



State Support for Clean Energy Deployment: Lessons Learned for Potential Future Policy

Charles Kubert and Mark Sinclair
Clean Energy States Alliance
Montpelier, Vermont

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Charles Kubert and Mark Sinclair
Clean Energy States Alliance
Montpelier, Vermont

NREL Technical Monitor: Karlynn Cory
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Charles N. Kubert (1959-2010)

It is with sadness that NREL notes that Charlie Kubert passed away in September 2010. Charlie was an environmentalist, outdoor enthusiast, athlete, and community leader. Charlie was the director of the Clean Energy Group's RPS Implementation Project and headed the State-Federal RPS Collaborative. His commitment to these projects was amazing, even up until his last days with us.

The staff at NREL joins the renewable energy community in mourning Charlie's death and in celebrating all of his accomplishments in life. Charlie was very passionate about his work, and his dedication to the public interest and the Clean Energy Group mission never wavered as he battled on. His work to advance clean energy exemplified his intelligence, integrity, dedication, and keen insights. Charlie was a wonderful colleague and friend. We will miss him greatly.

List of Acronyms

ACEEE	American Council for an Energy Efficient Economy
ACP	alternative compliance payment
ARRA	American Reinvestment and Recovery Act
B&I	business & industry
BPU	Board of Public Utilities (New Jersey)
BTU	British thermal unit
CCEF	Connecticut Clean Energy Fund
CEC	California Energy Commission
CESA	Clean Energy States Alliance
CFL	compact fluorescent light bulb
C&I	commercial & industrial
CO ₂	carbon dioxide
CPUC	California Public Utilities Commission
DOE	U.S. Department of Energy
DSIRE	Database of State Incentives for Renewables and Efficiency
EE/RE	energy efficiency and/or renewable energy
EEPS	energy efficiency portfolio standard
EERS	energy efficiency resource standard
EIA	U.S. Energy Information Administration
EM&V	evaluation, measurement, and verification
EPA	U.S. Environmental Protection Agency
ESCs	energy savings contracts
ETO	Energy Trust of Oregon
FIT	feed-in tariff
GHG	greenhouse gas
ITC	Investment Tax Credit
JEDI	Jobs and Economic Development model
kW	kilowatt
kWh	kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
MassCEC	Massachusetts Clean Energy Center
MMbtu	million British thermal units
MW	megawatt
MWh	megawatt-hour
NREL	National Renewable Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
PACE	property assessed clean energy
PACT	program administrator cost test
PAYS	pay as you save
PBF	public benefits fund
PBI	performance based incentive
PCT	participant cost test

PIER	Public Interest Energy Research initiative
PSE&G	Public Service Electric & Gas
PTC	production tax credit
PURPA	Public Utility Regulatory Policies Act
PV	photovoltaic
QECB	Qualified Energy Conservation Bond
R&D	research and development
REAP	Rural Energy for America
REC	Renewable Energy Certificate
REMI	Regional Economic Models, Inc.
RES	Renewable Electricity Standard
RFP	request for proposal
RPS	renewable portfolio standard
SBC	systems benefit charge
SBF	systems benefit fund
SCT	societal cost test
SMUD	Sacramento Municipal Utilities District
SREC	solar renewable energy certificate
STEP	Saratoga Technology & Energy Park
TRC	total resource cost
VEIC	Vermont Energy Investment Corporation

Executive Summary

Proposed federal clean energy initiatives and climate legislation have suggested significant increases in federal funding for clean energy deployment and investment.^{1,2} To date, much experience and many lessons learned have resulted from state and utility experience supporting energy efficiency and renewable energy (EE/RE)³ programs. Many states and utilities have over a decade of experience and spend billions of public dollars every year to support EE/RE deployment through programs that reduce the cost of technologies, provide financing for EE/RE projects, offer technical assistance, and educate market participants. Meanwhile, constraints on public expenditures at all levels of government continue to call upon such programs to demonstrate their value.

This report reviews the results of these programs and the specific financial incentives and financing tools used to encourage clean energy investment. Lessons from such programs (listed at the end of the executive summary) could be used to inform the future application of EE/RE incentives and financing tools. These lessons learned apply to use of distributed resources and the historical focus of these EE/RE programs.

EE/RE Program Outcomes

Energy Efficiency

Several mature state and utility energy efficiency programs are achieving year-over-year electricity use reductions in excess of 1% of the prior year's demand (Eldridge et al. 2009b). In 2009, these programs reported total electricity savings of 96 million MWh (out of total U.S. generation of 4,119 million MWh), including new savings from measures implemented during that year as well as persistent savings from program-induced energy efficiency measures in prior years (U.S. EIA 2010; Nevius et al. 2010). Programs are achieving these savings at an overall utility cost of saved energy of less than \$0.03 per avoided kWh (Friedrich et al. 2009), well below the average national wholesale cost of electricity of \$0.0572 per kWh (U.S. EIA 2007). Programs also are reporting overall lifetime benefit-cost ratios (using the Total Resource Cost test) of 2:1 or higher (Friedrich et al. 2009). These programs are leveraging private dollars at an average ratio of 1:1 (i.e., each program dollar is matched by an additional dollar from individuals, businesses, and other entities making energy efficiency investments) (Friedrich et al. 2009).

The effectiveness of these programs is attributable to a number of factors including the level and sustainability of funding, political and regulatory support, a diversity of designs, accessibility,

¹ Proposed legislation [H. 2454 (2009) and S. 1733 (2009)] allocates a share of allowances from a greenhouse gas (GHG) cap-and-trade system to states and grants them latitude in utilizing the value of these allowances to support programs, investments, and industries. A specific discussion of support for clean energy industries is provided in Appendix C.

² Note that this report does not address funds or programs provided by the American Reinvestment and Recovery Act (ARRA) of 2009 because the focus of this report is on assessing programs that existed prior to the passage of ARRA.

³ In this report, the acronym EE/RE will be used to collectively describe energy efficiency and renewable energy programs and activities run at the state or utility level to distinguish them from the Department of Energy's EERE (Energy Efficiency and Renewable Energy) program at the federal level.

and accountability through the use of performance targets and regular evaluation. The effectiveness of the programs is not dependent on any particular administrative structure.

Renewable Energy

Over the past decade, state and utility RE programs have been a key source of financial support and a market driver of distributed renewable energy⁴ installations, particularly solar photovoltaics. States have established these programs to build markets for these technologies, encourage technology cost reductions, and capture the economic, environmental, and electric system benefits associated with renewable generation.

The growth in distributed generation has been highly dependent upon the availability of federal and state/utility-level support because of the high up-front costs and long financial paybacks of these technologies. Despite the availability of federal tax incentives, there has been limited distributed renewable energy development in states without this additional direct support.⁵ Many of these programs provide education, public outreach, technical support, and quality-control functions that are important to building long-term markets for renewable energy technologies. Some of these programs support distributed generation only, while others support utility- or community-scale generation.

Financing Tools

State and utility EE/RE programs have a wide range of financial incentives and tools available to address market and financing inefficiencies. Direct incentives and grants have been the foundation of these EE/RE programs since their inception because they reduce up-front capital costs and shorten financial paybacks while being relatively easy to administer, adaptable, and widely accessible. Loans, interest rate subsidies, and various types of credit enhancement could be used to fill commercial lending gaps and improve access to credit for EE/RE investments. States are also now exploring alternative financing tools that are designed around the unique characteristics of EE/RE projects—high up-front costs but long useful lives and minimal maintenance and fuel costs—such as feed-in tariffs and property assessed clean energy (PACE) programs.

Because each state and utility program operates under specific regulatory, financial, and market conditions, there is no “one size fits all” solution. The selection of financing tools needs to be tailored to these local market conditions.

State Policies Supporting EE/RE

State-level regulatory policies are not the primary focus of the report but play an important role in enhancing the overall effectiveness of EE/RE incentive and financing programs. Renewable portfolio standards, energy efficiency resource standards, revenue decoupling, and other financial incentives require or encourage utilities to support EE/RE programs. Favorable

⁴ Distributed renewable energy includes power generation that is customer-sited and thus, on the electrical distribution system. It can either be located behind the meter, or on the utility-side of the meter at both residential and commercial sites.

⁵ In contrast to distributed renewable energy, large-scale renewable energy has received sufficient federal tax incentives and state policy support (e.g., RPS) to encourage its development without additional direct state or utility incentives.

interconnection and net-metering rules and uniform zoning and siting guidelines complement financial incentives.⁶

Major Findings and Conclusions

The following observations and lessons learned emerge from this report. These lessons could be applied to the possible future EE/RE incentive and financing programs.

1. The selection of financial incentives and financing tools needs to be program-specific based on a **program's goals**. Some financing tools could maximize near-term energy savings and GHG reductions, while others could provide greater funding leverage and long-term impact. The right incentive or tool will depend on that program's specific goals.
2. Federal, state, and local policymakers could consider a number of **local factors and market conditions** to determine the allocation and use of public funds for EE/RE deployment. These factors include current electricity consumption and rate of demand growth, electricity generation mix (and related GHG output), retail electric prices, and the funding level and performance of current EE/RE programs. For example, in states with low retail electric prices, consumers have a reduced financial incentive to make EE/RE investments. Relatively more funding might be necessary to incentivize consumer adoption.
3. **Durable and long-term funding** enhances EE/RE programs because time is needed for programs and clean energy markets to mature and become effective.
4. **Rigorous evaluation** with clear and consistent metrics and performance targets is essential to shape program design, motivate performance, and monitor results. Consistently applied metrics and evaluation methods can also facilitate the adoption of program best practices and allow policymakers to measure the aggregate national conservation, renewable energy, and greenhouse gas impact of these programs. One potential role for a centralized entity could be to facilitate consistent performance reporting and the creation of a national data repository on program design and results.
5. While state and utility EE/RE programs have historically relied heavily on direct incentives, such as rebates and grants, **innovative public-supported financing mechanisms** for EE/RE investments, including feed-in tariffs, loans, and PACE programs could play a significant role in leveraging available EE/RE funding and filling private financing gaps.

⁶ These policies, among others, are discussed in more detail in Appendix D. Many states also offer tax incentives to support EE/RE investments; however, these tax incentives have generally been of lesser importance (particularly relative to the impact of federal tax credits) in driving EE/RE investments (Lantz and Doris 2009).

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1 Introduction

Recent legislative proposals contain provisions that set aside or target federal funds from a greenhouse gas (GHG) mitigation scheme towards energy efficiency and renewable energy (EE/RE)⁷ investment and project deployment. A key policy question is how such funding—or new state-level funding—could be used to best achieve these reductions. This report explores past state and utility experience with EE/RE incentives and financing mechanisms and complementary policies to identify key lessons learned that could inform funding streams for the deployment of EE and distributed RE.⁸ Note that this report does not address funds or programs provided by the American Reinvestment and Recovery Act (ARRA) of 2009 because the focus of this report is on assessing programs that existed prior to the passage of ARRA.

States and utilities are spending billions of public dollars to support EE/RE deployment through various programs. These programs are designed to reduce the costs of and provide financing for EE/RE technologies, provide technical assistance, and educate the market.⁹ In 2009, states and utilities spent approximately \$5.3 billion on electric energy and gas efficiency programs,¹⁰ and over \$600 million on RE programs (Nevius et al. 2010;¹¹ CESA 2010b). Spending on electric efficiency programs alone has increased by 80% since 2006 (Nevius et al. 2010). Furthermore, many states and utilities have over a decade of experience in administering EE/RE deployment programs, including first-hand experience with a number of financial incentives, financing tools, and policies to support EE/RE investment.

There are many cost-effective EE/RE opportunities that could be captured with increased investments across all sectors, private and public. A recent report by McKinsey & Company, “Unlocking Energy Efficiency in the U.S. Economy,” identified a potential 23% reduction in energy consumption versus a “business-as-usual” scenario, even limiting opportunities to those that have positive net present value (Granade et al. 2009). Capturing this potential would require combined public and private investment of \$520 billion from 2010 through 2020—five times the current level of investment in EE (Granade et al. 2009).

Section 2 of this report reviews the status of current state and utility EE/RE programs, overall program performance, and lessons learned from program design and delivery. Section 3 focuses on current and emerging incentives and financing tools, with a review of the lessons learned and strengths and weaknesses of each. Appendix A compares the strengths and weaknesses of

⁷ In this report, the acronym EE/RE will be used to collectively describe energy efficiency and/or renewable energy programs and activities run at the state or utility level to distinguish them from the Department of Energy’s EERE (Energy Efficiency and Renewable Energy) program at the federal level.

⁸ This report focuses on distributed RE because RE programs supported by states so far have focused on distributed RE.

⁹ Educating the market refers to education of market players across the entire supply chain about opportunities associated with a new or unfamiliar product.

¹⁰ This report focuses on the electric programs because the data on these programs are more comprehensive.

¹¹ This excludes weatherization assistance programs, state/local government spending on public buildings, or any federal funds directed to state energy offices. RE funding is an estimate based on reported program spending from Clean Energy States Alliance (CESA) members, a consortium of 18 clean energy funds. It does not include spending for utility-administered public benefits funds or any non-CESA-member state-administered funds. The Database of State Incentives for Renewables and Efficiency (DSIRE) estimates total public benefit fund RE programs at \$587 million annually, excluding utility-run programs. This figure also does not include funds provided under ARRA.

alternative administrative models for these programs, and Appendix B presents the relationship between electricity consumption, electricity prices, and efficiency spending in each state. Appendix C examines using a portion of EE/RE funding to support clean energy industries. The role of complementary public policies as prerequisites and enhancements to the effectiveness of state EE/RE incentives and financing tools are identified in Appendix D. Appendix E provides brief descriptions of representative EE/RE programs.¹²

¹² The data in this report was primarily gathered during 2009 and reflects the most current data at that time. Consult cited references for updated data.

2 Status and Performance of State and Utility EE/RE Programs

This section explores the status of current state and utility EE/RE programs, overall program performance, and lessons learned from program design and delivery. This background information explains: the extensive experience of states and utilities; the wide range of drivers that motivated these EE/RE programs; the importance of program measurement and evaluation; and the performance of clean energy programs as they attempted to meet specified goals.

2.1 EE/RE Program Status and Policy Drivers

At the state and utility level, \$5.3 billion was spent on electric and gas energy efficiency programs¹³ and \$600 million on renewable energy programs in 2009 (CESA 2010b; Nevius et al. 2010).¹⁴ These programs are being run by state agencies, utilities, or independent third parties depending on the particular legislative and regulatory history establishing these programs as well as their funding mechanism. In some instances, the energy efficiency programs are run by utilities, while the RE programs are run directly by a state agency or independent entity. Many EE/RE programs are funded through system benefit charges (SBCs), surcharges (¢/kWh, typically) on ratepayers' utility bills (though sometimes through other mechanisms; e.g., emissions market revenues, utility settlements, and state appropriations). Statewide EE/RE programs supported by SBCs are called public benefit funds (PBFs). PBFs typically offer greater flexibility in spending funds and responding to market conditions than other types of funding structures. Many states also offer programs of a more limited geographic, technology, or customer focus with similar funding sources, but because of their limitations, they are not technically PBFs. Utilities also run their own programs, which are generally funded either through regulatory cost-recovery¹⁵ or system benefits charges.¹⁶ Table 1 summarizes the number of states with each type of EE/RE programs.¹⁷ The strengths and weaknesses of these different administrative structures are explored in Appendix A.

¹³ States and utilities spent close to \$1 billion in 2009 on natural gas efficiency programs (Nevius et al. 2010). Reported spending on natural gas programs has increased by 64% over 2008 levels. However, these programs will not be reviewed in this report for several reasons. One reason is that the GHG reduction benefits of natural gas EE programs are less than those for electricity because direct natural gas use is less carbon-intensive than the electric sector in aggregate. Another reason is that there is less available data on natural gas EE program performance.

¹⁴ This excludes weatherization assistance programs, state/local government spending on public buildings, or any federal funds directed to state energy offices. RE funding is an estimate based on reported program spending from Clean Energy States Alliance (CESA) members, a consortium of 18 clean energy public benefit funds (PBFs). It does not include spending for utility-administered public benefits funds or any non-CESA-member state-administered funds. The Database of State Incentives for Renewables and Efficiency (DSIRE) estimates total public benefit fund RE programs at \$587 million annually, excluding utility-run programs. This figure also does not include funds provided under ARRA.

¹⁵ Under regulatory cost recovery, a utility would file an EE plan and associated budget with a state regulatory commission. Upon approval of the plan, the commission would build the cost of the program into a utility's rate structure (rather than as a separate rider or surcharge). Program cost-recovery could be "disallowed" by a commission if the commission were to determine that funds were spent in an "imprudent" manner.

¹⁶ A systems benefit charge is most frequently used in restructured electric generation markets. Some state-level programs are also funded through oil overcharge penalties, other penalties, settlements with utilities, regional GHG programs, or general appropriations.

¹⁷ Regardless of the overall administrative structure, day-to-day administration of the individual EE/RE programs are often managed by private firms.

Table 1. Number of States with EE/RE Programs, by Type of Program

Type of Incentive	Number of States with Programs (includes DC)	
	EE	RE
Statewide PBF	20	19
Other Statewide Incentive Program	34	30
Utility Program	42	48

Source: DSIRE 2010a; DSIRE 2010b; DSIRE 2010c

The political and regulatory context that initially created these programs has varied among the states. However, some of the key policy drivers and goals found across numerous states include:

- **Utility Restructuring:** In states in which electricity distribution entities were separated from electricity generation, EE was no longer considered a “resource” by utilities but rather a potential reduction in distribution revenue. As a result, some of these load-serving entities have been required to provide ratepayer-funded efficiency programs via legislation and/or regulation.
- **Volatile and Rising Energy Prices:** EE/RE have been viewed as a hedge against uncertain energy prices, the high cost of future generation resources, and uncertain GHG mitigation regulation.
- **Ratepayer Savings:** EE programs help reduce energy bills for both participants (i.e., those utilizing an incentive to make an EE investment) and non-participants because program costs are intended to be below the cost of additional energy supplied, thus reducing the cost of electricity services for all ratepayers.¹⁸
- **Deferral of Generation, Transmission, and Distribution Expansion:** By investing in EE and distributed RE, there is the potential to delay the need for generation, transmission, and distribution resources.¹⁹
- **Overcoming Capital and Market Barriers:** Individuals and businesses often do not choose to invest in EE equipment and improvements despite the cost effectiveness of many EE measures.²⁰ There are a number of market and behavioral factors that help

¹⁸ A levelized cost assessment takes into account not only the installed cost of the system but also the lifetime operating costs and determines the net present value of the electricity produced by the system over its lifetime. This type of assessment allows for the costs of various energy technologies to be compared even when installed costs, lifetime operating costs, and production capacities vary.

¹⁹ Large-scale deployment of renewables could create a need for near-term distribution and transmission upgrades, as has been seen with the ramp-up in utility-scale wind generation in some regions.

²⁰ Cost effectiveness, as used in this report, is the length of time that it takes for the owners of EE/RE improvements to fully recover their costs via energy savings. Technologies with a shorter payback are more cost effective than technologies with a longer payback period.

explain this decision including the low up-front cost of energy relative to equipment capital costs, electric market rate structures, excessively high discount rates for EE investments, and landlord-tenant relationships.²¹ The long economic paybacks of RE systems similarly slow investment. State EE/RE programs are intended to lower capital costs, overcome behavioral barriers, build awareness, and accelerate market acceptance of these EE/RE products and technologies.

- **Air Quality and Climate Change:** In many states, air regulations and concerns over mitigating GHGs helped to lead to the creation of a mandate to support EE/RE.
- **Economic Development:** In some states, traditional generation is viewed as capital (rather than labor) intensive and as a net drain on state economies because fossil fuels are imported from other states. EE/RE generation is supported as part of near- and long-term in-state economic development strategy. States are also focused on building a “green jobs” workforce associated with EE/RE.

Leading²² state and utility EE programs have become important drivers of EE within their respective markets. Over time, many programs have become comprehensively designed, professionally managed, and rigorously evaluated. These programs provide direct financial assistance to reduce the purchase costs of energy efficient products and narrow the premium between these products and their less efficient counterparts. Programs also provide custom incentives to commercial and industrial customers to support more comprehensive EE improvements. While the bulk of program dollars and energy savings have been directed at lighting (because these are generally the lowest cost and most readily available EE opportunities), programs target an array of markets and technologies from commercial refrigeration and industrial motors to new residential and commercial construction. RE incentive programs²³ have different objectives from the perspective of policymakers. Because of more limited funding and operating history, these programs are viewed as longer-term investments towards developing distributed clean energy resources. Like their EE counterparts, these programs have matured and adapted to market conditions, and the largest programs are closely monitored and can serve as templates for newer and smaller ones. Leading RE programs are those recognized by their peers and by the Clean Energy States Alliance (CESA) for demonstrating innovation, an efficient use of available resources, and their ability to grow particular markets and technologies.²⁴ Financial incentives for “off-the-shelf” RE technologies [e.g., solar photovoltaics (PV)] include capacity-based rebates and, increasingly, performance-based incentives (PBIs) tied to energy production. Programs can also offer custom grants for larger projects and those involving non-standard or emerging technologies (e.g., anaerobic digesters, biomass boilers, and fuel cells). A few of the leading EE/RE programs are discussed in-depth in Appendix E.

²¹ There is an extensive body of economic and behavioral literature on this subject. For example, see Gillingham et al. 2009.

²² The term “leading” is subjective but based upon several factors including program spending levels, annual energy savings, cost effectiveness, and a program’s overall reputation among industry peers and professionals (Kushler et al. 2009).

²³ The programs discussed in this paper are independent of state RE policies such as renewable portfolio standards that provide different types of market-based incentives and are separately funded.

²⁴ For example, CESA issues annual “State Leadership in Clean Energy” (SLICE) recognition awards to certain members for innovative program development.

