EVALUATING RENEWABLE ENERGY PROGRAMS

A GUIDE FOR PROGRAM MANAGERS

by

Warren Leon
Senior Advisor
Clean Energy States Alliance

June 2011

About Clean Energy States Alliance

Clean Energy States Alliance (CESA) is a national nonprofit organization located in Montpelier, Vermont. It is the only organization that represents the collective voice and interests of the public clean energy programs in the United States. CESA serves as a forum for peer-to-peer learning and collective problem solving among the leading public clean energy programs. CESA also provides assistance on clean energy program design, finance and evaluation to all 50 states. Since 1998, CESA members have invested more than $2.7 billion dollars through grants, rebates, loans and other investments in over 74,000 clean energy technology projects and companies, while leveraging over $9.7 billion in additional investments. For more information about CESA, its programs and its members, please visit www.cleanenergystates.org.

Evaluating Renewable Energy Programs

A Guide for Program Managers

Prepared by

Warren Leon
Senior Advisor
Clean Energy States Alliance

June 2011

Table of Contents

Introduction: The Case for Evaluation and for this Report

Some state clean energy programs have implemented impressive evaluations of their initiatives but not all evaluations end up being perceived as valuable by program managers or stakeholders. This report considers evaluation from the perspective of the program manager. It suggests how to ensure that evaluation activities are useful, cost-effective, and well-received by program staff, policymakers, and stakeholders. It recommends how to approach and choose among different types of evaluations.

The report can serve as an introduction to evaluation for a new program manager of a recently established renewable energy agency but will also provide useful information and ideas for more experienced program managers and established agencies.

* * *

Evaluation is an essential part of good program management. When approached carefully and done well, it can significantly improve the quality and efficiency of a renewable energy program. It can also provide managers and stakeholders with a better understanding of what the program is accomplishing, and how those accomplishments compare to those of other programs. In addition, by making evaluation an integral part of program development and management, agencies demonstrate that they take their responsibilities seriously and are seeking to maximize the public benefits of public spending.

Even though most managers of state clean energy funds and agencies know that evaluation is important, there are several reasons why evaluations of renewable energy programs do not always end up being entirely successful:

1. ***Evaluation may not receive enough attention.*** Renewable energy program directors and managers usually have grueling workloads and many conflicting demands on their time. In their desire to implement renewable energy rapidly, they sometimes have difficulty devoting resources and time to evaluation. And even if the agency sets aside sufficient money for evaluation studies, program managers may not focus sufficiently on what they want to accomplish with those studies or may not put enough time or effort into working with the people hired to produce evaluation reports.

2. ***There are relatively few widely accepted protocols for evaluating renewable energy programs.*** In the clean energy program evaluation arena, energy efficiency has received extensive attention, because state and utility energy efficiency programs have been in place for several decades and regulators have had to develop clear measures of program impacts to determine appropriate payments to utilities for energy efficiency activities. As a result, there has been considerable exchange of evaluation strategies and methods among the various states and evaluation contractors. In comparison, most renewable energy programs are newer, they vary

more in their programmatic goals and approaches, and they have not had as much experience with evaluation.[1]

3. ***It can be difficult to evaluate the results of renewable energy programs.*** In some cases, as with a program that aims to build a self-sustaining industry focused on a particular renewable energy technology, the full impacts of the program may not be known for many years. In other cases, such as with R&D grants, impacts can be hard to quantify. At other times, quantitative data is available, but may be difficult to convert to easily defensible results (e.g., it may require assumptions about energy prices far into the future or necessitate complex modeling of the state's economy).

4. ***The goals of renewable energy programs may not be explicit or fully thought out.*** Program evaluators assess renewable energy programs in relationship to those programs' objectives. Consequently, if program managers have not been explicit about what they are trying to accomplish or if the articulated goals do not accurately reflect all of the program managers' expectations, it can be difficult to produce a satisfactory evaluation.

5. ***The decision about what to evaluate is not made by program managers.*** Regulators or others overseeing renewable energy programs occasionally choose to evaluate a program against a specific set of program objectives or standards that may not completely align with the program managers' goals for that program. For example, several funders have requested cost-benefit analyses that look only at end-users' direct financial savings from renewable energy installations, and then compared those savings to ones from comparable energy efficiency programs, even though the renewable energy program also had other important objectives, such as building a renewable energy business cluster or improving the quality of certain renewable energy products.

