

Current consumption exceeds that of other developed countries. For example, New Zealand residential electricity consumption of 8,000 kWh/year is twice that of the typical northern European of 3-4,000 kWh/year. Based on international experience, there's room to cut at least residential consumption by 50%.

Thus, there could be a series of conservation targets of increasing severity:

- Eliminate growth in consumption,
- Match conservation with declines in the Maui gas field, or
- Cut consumption by 50%.

6.4.2. Renewable Targets

By international standards the current target of 30 PJ by 2012 is aggressive. This is equivalent to 8.3 TWh/year or about 21% of current generation. Wind energy alone could provide this much generation within this time frame. Because of its world-class wind resource, New Zealand would require only 1,000 to 2,000 contemporary 2 MW wind turbines to produce 8 TWh/year.[75] These could be installed in 4-6 years if the policies were in place to do so.

Coupled with an aggressive conservation program, New Zealand's renewable target could eliminate the electricity sector's need for natural gas.

But New Zealand could do much more. Consider the amount of renewable capacity that has been installed in Germany in little more than a decade. See Table 6.4.

Table 6.4. New Zealand Electricity Supply with German Renewables.

New Zealand Electricity Supply with German Renewables		
	TWh in 2005	% Supply
Wind	30	75%
Solar PV	1	3%
Biomass	9	23%

German wind turbines produced about 30 TWh in 2005. If an equivalent capacity were operating in New Zealand, wind energy would meet three-fourths of New Zealand's supply. Biomass plants generated 9 TWh last year in Germany. If located in New Zealand, these plants would produce 9% of supply. Even solar PV, if installed on an equivalent scale, would provide 3% of New Zealand's electricity.

[75] Each turbine using an 80-meter diameter rotor sweeping approximately 5,000 m^2, with a specific yield of 1,000 to 1,500 $kWh/m^2/yr$.

Altogether, German renewables, if installed at a similar scale (60 TWh in 2005), would more than meet all of New Zealand's current electricity demand.

With New Zealand's existing hydro and geothermal generation for base load and load following, it is not unreasonable to expect that New Zealand could produce 100% of its electricity renewably by 2025, that is, approximately one decade beyond the current target.

Such a target is only achievable with concerted and consistent political support and the use of Renewable Tariffs to enlist the participation of the business community as well as New Zealand's citizens.

6.5 Ontario's Experience Developing Advanced Renewable Tariffs

Ontario is a bellwether for Canadian policy development on many issues. The province's experience with Advanced Renewable Tariffs, or what the provincial government calls Standard Offer Contracts, could portend policy changes elsewhere in Canada and possibly elsewhere in North America. The Ontario program is both the result of fortuitous circumstances and a bottom-up approach to policy development.

Ontario is Canada's most populous province. About one-third of Canada's population lives in Ontario. The province, notably the "Golden Horseshoe," is also the industrial heartland of Canada. For example, Ontario employs 40,000 in the auto industry alone.

Like New Zealand, Ontario's electricity system was originally built on hydropower. Even today, hydro provides one-quarter of Ontario's electricity.

In the fall of 2003 a new provincial government came to power with a mandate to close its coal-fired power plants, the source for nearly 20% of the province's electricity supply, on health grounds. The new government also had to confront the poor performance of provincially-owned nuclear plants. In response, the government committed Ontario to provide 10% of its electricity capacity from new sources of renewable energy by 2010.

Subsequently, the government launched a series of Requests for Proposals. The tendering program was chosen without any consideration of other competing mechanisms.

The Ontario Sustainable Energy Association (OSEA) is a small non-governmental organization that promotes the development of community-owned renewable generation in the province. OSEA envisioned replicating Danish and German success with renewable energy cooperatives. However, under the province's RFPs there was no way for community groups, farmers, and First Nations (the province's indigenous population) to participate.

To enable community participation in Ontario's renewable energy development, OSEA needed to promote not only the continental European concept of cooperative renewable ownership in the province, but also the policy mechanism that made this possible: renewable tariffs. Consequently, OSEA began a campaign for Advanced Renewable Tariffs in early 2004.