2.2 EE/RE Program Measurement and Evaluation

EE/RE programs often are using ratepayer funds, and thus, they can be subject to legislative and regulatory oversight. Formal assessment in the form of Evaluation, Measurement, and Verification (EM&V) by outside auditors/evaluators serves both as a feedback loop for program managers and provides metrics and analysis to ratepayers, regulators, policymakers, and stakeholders regarding program performance and progress against targets. EM&V is itself an important and sometimes significant expense of EE programs, typically representing 3%–6% of program budgets (National Action Plan for Energy Efficiency 2007).

EM&V provides an estimate of verified energy savings (or RE generation) to be used against an established performance target. In addition to reporting energy savings and a standard benefit-cost ratio, EM&V often also includes estimates of non-energy benefits of EE/RE programs (e.g., emissions, electric systems, and employment impacts). The results of the program evaluations provide administrators with ongoing feedback on the programs as well as recommendations for continuous improvement.

There are well-established EM&V industry protocols and methodologies for evaluating EE programs. Evaluation processes include “impact evaluation” (i.e., a measurement of energy saved, associated emissions reductions, and co-benefits), “process evaluation” (an evaluation of program administration), “market effects evaluation” (an evaluation of how the industry supply chain has responded to the program), and “cost effectiveness evaluation” (which measures the cost effectiveness of procuring energy savings versus supply-side resources). Table 2 summarizes these approaches.

Table 2. Energy Efficiency Program Evaluation Descriptions

Evaluation Type	Description	Uses
Impact	Quantifies direct and indirect benefits of the program	Determines energy and demand saved, emissions reduced, and co-benefits
Process	Evaluates program administrative procedures from both administrator and participant perspectives	Identifies possible improvements in program administration or processes
Market Effects	Indicates how supply chain and market have been impacted by a program (e.g., market share or cost reductions of EE products)	Determines market changes due to a program and whether changes are sustainable if program support changes
Cost Effectiveness	Compares program costs with benefits	Determines whether program is cost effective relative to other programs or procurement of supply-side resources

Source: National Action Plan for Energy Efficiency 2007

Rather than summarize these methods in greater detail here, the reader is encouraged to consult the “Model Energy Efficiency Program Impact Evaluation Guide” prepared for the U.S. Environmental Protection Agency (EPA) (National Action Plan for Energy Efficiency 2007).

A recent Lawrence Berkeley National Laboratory (LBNL) report (Messenger et al. 2010) reviewed the current status and effectiveness of EE evaluation practices across the country. The report highlighted five key issues in current evaluation methodologies that have yet to be addressed. Most of these issues center on inconsistent measurement practices and, therefore, the challenges of comparing program results across states. The issues identified were:

- Differences in how program savings are estimated and defined make it difficult to compare savings among states.
- While methods for estimating gross energy savings from specific EE measures are well documented and standardized, there is inconsistency in the approach to measuring “net” savings (net savings adjust for program “free riders” and “spillover”).
- Quality control and accuracy vary among states due to differences in evaluation budgets, the degree of importance that regulatory commissions place on accuracy, and lack of disclosure of the level of certainty in the evaluations.
- Some states focus on program evaluation but shortchange process evaluation or vice-versa.
- Evaluators maintaining independence of the programs that have contracted their services.

Evaluation methodologies for RE programs currently vary by state. Larger and longer-running programs such as those in California, New Jersey, New York, Wisconsin, and Connecticut are subject to rigorous evaluation.²⁵ Smaller programs might be less subject to regulatory scrutiny and reluctant to devote a significant share of limited budgets to evaluation.

Although the evaluation methodologies for RE programs can be as rigorous as those for EE programs, it is not appropriate to use identical metrics to evaluate the two types of programs. Because of the relatively higher cost of RE technologies, benefit-cost ratios for RE, particularly small-scale distributed technologies, are below those for most EE measures.

The EPA recently published an additional evaluation resource, “Assessing the Multiple Benefits of Clean Energy: A Resource for States” (U.S. EPA 2010). This guide presents a range of approaches and analytic tools that program evaluators and regulators could use in reviewing program results. Importantly, this guide goes well beyond energy impacts and benefit-cost metrics in providing methodologies for assessing electric system benefits, environmental benefits, and economic benefits of these programs.

2.3 Clean Energy Program Performance

To evaluate the effectiveness of EE/RE programs, it is important to define and apply specific performance metrics. Doing so provides an indication of what programs are having greater

²⁵ For example, the California Solar Initiative program has been subject to close review and approval by the California Public Utilities Commission (CPUC). Factors reported include total installed generation capacity, program cost, electrical system benefits, impact on rates, environmental benefits, impact on peak electricity demand, and progress towards reaching program goals (CPUC 2009).

effectiveness compared to others and helps to identify lessons learned in achieving specific goals.

The Department of Energy (DOE), in its application guidelines for supplemental State Energy Program funding under ARRA, established five performance metrics to evaluate the effectiveness of these initiatives (U.S. DOE 2009). This report utilizes these same criteria to review the performance of selective state and utility EE/RE programs and make general conclusions about overall program performance nationally where appropriate.

1. **Energy Saved or Generated:** Energy saved is measured as year-over-year reductions in demand that is attributable to an EE program. RE program measurement is based on estimated or actual energy production from installed RE systems that receive program support.
2. **GHG Emissions Reductions:** GHG emissions reductions can be derived from energy saved through EE measures or energy displaced by a RE system and by the non-baseload electric generation emissions profile of the geographic area where the savings or generation occurs.
3. **Energy Cost Savings:** Energy cost savings measures the lifetime value of energy saved through efficiency measures relative to the cost of the efficiency measure and is generally expressed as a “benefit-cost ratio.” There are several benefit-cost tests used in EE program evaluation. This report focuses on (1) the Total Resource Cost (TRC) test, which compares the total cost (including both customer and state contributions) of an EE/RE program or measure against the value of the lifetime energy savings attributable to the program or measure, and (2) the Program Administrator cost test, which compares program costs against the cost of energy not purchased due to the results of EE/RE programs.
4. **Funds Leveraged:** In general, the more private capital that program funds can leverage, the more projects a given level of public funding can support and the greater the energy savings or generation a program can deliver. However, if funds are not sufficient enough to incentivize investment, then the amount of private dollars leveraged could be low.
5. **Job Creation:** The creation of “green jobs” has been a focus of recent federal and state policies. Measuring and tracking job creation is subject to wide estimation variance. Most estimates utilize economy-wide, input-output models (such as REMI or IMPLAN), which capture the overall impact of an increase in EE/RE investments relative to baseline spending.²⁶ For example, a recent national study estimates that each million dollars of RE investment creates 9.7 direct and indirect jobs (Pollin et al. 2009). These macro-studies typically define changes in employment in terms of *gross* or *net* job creation.²⁷

²⁶ For information on REMI, see http://www.swosu.edu/bdc/remi_about.htm. For information on IMPLAN, see <http://implan.com/V3/Index.php>.

²⁷ Net job creation reflects any job losses resulting, for example, from reduced demand for conventionally-generated electricity, as well as any job that would have been created anyway.

2.4 Results of Energy Efficiency Programs

Despite the billions of dollars of ratepayer and other funds being spent at the state level on EE programs, the ability to report data consistently across states and to aggregate this data nationally is a limiting factor in reporting program results. At the state level, the regulatory requirements to report on program results vary considerably. More fundamentally, while third-party evaluators employ similar approaches, each evaluation is based on a reliance on program databases, a series of sampling decisions, and assumptions regarding the actual energy savings attributable to the program. Moreover, metrics such as avoided GHG emissions and net job creation are not captured in many state and utility reports. Finally, although several organizations attempt to aggregate results nationally, none of these reports are exhaustive and often include different metrics.²⁸

With these caveats, results of these programs, using DOE metrics, are outlined next. Aggregate national results are presented where available. However, because each state and utility program is managed individually and operates in separate market and regulatory contexts, individual state-level results could have more value in identifying lessons learned from these programs. Therefore, the following selective state-level results are also presented.

Energy Saved: Total reported electric energy savings from all electric efficiency programs combined were 96,319 GWh in 2009²⁹ (Nevius et al. 2010). Annual, verified energy savings from well-funded programs average 0.7% of the prior year's electric consumption but have reached as high as 1.8% of sales in Vermont (Eldridge et al. 2009a). Nationally, energy savings attributable to efficiency programs were equal to 0.34% of retail electric sales in 2008 (Barbose et al. 2009). This rate of energy savings is below the current national rate of growth in energy demand of 1.1% per year (U.S. EIA 2009).

Leading EE programs (as rated by ACEEE and an expert panel) are spending an average of 1.7% of annual electric utility revenue on efficiency programs. Several programs (Vermont,³⁰ California, and Connecticut) are spending at much higher levels and achieving corresponding higher rates of savings. On the other extreme, 37 states are reporting less than 0.1% reductions in annual electric consumption attributable to their EE programs. Most of these states and their utilities are spending little on EE on a per capita basis.³¹ Figure 1 displays electric EE spending per capita across states, while Table 3 compares electric EE spending against reduced demand in those states achieving the highest relative levels of savings.

²⁸ For example, the Consortium for Energy Efficiency publishes an annual report of spending and energy savings based on survey data, which can be found on their website at <http://www.cee1.org/ee-pe/AIRindex.php3>.

²⁹ This includes the bulk of state and investor-owned utility efficiency programs in the United States but is not a 100% sample. It represents the one-year savings from cumulative program investment as reported to DOE's Energy Information Administration.

³⁰ Vermont's program is discussed in greater detail in Appendix E.

³¹ Federal funding available through ARRA to state energy programs and Energy Efficiency and Conservation Block Grants have stimulated the development of substantive EE/RE programs in many of these states for the first time.

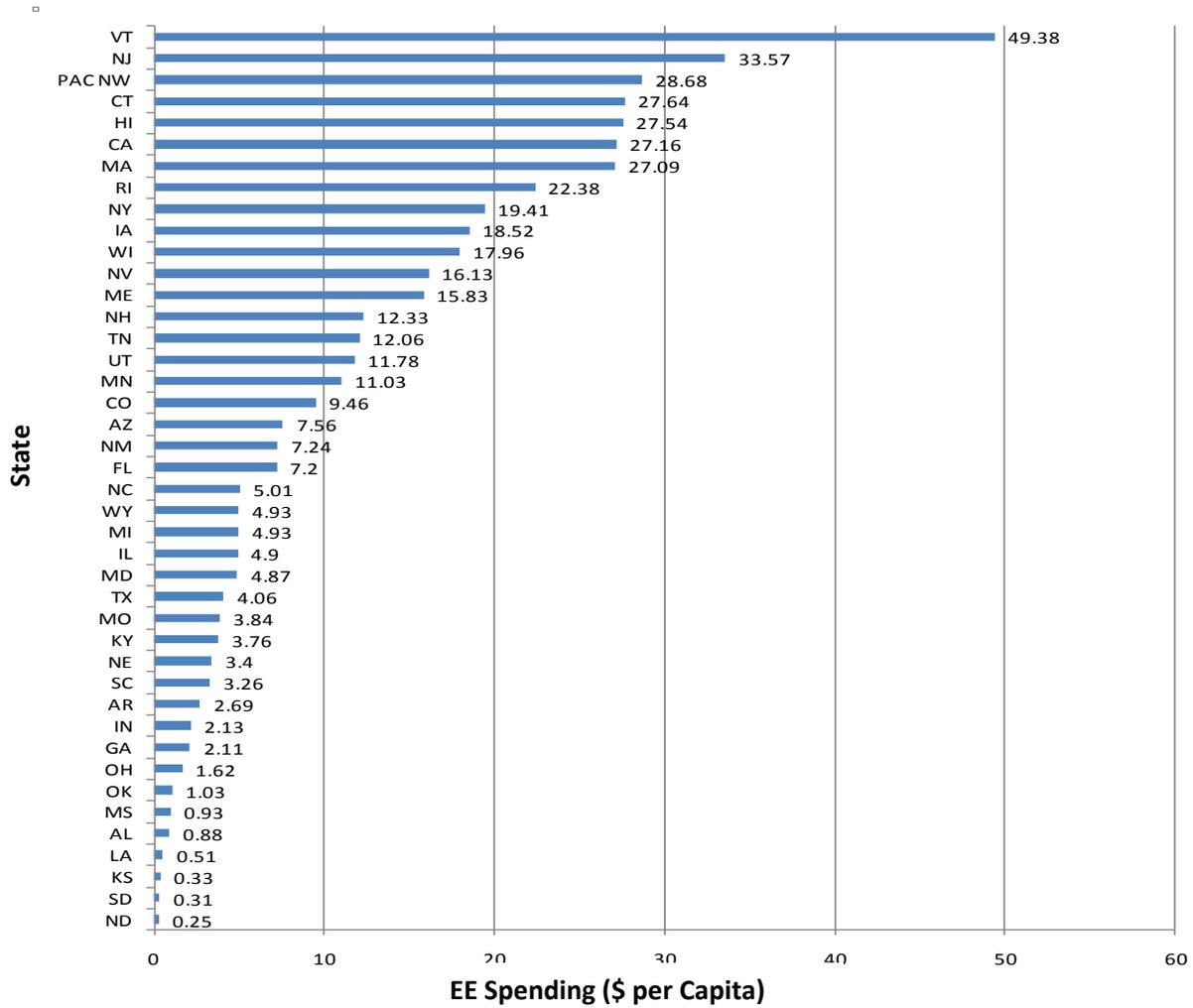


Figure 1. Ratepayer-funded electric energy efficiency spending (ranked by \$ per capita 2009)

Notes: PAC NW includes all programs in ID, MT, OR, and WA combined including those coordinated through the Bonneville Power Administration. No data reported for DE, VA, or WV. Excludes spending on peak load management programs.
Sources: Nevius et al. 2010

Table 3. 2007 Energy Efficiency Savings vs. Spending—Leading States

State	EE Savings as % of Prior Year Electric Demand	EE Spending as % of Utility Revenue
Vermont	1.8%	3.4%
California	1.3%	2.6%
Hawaii	1.2%	0.7%
Connecticut	1.1%	2.0%
Maine	0.9%	1.0%
Oregon	0.9%	2.1%
Massachusetts	0.9%	1.4%
Rhode Island	0.8%	1.9%
Washington	0.7%	0.9%
Iowa	0.7%	1.4%
New Hampshire	0.7%	1.3%
Minnesota	0.7%	1.7%
Wisconsin	0.7%	1.2%

Source: Eldridge et al. 2009a (based on 2007 EIA data)

The states in Table 3 represent those with both the highest levels of EE spending and resulting energy savings. These states also tend to have the highest retail electricity rates, the lowest per capita consumption of electricity, and the lowest GHG emissions per megawatt-hour of generation in the nation.³² Conversely, the states that historically have had limited EE spending (see Figure 1 above) have among the lowest electricity rates in the nation, the highest consumption of electricity, and the greatest reliance on coal-fired generation leading to the highest GHG emissions per megawatt-hour generated (U.S. EIA 2010a). This detailed data is contained in Appendix B. These findings suggest that there could be an opportunity to incentivize investments in EE/RE, particularly in states with low EE spending, higher than average electricity rates, and higher than average per capita consumption of electricity. Incentives might need to be larger in states with lower electricity rates than in states with higher electricity rates and comparable opportunities for EE/RE.

³² This is based on in-state generation. Most states are also importing electricity from regional power pools. This blended generation could have a different emissions profile than in-state generation.

An LBNL study projected future national EE spending in the electric sector funded by ratepayers. The study estimated it would rise from a current (2008) level of 0.7% of utility revenue (\$2.6 billion) to 1.0%–2.2% of revenue in 2020 based on low-, medium-, and high-case scenarios (assuming ratepayer but no federal program funding). Projected average annual savings in 2020 resulting from these programs would range from 0.41%–0.76% of demand based on the scenario with projected cumulative demand reduction in 2020 of 4.7%–8.6% below the Energy Information Administration’s (EIA) base case forecast (Barbose et al. 2009).

GHG Emissions Reductions: GHG emissions reductions can be estimated from the amount of electricity saved and the non-baseload electric generation mix within a regional power pool. EE allows this non-baseload, conventional generation to be ramped down or not dispatched.^{33,34}

Only a few state programs specifically report on GHG reductions achieved, as GHG emission reductions are not a specific goal for many state programs. One program that does report emissions reductions is the New York State Energy Research and Development Authority (NYSERDA). They report a cumulative program impact of 2.3 million annual tons of reduced carbon dioxide (CO₂) emissions (NYSERDA 2010). Because of this inconsistent program reporting, we estimate national GHG reductions from EE programs based on reported energy savings.

This calculation uses the electricity savings from of EE programs in specific states and the average avoided emissions factor for each state’s corresponding NERC sub-region to estimate a rough snapshot of emission reductions from a single year of EE program investment.^{35,36} While this does not produce results as accurate as a model using true marginal emission rates, it does allow for a general comparison among states. EE programs operating in 2007 led to an estimated 6.8 million tons of aggregate CO₂ emissions avoided, with California alone accounting for 27% of the total avoidance (CESA analysis; Eldridge et al. 2009b; U.S. EPA 2007), as shown in Table 4.

³³ The EPA recommends the use of non-baseload (rather than average) emission rates for estimating GHG reductions associated with reductions in electricity use (Pechan & Associates 2008). Average North American Electric Reliability Council (NERC) sub-region, non-baseload emissions factors range from 1,083 pounds of CO₂ per MWh of generation in California to 2,159 pounds of CO₂ per MWh in the Upper Great Plains (U.S. EPA 2008c).

³⁴ This analysis uses *annual average* non-baseload emissions rates to calculate GHG reductions, even though emissions rates and displacement of conventional generation both vary over time. This may underestimate the effect of the emissions rate during peak demand hours because EE measures have greater impact during those periods (e.g., air conditioning).

³⁵ This methodology is most appropriate at smaller scales (e.g., for a building or group of buildings). If EE programs actually achieve 1% of total electricity sales for several years in a row, the EE programs could have a measureable effect on how much new generating capacity is built. This important factor is not considered in this rough estimation. Moreover, it is important to note that average emissions factors (averaged over a year) are not a direct substitute for marginal emissions factors (that actually take into account the time of day and seasonal impacts of electricity supply and demand). Again, this approximation is designed to be illustrative of the relative differences between different regions, and it is not intended to be an exact calculation of marginal emissions.

³⁶ A more accurate estimate of GHG emission reductions would be based on the avoided generation in each hour that the savings occur. This analysis assumes an average non-baseload emissions profile and treats all EE investments equally in terms of avoided emissions by time of day and season. In addition, this analysis assumes all electricity in a region is met by generation within that region and ignores imports and exports of electricity that could affect the actual avoided emissions.

Table 4. Estimate of Aggregate Average Avoided CO₂ Emissions Derived from Ratepayer-funded Energy Efficiency Programs in a Single Program Year (Based on 2007 Energy Savings and 2005 eGrid Data)³⁷

State	2007 Electricity Savings from EE Programs (1,000 MWh)	% of Total Electricity Savings (2007)	2005 Average Avoided CO ₂ /MWh (lbs/MWh)	2007 Total Avoided CO ₂ Emissions from EE Programs (1,000 tons)	% of Total Avoided Emissions
CA	3,393	34%	1,083	1,837.3	27%
WA	635	6%	1,334	423.5	6%
NY	541	5%	1,515	409.8	6%
MA	490	5%	1,315	322.2	5%
WI	468	5%	1,876	483.9	6%
MN	464	5%	2,158	500.7	7%
TX	458	5%	1,119	256.3	4%
OR	437	4%	1,334	291.5	4%
CT	372	4%	1,315	235.6	3%
FL	348	4%	1,354	235.6	3%
IA	322	3%	2,158	347.4	5%
NJ	242	2%	1,790	216.6	3%
All Others	1,688	17%	1,500	1,266.0	19%
Total	9,858	100%		6,790.3	100%

Sources: CESA Analysis 2009 ; Eldridge et al. 2009b; U.S. EPA 2007

In its annual survey of EE programs, the Consortium for Energy Efficiency reports avoided CO₂ emissions in 2008 from all EE measures implemented both in the current and prior program years to be more than 50 million metric tons annually.³⁸ These emission reductions would continue to grow as program funding grows nationally, offset by the retirement of energy savings

³⁷ Savings and avoided emissions based on reported energy savings attributable to state- or utility-run efficiency program activity from a single year of program activities. These savings continue over the life of the EE measures.

³⁸ This is based on annual estimated savings of 96,319 GWh as reported on the EIA Form 861 (importantly, a reviewer points out that it appears to be a high degree of variability in how individual utilities respond to this section of the form, so the cumulative energy savings reported might not be accurate). It includes both EE measures implemented in the current year as well as previously-implemented measures with persistent savings. GHG estimates were based on EPA's GHG emission reduction calculator.

from previously-implemented EE measures that have exceeded their projected lives³⁹ (Nevius et al. 2010). In an LBNL study, which estimates current and future energy savings from state and utility EE programs (Barbose et al. 2009), annual avoided CO₂ equivalent emissions in 2020 from ratepayer-supported EE programs are projected to range from 42 million to 164 million metric tons relative to the EIA baseline scenario.⁴⁰

Cost Effectiveness⁴¹: Calculating cost effectiveness of EE programs is a complex modeling process and relies upon a number of variables, including an estimation of energy savings for individual EE measures, a forecast of future energy prices, and attribution rates, which attempt to isolate the amount of energy savings attributable to program incentives (National Action Plan for Energy Efficiency 2008).

There are five established cost tests used in evaluating EE programs and measures: the participant test, program administrator cost test, ratepayer impact measure, TRC test, and societal cost test. A summary of these measures and their definitions are described in Table 5.