Despite these problems, there have been enough useful renewable energy evaluation reports and enough evidence of the ways in which those reports have improved the performance of particular renewable energy agencies to indicate that all renewable energy agencies should give significant attention to evaluation. On the other hand, because there have been cases where agencies have been unhappy with the quality of evaluation reports or have not found them useful, it is important to proceed carefully in order to reap more of the potential benefits of evaluation. In an era of tight budgets, it is especially important to use evaluation to make sure that renewable energy programs have meaningful goals, are well designed, and are efficiently delivered.

[1] As evidence of the relative maturity of energy efficiency evaluation versus renewable energy evaluation, the 2010 International Energy Program Evaluation Conference included well more than 40 presentations that were explicitly about energy efficiency, but only one that focused on renewable energy. (There were also some presentations about transportation and general topics, such as behavior change programs.) For the conference agenda and links to individual conference presentations, see www.iepec.org/paris2010/Agenda.htm.

1. Types of Evaluations

According to the US Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), there are five different types of program evaluations:[2]

1. ***Needs and Market Assessment Evaluations*** identify target markets and seek to understand a particular market or audience. They also identify and analyze barriers to the adoption of renewable energy, establish market baselines, and explore customer needs. They can help program managers design appropriate, effective programs and establish baselines that can be used to measure future progress.

2. ***Process Evaluations*** examine program implementation processes and operations in order to determine how to improve the program's efficiency and effectiveness. They look at whether the program is well-designed, efficiently managed, effectively marketed, and is producing satisfied customers.

3. ***Outcome Evaluations*** determine the extent to which a program's intended outcomes and objectives are being achieved.

4. ***Impact Evaluations*** estimate the share of the outcomes that were the result of the program rather than other influences. Because this type of evaluation factors out outcomes that would have taken place anyway, the findings may be more meaningful than those produced by an outcome evaluation, but they are also more difficult to obtain. [Some private sector evaluators use the term "net outcomes" rather than "impacts," and use the term "gross outcomes" for evaluation type #3 above.]

5. ***Cost-Benefit Evaluations*** compare the value (generally financial) of a program's impacts to the cost of achieving those impacts. More elaborate cost-benefit analyses consider indirect effects, such as the economic impact of changes to retail electricity prices or the indirect jobs created by state spending on a major renewable energy installation. This type of evaluation is often of particular interest to politicians, regulators, and board members who oversee state clean energy agencies, but it can be difficult to produce precise results that are fully defensible and invulnerable to criticism, especially when indirect economic effects are considered.

[2] The material in the succeeding paragraphs is adapted from Harley Barnes et al., *EERE Guide for Managing General Program Evaluation Studies: Getting the Information You Need* (Washington: US DOE, 2006), pp. 2, 9, 17; available at http://www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf. The *EERE Guide* is a useful reference work for state clean energy program managers, because it offers a clear step-by-step approach for how to plan, design, and manage a program evaluation. Although the recommended approach is sometimes overly bureaucratic and aimed at federal program management needs, there is much useful information, some of which is reproduced in the appendix to this report.

Table 1. Types of Evaluations

Evaluation Type	What It Does	Why It Is Used
Needs and market assessment	• Identifies target markets • Identifies barriers to the adoption of renewable energy • Understand a market or audience	• Help program managers design programs • Establish baselines for measuring future progress
Process evaluation	• Examines program implementation processes and operations • Determines whether the program is well-designed, efficiently managed, and effectively marketed • Assess customer satisfaction	• Identify ways to improve the program • Understand the views of customers and other stakeholders
Outcome evaluation	• Determines whether the program is achieving its intended outcomes and objectives	• Keep program managers and others focused on the program's goals • Know whether a program is achieving its objectives • Determine whether the program should be modified so that it is better achieving its objectives
Impact evaluation	• Determines the share of the outcomes caused by the program rather than other factors • Identifies unintended but valuable benefits of the program	• Understand what the program is actually causing to happen • Determine whether the program is unnecessarily providing funding to free riders who do not need program to act
Cost-benefit evaluation	• Compares the economic and/or other benefits of a program's impacts to the cost of achieving those impacts.	• Determine the extent to which the program's benefits outweigh its costs • Understand whether the program is cost-effective • Decide whether the program should be continued as is, modified, or ended

2. Preparing for Effective Evaluation

"Not everything that counts can be counted,
and not everything that can be counted counts."
--Albert Einstein

The foundation for useful evaluation is laid at the initial development of a new program, well before most evaluation activities begin. A program should have clear goals and there should ideally be a program theory and logic model. Not only will goals, a theory, and a model help program staff manage and implement the program, but they will help evaluators determine what to evaluate and how. When program managers end up dissatisfied with an evaluation report it is often because the program managers, evaluators, and the state authorizing body did not have the same understanding of the program's goals and how the program was supposed to achieve those goals.

