International Experience with Public Benefits Funds: A Focus on Renewable Energy and Energy Efficiency

FINAL REPORT

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1. Introduction and Summary

1.1 Report Purpose and Content

Renewable energy and energy efficiency investments have long been supported through public policy efforts in a wide array of countries. Public benefits funds (PBFs) are one of several policy tools that might be used to provide this support, and PBFs have become increasingly common in recent years, especially as competition in the electricity industry has increased. While the objectives of different PBF programs are often similar, the structures and means to deliver energy efficiency and renewable energy services through PBFs show much wider variation across countries and U.S. states.

This report summarizes international experience with PBF policies that target renewable energy (RE) and energy efficiency (EE) investments, and identifies lessons learned from these experiences that are applicable to the Chinese context. Financially supported by the Energy Foundation, a number of Chinese organizations are exploring the possibility of applying PBFs at both a national and provincial level in China. This report is intended to assist these efforts by summarizing international experience.[1]

This report does not provide detailed information on each PBF in existence internationally. Instead, its purpose is to identify the key issues that arise when developing a PBF policy, and identify lessons learned, referencing examples in individual countries or U.S. states as appropriate. Because the PBF is a relatively new policy mechanism, experience with its use continues to grow. This report should therefore be viewed as a living document; experience with the PBF is by no means static, and lessons will continue to be learned over time.

This report is organized as follows:

- Chapter 2 provides an overview of PBFs, describes what a PBF is, and summarizes some basic information on the use of PBFs internationally in supporting renewable energy and energy efficiency.
- Chapter 3 discusses the reasons that PBFs have been established to support renewable energy and energy efficiency, and some of the advantages and disadvantages of the PBF as a policy instrument.
- Chapter 4 highlights various mechanisms that can and have been used to collect the funds for a PBF internationally, and describes the advantages and disadvantages of these different funding sources.
- Chapter 5 describes how the level of the PBF might be established, based on international experience, and also discusses the appropriate duration of a PBF as well as the ongoing need to defend and protect PBFs from political attack and re-appropriation.

[1] For additional details on energy efficiency benefits, opportunities, barriers, and policy recommendations for China, see a recent report by Finamore et al. (2003).

- Chapter 6 highlights various models for applying and distributing PBF funds in support of RE and EE, discusses available incentive types, and summarizes general fund disbursement options.
- Chapter 7 highlights a few of the most common programs and program types that have been funded by PBFs, in support of both RE and EE.
- Chapter 8 summarizes the different options for administering a PBF, discusses the advantages and disadvantages of different administrative structures, and highlights criteria that might be applied to select among different administrative options.
- Chapter 9 discusses the costs of administering PBF programs, and the staffing needs for those programs, based on international experience.
- Chapter 10 presents information on the management and monitoring of PBF funds, and discusses the need for different levels of administrative oversight depending on the administrative structure that is selected.
- Chapter 11 discusses program evaluation, and the need for credible, third-party evaluation to ensure the continued success of PBF-funded programs.
- Chapter 12 evaluates the effectiveness and impact of RE and EE PBF programs internationally, and discusses some of the important lessons learned based on that experience.
- Chapter 13 highlights the need to combine PBF policies with other forms of support for renewable energy and energy efficiency, and specifically discusses (1) the need to minimize utility financial disincentives for EE, and (2) the importance of power purchase agreements for renewable energy.
- Chapter 14 concludes this report by discussing some of the key emerging trends for PBF programs, and identifying key lessons and recommendations for China, based on this international experience, repeating the summary provided below in Section 1.2.
- Appendix A provides links to more detailed PBF case studies, and describes one PBF case study in some detail: the Vermont EE PBF program.

1.2 Report Summary

A public benefits fund (PBF) as defined in this paper is a fund that is collected through a defined surcharge on electricity rates or electricity generators, the funds from which accumulate and are used to directly support public purposes in the electricity sector. For most states and countries that use PBFs, they are simply a mechanism to collect revenues in an equitable manner to continue funding important public benefits that might be lost in a restructured utility environment.[2] While some might view this as a "tax" on electricity service, in reality, a PBF funds activities that are integral to the provision of electric service and therefore the surcharge should be seen as just another element of the cost of electricity service – like salaries, generation costs, and wires. For the purposes of this document, we focus on the use of such funds in supporting RE and EE investments, though in many jurisdictions these funds are also used to support public interest electricity research and development and to assist low-income electricity customers.

[2] A few entities, such as Norway, Thailand, and Vermont USA, created PBFs without any pressure from restructuring.

There are three key aspects of public benefits funds that are reviewed in detail in this report: (1) how the money for the fund is collected; (2) who administers the funds, and how does that administration take place; and (3) how the funds are distributed and used.

The key findings of this report can be summarized as follows:

General Findings

- PBFs have become increasingly popular internationally as a way to enhance renewable energy and energy efficiency investments and deliver important public benefits. Traditional PBFs are perhaps most commonly used in the United States, but useful experience also derives from Europe, Australia, Japan, Brazil, India, and other countries.
- PBFs can provide critical support for both renewable energy (RE) and energy efficiency (EE) investments, and can also be used to support public interest R&D and provide assistance to low-income electricity customers.
- PBFs are particularly important to implement in conjunction with reforms in the electric utility sector. Without early use of a PBF, EE and RE program momentum may be drastically slowed as electric reform begins, professional expertise may be dissipated, and timely opportunities are likely to be lost.
- In discussing a PBF to policymakers, it is easy to focus on the cost of the policy; while this cannot and should not be avoided, it is equally critical to continually emphasize the important public benefits of the PBF – it is all too easy for policymakers to only focus on the costs.
- Relative to other policy approaches, PBFs have certain advantages: (1) PBFs can be used regardless of the structure of the electricity sector, (2) an equitable funding mechanism can be used to collect the needed revenue, (3) the PBF can be established on a regional or national scale, depending on which is most appropriate, (4) there are multiple possible sources of funds for a PBF, (5) a PBF offers significant flexibility in how funds are applied to support RE and EE, and (6) the cost of a PBF can be fixed and known in advance.
- PBFs also have certain disadvantages relative to other policy approaches: (1) the public and policymakers may be sensitive to the fact that a PBF is sometimes viewed as a new "tax", (2) the administration and oversight of a PBF can sometimes prove challenging, and requires significant dedication by the government, (3) once a PBF is established, it is all too easy for policymakers to lose sight of the benefits of the PBF, and to regard a PBF as a "welfare" program, and (4) once collected, PBFs can and often are subject to political attack or re-appropriation of the funds for other government purposes, sometimes making it hard to develop stable, long-term RE and EE markets with PBF funds alone (though, it deserves note that general government tax revenue is likely to be an even more vulnerable funding target).
- PBFs should be employed in combination with, not in lieu of, other policy approaches. Complementary policies that offer long-term power purchase contracts for renewable energy are especially important, as is ensuring that regulated electric utilities have appropriate financial incentives to encourage energy efficiency.

Funding Source, Level, and Duration

- The amount of funds collected for a PBF should depend on the expected use of those funds, and must be informed by political circumstances. Nonetheless, international experience suggests a range of funding levels. Energy efficiency expenditure in the US has averaged as much as 2.5% of retail electricity sales revenue in some states, while renewable energy expenditure in the US has averaged as much as 0.75% of retail sales revenue; PBF funding outside of the US has often been even higher than these levels. Total EE and RE PBF funds of 1%-3% of retail sales revenue are not uncommon. Even at these levels, however, experience shows that significant additional opportunities exist for cost-effective EE investments, and that RE resource potential is vast. Therefore, in many circumstances it will make sense to establish a PBF as high as possible, given political realities and pressures.

- PBFs may be collected from numerous sources, including: (1) through surcharges on end-use electricity rates (i.e., a "wires" or "distribution" charge), or (2) through pollution levies and fees. RE and EE programs may also be funded through general government revenue sources. PBFs from electricity surcharges and special funds using general tax revenue are the most common approaches used internationally. The stability and permanence of a fund might be increased if a dedicated source of funds is used, however, suggesting that electricity rate surcharges or pollution levies might be the preferred source of funds. Funds that come from the central or provincial government can and have also been used for renewable energy and energy efficiency, but the permanence of these funding sources is unclear. Regardless of the funding mechanism that is used, funds should be collected in a way that is – ideally – equitable and non-bypassable (i.e. it is not possible for particular customers or groups of customers to avoid paying the fee).
- A critical challenge for PBF policies is to ensure the durability of the fund itself; long-term funding sources are essential in building robust markets for renewable energy and energy efficiency. Funding stability for a minimum of 5 years should be sought because markets take time to build, and programs take time to implement effectively.
- A key concern with PBFs is that their very existence can be subject to political attack on an almost annual basis, leading to unstable, weak markets for RE and EE. All efforts should therefore be made to protect PBF funds from re-appropriation by the provincial or federal government to serve other government needs. To defend and protect a PBF, they should (1) be designed effectively, (2) minimize carryover of funds from one year to the next, (3) demonstrate their success through independent evaluation, (4) use a dedicated charge to collect funds, (5) be build collaboratively by a wide variety of stakeholders, ensuring some level of political support.

Administration, Management, and Evaluation

- PBFs can and have been effectively administered in many different ways, and by many different organizations. The appropriate administrative structure for any specific jurisdiction will depend on institutional context, and there are advantages and disadvantages of each administrative approach. For RE and EE PBFs, the two most attractive administrative options include housing the PBF in an existing or new government agency, or allowing an independent organization to administer the PBF programs.
- Regardless of administrative structure, the degree of planning, program development and implementation, contract management, and program evaluation to effectively implement a PBF requires a full time, dedicated professional staff. Staff must be deeply experienced with RE and EE markets to ensure that funds are used most effectively. On a percentage basis, it is not uncommon for 5-10% of PBF funds to be used to cover administrative and management costs.
- Appropriate oversight and management of PBF administration are critical, and different administrative structures will require different levels and types of governmental oversight.

Stakeholder support and involvement is an important element of a successful PBF program, and will help ensure that the PBF has broad and deep support by its constituents.

- Programs and strategies should be discussed with and agreed upon by as a wide a stakeholder group as possible. This will help build support for the PBF and its efforts, and may give the fund added stability in times of political threat.
- Effective and independent evaluation of PBF programs is essential in both defending the very existence of the fund, and in identifying ways of improving the programs funded by the PBF. Successful PBFs internationally, especially for EE, generally place significant emphasis on independent evaluation.
- PBFs should be coordinated on a national, or at a minimum regional, basis; RE and EE markets are not limited to small geographic regions, so coordinated action should be sought.

Strategies and Programs

- PBF program strategies, planning, and key decisions should be guided by a clear vision and well-defined objectives and goals that are agreed upon in advance by a wide variety of stakeholders. PBF programs should, to the extent possible, build on existing domestic RE and EE infrastructure and experience.
- For RE, PBF program models are determined by the relative importance of (1) immediate RE installations through financial incentives versus, (2) longer-term industry and infrastructure development, versus (3) applying PBFs as investment vehicles. For EE PBFs, the different models for fund application include "resource acquisition" and "market transformation" models.
- Available incentive types include up-front capital grants, contracts for services, up-front rebates, production incentives, low-interest loans, and venture capital investments. Regardless of which incentive type is selected, the majority of funds distributed by a PBF should be distributed based on competitive processes, or be available to all eligible applicants. This will help to avoid the influence of political factors in funding decisions, and reduce any perceived favoritism or impropriety that might exist.
- Common RE PBF programs in place internationally include: (1) fixed production incentives, (2) auctioned production incentives or electricity contracts, (3) capital grants or rebates, (4) information and education programs, (5) low-cost consumer loans, (6) investment vehicles, (7) infrastructure building grants and contracts for services, and (8) research and development efforts. EE programs are often more varied than RE programs, and can target different technologies, customer niches, or market opportunity niches.
- The specific programs that are funded by a PBF will depend on the context of the country and market in which the PBF is applied, and should be informed by an analysis of low-cost and/or high-value renewable energy and energy efficiency opportunities. While there is no easy way to identify "best practice" PBF programs based on international experience, that experience does offer some important lessons learned. (See Chapter 12 for a summary of international experience with PBF programs and lessons learned based on that experience; those lessons are not repeated here).
- Regardless of which projects and programs are initially funded by a PBF, PBF funding should remain sufficiently flexible to allow the administrator of the fund to respond to targeted high-value funding opportunities as they arise. Ongoing feedback on the operation of PBF programs should be continuously sought in order to make mid-stream adjustments to program designs, services, and operations. Streamlined contracting processes should be in

place to ensure administrative efficiency and avoid being too “bureaucratic.” PBFs should partner, to the extent possible, with utilities, businesses, and industry to achieve greater impact. In delivering programs, PBFs should take advantage of existing, experienced delivery channels.

2. Overview

2.1 What is a PBF?

A PBF, as defined in this paper, is a fund that is collected through a defined surcharge on electricity rates or electricity generators, the funds from which accumulate and are used to directly support public purposes in the electricity sector. For most states and countries that use PBFs, they are simply a mechanism to collect revenues in an equitable manner to continue funding important public benefits that might be lost in a restructured utility environment.[3] While some might view this as a "tax" on electricity service, in reality, a PBF funds activities that are integral to the provision of electric service and therefore the surcharge should be seen as just another element of the cost of electricity service – like salaries, generation costs, and wires. For the purposes of this document, we focus on the use of such funds in supporting renewable energy and energy efficiency investments, though in many jurisdictions these funds are also used to support public interest R&D and assist low-income electricity customers.

In addition to standard PBFs, there are many renewable energy and energy efficiency funds that come from revenue sources outside of the electricity sector; for example, a large number of countries use general tax revenue to help fund renewable energy and energy efficiency investments. These sources of funds are not permanently dedicated to renewable energy and energy efficiency investments, however, and are typically subject to annual appropriations. While we include in this report some lessons from these programs (because lessons on program expenditure are relevant), we do not exhaustively cover those programs whose funding derives from general tax revenue.

2.2 Where Are PBFs Used?[4]

PBFs have become increasingly popular internationally, and especially in the U.S. as a way to enhance renewable energy and energy efficiency investments and deliver important public benefits. PBFs are particularly important to implement in conjunction with reforms in the electric utility sector. Without early use of a PBF, EE and RE program momentum may be drastically reduced, professional expertise dissipated, and timely opportunities lost.

U.S. Experience

In the United States, PBFs are being used in 15 states to support renewable energy investments, and in 22 states to support energy efficiency programs (note that many states have PBFs for both RE and EE, so the total number of states with an EE or RE PBF totals 23). The 15 states with renewable energy programs are collecting and spending approximately US$250 million per year, while the 22 states with energy efficiency PBFs are collecting and spending nearly US$1 billion

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[3] A few entities, such as Norway, Thailand, and Vermont USA, created PBFs without any pressure from restructuring.

[4] Original documentation (e.g., legislation, regulatory rules, etc.) on some of these PBFs are available from the authors, on request. Many of these original documents, for the RE PBFs in the US, can be found at: http://www.dsireusa.org/. Many links to original EE PBF documents can be found at: http://www.raponline.org/Pubs/RatePayerFundedEE/RatePayerFundedEEFull.pdf.

per year (Bolinger et al. 2001, York and Kushler 2002). PBFs targeted at energy efficiency in large part continue utility DSM programs that have been serving customers for upwards of two decades in the US, but that were in decline due to the introduction of electric industry reform in mid 1990s. PBFs also often replaced utility administration with government or non-profit administrators, who do not face the same conflicts of interest inherent in utility administration. Table 1, below, summarizes data on state PBF funding for renewable energy and energy efficiency (data primarily comes from York and Kushler 2002).

Table 1. Summary of U.S. State PBF Funding for Renewable Energy and Energy Efficiency

State	Renewable Energy		Energy Efficiency		Administration
	million $/yr	% of revenue	million $/yr	% of revenue	
Arizona	20	0.75%	4	0.15%	utilities
California	135	0.8%	228	1.3%	RE – state agency EE – utilities
Connecticut	22	0.75%	87	3%	EE – utilities RE – state agency
Delaware	0.3	0.05%	1.5	0.3%	state agency
D.C.	TBD	TBD	TBD	TBD	city government
Illinois	5	0.05%	3	0.04%	state agency
Maine	0	0%	17.2	1.5%	state agency
Massachusetts	30	0.7%	117	2.5%	EE – utilities RE – state agency
Maryland	0	0%	portion of 34	portion of 0.9%	utilities
Michigan	0	0%	portion of 50	portion of 0.7%	state agency
Minnesota	10	0.4%	44.3	1.9%	utilities
Montana	1.8	0.3%	8.9	1.5%	utilities
Nevada	0	0%	11.2	0.5%	utilities
New Hamp.	0	0%	6.9	0.7%	utilities
New Jersey	30	0.45%	89.5	1.35%	EE – utilities RE – state agency
New York	14	0.13%	83	0.72%	quasi-governmental
Ohio	portion of 15	portion of 0.15%	portion of 15	portion of 0.15%	state agency
Oregon	9.5	0.6%	31.5	1.9%	new non-profit
Pennsylvania	portion of 13	portion of 0.12%	portion of 13	portion of 0.12%	non-profit organizations and utilities
Rhode Island	2.5	0.5%	14	2.1%	EE – collaborative RE – state agency
Texas	0	0%	80	0.55%	Utilities
Vermont	0	0%	13.1	2.6%	new non-profit
Wisconsin	2.8	0.1%	62	2.3%	state agency and third party contractors

Though excluded from the table and from this report, it deserves note that a large number of the states listed in Table 1 also support low-income ratepayer assistance programs through additional

PBFs, and some states support public interest R&D efforts. Similarly, in some additional (typically non-reformed electricity sectors) states not listed on the table, utilities continue to fund DSM programs with internal funds, collected from ratepayers but not through a clear, dedicated charge; York and Kushler (2002) estimate additional annual funding levels of ~US$375 million from this source. Finally, though an electricity-surcharge based PBF is not applied on a national level in the U.S., the federal government does use general tax revenue to support a variety of renewable energy R&D and energy efficiency programs.

Experience Outside of the U.S.: Renewable Energy

Traditional PBFs, funded through surcharges on electricity consumers or producers, appear less common outside of the U.S. Where they are in existence, they have often been established in countries that have reformed their electric industries, and that have sought to continue their public benefits programs.

With respect to renewable energy, a number of countries have established feed-in tariffs whose costs are recovered through increased electricity rates.[5] These increased electricity rates are sometimes established as defined regional or nationwide surcharges, and in other cases the extra costs are simply embedded in electricity rates but not through a dedicated charge per se. This can be one of the most effective ways of supporting renewable energy, and the success of feed-in tariffs in Germany, Spain, and Denmark is well known. While we mention this experience briefly in several places throughout this document, it is not discussed in detail. This is because we define these policies as feed-in tariffs, with the PBF used in only a supplementary fashion to spread the cost of the policy evenly over all electric customers. Nonetheless, we emphasize that China should consider a feed-in tariff, given that policy's clear success internationally, and that a PBF-like instrument might be an appropriate way of spreading the cost of such a policy.

In addition to these feed-in tariff policies, a number of other countries have also established dedicated funds for renewable energy. In many cases, these funds derive from general government revenue (and are therefore not traditional PBFs), and only in a few cases do the funds come from specified surcharges on electricity consumers or producers. Based on our review, a non-exhaustive list of examples of these various approaches is provided below (these examples largely derive from Holt 2003, but also come from Haas 2000, Moore and Ihle 1999, Milborrow et al. 1998, Haas 2003, Filgueiras and e Silva 2003, Mitchell 2000, Bolinger and Wiser 2002c, Wiser 2002, and a variety of websites)[6]. Note again that we do not define all of these examples as PBFs per se, but include the broader set of examples here for the sake of completeness.

- **Australia:** The Australian Greenhouse Office (AGO) is responsible for a number of financial incentives for the production and use of renewable energy, including: (1) Renewable Remote Power Generation Program - supporting renewable energy in remote areas; (2) Photovoltaic Rebate Program - solar power your house; (3) Renewable Energy Industry Development

[5] A feed-in tariff is a policy that allows all eligible renewable generators to receive a fixed and known price for their electricity sales.

[6] Note that a number of countries also support renewable energy R&D with government revenue sources; these programs are not discussed in this report.

(REID) - supporting the renewable energy industry; and (4) Renewable Energy Equity Fund - provides venture capital for small innovative renewable energy companies.

The Renewable Remote Power Generation Program (RRPGP), which is funded through a tax on diesel fuel for electricity production, is available to participating States and the Northern Territory to fund approved programs or projects. Potentially eligible installations are those for which renewable energy generation replaces all or some of the diesel used for off-grid electricity generation. Up to $264 million will be available over the life of the RRPGP. Program funds are now available to participating States and Territories and are allocated on the basis of the relevant diesel fuel excise tax paid in each State or Territory by public generators in financial years 2000/01 to 2003/4. The Renewable Energy Industry Development program is funded at up to approximately $4 million US over 4 years, the Renewable Energy Equity Fund is set at approximately $12 million US over 10 years, and the PV Rebate Program is funded at an aggregate $20 million US (those funds were exhausted in May 2003, however, and another US$3 million has been announced). Each of these programs is funded through general government tax revenue.

In addition to these programs, the central government funds renewable energy R&D activities with general government tax revenue. Moreover, a number of additional programs are in place at the state level. In New South Wales, for example, SEDA issues grants, loans, and equity to new renewable technologies and applications; most other states have similar, though typically smaller, programs. Again, each of these programs is generally funded by government tax revenue, not through electricity surcharges or pollution taxes.

- **Austria:** The national Electricity Act of 2000 requires provincial governments to set minimum prices (feed-in tariffs) for electric energy purchased by grid operators from eligible renewable generators (eco-plants). If the expense from purchasing the electricity at fixed tariffs exceeds the revenue from sales, the grid operator will be reimbursed for the balance between the minimum of purchase price and the proceeds achieved. The required sums are raised by a surcharge to the network tariff (paid by the end-user) that is set by the Provincial Governor. This surcharge is set annually on the basis of the additional expenses incurred in the previous year. As one example, the province of Voralberg introduced feed-in tariffs in 2001; the surcharge to the network tariff is ~0.08 Euro cent/kWh, or less than 1% of retail electricity prices. Austria, from 1992 to 1994, also operated a small but reasonably successful PV support program, emphasizing capital cost rebates, and has subsidized the investment cost of other forms of renewable energy with government revenue; low-interest loans have also been used.

- **Brazil:** The Conta de Consumo de Combustiveis (CCC), or Fuel Consumption Account, is derived from a surcharge on electricity tariffs for all consumers in areas served by the national grid. The funds are used to subsidize electric energy generation costs in isolated diesel-fueled systems in Amazonia. In 2002, CCC amounted to R$2,053 million (~$700 million US dollars). Law 9648, regulated by resolution 245/99, allows generators utilizing small hydropower, wind, solar, biomass and natural gas to use this subsidy if they are used as a substitute for fuels derived from petroleum. This incentive is effective until 2022 for isolated systems. Three renewable projects are currently reported to benefit from the CCC subsidy: a 4 MW hydropower plant, a 1.1 MW hydropower plant, and a 9 MW wood residue thermal power plant. Most of the total amount available goes to interconnected units and the incentive for renewables only applies to plants isolated from the grid.

Brazil also has a broader support scheme for renewables, called the Alternative Power Source Incentive Program (Proinfa) that establishes a series of measures favoring wind and other renewables. The most significant of these is a requirement that utilities enter into power purchase agreements for the output from renewable generators (including 3300 MW of renewables by 2006). The above-market costs of these contracts are to be covered by a fund managed by Brazil's government and by an electricity holding company (Eletrobras). The fund is derived in large part from taxes applied to energy traders, and is planned to be in place for 25 years. The details of this program, and fund, are not yet firmly established. Finally, Brazil has required its electricity distributors to dedicate a portion of their revenue to R&D activities, which may include renewable energy, and some government revenue is also used to support RE systems.

- **Denmark:** Guaranteed capital grants of 30% were offered to wind projects in the 1980s, successfully helping to launch the wind industry in that country; capital grants for other renewable energy technologies, also funded through general government revenue, continued even after they were phased out for wind in 1989. More recently, feed-in tariffs and fixed production incentive payments have been used to support renewable energy; revenue for the fixed production incentives came form the central government general funds, putting a strain on government budgets.

- **France:** Until 2000, France ran a system similar to, though much smaller than, the UK NFFO. More recently, a feed-in tariff system replaced the earlier bidding system to encourage wind power.

- **Germany:** The costs of the well-known and successful German feed-in tariff (FIT) are borne by the gird operators and charged as part of electricity rates to all customers. No dedicated fund is created. Before this program was in existence, however, Germany offered cash subsidies (on a production basis) to certain wind projects under the "250 MW Wind Program." Moreover, Germany's CHP law, established in 2000, offers CHP plants fixed incentive prices above the wholesale market rate for 10 years. The incentives are financed by a dedicated surcharge on electricity rates of 0.1-0.15 Euro cents/kWh for households, and 0.5 Euro cents/kWh for larger users (or 0.7 to 4% of retail electricity rates).

  The first comprehensive support program for PV was arguably the "1000 roofs" program in Germany, which was in operation from 1990 to 1995. A total of 6 MW grid-connected PV was installed under this program, with average governmental subsidies covering 70% of the installed cost of the systems. More recently, the government has supported the provision of low-cost loans to PV systems, with a total budget of ~$500 million US dollars. In addition to federal programs, a number of German states have also directly supported renewable energy. For example, North-Rhine Westphalia has allowed its utilities to raise customers' electricity prices by as much as 1% to pay for electricity from renewable sources. Finally, Germany apparently imposes an "eco tax" on electricity, gasoline/diesel, heating oil and natural gas.

In 2003 the tax on electricity was slated to be 4Pf/kWh. A small portion of the revenues is used to fund a special program to promote renewable energy (see http://www.iea.org/pubs/newslett/eneeff/de.pdf).