OSEA's campaign was inaugurated in an address before an audience of nearly 900 people, mostly farmers. Subsequently, OSEA joined with the Ontario Federation of Agriculture (OFA), the province's principal farm group, in holding a series of evening programs across southern Ontario. Later, a smaller farm organization, the National Farmers Union (NFU) also joined the program. Both the OFA and the NFU paid for OSEA's evening workshops. In the meantime, OSEA also sponsored a series of workshops across the province for its member groups.

The workshops explained to farmers and OSEA supporters that they were being excluded from renewables development. Only those with the institutional power to bid into the RFPs would be permitted development rights. The message was simple: "If you want to participate in the renewable revolution sweeping the planet, then you must change government policy, and this requires political action." This message particularly resonated with Ontario farmers who wanted to use renewable energy as a new source of on-farm revenue. Consequently, farmers, with OSEA's guidance, began a letter-writing campaign urging government adoption of Renewable Tariffs. OSEA's campaign caught on, and soon farmers were lobbying their provincial parliamentarians without OSEA's direct involvement.

For its part, OSEA published a series of op-eds in the country's major newspapers and formed alliances with a myriad of other NGOs, both provincially and across Canada.

Following publication of one prominent op-ed piece in the Toronto Star, OSEA received a call from an energy analyst in the Premier's office asking for a meeting. This was the first major success of OSEA's campaign. The analyst later explained that the Premier, Dalton McGuinty, and his government was interested in a program "like" that proposed by OSEA. The analyst encouraged OSEA to gather information on the Renewable Tariff programs used in Europe that could be useful when the government chose to act.

In November 2004, the ruling party held a conference on policy proposals. At the conference, the party formally endorsed Advanced Renewable Tariffs, in those specific terms, citing OSEA's talking points.

In December, the Ministry of Energy hired OSEA to develop specific policy recommendations for what it termed “Standard Offer Contracts”. The subtle change in terminology was overlooked by OSEA, to its later regret.

OSEA quickly scheduled a pricing workshop with stakeholders. The workshop was led by ADEME’s Bernard Chabot, the architect of France’s wind tariffs. In early 2005, OSEA’s program was being mentioned on the floor of the provincial assembly; by spring, OSEA’s report was formally released.[76]

OSEA’s report called for a “pilot program” lasting five years, with a program review in the second year. OSEA chose not to directly challenge the traditional method of awarding contracts, the Tendering process, but instead to seek an “alternative” suitable for farmers, local landowners, First Nations, sand cooperatives that were effectively excluded from the provincial Tenders. In the Ontario political context, this was viewed as more “palatable” than switching all new renewable development to a policy mechanism that hadn’t been used in North America in two decades.

Further, OSEA chose to limit project size to 10 MW connected at distribution voltages. This was done in part because OSEA’s members were interested in smaller projects, and in part because it would maximize the benefits of distributed generation to Ontario’s electrical network. The specific amount of 10 MW was chosen because of a regulatory decision that projects of greater than 10 MW required more expensive interconnection studies than projects of less than 10 MW.

It was also felt that OSEA’s proposal might be less intimidating if it were seen as “small” and “insignificant” to policy makers wed to big, centralized solutions to energy problems. Thus, any “above-market” costs associated with the program might be more acceptable if the program were limited in scale.

Despite strong ministerial support, implementation of OSEA’s recommendations was hindered for months by the creation of a new contracting and electricity supply forecasting agency, the Ontario Power Authority (OPA). It was some time before the OPA could turn its attention to what for North America was a novel policy concept. In the fall of 2005, OSEA held another workshop with Chabot on the pricing model at the request of the OPA.

In November 2005, the OPA released a highly contentious consultant’s report on the elements of a Standard Offer program. The consultant, Navigant, elaborated on key questions that the OPA needed to answer before instituting such a program. Following a series of quickly scheduled public hearings, OPA issued a confidential report to the Minister of Energy on the program.

[76] Gipe, Paul; Doncaster, Deborah; MacLeod, David, Ontario Sustainable Energy Association, May 2005, http://www.wind-works.org/FeedLaws/Canada/PoweringOntarioCommunities.pdf, visited February 22, 2006.