2.1 Set Appropriate Program Goals

Program goals have a tendency to fall into one of two extremes that can leave out important intentions and objectives of the program:

1. ***They can stop with simple quantitative targets.*** Although it can be desirable to know that a program aims to "increase the solar capacity in the state by ten megawatts" or "provide feasibility study grants to 100 businesses" or "distribute $10 million in rebates to municipalities," it is also important to articulate the underlying reasons for selecting those targets and what you hope to accomplish by reaching those targets. For example, why is it meaningful to install ten megawatts of solar? Is it simply because it starts to diversify the electricity supply or is it a vehicle for expanding the solar installation businesses in the state, driving down the cost of solar installations, increasing utilities' comfort with distributed generation, and/or educating the public about solar electricity? In the example above of feasibility study grants, what is their purpose, what will successful completion of them lead to, and why is that important?

2. ***They can be too vague.*** When a goal is as general as "build a wind industry in the state" or "increase public awareness of biogas technology," it is hard to know exactly what is intended or if the program is being successful. For example, what specific type of wind industry will develop because of the program and what will be its size and composition at specific points in time?

2.2 Produce a Program Theory and Logic Model

Once you have program goals, it is desirable to write a program theory, which links those goals to the activities that will be necessary to achieve them. In fact, evaluators will generally want to see and understand the program theory before they begin an evaluation. *The California Evaluation Framework,* prepared for the California Public Utilities Commission, explains that "The program theory describes, in detail, the expected causal relationships between program goals and program

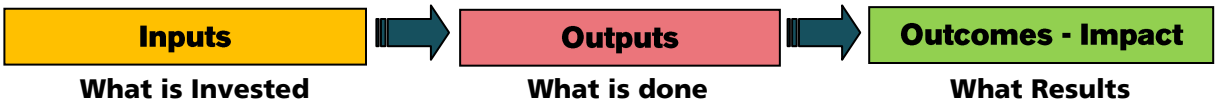
activities in a way that allows the reader to understand why the proposed program activities are expected to result in the accomplishment of the program goals."[3]

The program theory is often placed into a graphical form and called a program logic model. This model then becomes a visual representation of how the program is supposed to work. Although program logic models have been around since the 1970s, they have become much more popular over the past 15 years as evaluators, government agencies, and funders of nonprofits, most notably the W.K. Kellogg Foundation, have promoted their use.

Program logic models can take many different forms and there is no single right one for all programs. You should select a format that will be comfortable for your organization and seems to work well for your programs. One caution is that there is a danger that a program logic model will become so complicated that the eyes of program staff will glaze over, causing them to ignore the implications of the model. Clear writing, color coding, and elimination of extraneous information can help minimize this problem.

Many resources are available to help you choose among the possible formats and guide you through the process of writing a model.[4]

A simple logic model can look like this:[5]



More elaborate models may distinguish between intermediate and final outcomes, or add in additional categories, such as assumptions and market actors.[6] The logic model ensures that the program's staff agrees on what the program will accomplish and how it will accomplish it. It is especially important to develop a program theory and/or logic model when developing "complex programs with long-term goals such as information and educational programs, and programs that are trying to change how a market operates." In these cases, "the program activities and the desired long-term or ultimate outcomes of the program may be many steps removed from one another."[7]

One value of writing a logic model is that the exercise can reveal whether or not there really is a logical, plausible, clearly defined route from the program's activities to its final goals. Even if a

---

[3] TecMarket Works, *The California Evaluation Framework: Prepared for the California Public Utilities Commission and the Project Advisory Group* (Oregon, Wisc.: TecMarket Works, revised edition 2006), p. 31. Available at www.tecmarket.net/documents/California%20Evaluation%20Framework%20Jan%202006.pdf.
[4] In addition to *The California Evaluation Framework*, see, for example, the University of Wisconsin—Extension's online course and the W.K. Kellogg Foundation. *Logic Model Development Guide* described in Appendix E (Reference Works).
[5] Ellen Taylor-Powell et al., *Enhancing Program Performance with Logic Models: An Online Course* (Madison: University of Wisconsin—Extension, 2002), p. 5 in section 1. Available at www.uwex.edu/ces/lmcourse/#.
[6] The appendix includes an excerpt from *The California Evaluation Framework* on "Developing a Program Theory," as well as a sample program logic model from NYSERDA's Clean Energy Infrastructure Program.
[7] TecMarket Works, *California Evaluation Framework*, p. 36

program has been in existence for some time, it can be useful to go back and construct a logic model that reflects how the program is actually operating. In such cases, a model can be developed relatively quickly by program staff, especially for less complex programs.