- **India:** The Indian Renewable Energy Development Agency (IREDA) is a Public Limited Government Company established in 1987, under the administrative control of the Ministry of Non-Conventional Energy Sources (MNES) to promote, develop and extend financial assistance for renewable energy and energy efficiency/conservation projects. It operates a revolving loan fund for promotion, development and commercialization of New and Renewable Sources of Energy (NRSE): solar, wind, small hydro, bioenergy, hybrid systems, and energy efficiency. Loans are made available to renewable energy projects and to renewable energy technology manufacturers, in the form of debt financing, equipment financing, lease financing, and on-lending through financial intermediaries. Since inception, IREDA has disbursed US$659 million. IREDA fills the financing gap left by financial institutions in India who do not want to lend money for renewable energy development because of the large risk involved. Funding for IREDA comes from the Indian government, from tax-free bond issuances, and from bilateral and multilateral aid organizations.

- **Italy:** Italy has most recently established a system of tradable renewable credits and quotas. Earlier, a variant of a feed-in tariff system was used, with the extra cost of renewable energy covered by a surcharge on electricity customers. The electricity surcharge has apparently been criticized in the past, however, because of concerns over government use of the funds for other activities. This earlier program has supported over 5000 MW of renewable energy and over 6000 MW of cogeneration, is estimated to cost a discounted total of 13 billion Euro dollars from 1992 – 2012, and imposed upon consumers a cost of 0.48 Eurocents/kWh in 2001 (~6% of residential retail electricity rates).

- **Japan:** Japan leads the world in installed PV capacity, with over 300 MW in place by the end of 2001. Much of that capacity has been supported through generous capital rebates offered by the New Energy Foundation, part of the Ministry of Economy, Trade and Industry. Financing and marketing programs complement the aggressive subsidy. The budget for the program is sizable – roughly $200 million US dollars in 2001 alone, and $970 million since the program's inception in 1994 – though the Japanese government has announced that the subsidies will be phased out. Also in Japan, the New Energy Development Organization (NEDO) was expected to approve subsidies for around 470 MW of wind energy projects up to March 2003. NEDO awarded 14 billion yen ($116 million US) in subsidies to privately owned wind projects in fiscal year 2001. Another 11.5 billion ($95 million) was set aside for subsidies to public sector wind projects. NEDO's budget for renewable energy projects was expected to increase to around 40 billion yen in fiscal 2002.

- **Netherlands:** Since 1996, an "eco-tax" has applied to electricity. Though the charge has changed over the years, as of July 2003, the tax equates to approximately 6 Eurocents/kWh (see energy efficiency discussion, below). As part of this sizable tax, a "MEP-levy" is to apply to all connections to the electricity grid and is to be set at approximately 34 Euro dollars per year (or ~4% of residential retail electricity rates). Funds from this MEP-levy will be used to cover the costs of the country's feed-in tariff system for RE generators; renewable electricity is also partially exempt from the eco-tax. Moreover, revenue from the tax helps fund a subsidy for RE (50% average subsidy) and EE (25% average subsidy) for households and social housing corporations. Total funds collected from the levy are expected to be 258 million Euro dollars in 2003, of which 141 million Euro dollars will be used for RE; the remainder is used for CHP and climate neutral fossil energy. This MEP levy is collected by the distribution network operators, and then passed on to the national transmission operator, who is responsible for paying the subsidy to generators. In the past, the eco-tax has been used to provide fixed production incentives to renewable energy generators. In the early 1990s, government-funded capital grants were used to subsidize renewable energy.

- **New Zealand:** The National Energy Efficiency and Conservation Strategy (NEECS), introduced in 2001, identified a number of mechanisms by which renewable energy targets might be achieved. These programs are now being expanded to include: (1) a competitive bid-in fund designed to support a range of CO2 mitigation projects, whereby any type of CO2 mitigation projects, including renewable energy, may bid for subsidy (the first round of bids is expected to be invited in mid-2003, and the source of this fund is not specified in the documents we reviewed); (2) a specific renewable energy program focusing on information, education and training, demonstration projects and general market development, funding for which is to be NZ $0.5 million in 2002/2003 ($300,000 US), rising to $2-3M in 20003/04 ($1.2-1.8 million US) and $4-7M in 2005/06 ($2.4-4.9 million US). Bids for additional resources will be made as part of the normal Government budget process.

- **South Korea:** Beginning in May 2002, the Renewable Power Generation Subsidy has been offered as a standard price for renewable energy power generation in order to support the usage of new and renewable energy sources (NRE). The extra costs imposed on utilities due to the usage of NRE, instead of fossil fuels, are paid by the government.

- **Spain**: As with many other European countries, Spain has developed a successful feed-in tariff system in which the above-market costs are recovered from all ratepayers. Spain has also used capital cost rebates to stimulate PV and other technologies.

- **Sweden:** Between 1991 and 1996, Sweden provided capital cost subsidies for wind, solar and biomass; for wind, those subsidies amounted to 35% of installed cost. After 1996, the subsidies declined, to 15% in the case of wind power.

- **UK, Scotland, Northern Ireland, and Ireland:** The U.K. Non-Fossil Fuel Obligation (NFFO) is perhaps the most well recognized PBF for renewable energy in the world. Through the NFFO, renewable generators were able to bid for above-market power purchase agreements (PPAs) in five NFFO auctions spanning from 1990 to 1998. The Department of Trade and Industry oversaw these auctions. Electricity companies were required to take power under these contracts, but were reimbursed for their above-market costs through a fossil fuel levy – effectively a "wires" charge on electricity rates. Similar mechanisms have been used in Scotland, Northern Ireland, and Ireland. The levy for the UK NFFO itself has varied in size over time, but in latter years totaled a yearly annual maximum of £150 million, equivalent to a surcharge on electricity rates of 0.9%.

More recently, the UK's £10 million Clear Skies initiative (using funds from the central government) has funded community-scale and household sustainable energy projects. The Clear Skies Initiative aims to give homeowners and communities a chance to become more familiar with renewable energy by providing grants and advice. Homeowners can obtain grants between £500 to £5000, while community organizations can receive up to £100,000 for grants and feasibility studies. The UK government has also committed itself to subsidizing offshore wind plants. Finally, the government recently (in 2001) established the UK Carbon Trust, discussed below under international EE PBF experience.

Based on this review, we conclude that experience with traditional RE PBFs outside of the U.S. is somewhat limited. Several countries do use electricity surcharges to help fund their feed-in tariff policies (either implicitly or explicitly) – e.g., Austria, Germany, Italy, Spain, and the Netherlands. As noted above, however, we do not classify these policies as PBFs in this paper, and they are therefore not discussed in any detail in the pages that follow; these approaches might best be considered a cost equalization method to recover the costs of a feed-in tariff.

As shown in the above examples, another set of countries use general government revenue to help fund renewable energy programs (e.g., Australia, Denmark, Sweden, Japan, UK). We have not reviewed these policies in detail, in part because these do not represent standard PBF programs, and they are not covered further in this paper unless they lend specific lessons of relevance to China.

A final set of countries has employed traditional PBFs for renewable energy. The most commonly mentioned such policy is the U.K. NFFO, which is no longer in operation. Other notable examples of the use of traditional PBFs for renewable energy, besides the ones in the United States, include programs in Ireland and Brazil, and to a lesser extent (because they represent hybrids of a feed-in tariff and a PBF) programs in Germany and the Netherlands (also, see Norway, below).

Experience Outside of the U.S.: Energy Efficiency

A similar diversity exists with respect to international experience with EE PBFs, other dedicated funds, or ratepayer funds to achieve energy efficiency goals. In fact, there appears to be more international experience with EE PBF funds than with RE PBFs. Below we provide a range of EE examples, but again note that not all of these examples represent traditional PBFs:

- **Belgium:** In Belgium, electricity distributors and producers have been required to set aside funds to support "Rational Use of Energy" (RUE) activities in the three regions of the country since 1996. In 1999 the distributors contributed BEF 0.01/kWh sold, resulting in BEF 441.6 million. The production sector contributed BEF 350 million. The RUE funds from distributors were used to support energy audits, thermal solar systems, heat pumps and solar boilers, relighting and CHP. The production funds were used to study sector potential to reduce GHG emissions, renewable energy activities, and promote CHP. The BEF 0.01/kWh in 1999 equates to under 0.5% of revenue; if funds contributed by producers are included, total funds equal approximately 0.5% of revenue. Apparently, EE program funding has also increased substantially since 1999. In 2000 total RUE funds were 25 million Euro. They are scheduled to rise to 37.5 million Euro in 2003. (See http://www.iea.org/pubs/newslett/eneeff/be.pdf, and http://www.odyssee-indicators.org/Publication/PDF/Belgium_r01.pdf).

- **Brazil:** Since 1998 Brazil has captured one percent of revenues of privatized electric companies for investment in energy efficiency and research and development. Power sector reform began in 1995. In 1998 the new federal regulatory agency, the National Agency for Electrical Energy (ANEEL), announced that it would require all privatized utilities to spend at least 1% of revenues on energy efficiency improvements. Utilities began proposing projects in September 1998. ANEEL sets priorities and approves projects based on a technical review by PROCEL, the national electricity conservation agency. Initially distribution utilities had to spend 25% of the funds on end-use efficiency. Ten percent had to be invested in research and development. The remainder (65%) was available for supply side efficiency improvements.

  Brazil's energy efficiency program is now known as the Program to Combat Energy Waste (PCDE). Since 2000 half the funds from distribution utilities (0.05% of revenues) have been used for end-use efficiency projects. In 2000/2001 these funds totaled about US$70million. The portion dedicated to end-use efficiency is scheduled to drop to 0.25% of revenues from 2006 forward. Presently, the other half of distribution utilities' funds are used for research and development. Half of these funds (a quarter of overall resources) are administered by utilities with oversight by ANEEL. The remaining funds are managed by a committee (CTENERG) responsible to the Ministry of Science and Technology. The funds are centralized in the National Fund for Technological and Scientific Development (FNDCT).

  Privatized generating and transmission utilities, including IPPs, are also required to set aside a minimum of 1% of revenues for a PBF. In this case, all funds are dedicated to research and development. The utilities administer half, and the other 0.5% of revenue is managed by CTENERG (see above).(See Jannuzzi 2001, Poole and Guimaraes 2003, and Harrington and Murray 2003; additional source: correspondence with Gilberto M. Jannuzzi, Professor, Universidade de Campinas, Sao Paolo, Brazil).

- **Denmark:** In Denmark, funds paid by electricity consumers have been used to achieve end-use energy efficiency through programs run by the Danish Electricity Savings Trust, a private independent entity with a board named by the Ministry of Environment and Energy, and programs run by the electricity grid companies. The Danish Electricity Savings Trust was created in 1997 by the Ministry of Environment and Energy with the objective of reducing CO_2 emissions through electricity savings in the household sector and the public sector. Since 1998 its activities have been funded by a PBF: a volume-based levy of 0.08 Eurocents per kWh, collected by distribution companies only on households and the public sector (approximately 1% of retail sales revenue). The total amount collected in 2000 was around 90 MDKK. The Trust's mission is to develop, test, and implement cost-effective instruments that make it, *simple*, *safe*, and *cheap* for consumers to acquire and use energy-efficient appliances and systems (e.g. lighting, white goods, IT equipment, and ventilation), or to convert from electric heating to district heating or natural gas. Private companies or electricity companies are invited to tender an offer to design and implement projects. The projects with the highest reduction of CO_2 emissions at the lowest cost are selected. In accordance with current Danish Supply Acts, electricity grid companies, natural gas distribution companies, and district heating companies are central players in achieving energy savings in all sectors. In recent years, the grid companies have had an increasingly important role in implementing energy savings, and to reach energy-savings targets. Activities take the form of campaigns, energy consultancy and other activities that are carried out as public-service obligations by grid companies. These activities are funded by consumers through their energy bills. (See http://www.odyssee-indicators.org/Publication/PDF/Denmark_r02.pdf, and Wuppertal 2000).

- **Netherlands:** An energy levy or "ecotax" is applied to final consumption of electricity and natural gas. The primary objective of this policy is to stimulate energy conservation by raising the price of energy for small and medium-size customers. This ecotax is collected by the energy supply companies and consequently passed on to the tax authorities. Since its introduction in 1996, the ecotax has been increased several times. The current ecotax on electricity is 6 €ct/kWh. Consumption of renewable energy is partially exempt from this tax. The Netherlands uses government revenues to support energy efficiency activities. The organization Novem is in charge of programs, which may include feasibility studies, research, and market introduction. Subsidies are available from Decision Subsidies of Energy programmes (BSE). Earlier, in 1994, there was a voluntary agreement to charge a levy of up to 2.5% on the kWh price to end-users in order to finance energy conservation measures. The levy financed RE goals, including some wind power generation, and utility-run EE programs. In the mid-1990s, the levy ranged from 0.5% to 2.5%, with an average of 1.8%. The levy generated funds that were collected and spent by individual distribution utilities. In 1995, a levy on electricity collected 132 million guilders, while a levy on gas collected 143 million guilders. Distributors could freely decide on what CO2 emission reduction activities they would spend the levy. The way that funds were spent has been criticized; in particular, the administrative structure was criticized because the utilities did not have the right incentives to reduce energy demand, and were claimed to be using the funds for "commercial" activities with insufficient oversight. (See http://www.odyssee-indicators.org/Publication/PDF/Netherlands_2002.pdf, and Slingerland 1997).

- **New South Wales, Australia:** The Electricity Supply Act of 1995, effective 1997, made reduction of GHG emissions a condition of retail electricity supplier licenses, and required suppliers to submit draft strategies to the Minister of Energy for negotiation. When emission targets were not reached, new legislation created the Greenhouse Gas Abatement Scheme, with mandatory targets for abating GHG emissions from electricity production and use. There are penalties for noncompliance. Now retail electricity suppliers have to prove they have met their abatement targets by surrendering abatement certificates that document attainment of GHG emission reductions. Certificates are purchased from accredited abatement certificate providers who conduct activities that result in reduced consumption of electricity (energy conservation and/or efficiency activities); generate electricity in ways that reduce GHG emissions/MWh; or carbon sequestration to capture carbon from the atmosphere in forests. Large electricity users can elect to reduce on-site emissions. Certificates can be traded. Retail electricity suppliers pass the certificate costs on to customers. Though not a PBF per se, this is an innovative approach to achieving energy-related goals. (See Harrington and Murray 2003).

- **Norway:** Norway has funded energy efficiency measures since the 1970's. Responsibilities for voluntary initiatives were divided among the grid companies and the national regulatory agency. In March 2001, the Storting (Norwegian Parliament) relieved other parties of efficiency and renewable responsibilities, and approved the establishment of a new public agency, fully owned by the Norwegian government, Enova SF. Enova became operational in January 2002. Enova is funded from a levy on distribution tariffs and from grants from the State Budget. In 2002 the tariff levy contributed about 26 million Euro to the budget; government grants were about 36 million Euro (the distribution levy for energy efficiency equates, by our calculation, to approximately 3.5% of retail sales revenue). The primary mission of Enova is to reduce the environmental impact of non-hydropower generation of electricity by promoting energy efficiency, renewable generation and environmentally friendly use of natural gas.
  (See http://www.odyssee-indicators.org/Publication/PDF/Norway_r02.pdf).

- **Thailand:** During the early 1990's the National Energy Policy Office (NEPO) and the Electricity Generating Authority of Thailand (EGAT) agreed that electrical energy efficiency programs, and other demand-side measures, would be funded through an electricity tariff adjustment. The programs were very cost-effective, according to EGAT. However, towards the end of the 1990's the government decided to change the funding source. Now energy efficiency, other DSM programs, renewable energy, research and development and related public benefit programs are funded through the Energy Conservation Promotion Fund. This fund is supported by a levy on petroleum products, which exceeded US$750 million in recent years. The government administers the Fund, and program funding levels must be approved every year. Compulsory programs for factories, large buildings and government facilities are conducted, as well as voluntary and complementary programs. (Correspondence with Peter du Pont, PhD., Senior Consultant for Asia, Danish Energy Management. See also http://www.eppo.go.th/inter/wec/int-WEC-TD01.html and http://www.eppo.go.th/encon/encon-fund00.html.)

- **United Kingdom:** Energy efficiency efforts in the UK are considered key components of the UK's Climate Change Programme, which is a comprehensive package of plans, programs and policies. The goals of the Programme are to help meet the UK's obligation of a 12.5% reduction in greenhouse gas emissions (Kyoto Protocol), and move towards the Government's domestic goal of a 20% reduction in carbon dioxide emissions. Although many efficiency programs in the UK are funded with government revenues, the following examples describe the use of ratepayer funds for energy efficiency programs.

  The first key program is the Climate Change Levy (CCL). The CCL, which began in April 2001, is an energy tax on the non-domestic sector (industry, commerce, agriculture and public sector). Rates are based on the energy content of different energy products, equivalent to 0.07pence/kWh for LPG; 0.15pence/kWh for gas and coal, and 0.43 pence/kWh for electricity. Energy intensive sectors with binding commitments (negotiated with the government) to meet energy efficiency or carbon savings targets get up to 80% discounts on CCL rates. Electricity generated from 'new' renewable sources of energy or 'good quality' combined heat and power plants is exempt from the levy. Revenue from the levy was expected to be around 1 billion pounds in 2001/2002. All revenues raised are recycled to the non-domestic sector. Most CCL revenues are returned through a 0.3% reduction in employers' National Insurance contributions. However, CCL funds also support the Enhanced Capital Allowance Scheme (ECA), worth up to 200 million pounds over two years.

The ECA is managed by the UK Carbon Trust, an independent, not-for-profit company set-up by the government. The ECA gives 100% capital allowance against taxable profits in the first year for investments in any of the energy efficiency technologies on the list published by the Carbon Trust. The Carbon Trust will also use about 50 million pounds/year from CCL funds to conduct Carbon saving programs for business and industry. Programs supported by these funds and other sources include developing and delivering independent information and impartial advice for large energy users, developing and promoting programs (including a loan program) to encourage business to invest in qualifying energy efficiency measures, investing in the development of low carbon technologies in the UK, and coordinating and brokering between developing technologies and funding partners.

The second key program is the Energy Efficiency Commitment (EEC). From 1994-2000, under the Energy Efficiency Standards of Performance Program, electricity suppliers (and, later, gas suppliers) were obliged to achieve specified energy savings in the domestic and small business sector using a special revenue allowance or PBF. In 2000 the allowance was 1.2 pounds per customer per fuel per year. The Utilities Act 2000 resulted in a new program, the EEC. This program increased the energy savings goals three-fold. It requires major electricity and gas suppliers to meet environmental targets by focusing on domestic customers, with an emphasis on elderly and low-income households. Suppliers can pass on to customers as much of the energy savings costs as makes good business sense in the newly competitive supply market. Expenditures are estimated to be up to 3.60 pounds per customer per fuel per year, resulting in close to 500 million pounds over the three-year program period.

Again, many of the examples above cannot be considered to be traditional PBFs. While this experience is clearly varied, notable examples of traditional PBFs in support of energy efficiency (used either in the past, or present) include: Belgium, Brazil, Denmark, Netherlands (in the past), Norway, Thailand and the UK (primarily in the past, but to a lesser extent currently).

3. Why Have PBFs Been Established?

3.1 Historical Overview

For many years in the United States and some European countries, regulated utilities with monopoly franchises chose to and/or were required to deliver public benefits in addition to electricity services. These included investments in cost-effective energy efficiency, renewable resource development, low-income customer support, and research and development. Utility investment resulted in millions of dollars in efficiency savings, a cleaner environment, and a move towards universal electric service.

Even though these approaches had clear benefits for society, there was often a perceived or real tension between long-term societal interests and some of the primary interests of the utilities, e.g. making money for shareholders or reducing short-term rates. Regulators used a variety of strategies to minimize these tensions. Utilities were allowed to recover the costs for mandated public benefit programs through rates, and regulators ensured that the burden of these costs was appropriately shared among all electricity customers. In some cases revenues were decoupled from sales so that electricity load reductions due to efficiency would not negatively impact utility profits. In other cases utilities were allowed to recover revenues lost due to decreased sales. Some utilities were given incentives or shared savings for achieving public benefit goals. As a result, the costs for utilities to deliver these efficiency, environmental and social benefits were included in regulated electric rates.

As many U.S. states and European countries moved to restructure the electric utility system into a competitive market, it became obvious that the delivery of public benefits would be less likely. At least in the near-term, a utility that did provide public benefits would be at a competitive disadvantage. A competitive market increases the risk and hence decreases the likely investment in capital intensive, long-lived resources such as renewables and energy efficiency. Utility expenditures on R&D are less likely due to the long payback period. There is no incentive to provide low-income services since there would be no profit-making opportunities.

Policymakers created PBFs as broad-based, competitively neutral, non-bypassable funding sources for these important public benefits.

3.2 Why Support RE and EE Markets?

Reinforcing the historical overview above, the rationale for the creation of PBF funds to support RE and EE markets has been reasonably uniform across different states and countries, and includes:[7]

Renewable Energy and Energy Efficiency Advance the Public Interest: Renewable energy and energy efficiency investments have long been a target of government policy and support. This is because of the unique and valuable services provided by renewable energy and energy

[7] See Finamore et al. (2003) for a specific description of the benefits of EE for China.

efficiency to society, and because of the sizable remaining potential for both renewable energy and energy efficiency.

- Energy efficiency is often the lowest cost resource to individuals and society as a whole. It can allow consumers to obtain the energy services they need at a lower cost than new or existing generation, transmission and distribution systems.
- While renewable energy is sometimes more costly on a first-cost basis than traditional forms of generation, the prospect for continued and rapid declines in cost is alluring. On a longer-term basis, and in niche applications in the near-term, renewable energy will lead to reduced energy costs.
- Energy efficiency and renewable energy, by helping to reduce energy costs, can improve the economic competitiveness of the economy.
- Energy efficiency and renewable energy improve the security and diversity of energy supply.
- Energy efficiency and renewable energy improve the environment and public health, reduce waste, and conserve additional resources such as water and fossil fuels.
- Energy efficiency and renewable energy can create employment opportunities, and improve economic development.
- Both energy efficiency and renewable energy investments have often proven essential in restructured electricity markets to avert or reduce the incidence of market power by electricity generators and to lower wholesale power market prices.

Electricity Reform Puts at Risk Advancement of EE and RE Markets: Electricity sector reform can put at risk the continued advancement of energy efficiency and renewable energy markets. Unless specifically designed to do so, competitive electricity markets are unlikely to place value on the public benefits that renewable energy and energy efficiency provide. In fact, the introduction of electricity competition often results in investment decisions that are driven by short-term considerations, not long-term value, putting capital intensive RE and EE investments at risk. Utilities often cut discretionary spending to ensure their competitiveness post-reform, and, under competitive electricity systems, regulators may no longer be free to simply require vertically integrated utilities to pursue EE and RE activities, without similar requirements on other market players. Moreover, the uncertainty that often accompanies even the consideration of electricity reform can in itself severely damage the prospects for viable and stable renewable energy and energy efficiency markets.

Previous investments in building renewable energy and energy efficiency markets therefore are often at risk as the electricity sector is reformed. For example, as restructuring spread around the U.S. in the later half of the 1990s, spending for energy efficiency in the form of utility DSM programs fell dramatically, from a peak of over $1.6 billion in 1993 to about $900 million by 1997 (York and Kushler 2002). This rapid drop resulted in large part from the elimination of requirements to conduct integrated resource planning and implement associated DSM programs. PBF programs have since helped stem this tide. Total energy efficiency spending increased from $900 million in 1997 to $1.1 billion by 2000 (York and Kushler 2002, Nadel and Kushler 2000). Similarly, in the U.K., the utility regulatory body initially believed that market forces would create demand for energy efficiency services, so no special provisions for EE were established at first. By 1992, three years after restructuring in the UK began, it became apparent that this was not happening, and the UK government established the Energy Savings Trust funded by a small charge on electric distribution rates. A similar progression occurred in Norway, resulting in part in a small transmission surcharge earmarked for energy conservation information. For a detailed discussion of the impacts of different types of electricity reform on EE markets, see Vine et al. (2003).

There are Serious Market Barriers to the Creation of RE and EE Markets: It is widely recognized that serious market barriers and market failure constrain energy efficiency and renewable energy markets. Some of these barriers include: (1) high information or search costs, (2) performance uncertainties, (3) hassle or transaction costs, (4) access to financing, (5) organizational practices or custom, (6) misplaced or split incentives, (7) product or service unavailability, (8) environmental externalities, and (9) regulatory mis-pricing (Eto et al. 1998). These barriers ensure that the private sector alone will be unable to produce the socially optimal amount of renewable energy and energy efficiency investments, and that a large, untapped potential for RE and EE exists. Just in Europe, it has been estimated that overall electricity savings of 15-20% could be achieved with paybacks of 3 years or less (Didden and D'haeseleer 2003). Though electric reform may alleviate barriers to EE and RE, to some degree and over time, it will not immediately or significantly reduce these barriers (Eto et al. 1998, Vine et al. 2003).