The OPA report to the Minister of Energy dismissed OSEA's pricing model, substituted its own with a much lower initial price, eliminated solar PV entirely, and introduced new elements (peak period pricing for hydro and biomass) not considered during the development of the OSEA program. Significantly, it proposed the same price for all technologies, except for solar PV which it suggested needed an RFP for so-called "price discovery".

OPA, in effect, abandoned the principles of Advanced Renewable Tariffs, and instead proposed traditional Standard Offer Contracts like those used previously in California.

In retrospect, OSEA erred in adopting the language of its client, the Ministry of Energy, in writing its report. Use of the term "Standard Offer Contracts" conveyed two messages unintended by OSEA: that the contracts may include more than renewable energy, and that the contracts would be "standardized" across the differing technologies.

Initially, OPA wanted to include gas-fired cogeneration in the program. This was never OSEA's intent. Further, the literal interpretation of the term "standard" implied that all technologies would be treated identically. It was always OSEA's intent that each technology would be treated as unique and that prices and program elements would be determined by the nature of the technology. As an illustration of the conceptual differences, one Ministry staffer exclaimed in frustration that "this is the most non-standard, standard offer contract he'd ever seen." Indeed, responded OSEA, the program was never intended to standardize the treatment of each technology.

Considering their opposition to OSEA's pricing model, OPA's report surprisingly concluded that there were sufficient safeguards with a two-year policy review that the program should not be temporary, but permanent.

OPA's position created a policy dilemma for the then new Minister of Energy, a strong proponent of the OSEA model. Since the OPA had been created as an arms-length agency, what authority did the Minister of Energy have in giving it direction, specifically higher prices than those proposed by OPA? After a series of high-level meetings, an agreement was reached that called for the OPA to issue its report with a simultaneous "directive" from the Minister of Energy. This directive would make the case for diverting from OPA's recommendations and directing the agency to implement the Standard Offer Contracts in the manner suggested by the ministry.

The Ministry of Energy is expected to announce receipt of the OPA report and issue its directive to the OPA, implementing the program by the end of February 2006. The government expects to award contracts by mid year.

Development of Ontario's Standard Offer program, from the beginning of OSEA's campaign to the awarding of contracts by OPA, took nearly 2-1/2 years. OSEA's members expect that it will take another two years before any appreciable generating capacity is installed under the program.

6.6 Barriers to Ontario's Renewable Tariffs

The barriers encountered to Ontario's adoption of Renewable Tariffs are not unique and can be expected elsewhere. These can be summarized as a

- New or "foreign" concept, a
- "Non-market" mechanism, an
- "Above-market" price, and an
- Absence of Quotas or targets.

Each of these misconceptions can be and has been addressed in Ontario by an aggressive educational outreach to farmers, NGOs, government agencies, various stakeholders, and the business community.

Though Renewable Tariffs are new in many anglophone countries, they are not a new idea and where used have been extremely successful.

Renewable Tariffs can also be shown to be a more effective "market mechanism" than traditional policy choices, once the concept is fully grasped.

Initially, some of those most likely to benefit from Ontario's Renewable Tariffs--commercial wind developers--were opposed to the policy on ideological grounds. Interestingly, their opposition gradually weakened as they became more and more familiar with the disadvantages of the Tendering system they were competing in. Eventually the Canadian Wind Energy Association, the trade group representing the country's commercial wind developers, enthusiastically joined OSEA's campaign.

Criticism from individual CanWEA's members of OSEA's proposal gradually shifted from politically-tinged arguments about "non-market" mechanisms to criticism of OSEA's choice of a modest 10 MW project cap. The project limit should be higher than in OSEA's proposal suggested some CanWEA members who were initially critical of the entire program. This change of heart by CanWEA's members and others in the independent power community put OSEA in the unexpected position of acting as a moderating voice for its own program.

One of the most politically conservative elements of Ontario society, farmers, were quick to see the merit in Renewable Tariffs. Farmers, and their principal lobbying group, the OFA, quickly became one of the driving forces behind Renewable Tariffs.