Once developed, the program theory or logic model can help both program staff and evaluators determine which issues and activities to evaluate. Evaluators can use the model to identify research-able evaluation questions. The completed evaluation may uncover ways in which the logic model is incomplete or inaccurate, and provide recommendations for how the logic model needs to be modified. The evaluators should also distinguish "between theory failure (incomplete or inaccurate theory), and program failure (poorly designed or implemented operational procedures)."[8]

As the *EERE Guide for Managing General Program Evaluation Studies* points out, "A logic model should not be static. As the program matures, its logic model should be revisited at least annually to check the assumptions embedded in its theory and to update it for lessons learned and changes in its external environment."[9]

2.3 Create and Implement a Monitoring Plan for Each Program

Monitoring, which is the collection of relevant measurement data, is an essential building block of meaningful evaluation. Whenever a new program is added, a plan should be developed and put into place to collect data related to the program. Ideally, the data collection plan should flow from the program logic model. At the time a program's logic model is written, there should be discussion of the data that will be needed to measure whether the program is achieving its planned outputs, outcomes, and inputs. While some of that data can be collected at the time of evaluation, some of it must be gathered along the way or it will be lost or costly to recreate.

The monitoring plan should include information that directly reflects the agency's activity (e.g., number of applications received, number of grants awarded, size of grants, geographic distribution), as well as information that needs to be collected from grant recipients and others (e.g., cost of the system purchased, installation company). When putting together the monitoring plan, it will often make sense to find out what states with similar programs collect and how. To the extent that states collect similar data in the same formats, it will be easier to make comparisons among states.[10] It is also often good to consult with an experienced program evaluator who can advise you on which information is most likely to be useful for future evaluations and how to track that information in formats that will be easy to analyze.

The collected data can end up being useful for more than its original evaluation purposes. To take a simple example, information on solar rebate recipients that is collected to document whether the program is meeting its goals in terms of number and size of solar installations can be re-analyzed to find out whether some parts of the state are participating disproportionately in the program. You should periodically look afresh at the data that has been collected by your agency to determine whether it makes sense to use any of it in new ways. Because you already possess the data, it can be relatively easy and inexpensive to generate new evaluation findings.

---

[8]. *Ibid*., p. 33

[9] Barnes et al., *EERE Guide*, p. 25.

[10] For installation programs, the categories of data used by the CESA National Clean Energy Database can be a good starting point. See www.cleanenergystates.org/projects/cesa-national-clean-energy-database.

2.4 How to Choose Which Evaluations to Do

When deciding which evaluations to undertake, you should consider three factors:

- How important and useful it will be to have the results of a particular evaluation.
- How much it will cost (in both money and staff time) to carry out the evaluation.
- How confident you can be that the findings of the evaluation will be accurate.

Unfortunately, it will frequently be the case that the evaluations you conclude are the most useful will also be relatively expensive or may have considerable uncertainty associated with the results. Therefore, except when you are in a situation where particular types of evaluation are mandated by your agency's board, regulators, or authorizing authority, it may make sense to develop an overall annual evaluation plan that considers the agency's overall budget for evaluation. For example, you may have to choose between three easy, inexpensive but modest-value evaluations and one more difficult, more expensive but potentially more valuable evaluation.

After considering the three factors above and your available budget, you may conclude that it does not most sense to carry out the same evaluations that are most popular in other states or that first come to mind or are recommended by evaluation contractors. You may instead end up selecting a novel mix of evaluation projects.

2.5 Have Clear Evaluation Goals

Just as a program should have carefully developed and well-defined goals, an evaluation should have clear goals. You will get more out of the evaluation if you know in detail what you hope to achieve and you will increase the likelihood that the evaluator will design a research process that exactly meets your needs.

As an example, it is not enough to decide that you want to do a process evaluation of the effectiveness of a solar rebate program. There could be a variety of reasons why you want to know how effective the program is and where its strengths and weaknesses reside, such as desiring to:

- Identify modest process improvements that can be easily implemented in the near term.
- Prepare for a major program redesign that has been mandated by your board.
- Know how satisfied program participants (PV system purchasers) are with the program.
- Know how satisfied solar companies are with the program.
- Increase participants' satisfaction, even if that increases the program's cost.
- Identify process efficiencies that would save money or reduce staff stress, whether or not they increase participants' satisfaction.
- Understand the extent to which interconnection delays or installation quality issues, over which you have limited control, cause participants to have a negative view of your agency.
- Find out how your program compares to solar rebate programs in other states, and whether there are procedures and processes being used elsewhere that you should adopt.
- Learn whether there are significant differences in how the program has worked in different parts of the state or with different groups of electricity customers.