3.3 Advantages and Disadvantages of a PBF

Based on international experience, some of the specific advantages of PBF funding, relative to other forms of funding support for renewable energy and energy efficiency, include:

- A PBF can be applied regardless of the structure of the electricity sector – in regulated markets, competitive markets, and in markets in transition. While traditional PBFs are most commonly applied in restructured market contexts, there are numerous examples of the use of PBFs in still-regulated, monopoly markets as well.
- A PBF can be established through a fair and non-discriminatory funding mechanism. By applying the PBF charge on a volumetric $/MWh basis to electricity rates, for example, all electricity consumers will pay a fair portion of the costs of the PBF.
- A PBF can be established on a regional or national scale, ensuring that the scope of the PBF is consistent with the geographic size of EE and RE markets. EE and RE markets are often regional or national in scope. For example, high-efficient clothes washers can be sold nationally. To support markets for such products, it may be best to develop regional or national EE and RE support programs. PBFs are well suited for that purpose because they can be applied on a national or regional basis.
- There are multiple sources from which PBF funds might be collected (e.g. taxes on pollution, surcharges on electricity rates, etc.), with the selection of a funding source dependent on the goals and the institutional and political context of the country in which it applies. Accordingly, the source of PBF funds can be tailored to the context of the country in question.
- A PBF offers maximum flexibility in the use of the funds, allowing the fund administrator to target unique opportunities to support renewable energy and energy efficiency as they arise. Once the funds are collected through a PBF, the administrator can have great flexibility in the use of those funds to target uniquely attractive market opportunities for EE and RE. Some

other forms of RE and EE policies do not offer the same degree of flexibility. A PBF can also be used in a traditional fashion to support renewable energy and energy efficiency projects directly, or can be used to cover the cost of compliance with other renewable energy and energy efficiency policies (e.g., feed-in tariffs or an RPS for renewable energy). The PBF is therefore a very flexible tool for supporting RE and EE markets.

- The cost of a PBF can be fixed and known in advance. Because the PBF level can be established in advance, the specific costs of the policy are known. This can be beneficial politically.

Relative to other types of policies, international experience also shows that PBFs have certain potential disadvantages:

- The public, and policymakers, may be sensitive to the fact that a PBF is sometimes viewed as a new "tax." While we do not strictly agree with the view of a PBF as a tax, it is sometimes viewed in those terms. Raising electricity rates can sometimes prove challenging, even if the benefits strongly outweigh the costs.
- The administration and oversight of a PBF can sometimes prove challenging, and can require a significant level of dedication by the government. When any fund is established, spending those monies can become politically influenced. Establishing a strong administrative structure that is immune to such influence can sometimes be difficult.
- Once the PBF is established, policy makers may lose sight of the short-and long-term energy resource value of the programs, as well as the economic and environmental benefits, and begin to regard the PBF as a public welfare program.
- Once collected, PBFs are sometimes subject to political attack or re-appropriation for other governmental purposes. Ensuring that the funding source for a PBF, and the PBFs programs, are stable and durable can prove especially difficult. We address this issue further in a later chapter of this report.
- The existence of a PBF often does not eliminate the need for other, complementary renewable energy and energy efficiency policies. Again, this issue is covered in greater depth in a later chapter of this report.

4. Mechanisms for Collecting the Funds

4.1 Fund Collection Options

At least three sources of funds have been used to establish PBFs internationally.

- **Electricity Surcharge.** The most common source of funds in the U.S., where PBFs are in widespread use, is the establishment of a small surcharge on retail electricity rates, sometimes called a "wires" charge (all of PBFs listed in Table 1 are of this type). This surcharge typically applies on a cents/kWh basis to all retail electricity sales, thereby ensuring that funds are collected on a fair and non-bypassable basis. In other cases, funds are collected as a percent of retail electricity sales revenue. Some PBFs are collected through fixed monthly or annual charges per customer, which may vary by customer sector. The charge is most commonly placed on distribution service, but can also serve as an adder to transmission or generation rates.
- **Pollution Charge.** In other instances, funds can be collected through pollution levies or fees that are applied to electricity generators or utilities. This has so far been a relatively uncommon source of funds for PBFs internationally, but may be employed increasingly as environmental externalities begin to be internalized.
- **Tax Revenue.** While not specifically defined as a PBF in this report, the traditional source of revenue for RE and EE incentives has been central or regional governments via either general tax revenue or through special taxes. This has been popular in a number of countries, though maintaining stable levels of funding has proven challenging.

4.2 International Experience

Each of these sources of funds has been used internationally. Electricity surcharges on distribution rates have been most common in the U.S., where such surcharges regularly fund EE and RE programs. Electricity surcharges (either on distribution rates or applied to generators or transmission service) have also been employed in other countries to help fund RE and EE programs. In Belgium, Brazil, Denmark and Norway, a charge per kWh or percent of revenue is used to fund EE activities. Denmark, New South Wales, Australia, Japan and the UK obligate electricity suppliers to achieve goals through EE and/or RE activities; although a specific PBF is not mandated, consumers ultimately fund these programs through rates. For RE programs, as discussed earlier, a number of countries have applied explicit and implicit electricity surcharges to cover the costs of feed-in tariffs. Additionally, there are several examples of more traditional PBF funding from electricity surcharges: the UK offers the most commonly noted example, but programs in Ireland and Brazil, and to a lesser extent Germany, the Netherlands and Norway have been funded in similar ways.

Pollution charges have been a far less common way of collecting funds to directly support RE and EE investments. The Climate Change Levy in the UK, which (in small part) directly supports commercial and industrial EE and RE, could be considered a pollution levy since it is focused on carbon-based energy production. The petroleum levy in Thailand, which supports efficiency and renewable energy efforts, could be perceived as a pollution levy or a dedicated tax. “Eco-taxes” are increasingly used in Europe to steer energy consumption towards more efficient and less-polluting behavior. Generally, the tax revenue collected from these sources add to the general fund, however, and the general fund supports RE and EE programs. Outside of a very limited effort in the UK and the petroleum levy in Thailand, we have not identified any other countries in which a pollution charge per se has been used to fund a PBF to date, though we expect that this may become more common with time. In fact, if the primary policy justification for RE and EE is a reduction in pollution from electricity generation, then a pollution tax may be the most appropriate mechanism for collecting the funds.

Tax revenues have been a traditional and significant source of incentive support to RE and EE in the United States, the countries of the European Union, and most of the countries mentioned in Chapter 2.

4.3 Lessons Learned

Both a dedicated electricity surcharge and a dedicated pollution charge will result in end-use electricity customers contributing to the PBF. There are some strong advantages to this approach to fund collection over the use of general or targeted tax revenue.

- First, electricity surcharges and pollution charges are fair. As Eto et al. (1998) write: “The environmental consequences of electricity generation are significant, and electricity customers have a unique responsibility for the uninternalized consequences of their purchase decisions.” The collection of funds for a PBF directly from electricity consumers is consistent with this responsibility. Similarly, the collection of funds directly from polluting generators (and indirectly, therefore, from end-use customers) is also fair.
- Second, an explicit charge, if properly structured, helps ensure that all energy consumers, regardless of where they obtain their power, pay for the EE and RE programs that benefit them. Similarly, an explicit charge on all consumers removes incentives for customers to try to avoid paying the cost by switching electricity suppliers, and thus receiving the benefits for EE and RE without paying for them.
- Third, the stability and permanence of a PBF may be increased if a dedicated source of funds is used, suggesting that electricity rate surcharges or pollution charges may be the preferred source of funds. Funds that come from the general tax revenue of the central or provincial government can and have also been used, but these funding sources are often subject to year-to-year pressures on government funds for other purposes. In fact, there are several international examples (e.g., Italy and Denmark, among many others) in which government funding sources did not endure due to the financial difficulties of the government. Regardless of the funding mechanism that is used, funds should be collected in a way that is equitable and non-bypassable: ideally, all end-use electricity customers would contribute to the PBF.

If an electricity surcharge is used, an additional consideration is whether the charge should be established on a volumetric basis (cents/kWh or as a percent of revenue) rather than as a fixed charge per user (fixed $ per year for each customer class). The advantages and disadvantages of these different approaches are discussed in Eto et al. (1998) and Wuppertal et al. (2000). A volumetric charge is proportional to the energy consumed. This is consistent with the ‘polluter pays' principle and with efforts to internalize external costs, which are primarily dependent on the amount of energy used. A fixed charge penalizes the small consumer, since the charge is a higher percent of a small bill. A fixed charge also removes proportionality to energy consumed, distorts the price of energy, and keeps the marginal price of each kWh lower. On balance, we find the advantages of a volumetric charge to be persuasive.

5. Setting the Level and Duration of the PBF

Ultimately, setting the amount and duration of a PBF is almost always a political decision. International experience suggests that determining the amount and duration of funding for a PBF is among the most contentious decisions associated with establishing a PBF. This has been the case in U.S. states, and in Europe – rarely is the charge based on an explicit cost-benefit evaluation (see, e.g., Didden and D'haeseleer 2003). For example, it is our experience that the cost-effective energy efficiency potential in any state or country is virtually always far greater than what can be accomplished with the resources set-aside in PBF funds. In Vermont USA, which has one of the highest PBF rates for EE in existence, it was still found that "Vermont needs to spend three to four times as much money as is currently devoted to the [PBF] budget to achieve the [economically achievable] potential energy efficiency savings shown in the …report" (Docket 6777 Vermont Public Service Board Order 12/30/02). Accordingly, with PBF funds, it is generally true that they should be established as high as is politically feasible.

5.1 Funding Level

While politics will undoubtedly be a factor in setting the level of a PBF, the level of expenditure should optimally be set considering overall policy goals and objectives. Some of the factors to consider include: (1) how well the private market is functioning for EE and RE, (2) the current trends in electricity prices, and (3) the potential for public benefits beyond what the private market is likely to do, and (4) the program designs that have been proposed? (Eto et al. 1998). The level of funds for the PBF can then be established based on a careful review of the cost of EE and RE investments, the achievable potential of those markets, and an evaluation of the funding needed to achieve current policy objectives.

- **U.S. Renewable Energy and Energy Efficiency PBF Experience:** Looking at experience in U.S. states with PBF funds, we see that PBF funds for *renewable energy* are typically set at up to 0.75% of retail electricity sales revenue on an annual basis, while *energy efficiency* PBFs are funded at up to approximately 2.5% of retail electricity sales revenue (the national average level of funding for energy efficiency among all U.S. states is 0.5% of revenue). In those U.S. states with PBF funds, the combined funding for renewable energy and energy efficiency often averages 1-3% of total retail sales revenue. At an average retail electricity rate of 10 (US) cents/kWh, this collection amount totals 0.1-0.3 cents/kWh.

- **International Renewable Energy PBF Experience:** The few international PBFs outside the U.S. that have focused on RE have often been more sizable than those used in the U.S. For example, the UK NFFO was funded at up to 0.9% of retail electricity sales revenue. The PBF used in one state in Austria to fund its feed-in tariff is set at just below 1%, while Italy's electricity surcharge in 2001 was set at approximately 6% of retail electricity rates, and the surcharge in the Netherlands totals approximately 4% of retail electricity rates. Germany's CHP PBF adds 0.7-4% to retail electricity rates, while individual PV programs run on a local level also may add up to 1% on retail electricity rates; Germany's successful feed-in tariff adds significantly more to rates. In many of these cases, however, the PBF is used to fund a feed-in tariff, so is not perhaps directly comparable to U.S. PBFs, which average 0.75%.

- **International Energy Efficiency PBF Experience:** Brazil's PBF for energy efficiency is set at 1% of electricity sales revenues, with half of that available for energy efficiency applications, and the other half for technology development. In Belgium, electricity distributors reportedly contributed BEF 0.01/kWh in 1999, which equates to well under 0.5% of revenue; if funds contributed by producers are included, total funds contribute near 0.5% of revenue. Apparently, EE program funding has also increased substantially since 1999. In Denmark, since 1998 EE programs have been funded by a PBF: a volume-based levy of 0.08 Eurocents per kWh, which equates to approximately 1% of retail electricity sales revenue. In the Netherlands, in the mid-1990s, a PBF was used to support RE and EE investments, and ranged from 0.5% to 2.5%, with an average of 1.8% of retail sales revenue. In Norway, the distribution levy for energy efficiency equates, by our calculation, to approximately 3.5% of retail sales revenue.

In sum, international experience shows a significant range of PBF funding. PBFs in U.S. states for RE and EE often range from 1% to 3% of retail sales revenue. International experience appears consistent with – though significantly more variable than – this level.

5.2 Funding Duration

In terms of the duration of PBF funds, it is widely recognized internationally that energy efficiency and renewable energy markets will only be transformed with significant effort and staying power. A timeline that is too short does not inspire confidence, commitment or investment in the new markets and technologies needed to lead to flourishing RE and EE markets. If the duration of the fund is too short, new funding decisions may have to be made before program results are available for evaluation.

As a result, PBF funds are generally established with lengthy durations to ensure that they have the desired effect. In fact, it is not uncommon for PBFs to have no defined end-date, but instead to be established on a permanent basis. When end-dates are established, they are often 5-10 years from the date of PBF origination, and an expectation for funding renewal is common even after the end-date is reached. In still other cases, PBFs are created with a pre-defined review date, at which point continuation of the policy will be evaluated (Kushler and Witte 2000). In considering whether PBF funds should be continued at that point, Eto et al. (1998) recommend that certain criteria be considered:

- Have programs been effective in accomplishing their specified objectives?
- Are these objectives appropriate for the future or should they be modified?
- Are the programs cost effective – are the benefits greater than the costs?
- Would continued operation of these programs result in increased public benefits?
- Has a vibrant market for RE and EE emerged that will provide adequate benefits to all customer groups, or is continued policy support necessary?

5.3 Defending and Protecting the PBF

Though PBFs are generally established as long-term, dedicated funding sources, there is no question that PBFs are also often frequently subject to political attack or fund re-appropriation. A public benefit fund should generally be dedicated to serving public interest purposes in the electricity sector, and to the extent possible should be shielded from other political uses. A key risk of PBFs, as with any special fund, however, is that a PBF entails the collection of significant sums of moneythat can be an attractive target of politicians if and when other government budgetary gaps exist.

In a number of U.S. states, for example, PBF funds have been partially re-allocated to fill state general fund budgetary gaps; this is true in Maine, Wisconsin, Massachusetts, Ohio, Connecticut, and Rhode Island, among others. In fact, based on a survey of renewable energy PBF administrators in the U.S., Wiser et al. (2003) find that a key challenge facing clean energy funds is the risk of ongoing political interference and funding re-allocations.[8] International experience provides a similar set of examples: the government of Italy has been charged with using its RE PBF in part for other purposes, and there is little doubt that PBFs funded with government tax revenue have been especially prone to funding fluctuations. In Brazil, half of the relatively small amount of funding for direct energy efficiency applications is allocated for use by the utilities for their own supply-side efficiency investments. An noted by some observers: "There is no justification for including this kind of activity in a public benefits wire charge, since measures to reduce losses or increase load factor are of direct and obvious economic interest for a profit seeking utility" (Poole and Guimaraes 2003).

What can policymakers do to reduce the chances that a PBF is re-dedicated for other purposes?

- **Design Effective Programs**: The single most important way to reduce the chances of a funding raid is to design successful RE and EE programs that provide substantial social benefits to the jurisdiction in which the fund is dedicated.
- **Minimize Fund Carryover**: If at all possible, PBF administrators should allocate funds in the same year in which those funds are received. A large balance of unused funds can be an attractive target for politicians.
- **Demonstrate the Success of the Programs**: An important goal of program evaluation should be to demonstrate the successes the PBF is achieving to policymakers. Accounting audits should also be conducted to ensure that funds are being put to good use.
- **Use a Dedicated Charge:** A surcharge on electricity rates or a pollution charge that is specifically intended to support RE and EE is likely to be more resistant to funding raids than PBFs whose funds are generated from general government revenue sources.
- **Build Programs Collaboratively:** PBFs should be designed collaboratively, with a wide variety of stakeholders having a role in defining how the PBF will be designed and how the funds will be spent. This will help build support for the PBF and ensure a strong constituency that is opposed to any reallocation of the PBF funds.

[8] / Legislative language that authorizes the funds only for specific purposes (as in California) can be helpful but do not prevent the government from 'borrowing' the funds under an indeterminate repayment schedule, or altering the legislation to allow a broader re-appropriation of funds.

We return to some of these issues in later chapters of this report.

6. Models for Fund Application and Distribution

6.1 Models for the Application of RE and EE PBFs

Based on our review of international experience, we observe that different jurisdictions have used different general models for the application of PBF funds to support RE and EE programs. Which model a fund selects affects, in large part, the incentive types that are used (see Section 6.2) and the specific programs that are developed and implemented (see Chapter 7).

Renewable Energy

While each jurisdiction differs, and many jurisdictions incorporate elements of each model to some degree, Bolinger et al. (2001) observe that PBF programs for RE can be categorized into three different models:

- **Project Development Model** – Using financial incentives such as production incentives and grants to directly subsidize and stimulate renewable energy project installation. Most PBFs use this model, at least to some degree. The focus is largely on installing both utility-scale and distributed generation renewable projects in as cost effective a fashion as is feasible. The funds in this category have or are likely to provide direct financial incentives to large-scale renewable energy development, as well as customer-sited distributed generation projects. For the most part, these PBFs utilize production incentives, buy-downs, or other forms of grants as a means of distributing funds, rather than loans or other investment vehicles.
- **Industry and Infrastructure Development Model** – Using business development grants, marketing support programs, R&D grants, resource assessments, technical assistance, education, and demonstration projects to build renewable energy industry infrastructure. Many funds engage in these activities, at least to some degree, and these are likely to be of most value where an existing renewable energy market infrastructure is lacking or under-developed.
- **Investment Model** – Using loans, near-equity and equity investments to support renewable energy companies and projects. In the U.S., the PBF programs in Connecticut and Pennsylvania (and to a lesser extent Massachusetts) are using this model in which funds will be disbursed in part through loans, near-equity, and equity, as opposed to traditional grants, buy-downs, or other "subsidy"-based programs. These funds will actively seek private sector co-investment opportunities in order to leverage their impact. Accordingly, these funds emphasize the creation of "sustainable" renewable energy markets, and believe that the best way to accomplish this objective is to invest directly in companies or projects.

Which model a jurisdiction uses appears to depend in part on the goals of the fund, the size of the fund, the renewable resource potential, the strength of the renewable energy industry, and the organization selected to administer the fund. We offer this categorization with two important caveats. First, we note that most funds do not perfectly fit the mold of a particular model; most have remained at least somewhat flexible in their implementation, perhaps adopting elements of each of the three models. Second, the models themselves are not mutually exclusive and potentially overlap in certain areas. For example, one way to develop the renewables industry infrastructure is by investing seed capital in budding renewable energy companies.

Energy Efficiency

Energy efficiency programs, on the other hand, generally fit within the continuum of "resource acquisition" to "market transformation."

- **Resource Acquisition:** Historically, EE programs have most frequently been designed with the objective of maximizing immediate EE savings given the funds at hand: this is called resource acquisition. Using this goal signifies a philosophy that energy efficiency is a resource much like any other electricity generation resource. EE programs designed to meet the resource acquisition goal are generally directed at finding and encouraging the most cost effective energy efficiency investments. Considering EE as an immediate energy resource places emphasis on programs that can achieve efficiency gains in a relatively short period of time and in which the savings can be readily measured with some precision over the life of the EE measure. Programs that fund the incremental cost of building a home or commercial building in excess of EE standards, or that pay rebated to change the type of light bulbs or to upgrade heating and air conditioning systems are examples common to resource acquisition. In fact, programs that have been developed to serve the resource acquisition goal have frequently relied on customer rebates for EE equipment.
- **Market Transformation:** A more recently stated goal of PBF-funded EE programs is that of market transformation. This goal is based on the understanding that a great deal of cost effective EE does not occur because of certain barriers in the markets for EE goods and services. Market transformation programs seek to understand what the barriers are for a specific EE device, appliance or process and use funds to permanently alter or remove those barriers so that the EE market will function on its own in the future without ongoing public support. A transformed market, according to this approach, is one in which the market barriers to the adoption of cost-effective energy-efficiency products and services have been reduced to the point where efficient goods and services are normal practice in appropriate applications. If these changes are self-sustaining over time (i.e., without the need for continued intervention), then the market has been *fully* transformed. Market transformation programs therefore seek to change behavior over an entire market sector. This can take time, and changes rarely occur quickly. Quantifying the specific impact of these programs has also proven more difficult.

At times, the objectives of serving under-served market (low-income customers) or maximizing environmental benefits have also been significant priorities.

As a general matter, it is often hard to distinguish among these multiple goals, and many EE programs may have the effect of serving multiple goals simultaneously. Reliance on market transformation concepts clearly holds great promise for improving the cost-effectiveness of programs. Yet, as noted by Eto et al. (1998), experience with programs that have had substantial market transformation effects remains somewhat limited. Furthermore, no one has claimed, on the basis of these programs, that further intervention in these markets is no longer warranted. Commonly, once one level of efficiency becomes common practice (e.g., efficient magnetic fluorescent ballasts), higher levels of efficiency (e.g., electronic fluorescent ballasts) are promoted. In other words, few if any markets can be shown to have been *fully* transformed. It is therefore dangerous to believe that markets are easy to transform. As a result, PBF funding dedicated towards market transformation appears to require a duration as long, or perhaps longer, than specific resource acquisition programs.

6.2 Incentive Types

Once a PBF is collected, a large number of RE and EE programmatic activities can be supported (some of the most common programs are discussed in the next chapter). To help fund those activities, a range of incentive mechanisms exist, including:

- **Up-front capital grants:** grants provided to the owners of RE or EE installations (whether an end-use consumer, or a larger facility), or grants offered to support general infrastructure development (e.g., resource studies, training, etc.).
- **Contract for services:** incentives provided in the form of a grant, but only paid based on services delivered and milestones met over time.
- **Up-front rebates**: rebates generally offered to end-use customers automatically upon the purchase of a RE system or EE device.
- **Production incentives:** incentives offered on the basis on delivered (RE) or saved (EE) kilowatt-hour production.
- **Low-interest loans:** loans at attractive interest rates made available to RE and EE companies, or to consumers purchasing RE or EE devices.
- **Venture capital investments:** debt or equity investments provided by the PBF to RE or EE companies or projects.

6.3 General Fund Disbursement Options

Once a programmatic model and incentive types have been selected, yet another decision relates to how funds will actually be distributed by the PBF administrator. Generally, one of three options must be selected:

- **Competitive solicitation**, in which the administrator issues a request-for-proposals to solicit bids by potential suppliers of EE or RE services. Winners of the solicitation may have the lowest costs, be most likely to deliver results, and/or have the strongest capabilities. Such solicitations may be very rigid when the fund administrator knows exactly what they want, or may instead be relatively open-ended to solicit creative ideas from the private sector. In all cases, such solicitations seek to maximize competition and lower costs.
- **First-Come,** in which case a fixed incentive is available to any and all eligible projects until the funding limit is reached. This approach may be best used when a large number of incentive payments are to be made to a large number of end-use customers, and encouraging competition among these customers entails substantial transaction costs (e.g., appliance rebate programs, or programs to buy-down the cost of small PV systems). It may also be important where the stability of a program and market is essential to achieving industry strength and low-cost finance (e.g., initial efforts to grow large-scale RE and EE markets, such as via fixed production incentives or feed-in tariffs).
- **Bilateral Negotiation with Unsolicited Proposals:** A final approach is to negotiate with individual project proposals as they are offered. Because this approach does not offer the

benefits of competition, and can be subject to political tinkering and influence, it should be avoided in most circumstances.

As a general matter, competitive solicitations for performance-based incentive awards should be emphasized by PBF administrators in order to maximize competition and allow for effective oversight of the actions of the administrator. The benefits of defined competitive solicitations are clear:

- they help focus fund activities and, as a result, can assist the fund in achieving its goals in a more efficient, orderly, and prudent fashion;
- they encourage competition for funds, potentially lowering costs while increasing quality and likelihood of success;
- they result in an open and less politically sensitive proposal selection process; and
- they reduce administrative burdens and complications relative to bilateral negotiations, because they create a more defined and open decision process than if bilateral negotiations are used (note that a first-come process would be even less administratively burdensome than a competitive solicitation).

Fixed rebates or incentives offered on a first-come basis may also be employed, especially when a large number of smaller awards are expected (e.g., appliance rebate programs, or PV buy-down programs), or when market stability is a must. Bilateral negotiations with those that provide proposals that have not been solicited should generally be avoided, unless they represent extraordinary one-time opportunities. The example of Italy provides a good example for this point. Until recently, Italy had a system in which an electricity surcharge was used to collect funds in order to cover the above-market cost of the country's feed-in tariff. Contracts to receive the feed-in tariff price were rationed, however, in a non-transparent process. The end result was that facilities owned by the electricity utilities were favored, resulting in complaints of favoritism and unfair selection procedures (Lorenzoni 2003). For additional information on the choice between different fund disbursement options, with specific reference to U.S. RE PBFs, see: http://eetd.lbl.gov/ea/EMS/cases/Competitive_Solicitations.pdf

7. Common Program Types

7.1 Renewable Energy Programs

Historically, the most common ways of supporting renewable energy through special funds (especially those collected from general government revenue) have been through capital grants to renewable energy installations and through the support of research, development and demonstration programs. More recently, a wider variety of innovative program types have been developed and implemented in conjunction with PBF funds. Some of the most common program types include the following:[9]

- **Fixed Production Incentives:** Several countries have offered and continue to offer fixed production incentives, generally to utility-scale, grid-connected renewable energy installations. These programs offer a fixed incentive, denominated in $/MWh, which is additional to electricity sales revenue and is provided for a known duration to either all eligible renewable energy projects or to projects that are pre-screened by the administrator (perhaps up to a cap in funding levels). Few examples of such programs exist in the U.S., but as noted in Chapter 2, Denmark has used such a system in the past (funded by central government revenue), Germany has applied this approach to CHP funding, and the Netherlands has previously used this approach (funded through an electricity surcharge). In some ways, this approach is a hybrid of a PBF and a feed-in tariff.
- **Auctioned Production Incentives or Electricity Contracts:** Within the last 10 years, a number of countries have instead opted to auction off production incentives, whereby those projects requiring the least incremental "subsidy" are selected in the auction. These programs generally hope to achieve cost reductions over time as competition drives down the needed production incentive; this is in contrast to fixed production incentives, discussed above. U.S. states that have used this approach include California, Pennsylvania, and New York. Related, other jurisdictions have opted to auction off electricity contracts whereby the least cost projects are selected, and the "above-market" costs of the contracts are paid for by a PBF. The UK NFFO, as well as related policies in Ireland, Northern Ireland, Scotland, and France, have all used this approach, as has the state of Oregon. Brazil plans to use this approach in the future.
- **Capital Grants and Rebates:** Another common approach is to provide up-front capital grants or rebates for renewable energy installations. Such grants for large renewable projects were once common, often funded by general tax revenue (see, e.g., examples of Sweden, Denmark, and the United Kingdom in Chapter 2) and by multilateral and bilateral lending institutions. These types of programs are now increasingly rare, however, because they offer fewer incentives for project performance than do production-based payments. Rebates for customer-sited PV and other distributed renewable energy projects (e.g., small wind, digesters, etc.) have become more common, however, because these programs target a key barrier to these RE applications – up front cost. Some of the most significant "buy-down"

[9] / We do not discuss here another common and effective option for RE – the use of PBFs to fund the above-market cost of feed-in tariff policies. While this has been shown to be an effective approach, and should be considered in China, we define such an approach as a feed-in tariff, and it is discussed in other of our Energy Foundation reports.

rebate programs from RE in distributed applications currently exist in Japan, Australia, California, New Jersey, and a large number of additional U.S. states. Other programs in existence, or once used, include those in Austria, Germany, the Netherlands, and Spain. Those programs mentioned in Chapter 2 that emphasize off-grid RE installations include efforts in Brazil, India, and Australia; many other examples exist of such programs, often funded in significant part by multilateral and bilateral aid organizations.