Where used, Renewable Tariffs do not necessarily result in excessive costs or even in above-market costs, as demonstrated in Europe.

One of the more intriguing barriers is the difficulty encountered when proponents try to explain why a policy mechanism is important or worth consideration when there are no Quotas or targets attached to it. Politicians and bureaucrats are accustomed in thinking linearly: Problem X requires so much generating capacity, therefore issue an RFP for X, and then build X. However, using a Renewable Tariff mechanism approaches the problem differently: Problem X requires so much generating capacity; therefore, what is the price that will stimulate the rate of development desired? Targets, of course, can be attached to any program to gauge progress. But the targets must be large enough that they don't cause hoarding or a rush to contracts, or must reflect the minimum desired, and not be limited to a maximum amount.

German Renewable Tariff policy began without any targets. The StrEG was proposed to deal with an issue affecting conservative Bavarian farmers. Later revisions include ambitious minimum targets:

- 12.5% of electricity supply by 2010,
- 20% of electricity supply by 2020, and
- 50% of energy supply by 2050.[77]

German energy policy reflects these targets, which are included in the coalition agreement between the conservatives and the social democrats.

In retrospect, one issue which should not have come as a surprise was the amount of continual education required of political leaders and especially policy analysts responsible for energy policy.

OSEA practiced a policy of full transparency. OSEA's program and all supporting documents were available on its web site. OSEA, in response to request from an energy analyst in the Premier's office, built an extensive collection of articles and technical reports in English, French, and German on the use of Renewable Tariffs in Europe.

Despite this or perhaps because of the overwhelming amount of material OSEA had amassed, many Ontario policy analysts remained ill-informed. Questions about fundamental aspects of OSEA's program and its reasoning were raised again and again as new individuals came into the policy-making mix.

Many of those responsible for energy policy knew little about renewable energy, thought they knew more than they did, or were not convinced of the merits of renewable energy.

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[77] It's important to note that Germany is the world's third largest industrial economy and consumes ~500 TWh of electricity annually.

6.7 Recommendations

While it is conceivable that policy development could take less time where the principal stakeholders, regulators, and politicians are supportive and a strong leader with sufficient political backing could simply short-circuit the grass-roots phase described here, it is unlikely.

Of course a major interruption in the supply of oil due to political turmoil or war, for example in Iran, may force politicians to take dramatic and potentially hasty steps, resorting to familiar policy choices such as Tendering.

Despite their success in Europe, Renewable Tariffs are a novel concept in anglophone countries, as evidenced by the many names used to describe the policy in English. Politicians, regulators, the business community, and even renewable energy advocates must become comfortable with the policy before it can be more widely adopted. This takes time.

However, institutions such as EECA can facilitate the process by educating regulators and political leaders about the most successful policies. EECA can also move the debate by supporting NGOs, such as the New Zealand equivalent of OSEA in Ontario, who may have an interest in developing a Renewable Tariff policy for New Zealand.

One step toward this goal could be a series of small workshops or private meetings with NGOs around the country, leading up to a nationwide conference with leaders in the Renewable Tariff field. Participants could include political figures, such as Hermann Scheer or Hans-Josef Fell of Germany's Bundestag, as well as economists, political scientists, and consultants from North America and Europe.

As new policy options, New Zealand and EECA should consider

- Targeting a 50% cut in electricity consumption,
- Targeting a 100% renewable electricity supply by 2025,
- Holding informal NGO and stakeholder workshops to introduce Renewable Tariffs,
- Sponsoring a nationwide conference on Renewable Tariffs for political leaders, the business community, farmers, NGOs, and other stakeholders, and
- Following the conference, beginning discussions with regulatory authorities and parliamentarians on how best to introduce Advanced Renewable Tariffs in the country.

Renewable Tariffs offer a better prospect than any other policy mechanism available today for the rapid deployment of renewable energy in New Zealand with the cooperation and participation of its citizenry.

-End-

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8. Additional Sources of Information

There is an extensive collection of articles and commentary on feed laws or Renewable Tariffs at http://www.wind-works.org/articles/feed_laws.html.

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