Some evaluators may say that it is not desirable to get too specific at the beginning. They may instead want to approach the assignment without preconceived notions and let the research data be the sole determinant of the report's findings and recommendations. But it is generally best to point the evaluation towards your specific evaluation goals and needs. For example, it does not make sense for the evaluator to provide detailed recommendations for how the program could be totally revamped if funding will be ending soon and only small, incremental changes are possible.

2.6 How to Select Evaluators and Get the Most from Them

In some ways, selecting an evaluator is similar to selecting any other contractor. You need to prepare a scope of services, solicit proposals, review proposals and qualifications, and discuss the assignment with final candidates before making a decision. However, there are several special considerations when choosing an evaluator.

2.6.1 Outside Contractors versus Internal Staff

Early on, you need to decide whether to recruit a specialized, outside evaluation firm for the assignment or rely on staff members to carry out the evaluation. For many evaluation projects, it is necessary to use an external evaluation expert because no staff member has the necessary expertise or is perceived to be sufficiently impartial and objective. The more the assignment requires specialized skills in sophisticated evaluation methodologies and the more public the results will be, the more important it is to use an external evaluator.

Nevertheless, there are situations in which it makes sense to use a staff member for an evaluation project. Not only is this likely to be a less expensive option but it can save time and effort to avoid procuring a contractor and educating an outsider on the mission and activities of your agency. You might consider using internal staff for evaluation if the particular evaluation task is narrowly focused and designed for internal use rather than public dissemination. Examples include:

- a short, several-question survey in which respondents' responses are not likely to be affected by knowing that the survey is being conducted by a staff member;
- an informal market assessment focus group of clean energy business representatives, in which your agency's performance is not the subject of the focus group.

Another good use of internal staff is for analyzing data collected through the program's monitoring plan (see above) using a research methodology that is clear-cut and based on precedents either within the agency or elsewhere. An example is an analysis of the size, geographic distribution, and installation cost over time of solar projects supported by the agency.

Of course, if you are going to use a staff member for evaluation, that individual needs to possess good general research skills and have experience with the specific evaluation methods required by the project. Moreover, the person should not be directly involved in the program's implementation and should have the ability to bring a fresh, objective perspective to the task.

2.6.2 Choosing a Contractor

Before selecting an outside party to conduct an evaluation, you should think broadly about the nature of the specific evaluation assignment, including the complexity of the research task, the content knowledge the evaluator will need, and the audience for the final product. Decide up front which

of the following is most important for the evaluator to possess: significant experience with specific complex research methods; knowledge of the clean energy industry or particular clean energy technologies; or understanding of your state's political and economic context. For example, with an evaluation requiring use of a general equilibrium model of the state's economy, it may make sense to select the evaluator with the most proven success using that model rather than the evaluator who has done the most work on clean energy. In another situation, the clean energy experience might be more significant.

You should also consider how the particular evaluation project fits into your long-term evaluation plans. Are you likely to do other, similar evaluations in the future? Will you want to establish an ongoing relationship with the contractor, under the assumption that future projects will be easier and more cost-effective if you work with an evaluator who already knows your agency and its programs? Your selection of a contractor might be different depending upon whether you consider the project a one-shot deal or the first of recurring assignments.

When interviewing firms that respond to your RFP, it is useful to explore their approach to evaluation and their perspective. Although evaluators seek to be objective and fair, their conclusions can be shaped by their views on evaluation, energy, the economy, and the role of government. For example, you may want to ask:

- Which research methods will they use and why? What do they think are the strengths and weaknesses of those methods? Using those methods, how precise will the findings of the evaluation be? What degree of uncertainty will there be in the results?
- Leaving aside what you have asked for in your RFP, is there a different approach to the evaluation task that they think would be better? You may discover something that causes you to change course or find out that one of your RFP respondents is not completely comfortable with what you are asking them to do.
- Do the evaluators accept your program goals as valid and appropriate for an agency like yours? You may discover that one of your respondents would come to the assignment with philosophical concerns about certain programs or activities, including those that have been mandated by legislation or established by your board.

You should also make sure that you understand (and accept) what the evaluator will expect from you and your staff during the evaluation process. Many program managers have been caught off guard because these expectations were not spelled out. An evaluator then later asked program staff to provide much more information or participate in many more meetings than the program manager anticipated.

2.6.3 Starting with a Shared Understanding

Although the process of interviewing respondents to your RFP can help ensure that you and your evaluator start off with a shared general understanding of the assignment and your respective roles, more extensive discussions should be held once the contractor is selected. You can thereby make sure that the evaluator is aware of all the different in-house and external audiences that may read the final report. You can help the evaluator understand the knowledge levels and needs of those audiences. For example, an external evaluator is not likely to know ahead of time the extent

to which your board members or those on your authorizing body are familiar with the details of your programs or the workings of the renewable energy marketplace.