- **Information and Education:** Information and education programs often accompany PV rebate programs, or other programs targeting customer-sited RE applications, and such programs have been implemented in several U.S. states, in Japan, and in other jurisdictions. These programs may be implemented by a PBF administrator directly, or may alternatively be conducted by another organization under contract to the administrator.
- **Low-Cost Consumer Loans:** A common barrier to customer-sited PV and other RE distributed generation installations is the up-front cost of those facilities. Accordingly, several countries have implemented low-cost loans for customer-sited RE installations. Examples include programs in Germany, several U.S. states, Japan, and India, as well as Australia and, earlier, Austria.
- **Investment Vehicles:** Most recently, several jurisdictions have sought to use a different approach to supporting the renewable energy market: offering favorable financing to renewable energy companies or renewable energy projects. Such favorable financing can come in the form of equity investment and debt. States or countries that are beginning to experiment with this approach, and its application towards renewable energy companies, include Australia, Connecticut, Massachusetts, Pennsylvania, and the United Kingdom; Germany, India and other countries have also used more standard low-cost loans to support large renewable energy projects.
- **Infrastructure Building Grants and Contracts for Services:** A large number of U.S. states have also funded various organizations to help build the market infrastructure for renewable energy. These include training programs, RE installer certification programs, resource assessment studies, and related efforts.
- **Research and Development:** A large number of countries have used general tax revenue to help fund RE R&D activities. Far fewer countries have used traditional PBFs to fund these activities, but there are some examples of the use of electricity surcharges to fund RE R&D (e.g., California).

7.2 Energy Efficiency Programs

In Europe, it has been claimed that overall savings of 15-20% in electricity consumption could be accomplished if all energy saving measures with a payback time of less than 3 years were to be carried out (Didden and D'haeseleer 2003). Similarly, the central lesson of studies and initiatives in the United States is that very large reservoirs of low-cost energy and capacity resources on the customer side of the electric meter are still available. "A careful review of past programs and current market data supports a conclusion that a large fraction -- as much as 40 to 50 percent-- of the nation's anticipated load growth over the next two decades could be displaced through energy efficiency, pricing reforms, and load management programs" (Cowart 2001). Meanwhile, the well-known "Five Lab Study," prepared by the US Department of Energy's five National Energy Laboratories in 1997,found that cost-effective energy efficiency investments could displace 15% to 16% of the nation's *total* electrical consumption by the year 2010 (Interlaboratory Working Group 1997).

With all of this potential, what energy efficiency programs are commonly funded with PBFs? Energy efficiency programs are diverse and multifaceted (more so than renewable energy PBF programs). Different programs tend to combine elements from the dimensions listed below, to meet the specific goals of the program administrator (adapted from York and Kushler 2003):

- **Customer Sector/End-Users:** residential, with a distinct low-income subset; small commercial and industrial, including farms; municipal; institutional; and large commercial and industrial.
- **Targeted Technologies or Electricity Uses:** lighting, HVAC, industrial processes, appliances, building envelope, compressed air systems, wastewater, industrial motors/drives, and traffic signals.
- **Market Opportunity Niches:** new construction; equipment replacement; process modernization; renovation and retrofits.
- **Program Services:** financial incentives, technical assistance, consumer and professional education, marketing, customized services, performance contracting/bidding, appliance replacement/recycling, and technical support for codes and standard development.
- **Underlying Approach:** resource acquisition and/or market transformation.

For example, a program might target existing large commercial customers with a lighting replacement program supported by financial incentives and technical assistance, resulting in resource acquisition and, to a lesser extent, market transformation. A different program might educate architects, contractors and lighting professionals to influence the choice of lighting in new construction, resulting in market transformation and, in the long run, resource acquisition.

Given the multitude of different program possibilities, a jurisdiction with a PBF first needs to define its priorities, then design and implement programs consistent with those priorities, and finally evaluate the programs so they can be improved. Priorities can be set by focusing on specific opportunities for long-term high-savings investments, the needs of particular customer classes, or specific technology options. Policymakers need to assess their preferences for near-term measurable savings (resource acquisition) on the one hand, and long-term market transformation efforts on the other, as discussed in the previous chapter. Since the approaches are complementary, at present, most countries/states choose a mix of resource acquisition and market transformation efforts. Program emphasis can, of course, be reset from time to time. For example, California EE PBF programs in the late 1990s focused on market transformation objectives, but with the onset of the California electricity crisis in 2000/2001, California's priorities shifted towards near-term measurable savings with a "resource acquisition" focus. Policymakers may want programs to be available to all customer classes (residential, commercial, and industrial), and across all geographic locations to ensure that all customers that pay the PBF also have an opportunity to benefit from its programs. Conversely, policymakers may instead want to do some level of "cherry picking" – targeting early year dollars to programs with the largest savings – or focus on a region with transmission constraints or peak load issues to ensure maximum social benefit from their programs (RAP 2002).

International experience shows that PBF resources are used to support EE programs using all the financial mechanisms discussed in Chapter 6. Nadel and Geller (1996) described the most common EE program types as follows:

- **Information and Education:** Over the years, a wide variety of EE information-only programs have been developed in every country and US state reviewed for this paper. The simplest would be educational materials distributed to consumers. However, programs also include dissemination of curriculum to schools, professional training programs, energy audits for all customer niches, energy information centers, kiosks and model homes, and labeling of energy efficient appliances, buildings and building supplies. Although information programs can have a positive impact (e.g. Energy Information Centres in the UK have been credited with significant savings), the limited data available indicates participation rates and savings are usually small. Commercial audit programs that emphasize personal, one-on-one marketing and financial incentives have achieved high participation and savings rates. Professional training and certification programs are gaining favor. Studies have shown that programs that combine information efforts with financial incentives result in higher participation and savings than either program type alone.
- **Loans and Leasing:** Low- and no-interest loans and leasing programs were more common in the 1980's and, to a lesser extent, in the 1990's than they are today. Consumers used these financing mechanisms to pay for weatherization, lighting installation, new equipment, comprehensive efficiency packages or other energy saving measures. Although consumers paid for the equipment, successful programs required aggressive marketing and extensive technical assistance resulting in significant costs to program administrators. Experience showed that consumers favored rebates over loans, and administrators found that rebates were easier to administer than loans. However, cost-effective results have been obtained, and there are still some loan/lease programs in existence, targeted to specific customers and/or technologies (see, e.g., the UK's Carbon Trust programs.) However, many loan programs have been abandoned in favor of rebates or other financial incentives.
- **Performance Contracting[10]:** In these programs, one party contracts with another party to produce energy savings in return for specified financial remuneration. In standard performance contracting, the program administrator, utility or consumer offers fixed price incentives to energy service companies (ESCOs) or other entities that produce annual energy savings. Streamlined measurement and verification protocols are often used to demonstrate savings. The contractor may identify, install and/or maintain efficiency measures. The contractor may receive payment or incentives from the program administrator for each kWh or KW saved, and/or may receive payments from the customer based on shared savings. Sometimes the posted price varies with the targeted technology. New York, California and other states have used PBFs to fund standard performance contracts. Demand-side bidding is another form of performance contracting. Utilities or program administrators may request competitive proposals to supply demand-side resources, such as savings due to energy efficiency. Alternatively, they may approach an entity and request a bid. Successful bidders are selected on the basis of price per kWh and/or kW saved, and other factors such as reliability and persistence of savings. In one example, the Bonneville Power

[10] For an excellent discussion of performance contracting, please see Schiller et al. 2000. http://eetd.lbl.gov/ea/EMS/reports/46071.pdf.

Administration's ConAug program uses ratepayer funds to purchase reliable energy savings from large customers at the lowest bid price.

- **Load Management:** Load management programs shift electric loads from one time period to another, typically from peak to off-peak periods, or reduce loads during peak periods. Although some energy savings may result, these programs are generally funded to solve other problems such as system congestion/reliability, price volatility, or avoiding the construction/use of peak generation plants.
- **Rebates/Subsidies:** Rebates and subsidies are some of the most common financial incentives used in EE programs. They reduce the cost of an EE measure, either at the point of sale or after purchase. They have been used in many international jurisdictions to encourage customers to replace existing equipment with high efficiency equipment, such as light bulbs, lighting systems, refrigerators, air conditioners, washing machines, and motors. Some rebate programs are customized to multi-use commercial and industrial settings. Rebate programs must be designed carefully to reduce the number of "free riders" and stay within budget. Rebates for products with low market shares and/or less rapid payback periods reduce the number of free riders. Denmark's Electricity Savings Trust uses subsidies to meet most of its goals.
- **Comprehensive/Direct Installation:** These programs typically include audits, arranging for measure installation, financing assistance (loans or grants) and sometimes follow-up services. The UK's Energy Efficiency Commitment is an example of this kind of program, directed at residential customers. Comprehensive/direct installation programs can achieve high participation rates and higher savings than other approaches. However, due to their relatively high costs, these programs have often been narrowly targeted at hard-to-reach customers such as low-income or small commercial and industrial customers.
- **Market Transformation**: Under market transformation, a wide variety of programs and strategies are used to change an entire market so that, ultimately, energy efficient products and services are the norm and do not need to be promoted with incentives. Market transformation efforts usually involve many actors (e.g., government, utilities, manufacturers, trade associations, and private customers) working together, and involve a combination of program and policy approaches. Interventions are made at all levels, from manufacturing and distribution to end users, to reduce barriers to energy efficiency improvements. For example, in the northwest US a coordinated regional effort was made to promote efficient residential construction practices using demonstration projects, contractor/builder training, incentives, and local/state government involvement. As a result, building codes now include strong energy efficiency requirements and incentives are not needed in the residential new construction market. Market transformation efforts have the potential to save more energy than other strategies because participation will approach 100%. However, market transformation usually takes more time to achieve goals, the cooperation of diverse parties is essential, and progress can be difficult to evaluate. While long-term costs can be low, initial costs can be fairly high.

There are other EE program types that were not discussed in Nadel and Geller (1996) and that are supported by PBF funds in a variety of jurisdictions today. Research and development of efficient, targeted technologies such as motors, for example, has been supported by PBF funds in Brazil, New York and other settings.

8. Administrative Options

8.1 The Three Administrative Options

International experience shows that one of the most complicated issues associated with PBFs is assessing the advantages and disadvantages of various administrative and governance options. In many countries (but especially in the U.S.), electric utilities have historically played a central role in administering EE programs, and to a lesser degree RE programs. In the U.S., for example, utility DSM programs have been in operation for three decades. Utility regulators set the policy parameters for these programs by defining how cost effectiveness would be measured, approving budgets, verifying results, and in many jurisdictions providing financial incentives to utilities to make it profitable for those utilities to engage in EE activities. When the electricity sector is reformed, however, the past performance of the utilities in administering EE and RE programs, and the changing incentives now faced by these same utilities, requires policymakers to carefully consider all options for program administration and governance.

Administration of a PBF may include a large variety of different activities, including: (1) general administration and coordination; (2) program development, planning and budgeting; (3) program administration and management; (4) program delivery and implementation; and (5) program assessment and evaluation. Most PBF administrators do not perform all of these functions. Policymakers, or the administrator itself, will decide on the division of responsibilities that makes sense given the goals and resources of the jurisdiction. It deserves special note that PBF administrators often hire contractors to perform a large number of these functions.

Three major options for general PBF administration have been proposed, and are in use internationally:

- utility administration,
- government administration through regional or central governmental agencies, and
- use of an independent, non-governmental organization to administer the PBF.

8.2 Experience Summary

International experience shows that there is no single right answer in selecting among these various administrative options. Effective PBFs have been administered through all of the administrative structures identified above. That said, utilities generally have little past experience in administering renewable energy PBFs, and significant conflicts of interest are possible, so as a practical matter RE PBFs should generally be administered by either a government agency or a non-profit organization. Where utilities in the U.S. have administered PBF programs, concerns over that administration have almost universally arisen (Wiser et al. 2003). Energy efficiency PBFs may also be best administered through government agencies or independent non-profit organizations, unless utilities have considerable past positive experience in administering DSM programs and regulatory disincentives to promote EE can be eliminated.

Experience in the U.S. provides examples of each of these administrative structures. As noted in Table 1, earlier, 3 of the RE PBF funds are administered by electric utilities, 10 by government agencies, and 2 by non-profit organizations. Of the EE PBF funds in the U.S., 11 are administered by electric utilities, 7 by government agencies, and 3 by non-profit organizations. The general trend, however, is to move away from utility administration especially as electricity markets are restructured. Nonetheless, utility administration of PBF funds is far more common in EE than RE, in large part because of the historic role utilities have played in EE investments.

Outside of the U.S., all three forms of administration have also been used, sometimes with more than one administrative structure being used within a single country. Utilities in Brazil, grid companies in Denmark, and retail suppliers in the UK and in New South Wales all use ratepayer funds or company revenues to reach EE goals. In the Netherlands, serious questions were raised about the spending of the PBF by distribution companies (Slingerland 1997); in particular, there was a concern that funds were being used to largely build the utilities' image, and were not being used as effectively as they could have been in building markets for EE. Now some administrative responsibilities have been assigned to a government agency, Novem (Netherlands Agency for Energy and the Environment). Other countries using government entities to administer PBFs include Norway, where the government created a new, single-purpose government agency, Enova, to administer the PBF and other EE funds, Thailand's Energy Conservation Promotion Program, and the UK under its NFFO program. In Belgium, each of the three federal regions chooses its own method to administer the "Rational Use of Energy" funds. Two of Belgium's regions use a government ministry. The third, Flanders, created VIREG, which is governed by representatives of both the government and the energy sector. Independent, non-utility, non-government, single-purpose entities have been established in some countries to support EE and RE activities, such as Mexico's Fund for Saving Electric Energy (FIDE). Some, like the Energy Savings Trust in the UK and SEDA in New South Wales, Australia, are funded with government revenues. Others, like the Danish Electricity Savings Trust and the UK's Carbon Trust, use tariffs/taxes on electricity to support EE programs.

Regardless of the administrative structure that is ultimately chosen, Harrington and Murray (2003) note that successful deployment of PBFs requires three fundamental cornerstones:

- *Clarity* of stated purpose at every level (from overarching goals to individual program design and evaluation metrics). Clarity begins with the policy reasons for pursuing EE and RE found in the enabling legislation or regulation.
- *Consistency* of the policy, over time. EE and RE programs take time to implement. Frequent changes to the goals, program designs, or commitment to the programs will do harm to implementation results. EE and RE PBFs require ongoing political support.
- *Consensus* of key stakeholders, as to goals and structure, as well as program design. At a minimum, key stakeholders include the regulators, policymakers, utilities, and RE and EE service providers. The broader the consensus on program design, the more successful the PBF is likely to be, and the more resistant it will be to elimination.

8.3 Advantages and Disadvantages of Different Administrative Structures[11]

There is no one best solution to the administration of a PBF, and the relative strengths and weaknesses of each option require tradeoffs that can only be assessed by decision-makers in each nation. Some of the major tradeoffs among alternative institutional and governance options for administration of publicly funded EE and RE programs are discussed below, pulled in large part from Eto et al. (1998). Based on international experiences to date, we organize our discussion around three generic options: (1) utility administration with regulatory oversight, (2) administration by a government agency, and (3) administration by an existing or new statewide or regional independent institution. These options reflect the broad categories of approaches used so far internationally, although many variants and hybrids are possible. Please note, however, that although all independent administrators reviewed for this paper are not-for-profit institutions, there is no known reason to exclude the possibility of a for-profit institution with appropriate oversight. Vermont was open to contracting with a for-profit corporation to serve as its Energy Efficiency Utility. Although a not-for-profit won the contract, it has received significant financial performance incentives that might be attractive to a for-profit organization.

Criteria that may be useful for policymakers to consider when selecting among these administrative options include compatibility with broader public policy goals and utility industry structure, accountability and oversight, and administrative effectiveness. These criteria, which are amended from those offered by Eto et al. (1998) and Blumstein et al. (2003), are summarized in more detail in the table below.

[11] This section reproduces, in significant part, sections of text from Eto et al. (1998). Other reports were utilized that discuss administration options and issues, including Didden and D'haeseleer (2003), Harrington and Murray (2003), and Blumstein et al. (2003).

Table 2. Factors to Consider in Choosing Among Administration Options for PBFs

Criteria	Examples of Possible Objectives
Compatibility with Broader Public Policy Goals	• Supports EE and RE market transformation goals • Fosters provision of EE services by competitive market • Makes best use of existing EE and RE expertise and resources of utilities, EE and RE service providers, and governmental agencies • If market transformation is a goal, administrator must have comprehensive knowledge of EE and RE markets, and be very flexible in program design and contracting practices • Ability to achieve economies of scale and scope – because EE markets are often regional or national ones, administrators should be able to cover a broad market area
Accountability and Oversight	• Avoids conflicts of interest between those who allocate and those who receive public funds • Provides for public oversight necessary to assure accountability for responsible and effective expenditure of public funds • Minimizes regulatory or administrative procedures that might hamper relationship between service providers and customers • Aligns administrator's financial interests and incentives with desired public outcomes
Administrator Effectiveness	• Provides opportunities for input and feedback from stakeholders, market participants, experts, and customers • Does not impose significant avoidable or unnecessary transaction costs on service providers • Promotes minimization of all costs including administrative, regulatory, evaluation, marketing, and customer decision • Able to adapt quickly and flexibly to changing circumstances, including changing policy goals • Attracts highly qualified administrative and technical personnel

Option #1: Utilities Administer EE and RE Programs

Description: In this option, the utility administers EE and/or RE activities, providing general administration, program design, oversight of implementation (significant elements of which could be contracted out to private firms), evaluation, and cost recovery subject to regulatory oversight. The utility submits an overall plan with proposed program designs and budgets. Budgets and use of PBF funds are reviewed and approved by the utility regulatory body. Utility management designs individual programs and is responsible for overall program management and administration. Typically, utility plans reflect input from major stakeholders.

One must keep in mind the distinctions between a vertically integrated utility and a distribution-only utility when considering this option. When utilities are vertically integrated in a traditional regulated monopoly environment, the utilities may be given an incentive to promote EE programs that are more economical than avoided generation, transmission and distribution costs.

They may also have DSM shareholder incentives or other rewards for EE results. A distribution-only utility, on the other hand, is likely to have no EE incentives tied to avoided costs. Distribution utilities administering EE programs are generally only responding to a regulatory or legislative mandate, though they may have incentives and/or penalties tied to program results. While important differences do exist between these two types of utilities, however, most utilities of both types have historically had their revenues tied to electricity sales, providing a powerful disincentive for EE activities.

Pros: Proponents of utility administration of EE and RE programs argue that the approach has been successful in some states and with certain utilities, particularly since the advent of DSM shareholder incentives in some countries. Those utilities have developed significant expertise in administering EE programs, in particular, so new institutional arrangements in these cases may not make sense, particularly where state policymakers have determined that public-benefits funds are likely to be available only during a short transitional period (which we do not recommend, as discussed in Chapter 5). Some utilities in some countries have track records that show their strengths as program administrators even if the policy goals for energy efficiency have changed from resource acquisition to market transformation. These strengths include name recognition among customers, clout with manufacturers and trade allies, acknowledged technical expertise on energy use, lack of direct financial interest in promoting particular energy-efficiency products or services, access to detailed information on customer energy-use patterns, and a system for billing customers. One of the attractive features of continued reliance on utilities for these activities (in jurisdictions in which utilities have played a central historic role in EE) is that accountability and oversight mechanisms are well established. There are also sometimes well-developed mechanisms for input and feedback from key stakeholders through collaborative working or advisory groups.

Cons: There are also many opponents to utility administration. These opponents argue that some utilities have had little past experience with EE or RE. Where they do have experience they have often done a poor job. Many utilities are no longer interested or well-suited to administer EE or RE activities given new policy objectives, or have interests that are fundamentally incompatible with these objectives in a restructured industry. For example, if the EE policy objectives move from resource acquisition toward creation of a vibrant, private-sector energy-efficiency services industry, market participants will have great difficulty perceiving that a regulated utility can dispense funds in a competitively neutral manner if the utility has a retail energy service affiliate that operates in the local service territory. Perhaps most importantly, utilities often have significant incentives to increase sales; thus the utilities' financial or business interests may not be well aligned with the desired outcomes of ratepayer-funded energy-efficiency programs (this point has been made persuasively in the U.S. and Europe). EE and RE measures that would be cost-effective for society as a whole often do not meet the cost-effectiveness tests of utilities, or even of certain regulators. Opponents of utility administration also argue that utilities' historic administrative and organizational strengths in EE program administration may be redundant and not particularly relevant because energy-efficiency services markets are not defined by service territories. Substantial coordination and administrative benefits could result from moving to regional or national administration of programs. Finally, worldwide, utilities do not have the same breadth and depth of experience in administering RE programs, so any advantages of having utilities administer RE funds are not nearly as clear as they are for EE.

Option #2: Government Agency Administers EE and RE Programs

Description: In this option, an existing, expanded, or new government agency or ministry (e.g., government energy office, regulatory commission, general services administration, economic development agency, or housing and social services agency) administers publicly funded EE and RE programs.

Pros: Proponents of this approach argue that national or regional administration provides economies of scale and scope and can minimize costs. A government agency may be less likely to be perceived by market participants as having conflicts of interest. Government agencies sometimes have significant relevant experience and can dispense funds through competitive solicitations. Government agencies often use contractors to implement EE and RE programs, which can support the development of competent ESCOs. In theory, government agencies have well-developed processes to ensure input and accountability for use of public funds. Single-purpose government agencies, such as Enova or the Danish Electricity Savings Trust have the advantage of a clear, focused, aligned mission.

Cons: Opponents caution that there are problems associated with utilizing a government agency. Worldwide, government agencies often do not have experience administering the full scope of activities needed under PBF-funded EE and RE programs. Public employment many not pay enough or offer enough opportunity to attract the best and the brightest staff. Government procurement and civil service procedures may not be flexible enough, and may pose barriers to the timely acquisition of resources, contractors, and staff. A government agency's staff, budget and mission are subject to political pressures. Funds or staff may be siphoned off to support efforts bearing little relationship to EE or RE. The mix of programs funded may be due to political pressure rather than EE and RE goal attainment. It can also be challenging to provide effective incentives to government programs. If the government agency is multi-purpose, staff may have difficulty focusing on the new mission, or their efforts may be less than optimal due to other duties. Unless utility incentives are aligned, the government agency may find itself in competition with an uncooperative energy supply sector. If the government agency attempts to conduct all aspects of EE and RE program implementation, it may also arguably dampen the development of vibrant, competitive ESCOs. Many of these disadvantages can be minimized through the use of competitively bid contracts, strong government commitment, and clear enabling legislation. However, these constraints should be considered seriously.

Option #3: Rely on an Existing or Create a New Independent Institution

Description: In this generic option, regional or national policymakers would support an existing or create a new regional or national independent, institution to administer the RE and/or EE PBF. As mentioned above, existing examples are all not-for-profit, but a for-profit organization has not been ruled out as a possibility.

Pros: Proponents argue that this administrative approach has a proven track record. During the past 20 years, for example, a number of nongovernmental institutions have gained experience administering large-scale energy-efficiency programs in the U.S., the UK, and Denmark. These organizations are typically single-purpose, with the potential to focus all institutional resources (e.g. staff and funds) on clear, non-conflicting goals. The independent institution's service area can be designed to match economies of scale. Other potential advantages of nonprofit administration of EE and RE programs include: (1) the organizational form, structure, and mission of nonprofits could be very compatible with public-policy goals for EE and RE, (2) market participants are unlikely to perceive conflicts of interest, (3) flexible planning and competitive procurement processes can be employed, (4) the organization may be able to attract highly motivated, skilled technical and administrative staff relatively rapidly, and (5) incentives can be designed to meet or exceed EE and RE goals.

Cons: This option, however, also has some significant challenges. First, the creation of a successful, trusted new institution hinges on a broadly shared consensus regarding mission, objectives, funding sources, and appropriate organizational form and governance. Significant political will, commitment, and vision are required from many parties in order to work out the many issues that arise in creating a new organization, or significantly enlarging the scope and responsibilities of an existing institution. Success is certainly not guaranteed. Second, the issues associated with accountability and oversight of public funds and governance are particularly significant. The enabling legislation, charter, contract, and/or memorandum of understanding must be clear. The role of all parties (government, Board of Directors, fiscal agents, other stakeholders) should be well defined. Mechanisms for amending goals, funding, responsibilities, incentives and other important issues should be spelled out. In the beginning, these issues may be time- consuming to address. For example, even with knowledgeable staff on loan from the Northwest Power Planning Council, it took four to six months of discussions prior to and after the creation of the Northwest Energy Efficiency Alliance for the parties involved to reach consensus on administration and governance issues (Keating 1998). If existing EE or RE programs are to be transferred from utilities or government agencies to the independent institution, there will be transition issues. Clear protocols on the details of transfer must be established and enforced. Given the high start-up costs of a new institution, this option is more attractive if policymakers in a state or country have indicated a relatively long-term commitment to EE and RE (e.g., five years or more).