Table 5. Cost Tests for Evaluating Energy Efficiency Programs and Measures

Acronym	Measure	Question Answered	Summary Approach
PCT	Participant Cost Test	Will the participant(s) come out ahead financially?	Compare participant share of EE investment to participant lifetime energy savings
PACT	Program Administrator Cost Test	Will utility bills increase?	Compare program costs to supply-side resource costs
RIM	Ratepayer Impact Measure	Will utility rates increase?	Compare program costs and net utility bill reductions to supply-side resource cost
TRC	Total Resource Cost	Will the total cost of energy decline?	Compare total investment (program and private) to total retail energy savings
SCT	Societal Cost Test	Is society better off overall?	Include indirect benefits (e.g., public health and jobs in TRC calculation)

Source: National Action Plan for Energy Efficiency 2008

While all of these metrics have value, the PACT and the TRC are used most frequently by evaluators and are the focus of this report. The PACT allows a comparison of the incentives

³⁹ For example, energy-saving light bulbs installed 4 years ago could wear out and might not be replaced by similar bulbs.

⁴⁰ By contrast, the climate legislation passed by the U.S. House of Representatives in 2009 (American Climate and Energy Security Act) requires an estimated emission reduction of 912 million metric tons of CO₂ equivalent in 2020.

⁴¹ Cost effectiveness, in this report, is used to describe the lengths of time that it takes for the owners of EE/RE improvements to fully recover their costs via energy savings. The shorter the payback, the more cost effective the improvement.

provided by programs against the avoided lifetime wholesale cost of energy not purchased (or generated) as a result of energy savings attributable to the program. It indicates whether total program costs are above or below the cost of procuring an equivalent amount of supply-side resources (i.e., electric generation, transmission, and distribution). The TRC compares the total cost of an EE investment against lifetime energy savings and essentially indicates whether an individual EE measure, set of EE investments, or total program are a net positive investment, regardless of the capital source of the investment (public or private).

On a portfolio basis, leading EE programs are demonstrating overall benefit-cost ratios using the TRC measure well above 2.0, meaning that the discounted present value of lifetime energy savings exceeds the total cost of EE investments (both the program costs and participant costs) by a 2:1 ratio. Any TRC above 1.0 is considered a net positive investment. At the individual measure level, benefit-cost ratios can be considerably higher or lower depending upon the cost of the measure.⁴² For example, many EE programs include measures targeted at low-income homeowners. Because these low-income measures often require significant expenditure per home (for example, health and safety-related measures) yet result in limited energy savings, the measure-specific TRCs are often well below 1.0. A recent ACEEE study reported benefit-cost ratios for select EE programs using the TRC test. These ratios are displayed in Table 6.

Table 6. Benefit-cost Ratios for Select Energy Efficiency Programs

State	Benefit-cost Ratio (TRC)
MA	3.6
NJ	2.9
NY	2.6
OR	2.4
CA	2.3
IA	2.2
WI	2.2

Source: Friedrich et al. 2009

These programs represent all three types of administrative structures (utility, state, and third-party) and operate in markets with utility rates that range from moderate (IA and WI) to among the highest in the country (MA, NJ, and CA). It is difficult to isolate specific factors that could impact program effectiveness without more comprehensive analysis; however, high levels of

⁴²A “measure” is an individual targeted program within energy-saving activity undertaken by a participant in an overall EE program. For example, replacing an inefficient refrigerator, light fixture, or washing machine with more efficient models are all EE measures.

program funding, strong regulatory oversight, comprehensive programs, and a long operating history are common factors that can contribute to program performance.

The ACEEE study also reported on the levelized utility cost of saved energy from select EE programs in which this data was publicly available. The utility cost of saved energy is used to compare program expenditures against future avoided energy purchases that result from EE investments.

Table 7. Levelized Utility Cost of Saved Electricity (PACT) from Select EE Programs

State	Program Cost (cents/kWh)	Current Avoided Electricity Purchases (cents/kWh)
OR	1.6	5.1
IA	1.7	4.9
NV	1.9	5.1
NY	1.9	5.5
MN	2.1	4.9
NJ	2.6	5.5
CT	2.7	5.5
VT	2.7	5.5
CA	2.9	5.1
RI	3.0	5.5
MA	3.1	5.5
Note: Avoided electricity purchases are 2007 average wholesale electricity costs for the corresponding NERC region.		

Sources: Kushler et al. 2009; U.S. EIA 2009

Funds Leveraged: Among eight states surveyed in the ACEEE report, the average ratio of program costs to private investment was approximately 1:1, (i.e., \$1 of public spending for every \$1 of private spending) ranging from nearly 3:1 in Massachusetts to 1:2 in New York (Friedrich et al. 2009).⁴³ This finding does not imply that state and utility programs are paying for 50% of

⁴³ Note that the actual amount of funds leveraged is not known, and this data should be treated as a general estimate only.

the cost of EE measures overall. Program costs also include administration, outreach, and evaluation. Some programs, such as Efficiency Vermont, offer lower direct incentives but more indirect technical assistance and marketing to achieve savings targets. In addition, there can be a tradeoff between funds leveraged and energy savings delivered.⁴⁴ A reduction of incentive levels could lead to reduced EE investments as the out of pocket participant share of these investments goes up and financial payback of these investments lengthens.

Job Creation: EE programs create employment in two ways:

1. Direct job creation from the increased manufacture, sales, and installation of EE equipment attributable to these programs.
2. Indirect job creation from the reinvestment of energy savings elsewhere in the economy. For example, if a business spends less on electricity, it can spend more on payroll, capital investment, or other goods and services, which could have greater net employment impact than electricity generation and distribution.

As with GHG emission reporting, there is not a consistent reporting method across all states that report employment impacts from their programs. NYSERDA, which oversees many of the efficiency programs for New York State, estimates that 4,900 net⁴⁵ new direct jobs related to EE are attributable to its EnergySmart program initiatives since inception (NYSERDA 2010).⁴⁶ A meta-review of 48 studies examining the projected economic impact of EE spending⁴⁷ reported an average net benefit of 49 jobs per trillion BTUs (293,000 MWh) of energy savings (Laitner 2009). Applying this formula to the aggregate reported EE program, EE savings in 2007 of 9.8 million MWh as reported by ACEEE (Eldridge et al. 2009b) yields 1,648 net jobs nationally created from this single program year. An input-output model performed by the University of Massachusetts' Political Economic Research Institute concludes that each million dollars invested in EE building retrofits yields 11.9 gross job-years (Pollin et al. 2009). Extrapolating this ratio to national EE spending, this would suggest that, at current program spending levels, state and utility electric EE programs generate 102,000 job years per program year.⁴⁸ While each of these studies is directionally consistent, these estimates vary widely, and different methodologies make it difficult to directly compare studies.

2.4.1 Results of Renewable Energy Programs

State and utility RE programs range in size from those in California with annual budgets close to \$400 million per year to some programs spending under \$1 million per year. CESA is a network of 18 state-sponsored RE programs with collective budgets of \$600 million per year;⁴⁹ these

⁴⁴ For more detail on Efficiency Vermont, see Appendix E.

⁴⁵ Net jobs would take into account any job losses associated with these investments; for example, reduced employment in the utility sector.

⁴⁶ For more information on NYSERDA's program, see Appendix E.

⁴⁷ This impact is independent of whether EE investments are induced by EE programs or financial incentives.

⁴⁸ This figure was calculated by using the \$4.3 billion in reported electric program spending, doubling this (to reflect the public-private cost share) and multiplying by 11.9 job years per million dollars in spending. A job-year represents one full-time equivalent job for one year regardless of the skill or wage level.

⁴⁹ The members of CESA as of January 1, 2011 are: Alaska Energy Authority; California Energy Commission; Colorado Governor's Energy Office; Connecticut Clean Energy Fund; D.C. District Department of the Environment, Energy Trust of Oregon; Illinois Clean Energy Community Foundation; Long Island Power Authority; Maryland Energy Administration; Massachusetts Clean Energy Center; NYSERDA; New Hampshire PUC; New Jersey's

programs represent over 80% of state and utility RE program spending and are primarily focused on demand-side distributed generation projects. RE programs tracked and reported by CESA members have supported over 52,000 individual RE projects through 2008, with over 62% of these projects installed from 2006 to 2008⁵⁰ (CESA 2010a). Over the next decade, an estimated \$7.2 billion dollars in additional ratepayer funds will be collected for just the state RE programs, \$4.6 billion in California alone (DSIRE 2010a).

In assessing the results of these programs, it is important to recognize that there are significant data gaps in RE program reporting. CESA's national database on project installations supported by public clean energy funds is the first attempt to aggregate the results from these programs but includes only data as reported by its members (and does not include utilities operating rebate programs).⁵¹ Moreover, this database tracks only the number of projects by technology, program spending, and total project investments. It does not capture other performance metrics. The results shown in Figure 2 are based on estimates from CESA's project database and other sources that track solar PV installations as well as individual state performance reporting where available.

Energy Generated: CESA member RE programs have provided direct support (rebates and grants) for over 1,300 MW of new renewable generation capacity since their inception (CESA 2010a), including 587 MW of wind energy⁵² and 484 MW of grid-connected solar PV systems.⁵³ See Figure 2.

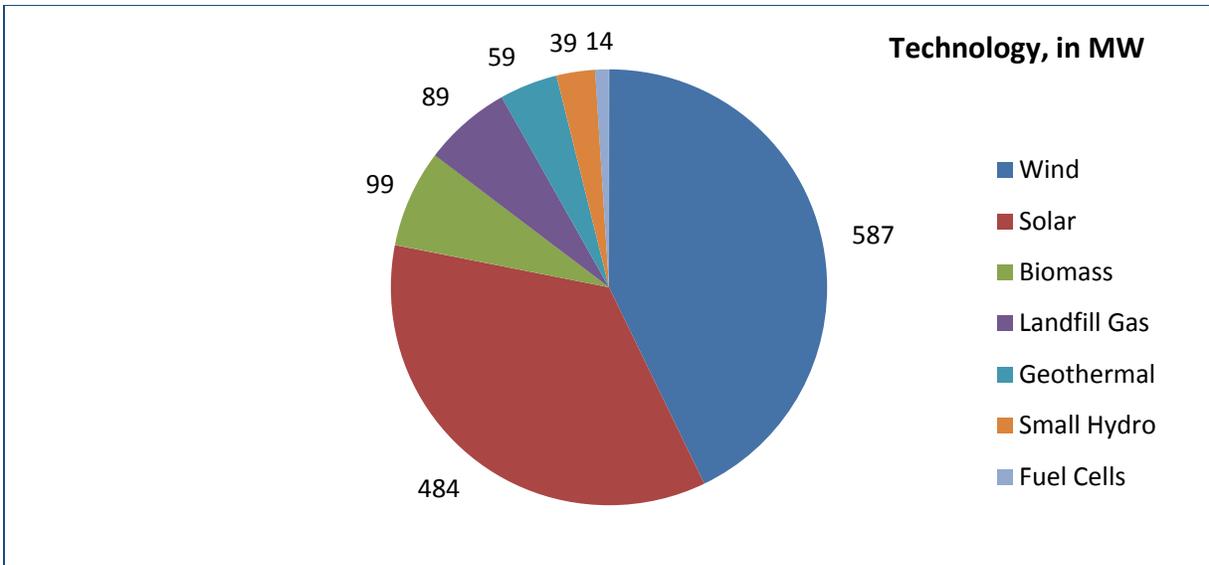
Clean Energy Program; Ohio's Advanced Energy Fund; Sacramento Municipal Utility District; TRF Sustainable Development Fund (PA); Wisconsin Energy Conservation Corporation; and the Xcel Energy Renewable Development Fund (MN). The CESA member project count is based on internal data as reported by member funds. Significant programs not included are utility-run programs in Arizona, Colorado, and Nevada.

⁵⁰ These figures include only projects reported by CESA members and exclude RE programs offered by utilities or non-CESA member state programs.

⁵¹ However, the Interstate Renewable Energy Council tracks solar energy specific projects nationally (Sherwood 2009).

⁵² During early program years, funds provided support to commercial wind projects. This largely ended when state RPSs began to take effect and the federal tax credits were extended, reducing the need for direct state support.

⁵³ This figure is based on cumulative installed solar PV capacity in CESA-member states with clean energy funds that support solar PV. It excludes states with utility rebate programs (e.g., Colorado and Arizona). Total cumulative grid-connected PV capacity at the end of 2009 is estimated at 1,257 MW. Virtually all of these installations received state or utility rebates (Sherwood 2010; Wiser et al. 2009).



Source: CESA 2010a

Figure 2. Renewable energy capacity supported through CESA-member renewable energy funds (through 2008; in MW)

Individual generation data from these projects are not available; lifetime energy generated can be estimated using these installed capacities and assumptions regarding technology-specific capacity factors and energy production. These estimates are shown in Table 10.

Cost Effectiveness: Unlike EE programs or state renewable portfolio standards (RPS),⁵⁴ RE programs—outside of utility RE procurement—thus far have not been structured to primarily support the most cost-effective or least-cost measures and technologies. Therefore, it is not meaningful to compare their cost effectiveness against other programs and policies. Even with this caveat, it is still difficult to assess the overall cost effectiveness of the RE programs using standard metrics due to the lack of consistent reporting among programs. Large programs such as the California Solar Initiative engage outside evaluators for comprehensive reviews (CPUC 2009) while smaller state or utility programs undertake modest reviews due to limited budgets or regulatory requirements.

A generalized ratepayer (PACT) cost test can be performed for solar PV, which represents over 90% of RE program spending (CESA 2010a). The average solar incentive in 2008 was \$2.25 per watt⁵⁵ (Wiser et al. 2009) but had declined to \$1.75 per watt by the end of 2009. Assuming a useful solar PV system life of 20 years, the levelized cost of these incentives to clean energy programs would range from 5.8–8.8 cents per lifetime kWh produced, depending on location. This analysis is summarized in Table 8.

⁵⁴ Under a state RPS, utilities are obligated to meet a certain percentage of their load with RE. In most states, they meet this requirement through the purchase of renewable energy certificates from renewable energy generators. Since state RPSs encourage “least-cost” compliance, utilities most frequently meet these requirements by purchasing RECs from wind power projects rather than higher cost technologies.

⁵⁵ The \$2.25/watt average incentive is based on systems installed in 2008 in which the incentive might have been “reserved” in 2007. Incentive levels in 2009 have dropped significantly due to changes in the federal income tax credit for solar systems and declining equipment costs.

Table 8. Estimated Levelized Program Administrator Cost of Solar PV Incentives, 2009

	High Solar Location	Low Solar Location
Incentive per kW	\$1,750	\$1,750
Generation per kW per year (kWh)	1,500	1,000
System Life	20 years	20 years
Lifetime Generation (kWh)	30,000	20,000
Levelized Cost of Incentive (¢/kWh)	5.8¢	8.8¢
Note: Program administrator cost excludes indirect costs (e.g., administration and marketing).		

Source: CESA analysis 2009

At either of these levels, the levelized cost of these incentives is generally above the average cost of procuring conventional energy supply in most regions of the country, as shown in Table 9 (U.S. EIA 2009a).

Table 9. Average Wholesale Electricity Price by Selected NERC Regions, 2007 (¢/kWh) vs. Levelized Ratepayer Cost of PV Rebates

	Florida	Mid-west	NY/ New Eng-land	Eastern Midwest	South-east	KS / OK	ERCOT	West
Avg. Wholesale Rate (¢/kWh)	7.1	4.9	5.5	5.5	5.5	4.9	6.3	5.1
Amount Above/Below Levelized Solar Rebate at \$1.75/watt in High Productivity Solar Location (e.g., CA, AZ)	2.3	-0.9	-0.3	-0.3	-0.3	0.9	0.5	0.7
Amount Above/Below Levelized Solar Rebate at \$1.75/watt in Moderate Productivity Solar Location (e.g., NJ, IL)	-1.7	-3.9	-3.3	-3.3	-3.3	-3.9	-2.5	-3.7

Source: U.S. EIA 2009a, based on Annual Electric Power Industry Report

However, the levelized cost of these incentives could be below the avoided cost of purchasing wholesale electricity or generating electricity in specific power markets during peak periods when solar PV systems are most productive (i.e., hot afternoons in summer months).⁵⁶

Avoided GHG Emissions: Table 10 shows a rough approximation of energy generation and avoided GHG emissions from state and utility RE programs. For non-solar PV technologies, the calculation uses the CESA-member database of completed project capacity by technology. Using this database assumes that CESA membership is involved in most state or utility, non-solar PV project deployment (a reasonable assumption since most states use CESA member programs to target non-PV technologies as well as larger, centralized projects). However, it is much more challenging to estimate the GHG emission reductions from state and utility RE programs because a lot of deployment happens outside of CESA member programs. Therefore, a broader estimate of grid-tied solar PV capacity is used. This assumes that most solar PV is deployed as a direct result of a state or utility RE program (and not on its own due to high upfront costs and long payback periods). Based on these assumptions, these RE programs collectively helped to displace 3.3 million tons of CO₂ per year for projects funded through the end of 2008.

Table 10. Avoided GHG Emissions Estimates from State and Utility RE Programs

Technology	Cumulative Installed Capacity (MW, 2008)	Electricity Production per MW per Year (MWh)	Total Electricity Production per Year (1,000 MWh)	Displaced CO ₂ Emissions per MWh (tons)	Total Annual Displaced CO ₂ Emissions (1,000 tons)
Solar PV	793	1,400	1,110.2	0.61	678.5
Wind	587	2,190	1,285.5	0.75	964.1
Biomass	99	7,884	780.5	0.75	585.4
Other*	201	7,446	1,496.6	0.75	1,122.5
Total	1,680		4,672.8		3,350.5

Notes: Installed solar capacity is an estimate of all grid-tied solar PV systems including those supported by non-CESA members and utilities and those that might not have received any state or utility program incentive. Capacity factors assumed are 16% for solar, 25% for wind, 90% for biomass, and 85% for other. "Other" does not include the value of recaptured waste heat in fuel cells. Displaced emissions based on NERC sub-region non-baseload emissions, weighted for distribution of projects by region.
*Other includes geothermal, landfill gas, fuel cells, and hydropower.

Source: CESA 2010a; CESA analysis 2009; U.S. EPA 2007; NREL 2008; Sherwood 2009

Some individual state clean energy programs directly estimate GHG reductions attributable to their programs. For example, the Connecticut Clean Energy Fund reported that, from its launch in 2002 through 2009, it has funded 1,740 on-site RE systems (fuel cells, solar PV, biomass, wind, and advanced hydro projects), which cumulatively will avoid 444,682 tons of CO₂ over

⁵⁶ This does not reflect the potential ratepayer cost of paying for excess generation (beyond the system owner's use) due to net-metering laws, which vary from state to state.

the expected life of the installations (CCEF 2010). An evaluation of the California Solar Initiative estimated that each megawatt of grid-connected solar installed with program support through 2008 represents an estimated annual CO₂ reduction of 885 tons (CPUC 2009).

Market Growth: State and utility RE incentive programs are playing an important market-building role for RE technologies in the United States, in particular for solar PV. First, over 85% of the installed solar PV is in states with public benefit funds, and almost all of the remainder is in states with utility incentive programs (Wiser et al. 2009). Second, the installed cost of solar PV systems has been showing steady declines of about \$0.30/watt/year and in 2008 averaged \$7.50/watt (Wiser et al. 2009) with further declines in 2009 due to the reduced cost of solar PV panels globally. The lowest installed costs are in states with the most comprehensive and well-funded solar incentive programs, such as California and New Jersey. State programs are leading to a reduction in installation costs by stimulating the growth of a competitive dealer and installer market.

These programs are, of course, not the sole driver of solar PV growth. Other factors such as the rise in third-party ownership,⁵⁷ net-metering policies and, since early 2009, the extension of the solar investment tax credit (ITC) and the lifting of the \$2,000 cap on tax credits for residential systems are also playing an important role in driving demand. However, the paucity of solar installations in states without state or utility incentives indicates the importance of these programs in driving demand.⁵⁸

Funds Leveraged: State RE programs have leveraged more non-program funds as a percentage of total project costs than EE programs, in part due to the broader availability of federal tax incentives, which reduces the level of direct incentives required.⁵⁹ CESA members' RE programs have spent \$1 for every \$3 of total capital investment (CESA 2010a).

Job Creation: Although there have been a number of studies assessing the employment impact of commercial wind development [e.g., NREL's JEDI⁶⁰ model (NREL 2008)], it is more difficult to gauge the aggregate employment attributable to state and utility RE programs, which are supporting a number of different technologies. Many of the firms engaged in distribution and installation of these systems are small or participate in broader industry categories (e.g., electricians can install solar systems as a component of their work) and are difficult to count. In California, the country's largest solar market (and solar incentive program), one study estimated that 770 firms are engaged in the solar industry (86% employing 25 or fewer people) with total industry employment at 17,000 (Carrese 2009). Also, net job growth in the RE industry would

⁵⁷ Third-party ownership refers to a solar system installed and owned by an outside firm at a host site (e.g., the rooftop of a commercial or government building). The third-party owner sells the electricity output of the system to the host but captures all of a project's direct and tax incentives. Third-party ownership is becoming increasingly common for commercial-scale projects and is also emerging in residential projects.

⁵⁸ The recently implemented market-based solar Renewable Energy Certificate program in New Jersey has largely replaced the state's direct incentive program for solar systems. However, this program can still be characterized as a ratepayer-funded financial incentive program.

⁵⁹ Until 2009, the 30% investment tax credit was capped for residential solar and wind installation, limiting the leveraging of program dollars for residential projects.

⁶⁰ "JEDI" is Jobs and Economic Development. It is a spreadsheet-based tool that estimates project-, county-, or state-level economic impacts of wind energy or solar projects based on default or user-input assumptions.

need to account for indirect effects such as potential job decline in another industry (e.g., conventional energy plants).