Although the general parameters of the evaluation are likely to be clear from the RFP that was used to select the contractor, there will still be considerable leeway about which specific questions should be asked and answered, as well as how important the different questions will be. You should therefore discuss with the evaluator the list of questions. Although it may be necessary to defer to the evaluator's professional judgment, it is also important for the evaluator to understand the agency's point of view. As a starting point for thinking about possible questions, you may want to refer to list of specific evaluation questions developed by DOE's Office of Energy Efficiency and Renewable Energy. They are reproduced in Appendix C below.

3. Recommendations for the Five Types of Evaluation

Although each state or agency needs to reach its own conclusions about which evaluations to carry out, the research and discussions that underlie this report lead to some general thoughts on the five different types of evaluation.

3.1 Needs and Market Assessment Studies

- **They can lead to better programs.**
- **They can create baselines for future evaluations of program outcomes and impacts.**
- **Renewable energy agencies should do them more frequently.**

It is obviously easier for an agency to design a successful program when it has an in-depth understanding of the audience it is trying to reach and the market it is trying to influence. Needs and market assessment studies can be especially useful to programs that seek to build sustainable, ongoing markets for renewable energy technologies. As program evaluators Mitchell Rosenberg of KEMA and Lynn Hoefgen of NMR Group point out, "Programs designed to change the behavior of market actors are most likely to succeed when their approach reflects market realities. Market characterization studies that address issues of market size, customer segmentation, supply chain structure and operations, incremental costs, patterns of customer behavior, and current levels of product assessment provide the data required to develop effective program plans."[11]

Renewable energy agencies will usually need to hire outside market assessment specialists and industry experts to produce market assessment studies, but these reports can be less expensive than some other types of evaluation, especially when the target technology and market are well-defined. Moreover, even if it turns out that there is considerable uncertainty in some of the market assessment's conclusions (e.g., the size of the potential market, the most likely motivators of customer action), the study is still likely to turn up useful information and identify issues that deserve attention in program design. Market assessment studies can also help provide a baseline for later measuring progress and program accomplishments.

3.2 Process Evaluations

- **They come in many shapes and sizes.**
- **Renewable energy agencies should do them more frequently--especially small, focused evaluation reports.**
- **Customer satisfaction surveys are especially important.**

Good program managers are always striving to improve their programs, and process evaluations can help them do that. Not only can a process evaluation assess the program's design, operations, and

[11] Mitchell Rosenberg and Lynn Hoefgen, *Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation* (Oakland: California Institute for Energy and Environment, 2009), p. 6. Available at http://uc-ciee.org/downloads/mrkt_effts_wp.pdf.

processes, but it can identify ways to improve a program's management, increase its efficiency and cost-effectiveness, strengthen its marketing, sharpen its audience targeting, and increase the satisfaction of its customers and stakeholders. Even with a program that seems to be highly successful, there is always room for improvement.

The key starting point for a successful process evaluation is a commitment on the part of program managers and staff to use the results of the evaluation to improve the program. A process evaluation can be strictly for internal staff use or it may be requested by a program's governing authority or be designed to share with wider audiences. It can start with a specific issue, such as a desire to understand the reasons for low participation rates or a desire to reduce administrative costs. But a process evaluation can also start from a more general interest in understanding and improving a program. A process evaluation can be structured to focus on just one topic or can be a comprehensive assessment of the entire program.

A process evaluation can be conducted at any time, but it is obviously best to do it early enough in a program's lifecycle that there is still time to implement the report's recommendations and make changes to the program. A program can have multiple process evaluations over time.

Because process evaluations come in so many sizes and shapes, the budget for a study by an outside evaluator can vary significantly—from perhaps $15,000 to $100,000—but this type of evaluation tends to be less expensive than the other four types. And because process evaluations should lead to near-term program improvements, it is well worth doing them frequently. An evaluation focused on one or two specific questions can be especially desirable, because it is easy to implement and can yield quick results.

It is even possible to use internal staff for a process evaluation that is narrowly focused and designed for internal use. But it is important to consider the specific research skills needed—surveys, interviews, focus groups, public opinion sampling techniques—and make sure that the evaluator, whether internal or external, has them.