8.3 Summary

In summary, we find that international experience does not lead one to conclude that certain administrative structures are always more effective than others. For renewable energy programs, however, the value of utility administration is low, and therefore appropriate administrative options include a state agency or an independent, non-profit administrator. For PBF programs that emphasize EE efforts, all three administrative options deserve some consideration. While utility administration may have certain merits, strong regulatory oversight of these efforts is required and aligning the utilities' financial interests with EE goals can be challenging; eliminating conflicts of interest is essential. If the utility has been restructured and disaggregated into separate generation/transmission/and distribution companies, the value of utility administration decreases even further because integrated supply and demand-side planning is no longer possible. Governmental administration can eliminate these conflicts of interest, but state agencies are often bureaucratic and inflexible. The use of independent organizations as administrators can be effective because the interests of the administrator may be directly aligned with the goals of the program, but the creation and governance of a new organization has its own challenges.

No matter which option is chosen, Blumstein et al (2003) raise an important issue to be considered by policymakers. Will the PBF administrator be a "human capital" institution, made up of staff with the expertise to implement EE and RE programs? Or will it be primarily a funding agent, outsourcing programs and therefore supporting the development of private, non-profit and other institutions proficient in delivering EE/RE services? This decision requires a careful consideration of the capability of existing resources, short and long-term goals, support for institution building, and other factors.

9. Administrative Costs and Staffing

Regardless of the administrative structure, the degree of planning, program development, program implementation, contract management, and program evaluation to fully allocate PBFs requires a full-time staff dedicated and committed to the management of the PBF. Staff must be deeply experienced with RE and EE markets to ensure that funds are used in the most effective way possible. Appropriate financial resources must be made available to this staff to meet the program administration needs. The importance of adequate staffing is illustrated by the fact that the most significant challenge faced by renewable energy PBFs in the U.S., as revealed through a survey of PBF fund managers, was found to be inadequate staffing and staff expertise (Wiser et al. 2003).

Wingate (2003) summarizes the staffing needs and administrative costs of a number of PBFs for renewable energy. Harrington and Murray (2003), meanwhile, describe a variety of staffing and administrative arrangements for EE PBF programs. These examples offer the reader some idea of the range of administrative costs that can be expected to implement a PBF, although the numbers are very specific to the individual policies and programs.

Harrington and Murray (2003) found it difficult to document exact staffing levels and administrative costs for EE PBF programs. Programs vary widely in their use of institutional staff versus contractors. For instance, the Vermont EE administrator employs about 70 full-time equivalent staff (FTEs) for a US$13 million program, while the Wisconsin administrator uses 7 direct FTEs for a US$60 million program. However, the Wisconsin program relies primarily on contractors and sub-contractors to perform many program administration and implementation functions, while the Vermont program uses its own staff to perform most functions. In addition, it is difficult to compare administrative costs as a percent of budget. Most reported administrative costs do not include the cost of oversight, evaluation, incentives, or the administrative costs incurred by contractors. Many reports and evaluations by Harrington and Murray (2003) concluded that program results are a more effective indicator of effective administration than the size of the administrative budget itself.

As shown by Harrington and Murray (2003) and Wingate (2003), the large range in the types of activities, structure, and complexity of public benefits funds in the U.S. and throughout the world also creates a large variation in the costs to administer such funds. Therefore, the reader is urged to use the numbers shown below with caution, and recognize that they may or may not be directly applicable to a PBF in China. Table 3 gives a range of public benefits funds for RE and shows the staffing levels and administrative costs of the funds. Table 4 describes the administrative costs and staffing of several EE programs supported by PBFs.

Table 3. Summary of a Administrative Costs for a Select Number of RE PBFs

U.S. State	Amount of RE Fund per Year (US$)	Description of Programs Funded	# of Full Time Employees (40 hrs/wk)	% of Fund Spent on Admin.
UK	$190 M in 1999	• Non-Fossil Fuel Obligation tenders for renewable energy • Five competitive tenders for grid-connected RE projects over 8 years • 75-261 tenders awarded for each bidding process	9	< 1% ($1.2 million/year)
CA	$135 M	• Tendering process for new renewables • Production incentive for existing renewables • Rebate program for small scale distributed resources • Customer rebate for renewable purchases • RE education	13-15	2-3%
NY	$14 M	• Small scale renewable support • Wholesale large scale renewable support • Green marketing/customer education • Market mechanisms research and analysis	7-10	7%
OR	$10.2 M	• Wind data collection assistance • Grid-tied RE incentives for wind, solar, biomass, geothermal • Open-ended solicitation for financial assistance related to renewable energy projects • Market and resource potential analysis	2-4	20%
MA	$26 M	• Green building program (Distributed PV and energy efficiency) • Premium power (fuel cell support program) • Wind development support program	20-25	24%
IL	$5 M	• RE grant program for large scale RE • Rebate program for small scale DG	1	.02%*

* Administrative costs do not come out of the fund, so technically this number is zero. The .02% is an estimate of the proportion of the costs of managing the fund relative to the total fund.

Table 4. Summary of Administrative Costs and Staffing for several EE PBFs

State	Approx. Amount of EE Funding Per Year (US$)	% of Fund Spent on Administration* and Staffing Levels
CT	$87 million	1.6% reported by utilities. Administrative costs may not exceed 5%. Utility staff and contractor numbers not available.
IL	$3 million	1 full time equivalent (FTE)
ME	$17 million	4-8%, not to exceed $1.3 million 4.5 FTE + contractors
MA	$117 million	7%; varies by utility from 3-19% 14 part-time consultants, utility staff and subcontractors
MN	$53 million	Programs must be "cost-effective"
NJ	$90 million	6% reported by utilities 30 FTE utility staff + consultants and contractors
NY** OR**	$139 million $45-50 million	Administrative costs may not exceed 7% 110 FTE + consultants and contractors 4-5% 20 FTE + contractors
VT	$13 million	70 FTE + contractors
WI**	$62 million	10-13% includes marketing, evaluation, IT consulting 7 FTE at state agency + contractors and consultants
UK	160+million pounds	21% for administrative and marketing costs before retail competition; anticipate lower administrative costs now

* Reported costs do not generally include the costs of government oversight, planning, analysis, marketing, evaluation activities, incentives, consultants or advisory committees.

In general, administrative costs increase in relation to the number of specific programs a fund runs and the complexity of those programs. The number of allocations a fund makes can also increase administrative costs. For example, the administrative costs of a PBF that is used to buy-down many small-scale RE projects would probably be higher than a fund used to support one or two large grid-tied renewable projects. Similarly, funds that administer one program, for example, a grid-tied RE production incentive, have fewer costs than funds that try to administer a variety of subsidy programs.

More generally, funds that establish clear funding guidelines, application procedures and evaluation mechanisms upfront will require fewer staff and administrative expenditure than a fund that intends to flexibly alter its spending over time. Illinois, for example, has limited the amount of management needed for its RE PBF by establishing clear funding guidelines up front. The Bonneville Power Administration's C&RD program and the UK's Energy Efficiency Commitment support EE measures with pre-determined cost-effectiveness values. Their administrative costs and staffing needs are relatively low. Other funds, such as Massachusetts (RE) and the New York State Energy Research and Development Authority (NYSERDA) in New York (RE and EE), have attempted to remain flexible enough to respond to market needs by supplementing certain programmatic areas, reducing others, or even completely changing course if need be. To effectively implement such a flexible and responsive approach requires a higher level of staff expertise and a larger staff size.

Another factor to be considered is economies of scale. Small funds have fewer economies of scale than very large funds, and therefore the proportion of the fund that is spent on administrative costs tends to be larger with small funds. For example, the smallest utility in Massachusetts' EE program reported spending 19% of funds on administration, while the largest utility spent close to 3%.

In conclusion, it should be clear that effectively administering EE and RE programs with PBFs is a labor-intensive process that requires adequate funding and staffing levels. Though the specific staffing levels and funding necessary for administration depends on the programs being designed, the staffing/contractor balance and the size of the overall fund, on a percentage basis a minimum of 5-10% of funds may need to be dedicated to cover administrative costs.

10. Management and Monitoring of the Fund

An underlying assumption to the establishment of a PBF is that investment in energy efficiency and renewable energy contributes to the public good in a variety of ways: through reduced pollution, increased productivity, reduced energy costs, increased comfort and security, and other societal goals discussed in Chapter 3. However, reaching these goals requires efficient and effective use of the PBF. This in turn requires the effective use of stakeholder and technical input, objective and transparent oversight mechanisms, and clear accountability relationships and measures. Moreover, even the best designed oversight and accountability systems can be undermined by a lack of regulatory or legislative attention and interest.

Based on international experience, the needed type and level of stakeholder input, and management oversight and accountability, will vary depending upon the nature of the PBF administrator (see Chapter 8). Below we discuss management and monitoring needs for PBFs administered by (1) utilities, (2) government agencies, and (3) independent organizations.

10.1 Utility Administrator

When utilities administer EE and RE programs, oversight is especially crucial given what are often inherent conflicts of interest in such utility administration. In general, utilities that administer EE and RE programs are directly accountable to the electricity regulatory commission in their jurisdiction, or another government ministry. Oversight of all PBF program aspects generally occurs through the legal, transparent proceedings of the regulatory body. Through that regulatory process, members of the public and other stakeholder groups can provide input to the utility's goals, plans, budgets, evaluation strategies, and incentive mechanisms. Utility-run programs will generally benefit from the up-front involvement of strong advisory committees representing most stakeholders (e.g. residential, commercial and industrial customers, low-income interests, trade associations, and environmental advocates) or from formal collaborative relationships with stakeholders, government agencies, and other utilities. Utility PBF administrators should typically receive technical input from both in-house and external experts. The movement of funds into and out of the utility programs should be regularly reviewed by independent auditors. Because utilities' financial interests are often not fully aligned with EE and/or RE goals, most utility administrators will also have specific financial incentives and/or penalties tied to performance milestones or outcomes associated with their administration of EE and RE programs. Program results are typically reported and evaluated on a regular basis.

As described previously, many US states have years of experience with utility administration of EE programs (generally known as demand side management, or DSM, programs). States such as California, Connecticut, New Jersey, Massachusetts and Minnesota have recent experience with PBFs using most aspects of the oversight model described above (See Harrington and Murray 2003 for a detailed description of most of these states.)

There are examples of similar oversight/accountability models outside of the U.S. as well. These are just a few examples:

- **Brazil:** In Brazil, utilities administering EE programs are accountable to the National Agency for Electrical Energy (ANEEL), the national electricity regulator. ANEEL defines the EE priorities and goals, and approves the utilities' annual plans. The utilities receive technical assistance in developing plans from PROCEL, Brazil's federal energy conservation agency. PROCEL also certifies the adequacy of the implemented programs.

- **Denmark:** In Denmark the government established the Energy Supervisory Board specifically to oversee the actions of the utilities and grid companies that use PBF funds for EE/RE "public commitments."

- **United Kingdom:** Under the Energy Efficiency Commitment program, a national ministry, the Department of the Environment, Food and Rural Affairs (Defra), sets the overall targets and program policy. The retail electricity and gas suppliers are accountable to the Office of Gas and Electricity Markets (Ofgem), the national regulatory body. Ofgem determines each supplier's goals, using objective criteria established by Defra. Ofgem provides technical assistance to the suppliers through a technical manual. Ofgem uses some outside contractors to assist with oversight and evaluation. The Energy Savings Trust, a non-profit energy efficiency organization supported by government revenues, has provided technical assistance to Ofgem and suppliers. The National Audit Office and outside contractors have independently verified results. Because the suppliers' financial interests are not necessarily always aligned with the goals of the policy, Ofgem can fine non-compliant suppliers.

10.2 Government Agency Administrator

Government agencies that administer PBF programs are typically accountable to another governmental agency and/or the legislative body. Goals, budgets and policies should be established in a legislative or regulatory forum with opportunities for public input. Program accountability is often strengthened by an independent, engaged advisory group representing stakeholders. Technical input is provided by expert in-house staff, staff from other agencies, and/or outside consultants. An independent financial audit is often conducted. Program results are reported and independently evaluated on a regular basis. Since the goals of a government administrator should not conflict with the PBF goals, there are not necessarily any specific incentives or penalties that are tied to performance. However, achievement of performance milestones or similar measures is often required for program and budget survival.

A large number of states in the U.S. have experience with government administration of PBF programs. There are varying levels of complexity in their administrative structure and the resulting oversight and accountability mechanisms. In Ohio and Illinois, for example, the state legislatures established very specific goals for the use of relatively small funds, and also specified in detail the types of measures available for funding. As a result, the state agencies administering the funds have very little flexibility, and there is little need for further input. Auditing program results and the flow of finances is fairly routine.

New York, on the other hand, has a fairly complex program with a variety of checks and balances in its system. The program administrator, NYSERDA, is directly accountable to the state regulatory agency, the PSC, through a Memorandum of Understanding agreement regarding the PBF program. However, it is also accountable to its own Board of Directors, and ultimately to the state legislature and the Governor. The PSC establishes overall program policies and priorities, including budget priorities. However, that leaves NYSERDA with considerable flexibility in establishing programs and program goals. An Advisory Group made up of major stakeholders (including representatives of the electricity generators and suppliers, the energy services sector, the industrial, residential, commercial, research, low-income and environmental communities, and the legislature) performs two functions. The Advisory Group provides input to NYSERDA and also serves an oversight role as it ultimately certifies evaluation results to the PSC. Another state agency serves a key function. The Department of Public Service provides technical guidance and planning support to NYSERDA, and monitors program progress and evaluation for the PSC. The usual state financial auditing procedures apply. NYSERDA reports results to the PSC on an annual basis, and contracts for independent evaluation of itself and most programs.

Wisconsin is another state with a fairly complex program. It differs from New York in several ways, including that the program administrator, the Department of Administration (DOA), is accountable to the legislature and Governor, not the regulatory agency. However, through competitive bids, the DOA contracts almost all elements of program administration and implementation out to non-profit organizations. As a result, the DOA might be perceived as performing more oversight functions than administrative functions. The DOA does have an advisory council, and must provide for an independent audit and report to the legislature annually.

Outside the U.S., Enova in Norway, Novem in the Netherlands, and the DTI in the UK (under the NFFO) are international examples of government entities that provide administrative services for PBF programs. All are accountable to related ministries, and through them, to legislative bodies.

10.3 Independent Institution Administrator

Since independent PBF administrators are often relatively new entities, created specifically to run the PBF programs, their attendant systems for oversight and accountability often have to be created "from scratch." In most cases, the organization itself is accountable to the electricity regulatory agency or to a government ministry through a contractual relationship that details responsibility for oversight and accountability mechanisms. Independent administrators generally have a Board of Directors with fiduciary and legal responsibilities for management of the organization. The staff is accountable to the Board. Government staff usually provide oversight. Advisory councils provide stakeholder input. Technical input is generally obtained from staff, appropriate government agencies and contracted consultants. The administrator's contract, or subsequent agreements, detail performance milestones, auditing procedures, reporting and evaluation expectations, and terms for contract renewal. At least one independent PBF administrator (Vermont's) does receive financial incentives for exemplary performance. In general, however, independent PBF administrators are single-focus organizations with perhaps little need for financial incentives to align their goals with the goals of the PBF. These single-purpose organizations rely on excellent performance to maintain the good will of the regulatory agency, legislature and stakeholders, which is necessary for survival.

In the U.S., the Energy Trust of Oregon and Efficiency Vermont (among others) follow the model described above. The details of accountability and oversight in those two state programs are detailed in Harrington and Murray (2003). The Electricity Savings Trust in Denmark and the Carbon Trust in the UK are similar. These two independent PBF administrators were created by legislation with a focused mission aligned with policy goals. They each have an independent Board of Directors and are accountable to their respective legislatures. Neither organization appears to have an advisory council separate from its board, but the Carbon Trust gathers stakeholder input from public strategy workshops. The board of the Electricity Savings Trust is composed of consumer and utility representatives, as well as experts in energy savings and economics.

10.4 Performance Incentives

As alluded to above when discussing utility administration of PBF funds, financial performance incentives may be used to hold administrators accountable to PBF goals. These are particularly important when the administrator has conflicting goals, such as when utility administrators lose revenues when EE or RE goals are met. According to Didden and D'haeseleer (2003) if private utility administrators do not have financial performance incentives, governments have only a few less-effective strategies, such as mandated obligations or license requirements along with penalties or fines, to produce positive results. These concerns are discussed more fully in Chapter 13.

11. Program Evaluation

Energy efficiency and renewable energy PBF programs represent significant investments of financial, human, and material resources. Policymakers and stakeholders want the most effective use of these resources. Program evaluation before, during, and after program interventions is the process used to obtain the information needed by decision makers to ensure that program resources are well targeted, and to also defend the PBF when it is under political attack or review. The issues in evaluating EE or RE PBF programs do not differ greatly from those evaluating EE or RE programs funded in any other way. As a result, a great deal of relevant experience has been gained in evaluating decades of utility DSM programs in the U.S., and to a lesser extent, recent EE PBF and RE programs. In this chapter we describe useful program evaluation concepts and experiences, drawing heavily on the work of experienced consultants in this field. While most of the examples and text come from EE evaluation experience, the conclusions of this chapter relate equally well to RE programs.

11.1 Why do Program Evaluation?

When financial resources are invested in RE and EE programs, policymakers want to know ahead of time what they can expect from the investment. As the program gets underway, they want to know about progress. After some time has passed, they want to know what the results are and whether changes need to be made. Program evaluation should address these concerns.

Some of the specific questions that arise in evaluating EE and RE PBF programs are:

- Is the program achieving its overarching goals?
- What energy savings, energy production, and non-energy benefits are due to the program?
- What are the program costs?
- Is the program cost-effective?
- Is the market being impacted or transformed?
- Can program performance or administrator performance be improved?
- What incentives, if any, are due?
- How are the technologies supported by the PBF performing?
- How are the PBF benefits distributed among customer sectors?
- What remaining potential exists for EE and RE impacts?

In addition to answering these questions, well-done evaluation can be helpful in at least two other ways. First, when there are changes in the people who hold positions as regulators, legislators, other policymakers and stakeholders, regular evaluation reporting can educate the new-comers to the EE and RE potential, and the goals, concerns, and successes of the PBF programs. Second, when PBF programs with long-term goals are vulnerable to governments with short-term concerns, evaluation is very important in communicating the benefits of the PBF to policymakers in order to defend the PBF program in the face of political attacks.

It is, however, possible to over-do evaluation. Policymakers need to keep in mind what decisions need to be made, and what level of information is truly needed to make those decisions. If the evaluation process is too detailed, it can take years and use resources better spent on programs. Results need to be timely, and the financial and human resources devoted to evaluation need to be reasonable.

Evaluation budgets have often not been extensively documented. Some activities may be conducted and paid for outside the bounds of the PBF program (e.g., efficiency potential studies, utility-regulation activities). However, recent, fairly thorough evaluation activities for the New York and Massachusetts' PBF funds were on the order of 2% of total PBF program funds.

11.2 The Evaluation Process

Internationally, program evaluation is often designed as an integral part of EE and RE programs right from the start, not after the fact. Policymakers, PBF fund administrators, specific program managers, trade allies, consumers, and other stakeholders have different informational needs that need to be kept in mind as evaluation programs are designed. In general, however, evaluation is on-going during three distinct time periods. The information gathered and the techniques used vary with these time periods, although there will be some overlap (see Table 5).

Table 5[12]: The Program Evaluation Process

Stage of Program Implementation	Results	Possible Information/Techniques
Before	Predicted savings Expected cost-effectiveness Predicted non-energy benefits Market assessments	Engineering estimates Tracking systems Best practice and other previous studies Efficiency and RE potential studies Avoided cost estimates Surveys
During	Process evaluation Market evaluation Improved estimates Verified savings	Surveys Site visits Spot or short-term metering Preliminary billing analysis Sales data studies Accounting audits
After	Measures savings Goal/impact evaluation Performance incentive determination	Billing analysis Longitudinal studies Multiple methods Metering, sales tracking Non-energy benefit measurements

[12] This table, and other information in this chapter, uses and amends the work of N. Hall and L. Megdal (see, for example, http://www.calmac.org/events/CALMAC_April29_Workshop_Minutes.doc), J. Raab and J. Schlegel (see, for example, workshop for the Public Utilities Commission of Ohio, 1993) and other consultants to PBF programs, as described in various workshop presentations, annual reports, task force minutes and other consultant reports.

11.3 Evaluation Issues

Evaluation will be most meaningful to policymakers and other parties if several issues are clearly settled ahead of time. Perhaps most importantly, the **goals** of the program must be clear. The data tracked and processes evaluated will differ depending on whether the goals are energy saving or generation, peak load reduction or generation, emissions reduction, increasing distributed generation, and so on. In addition, a **baseline** must be agreed upon: what is expected to happen if there is no program? Although this may be modified as time goes on, it is difficult to gauge program results without some consensus as to likely scenarios without intervention.

Evaluation mechanisms also need to be **transparent**, **timely,** and reasonably **easy to use**. Evaluation results are most valuable if they are available in time for policymakers to make decisions about budgets, program re-direction, process changes, and finalization. Planning horizons may need to be lengthened, or evaluation timelines shortened, to reach a practical balance. Many states and countries have developed standardized reporting formats and technical manuals to improve the efficiency of some portions of the process.

If evaluation results are going to be truly useful to decision makers at all levels, the process must also be reasonably **unbiased**, **balanced**, **fair** and **free of conflicts of interest**. Although this goal will never be perfectly realized, international EE and RE PBF programs often use external advisory groups, technical expert panels, government agencies, and third-party consultants or verifiers to come close. In this process, it is helpful to define the roles of program administrators, managers, and evaluators clearly.

Decision makers need to decide upon measures of success, to know what to evaluate and how results relate to goals. Some measures of success may invoke little controversy such as market penetration, number of participants, or actual energy savings (EE) or energy production (RE). Many calculations and their relationship to program results will involve uncertainty, however, such as avoided costs, measure life, persistence of savings, emission reductions, etc. Cost-effectiveness of EE programs is also an important measure, but also one that can be controversial. Internationally most PBF programs use some variation of the Total Resource Cost test. Program, customer, and utility costs are compared to lifetime savings and avoided costs. Non-energy benefits (e.g. economic, environmental) are often included. The elements included or omitted from the chosen cost-effectiveness test(s) will impact what programs are implemented because they pass initial screening decisions. They will also affect what programs appear successful at the end.

11.4 Some International Experiences with Evaluation

The *Bonneville Power Administration* (BPA), in the US Northwest, uses two different evaluation processes for two separate programs, each with different goals. One program gives BPA customers a discounted electricity rate provided that the resulting funds are used for certain EE or RE measures. The Regional Technical Forum, composed of technical experts, BPA engineers, utility staff and consultants, helped BPA develop a manual and software describing “deemed EE and RE measures” or procedures for custom measures that meet simple energy payback rules for cost-effectiveness. This stage of evaluation gives BPA customers guidance about what EE or RE measures to pursue. The participants report their accomplishments annually, with a final reconciliation after five years. The manual and tracking and reporting software give technical measure and evaluation guidance to participants and allows the BPA to track EE achievement. Certified energy auditors inspect and verify EE and RE measures to ensure that they are in compliance with technical specifications. In a different EE program, BPA contracts for energy savings with individual customers. Historical data and technical expertise are used to agree upon a baseline. The contract includes a detailed, transparent verification process.

Initially in *Brazil*, the EE PBF program had no requirement for independent verification of results. Programs were considered a success if the financial benefits to the utility of the saved energy paid for the funds invested. Recently technical experts have been working with ANEEL (the national regulatory agency) and PROCEL (the national energy efficiency agency) to develop new measurement, verification, and evaluation processes.

In *New South Wales, Australia*, the government has set very clear goals for the Greenhouse Gas Abatement Scheme for the state as a whole, as well as for each participant. Technical experts have assisted the government in developing a technical manual and other aids based on engineering studies, best practices and other studies, to guide participants in their choice of cost-effective measures. Participants provide benchmark statements at least annually. The program administrator uses third party verifiers to audit and verify program compliance and results. The importance of evaluation was shown when unsatisfactory results of previous programs were used to justify new legislation in 2002, which created this program.

In *New York*, the PBF goals are established by the regulatory body. These have changed over the lifetime of the PBF programs; the evaluation program has been amended accordingly. During the first phase of evaluation, program screening and predictions, NYSERDA (the program administrator) uses Technical Advisory Panels. These include outside technical experts as well as staff from the Department of Public Service (DPS). Evaluation metrics and performance measurements are included in program design. The DPS staff, consultants and the Advisory Group all provide evaluation guidance and add to the perceived fairness and balance of NYSERDA's evaluation process. NYSERDA uses almost continuous evaluation to reveal opportunities to improve programs and processes. NYSERDA has to file detailed evaluation reports biannually with the utility regulatory body (the pblic service commission, or PSC), and files many interim reports. NYSERDA primarily uses the Total Resource Cost test to determine cost-effectiveness of EE programs. NYSERDA uses third party contractors to evaluate its own performance. Ultimately, the Advisory Group is supposed to independently certify evaluation results to the PSC.