2.5 Program Design Lessons Learned

A set of lessons learned can be identified from state and utility experiences in managing these programs, which are described below. These lessons were derived from webinars and discussions at CESA member meetings, among other sources. They represent the authors' best judgments based on a literature review (CESA 2009; Lantz and Doris 2009) but are inherently qualitative.

2.5.1 Governmental Commitment is Important

Consistent governmental commitment achieves results more consistent results than commitment that varies over time or across different parts of government. Long-term, committed support from state legislatures, governors, and regulatory commissions could help ensure sustained funding, establish performance targets, and ensure accountability for results.

2.5.2 Stakeholder Involvement Creates More Accountability

Programs that engage diverse stakeholder groups (e.g., regulators, consumer advocates, industry, community leaders, and other interested parties) in program design, implementation, and oversight are more likely to construct programs that comprehensively address market barriers and reach multiple customer and market segments.

2.5.3 Adequate, Sustained, and Protected Funding Facilitates Long-term Effectiveness

The system benefits charge or other sources of funding are more effective if they are sufficient to support a range of programs, due to synergies across programs and effects of reaching a threshold or "critical mass" of program activity. Exemplary EE programs have budgets equal to at least 1.5% of utility revenue (Eldridge et al. 2009b). The most robust RE programs are funded at a level as high as 1% of utility revenue (CESA 2009; U.S. EIA 2009). A longer commitment to program funding helps to build awareness of and demand for programs, create market confidence, evaluate program performance trends, and incorporate lessons learned from those evaluations. Program funds that are protected from potential drawdowns for other governmental uses further ensure program continuity.

2.5.4 Program Offerings are Tailored to Market Needs and Program Goals

EE/RE programs have a wide range of technologies and markets that they can support. These options are constrained due to limited funding and resources as well as regulatory requirements. Well-established EE/RE programs often consider the following elements when determining how to allocate resources:

- **Market Needs:** Program design reflects the market potential and barriers of different technologies and allocates appropriate incentives toward achieving this potential.
- **Diverse Technology and Market Portfolio:** Programs include a range of targeted technologies, measures, and markets including emerging and higher-cost technologies, which could have a longer financial payback.
- **Accessibility:** Although the most cost-effective projects often come from commercial and industrial programs, program funds are allocated in a reasonably equitable

manner across customer classes. This distribution could help to build public support for programs, although it could also result in lower EE savings per dollar spent (e.g., program transactions costs could be larger for a residential program than an industrial program). Programs also attempt to increase awareness and distribute available funds across their geographic service territories and demographic groupings.

- **Adaptability:** Individual programs and incentives can be adjusted to changing demand and market conditions. At the same time, programs avoid abrupt stops or frequent changes in incentive levels, which leads to market confusion and lack of vendor/partner support.

2.5.5 Direct Incentives Might Not Be Enough to Encourage Consumer Uptake

Reducing the capital costs of EE/RE products and investments needs to be complemented by support services that are less easily measured. These include:

- **Technical and Feasibility Support:** Energy audits, engineering services, and feasibility support to identify and evaluate EE/RE opportunities.
- **Customer Education:** Education and outreach to help customers learn about EE/RE opportunities and technologies, understand the economics and merits of the investments, and identify quality vendors and installers (who are sometimes pre-certified as meeting specific base criteria).
- **Comprehensive Marketing:** General program and market-specific advertising and brand building create program awareness and encourage participation. Marketing is targeted at end-use consumers as well as retailers and contractors (Rosoff and Sinclair 2009).

3 Financing Tools

This section of the report reviews and evaluates the EE/RE financing tools most commonly used by EE/RE programs as well as those tools that are just emerging for use in EE/RE programs. Several of these tools—rebates and grants—have served as the foundation of these programs since their inception. Other innovative financing tools could play an important role in advancing the effectiveness and financial leverage of these programs in the future.

3.1 Rebates

Rebates have been the primary form of support for EE/RE investments at the state level.

3.1.1 Energy Efficiency Rebates

State and utility EE programs have established standard rebates for a full range of EE measures, from household compact fluorescent light bulbs (CFLs) to commercial food service equipment and industrial motors. Rebates are designed to narrow the price differential between conventional products and more EE alternatives and accelerate demand for these products.

Table 11 lists the frequency that state and utility programs offer rebates for certain EE technologies, as reported by the Consortium for Energy Efficiency.

Table 11. State Rebates for Select Efficiency Technologies

Technology	Percent of Programs Offering Support
Commercial and Industrial (C&I): High-efficiency Lighting	92%
C&I: Motors	82%
C&I: Packaged Air Conditioning	80%
Residential: CFLs	80%
Residential: Air Conditioning	66%
Residential: Refrigerators	56%

Source: Nevius et al. 2010

Rebates have been an effective market transformation tool for certain EE technologies. For example, rebates for CFLs have been a cornerstone of most state and utility EE programs. CFL shipments increased at an average annual rate of 50% per year from 2000 to 2007 (U.S. DOE 2009a), and CFL share of screw-in type light bulbs has increased from 1% to 23%, while the average price of these bulbs has fallen from \$9.00 to just over \$2.00 (U.S. DOE 2009a). Rebates are not the sole driver of this growth. EPA's ENERGY STAR[®] program, merchandising

decisions by retailers, and growing consumer awareness are also contributing factors.⁶¹ Nevertheless, the higher rate of CFL household penetration in states with active utility or state incentive programs (U.S. DOE 2009a) suggests that rebates have been an essential component of this growth. In the commercial lighting sector, the replacement of T12 fluorescent fixtures with T8 and High Performance T8 fixtures has shown similar growth, again attributable to available rebates (Mosenthal 2009).

3.1.2 Renewable Energy Rebates

Rebates for at least one RE technology are available in 38 states.⁶² The most common technologies supported through rebates are solar PV systems (25 states), solar hot water systems (26 states), and geothermal heat pumps (27 states) (Lantz and Doris 2009). Among CESA members surveyed, 93% of program funds in 2008 were spent on solar PV rebates (CESA 2010a). Table 12 is a summary of select state solar PV rebates for residential systems.

Table 12. 2010 Residential Solar PV Incentives, Selected States

State	Rebate Level (\$/Watt)	Max. System Rebate	Notes
CA	\$1.10 to \$1.55/watt (varies by utility and siting; incentive declines as capacity tiers are reached)	None	Alternative PBI of \$0.15 to \$0.22/kWh.
CT	\$1.75/watt (first 5 kW); \$1.25/watt (next 5 kW)	\$15,000	Incentive adjusted for expected system performance
MD	\$1.25/watt (first 2 kW); \$0.75/watt (2 to 8 kW); \$0.25/watt (8 to 20 kW);	\$10,000	Maximum system size eligible for rebates: 20 kW; home energy audit required.
NJ	\$0.75/watt	\$7,500 (7.5 kW)	Residential rebate levels have declined sharply in the past year
NY	\$1.75/watt (up to 7 kW)	\$12,250	Applies to geographic areas covered by NYSERDA programs only
OR	\$1.50 to \$1.75/watt based on utility	\$20,000	—
WI	\$1.00 per estimated kWh of production per year	25% of system cost up to \$50,000	—

Source: DSIRE 2010 d-f and DSIRE 2011a

⁶¹ There is some discussion whether the rebates themselves artificially “prop up” retail prices for EE products and, in their absence, whether gross retail prices would fall to the level of net retail prices inclusive of these rebates.

⁶² Including state, third-party, and utility-run programs.

The concentration of solar PV installations in those states with the most well-funded and consistent rebate programs (California and New Jersey) indicates the positive response of the solar market to these programs as well as other policies in those states that incentivize or are conducive to solar PV.⁶³ When combined with federal tax credits and accelerated depreciation, total incentives can exceed 70% of project costs for commercial installations. The growth in projects is also leading to declines in installed costs in those markets with the most active programs (Wiser et al. 2009). These installation cost declines are attributable to an increased number of larger, commercial projects (realizing economies of scale) and more efficiency and competition among solar PV installers.

The importance of rebates to the solar PV market is underscored in a recent NREL analysis (Cory and Coughlin 2009). The analysis compared the cost of a residential solar PV system to the value of the energy produced by the system over its useful life. Before applying incentives and federal tax benefits, the net present value of the estimated energy produced was less than 25% of the gross cost of the system, representing a levelized cost of energy above \$0.30/kWh in current dollars. At current system costs, even with the 30% federal tax credit, the solar PV system becomes a break-even investment only by including some form of direct incentive.

Table 13. Economics of Residential Solar PV Projects for System Owner

	Moderate Solar Resource and Moderate Electricity Prices	High Solar Resource and High Electricity Prices
System Cost (per kW)	\$7,000	\$7,000
Electricity Rates (per kWh)	\$0.12	\$0.16
Renewable Electricity Generation per kW (kWh/year)	1,200	1,500
Lifetime Electricity Generation per kW (kWh, assuming 20-year system life)	24,000	30,000
Lifetime Energy Value (NPV @ 5% discount rate, 3% annual electricity rate increase)	\$2,298	\$3,881
Value of Federal Tax Credit/kW (30% of system cost)	\$2,100	\$2,100
Rebate Needed per kW for system to be break-even investment over lifetime	\$2,602	\$1,019

Source: CESA analysis 2009

⁶³ Note: Both California and New Jersey have replaced direct rebates for commercial PV systems with other financial incentives described elsewhere in this report.

Table 13 demonstrates the importance of direct incentives for project economics. In the examples shown, even a residential system owner in a high electricity market like California would need to receive a rebate of at least \$1,019 per kW installed simply to ultimately break even on the investment. It is important to recognize that one principal objective of these rebates is to continue to drive down installed costs, eventually eliminating the need for a subsidy.

3.1.2.1 Lessons Learned for Rebates

The “lessons learned” on all financing tools are based on the collective experience and insight of the authors, their colleagues, and state clean energy fund managers that CESA works with.

Because rebates have been the most widely used financial incentive for both EE and distributed RE, state and utility experiences in administering rebate programs have led to an extensive set of lessons learned on rebate program design and implementation. These lessons have been culled from a number of sources including webinars and discussions at CESA member meetings. They are not quantitatively or statistically based but rather represent the authors’ best judgment based on a literature review and these discussions (CESA 2009; Lantz and Doris 2009).

Consistency and Duration: Rebate programs with long durations and adequate funding are more likely to build consumer awareness and avoid market confusion.

Appropriate Support Levels: Setting an appropriate rebate level is difficult. Rebates need to be sufficient to drive product demand without over-subsidizing. Inadequate rebates do not move the market and result in high free-ridership: with low rebates, a greater share of recipients would have made the purchase anyway than with high rebates that attract broader participation. Excessive rebates could overheat a market and cause rapid depletion of program funds and abrupt program terminations.⁶⁴ RE rebate levels need to reflect the availability and usefulness of all other available state and federal tax credits and incentives, local electricity rates, installed costs, and expected system performance.

Targeted Markets and Advanced Technologies: EE rebates can be designed to support both broad (e.g., lighting) and targeted (e.g., food service) markets and continuously advance demand for next-generation technologies (e.g., LED lighting). RE rebates have typically been distributed to a narrower set of technologies (e.g., solar, PV, solar hot water, geothermal, and small wind), but they can be structured to differentially support advances in technology.

Declining Funding Blocks: RE rebates can be distributed over a series of capacity blocks of decreasing incentive value to encourage cost reductions over time. This approach also allows a state to set the maximum lifetime cost of the program. If the initial rebate level is too high and the capacity block sells out quickly, the incentive level drops.

Simple Fulfillment: For EE products, point of sale and “upstream” (manufacturer) rebates are more effective with lower administrative costs than mail-in programs.

Technology-friendly Policies: RE rebates will not help to build a market if potential customers face other significant barriers to installing a RE system. Building and zoning codes as well as

⁶⁴ This rapid depletion occurred with the energy efficient appliance rebate program that states offered using ARRA funding.

net-metering and interconnection standards typically need to be in place in order for the rebate programs to be effective. These policies are discussed in more detail in Appendix D.

3.1.2.2 Strengths and Weaknesses of Rebates

Rebates are the simplest form of EE/RE financial incentive to provide because the incentive is established in advance on a measure or technology-specific basis, clearly states eligibility criteria, and provides for simple fulfillment, which could be handled in many cases by third-party processors, manufacturers, or retailers directly. They are easy to explain to consumers and provide immediate cost reductions. For EE products, rebates can create a point of price parity between less and more energy efficient alternatives or reduce the financial payback on EE investments. For RE technologies, rebates have proven to be essential in stimulating demand by substantially lowering what are otherwise high up-front capital costs. Rebates can be structured to decline over time as installed capacity levels are reached, encouraging early adopters and reflecting anticipated technology cost reductions.

However, in the simplicity of rebates lie their drawbacks. Specifically, uniform rebate levels can create an economically inefficient level of support, over-subsidizing some purchasers of EE/RE equipment and under-supporting others. This could lead to “free ridership,” in which individuals and businesses capture rebates for actions they likely would have taken without the support of a rebate and, therefore, program dollars are not utilized most effectively. This free ridership is accounted for in program evaluations. Because rebates are direct cash subsidies, program dollars need to be replenished to sustain a program. Finally, unless rebates are somewhat performance based, programs run the risk that anticipated energy savings or generation will not be achieved. As a simple example, a consumer could accept a rebate for a CFL bulb that is not installed, or a solar PV system could be installed on a roof where there is excessive shading from adjacent trees.

Table 14 provides a summary assessment of the strengths and weaknesses of rebate programs. A similar table is included for each financing tool discussed in this report.⁶⁵

⁶⁵ Like “lessons learned” above, these assessments of strengths and weaknesses represent the authors’ best judgments based on webinars, meetings, and discussions with professional peers. They are subjective rather than empirical assessments.

Table 14. Assessment of Energy Efficiency and Renewable Energy Rebate Programs

Strengths	Weaknesses
Simple administration (could be subcontracted to third-party administrator) and application process	“One size fits all”: Rebates provide similar support to similar projects regardless of owner’s financial need or project quality (unless adjusted to expected performance)
Capital cost buy-down: Rebates provide up-front project support, which is particularly valuable to residential and other small projects that are not easily financed	Free riders: EE rebates for certain mature technologies could have a high incidence of free riders
	Lack of leverage: Rebates could represent as much as 50% of the EE or RE equipment cost
Adaptable rebate levels could be quickly changed to reflect changing market conditions	Rebate dependency: Markets become accustomed to availability of rebates; rebates could slow product price reductions
	System performance risk: RE rebates are not tied to long-term system performance
Measurable and transparent: Rebates are easily counted and converted to lifetime energy savings or generation for evaluation purposes	Reduced federal support: Rebates reduce the amount of federal ITCs or cash grants that a project could claim by reducing the project’s basis

3.2 Performance-based Incentives for Renewable Energy⁶⁶

PBIs are directly tied to RE system performance and actual energy generation rather than units of installed capacity. They are paid on a per-kilowatt-hour basis for a fixed number of years. States are increasingly moving to adopt PBIs because they encourage good RE system siting (to take advantage of the best resources), the use of equipment that meets performance specifications, quality installations, and ongoing maintenance. The value proposition of PBIs is that they ensure the effective use of public dollars by aligning PBI awardees’ long-term interests with the performance objectives of RE programs.

A number of different variations on PBIs can be adopted (Barbose et al. 2006). These include:

- Multi-year incentive payments that are based strictly on actual system performance.
- Expected performance-based buy-downs (i.e., an up-front rebate payment adjusted to the expected performance of the system based on rated system efficiency and siting factors).

⁶⁶ PBIs could potentially exist for EE, but the authors are not aware of any such programs. Therefore, this section focuses on PBIs for RE.

- Incentive holdbacks in which a portion (50% or more) of a rebate is paid 6–12 months after system installation, upon submission of satisfactory performance data.
- Payment of PBIs based on estimated, rather than verified, system output (to reduce system monitoring requirements).

Example of Performance-based Incentives

California Solar Initiative: The California Solar Initiative has introduced a PBI for solar PV systems between 50 kW and 1 MW in size. This program currently offers a 5-year PBI for commercially-owned systems of \$0.15–\$0.22/kWh, depending on utility (\$0.26–\$0.32/kWh for public/non-profit systems). The PBI will gradually decline as more solar capacity is installed. After January 1, 2010, all systems over 30 kW in size must use these PBIs instead of rebates. Residential customers can also opt for an expected PBI, a lump-sum rebate adjusted for estimated system performance (California Solar Initiative 2010).

3.2.1 Lessons Learned for PBIs

In establishing PBI programs and incentive levels, program managers could consider the following:

Technologies and Project Sizes: PBIs could be used for any technology or project size. However, they might be more appropriate for large-scale commercial projects. Larger projects are less dependent on an up-front incentive (i.e., projects can be more readily financed); performance monitoring is less of an administrative burden than it is for small-scale residential systems; and the financial risk to a RE program of providing a large up-front incentive to a large project that may fail is greater than the risk of losing a small up-front incentive to a residential system that performs poorly. Conversely, residential customers who would have participated in a program with an up-front rebate could choose not to participate in a program in which incentives are paid out over time.

Customer Class: PBI incentive levels could be set separately for residential, commercial, and public-sector projects to reflect both size-related system cost differences and the ability of customers to utilize state and federal tax incentives. Public and non-profit owners cannot directly take advantage of state and federal tax incentives, and thus, program incentives might need to be higher to encourage participant uptake.

Duration of Incentive Payments: Payments spread out over multiple years encourages ongoing system performance (but also increases program administration).

3.2.2 Strengths and Weaknesses of PBIs

PBIs guarantee that the greatest incentives go to the most productive projects. Because they are based on energy output rather than capacity installed, production incentives can ensure that project owners are thoughtful with both equipment and site selection. A poorly performing project will receive less support over the life of the incentive than a high performing one. PBIs leverage private capital by placing the burden of up-front capital costs on private debt and equity contributions. Finally, although recent changes in the tax code have eliminated the federal tax

credit “haircut” problem for now, PBIs, unlike direct rebates, do not affect the ability of a project owner to claim all federal tax credits and depreciation benefits (Bolinger 2009).

The weaknesses of PBIs relative to capacity-based rebates include a lack of up-front project support unless they are paid up front based on estimated system performance. PBIs also create an ongoing financial obligation by the program. Similarly, they require the administrative burden of ongoing performance tracking and measurement of individual systems or at least some estimation of system performance.

Table 15 provides a summary assessment of the strengths and weaknesses of PBIs.

Table 15. Assessment of Performance-based Incentives

Strengths	Weaknesses
Motivates good projects: “Pay for performance”	No up-front capital support: Incentives are periodic payments made after project is operating (except in expected PBIs)
Reduces fund exposure to poorly performing projects	Administrative burden: Ongoing project monitoring and payments required

3.3 Feed-in Tariffs

Feed-in tariffs (FITs) require utilities to purchase electricity from renewable electricity system owners at long-term, fixed rates approved by regulatory commissions. These rates are based on technology, system size, and project location. By creating revenue certainty (subject to the variable output of the project) for RE projects, long-term FITs help to drive investor confidence and lower financing costs and a project’s required rate of return (by reducing the investment “risk premium”).

FITs are the dominant policy mechanism for supporting RE in Europe, used in 18 of 25 European Union countries (Cory et al. 2009). In the United States, FITs have generated considerable discussion in recent years but have had limited implementation.

FITs could substitute for either rebates or PBIs in supporting technology-specific renewable generation. The cost of a FIT program could be cost-recovered by utilities through rates or supported through public benefit funds (either existing or newly established). Within the constraints of federal laws surrounding the use of FITs,⁶⁷ a state RE program could provide the

⁶⁷ State-established FITs have to address either the Federal Power Act or the Public Utilities Regulatory Policies Act (PURPA), both of which regulate the establishment of wholesale electric rates. The primary issue is whether a state regulatory commission has the authority to require utilities to purchase electricity above a utility’s “avoided cost” from a RE producer. The issues surrounding this are complex and unresolved. However, FITs could be structured to comply with the applicable federal statute (only one or the other will apply). For example, a recent legal analysis has shown that states have several mechanisms that are outside of FERC’s jurisdiction and that can be provided as supplements to avoided cost, including public clean energy funds, renewable energy certificate (REC) payments, and state tax credits (Hempling et al. 2010).

above-market premium above a utility's "avoided cost" as a separate incentive payment to provide projects with the financial support needed.

The most common rate-making principle used in establishing FITs is to establish tariff levels that reflect the relative cost of the project, broken out by technology, project size, availability of other incentives, and required rate of return for investors. Other factors could include a project's geographic location (either based on resource quality or actual location—such as offshore wind versus onshore wind), ownership (e.g., reflecting a policy preference for locally-owned projects), the desire to advance a specific technology, and avoided externalities (e.g., ability of a technology to offset peak demand). These value-based considerations could supplement a cost-based approach (Cory et al. 2009).

FIT payment levels need to be high enough to attract the desired amount of RE capacity without providing an excessive economic windfall to the least-cost projects. At the same time, creating a wide range of FITs for a single technology adds complexity to the tariff-setting process.

Examples of Feed-in Tariffs

California: The California Public Utility Commission (CPUC) approved a FIT program for RE generators up to 3 MW in size. Under this program, investor-owned utilities are required to enter into long-term (10- to 25-year) contracts with generators and pay a "market-price referent" for all power not consumed on-site. This price is based on the levelized cost of natural gas generation (currently around \$0.10/kWh). Further, California AB 1613, passed in 2009, directs the CPUC to establish a FIT for combined heat and power facilities up to 20 MW in size.

Vermont: On May 27, 2009, the Vermont legislature passed a first-in-the-nation comprehensive pilot FIT program (HR 446). The cost-based program was capped at 50 MW of capacity with no eligible project larger than 2.2 MW. The program initially included FITs for wind systems (\$0.125–\$0.20/kWh), landfill gas (\$0.12/kWh), biogas (\$0.16/kWh), biomass (\$0.125/kWh), hydropower (\$0.125/kWh), and solar PV (\$0.30/kWh).