For a comprehensive process evaluation, it is best to use an external independent evaluator. Such an evaluation may start by documenting current program practices as a baseline. According to the *California Evaluation Framework*, the types of research activities that can be used in a comprehensive process evaluation include:

a. *Reviews and tests of records, materials, tools, etc.,*
b. *Interviews and discussions with program management and staff, implementing contractors, subcontractors, and field staff,*
c. *Interviews and discussions with policy makers, key stakeholders, and market actors,*
d. *Interviews, discussions, surveys and/or focus groups with participants and non-participants,*
e. *Collection and analysis of relevant data available from third-party sources (e.g. equipment vendors),*
f. *Field observations, measurements, and examinations,*
g. *Other activities as needed to address researchable issues.*[12]

[12] TecMarket Works, *California Evaluation Framework*, p. 216.

Renewable energy agencies should think of themselves as service providers with "customers." A process evaluation can determine whether those customers are happy with a particular program and with the agency. As evaluator Eric Oldsman of Nexus Associates points out, "All organizations need to be concerned with the extent to which they are able to satisfy their customers. The degree of satisfaction has a direct bearing on client loyalty, repeat business and the acquisition of new customers."[13] Of course, this should by no means be the only measure of whether a program is successful, but it is one important indicator. It is especially important to consider at a time when all government operations are facing close scrutiny from the public and political leaders.

A customer satisfaction survey can be the centerpiece of a focused process evaluation or it can be a component of a more comprehensive study.[14] Such a survey is different from an interview with customers to solicit their ideas for program improvement, although the two tasks can overlap or be combined.

3.3 Outcome Evaluations

- **It is important to know whether a program is achieving its goals.**
- **Depending upon the program and its intended outcomes, an outcome evaluation can be relatively straight-forward or very complicated.**
- **Consider up front whether the dissemination of research findings can help key stakeholders and will move a program toward its goals.**

Any renewable energy program that an agency defines as major should have a plan for measuring its outcomes. After all, if a program is aiming to achieve something meaningful, it is relevant to know whether that milestone has been reached. Outcome evaluation should first be considered when the program is being established. Are the goals and projected outcomes clear and specific enough that there will be a way to assess—either quantitatively or qualitatively—whether they have been achieved?

Some outcomes can be measured easily—simply by analyzing data that has already been collected through a program's monitoring activities (see section III above). But other outcomes are hard to measure. For example, in the case of NYSERDA's Clean Energy Infrastructure Program, whose program logic model is included in Appendix B, there are both easy-to-measure outcomes (e.g., increase in trained/certified installers) and much more difficult ones (e.g., end-users more accepting of clean energy technology).

Although each program has its own wrinkles, we can divide programs into five groups for the purpose of discussing how to do outcome evaluations of them.

---

[13] Nexus Associates, Inc., *Evaluation of Selected Initiatives Pursued under the Green Building and Infrastructure Program* (Belmont, Mass.: Nexus Associates, Inc., 2004), p. 23.

[14] The Energy Trust of Oregon has developed a systematic way to get timely feedback from the homeowners, businesses, and organizations that receive its grants. This approach could be adapted to other states. See Jane S. Peters and Ryan E. Bliss, *Final Report: Fast Feedback Program Rollout: Nonresidential and Residential Program Portfolio* (Portland: Research Into Action, 2010). Available at http://energytrust.org/library/reports/101231_Fast_Feedback_Rollout.pdf.

3.3.1 Installation Programs

Programs that seek primarily to induce the installation of renewable energy technologies represent the largest renewable energy program category. Depending upon the program's goals, there can be up to four different types of outcomes, which are described in a recent report from the US Environmental Protection Agency on *Assessing the Multiple Benefits of Clean Energy: A Resource for States*:[15]

- Energy outcomes
- Environmental outcomes
- Electric system outcomes
- Economic outcomes

3.3.1.1 Energy Outcomes.

An outcome evaluation of an installation program usually starts with assessing the energy outcomes.

Although program managers often set goals and outcomes for their renewable energy programs in terms of the rated capacity of the systems (e.g., 25 megawatts of installed solar), it makes sense to establish targets for the actual energy that will be produced. After all, energy production is the reason why the systems are being installed so a program should know what it is hoping to achieve in terms of megawatt hours per year.[16] The evaluation can then determine whether the installations are actually achieving that.

If the program is new and there is little experience with the particular technology in the state, it may be difficult for program managers to establish precise production targets. But even approximate targets based on publicly available estimates of capacity factors can serve as a useful starting point. The evaluation can then test the validity of those estimated targets.

For an evaluation to get from rated capacity to energy produced requires actual measurement of system performance for at least a sample of the systems in your service area. The resulting data not only helps program managers know whether they are achieving what they hope, but it can also inform consumers' decisions about whether to install renewable energy. In some cases, such as with small wind systems in some parts of the country, energy production has turned out to be much less than projected.