In the *UK*, clear goals for EE programs derive from the Climate Change Programme. Two EE programs paid for with ratepayer funds are the Energy Efficiency Commitment (focused on residential customers) and the Enhanced Capital Allowance Scheme (focused on commercial and industrial customers). In both cases, for the first phase of evaluation the UK uses technical experts, studies, and previous experience to determine qualifying measures or technology, and to determine the impact of these measures on program goals. The government regulator, Ofgem, uses staff and contractors to collect data on the actual results achieved by the Energy Efficiency

Commitment. An expanded Total Resource Cost test, including economic, social and environmental gains is used to determine cost effectiveness.

California has been a world leader in the evaluation of EE programs. Its Standard Practice Manual, and Database for Energy Efficiency Resources, as well as protocols, guidelines and handbooks for evaluating DSM programs, are well known. Presently state agencies, consultants and utility staff cooperate to conduct thorough evaluations of PBF programs. However, California is moving to improve its energy program evaluation practices through the Statewide Evaluation Framework Project. Regulators, technical experts, and other stakeholders are involved in this substantial re-thinking of evaluation. For an extensive discussion of the issues raised by this process, see the 4/28/03 minutes of the California Measurement Advisory Council (CALMAC) Public Workshop on the Statewide Evaluation Framework Project at http://www.calmac.org/events/CALMAC_April_29_Workshop_Minutes.doc

12. Effectiveness of PBF Programs

Public benefits funds for RE and EE, where they have been applied consistently and thoughtfully, have begun to have significant effects on building RE and EE markets, as well as reaching other goals such as saving energy, reducing peak load, and increasing the diversity of environmentally-friendly supply. Below we review some of these experiences, and discuss some of the most important lessons learned. We do not describe the effectiveness or results of individual PBFs in detail; these details are best understood by reviewing detailed documentation from each individual PBF program.

One underlying lesson should be emphasized up-front: while PBFs have now demonstrated some significant successes, a PBF is unlikely to be the most important mechanism for achieving significant RE and EE investments. For EE, minimum appliance and building energy efficiency standards are likely to be the least-cost method of achieving significant savings. For RE, feed-in tariffs and renewables portfolio standards may ultimately be more important in driving large-scale renewable energy developments. It may therefore be useful to consider a PBF as a key *complementary* policy that can have significantly beneficial effects, especially when used in *combination with* other public policies and efforts.

12.1 Review of Early Lessons Learned

Before discussing the effectiveness of EE and RE PBF programs individually, however, it is useful to review some of the most significant overarching lessons from PBF experience, as discussed in Wiser et al. (2002), Wiser et al. (2003), York and Kushler (2003), and Harrington and Murray (2003):

- **PBF Funds Are Continuously Learning from Experience:** Perhaps the most obvious observation from experience with PBFs is that a large number of innovative renewable energy and energy efficiency programs have already been developed by these funds. It is also evident that PBF fund administrators are learning from their own experiences, and the experiences of others, and that program designs are therefore in constant flux.
- **No Single Program "Solution" Is Apparent:** The renewable energy market is a diverse and complex one, with a variety of technologies and applications vying for market share. These diverse technologies and markets have driven different jurisdictions to design an equally diverse set of programs, each using incentives that are targeted to specific renewable energy markets and applications. Moreover, even among the policy approaches used to target individual technologies and applications, frequently no single program stands out as optimal. This may in part be due to limited experience with different program options. This experience suggests that multiple program designs, careful use of professional judgment, and a willingness to experiment with a variety of program options will be keys to the success of a renewable energy PBF fund. Although the results of a specific energy efficiency program may be slightly more predictable than a renewable energy program, the optimal mix of energy efficiency programs for a given jurisdiction is often not immediately apparent, either. The unique efficiency opportunities, PBF resources, and priorities of a jurisdiction will result in a constantly evolving set of energy efficiency program portfolios.

- **Programmatic Goals Should Drive Program Designs:** Experience with PBF funds illustrates the need to tie program design and fund allocation to the more fundamental mission, goals, and objectives of the fund. With clearly articulated mission statements, goals, and objectives, for example, it may be easier to select among the multiple options for supporting photovoltaic markets. Similarly, allocation of funds across customer sectors (e.g., industrial vs. small commercial), technology types (e.g., wind vs. PV), and incentive structures (e.g., grants vs. loans) must be driven by an initial set of goals and objectives. Clearly articulated goals may also ease the task of establishing appropriate metrics to measure a fund's success.
- **Discretion and Flexibility in Program Design Can Enhance Success:** PBF fund managers are continuing to experiment with new program designs and innovations, and knowledge of how best to support renewable energy and energy efficiency markets is rapidly being gained. To capitalize on this learning process, flexible program designs and ample use of discretion by fund managers in designing programs and selecting projects appear to be essential. Seeking input (and buy-in) from outside advisory groups and stakeholders can be vital to this process.
- **Long-term Funding Uncertainty Can Severely Limit the Effectiveness of a PBF Fund:** This issue is discussed in Chapter 5, and is not further discussed here.
- **Markets for Smaller, Distributed Projects Have Proven Harder to Build:** Customer-sited, distributed renewable projects have typically required far more aggressive funding levels on a per-kWh basis than larger-scale RE projects. U.S. states and different countries continue to experiment with a variety of program types to enhance the success of their efforts towards customer-sited installations.
- **Working Closely with Utilities Can Prove Critical to RE Fund Success:** Electric utilities and competitive electricity suppliers play a significant role in the renewable energy market. Utilities will generally retain responsibility for the interconnection of customer-sited renewable generation regardless of electric industry structure. Utilities and other electricity suppliers will also remain the primary purchasers of renewable electricity through long-term, power purchase agreements. Experience described below shows that the success of renewable energy PBFs will be strongly influenced by the willingness of utilities and competitive electricity suppliers to sign long-term power purchase agreements with renewable energy projects.

12.2 Effectiveness of Renewable Energy PBF Programs

A large variety of programs have been implemented through PBF mechanisms, but experience with renewable energy PBFs and related mechanisms are not described in comprehensive detail here. Instead, this section summarizes key impacts and lessons learned in four areas: (1) support for large-scale RE projects, (2) support for RE distributed generation, especially PV, (3) industry support activities, and (4) more general lessons applicable to developing countries.

Support for Large-Scale Renewable Energy Projects

Some of the most visible successes – and failures – of PBF programs have come from the development of large-scale RE projects. PBF programs have supported utility-scale renewable energy projects in a variety of ways. We describe many (but not all) of these efforts below.[13] For additional information on US experience, see Bolinger and Wiser (2002b), Wiser et al. (2002), and a number of case studies at http://eetd.lbl.gov/ea/ems/cases/. For additional information on the UK NFFO (and a corollary policy in Ireland), see Mitchell (2000) and Wiser (2002).

- **Capital Grants:** Most common in early programs (often funded by general government revenue) was to use up-front capital grants to support wind, biomass, geothermal, and other technologies. These programs did in fact have some success in initially launching renewable energy markets. For example, programs in Denmark helped to launch the wind industry in that country, and efforts in Sweden and other countries have also shown some success (see Haas 2000 for some additional details on these programs). Despite some positive experiences, however, it has become increasingly unpopular to use such capital subsidies (there are some examples, however, e.g., Illinois and Minnesota in the U.S.). The principal reason for this is that up-front capital grants do not offer as strong an incentive for project performance as other production-based incentive mechanisms. On the other hand, it deserves note that there is one major disadvantage with production-based incentives, and a corollary advantage for up-front capital grants: production-based incentives require surety that incentive funds will be available for the entire duration of the production payment. Elimination of the production-based incentive (or even the risk of elimination) due to political forces, budget cutbacks, or other reasons can devastate a production-based incentive program. Such is not as obviously the case with up-front capital awards, which are at least certain once they have been paid. The bottom line is that for developers, capital grants provide a more stable and certain revenue stream than do production-based incentives.

- **Fixed Production Incentives:** Recognizing the poor incentive properties of capital grants, some countries instead turned to fixed production incentives. These programs offer a fixed incentive, denominated in $/MWh, which is additional to electricity sales revenue and is provided for a known duration to either all eligible renewable energy projects or to projects that are pre-screened by the administrator (perhaps up to a cap in funding levels). These programs have been used in Denmark (funded by central government revenue), Germany for CHP funding, the Netherlands (funded through an electricity surcharge), and Minnesota (funded with general government revenue and through electricity rates). In some ways, this approach is a hybrid of a PBF and a feed-in tariff. Because it contains some of the key benefits of a feed-in tariff – market stability and certainty of payment – this approach has shown significant success where the combination of the production incentive and an electricity sales contract makes a project profitable. However, as noted above, developers must be certain that the incentive will in fact be available for its entire stated duration.

- **Auctioned Electricity Contracts:** Within the last 10 years, a number of countries have instead opted to auction off incentive funds, in the hope of encouraging competition and driving down costs. One approach to such an auction has been applied in the UK, and to a lesser extent in Northern Ireland, Ireland, Scotland, France, Oregon, California, and Brazil: auctioned electricity contracts, the above-market costs of which are recovered through a PBF.

[13] / Note, again, that we do not discuss here the use of PBFs to help fund traditional feed-in tariff systems; while these systems have arguably been far more successful than the efforts discussed below, they are outside the scope of this report.

The UK has the most experience with this approach, through the NFFO, and it is therefore experience in the UK that is emphasized here, along with experience in Ireland.

Until recently, the NFFO was the principal form of support for renewable energy in the UK. Through this process, between 1990 and 1998, renewable generators were able to bid for above-market PPAs in five NFFO auctions intended to result in 1500 MW of declared net capacity (DNC) by 2000 (Mitchell 2000). The UK's 12 regional electric companies were required to purchase the output of any project in their region awarded an NFFO contract, and were refunded the difference between the monthly NFFO price and the market price of power (the UK power pool price) via a surcharge on electricity consumption (i.e., a PBF). A similar mechanism has been operating since 1995 in Ireland and continues to this day (called the AER), with 5 competitive bidding rounds held so far.

These solicitations were "full cost" auctions that asked renewable developers to bid the PPA price that they would require to come on line. Instead of the state paying this price directly to the developers, however, the utilities were required to enter into these PPAs but were subsequently reimbursed for any above-market costs that were incurred. Clean energy fund support was therefore directed to the purchaser of the electricity – the utilities – rather than to the project developer. Unlike a production incentive (discussed below), a full cost auction eliminates the risk of not finding a long-term PPA with a credit worthy buyer.

NFFO1 and NFFO2 offered PPAs that expired at the end of 1998, while NFFO3, 4, and 5 offered 15-year contract terms, as has the AER in Ireland. Within each auction there have been separate "bands" for different renewable technologies, and in some rounds there have been sub-bands for small wind projects, therefore ensuring a more diverse set of winning bidders. Winning bidders are those that have the lowest PPA bid prices in their specific band, and winners are offered PPAs at their bid price.

The structure of the NFFO and AER solicitations solved one major problem – that of the PPA – and also resulted in deep price reductions over time. For example, the average 15-year PPA price of winning bidders in NFFO3 was 4.2 pence/kWh, while similar bids in NFFO5 were down to 2.7 pence/kWh. The table below shows results from the five rounds of the NFFO, which resulted in 880 awarded contracts for 3271 MW of renewables declared net capacity (DNC). Note that prices in NFFO1 and 2 are not directly comparable to NFFO3, 4, and 5 because PPA lengths were raised from 8 to 15 years. (Results of the AER, not presented here, show similar trends, though the AER competitions have been far smaller in size).

	NFFO1	**NFFO2**	**NFFO3**	**NFFO4**	**NFFO5**
period of guaranteed contract	1990-1998	1991-1998	1994-2009	1997-2012	1998-2013
capacity of winning bids (MW, DNC)	152	472	627	843	1177
installed capacity (MW, DNC)	145	172	293	156	55
average price (pence/kWh)	6.5	6.6	4.4	3.5	2.7

While the basic structure of the NFFO and AER has merit, and the results of the solicitations have been widely lauded as encouraging efficient cost reductions, the NFFO and AER processes have also been strongly criticized. This criticism is based on the observation that the majority of winning bidders have been unable to bring their projects on-line. Out of 3271 MW of awarded contracts, only 821 MW has been installed – a success rate of just 25% so far. AER results are similar. As described by Mitchell (2000), the government's desire to reduce the average price per kWh for each successive order created tremendous competitive pressures to lower bid prices. Two specific design features of the NFFO and early rounds of the AER contributed to what many believe to be a high degree of speculative bidding:

– No Penalties for Non-Performance and Lengthy Development Times: Bid prices have been the primary metric by which winning projects are selected. With no penalties applied to winning bidders that are unable to develop their projects, and with up to 5 years to bring one's project on line, generators were encouraged to bid speculatively based on assumptions of declining technology costs in the future.

– Permitting Hurdles: To further increase their chances of securing a contract, developers naturally looked to the strongest wind sites – which in the UK often coincide with prominent features of the landscape. With no requirements that projects have permits before bidding into the NFFO and initial rounds of the AER, numerous projects faced permit denials after winning an NFFO contract.

Though these elements of the NFFO and AER process do not deserve emulation, the concept of working with or through the utility buyer of renewable electricity deserves the attention of other PBF funds. The idea of regular competitive solicitations to allow technologies to mature and technology bands to ensure resource diversity deserves consideration as well. It is also useful to note the NFFO's move away from the initial 8-year PPAs to 15-year PPAs in later rounds, and the consequent reduction in bid prices. Learning from the NFFO and AER, it is also apparent that penalties for non-performance and closer consideration of siting and permitting issues should be incorporated in competitive bidding processes. These lessons have apparently been learned in Ireland, where the latest round of the AER required that projects have permits *before* they bid, and that winning bidders maintain a tight schedule for completion.

- **Auctioned Production Incentives:** In the United States, a fourth approach has also been tried: auctioned production incentives. Unlike fixed production incentives, in this case projects compete to receive funds (those projects that require the lowest production incentive will win the bid). Unlike auctioned electricity contracts, meanwhile, under an auctioned production incentive the project is assumed to negotiate their own long-term power sales contract, and bid for production incentives separately. This approach to funding large-scale RE projects has been used most prominently in California, Pennsylvania, and New York, though it has also seen some experience in New Jersey, Montana, Rhode Island.

  The specific design of the auctions varies by states, but most typical has been to auction production incentives of 5-year duration. In aggregate, these U.S. states over the last several years have obligated approximately $300 million of PBF funds to support large RE projects through the use of auctioned production incentives. These funds have been obligated to ~2000 MW of renewable energy capacity, over 1600 MW of which is wind power. Projects have, on average, asked for an equivalent production incentive of 0.7 cents/kWh over a 5-year production incentive term, though actual production incentives have varied greatly from one state to the next. The most experience exists in California, where three auctions of 5-year production incentives have been held. A total of 1300 MW of renewables have been obligated ~US$250 million in funds under these three auctions, 900 MW of which is wind power (the remainder being primarily geothermal and landfill gas).

While an impressive amount of funds have been obligated to an impressive number of projects, and at low incentive levels, substantial success cannot yet be claimed. This is because only approximately 400 MW of the 2000 MW has actually been installed to date, and quite a lot of the remaining 1600 MW is not expected to come on line in the near future. Clearly, auctioned production incentives are not a panacea in all circumstances. Key lessons from this experience include:

- Incentives Should Be Linked to a PPA: RE PBF managers often face a "chicken and egg" problem when it comes to auctioning production incentives. On the one hand, these projects require not only PBF-funded incentives, but also a long-term power purchase agreement (PPA). Without long-term revenue certainty from both sources, renewable developers are generally unable to obtain suitable financing to develop their projects. Because auctioned production incentives are not linked to a power purchase agreement (PPA), however, bidders in the auction are uncertain on how much PBF funds they need to make their project economic. This has led to a certain degree of uncertainty in bidding strategies, and to aggressive – even speculative – bidding. A superior approach for China to consider is that of the UK's NFFO, where projects bid their full cost, were promised a PPA, and the PBF was used to cover any "above-market" cost associated with the project. This link to a PPA will generally lead to more certainty in results than a pure production incentive auction, as has been attempted in a number of US states.

- Overly Optimistic Bidding Must be Controlled: While competitive mechanisms have many merits, effective design of the auction is necessary to ensure that funds are put to good use. As with the UK NFFO, a certain degree of overly optimistic bidding has been associated with US experience with production incentive auctions. If there are few penalties for opting out of a successful bid, and if developers do not know the price level of the PPA that might be obtained, renewable energy developers have often bid very low bids into production incentive auctions just to get the bid. If the incentive bid turns out to be too low to allow the project to go forward, the developer was still able to keep other competitors from gaining support. While this has resulted in low production incentive levels, many of these projects have subsequently been unable to come on line, holding up scarce PBF funds in the meantime. More recently, as a result of this concern, state funds have imposed more significant penalties for projects that fail to meet certain development milestones, and have attempted to select projects not only based on a low production incentive bid, but also on the likelihood that the project will be able to obtain a PPA and subsequently achieve commercial operation. A known schedule of smaller auctions might also help alleviate this concern.

- **Low-Cost Loans:** At least one US state has explored using low-cost debt as a way of supporting utility-scale RE projects with PBF funds (Pennsylvania). IREDA, in India, has also pioneered the financing of renewable energy projects, and has helped to bring on line numerous large and small renewable energy projects through its revolving loan program (more than 360 MW of wind alone, and a sizable amount of small hydro as well). Other countries such as Germany have offered low-cost capital to renewable energy projects as well, though not always financed with PBFs per se. While the availability of financing alone is unlikely to be sufficient to drive substantial expansion in RE markets, the combination of PBF-funded financing assistance with other policy efforts can be effective. These programs are especially valuable if they help to leverage private capital, assuring that – over time – the private market obtains the comfort necessary to finance projects directly. Based on this positive experience, the use of PBF funds to provide low-cost debt to large renewable projects should be considered in China, but only if projects are able to receive favorable PPAs or have access to other incentive funds to make the projects profitable.

Support for Distributed Renewable Energy Systems

PBFs have also been extensively used to support distributed, customer sited RE systems, especially photovoltaics. The most common system of support is through capital rebates that lower the up-front cost of PV systems. Such rebates for customer-sited PV and other distributed renewable energy projects (e.g., small wind, digesters, etc.) are common because these programs target a key barrier to these RE applications – up front cost. Capital rebate programs of this type are also relatively easy to design and implement, and can create quick and tangible results.

Some of the most significant "buy-down" rebate programs from RE in distributed applications currently exist in Japan, California, New Jersey and a large number of additional U.S. states, and Australia. Other programs in existence, or once used, include those in Austria, Germany, the Netherlands, and Spain. Operating in developed countries, most of these programs focus on grid-connected markets for RE distributed generation. Those programs that emphasize off-grid RE installations include efforts in Brazil, India, and Australia; many other examples exist of such programs, often funded in significant part by multilateral and bilateral aid organizations.

Here we focus just on the efforts in the US and Japan, the two largest current rebate programs for PV. Experiences in other jurisdictions are rather similar to that in California and Japan, so additional detail on other jurisdictions is not offered here. (For experience from other rebate programs, see Haas 2003).

- **Japanese Experience with An Aggressive Rebate Program for PV:** Though funded with central government revenue, not through a traditional PBF, Japan has perhaps the longest and most successful experience with a rebate program for PV. The program, which consists of aggressive, yet declining, incentive levels and (in some locales) low-interest consumer loans and a parallel education campaign, has achieved significant success. From 1994 through 2001, the program has supported ~300 MW of grid-connected PV capacity; the growth in installation rates, from 1.9 MW in 1994 to 115 MW in 2001, is astounding. Incentives began at approximately 50% of installed costs, but have since dropped to 30% or less of installed costs. The program funds primarily residential systems, unlike experience in the U.S. where larger commercial rooftop systems have dominated. The rebate is administered by the New Energy Foundation, part of the Ministry of Economy, Trade, and Industry. As the market has grown, so too have costs declined: an important result for such a program that seeks to create a sustainable market over the long-term. The installed cost of residential grid-connected systems has reportedly declined from nearly $11/W in 1995 to less than $7/W in 2001. These results have, however, come at a cost. In 2001 alone, roughly US$200 million were allocated to the PV buy-down program. The Japanese government is now beginning to phase out the incentives. (See Haas 2003 and Bolinger and Wiser 2002c).

- **U.S. Experience with Buy-Down Programs:** Most of the US state PBF programs have established rebate programs for customer-sited (and typically grid-connected) PV, small wind, and even biogas systems. These rebates, at least for PV, range from US$2/Watt to US$6/Watt, often capped at 50-60% of installed cost. The design details of each state program are somewhat unique (in terms of incentive levels, installation and equipment requirements, etc.), but each program intends to help overcome the first-cost barrier for PV. The largest program is in California, with sizable programs also in existence in New Jersey, Illinois, New York, and other several other states. These programs have been operating for a maximum of 5 years, and have so far supported over 50 MW of PV (not all of which is yet installed). Installation rates under these programs were initially below expectations, but have continued to increase over time. In aggregate, these programs are having their intended effect in increasing PV generation in grid-connected applications. In California alone, 44 MW of total grid-connected PV capacity is currently on line; 35 MW of this has come on line since 2000 under the available incentive programs with growth continuing. Both residential and commercial PV systems are common, though the greatest growth has been for commercial rooftop PV systems. This level of growth requires substantial incentive funds, however, with California currently obligating more than US$100 million each year just for PV systems, and with incentive levels currently averaging over $4/Watt. For additional details on U.S. experience, see Bolinger and Wiser (2002a), Bolinger and Wiser (2003), Wiser et al. (2002), and case studies at http://eetd.lbl.ea/ems/cases, etc.

While experience in both Japan and the US is positive, again a number have lessons (both positive and negative) have been learned:

- **High incentive levels are required to support customer-sited PV**: While the cost of PV continues to decline, it remains an expensive technology, requiring substantial incentives to spur the market especially in grid-connected applications where less expensive, grid-power is available. Initial incentive levels of US$4-6/W seem necessary to spur significant sales in a developed-country context for grid-connected systems. China is not likely to be an attractive market for grid connected PV (given its costs), though off-grid and mini-grid markets may be especially attractive.
- **Consider declining incentives over time**: While incentives must initially be high, incentive levels for PV should, in theory, decline over time, helping to ensure the creation of a self-sustaining market over time. Assuring that PV costs decline, however, may require a sustained, long-term, stable incentive policy that is able to attract manufacturers and

installers to make significant investments in a state or country. PV cost reductions should not be taken for granted.

- **Complementary policies are essential**: Simply offering a rebate program is not sufficient to grow the market for grid-connected PV. Interconnection barriers must be eliminated, net metering offered, customer education must be built, and complementary loan programs may help increase the size of the potential market. Where PV markets have really blossomed (e.g., Japan, Germany, and now California), all or most of these complementary policies have been in place.
- **Incentives for system performance may be necessary**. Smaller residential PV systems in particular have faced some performance problems. As a result, several US states are experimenting with some level of performance based payment ($/kWh rather than $/kW), installation training and certification programs are being developed, and extended warranties are beginning to be required. In general, if incentives are established on a $/kW basis, some type of performance monitoring system should be developed. Additionally, over time, a transition to production-based support should be considered. (It also deserves note that the second largest market for PV worldwide, Germany, has successfully used $/kWh payments in lieu of up-front rebates to drive growth in the PV market).
- **Targeting "niche" applications**: Given the high relative cost of grid-connected PV and other distributed RE systems, some US states are emphasizing "niche" markets for PV: markets in which the economics of PV, small wind, or other renewable distributed generation are more favorable. Such markets include new construction, agricultural pumping, remote telemetry, green buildings, PV as a way to offset T&D needs, etc.

Industry Support Activities:

While the above incentive policies emphasize near-term renewable energy installations, there is no doubt that building industry infrastructure over a longer time period can be essential, especially where limited RE industry infrastructure currently exists. Though hard to evaluate analytically, a number of US states and countries have found value in augmenting project-specific financial incentives with various programs to increase the capacity of renewable energy firms in developing and marketing their products.

Of course, the appropriate scope and type of industry and infrastructure development will vary by jurisdiction, but might include: (1) market assessments, resource studies, and renewable resource site prospecting, (2) low-interest loans and equity financing to renewable energy manufacturing companies, (3) renewable energy R&D grants, (4) business development grants, and (5) customer education on the merits of and applications for renewable energy.

Other Lessons Learned – Multilateral Aid Experience

While not strictly PBF programs, experience with multilateral and bilateral donor grants and incentives offers some lessons that are of relevance to the development of PBF programs. This is especially the case because many of the RE programs discussed above were implemented in a developed country context, while bilateral and multilateral aid programs emphasize developing countries and the unique institutions and needs of those markets.

Some of the key lessons from this experience are described in Martinot (2001, 2002), and Martinot et al. (2000, 2002), and can be extrapolated to include:

- Affordability is a key barrier to rural household use of RE; while grants can help alleviate this barrier, building an infrastructure for credit (i.e., low cost loans) should also be explored. Programs should not be constrained by requiring systems to be larger than can be afforded by the target population.
- Subsidies can be used to effectively increase initial market volume, local expertise, user awareness, technology standards, and entrepreneurial activities. However, subsidies are unlikely to lead to sustainable markets unless they explicitly create the conditions whereby they are no longer needed (i.e., "smart" subsidies). Subsidies can undermine private investment and business in new markets, and should be applied with attention to private sector conditions in a particular market. Subsidies would ideally be targeted at production, not investment.
- Codes, standards, testing, and certification regimes are necessary to ensure that only high quality RE equipment is employed. Funding mechanisms that promote production-based rather than investment-based incentives should be preferred.
- There is perhaps a greater need to target incentives to off-grid renewable energy applications that are integrated into "productive" uses (either income-generating uses, or social uses, e.g. water, health, education, agriculture, entrepreneurship).
- Renewable energy businesses – especially in rural areas – often face a high-risk business environment. Funds should be targeted to assist RE-based businesses to build sustainable and viable businesses (through loans, technical assistance, marketing support, market studies, pre-feasibility studies, and other means).
- Developing private-sector financing mechanisms is key to large-scale RE development.