Sacramento Municipal Utility District: The Sacramento Municipal Utility District (SMUD), one of the largest municipal utilities in the country, launched its new FIT program on January 1, 2010. The initial program cap is already fully reserved. SMUD's FIT rates are differentiated based on technology (combined heat and power projects versus electric-generation-only renewables), contract length, and time of day. For example, current rates under the renewables program range from \$0.075/kWh for winter off-peak generation to \$0.294 for summer "super peak" generation (2–8 p.m., Monday through Saturday). Its rates were based on both the energy value and the capacity value of the generation as well as projections of natural gas costs. As a municipal utility, SMUD is not subject to either the Federal Power Act or PURPA and, therefore, is exempt from any regulations restricting the use of FITs.

3.3.1 Lessons Learned for Feed-in Tariffs

In designing an effective FIT, there are several key elements that need to be considered (Kubert and Sinclair 2009).

Continuity and Long-term Investment Policy: As with all state-based EE/RE financing mechanisms, a stable policy attracts investors, and thus project development. The term of a FIT

needs to be linked to the life of a project and guaranteed for 1–3 years longer than the minimum length of typical project debt (5–10 years). Debt lenders typically require a few years of additional guaranteed revenues to reduce investment risk. Regular reviews of FIT levels would help program administrators to determine if the FIT payment levels are still consistent with the policy objectives and the needs of the market.

Size Limits: The cost of a FIT program could be managed through program or project size limits, by technology, or through capacity block pricing. However, limiting eligibility or reducing pricing based on project size can prevent inclusion of larger projects that are more economic to build.

Pricing: Most commonly, FITs are generally established based upon the technology's costs plus a required rate of investor return (Cory et al. 2009). They also could incorporate an estimate of the energy and environmental value of the generation supported by the program, such as the value of distributed generation in reducing transmission losses. A FIT could be structured as a level, fixed payment for all output (¢/kWh), a premium payment above the current market price (wholesale or retail) of electricity, or a tiered payment in which output beyond a certain level per unit of capacity receives a reduced price.

Technology Advancement: The tariff structure could be designed to accelerate the adoption of emerging technologies by providing greater support for these technologies.

“Degression”: FITs could include a schedule of planned tariff reductions for future projects in anticipation of and to drive technology cost reductions. These can be established based on achieving specific steps of capacity installations in the market based on time increments (e.g., annually). Based on the potential for PV to rapidly ramp up manufacturing and installation capacity, annual time increments used in Spain and Germany were found to be quite costly to ratepayers by flooding the market with new projects in short time periods (Voosen 2009); tariff level degression could potentially address this issue.

3.3.1.1 Strengths and Weaknesses of Feed-in Tariffs

There are a number of advantages to FITs as a financing mechanism for RE projects. Like PBIs, FITs reward production, not installations. A FIT's long duration, guaranteed market for electricity output, and guaranteed grid access help to secure both debt and equity financing for a project. The result is that a FIT can lower the risk for project developers, lenders, and investors and, consequently, lower the cost of capital and required rate of return on these projects (Cory et al. 2009). FITs could be used to encourage both large and small decentralized projects through a standardized contract and tariff. At the same time, this tariff structure could be customized to support particular technologies, project sizes, ownership, location, and other factors based on program goals. Finally, FITs eliminate the administrative burdens associated with rebate and PBI programs.

However, the experience of FITs in Europe and early experience in the United States point out several weaknesses to FITs as a financial incentive (Kubert and Sinclair 2009). First, unlike most other RE financing mechanisms, FITs require both up-front legislative authority and ongoing regulatory review and approval (in contrast, regulators generally do not need to approve changes in rebate levels). Second, it is difficult to set FIT prices without over- or under-subsidizing some

project owners. Frequent alterations to the FIT payment levels and structure could lead to regulatory complexity and market confusion. Third, FITs do not provide up-front capital support to projects, forcing the projects to assume higher debt burdens or invest greater equity than is necessary under a rebate program. Fourth, unless reasonable caps are placed on a program, FITs can either reach capacity too quickly (as has been the case when they were introduced in the United States) or lead to a surge in projects, placing an undue burden on ratepayers or governments (as has occurred in Spain and Germany). Finally, without resolution of the legality of FITs either through congressional or regulatory action at FERC, FITs could potentially be challenged for violating the Federal Power Act and PURPA, depending on how states establish a FIT payment and what entities they allow to participate (Hempling et al. 2010). Table 16 summarizes strengths and weaknesses of FITs.

Table 16. Assessment of Feed-in Tariffs

Strengths	Weaknesses
Supports higher costs and emerging technologies	Tariff setting challenge: Difficult to avoid over- or under-subsidizing certain projects; fine-tuning could lead to tariff complexity and market uncertainty
Adaptable: Could be structured to provide differential support to technologies, project sizes, ownership, location, and environmental/economic benefits	PUC involvement: FITs require regulatory approval and ongoing review, slowing adaptability to change in response to fluctuating market conditions
Aids project financing: Guaranteed long-term rate lowers risks for developers, lenders, and investors	No up-front capital: Lack of up-front support could create the need for smaller projects to access financing, which might not be easily accessible
Ease of administration: Administrative burden shifts to utilities, although public utility commission must establish and oversee program	Could violate Federal Power Act and PURPA by allowing state regulators to establish wholesale power rates with independent power producers
Ratepayer recoverable: FIT costs are assessed to ratepayers; no need for dedicated fund or program	

3.4 Custom Incentives and Grants

Many utility and state programs have used “custom incentives” and grants to provide direct support to EE/RE projects that include multiple measures (e.g., comprehensive building design or renovation), are custom engineered, or involve emerging or non-“off-the-shelf” technologies.

3.4.1 Custom Incentives for Energy Efficiency

In EE programs, custom incentives are used for new buildings or significant retrofits to existing commercial or industrial facilities. These incentives are designed to help pay for EE measures not amenable to standard incentives. They are well suited for supporting a suite of integrated

measures that will have a lasting and comprehensive impact on a building's energy use. For most efficiency programs, custom incentive levels would be guided by a ceiling payment that does not exceed a certain amount per saved unit of energy with higher incentives to encourage multiple EE measures. Incentives can also be capped at a percentage of total (or incremental) project cost or a total amount per project (Mosenthal 2009).

Examples of Custom Incentive Programs

Wisconsin: Wisconsin's Focus on Energy program offers a competitive custom incentive program for industrial efficiency projects. The program will provide up to a 50% cost match for projects that have 1–4 years simple payback; however, incentive support cannot exceed \$0.06/kWh, \$200/kW of capacity reduction, or, for natural gas, \$0.60/therm of annual gas savings (Wisconsin Focus on Energy 2009).

New Jersey: New Jersey's Clean Energy Program offers custom incentives for more complex projects that involve multiple measures or do not lend themselves to existing prescriptive incentive offerings. The incentive can be up to 80% of the incremental cost of the measure (versus standard practices) or an amount required to reduce financial paybacks to fewer than 2 years (NJ Clean Energy Program 2009).

3.4.1.1 Lessons Learned for Custom Incentives

Technical Assistance: By offering energy audits and technical assistance, programs could help participants identify all EE opportunities within their facilities (York et al. 2008).

Comprehensive Improvements: Enhanced incentives could help encourage the implementation of all recommended measures, including those with longer paybacks (York et al. 2008).

3.4.2 Grants for Renewable Energy Projects

Clean energy funds have used grant programs to tailor support to RE projects that are more highly engineered, larger in scale, or represent demonstration projects or emerging technologies. In these projects, the degree of required project support and the expected energy output of the project can vary considerably. RE projects that have received grant funding from state programs include anaerobic digesters, biomass facilities, and both large wind farms and mid-sized “community-scale” wind turbines. Some clean energy funds also use grant programs to support project feasibility studies and pre-development activities. Other states have used grant solicitations to assist companies manufacturing RE products or components in locating or expanding facilities within their state.

RE grant programs are run through a solicitation or request for proposals (RFP) process and require applicants to develop a comprehensive application package including technical, economic, environmental, and financial details on their project. Grant funding also could be awarded through a “reverse auction” process, in which projects bid against one another and grants are awarded to the set of projects that request the least amount of public funding.

Examples of Renewable Energy Grant Programs

Massachusetts: Massachusetts' Clean Energy Center's Commonwealth Wind program provides grants for projects between 1 kW (micro) and 2 MW developed on private, institutional, or public sites and is specifically targeted at on-site behind-the-meter applications. The program provides grants for site assessment, feasibility study support, and design and construction support of up to \$260,000 for non-public projects and \$400,000 for public projects (Mass CEC 2010).

Oregon: The Energy Trust of Oregon (ETO) has an open solicitation for grants supporting the "above-market cost" of commercial RE projects. ETO's objective is to provide sufficient grant assistance so that a project owner can earn an appropriate return on investment. In addition, ETO provides feasibility and planning grants (DSIRE 2010h). For more information on ETO, see Appendix E.

Wisconsin: Wisconsin's Focus on Energy program has promoted and supported installation of anaerobic digesters and energy generation through biogas combustion for many years. Wisconsin provides extensive feasibility and technical assistance to dairy farmers considering the installation of a digester and up to \$250,000 in construction costs for qualifying systems. The state grant program has been leveraged by grant awards through the USDA's Renewable Energy for America Program (Wisconsin Focus on Energy 2010).

3.4.2.1 *Lessons Learned for Renewable Energy Grants*

The lessons learned described below are based on the experience of state clean energy funds, as compiled by CESA over 10 years of experience working with the states on the development and evaluation of these programs (CESA 2009).

Focused RFPs: RFPs can target certain technologies that are best aligned with the program's goals.⁶⁸

Clear Evaluation Criteria: An RFP with clear and specific evaluation criteria helps applicants to be responsive in providing useful project information and allows grant reviewers to review each application consistently and effectively.⁶⁹

Grants Based on Project Need: Grant awards are based on the financial support required to achieve a reasonable rate of return on the investment, taking into consideration other incentives and financing opportunities available to the project. While a fixed amount per unit of capacity or expected generation could be a factor, this type of funding formula can be considered alongside project-specific financial criteria.

Ongoing Project Assistance: Program staff might need to provide ongoing technical and financing assistance to projects to ensure timely and successful project completion.

Milestone-based Payments: By paying grant awards out over time based on a project reaching specific development milestones, the program administrator is able to reduce the financing burden on the project owner while encouraging timely project development progress and limiting

⁶⁸ Focused RFPs could potentially be applied towards EE grant programs. This report did not explore grants for EE, but it is a potential area for future research.

⁶⁹ Clear evaluation criteria is another lesson learned from RE grant programs that could be applied towards grant programs for EE, which were not examined in this report; this is potentially an area for future research.

the exposure of public dollars to incomplete projects. An alternative to this is to require grantees to place milestone-based security deposits with the grantor to ensure movement towards these milestones. These modest deposits avoid the long-term commitment of grant funds towards projects that are not moving forward in a timely manner (Sanders 2010).

3.4.2.2 Strengths and Weaknesses of Custom Grants and Incentives

The key advantages of custom grants and incentives are that they provide programs with a greater degree of flexibility than rebates allow in supporting projects that are larger, more comprehensive, more complex, or carry greater performance risk than discrete EE measures or widely available RE systems. The custom level of support is tailored to the unique operating or site-specific conditions of a project. However, a custom incentive approach requires the resources to solicit individual projects, review applications, make judgments on appropriate award levels, and follow projects closely through completion. Because of the often-significant awards (up to hundreds of thousands of dollars) provided to these projects, each project also can carry significant risk to the program with respect to potential project failures (Kubert and Sinclair 2009).

Table 17 summarizes the strengths and weaknesses of custom incentive and grant programs.

Table 17. Assessment of Custom Incentives and Grants

Strengths	Weaknesses
Incentive flexibility: Support is tailored to a project's financial needs	High administrative requirements: Need to solicit and review grant applications, provide technical assistance, and oversee projects
Supports soft costs: Grants could be used for technical and feasibility studies	
Supports higher risk projects and emerging technologies	
Supports multiple measures for EE; encourages comprehensive improvements	Higher financial risk: Individual grants, particularly for RE, are generally greater than other direct incentives; project failures could be costly to the program; these risks could be mitigated through milestone-based progress payments
Creates showcase projects: Successful projects could be promoted by the program to demonstrate program effectiveness	

3.5 Loans and Related Tools

Accessible and affordable project financing is essential to the growth of EE/RE investments at all project scales. For residential projects, the high up-front costs of EE improvements and RE systems coupled with often long financial payback periods can block these investments, even when up-front incentives are available. Smaller and less-specialized lenders often perceive EE/RE projects as risky loans and, therefore, charge high interest rates, have unfavorable repayment terms, or impose other restrictive conditions. This section details the several

approaches to loan programs and other forms of subsidized financing that states are using or could adopt to support EE/RE investments.

3.5.1 Direct Loan Programs

Currently, there are 128 clean energy loan programs offered by states or utilities (DSIRE 2010g).⁷⁰ These programs are generally not linked to or incorporated within state or utility EE/RE direct incentive programs but rather exist as standalone loan funds. Among these 128 programs, the Database of State Incentives for Renewable Energy and Efficiency (DSIRE) identifies 33 states that have a state-sponsored direct loan program targeting at least one customer group (residential, commercial, or government/institutional) and sector (EE or RE) (DSIRE 2010g). These programs are generally offered through state energy offices or economic development agencies (IREC 2009a). A distribution of these state loan funds by sector is shown in Table 18. Note that these are not each unique programs as many target multiple groups and sectors. Further, many of these loan funds have small capital bases and therefore can support only a limited number of loans.

Direct loan programs could play an important role in addressing the financing challenges outlined above. Moreover, because these loan funds revolve, the program’s initial capital is preserved (not factoring in defaults and the need for recapitalization for any with subsidized lending terms).

Table 18. Summary of State-sponsored Clean Energy Loan Programs (Number of Programs Targeting Each Sector)

	Residential		Commercial		Government	
	EE	RE	EE	RE	EE	RE
Number of Loan Programs	14	12	15	15	21	16
Note: Some individual state loan programs cover multiple sectors.						

Source: DSIRE 2010c

With a few notable exceptions (highlighted in the case studies below), these programs have had limited effectiveness and, by extension, limited impact on EE/RE investments in their respective states. Some possible reasons for this limited efficacy and suggestions for program design improvement, based on analysis by LBNL, are explored next (Fuller 2009).

Residential Programs: In the residential sector, financeable EE improvements consist primarily of three types of investments: (1) “reactive” measures such as emergency furnace replacements; (2) single measures such as new central air conditioning or window installation; and (3) whole house improvements. The first two types of measures are generally financed with cash, credit cards, or contractor financing, while more comprehensive renovations are more likely to be financed with some form of home equity loan due to the greater up-front cost. Few state EE/RE loan programs have been able to provide a compelling advantage over these other sources of

⁷⁰ These include programs offered by electric cooperatives and municipal utilities. A number of municipalities also offer clean energy loan programs, but these are not included in the numbers here.

credit in either ease of access or favorable terms. In addition, few RE systems are financed through these programs.

The value proposition for an effective EE/RE residential loan program is not simply in the availability of credit; financing programs by themselves are not sufficient to drive consumers to take action (Fuller 2009). Rather, it is in the development of an integrated program that combines active consumer education, technical assistance (e.g., energy audits), partnerships with contractors, and easily accessed and low-cost financing.

Examples of Residential Loan Programs

Pennsylvania: Pennsylvania's newly established residential EE program, Keystone HELP, was established with initial capitalization from the state treasurer's office and additional support from the state's Department of Environmental Protection. The program is marketed and administered by AFC First Financial, an independent lending services firm. Keystone HELP offers unsecured loans of up to \$15,000 with lower interest rates for products that exceed ENERGY STAR standards and improvements accompanied by an energy audit. Long-term (up to 20-year) secured loans of up to \$35,000 are also available for whole-house improvements. Borrowers must use approved contractors who market and act as the customer interface of the program (Keystone HELP 2010; Krajsa 2010). The program is compelling because it is administered by an outside entity, offers quick loan approvals, uses contractors to market the program, and addresses both immediate-need and more discretionary loan requests.

Nebraska: The Nebraska Energy Office has processed more than 23,000 residential EE loans since 1990. The program relies on participating lenders for loan processing. The state purchases half of each qualifying loan and offers a 0% interest rate, creating a blended interest rate equivalent to half the market rate. This approach minimizes administrative costs and reduces capital requirements to the state, creates a wider awareness and market for the program, and provides favorable interest rates to the borrower (Brown 2009a; Loos 2003).

California: SMUD (Sacramento Municipal Utilities District) has been managing a single-family EE loan program since 1977 and has issued 78,000 loans since 1990. SMUD works with a network of 180 contractors who promote the program and assist in loan applications; it then approves all loans within 24 hours. The program is administered entirely in-house. The average loan amount is \$8,750, with the majority of loans supporting new air conditioning systems or windows (Fuller 2009).

New Jersey: New Jersey's largest investor-owned utility, Public Service Electric and Gas (PSE&G), has established a \$100 million loan program for both residential and non-residential solar PV systems. The program will finance up to 60% of the cost of a residential system at current interest rates of 6.5% and a 10-year repayment schedule. Uniquely, system owners can repay the loan through the transfer of solar renewable energy credits (SRECs) from the project back to PSE&G, which needs to acquire the SRECs for compliance with the state's RPS (see discussion on SRECs in Appendix D) (PSE&G 2010).

Commercial/Industrial Programs: EE/RE loan programs targeted at commercial and industrial customers can be valuable, particularly in periods of tight credit. Because of their singular focus on EE/RE projects, state EE/RE loan program administrators can develop a greater understanding of technologies and project economics than many private lenders who underwrite

only a few of these projects. State loan program administrators also may be able to provide more flexible terms of required collateral, lower interest rates, and longer repayment terms that are tied to energy savings or production from these projects (Sanders 2009).

Examples of Commercial Loan Programs

Oregon: Oregon's Energy Office has run a State Energy Loan Program since 1980. The program has focused on large loans to the commercial, industrial, and government sectors (although residential projects are also eligible) for both EE and RE projects. Approximately 60% of the \$420 million loaned since program inception has been for RE projects and 40% for EE. The average RE loan has been over \$1 million (\$3 million for hydropower and biomass projects), while EE loans have averaged \$300,000. The program is run entirely in house, including underwriting and loan administration. The program is capitalized with tax-exempt bonds issued by and guaranteed by the State of Oregon. The fund's current outstanding loan portfolio is \$140 million (Oregon Energy Office 2010). The strengths of this program are that the Energy Office has developed expertise in EE/RE technologies, offers flexible terms, and relies on private capital markets (bond holders) to fund the program.

Pennsylvania: The Reinvestment Fund's Sustainable Development Fund in Pennsylvania offers development loans, construction financing, term loans, and energy lease financing for new or retrofit EE or RE projects to commercial, industrial, municipal, and non-profit entities. The Fund will provide up to 100% financing and offers low- or no-interest loans for pre-development work. The Fund is careful to structure its financing to encourage the participation of private lenders and to mitigate the above-market risk of a project (The Reinvestment Fund 2010a).

Recognizing the value of loan programs in leveraging available funds, the DOE guidelines for the supplemental State Energy Program funding through ARRA have encouraged the establishment of revolving loan funds.

3.5.1.1 *Lessons Learned for Direct Loan Programs*

The following lessons learned are derived from both the successes and shortcomings of current loan programs (Fuller 2009; Kubert and Sinclair 2009).

Clear Market Purpose: Public or utility loan programs that avoid competing against private lenders and encourage their participation optimally leverage available capital by addressing specific market gaps or providing greater loan accessibility or more favorable terms.

Appropriate Repayment Terms: Longer amortization periods reduce payments to levels that match the positive cash flow from energy savings or energy sold.

Low Interest Rate: Participation can be limited if interest rates are not competitive with or below market rates. Lower interest rates can be used to incent desired actions. For example, interest rates can be set lower if EE improvements are more comprehensive or preceded by an energy audit.

Low Application Burden: Applications, paperwork, and fees are kept to a minimum with quick approval for smaller residential loans.

Partnering: By outsourcing loan approval and administration of residential programs to private financial institutions, administrative costs are lowered, thereby enabling more program funds to go towards loans to participants. Partnering with EE/RE contractors/installers can also increase program demand. Loan fund programs can perform their own underwriting for programs that target commercial borrowers (due to the lower loan volume), but they might want to consider partnering with either state finance agencies or private lenders, which have both underwriting and loan administration capabilities (Kubert and Sinclair 2009).

3.5.1.2 Strengths and Weaknesses of Direct Loan Programs

The key advantage of direct loan programs from the perspective of a state or utility EE/RE program is that they are a “sustainable” use of program funds to the extent that loans are repaid and that they can help overcome capital cost barriers of EE/RE investments without directly subsidizing projects.

However, if they do not provide a clear market advantage over commercially available credit or they assume an unacceptable level of risk, then these programs will not be filling a market gap and will, rather, be competing against private lenders.⁷¹ Further, if these programs assume an unacceptable level of risk, then loan fund capital could potentially be lost. In addition, a direct loan program is not leveraged to the extent that the program provides all funds to be loaned, either through a general appropriation, an allocation of program funds from an EE/RE program, or the issuance of bonds to support the program (Oregon Energy Office 2010). It is better leveraged if the fund requires project level match financing from private lenders or other sources (Sanders 2010). Table 19 summarizes the strengths and weaknesses of direct loan programs.

Table 19. Assessment of Loan Programs

Strengths	Weaknesses
Flexibility: Loan terms can be adapted to project life and expected performance	High administrative burden: Requires specialized underwriting and administration resources unless partnering with a third party
Revolving: Principal and interest are returned to fund additional loans	Large capital requirements: Funds need to allocate or raise significant financial resources to support meaningful loan programs
Risk tolerance: Greater knowledge of EE/RE technologies could allow state funds to absorb greater project risk than private lenders	Competing with private lenders: Loan programs need to establish clear value proposition to avoid competing with private banks; this is less of an issue during a period where private credit is difficult to obtain
	Default risk: Funds need to absorb any loan defaults

⁷¹ Note that in the current lending environment, access to loans might be constrained. Therefore, state loan programs could potentially be filling this gap.

3.5.2 Interest Rate Buy-down Programs

Under an interest rate buy-down program, an EE/RE program subsidizes the interest rate offered by a private lender for a qualified EE or RE loan. The easiest way to administer this is by making a lump-sum payment to the lender that represents the present value of the foregone interest to the lender over the life of the loan. An alternative approach would be to establish a linked deposit program in which funds are deposited with a participating lender at a low or zero interest rate and re-loaned by that lender for an approved, qualified EE/RE project at a below-market interest rate. This linked deposit program has been implemented in some states through state treasurers (Colton and Sheehan n.d.; Illinois State Treasurer 2010).

An interest rate buy-down allows a state program to assist rather than compete with private lenders. It also relieves states of the underwriting and loan administration burden of a direct loan program. Prior to changes in the federal tax code associated with ARRA, these interest rate subsidies were considered “subsidized energy financing” for RE projects and therefore prevented a borrower from also utilizing applicable federal tax credits on the underlying project (Novogradac and Company n.d.). The Recovery Act clarified that these programs no longer interacted with the ITC and, therefore, project developers can take advantage of both the ITC and interest rate buy-downs⁷² (Bolinger 2009).

Example of Interest Rate Buy-down Programs

New York: NYSERDA’s “Smart Energy Loan Program” buys down the interest rate on a qualifying commercial loan for an EE improvement or RE project. For example, if a participating bank offers a loan at 8% interest, NYSERDA effectively reduces the interest rate to 4% by providing a lump-sum payment to the lender equivalent to the net present value of the interest rate spread over the term of the loan. NYSERDA also offers a parallel program through a third-party finance company. The program, funded through the public benefits fund, has supported over 7,000 loans over the past 7 years with a cost to the fund of \$8 million in interest rate subsidies on total customer loans of \$56 million (NYSERDA 2010a). For more information on NYSERDA, see Appendix E.

3.5.2.1 Lessons Learned for Interest Rate Buy-down Programs

Interest rate buy-down programs have operating history in different states throughout the country. The experience of these programs prompts the following lessons learned (Brown 2009a).

Create Broad Lender Network: Building a wide network of partner banks and contractors who understand and promote the program could help expand market awareness.

Adapt Subsidy to Market Conditions: Borrower participation is unlikely unless the reduced interest rate is meaningful and adapts to prevailing market rates. For example, the interest rate buy-down could be 50% of the applicable market interest rate for a particular project or a certain level above or below a benchmark interest rate.

⁷² Note that these changes do not apply to the RE production tax credit that remains impacted by any type of subsidized energy financing.

Provide Lump-sum Support: The provision of lump-sum payments to participating lenders rather than periodic interest payments reduces administrative complexity to an EE/RE program (Kubert and Sinclair 2009).

3.5.2.2 Strengths and Weaknesses of Interest Rate Buy-downs

The key strength of an interest rate buy-down from the perspective of an EE/RE program is that it provides significantly improved credit terms for borrowers without the program having to administer a loan program or bear default risk.

However, interest rate buy-downs represent lump-sum payments out of available program funds and, therefore, share similar characteristics of grants to the fund. To be effective, they are also reliant upon private lenders making favorable credit decisions. Table 20 summarizes these strengths and weaknesses.

Table 20. Assessment of Interest Rate Buy-downs

Strengths	Weaknesses
Limited capital requirements: Private lenders are providing loan principal	Dependency on private lenders: Private lenders make all loan decisions; risky projects or borrowers might not be able to obtain loans or have inadequate loan terms
No default risk: Private lenders bear the risk of loan defaults	Funds do not revolve: Interest rate buy-downs, like rebates and grants, are a non-recoverable expense to a clean energy fund
Limited administration: Private lenders perform all loan underwriting and administration	Might not appeal to participants: Homeowners might be more attracted to the offer of a new appliance than an interest rate buy-down (Fuller et al. 2010).

3.6 On-bill Financing and Property Assessed Clean Energy Programs

On-bill financing and property assessed clean energy (PACE) are two emerging financing mechanisms for removing the up-front capital cost hurdles that discourage EE and RE investments, both at residential and commercial properties. While neither mechanism has been widely implemented yet, both have a significant opportunity to widen accessibility to EE/RE financing. PACE, in particular, has captured national attention for its broad applicability and large market potential.

Both programs are designed to rely primarily on private capital markets to provide the financing. However, there could be a role for EE/RE programs to provide initial program capital, support administrative costs, lower interest rates, provide a payment guarantee, or continue to offer direct incentives to lower up-front costs and monthly payments.

3.6.1 On-bill Financing or “Pay as You Save” Programs

On-bill financing or “Pay as You Save” (PAYS) is essentially an installment payment plan for EE improvements with two unique features. First, the monthly payments, ideally, are structured to be below the value of the monthly energy savings, thereby making the investment cash-flow positive to the building owner. Second, the debt obligation is tariff-based⁷³ and, therefore, linked to the building’s gas or electric meter, not to a specific building owner. As a result, the obligation is transferred with a change in building ownership. This removes the disincentive to invest in improvements with financial paybacks that exceed an owner’s expected time in a building and that might not be fully captured in a building’s selling price. Monthly payments are incorporated into utility bills so that the building owner does not need to make a separate loan payment.

The primary barriers to overcome in more widespread adoption of this financing mechanism are establishing the regulatory authority for an on-bill financing program, gaining support from utilities in administering the program, protecting utilities against defaults, and protecting building owners against monthly obligations that exceed savings from the EE/RE investment.⁷⁴

Examples of On-bill Financing

While on-bill financing is at an early stage of adoption, there are several pilot projects and new programs:

- San Diego Gas & Electric offers on-bill financing for efficiency improvements at commercial and public facilities in amounts up to \$100,000 for 5 years (commercial) and \$250,000 (public) with a 10-year term (San Diego Gas & Electric 2010).
- National Grid offers a similar commercial program in Massachusetts; however, the repayment term is only 2 years (Brown 2009b).
- MidWest Energy, a utility in Kansas, offers an on-bill EE financing tariff targeted at both residential and commercial customers that allows for repayment terms of up to 15 years and requires that the financing cost be below the energy savings (Brown 2009b).
- Portland, Oregon, is currently piloting an on-bill financing program, utilizing \$3 million in federal stimulus funds and a Community Development Financing Institution as program administrator (Clean Energy Works Portland 2010).
- Efficiency Kansas, a state revolving loan program recently established with ARRA funding, gives utilities the authority to offer on-bill financing for EE improvements (Kansas Corporation Commission 2010).

3.6.1.1 Lessons Learned for On-bill Financing

Multi-sector Programs: Program offerings to single- and multi-family residential as well as small commercial and industrial properties will allow for wider participation.

Cash-flow Positive Projects: Repayment terms that are structured so that energy savings exceed monthly payments will not hinder a participant’s ability to repay the loan, which benefits both the participant and the program as it reduces the risk of nonpayment.

⁷³ There are also on-bill financing programs that are not tariff-based and act more like consumer loans.

⁷⁴ While a project could be projected to be cash flow positive (electric bill savings exceeding payments), declining system performance or sub-optimal operation could cause the payments to exceed savings.

Low Interest Rates: Interest rates that could be brought down through the support of a state EE/RE program would generate increased transaction volume.

Guaranteed Debt Obligations: Although the default rate on utility bills is quite low, an EE/RE fund could be needed to protect utilities against potential payment delinquencies or defaults (Brown 2009b).

3.6.1.2 Strengths and Weaknesses of On-bill Financing

Because on-bill financing can remove much or all of the up-front cost hurdles of EE/RE investments, it has the potential to engage customers who otherwise might not make the investments, particularly if the interest rate used were zero or close to zero. By tying the debt to the electric meter rather than an individual property owner, the obligation can be transferred to a new property owner, reducing the barrier of making investments that might not pay for themselves quickly or be recaptured in a building’s selling price. Tying the obligation to the meter also avoids adding debt obligations and impacting credit access to the building owner. Finally, the capital for an on-bill financing program need not come from public sources, freeing up public funds to support interest rate reductions, rebates, or other forms of support. Implementing an on-bill financing program has significant challenges—both regulatory and operational. As a tariff-based program, regulators must approve the program and its terms. This will require utilities to support the program by protecting them against the incremental risk of defaults on bills that integrate EE/RE financing. Utilities will also need to overcome the administrative and billing hurdles associated with the program. Perhaps most importantly, on-bill financing carries the risk that the EE/RE measures installed do not ultimately and consistently result in positive cash flow to the building owner.

Table 21 reviews the strengths and weaknesses of on-bill financing.

Table 21. Assessment of On-bill Financing

Strengths	Weaknesses
Eliminates up-front cost hurdles: Easy access to financing reduces first-cost project barriers	Requires authorizing legislation and/or regulatory order
Cash-flow positive: On-bill financing is intended to structure payments so that monthly energy savings exceed monthly payments	No guarantees of savings exceeding loan payments: Savings or system performance could decline over time
Uses private capital: Program could use either state funds or private capital	Narrow range of projects: EE or RE projects that are not cash-flow positive cannot be supported.
Low credit risk: Default rates on utility bills are low	Utilities are reluctant to administer these programs and are concerned with bad debt expense
Debt stays with the property: The debt obligation is tied to the electric meter allowing the transfer of property ownership without the need to pay off the debt early	

3.7 Property Assessed Clean Energy Loans

The creation of “clean energy assessment districts” and PACE financing is rapidly gaining interest by both state and federal officials. Under PACE, a municipality or other property-taxing unit of government (e.g., county or state) creates a special taxing district in which participating building owners (residential or commercial) finance EE improvements or RE systems through an additional line item on their property tax bill. Repayment terms are structured to match both the estimated periodic energy savings and energy generation attributable to the investment and the useful life of the asset. The financial obligation stays with the property, regardless of a change of ownership. Because the taxing authority has a senior lien on the property, payments on the special assessment are intended to be as secure as property tax payments themselves.

While PACE financing originated just over a year ago, with only a few operational programs, 18 states have already passed enabling legislation giving municipalities the authority to develop PACE programs. In addition, at least one firm (Renewable Funding) is providing turnkey administration of these programs, from applicant processing through program financing. PACE programs are designed to use funds raised through issuance of tax-exempt bonds or other financing from private capital markets to provide project financing. A PACE program could be facilitated by providing the pool of capital to support the program, lowering the interest rate to borrowers, or covering program administrative expenses. It can also be supported by supplementary rebates or PBIs, which would help to make the PACE financed projects cash-flow positive.

One of the areas of prime concern surrounding widespread adoption of PACE financing is the increase in property taxes associated with a PACE-financed project and the resulting increased marginal risk that these tax obligations place on mortgages (because property taxes are senior to mortgages in the event of loan defaults). In preliminary letters to mortgage lenders, Fannie Mae and Freddie Mac have stated that these “energy loans” are not integral to the property tax bill and, therefore, the PACE portion of the property tax bill is not senior to any mortgage on the property (Freddie Mac 2010). In most states, the implementing government (e.g., city or state) would only claim the unpaid portion of the PACE assessment (i.e., not the entirety of the remaining assessment) for the period during which the property was foreclosed and re-sold (because the new owner would again be responsible for the assessment) (PACE Now 2010).⁷⁵ However, only claiming the unpaid portion of the assessment might not be legal in all states. For example, the Boulder County ClimateSmart Loan Program would claim the entire remaining portion of the assessment in the event of a default, as the program believes it is illegal under state law to claim only the overdue portion of the assessment.

⁷⁵ As of publication date, the Federal Housing Finance Administration (FHFA), which regulates Fannie Mae and Freddie Mac, has essentially frozen all PACE programs due to concern over this issue. FHFA, Fannie Mae, and Freddie Mac are currently under litigation by the State of California; Sonoma County, California; and the Sierra Club. The outcome of the litigation is uncertain.

Examples of PACE Programs

Boulder County, Colorado: Boulder County implemented its ClimateSmart Loan Program in 2009, issuing approximately \$7.7 million in taxable bonds to provide financing for both EE improvements and RE systems at private homes. Each project has to have a minimum value of \$3,000, and the maximum financing per project cannot exceed \$50,000 or 20% of the property's value. The County has since expanded the program to commercial property owners in early 2010 (Home Performance Resource Center 2010), and it is currently only operating the commercial program while residential PACE programs are on hold.

San Francisco, California: San Francisco recently launched GreenFinanceSF, a PACE program that will support both EE improvements and RE systems on both residential and commercial buildings. The program will utilize an outside program administrator and will use federal ARRA funds to reduce the interest rate built into the financing (GreenFinance SF 2010).

3.7.1.1 *Lessons Learned for PACE Programs*

Emerging lessons learned for PACE programs include:

Easy Program Access: Providing a one-stop, Internet-based resource for potential borrowers to learn about the program and apply online.

Cost-efficient Improvements: Require applicants to make EE investments or demonstrate that minimum EE standards are met before RE systems can be financed through a PACE program.

Third-party Administrators: PACE programs are conceptually simple but administratively complex. The use of outside administrators to handle customer inquiries, applications, and loan structuring as well as securing capital for the program could streamline administration and lower the burden on localities.

Need to Protect Lenders: A debt service reserve fund can protect mortgage lenders against incremental risk of late or defaulted mortgage payments due to increased property tax liability. Also lender risk can be reduced by limiting PACE financing to under 10% of property value and by not providing PACE financing to a property in tax arrears or where outstanding debt exceeds the appraised property value (i.e., a house that is “under water”).

3.7.1.2 *Strengths and Weaknesses of PACE Programs*

Because PACE financing exists more as a concept than a series of well-established programs, strengths and weaknesses are not based on empirical evidence. PACE shares many of the characteristics of on-bill financing. Specifically, PACE removes the up-front costs and financing hurdles of EE improvements and distributed RE systems by providing an easily accessible source of low-cost, long-term financing. The interest on these loans is tax-deductible to the property owner (although the principal is not) because it is integrated into a property tax payment, providing the same tax benefit as a mortgage or home equity loan. The repayment obligation is transferred to subsequent property owners, removing the barrier of not making EE/RE investments because of their long payback periods. PACE financing is designed to rely on private capital markets, specifically the issuance of tax-exempt bonds, because of the similar nature of the improvements being made to buildings and the low level of defaults anticipated. This standardization also lends itself to outsourcing program administration to a third party,

which will lower transaction costs to the borrower and administrative costs to the sponsoring municipality (Fuller 2010).

The weaknesses of PACE programs have yet to be borne out in practice. However, potential weaknesses include the aforementioned issue regarding the impact of PACE financing on mortgage defaults and the importance of projects demonstrating positive cash flow to attract consumer interest. In addition, although PACE assessments can be transferred to new property owners, this could become a point of negotiation in any real estate transaction. Current owners could have to pay off the assessment in full or potentially accept a lower price for the property because it is encumbered with an additional property tax lien (regardless of the associated energy savings) (Coughlin et al. 2010).

Table 22 presents a summary of PACE financing strengths and weaknesses.

Table 22. Assessment of PACE Financing

Strengths	Weaknesses
Removes up-front financing barriers for EE/RE investments	Requires authorizing legislation and/or regulatory order
Makes debt obligation transferable to future building owners, removing temporal uncertainty of EE and RE investments	No guarantees of savings exceeding loan payments: Energy savings or system performance could decline over time
Could utilize tax-exempt debt financing	Mortgage lenders object to associated increase in property tax bills (mortgage payments are subordinate to real estate tax payments); this is a significant issue as Fannie Mae and Freddie Mac have essentially frozen PACE programs until this issue is resolved
Program administration could be outsourced	Unless program administration costs are covered by the program (an initial capital infusion), the interest rate can be quite high to the system owner—to cover the initial set up of the program, the ongoing annual participation, and the debt reserve fund
Can be used to support EE improvements and RE systems	Could still require supplemental incentives to create cash-flow positive investment
Property taxes are secure form of repayment	Transferability of the assessment could be both a legal and practical issue (e.g., will the property be more difficult to sell with the additional tax liability?)
	Can create boom/bust cycles for installations when programs issue PACE assessments in conjunction with bond issuances (as opposed to rolling assessment originations)

3.8 Leasing Programs

A leasing program provides another avenue to eliminate the up-front capital cost barriers of installing distributed RE systems and EE measures while ensuring the effective use of all federal tax incentives. Under an operating lease⁷⁶ program, an outside financing company owns the RE system or EE improvements, and the host (residential or commercial) makes a monthly payment for its use. The monthly payment is fixed and does not vary with the output of the system—or with the energy savings in the case of EE improvements—and thus must be paid even if the system is not operational. The financing company captures all of the project’s tax benefits and other incentives, while the energy savings flow to the host. The lessee/host could be responsible for system maintenance (e.g., replacement of the inverter for a solar PV system) unless these services are provided for within the lease. However, systems carry installer and manufacturer warranties.

It is important to note that a lease program for RE systems can operate independently of a state or utility RE program. Indeed, many large solar installation companies are offering leases as a way of overcoming up-front cost barriers. However, the endorsement by a state or utility RE program could encourage greater use of a private lease program. In addition, an up-front rebate or PBI from a RE program are typically needed to make monthly lease payments competitive with local retail electricity rates, an important incentive for many consumers.

Example of Lease Program

The Connecticut Solar Lease Program is sponsored by the Connecticut Clean Energy Fund (CCEF) and administered by AFC First Financial, an independent financing company. The program is targeted at residential solar installations. CCEF provides low-cost debt capital, combined with monetization of the tax benefits, which the financing company uses to pay for the cost of installation to the contractors. Homeowners must use an approved solar system installer and be credit-approved by the leasing company. Typical monthly lease payments for a 5 kW residential system are \$120 per month for 15 years with an option to purchase the system or pay a reduced lease fee after that point. The homeowner can pre-pay lease payments, but they cannot purchase the system until all tax benefits are captured by the lessor and then only at fair market value. The finance company aggregates and sells renewable energy certificates (RECs) from all projects to utilities for compliance with the state’s RPS program. A portion of the value of these RECs is held in escrow for the homeowner to either pay for system maintenance or purchase the system when the lease expires. CCEF continues to provide an up-front rebate to lower the capital costs, which translates into reduced monthly lease payments for use of the system (Connecticut Solar Lease 2010).

3.9 Lessons Learned

Solar leasing programs are established in several states and are an increasingly common way of financing solar systems. However, private developers offer leases independently of states or utilities. Leases in the absence of other state incentives (or in states with low retail electricity rates) might not be able to incentivize consumers if lease payments are larger than electric utility bill savings.

⁷⁶ This is in contrast to a capital lease where the asset is on the balance sheet of the company where the system or improvement is installed.

Although a lease allows the financing partner to reduce federal income taxes by claiming depreciation on the system (which residential owners cannot do), this economic benefit is likely not sufficient to provide financial benefit to the lessee unless rebates or other direct incentives continue to be available.

Capital leases and—to a lesser degree—operating leases are fairly straightforward. Energy savings contracts (ESCs), which are effectively a variation on operating leases, might be less transparent. The financing costs, interest rates, and unspecified engineering and installation costs might not be clearly broken out for the consumer. And, like all financing decisions, a lease option is best considered on an individual basis.

3.9.1 Strengths and Weaknesses of Leasing Programs

Like other financing programs, the key advantage of a leasing program is the ability to remove up-front capital cost barriers for RE systems. Because the leasing company owns the system and, often, the RECs associated with energy production, the lessee/host does not need to utilize the system’s tax benefits or find a buyer for the small number of RECs produced by the system. These programs can operate independently of a state or utility RE program; therefore, public funds are not required to capitalize the lease program, although EE/RE program dollars could continue to be used for rebates or to lower the cost of borrowed funds and, therefore, lease payments.

Lease payments to the system owner could exceed the energy cost savings from the system. In addition, if the lessee wants to sell the property and the new owner does not want to assume the lease obligation (perhaps because the system is not cash-flow positive), then the lessee would be required to pay off the remaining lease obligation out of the property’s sale proceeds (unlike PACE or on-bill financing, which legally transfers the obligation to the next owner). Table 23 summarizes these strengths and weaknesses.

Table 23. Assessment of Lease Programs

Strengths	Weaknesses
Removes up-front financing barriers for RE investments	Lease obligation could complicate the sale of property; lessee could be required to pre-pay lease and/or remove system upon transfer of property ownership
Makes efficient use of federal tax benefits and RECs	
No direct costs to state/utility RE programs unless capitalizing the program	

3.10 Credit Enhancement Tools

The purpose of credit enhancement tools is to reduce the lending risks (real or perceived) associated with clean energy projects to facilitate a project loan and ideally a lower interest rate or improved loan terms. Credit enhancement tools include:

Loan Guarantees: Loan guarantees leverage available dollars while providing valuable protection to commercial lenders underwriting large RE projects. A typical loan guarantee program might protect a lender against as much as 85% of its capital losses should a borrower default on a loan. In addition, the guaranteed portion of a loan is removed from a bank's balance sheet, allowing the bank to make more loans with the same capital base. The program sets aside a portion of the guarantee amount as a reserve against defaults, depending on the risk of the overall loan guarantee portfolio. However, regardless of the reserve, the program is responsible for the full amount guaranteed in the event of a default.

While loan guarantees have not been used at the state EE/RE program level, there are several federal loan guarantee programs for clean energy.