For additional detail on World Bank/GEF experience, the series of reports by Martinot, cited above, should be consulted.

12.3 Effectiveness of Energy Efficiency PBF Programs

Energy efficiency programs funded through utility rates have been proven effective over the last twenty or more years. In the last five years, energy efficiency funding derived from statewide or regional public benefits funding has proven its practical value as well (Nadel and Kushler 2000). We have learned that there is no single correct approach to fund design, PBF administration or specific program design. Every one of the program types outlined in Nadel and Geller (1996), and described in Chapter 7, is still used cost-effectively today. In fact, as time has progressed, program targets have been refined, new partners/allies have been identified, and many PBF program evaluations note the synergies of different EE programs supporting each other.

Energy efficiency programs funded by utility funds or PBFs during the 1990s saved energy at an average cost well below the cost of supplying electricity. In fact, a 1998 study of six market transformation programs in the U.S. showed savings produced at less than US$0.01/kWh (Nadel and Latham 1998). Those energy savings provided environmental benefits by reducing the need to operate fossil fuel-based power plants. EE programs also often cut peak power demand, postponing costly investments in new power plants as well as transmission and distribution system upgrades, and helped to improve power system reliability. While not all EE programs will save energy at a cost as low as US$0.01.kWh, EE programs have been consistently shown to provide energy savings at a lower cost than conventional electricity production options.

Energy efficiency programs in the U.S. have continued to be effective despite the fact that funding has not yet rebounded to the level of the early 1990s, pre-electricity reform. States have varied in their commitment to EE programs. In 1998, the top spending states (dedicating at least 1-2% of utility revenues to EE) saved the equivalent of 6% of their total electricity sales. The American Council for an Energy Efficient Economy (ACEEE) calculated that if all states and utilities had achieved this level of savings, national electricity consumption in 1998 would have been reduced by about 200 billion kWh, nearly four times the actual savings (Nadel and Kushler 2000).

A review of PBF program evaluations and annual reports yields some generalizations about program effectiveness. One of these findings is that there are clearly cost-effective EE programs for every customer sector. However, in general, EE programs focused on the industrial sector have proven to be the most cost-effective; these programs often save the most energy for the least cost per kWh. Programs focused on commercial customers often cost a bit more, and small commercial customers are typically harder to involve than large commercial customers. Residential programs have also been shown to be cost-effective, but often do not bring the dramatic results of large commercial and industrial programs. Nonetheless, residential participation rates are often higher than small commercial participation. Low-income programs can also be cost-effective, but will generally require more investment per kWh of savings than most other EE programs. Still, most EE PBF programs target all customer sectors for reasons of fairness, for market transformation, and because there are energy efficiency savings to be gained.

Although the U.S. has many years experience with EE programs, there are still fairly simple program opportunities that could have a large impact. For instance, Nadel and Kushler (2000) identified four highly effective EE programs that could significantly reduce peak demand:

- Commissioning (tuning) heating, ventilation, and air conditioning (HVAC) and other systems in existing large commercial buildings;
- Improving the installation and maintenance of residential and small commercial air conditioning systems:
- Purchasing high-efficiency air conditioning and chiller systems when new systems are installed or old systems are replaced; and
- Upgrading lighting systems in commercial buildings.

Together, these four measures have the potential to reduce peak US electrical demand by about 100 GW (more than 10% of 2000 national peak demand).

Results from Three U.S. States

Here we briefly discuss results from three states that have used PBF funds to support EE activities for three to five years. Each of these states uses a different administrative model, and supports a wide-ranging portfolio of EE programs that matches each state's unique opportunities and priorities. Each state has used independent evaluation to report results related to goals. The results make it clear that energy savings and other desired results can be achieved cost-effectively using different administrative structures and program approaches. The reader also gains an appreciation for the unique priorities of each of these jurisdictions by reviewing the results they choose to report.

Massachusetts (utility administered EE PBF)

Results taken from *2001 Energy Efficiency Activities in Massachusetts*, published by the Division of Energy Resources, summer 2003 at http://www.state.ma.us/doer/pub_info/ee01.pdf

Massachusetts spent US$135.1 million in PBF funds on EE in 2001

EE PBF fund = 2.4% of electric rates (approximately)

- 60% of funds were spent on retrofit programs for all customer sectors. Funds used primarily for rebates.
- 24% of funds were spent on lost opportunity/new construction programs. Funds used for rebates and to influence standard building practices as well as codes and standards.
- 11% of funds were spent on regional market transformation activities
- 4% of funds were spent on educational activities

Total Expected Lifetime Energy Savings	4,571 GWh
Total Participant Annual Energy Savings	$28 million
Total Participant Measure Lifetime Energy Savings	$332 million
Average Cost for Conserved Energy	$0.04/kWh
Average Retail Cost of Electricity	$0.097/kWh
Estimated savings due to peak demand reduction	$3.6 million
New Jobs created	1,841
Disposable Income from Net Employment	$66 million
Estimated:	
NOX Emissions Avoided: Annual/Lifetime	791/7190 tons
SOX Emissions Avoided: Annual/Lifetime	1,581/10,029 tons
CO2 Emissions Avoided: Annual/Lifetime	280,100/2,231,400 tons
Benefit: Cost Ratio	>2:1

Massachusetts Program Result Issues

- Funds were spent equitably across customer sectors (low-income, residential, commercial and industrial).
- Low-income customers do not participate at as high a rate as other residential customers.
- Small commercial and industrial customers participate less than hoped for, despite potential energy/cost savings and program efforts to target these customers. One identified problem is that these customers lack energy management resources.
- Large commercial and industrial customers participate at a high rate, which was expected due to the high rate of savings they achieve.
- The PBF program increased its competitive procurement of services to 83% of total services.

New York (NYSERDA is the state agency PBF administrator)
Results taken from *New York Energy $mart Program Evaluation and Status Report May 2003,* published by NYSERDA at http://www.nyserda.org/sbcadvisorymay2003.pdf

This report provides an exhaustive discussion of the evaluation of dozens of programs.

New York's PBF program reports the following allocation of funds over its 8-year budget period:

- 38.1% Business and Industrial
- 17.7% Residential
- 12.8% Low-income Energy Affordability
- 22.6% Research and Development, including Renewable Energy deployment
- Remainder: Administration, Evaluation, Environmental Protection

Most of NYSERDA's programs are competitively bid through Requests for Proposals or Program Opportunity Notices. NYSERDA has cost-effectively used all the program types mentioned in Chapter 7:

- audits and technical assistance,
- consumer education,
- professional training,
- financing options (loans, aggregation),
- financial incentives (rebates and others),
- recycling/replacing appliances,
- performance contracting,
- load management,
- direct installation, and
- many market transformation activities.

New York Program Result Issues: Market transformation is an important objective of the NYSERDA program. NYSERDA's evaluation shows that the PBF program is resulting in a higher market share of energy efficient appliances, lighting, new housing and other technologies. Process evaluation showed a high level of participant satisfaction.

NYSERDA uses frequent measurement and evaluation to fine-tune program offerings. The commercial new construction program exhausted its initial budget quickly due to high levels of customer participation. NYSERDA therefore allocated more funds to the program. Standard performance contracting and premium efficiency motors programs, on the other hand, were undersubscribed at first. These programs are still offered, but NYSERDA has refined the targets of the programs.

The following table quantifies the most recent results of NYSERDA's PBF program, as they relate to the overall goals of energy saving, demand reduction, economic development and environmental improvement.

Table S-2. Estimated Energy, Environmental, and Economic Benefits of New York Energy Smart[SM]

Outcomes and Impacts		Outcomes Anticipated From Funds Awarded Through Year-End 2002	Outcomes from Installed Measures Through Year-End 2002
Annual Electricity Savings from Energy Efficiency (GWh)		1,570 GWh	690 GWh
Summer Peak-demand Reduction Potential (MW)[1]		1,120 MW[2]	690 MW[3]
Peak Load Capacity of Combined Heat and Power Projects[4]		44.4 MW	4.8 MW
Annual Energy Generation from Renewable Energy (GWh)		1,000 GWh	150 GWh
Annual Natural Gas and Oil Savings (TBtu)[5]		7 TBtu	3 TBtu
Annual Energy Bill Reduction ($ million) - all fuels[6]		$240 million	$102 million
Annual Emission Reductions[7]	NO_X	2,280 tons	790 tons
Annual Emission Reductions[7]	SO_2	3,950 tons	1,270 tons
Annual Emission Reductions[7]	CO_2	1,834,000 tons (366,000 cars)	639,000 tons (127,000 cars)
Economic Benefits[8]	Jobs per Year	7,600 jobs	3,200 jobs
Cost per KWh Saved[9]	$0.011 per kWh without co-funding $0.044 per kWh with co-funding		
Cost per KW Reduction[10]	$50 per kW without co-funding $70 per kW with co-funding		

(1) Includes energy efficiency measures (permanent reductions) and curtailable load (callable) reductions.
(2) Approximately 62%, or 698 MW is from curtailable load.
(3) Approximately 72%, or 486 MW is from curtailable load.
(4) Represents on-site generation of electricity.
(5) Natural gas and oil savings from the Technical Assistance Program.
(6) Includes bill savings from electricity, natural gas, and oil.
(7) Emission reductions are estimated by applying emissions factors to the energy savings expected from the **New York Energy Smart[SM]** Program. Statewide tonnage caps on nitrogen dioxide and sulfur dioxide emissions from electricity generation sources limit the impact of reduced electricity use on actual emissions of these pollutants. However, the reduction in electricity use represents lower emissions controls costs and reduced need to purchase emission allowances. Based on the current market price of NO_x allowances, the value of the anticipated NO_x reduction of 2,280 tons is $3.8 million. Based on the current market price of SO_2 allowances, the value of the anticipated SO_2 reduction of 3,950 tons is $0.6 million.
(8) Jobs created or retained.
(9) Includes only **New York Energy Smart[SM]** programs specifically targeted toward improving energy efficiency and transforming markets, with sufficient program experience to derive a reliable cost estimate. Low-income, R&D, and renewable energy generation programs are excluded.
(10) Includes only **New York Energy Smart[SM]** programs specifically targeted toward procuring peak KW reductions, including both permanent reductions and callable (demand management) initiatives.

Note: The costs of electricity generation averages between $0.04 and $0.08 per KWh, and between $400 to $500 per KW for a base load and peaking natural gas-fired electricity generator. These cost estimates exclude the cost of transmission and distribution, line losses, and metering and billing, and other ancillary services, which could add well in excess of $0.05 to the KWh costs.

Vermont (Efficiency Vermont is an independent PBF administrator)
Results taken from *Power of Efficient Ideas: Efficiency Vermont: Preliminary Report 2002* published by Efficiency Vermont in 2003 at
http://www.efficiencyvermont.com/DOCS/EVTExecSummary47.pdf

Efficiency Vermont (EVT) attempts to achieve customer sector and geographic equity with its programs. Like Massachusetts and New York, all technologies are targeted, and most forms of program services are utilized. Market transformation and resource acquisition are both goals.

For 2002, the program's costs and impacts can be summarized as follows:

Total costs (participant and EVT)	$16.8 million
Lifetime energy savings (2002 efforts)	573,649,000 kWh
Total annual energy savings	39,560,000 kWh
Total annual participant savings	$26,000,000
Cumulative energy savings 2000-2002	99,248,000 kWh
Cumulative participant savings 2000-2002	$66,800,000
Average cost for conserved energy	$0.029/kWh
Average utility wholesale cost of electricity	$0.063/kWh
New jobs created	100
NOX emissions avoided	1,300+ tons
SOX emissions avoided	4,400+ tons
CO2 emissions avoided	1,000,000+ tons
Business investment rate of return	$65%

Vermont Program Result Issues: Geographic and customer sector equity are important goals for the Vermont program. Initially some parts of the state, and some customers (e.g. small commercial companies), were underserved. Efficiency Vermont took a two-pronged approach. It developed a strong network of partnerships throughout the state with design professionals, builders, contractors and vendors, so that services could be provided statewide. They also targeted campaigns to reach the under-represented markets. Results in 2002 showed that reasonable equity has been achieved.

International Examples
Results from two additional countries, Brazil and Denmark, are described here.

Brazil (national agency and utilities administer programs)
Results reported in H. Geller et al. *Executive Summary of Update on Brazil's National Electricity Conservation Program (PROCEL)*, June 1999, published at http://www.aceee.org/pubs/i992.htm

It is difficult to interpret the results of Brazil's energy efficiency programs under that country's PBF for many reasons. A major difficulty is that supply capacity and electricity demand issues caused the recently departed government to implement electricity rationing. Energy consumption therefore decreased dramatically, but it is difficult to attribute it to the PBF programs. However, we can get some sense of EE program results by examining the program in place just prior to the 1% of revenue program. Until recently Eletrobras/PROCEL, the national energy utility/conservation agency, was responsible for electricity activities. Electrobras/PROCEL estimated that its EE activities from 1986-1998 resulted in approximately 5.3 terawatt-hours per year of savings in 1998, equivalent to 1.8% of electricity use in Brazil.

1986-1998 spending	$260,000,000
1998 savings	5.3 TWh/year
1998 power plant efficiency improvement	1.4 TWh
Avoided construction	1,560 MW of new capacity
Avoided investments	$3.1 billion
Benefit: cost ratio for utilities	12:1
Environmental benefits	Avoided need for fossil-fuel plants
Source of savings	33% efficiency improvements in appliances
	31% lighting efficiency improvements
	13% meter installation
	11% motor upgrades
	8% industrial programs
	4% other

Denmark (independent organization and utilities administer PBFs)

Results reported in *Energy Efficiency in Denmark June 2003*, published by the Danish Energy Authority at http://www.odyssee-indicators.org/Publication/PDF/Denmark_r02.pdf

Although this report does not attribute specific energy savings to particular energy efficiency programs, it did report on the effectiveness of several types of programs:

- **Energy labeling:** Extremely effective at increasing choice and sales of the most energy efficient appliances, as well as consumer electronics, windows, oil boilers, small buildings, and industrial electric motors and ventilation equipment.
- **Energy management scheme:** Subsidized audits of all large buildings revealed opportunities to reduce energy and water use. Substantial savings were achieved, but the program was not as efficient as it could have been because all buildings had to be audited every year, even those with little likelihood of savings, and the audit was not always compatible with the user.
- **Tax reduction for efficiency agreements:** Large consumers received an energy tax reduction if they committed to energy savings investments with paybacks of less than 4 years and agreed to implement an energy management plan. Over half the energy savings came from the energy management implementation rather than savings investments.
- **Demonstration projects:** Subsidies were available for new processing plants or larger renovations to utilize energy-conscious planning and serve as demonstration projects. On average, these projects saved 50% compared to conventional building/renovation.

Danish Program Result Issues: For many years, until the recent change in government, Denmark used subsidies/rebates as the primary tools for achieving energy efficiency with its PBF programs. The new government intends to move from subsidies to market initiatives, and allow no increases to taxes. Program incentives are likely to change substantially.

Lessons Learned/Best Practices in EE PBF Programs

The American Council for an Energy Efficient Economy (ACEEE) recently requested nominations and conducted a national (US) review of EE programs, many funded by PBFs, to identify exemplary programs that could be replicated elsewhere (York and Kushler 2003). The factors considered to identify high quality programs were: direct energy savings, market transforming effects, good quality ex post evaluation methods, innovation, replicability and qualitative achievements such as participation rates, customer satisfaction, and stakeholder support. Nominated programs addressed the full range of customer sectors, targeted end-uses and technologies, and program services. Both resource acquisition and market transformation programs were represented.

Although every nominated program was noteworthy and the overall quality of programs was considered high, approximately 40 programs were honored as exemplary. The exemplary programs reported the following results:

Annual Energy Savings	Cumulative Energy Savings (to date)	Peak Demand Savings (1^{st} year)	Total Cost	Cost/kWh
2,000 GWh	20,000 GWh	500 MW	$250,000,000	$0.0125

York, Kushler and their panel of experts observed the following traits and features in high quality programs (not all programs include all traits):

- "Comprehensive" approaches are being taken in all customer sectors. Services that address all systems and technologies that function together in a building or process can yield more savings at less relative cost than services focused on only one system or technology.
- Customized services and customer-focused approaches are common. "One size fits all" approaches do not meet customer needs in many markets.
- Programs sell more than energy efficiency. Achieving energy savings requires providing other values to customers. Residential customers are interested in the comfort, convenience, cost savings, superior product performance, and increased home value that can come with EE improvements. Commercial and industrial customers value improved productivity, greater reliability, cost savings for operations and maintenance services, improved aesthetics, and comfort.
- Some successful programs are tightly focused on a single technology or service. Targeting a single end-use technology (e.g. lighting, windows, commercial HVAC, compressed air) can be very effective. ACEEE noted that successful programs used a variety of integrated tactics to promote the technology.
- Program marketing and support services are essential for program success. Good marketing is essential to achieve high participation rates. Good training and technical assistance are essential for the programs to result in high energy savings.

- Financial incentives are still important and effective elements of successful programs.
- Partnerships, alliances and collaboratives that bring together a wide variety of market actors are keys to achieving significant market impacts.
- ENERGY STAR label has become more widely recognized as the brand for energy efficiency, which aids program marketing and significantly impacts customer purchasing behavior. (It should be noted that although the success of the ENERGY STAR label is helpful, in some applications ENERGY STAR is not the most energy efficient option and should not be considered the best practice.)
- Support programs such as research, development and demonstration programs and consumer and professional education programs complement the more targeted EE programs. RD&D programs identify and develop the next generation of EE technologies. Education and training programs improve the energy use, management and decision-making skills of consumers and professionals.

13. The Need for Complementary Policies

International experience proves that PBF programs can effectively spur energy efficiency and renewable energy markets, but that complementary policies are also needed to ensure that these markets flourish. For energy efficiency, such policies might include: (1) building codes and standards, (2) appliance efficiency standards, (3) labeling initiatives, (4) and regulatory incentives. For renewable energy, complementary policies to be considered include: (1) renewables portfolio standards, (2) feed-in tariffs, (3) tax incentives, and (4) standardized interconnection policies and power purchase agreements. We do not discuss each of these complementary policies here, but we do discuss two of the most important policies: (1) regulatory incentives for regulated utilities that encourage EE, and (2) the need for long-term power purchase agreements for RE.

13.1 Minimize Utilities' Financial Disincentive to Pursue Energy Efficiency

In Chapter 10, we mentioned the potential need for specific financial performance incentives if regulated utilities are to administer energy efficiency programs in particular. Even if utilities are not selected to administer EE PBFs, however, minimizing the utilities' financial disincentives to pursue EE remains critical.

As discussed in Eto et al. (1998), it is important for policymakers in a restructured electricity industry to ensure that ratemaking and other regulatory policies do not work at cross purposes to energy-efficiency policy objectives. Of critical importance are ratemaking incentives for regulated firms (i.e., transmission and distribution utilities). Regardless of the ultimate structural or organizational form that utilities will take, regulatory policies will continue to influence utilities' decisions on the expansion of local distribution systems and investment decisions in supply- and demand-side resources to meet load. The approaches taken to regulate the prices and revenues of these utilities will have a sizable influence on whether these same utilities fairly compare supply and demand side options. The single most important factor affecting utilities' willingness to treat demand-side resources on an equivalent basis as supply-side options is profitability. Does investment in demand-side resources improve or worsen the companies' profitability? The answer to this question depends on how the utilities' rates are set.

Traditionally, rates are set so as to assure a utility a reasonable opportunity to recover the reasonable costs it incurs to provide service. Described very simply, the regulatory body estimates (1) what a utility's electric sales in a defined period (generally a year) will be and (2) what its total costs to produce those sales in that period will be. By dividing cost by sales, the regulator can determine a simple price per kilowatt-hour. (This is true for both vertically integrated and distribution-only utilities.) This method of rate setting gives companies a very strong incentive to do two things: cut costs and increase sales. Both actions will lead to increased profits. Energy efficiency, however, reduces sales, and consequently utilities are disinclined to invest in it, unless their profits can be assured through some other means.

One method for protecting a utility's profits from being eroded by the reduction in sales caused by energy efficiency is called the "net lost revenue" adjustment. This accounting mechanism treats certain revenues that a utility would have collected from kilowatt-hour sales that were avoided by EE as a cost to be included in future rates. This method can be effective at reducing the utility's disincentive to invest in EE, but it requires accurate estimates of (1) revenues the utility would have received but, because of the EE, did not and (2) the cost that the utility would have incurred if it had made those avoided sales. The difference between the two numbers is the net lost revenue (it consists of that portion of the rate that covers profits and fixed costs that the utility cannot avoid through EE in the short run).

Traditional rate-making methods and accounting adjustments can be administratively burdensome and, in an effort to reduce the time and costs of setting rates, alternative approaches, generically referred to as performance-based regulation (PBR), have been developed. Many countries that have reformed their electricity industries have experimented with various forms of PBR, which attempt to mimic the pricing and cost-minimizing discipline of unregulated markets, for business activities that remain regulated after restructuring. However, the predominant form of PBR, called price caps, is similar to traditional ratemaking because it provides strong incentives for regulated firms to increase sales, which is at odds with promoting energy efficiency. This has been a concern raised in a number of countries, including in the U.K., where distribution utility profits have been tied in large part to electricity sales (Eyre 1998). Revenue cap approaches to PBR eliminate the incentive to increase sales while retaining the important cost-minimizing incentives inherent in performance-based rates (Comnes et al. 1995).

Although price caps and revenue caps have profoundly different effects on a utility's behavior, they certain general features in common. The following formula can be used to describe either structure.

$$Cap_2 = Cap_1(I\text{-}x) +/- z$$

The cap (Cap_2) (capped prices or revenue) equals last year's cap (Cap_1) times some index(I) (such as consumer inflation) which broadly gauges growth in costs, less a productivity factor (x), plus or minus items that are not covered by the PBR ("z" factors, which typically deal with events that are beyond the utility's control but not reflected in the inflation adjustment).

Under either the price or revenue approach, the caps are typically set for a fixed period of time. The cost-cutting incentives for price and revenue caps are identical. The main difference is, as previously mentioned, that price caps also encourages increased sales and hence discourage end-use energy efficiency. Under revenue caps, the incentives to invest in energy efficient range from neutral to significant.

Revenue caps make the most sense if one of the goals of the PBR is to encourage end-use energy efficiency and if costs in the short run do not vary with sales volume. Price caps make the most sense if end use energy efficiency is not a goal and if costs vary with volume. With respect to distribution utilities, the data are fairly clear that costs do not vary much with kWh volume, making revenue caps the most sensible approach. (Costs may relate to growth in the number of customers served but not to the growth in electricity use per customer.) The primary difference between price caps and revenue caps is the incentive created for demand-side management or end-use energy efficiency.

Lastly, we note that it is possible to create a set of financial incentives designed specifically to reward superior performance in delivering energy efficiency services. Such performance incentives could be offered under both traditional rate-making and PBR schemes. A variety of incentives could be designed, for example, a higher rate of return on investment or a small payment per kilowatt-hour saved. These "bonuses" would be collected in future rates. It is critical that the incentives be carefully designed and monitored, in order to assure that they encourage the behavior desired.

13.2 Ensure that RE Projects Can Sell Their Power Under a Long-Term PPA

Experience shows that the success of renewable energy PBF funds will be strongly influenced by the willingness of utilities and competitive electricity suppliers to sign long-term power purchase agreements with renewable energy projects. In fact, PBF administrators often face a "chicken and egg" problem when it comes to providing incentives to utility-scale renewable energy projects. On the one hand, these projects typically require not only financial assistance from the PBF, but also a long-term power purchase agreement (PPA); in fact, reliable PPAs are the single most critical requirement of a successful renewable energy policy. On the other hand, RE PBFs are often responsible for only one of the two requirements: state financial assistance. The somewhat limited success of the production incentive auctions in the United States therefore perhaps comes as little surprise: these incentives were provided without the promise of a PPA.

Clearly, a proper linkage between fund solicitations and long-term PPAs is crucial to success (Bolinger and Wiser 2002b). In several US states, PBF managers have taken limited steps to break this chicken-and-egg problem: (1) use of more regular competitive solicitations, (2) selection of projects not only on the basis of low cost bids, but also likelihood of achieving commercial operations, and (3) more stringent development milestones and penalties for missing those milestones, providing a more direct incentive for projects to achieve commercial operations.

Perhaps the most direct approach to alleviating the PPA barrier, however, is to organize competitive solicitations in the way that the UK's NFFO did: auction PPAs, not just production incentives. Alternatively, PBF funds might be used to help fund the cost of a feed-in tariff, which has proven extremely successful in Europe. Finally, policymakers might consider applying an RPS in additional to a PBF, with the RPS assuring that electricity suppliers will be interested in purchasing renewable energy. Most importantly, when applying a PBF, policymakers must consider whether there will be willing long-term purchasers for the electrical output of funded projects. If there are unlikely to be such willing purchasers, then additional policy actions will be required.

Finally, not only the price, but also the specific terms and conditions of the PPA affect the level of subsidy a project will require. The more contract information a project developer has available at the time the bid proposal is created the more likely there will be actual project implementation of the project bids selected. Including standard contract terms and conditions as well as price as part of a PBF incentive bid package will likely result in more accurate bids and a more effective and successful PBF program.

14. PBF Trends, and Lessons for China

14.1 PBF Trends

Several key trends in the development and implementation of PBF programs deserve mention:

- First, some U.S. states and countries are using PBFs even without partial or full electricity restructuring, due to the recognition that utilities' financial incentives are not fully in line with society's long term goals. Accordingly, while PBFs have most commonly been established in the transition to electricity reform, increasingly, states and countries are developing PBFs outside of the electricity reform process.