The Department of Agriculture's Business and Industry (B&I) and Rural Energy for America (REAP) programs, administered by USDA Rural Development, each offer substantial loan guarantees for qualified EE/RE projects located in rural areas (USDA 2010). The B&I program, which is not specifically targeted at energy projects, offers loan guarantees of 60%–80% of the underlying loan amount up to \$10 million (with the lesser guarantees for the larger amounts). The REAP program, which funds only EE/RE projects, offers maximum loan guarantees of \$25 million. The percentage guarantee also declines as the guarantee amount exceeds certain size thresholds. Both programs are nationally competitive. Projects and project owners both must be "small businesses" (according to federal definitions) and located in rural areas (as defined by USDA Rural Development).

The DOE has expanded its advanced energy loan guarantee program through ARRA (U.S. DOE 2009b). This program includes an opportunity for states to become "designated lending authorities" in underwriting these federal loan guarantees. State energy programs can collaborate with state economic development agencies or finance authorities by providing the technical and market expertise to assist in these loan guarantee decisions. However, early indications suggest that, due to high legal and administrative costs on the part of the applicant, this DOE program is best suited for large projects. Establishing a more streamlined loan guarantee program targeted at smaller projects might effectively complement the current DOE program.

Loan Loss Reserves: A loan loss reserve differs from a loan guarantee in that reserve funds generally provide credit enhancement to a pool of loans, whereas a loan guarantee must be paid regardless of availability of funds. In other words, a claim against a loan loss reserve cannot exceed the value of the project-specific reserve, whereas a claim against a loan guarantee can be up to the amount of the guarantee, regardless of the amount of reserve funds set aside. Loss reserves are physically deposited in an account as long as the loan is outstanding. These funds, like a loan guarantee, could represent 5%–25% of the outstanding loan amount and reflect the probability of loan non-payment or default. Federal ARRA funds can be used for loan loss reserves but cannot be used for loan guarantees (Brown 2010).

Subordinated Debt: Under subordinated debt, a state can participate in an EE/RE project loan by providing of the loan amount in a junior lien position. This junior debt would cover the first losses on a loan default. ARRA funds can also be used for subordinated debt.

Examples of Credit Enhancement Tools at the State Level

Michigan: MichiganSAVES is funded by the Michigan Public Service Commission and administered by a non-profit partner. The program has two loan loss reserve programs. The first is targeted at homeowners making EE upgrades through approved contractors and supports loans of up to \$12,000. Lenders can claim against these reserves when loans are more than 90 days past due. Michigan SAVES is also running a small commercial business pilot program providing 50% loss reserves for loans up to \$150,000 in a targeted geographic area in Detroit (Brown 2009c).

Pennsylvania: Pennsylvania's Sustainable Development Fund, administered by The Reinvestment Fund, was created by the Pennsylvania Public Utility Commission in its final order in the PECO Energy electric utility restructuring proceeding. The Fund provides a number of financing options for RE projects, including subordinated debt of up to \$5 million for a term of up to 12 years at a per annum interest rate of 4.0%–6.5% fixed (The Reinvestment Fund 2010).

3.10.1 Lessons Learned for Credit Enhancement Tools

Clean energy financing tools are relatively new at the state level, and thus there are few EE/RE lessons learned at this point in time. However, these tools have been used broadly by states to support loans for other targeted purposes, and lessons learned can be derived from these parallel experiences (Brown 2010):

- Credit enhancements that improve credit access, flexibility, and affordability for targeted projects appear to provide the greatest opportunity for increased lending.
- Guarantees, loan loss reserves, or subordinated debts that are based on realistic risk assessment will help ensure that a sufficient reserve is created.
- Guarantees that are limited to less than 100% of the project financing help ensure that the lender has “skin in the game” for proper due diligence and loan collection effort.
- Guarantees and reserves that are structured as a consistent amount for the portfolio rather than a negotiated amount for each loan could help maintain longevity of the program.

The primary benefits of these credit enhancement tools are that an EE/RE program can significantly leverage its available financial resources to improve the likelihood and terms of commercially available debt for EE/RE projects while, at the same time, leaving the ultimate credit decisions and the capital requirements to the private sector. However, there is no assurance that even solid financeable projects can secure credit at favorable terms, even with these enhancements. Further, while properly structured credit enhancements can limit public exposure to loan defaults, risk exposure to the implementing program can still be considerable, particularly for loan guarantees. Table 24 presents strengths and weaknesses of credit enhancement tools as a state financing mechanism for clean energy projects.

Table 24. Assessment of Credit Enhancement Tools

Strengths	Weaknesses
High funding leverage: Loans are coming primarily from private sources with the state providing only the enhancement tool	Dependency upon outside lenders for loan approval and to incorporate improved terms to borrowers as a result of state providing credit enhancement
Facilitates loans and improves loan terms for clean energy borrowers	Under reserving against defaults for loan guarantees exposes state to the full extent of the guarantee
All funding is recoverable except for defaults	States dependent on lenders for underwriting; a condition of lender involvement is state-performed project and borrower due diligence to limit risk exposure

3.11 Overall Observations on Financing Tools

While the results of state and utility EE/RE programs to date have primarily been achieved through direct incentives, other financing mechanisms and programs can complement or substitute for these direct incentives while leveraging available program dollars. The choice of which financing tools to consider will depend on the state and utility EE/RE program goals, as different financing tools can more effectively support different program goals. These goals can include maximizing near-term reductions in energy demand, reducing GHG emissions, or long-term creation of “green jobs.”

Match Tools to Available Resources: The financing tools need to reflect available financial and administrative resources, the administrative complexity of the tool, and the skills of fund personnel internal to the program. For example, if program funding is limited or not recurring, an extensive set of rebates might not be appropriate. Loan programs can be effectively administered only if the fund has the underwriting and administrative capabilities or is willing to contract program administration to a private company.

Use Tools to Fill Financing Gaps: If the goal of the program is to leverage private dollars, then financing tools could be targeted to mitigate credit and technology risks that the private sector is unable or unwilling to fill. For many projects, access to long-term financing could be more valuable than direct subsidies.

Align Tools with Program Goals: If the primary goal is to maximize GHG emission reductions per dollar invested, then credit enhancement tools (e.g., loan guarantees and interest rate buy-downs) could be more effective than direct incentives because of the manner in which they leverage private capital markets. If the goal is to maximize near-term energy savings, then broad EE incentives could be preferable to RE support. Note that programs can have multiple goals and that optimizing design for certain goals can subordinate others, so program design will need to reflect overall priorities.

Loan Programs Preserve Program Capital: Loan and credit enhancement programs reduce dependency on recurrent funding and can provide critical financing at favorable terms, particularly in an environment in which private lenders are reluctant to underwrite EE/RE projects.

Innovations in Finance are Occurring: New financing and market-based tools such as FITs and PACE programs can expand markets for EE/RE investments while reducing dependency on direct incentives.

No Financing Tools Achieve All Program Goals: Each financing tool has limitations. These limitations prevent programs from optimizing on all goals—GHG reductions, energy savings, financial leverage, job creation, market transformation, and others. Those designing and evaluating programs need to recognize these trade-offs. EE/RE program managers seeking to achieve multiple goals might want to consider offering a portfolio of tools.

4 Conclusions

The experiences and lessons learned through the implementation of existing state and utility EE/RE incentive and financing programs can be important benchmarks for future clean energy action, whether at the local, state and utility, regional or federal level. The following lessons could inform design of future incentive and financing programs to advance additional EE/RE investment and deployment:

There is no simple, standard, or optimal EE/RE program design and practice for all states and markets. Instead, employing a broad portfolio of financing tools and market strategies to reflect location-specific conditions and available financial resources is most likely to meet program goals. Federally-funded EE/RE programs can learn from and leverage existing states and utility experience. States and utilities with experience could help design programs adapted to local market conditions and available resources.

There is currently a large disparity in both EE/RE funding and program experience levels among states, with many states recently developing programs for the first time after receiving ARRA funds. Reasons for this disparity including wide differences in the cost of electricity in different markets; the presence of traditional vertically-integrated versus restructured utilities; and political, regulatory, and social factors that affect the support of EE/RE funding with public or ratepayer dollars. Federal decision-makers need to decide how to address these disparities. One approach is to structure federal investments to increase funding levels in states with limited funding of EE/RE programs. This approach could have a disproportionate impact on future GHG emission reductions because many of the states with limited EE/RE funding also have among the most carbon-intensive electricity generation.⁷⁷

Durable and long-term funding is necessary for programs to build robust markets for clean energy and enable cost reductions in projects and technology.

Clear and appropriate metrics, established performance targets, and comprehensive, independent evaluation are essential in guiding the direction of EE/RE programs and in providing clear accountability of program results. There is a need for a centralized entity to coordinate and/or support consistent reporting among programs and in collecting and aggregating program-level data. This process would allow for better comparisons of results across programs, sharing of information, and ongoing program design improvements.

EE/RE programs can be more effective when coupled with state and local policies that align utility incentives with program performance and remove utility and local barriers to project investment.

Although EE investments can generally achieve GHG reductions at greater cost effectiveness than RE technologies, state and utility programs support RE deployment for a variety of reasons. These include GHG reductions; deferred new conventional generation and transmission; avoided distribution investment (through growth in distributed generation); avoided electricity generation during periods of peak demand; and employment growth in the RE

⁷⁷ See Appendix B for supporting data of this conclusion.

sector. These programs often have a goal of reducing installed RE costs over time, and can be structured accordingly.

While rebates and direct incentives are the dominant financing mechanism used by states and utilities today to support EE/RE investments, states recognize and are adopting financing tools that better leverage available program funding with private capital. Federal programs and new state and utility programs to support EE/RE deployment similarly face choices about the balance between loans and other types of credit enhancements, relative to direct incentives.

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Appendix A. EE/RE Program Administrative Structures

A recent study by the American Council for an Energy Efficient Economy (ACEEE) assessed the factors that contributed to an EE program’s effectiveness (Kushler et al. 2009). The study concluded that there was no relationship between a program’s performance and its administrative structure (utility, state, or third-party administered).

For RE programs, the choice of administrative models can be important to program efficacy (Sinclair 2007). Utilities are today managing technology-specific incentive programs that include a variety of programs (e.g., customer outreach or technical assistance). However, more comprehensive RE programs primarily are being run by state agencies or third-party administrators.

While the federal State Energy Program funds are directed at state energy offices, in considering the future use of federal funds for EE/RE programs, there could be reasons to allow different entities to manage these programs (e.g., counties and cities have managed ARRA-funded EE/RE initiatives). Table A-1 offers a brief description of the three administrative models referenced in the report (National Action Plan for Energy Efficiency 2008a). Below is a comparison of the strengths and weaknesses of each administrative model.

Table A-1. Summary of Clean Energy Fund Administrative Structures

Administrative Structure	
Utility	Delivered by utilities (integrated utilities in regulated markets or distribution-only utilities in restructured markets)
State	Delivered by an existing or newly created state entity (public utility commissions, departments of economic development, state energy offices, and public benefits corporations); relying on contractors to perform many administrative functions
Third Party	Delivered by independent private or non-profit entity whose purpose is to administer EE/RE programs

Source: National Action Plan for Energy Efficiency 2008a

Utility-run Programs

Under a utility-run program, load-serving entities are responsible for both the design and delivery (usually through outside contractors) of EE/RE programs. A regulatory commission must approve the program design and oversee the results.

Advantages of Utility-run Programs

Existing Customer Relationships: Utility-run programs could benefit from existing relationships with customers. In many cases, utilities are already trusted as authorities on energy use and EE opportunities. Utilities also already have an established market presence and access to customers.

Customer Data: Utilities capture a wealth of individual customer data that can be used to identify EE/RE opportunities and provide targeted technical assistance, particularly for larger commercial and industrial customers.

More Flexible Contracting: Utilities are not bound to the same restrictive procurement rules that state agencies are required to follow.

Enforceable Targets and Incentives: Utilities can be given performance targets (e.g., Energy Efficiency Resource Standards) and incentives for meeting those targets. Incentives can include performance rewards, revenue decoupling, or the disallowance of cost recovery for efficiency programs that are ineffective or poorly executed.

Disadvantages of Utility-run Programs

Conflict of Interest: Because utility financial performance is traditionally based on volume of energy sold, utilities could have an inherent disincentive to run effective EE programs unless provided the targets and incentives mentioned above.

Redundant Administration: In states with multiple utility-run programs, there are redundant program developments, administration, and evaluation expenses.

Municipals and Cooperatives: A utility-run program might not be suitable in states with many small public power and rural electric cooperative entities.

Least-cost Planning: Utility administration could conflict with least-cost planning requirements of state regulatory commissions, particularly for RE programs, even if the programs themselves have been approved.

State-run Programs

State-run programs, which are typically administered by a state energy office, have several strengths and weaknesses.

Strengths of the State-run Model

No Performance Disincentives: State-run programs operate in the public interest and, therefore, have an incentive to maximize the efficient use of public/ratepayer dollars.

Reduced Administrative Costs: Offering a unified state program lowers administrative costs by centralizing activities that would otherwise be run by individual utilities. This is particularly valuable for states with many smaller utilities, public power entities, and cooperatives.

Unified Program Offering and Marketing: A state-run (or third-party administered) program offers consistent programs and messaging within states that have multiple utilities.

Weaknesses of the State-run Model

Political Pressure: State-run programs are more subject to political pressure in funding risk, program design, and the selection of contractors.

Lack of Performance Incentives: While state-run programs can build performance incentives into contracts with implementation contractors, the program administrators themselves, as public-sector employees, have no direct financial incentive to maximize energy savings.

Independent Entity (Third Party)

Independent entities can be quasi-public organizations created to administer EE/RE programs (e.g., ETO) or entirely independent organizations (e.g., the Vermont Energy Investment Corporation) that are competitively selected by state regulatory commissions.⁷⁸

Advantages of the Third-party Model

Clear and Specific Mission: As the “clean energy utility” for the state, the independent administrator’s role and target objectives are clearly spelled out in its contract, and the entity is designed and staffed specifically to administer an EE/RE program.

Protection from Potential State Funding Raids: A third-party structure could help to protect ratepayer funds dedicated to EE/RE programs from being re-appropriated to support general state revenue needs. Several state funds have been under periodic pressure from these funding raids despite specific legislative language that protects them.

Better for Fragmented Utility Markets: In states that have a large number of utilities, a third-party administrator, like a state administrative model, would reduce administrative redundancy and provide a unified market presence relative to standalone programs for each utility.

Performance Incentives: A state can design financial incentives for a third-party contractor that meets or exceeds performance goals. Independent contractors bid for the right to administer the program and are subject to performance reviews and contract termination.

Potential Disadvantages of the Third-party Model

Lack of Customer Relationships: Independent entities do not have the benefit that utilities have of existing customer relationships.

Higher Administrative Cost: An independent entity could have a higher cost structure and overhead and might need a profit margin that state agencies do not require, although a competitive bidding process could help to keep these at reasonable levels.

⁷⁸ See www.energytrust.org and www.veic.org.

Appendix B. Relationship between Energy Consumption, GHG Emissions, Electricity Prices, and EE Spending

While not perfectly correlated, in general, states with the highest electricity consumption also tend to have the highest relative GHG emissions in their electric generating sector due to a high reliance on coal-fired generation, low electricity prices, and low investments in EE by state or utility programs as compared to the national average. Conversely, those states with the highest electricity rates (primarily California and the Northeast) use far less electricity on a per customer basis and have ratepayer-funded EE programs at levels well above the national average partly as a response to these high prices. There is a third group of states, primarily in the Midwest and Pacific Northwest, that do not have economic conditions that naturally incentivize high investment in EE (i.e., high electricity prices) but have nevertheless managed robust EE programs and stimulated higher than average consumer investment in EE measures for a number of years.

Table B-1 presents data on electricity use, CO₂ emissions, electricity prices, and electric EE program spending for all 50 states, ranked by electricity consumption per capita (highest to lowest).

Table B-1. State Electricity Use, Generation Profiles, and Efficiency Spending (Ranked by per Capita Electricity Consumption, 2008)

State	MMBtu per Capita (kWh/customer)	CO ₂ Emissions in lbs per MWh (U.S. Rank)	Coal as % of In-state Generation	Average Retail Electricity Price (¢/kWh)	Electric EE Program Spending (\$/Capita, 2009)
WY	1,016.1 (51,968)	2,205 (2)	94%	5.67	4.93
AK	945.7 (19,951)	1,421 (24)	9%	14.73	n/a
LA	783.4 (35,695)	1,302 (28)	26%	9.44	0.51
ND	687.4 (32,898)	2,217 (1)	91%	6.69	0.25
TX	475.3 (31,577)	1,373 (25)	36%	10.99	4.06
IA	472.4 (29,472)	1,903 (8)	76%	6.89	18.52
KY	462.4 (41,888)	2,116 (5)	94%	6.26	3.76
WV	457.8 (33,835)	2,044 (4)	98%	5.61	0.00
MT	448.7 (27,038)	1,505 (20)	62%	7.72	28.68
IN	447.3 (34,595)	2,118 (4)	94%	7.1	2.15
AL	441.5 (36,010)	1,253 (30)	51%	8.59	0.88

OK	440.0 (29,383)	1,535 (17)	48%	7.81	1.03
NE	438.8 (29,154)	1,519 (18)	66%	6.58	3.40
SD	435.3 (25,432)	1,249 (31)	52%	7.14	0.33
KS	406.0 (27,403)	1,752 (14)	73%	7.45	0.33
MS	403.2 (32,459)	1,184 (35)	35%	8.99	0.93
AR	392.2 (30,421)	1,220 (33)	47%	7.6	2.69
MN	378.4 (26,878)	1,510 (19)	58%	7.79	11.03
SC	368.5 (33,389)	928 (40)	41%	7.85	3.26
TN	362.3 (33,091)	1,423 (23)	63%	8.18	12.06
ME	355.6 (14,853)	685 (44)	0%	13.83	15.83
NM	349.0 (22,452)	1,827 (12)	73%	8.35	7.26
ID	346.5 (30,653)	187 (50)	0%	5.69	28.68
OH	345.9 (28,846)	1,850 (11)	85%	8.39	1.62
DE	337.0 (26,617)	1931 (7)	70%	12.36	n/a
WI	330.9 (24,030)	1,713 (15)	66%	9.00	17.96
MO	325.2 (27,509)	1,868 (9)	81%	6.84	3.84
VA	322.5 (30,766)	1,254 (20)	44%	8.00	n/a
IL	318.4 (25,411)	1,169 (38)	48%	9.3	4.9
WA	312.2 (27,594)	271 (49)	8%	6,55	28.68
GA	310.9 (29,423)	1,449 (22)	63%	8.84	2.11
PA	310.3 (25,339)	1,228 (32)	53%	9.32	n/a
NJ	304.4 (20,686)	695 (43)	14%	14.44	33.57
CO	303.6 (20,476)	1,711 (16)	65%	8.60	9.46
UT	293.1 (26,864)	1,861 (10)	82%	6.50	11.78
NC	292.2 (27,055)	1,325 (27)	60%	7.96	7.20
OR	292.0 (26,253)	405 (48)	7%	7.23	28.68

MI	291.8 (21,938)	1,478 (21)	61%	8.94	5.01
NV	286.7 (29,059)	1,139 (38)	22%	9.89	16.13
MD	255.7 (26,074)	1,356 (26)	57%	13.00	4.81
VT	248.7 (16,121)	2 (51)	0%	12.33	49.38
FL	241.4 (23,486)	12,146 (34)	30%	10,74	7.26
AZ	238.9 (26,911)	1,078 (39)	37%	9,11	7.56
NH	235.5 (15,669)	653 (47)	15%	14.65	12.33
CT	231.2 (19,196)	684 (45)	14%	17.79	27.64
CA	229.1 (18,086)	663 (43)	1%	12.48	27.16
MA	225.4 (18,373)	1,154 (37)	25%	16.27	27.09
HI	220.4 (22,012)	1,753 (13)	15% (76% petroleum)	29.2	27.54
RI	208.9 (16,018)	892 (41)	0%	16.01	22.38
NY	204.9 (18,147)	740 (42)	14%	16.57	19.41

Notes: All data from 2008 except efficiency program spending which is 2009. In-state CO₂ emissions per MWh and generation mix do not reflect imports-exports of electricity consumed in-state.

Source: U.S EIA 2010; U.S. EIA 2010a; U.S. EIA 2010b; U.S. EIA 2010c; U.S. EIA 2010d; U.S. EIA 2011

Appendix C. Financing Support for Clean Energy Industries

One potential use of public EE/RE funds could be to support both established and emerging EE/RE industries. This practice is becoming increasingly common among state clean energy funds and economic development agencies and was an area targeted by several states in their use of the ARRA SEP funding (U.S. DOE 2009c). States have provided grants, loans, and loan guarantees to encourage the establishment or expansion of these clean energy industries. Several states such as Iowa, Kansas, and Colorado have grown clean energy manufacturing cluster in recent years.⁷⁹

There are several ways in which public funds can support early stage EE/RE companies and existing industries.

Research and Development Grants

Public funds can provide cost-share grants for targeted research and development (R&D) projects. While this is a core function for the DOE, some state programs are providing R&D support as well. For example, the California Energy Commission's \$85 million Public Interest Energy Research (PIER) program is funded by the state's investor-owned utilities (Kulkarni 2009). The general goal of the program is to develop, and help bring to market, energy technologies that provide increased environmental benefits, greater system reliability, and lower system costs, and that ultimately provide tangible benefits to ratepayers (California Energy Commission 2010). California's PIER program supports both industry and the Clean Energy Research and Market Development program, which funds both basic and applied research in electricity grid improvement, building and lighting technologies, industrial process improvement, energy storage, RE technologies, transportation-related efficiency improvements, and other areas. NYSERDA operates a clean tech industrial park, the Saratoga Technology and Energy Park (STEP), which is home to several clean energy businesses.⁸⁰

Venture Investing

Public dollars can invest in or establish a clean energy venture fund (co-invested and/or co-managed with private capital). The Connecticut Clean Energy Fund, through its parent agency, Connecticut Innovations, dedicates a portion of its annual budget to strategic investments in emerging EE/RE companies (CESA 2010c). It does so in three ways: grants with equity rights for early stage R&D companies, non-recourse debt for pilot or pre-commercial demonstration projects, and structured debt with equity investments of up to \$500,000 for expanding companies. CCEF invests alongside private equity sources, effectively leveraging its investments by 20:1 (CESA 2010c). The Massachusetts Clean Energy Center (MassCEC) is the state's lead agency in the development and promotion of the Massachusetts clean energy cluster. MassCEC's Investments in Clean Technology program makes direct investments in "game changing" clean energy technologies through, among other programs, equity investments in promising early-stage Massachusetts clean energy companies that are developing and commercializing technologies

⁷⁹ Each of these states has focused on the wind energy supply chain.

⁸⁰ See www.step.nyserda.org.

(MassCEC 2010a). NYSERDA provides business incubator services and seed capital to bring research concepts to prototype, demonstration, and commercialization stages.⁸¹

Contingent Grants

Contingent grants address the financial needs of companies during the “valley of death” pre-commercial stage for a technology. These companies are past the R&D stage but lack the investment capital needed to move from a laboratory or pilot scale into production. Contingent grants are direct grants that are disbursed based on a company achieving certain specified milestones. These grants could be repaid out of a share of revenue when a product reaches commercial stage or forgiven if it never comes to market. From the grantee’s perspective, the grants are not considered a liability on the company’s balance sheet, and repayment can be structured as a royalty rather than as a loan repayment. This is a model currently being used by the BIRD Foundation to fund joint U.S.-Israel bi-national clean energy ventures and technology commercialization (BIRD 2010).

Convertible Loans

The use of convertible loans provides an option to take an equity position in a company instead of loan repayment. Like contingent grants, they can provide financing at a critical stage in a company’s development when private sources of financing are difficult and expensive to access. However, convertible loans carry a greater cost to the company through interest expense (albeit often at a low rate), increased debt on the company’s balance sheet, and dilution of ownership if the lender opts to take an equity position in the company instead of repayment. Convertible loans have not yet been used by states to support clean energy companies.

⁸¹ See <http://www.powernaturally.org/programs/manufacturingbusinessdevelopment/brochure.pdf>.

Appendix D. Public and Regulatory Policies

For public funding for EE/RE investments to be most effective, public and regulatory policies need to be properly aligned.

Renewable Portfolio Standards

Twenty-nine states and the District of Columbia have implemented RPS policies. Figure D-1 identifies states with an RPS. Together with the federal production tax credits (PTCs) and ITCs, RPS policies have been the primary policy driver for large-scale RE development in the United States.⁸² At the Federal level, the U.S. House of Representatives and Senate have, at different times, each passed versions of a national RPS, although none has thus far been signed into law.

Of the more than 37 GW of non-hydro renewable energy capacity added from 1998 through 2009 in the U.S., roughly 61% (23 GW) occurred in states with an active or impending RPS compliance obligation (Wiser et al. 2010).

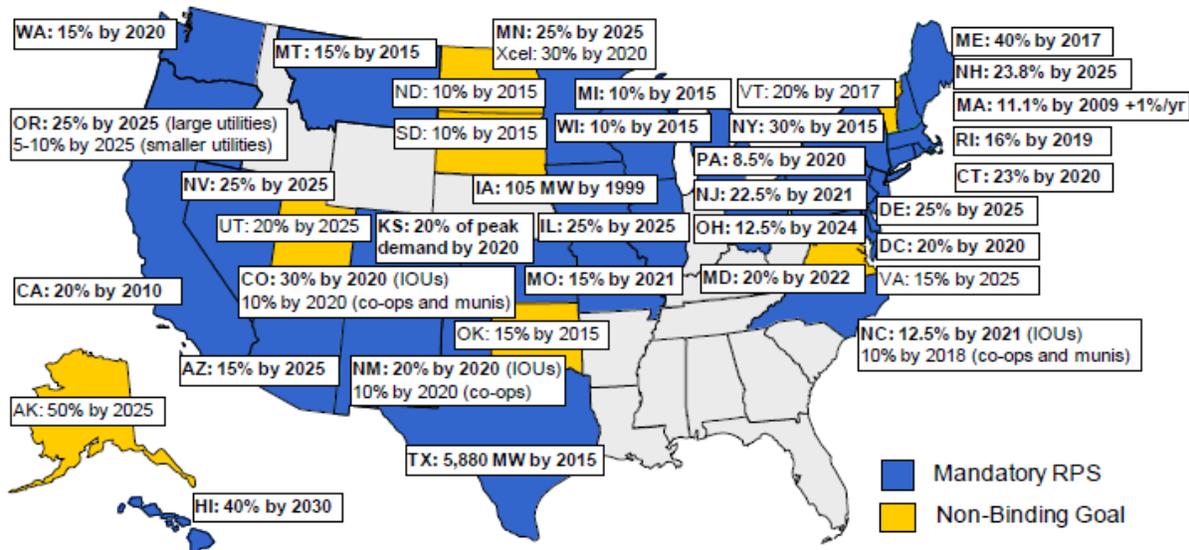


Figure D-1. States with renewable portfolio standards

Source: Wiser et al. 2010

⁸² This does not include projects that qualify for a state’s RPS that pre-date the implementation of the requirement or projects built in “non-RPS” states that satisfy an RPS in other states.

RPS Set-asides

Under an RPS, utilities generally procure RE or RECs from least-cost resources (typically wind or legacy projects such as older hydropower). As a result, higher-cost RE technologies can be shut out of a standard-design state RPS. In response, some states are establishing an RPS “set-aside,” in which some portion of the RPS requirement must be met with solar PV or other distributed resources. Sixteen states now have RPS set-asides for solar or distributed generation.⁸³

A utility must comply with the set-aside requirement by acquiring technology-specific RECs [e.g., solar RECs (SRECs)] or otherwise make a technology-specific alternative compliance payment (ACP). The ACP is a backstop mechanism to protect both utilities and ratepayers from unexpected cost impacts of the set-aside. The ACP sets an upper limit for the cost of compliance with the set-aside, removes the risk of unknown financial penalties for any solar energy shortfalls, and gives suppliers flexibility in complying with the set-aside requirements. ACP prices are set by a regulatory board to be above the expected REC market price so that utilities have an incentive to purchase RECs instead of making ACPs.

New Jersey’s RPS Set-aside Policy

New Jersey has an aggressive solar target (5,316 GWh by 2021) within the RPS. The state clean energy fund has historically provided generous rebates to encourage solar installations. As a result, New Jersey became the second-largest solar PV market in the country. However, in 2008, the state’s Board of Public Utilities (BPU) determined that a SREC approach would reduce the ratepayer impact of fulfilling the RPS solar carve-out. If the rebate levels were to remain unchanged, achieving the state’s 2.12% solar RPS requirement by 2021 would have required an estimated \$10.9 billion in rebates, adding about 7.5% to electricity rates.

Starting in 2009, New Jersey began to phase out its rebate program and raised the Solar ACP level for solar RECS to \$711 per MWh, declining by 3% per year. This Solar ACP level represents the maximum price premium that state regulators have determined is necessary to economically support solar installations. This Solar ACP does not provide a guaranteed level of support to all system owners. The market-clearing price for SRECs has been well below the Solar ACP.

System owners will be able to sell their SRECs toward utility fulfillment of New Jersey’s RPS for 15 years from the date of system installation. Any solar ACPs paid by utilities will go to support solar systems on public facilities. The cost of acquiring these SRECs is recoverable through rates and frees up more of the state’s EE/RE program dollars to support other technologies and markets.

Energy Efficiency Portfolio Standards

Analogous to an RPS, an Energy Efficiency Portfolio Standard (EEPS) requires utilities to “deliver” increasing annual electricity demand reductions and often peak load reductions over the prior year. Twenty-two states now have passed some form of an EEPS (U.S. EPA 2010a). An EEPS is a policy tool that creates a defined performance target for EE programs. However, these

⁸³ LBNL reports that the impact of state RPS set-asides on solar PV already has been substantial. Excluding California, 67% of PV additions from 2000 through 2006 came from states with active RPS solar targets. Further, the future impact of existing state RPS solar set-asides could be sizable: 400 MW by 2010 and 2,000 MW by 2015, assuming full compliance.

EEPSs are often established by state legislatures with little assessment of the technical or economic potential of EE in the state, the pace with which it can be achieved, or the required program funding to reach the target. EEPS requirements might also lack either financial rewards or penalties for utility EE programs that exceed or fall short of the targets. Finally, the annual EEPS targets might encourage EE program administrators to make conservative program choices in capturing low-hanging EE opportunities while deferring programs and targeted markets that have potentially greater but longer-term energy savings (Kushler et al. 2009).

Utility Financial Incentives

One of the principal shortcomings of EE programs run by utilities is the absence of financial incentives for utilities to support these programs. Under traditional utility ratemaking, rates are primarily volumetric and are based on an anticipated level of customer demand. Even in restructured markets in which utilities only own distribution systems, rates similarly are based on a target return on these distribution assets. Because EE programs drive reductions beyond what would naturally occur, it is not in utilities' financial interest to maximize the effectiveness of these programs.

In response, an increasing number of state regulators are building financial incentives (or at least removing financial disincentives) for utility support of these programs. These incentives take several forms, including revenue decoupling and allowing utilities to earn a financial return on delivered demand reductions. Governors accepting federal ARRA funds for their states through the SEP program were required to sign a pledge that they would work with regulatory commissions to develop some type of appropriate financial incentives for utilities to support EE programs. A full discussion of decoupling and utility financial incentives is beyond the scope of this report but can be found in other papers referenced (Kushler et al. 2006; Schwartz 2009).

Interconnection Standards

Historically, utilities have created barriers for distributed generation to connect to their distribution lines. They have erected these barriers in principal to protect the safety and reliability of their distribution systems. Independent generators and system owners often have had to wait long periods of time and pay high up-front fees to interconnect their systems.

In recent years, state legislatures and public utility commissions have intervened and passed interconnection rules that both standardize and simplify the process of interconnection for distributed generation. Thirty-seven states now have some form of statewide interconnection standards. These are outlined in the Interstate Renewable Energy Council's "Model Interconnection Standards and Procedures for Small Generator Facilities" (IREC 2009) and the annual "Freeing the Grid" report (Network for New Energy Choices 2010.) Uniform and equitable interconnection standards are critical to the effectiveness of RE programs.

Net Metering

Closely tied to interconnection is net metering—the regulations governing how a utility will compensate the owner of a behind-the-meter distributed generation system for surplus electricity that is added to the distribution grid. Model state policies provide for credit at the applicable retail rate (e.g., residential, commercial, or industrial) for all surplus generation (total generation less total consumption) including factoring in time of use pricing when applicable (IREC 2009). Some policies compensate system owners only at a utility's avoided cost, which is a lower

payment, providing less of an incentive to install a system. State net-metering rules also set limits on project size that could range from as little as 40 kW in some states to 2 MW or more in others, as well as caps on the aggregate amount of capacity that a utility is required to net meter (DSIRE 2011).

States are also beginning to pass virtual or community net-metering rules, which allow the aggregation of individual meters to be offset by generation from a single larger RE project. (Kubert 2010; Rose 2009). For example, in some states, a municipality could install a larger megawatt-scale turbine, which could be net metered against the electric loads of multiple, separately metered municipal facilities. Note, however, that despite the importance of net metering, it is not generally perceived as being an adequate incentive to spur deployment by itself.

Standards and Codes

Federal and certain state appliance standards and state/municipal energy efficient building codes (when enforced) can play an important role in slowing demand growth. In 2000, higher federal appliance standards were estimated to save 1.2 quads of energy per year, twice as much as utility efficiency programs at the time (Gillingham 2004). Actively enforced energy efficient building codes address “lost opportunity” issues by locking energy savings into the design and construction of new buildings. However, these are complementary policies rather than substitutes for EE programs because they typically only address new construction and major renovation. Federal and state appliance standards “raise the bar” with an objective of lowering the costs of baseline EE products by mandating a market for these products. States can choose to further these markets by providing additional incentives targeting any technologies and/or sectors they choose. But both types of programs (mandated and voluntary) can drive markets. For example, a recent study of Pennsylvania’s EE potential by ACEEE concluded that EE programs could reduce demand by 16% in 2025 relative to baseline, while higher appliance standards would deliver only 4% savings and improved building codes just 1% (Eldridge et al. 2009a).⁸⁴

Permitting and Zoning

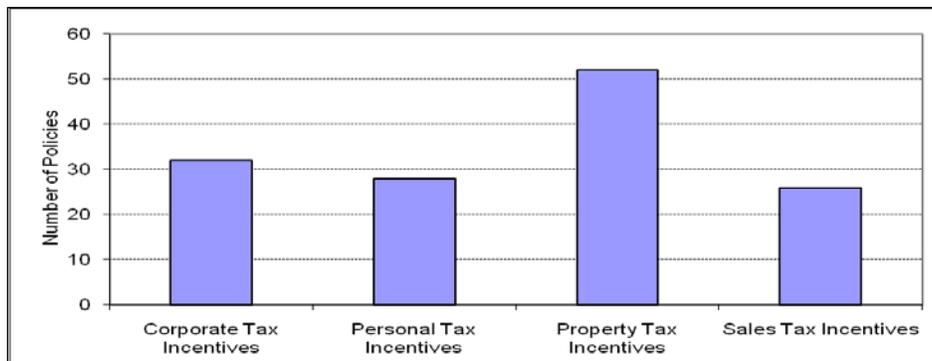
Local zoning and siting laws can restrict the siting of both large- and distributed-scale RE projects. While these are normally local land-use and building decisions, states can play an important role in developing model zoning and siting ordinances that encourage RE installations while still respecting public safety and aesthetic concerns, among other community interests. In certain instances, states can also pass legislation that overrides home rule in the development of local ordinances or approval of specific projects. For example, California has adopted comprehensive solar access laws that, among other provisions, prohibit local governments from blocking the installation of solar PV systems on the basis of aesthetics (CESA 2008). By statute, the Minnesota Public Utilities Commission has jurisdiction over the approval of any wind energy project over 5 MW and allows local jurisdictions to approve projects under 5 MW. Projects between 5 MW and 25 MW can be subject to local control if their respective county, with notice to the Minnesota PUC, assumes permitting responsibility (MN PUC 2010). This state-permitting control could create more predictability for wind developers and allow for greater state-level planning over the location of commercial wind development. While this degree of state control is

⁸⁴ The low impact of building codes is due to the slow rate of replacement of the building stock.

rare, many states have developed model wind turbine siting ordinances that could create greater consistency in permitting decisions within a state.

State Tax Incentives

To supplement federal clean energy tax incentives, a number of states also have established state-specific tax incentives as a substitute for or complement to direct project support. States and local governments have used ITCs or PTCs, sales tax exemptions, and property tax exemptions. Figure D-2 summarizes the number of states using each of these basic tax incentives to support RE (Lantz and Doris 2009).⁸⁵



Source: Lantz and Doris 2009

Figure D-2. State tax incentives by type

Investment and Production Tax Credits

ITCs and PTCs reduce the cost of RE systems through a credit on the project owner’s personal or corporate state income taxes. An ITC would represent a share of the system’s capital cost, while a PTC would be based on measured energy output of the system. Well established at the federal level, 24 states also have implemented tax credits for renewables (DSIRE 2010i). ITCs on residential systems are frequently capped at low amounts [e.g., \$2,000 in Utah (DSIRE 2010j)], while commercial systems have caps that range up to \$20 million per project (e.g., Oregon).⁸⁶ Tax credits are easy to administer and adaptable to reflect changing market conditions, but they require project owners to have state tax liability or investors with a need for the credits. In addition, these credits have uncertain fiscal impact and, at low levels, likely do not drive incremental EE/RE investments or GHG reductions (Lantz and Doris 2009).

Sales Tax Exemptions

Twenty-six states currently offer state sales tax exemptions on the purchase of qualified RE systems (DSIRE 2010k). While sales tax exemptions improve project economics marginally, there is no empirical evidence that these exemptions drive additional EE/RE project investment beyond what would have otherwise occurred (Lantz and Doris 2009). For example, a state that

⁸⁵ Although these incentives are primarily targeted at RE, in some states they also apply to certain EE investments.

⁸⁶ The Oregon Business Energy Tax Credit (BETC) allowed tax credits to be transferred at a discount from entities with no or limited state tax liability to those that had sufficient tax appetite. Due to its high cost to the state, primarily from its use by utility-scale wind projects, the BETC program is being ramped down and will sunset in 2012.

already offers solar PV rebates is gaining few additional projects from the sales tax exemption. Conversely, a state that has no rebate program will see little PV development attributable to a sales tax exemption alone (Lantz and Doris 2009).

Property Tax Exemptions

Thirty-four states offer property tax incentives for renewables on the installed value of residential and/or commercial RE systems (DSIRE 2010). These exemptions vary considerably from state to state. Some states offer exemptions only on residential systems; others extend the exemption to commercial systems below a certain size. Some states have no capacity size limit but substitute a royalty payment (percentage of gross) for property taxes. Others simply give local governments the option to exempt these systems from local property taxes (DSIRE 2010). For residential and small commercial projects, these exemptions are a way to make installation of these systems non-punitive from a property valuation perspective but, like sales taxes, there is little evidence that these exemptions lead to additional RE development, particularly in the absence of other incentives (Lantz and Doris 2009).

Appendix E. Case Studies of Leading EE/RE Programs

Several case studies illustrate effective EE/RE programs. What distinguish these programs are high relative funding levels, the targeting of diverse technologies, providing a combination of technical and direct financial assistance, and careful tracking and evaluation of results.

Efficiency Vermont

Efficiency Vermont is run by the non-profit Vermont Energy Investment Corporation (VEIC), a competitively selected contractor that serves as the state's "energy efficiency utility." (Efficiency Vermont 2009). The Vermont Public Service Board maintains program oversight and establishes energy and peak demand savings targets in its contract with VEIC. VEIC receives performance bonuses for meeting or exceeding targets. A third-party evaluator verifies the results.

The state's system benefits charge is among the highest in the country, at 3% of electricity revenue. In 2008, the program reduced energy demand by 2.5% of total electricity sales, in excess of the 1.5% projected demand growth in the state). The program has a levelized cost of saved energy of approximately 2.7 cents/kWh (this represents the overall ratepayer cost), comparing favorably to an avoided cost of wholesale energy purchased of 10.7 cents/kWh (Efficiency Vermont 2009, Resources for the Future 2009). Efficiency Vermont's comprehensive portfolio of programs includes rebates for energy efficient products, technical assistance, customer incentives for commercial and industrial customers, aggressive marketing, and targeted outreach (Efficiency Vermont 2009). The program has an overall TRC benefit: cost ratio of 2:1, meaning the expected lifetime avoided cost of energy acquisition from program-supported efficiency measures is twice the total up-front cost of those measures (Efficiency Vermont 2009).

Energy Trust of Oregon

ETO is an independent public administrator of the state's EE/RE programs. ETO was established by the PUC in 2002 and is funded through a system benefits charge from customers of the state's investor-owned utilities equal to 3% of utility revenue. The program spent \$96 million on all programs (electric efficiency, natural gas efficiency, and RE) in 2009, of which only \$53 million represented direct project incentives; the remainder was spent on technical assistance, outreach, and administration (Energy Trust of Oregon 2010).

Through its efficiency programs, ETO has reduced energy demand in the state by over 222 MW (the equivalent of electricity use at 187,000 homes) and saved 13 million therms of natural gas (the equivalent of heating 26,000 homes for one year) since its inception. It is delivering these savings at a program cost of saved energy of just over 2 cents/kWh (2.8 cents/kWh in 2009), well below the utility avoided cost of 8 cents/kWh. Since its inception, ETO's programs have resulted in a cumulative reduction in carbon emissions of 1 million tons (the equivalent of 175,000 vehicles) and an estimated 2,300 new jobs. The EE program reached 92,000 customers in 2009 (including 51,000 ENERGY STAR appliance rebates and 28,000 home retrofits).

ETO's RE program represents approximately 13% of annual program spending (\$13 million in 2009). The program has led to the development of 100 MW of RE since 2002. It has focused programs in biopower, solar PV, and community wind. The levelized program costs of direct incentives plus program costs expended in 2009 ranged from 0.8 cents per kWh for a biopower

project to 13 cents per kWh for solar PV. The program provided incentives for 495 RE projects in 2009, 481 of which were solar PV installations (Energy Trust of Oregon 2010).

NYSERDA

NYSERDA is a public benefits corporation that acts as a “super energy office” for the State of New York and has a broad mission: “to advance innovative energy solutions that improve New York’s economy and environment” NYSERDA offers a comprehensive set of programs that form an integrated set of activities: R&D, investments in emerging technologies and industries, direct support for EE/RE deployment, and administration of the state’s RPS. In addition to \$250 million in annual funding from a system benefits charge, NYSERDA also receives ratepayer funding for RPS procurement, a share of the auction revenue from the Regional Greenhouse Gas Initiative, state appropriations, and federal grants. Measured and verified benefits of NYSERDA’s core Energy\$mart program since inception include 700 MW of permanent and 575 MW of callable demand reduction, \$590 million in annual consumer energy savings, the installation of 865 solar PV systems, an overall TRC benefit-cost ratio of 1.8, annual CO₂ emissions reduction of 2.2 million tons, and the creation of 4,900 net jobs (NYSERDA 2008).

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