- Second, some jurisdictions exempt large energy consumers from PBFs if they enter into voluntary, but binding, agreements to reach agreed-upon RE or EE goals. This is usually done to serve a political end – minimizing the political opposition of large electricity consumer towards a PBF – and is still somewhat uncommon. However, it is an emerging trend in some jurisdictions.

- Third, some U.S. states and countries are succumbing to short-term financial pressures, losing sight of the long term societal benefits, and re-appropriating public benefit funds for short term budget needs. This disturbing trend is an issue covered in an earlier chapter of this report.

- Fourth, some jurisdictions are moving away from PBF policies, and towards setting public benefit goals, obligations or requirements, letting utilities and other electricity suppliers meet these requirements as economically as possible, and then passing on the costs of compliance in rates implicitly. For example, in addition to renewable energy PBFs or instead of PBFs, some states and countries have set Renewable Portfolio Standards (RPS). Under an RPS, electricity suppliers are generally required to obtain an increasing percent of electricity from renewable sources.

- Finally, some countries in Europe are moving away from PBFs and other strategies to support EE and RE, and to "environmental tax reform." These countries use revenues from environmental and/or energy taxes that tax pollution or natural resource depletion to lower taxes on valuable economic activities such as employment or investment. The governments may use some of these tax revenues for efficiency investment, renewable energy, or other public benefits. However, most of the revenue will be used to cut employers' social security contributions, or personal income taxes. Ostensibly the higher taxes will increase incentives for consumer investment in EE and RE. The goal may also be to change energy consuming or polluting behavior, or address climate change. Most countries that have imposed environmental taxes have also adopted measures, such as tax exemptions or incentives, to promote new clean energy technologies at the same time.

14.2 PBF Lessons and Recommendations for China

Repeating the summary from Chapter 1 of this report, our key findings are as follows:

General Findings

- PBFs have become increasingly popular internationally as a way to enhance renewable energy and energy efficiency investments and deliver important public benefits. Traditional PBFs are perhaps most commonly used in the United States, but useful experience also derives from Europe, Australia, Japan, Brazil, India, and other countries.
- PBFs can provide critical support for both renewable energy (RE) and energy efficiency (EE) investments, and can also be used to support public interest R&D and provide assistance to low-income electricity customers.
- PBFs are particularly important to implement in conjunction with reforms in the electric utility sector. Without early use of a PBF, EE and RE program momentum may be drastically slowed as electric reform begins, professional expertise may be dissipated, and timely opportunities are likely to be lost.
- In discussing a PBF to policymakers, it is easy to focus on the cost of the policy; while this cannot and should not be avoided, it is equally critical to continually emphasize the important public benefits of the PBF – it is all too easy for policymakers to only focus on the costs.
- Relative to other policy approaches, PBFs have certain advantages: (1) PBFs can be used regardless of the structure of the electricity sector, (2) an equitable funding mechanism can be used to collect the needed revenue, (3) the PBF can be established on a regional or national scale, depending on which is most appropriate, (4) there are multiple possible sources of funds for a PBF, (5) a PBF offers significant flexibility in how funds are applied to support RE and EE, and (6) the cost of a PBF can be fixed and known in advance.
- PBFs also have certain disadvantages relative to other policy approaches: (1) the public and policymakers may be sensitive to the fact that a PBF is sometimes viewed as a new "tax", (2) the administration and oversight of a PBF can sometimes prove challenging, and requires significant dedication by the government, (3) once a PBF is established, it is all too easy for policymakers to lose sight of the benefits of the PBF, and to regard a PBF as a "welfare" program, and (4) once collected, PBFs can and often are subject to political attack or re-appropriation of the funds for other government purposes, sometimes making it hard to develop stable, long-term RE and EE markets with PBF funds alone (though, it deserves note that general government tax revenue is likely to be an even more vulnerable funding target).
- PBFs should be employed in combination with, not in lieu of, other policy approaches. Complementary policies that offer long-term power purchase contracts for renewable energy are especially important, as is ensuring that regulated electric utilities have appropriate financial incentives to encourage energy efficiency.

Funding Source, Level, and Duration

- The amount of funds collected for a PBF should depend on the expected use of those funds, and must be informed by political circumstances. Nonetheless, international experience suggests a range of funding levels. Energy efficiency expenditure in the US has averaged as much as 2.5% of retail electricity sales revenue in some states, while renewable energy expenditure in the US has averaged as much as 0.75% of retail sales revenue; PBF funding outside of the US has often been even higher than these levels. Total EE and RE PBF funds of 1%-3% of retail sales revenue are not uncommon. Even at these levels, however, experience shows that significant additional opportunities exist for cost-effective EE investments, and that RE resource potential is vast. Therefore, in many circumstances it will make sense to establish a PBF as high as possible, given political realities and pressures.

- PBFs may be collected from numerous sources, including: (1) through surcharges on end-use electricity rates (i.e., a "wires" or "distribution" charge), or (2) through pollution levies and fees. RE and EE programs may also be funded through general government revenue sources. PBFs from electricity surcharges and special funds using general tax revenue are the most common approaches used internationally. The stability and permanence of a fund might be increased if a dedicated source of funds is used, however, suggesting that electricity rate surcharges or pollution levies might be the preferred source of funds. Funds that come from the central or provincial government can and have also been used for renewable energy and energy efficiency, but the permanence of these funding sources is unclear. Regardless of the funding mechanism that is used, funds should be collected in a way that is – ideally – equitable and non-bypassable (i.e. it is not possible for particular customers or groups of customers to avoid paying the fee).
- A critical challenge for PBF policies is to ensure the durability of the fund itself; long-term funding sources are essential in building robust markets for renewable energy and energy efficiency. Funding stability for a minimum of 5 years should be sought because markets take time to build, and programs take time to implement effectively.
- A key concern with PBFs is that their very existence can be subject to political attack on an almost annual basis, leading to unstable, weak markets for RE and EE. All efforts should therefore be made to protect PBF funds from re-appropriation by the provincial or federal government to serve other government needs. To defend and protect a PBF, they should (1) be designed effectively, (2) minimize carryover of funds from one year to the next, (3) demonstrate their success through independent evaluation, (4) use a dedicated charge to collect funds, (5) be build collaboratively by a wide variety of stakeholders, ensuring some level of political support.

Administration, Management, and Evaluation

- PBFs can and have been effectively administered in many different ways, and by many different organizations. The appropriate administrative structure for any specific jurisdiction will depend on institutional context, and there are advantages and disadvantages of each administrative approach. For RE and EE PBFs, the two most attractive administrative options include housing the PBF in an existing or new government agency, or allowing an independent organization to administer the PBF programs.
- Regardless of administrative structure, the degree of planning, program development and implementation, contract management, and program evaluation to effectively implement a PBF requires a full time, dedicated professional staff. Staff must be deeply experienced with RE and EE markets to ensure that funds are used most effectively. On a percentage basis, it is not uncommon for 5-10% of PBF funds to be used to cover administrative and management costs.
- Appropriate oversight and management of PBF administration are critical, and different administrative structures will require different levels and types of governmental oversight. Stakeholder support and involvement is an important element of a successful PBF program, and will help ensure that the PBF has broad and deep support by its constituents.

- Programs and strategies should be discussed with and agreed upon by as a wide a stakeholder group as possible. This will help build support for the PBF and its efforts, and may give the fund added stability in times of political threat.
- Effective and independent evaluation of PBF programs is essential in both defending the very existence of the fund, and in identifying ways of improving the programs funded by the PBF. Successful PBFs internationally, especially for EE, generally place significant emphasis on independent evaluation.
- PBFs should be coordinated on a national, or at a minimum regional, basis; RE and EE markets are not limited to small geographic regions, so coordinated action should be sought.

Strategies and Programs

- PBF program strategies, planning, and key decisions should be guided by a clear vision and well-defined objectives and goals that are agreed upon in advance by a wide variety of stakeholders. PBF programs should, to the extent possible, build on existing domestic RE and EE infrastructure and experience.
- For RE, PBF program models are determined by the relative importance of (1) immediate RE installations through financial incentives versus, (2) longer-term industry and infrastructure development, versus (3) applying PBFs as investment vehicles. For EE PBFs, the different models for fund application include "resource acquisition" and "market transformation" models.
- Available incentive types include up-front capital grants, contracts for services, up-front rebates, production incentives, low-interest loans, and venture capital investments. Regardless of which incentive type is selected, the majority of funds distributed by a PBF should be distributed based on competitive processes, or be available to all eligible applicants. This will help to avoid the influence of political factors in funding decisions, and reduce any perceived favoritism or impropriety that might exist.
- Common RE PBF programs in place internationally include: (1) fixed production incentives, (2) auctioned production incentives or electricity contracts, (3) capital grants or rebates, (4) information and education programs, (5) low-cost consumer loans, (6) investment vehicles, (7) infrastructure building grants and contracts for services, and (8) research and development efforts. EE programs are often more varied than RE programs, and can target different technologies, customer niches, or market opportunity niches.
- The specific programs that are funded by a PBF will depend on the context of the country and market in which the PBF is applied, and should be informed by an analysis of low-cost and/or high-value renewable energy and energy efficiency opportunities. While there is no easy way to identify "best practice" PBF programs based on international experience, that experience does offer some important lessons learned. (See Chapter 12 for a summary of international experience with PBF programs and lessons learned based on that experience; those lessons are not repeated here).
- Regardless of which projects and programs are initially funded by a PBF, PBF funding should remain sufficiently flexible to allow the administrator of the fund to respond to targeted high-value funding opportunities as they arise. Ongoing feedback on the operation of PBF programs should be continuously sought in order to make mid-stream adjustments to program designs, services, and operations. Streamlined contracting processes should be in place to ensure administrative efficiency and avoid being too "bureaucratic." PBFs should partner, to the extent possible, with utilities, businesses, and industry to achieve greater

impact. In delivering programs, PBFs should take advantage of existing, experienced delivery channels.

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Appendix A. Case Studies of PBF Programs

A variety of PBF case studies exist. During a September 2003 workshop in Beijing, CRS and RAP provided presentations on the VT EE PBF, the CA RE PBF, and the UK RE PBF (i.e., the NFFO). For copies of those slides, email Ryan Wiser (ryanwiser@earthlink.net) or Wang Wanxing (wxwang@efchina.org).

For case studies on RE PBF experience in the U.S. (as well as the UK NFFO, and the Japan and Germany PV programs), see:

- http://eetd.lbl.gov/ea/EMS/cases/Renewable_Energy_Case_Studies.pdf,
- http://eetd.lbl.gov/ea/EMS/reports/47705.pdf,
- http://eetd.lbl.gov/ea/EMS/reports/49668.pdf, and
- http://eetd.lbl.gov/ea/EMS/reports/49667.pdf.

For case studies on U.S. and non-U.S. experience with EE PBFs, see:

- http://www.raponline.org/Pubs/RatePayerFundedEE/RatePayerFundedEEFull.pdf
- Also see Finamore et al. (2003)

For additional non-U.S. PBF experience, see the many citations provided in the body of this report.

A. 1. The Vermont Energy Efficiency Utility

Here we briefly summarize experience in the state of Vermont with an EE PBF, in particular the Vermont (USA) energy efficiency utility (EEU), which does business under the name *Efficiency Vermont*. The EEU is supported by a public benefits fund (PBF), which is collected through a volumetric (per kWh) charge on retail electric sales in the state.[14]

I. Vermont

Vermont is a small, rural state in the northeast United States. It has population of approximately 615,000. Its peak electric demand during the winter peak season is slightly more than 1,000 MW, and its annual electricity consumption is around 5.7 million MWh.

II. The EEU

A. In Summary

Funding Mechanism: PBF with a volumetric charge on retail rates, maximum of $0.0029/kWh

Creation: By regulatory order and legislation

Duration: Indefinite

[14] This paper is based on information provided in the report, *Who Should Deliver Ratepayer Funded Energy Efficiency?*, prepared by the Regulatory Assistance Project, May 2003, which can be found at www.raponline.org.

Structure: The EEU is an independent contractor to the state. It operates under a three-year contract, which has been renewed for a second three years (through 12/31/05).

Budget: Not to exceed $17.5million/year. Presently about $14 million/year.

B. Process and Timeline

In January 1999, the Vermont Public Service Board (PSB, the state's utility regulator) concluded that, under existing law, it had authority to create an independent entity to provide end-use energy efficiency services, and to fund that entity through the imposition of a public benefits sucharge on retail electric rates.

In the spring of that year, the state legislature passed a law confirming the PSB's authority to create an energy efficiency utility and to establish a volumetric wire charges to fund statewide to fund it. The law set an annual budget limit for statewide programs of $17.5million/year (approx. 3.3% of Vermont's total electric revenues).

On September 30, 1999, the PSB issued an order approving an agreement (called the Memorandum of Understanding, or MOU) signed by the State's consumer advocate, the electric companies, certain business representatives, and non-profit environmental and efficiency advocates. The MOU called for the creation of the EEU and defined a set of seven initial "Core Efficiency Programs" that the EEU would implement throughout the state. The MOU outlined the new administrative structure, operational and fund-handling details of the EEU. It relieved VT distribution utilities of obligation to deliver energy efficiency programs. It established a schedule for implementation of the EEU. The MOU set initial five year budgets for the EEU and it also outlined the continuing role and responsibility of the electric distribution utilities.

After a rigorous competitive bidding process, the PSB chose Vermont Energy Investment Corporation (VEIC, a non-profit, independent company) from among six competitors to serve as the EEU contractor. In March 2000, the EEU began operation under the name *Efficiency Vermont*.

C. Organization and Administration

The organizational and administrative structure that supports the EEU is somewhat complex. The reason for it, as the PSB stated in its September 1999 order, "is intended to protect not only the EEU's independence, but also to assure that its performance is continually and closely monitored and that it always has the strongest incentives to operate as efficiently as possible."

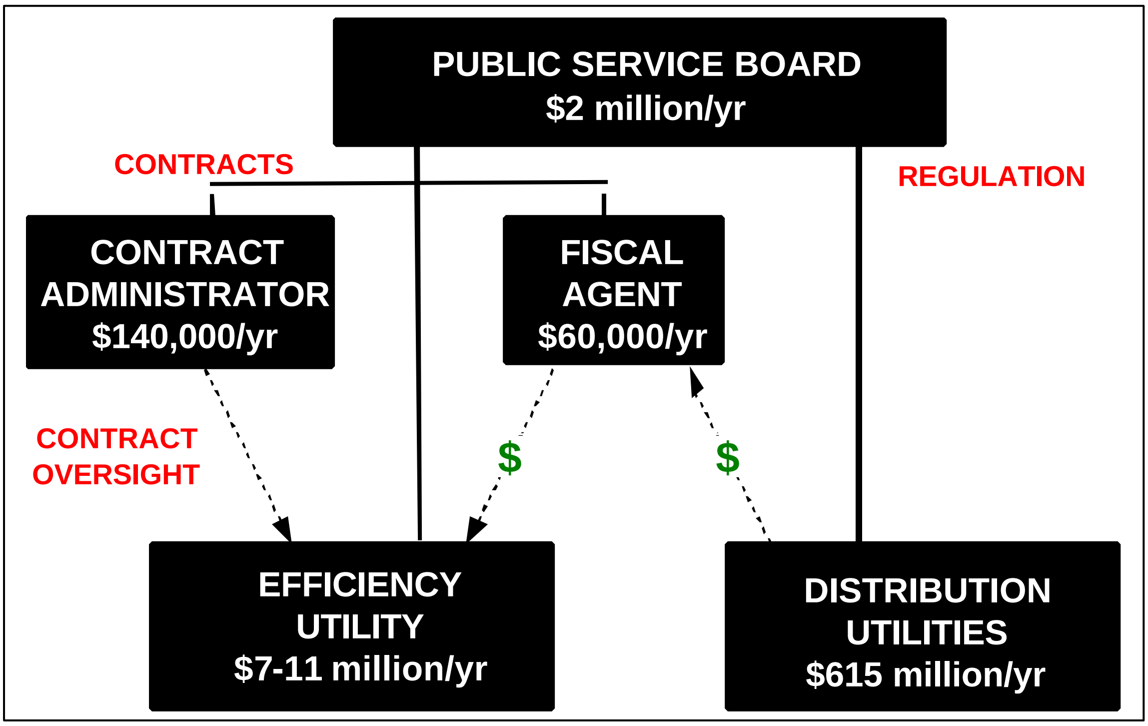
The picture below describes graphically the relationships among the EEU and the various organizations and contractors that support its work. It also gives the annual revenues (or budgets of the organizations. The PSB and DPS are government agencies funded by a 0.5% tax on the revenues of all regulated companies in the state (electric, telecommunications, natural gas, water, and cable TV). The budgets of the EEU, Contract Administrator, and Fiscal Agent are all funded by the PBF charge on retail electric sales.

Vermont Public Service Board: The PSB makes final determinations regarding the EEU's performance and contract renewal. It establishes the Energy Efficiency Charge (EEC) annually. It issues requests for proposals (RFPs) and hires the EEU contractor, the Contract Administrator, and the Fiscal Agent. It approves EEU plans, programs, and major budget modifications annually. It appoints the Advisory Committee and reports annually to the legislature on EEC revenues.

Energy Efficiency Utility: The PSB issued a request for proposals for an EEU contractor, which could not be an agent of a distribution company. The contract was awarded to the non-profit company VEIC, Inc. It does business under the name *Efficiency Vermont* (EVT). EVT provides statewide administration of the Core Programs and any other “system-wide" energy efficiency programs approved by the PSB. EVT is responsible for program administration, design, marketing, delivery and implementation under terms of an extensive and detailed contract with the PSB. EVT has chosen to implement many programs using its own staff, rather than subcontracting activities. Staffing levels at EVT are about 70 full-time employees.

Contract Administrator (CA): The PSB issued an RFP and hired an independent contractor. The CA handles day-to-day EEU contract administration responsibilities on behalf of the PSB. The CA also resolves disputes concerning the EEU's performance and refers them to the PSB if settlement not reached. The CA also works with the DPS (the consumer advocate) to define and verify the EEU's compliance with contractual performance indicators. The CA is one person, who devotes approximately three-quarters of his time per year to the work.

Fiscal Agent (FA): The PSB issued an RFP and hired an independent contractor. The FA’s primary responsibility is to receive EEC funds from the distribution utilities, and disburse them upon approval by the CA to the EEU, the DPS (for EEU evaluation efforts) and other relevant entities. The FA reports directly to the PSB and provides the PSB with monthly, quarterly, and annual financial statements and accounting reports. Funds collected *never* become funds of the state (that is, they are not considered tax revenues). The FA is presently the National Exchange Carrier Association (NECA), a nationally known organization that also handles similar financial arrangements in the telecommunications industry.



Vermont Department of Public Service (DPS): The DPS serves as Vermont's consumer advocate and energy policy office. It provides evaluation of PSB-approved EEU programs, including annual verification of savings claims, usually through contracts with independent consultants. After approval by the CA, the FA reimburses the DPS for these evaluation activities from the EEC funds. The 2003 budget for Program Evaluation by the DPS is $462,000. The DPS also provides electric industry cost data for use in EEU analyses of program and measure benefits (cost-benefit analyses). The DPS advises the PSB on economically achievable energy efficiency potential, and makes recommendations on EEU program changes and budgets. EEU matters require roughly three full-time employees at the DPS.

Advisory Committee: The PSB appoints an advisory committee to the EEU to provide substantive input on program design, annual re-allocation of program funds and other issues. The Advisory Committee includes representatives from the distribution utilities, consumers, the DPS, and others deemed necessary by the PSB. It meets at least quarterly, typically six times per year, to provide advice to the EEU. It has no budget or authority. The EEU may also develop other advisory committees itself, e.g., for specific market segments, as needed.

D. Funding Mechanisms

Vermont law sets a maximum annual budget of $17.5million for the total EEU, which is approximately 3.3% of Vermont's total electric revenues. The MOU set another limit: during the first five years the PBF surcharge (called the "energy efficiency charge," or EEC) cannot exceed the equivalent of $0.0029/kWh. Funds raised by this charge cover the following expenditures each year:

- The EEU contractor costs, including performance incentive fees;
- DPS evaluation costs;
- Contract Administrator costs;
- Fiscal Agent costs;
- Independent audit of the EEC fund; and
- and other miscellaneous costs as determined by the PSB.

E. Relationship of EEU Programs with Long-Run Resource Planning

The EEU has a strong association with long run resource planning. The distribution utilities (DUs) in Vermont are required to prepare a least-cost integrated plan (IRP) for provision of electricity services every three years. The law defines a least-cost integrated plan as "a plan for meeting the public's need for energy services, after safety concerns are addressed, at the lowest present value life cycle cost, including environmental and economic costs, through a strategy combining investments and expenditures on energy supply, transmission and distribution capacity, transmission and distribution efficiency, and comprehensive energy efficiency programs."

According to the MOU, the DUs' responsibilities will now include least-cost transmission and distribution system planning and implementation. As long as the PSB finds that the system-wide programs of the EEU are satisfying existing statutory and regulatory requirements for energy efficiency programs, the DUs will only be obligated to invest in energy efficiency when it can cost-effectively achieve delay or avoidance of transmission and distribution investments. If, for any reason, the PSB finds the EEU structure or programs inadequate for meeting existing requirements, the DUs would resume those responsibilities as well.

According to the MOU, the DUs must "maximize coordination among themselves and with the EEU for planning inputs and implementation capability." The EEU is required to make customer-specific data available to the DU serving the customer, for use in DU planning, load forecasting, DSM program planning, distributional equity determinations and other specified purposes. The MOU anticipates that the EEU will have a role in the implementation of DSM related to transmission and distribution planning.

F. Guidelines for Program Effectiveness and Success (upfront)

The overall scope of work to be accomplished by the EEU was laid out in Attachment A of the original contract and as modified slightly in the second (2003-2005) contract:[15]

- Achieve the maximum magnitude of societal net benefits while acquiring comprehensive cost-effective electric efficiency savings;

[15] The contracts of the EEU, CA, and FA can all be downloaded from the PSB's website, www.state.vt.us/psb.

- Respond appropriately to markets in order to increase the level of and comprehensiveness of energy efficiency services to Vermonters;
- Effectively capture potential "lost opportunity" markets; and
- Strive for distributional equity across customer classes and geographic regions.

As in the original contract, the second contract sets performance-based standards that the Eeu must achieve in order to be paid bonuses (performance incentives). The goals include, among others:

- Cumulative annual energy savings* of 117,373MWh;
- Committed Electricity Savings Target of 6,200 MWh;
- 14.834 MW summer peak reduction*;
- Total Resource Benefits* of $74.5million (in 2000 dollars);
- Double market share of *Energy Star* (high efficiency) homes; and
- Increased participation of small business in the EEU's programs.

G. Results of Program Evaluation

The *Report and Recommendations to the Vermont Public Service Board Relating to Vermont's Energy Efficiency Utility,* issued in 2002, describes the results of the independent evaluation of the EEU's programs. The evaluation was overseen by the DPS.[16] *Efficiency Vermont's* Annual Reports also describe the EEU's achievements.[17]

The 2001 Annual Report of the EEU indicated that EVT spent $8.5million and participants paid $5.5million, for a total of $14million, to achieve close to 37,000MWh of energy savings in 2001. Over their lifetime these measures are predicted to result in close to 545,000 MWh of savings. Measures also resulted in peak demand reduction of 4.2MW in summer and 6.6MW in winter, 2001. The PSB, in an order issued 12/30/02, stated:

> In 2001, energy efficiency was obtained by the EEU at a cost of 2.6 cents per kilowatt-hour… using total costs for the EEU for that year, including participant and third-party investments in the cost of the measures installed, of $14,014,124…. The average delivered cost of purchased power for Vermont utilities…was 7.3 cents per kWh…the average retail rate…charged by Vermont electric utilities for delivered power was 10.6 cents per kWh.

The PSB also pointed out that there were far more efficiency saving available than the EEU, at its current budget, could acquire:

> The economically achievable potential of energy efficiency in the state continues to far exceed any level of savings that could be secured by the activity of the EEU at the budget levels proposed…Vermont needs to spend three to four times as much money as is currently devoted to the EEU budget to achieve the potential energy efficiency savings shown in the DPS Report [the 2002 evaluation].

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[16] This report is available on the DPS website, www.state.vt.us/psd.
[17] *Efficiency Vermont*'s website is www.efficiencyvermont.org.

The PSB also found that energy efficiency investments made by businesses working with the EEU produced, on average, "an internal rate of return of 71 percent."

H. Performance Incentives

A certain portion of the EEU budget is held aside by the PSB for incentive payments to the EEU for achievement of performance indicators. The total amount of potential incentive payments for the first three years was $795,000, or about 2.9% of the contract value if 100% of the performance criteria were met. The maximum performance incentive award for the second three years is $1.28million.

Each performance indicator has a target, and a threshold below which no incentives are paid. Each indicator has a predetermined weight as a percent of the total potential award. The contract defines a documentation and verification process for each performance indicator. Incentive funds are not paid until after the end of the three-year contract.

I. Program Areas

The EEU administers a set of efficiency programs for all customer classes. Under the contract renewal, the original programs were reorganized and re-named, as follows:

- Business Sector
- Business New Construction (includes multi-family)
- Business Existing Facilities
- Customer Credit (EEC discounts for customer investments in efficiency)
- Commercial and Industrial Emerging Markets
- Residential Sector
- Residential New Construction
- Residential Existing Buildings
- Energy Efficient Products
- Residential Emerging Markets

Details on these programs can be found on the PSB, DPS, and EEU websites.

III. Resources

Vermont Public Service Board
www.state.vt.us/psb/news/EEU_info.htm

Efficiency Vermont
www.efficiencyvermont.com

Efficiency Vermont 2001: A Year of Progress and Success, March 2002, available at
www.efficiencyvermont.com/about/annualreport2001.pdf

Vermont Dept of Public Service
802-828-2811, www.state.vt.us/psd/ee/ee.htm

Regulatory Assistance Project
www.raponline.org