The task of monitoring production varies greatly with technology and system size. With large utility-scale generators, owners already keep detailed production data. For photovoltaic systems, the National Renewable Energy Laboratory's PVWatts calculator[17] can be used to estimate production from systems in your area, although some sampling of actual production should be used to test the accuracy of the estimates. Wisconsin's Focus on Energy program has found Natural

[15] US Environmental Protection Agency, *Assessing the Multiple Benefits of Clean Energy: A Resource for States* (Washington: US EPA, 2010). Available at http://www.epa.gov/statelocalclimate/resources/benefits.html . This report talks about four different types of benefits from installing clean energy, but outcomes can be placed into those same four categories.

[16] In the case of Wisconsin Focus On Energy, they go even further by setting targets not just for total megawatt hours but also for peak megawatt hours, which are defined as 1 PM to 4 PM from July to September.

[17] See www.nrel.gov/rredc/pvwatts/.

Resources Canada's RETScreen[18] to be a useful tool for estimating production from solar water heating installations. Other small systems, such as biogas and small wind, can vary greatly depending upon the site, manufacturer, installer, and operator, so estimates are difficult and sampling techniques are tricky.[19]

Basic data on installations, costs, and energy production can be revealing and valuable when analyzed for trends and key findings. California collects and disseminates hundreds of pages of data evaluating the outcomes of the California Solar Initiative, including information by when the systems were installed, type of system, customer categories, region, production by time of day and season, and many other variables.[20] This rich vein of information helps the California Public Utilities Commission and California Energy Commission plan for the future, and it influences the business strategies of the solar industry and electric utilities. Because other states do not have as many installed systems as California, they may not have a large enough sample to produce the range of findings that California does. Yet even with smaller numbers of systems and other technologies, much can be learned by evaluating installation data and energy outcomes.

3.3.1.2 Environmental Outcomes.

Given that environmental improvement is usually a major reason for installing renewable energy technologies, it often makes sense to quantify the emissions reductions associated with replacing conventional generation with renewable energy.

The starting point for doing that is the energy production data gathered when evaluating the program's energy outcomes (see above). The next step is to determine the air pollution and greenhouse gas emissions associated with that quantity of conventional generation, as well as the emissions from any of the installed renewable energy technologies, such as biomass and geothermal. There are a variety of approaches for doing that, some more precise and sophisticated than others. At the simplest level, one can take the state's overall generation mix and assume that the renewable energy generation displaced the various existing sources of electricity production proportionately. That can yield results quite easily and can be sufficient for a modest evaluation report that will not be disseminated outside the agency. But it does not account for the differences between baseload and peak power, or that generating units that operate at the margin are the ones most

[18] See www.retscreen.net/ang/home.php.

[19] As part of the evaluation of Focus on Energy's programs, a report described methods for calculating the performance of various small-scale renewable technologies. This document can be useful to other states. See Bobbi Tannenbaum et al., *Focus on Energy Evaluation: Standard Calculation Recommendations for Renewable Energy Systems* (Madison, Tetra Tech, Inc., rev. ed. 2010); available at www.focusonenergy.com/files/Document_Management_System/Evaluation/standardcalculationrecommendationsCY10_evaluationreport.pdf. For those who want to understand more about the advantages and reliability of different methods for calculating the performance of distributed generation technologies, see a conference paper by Tannenbaum's colleagues at KEMA: Brian Dunn et al., "Evaluating the Impacts of Customer-Sited Renewable Energy Systems: Methods and Challenges," paper presented at the 2009 International Energy Program Evaluation Conference; available at www.iepec.org/2009PapersTOC/papers/024.pdf#page=1.

[20] Itron, Inc. and KEMA, Inc., *CPUC California Solar Initiative 2009 Impact Evaluation: Final Report* (Itron, Inc.: Davis, Cal.: 2010). Available at: www.cpuc.ca.gov/NR/rdonlyres/70B3F447-ADF5-48D3-8DF0-5DCE0E9DD09E/0/2009_CSI_Impact_Report.pdf. An interesting collection of graphs is presented in a PowerPoint slide collection by Glenn Harris, *The CPUC's CSI in Pictures: An Update through March 2010.* It is available at www.suncentricinc.com/downloads/SunCentric_CSI_Study_May_2010.pdf.

likely to be displaced by renewable energy. So it is better to use a methodology that tries to identify and recognize which types of generators have been displaced.

Once an evaluation has decided to identify the types of generators that have been displaced, there is another fork in the road, since either basic or more sophisticated approaches can be used for that task. In most cases, the basic, less expensive approaches should provide sufficient precision and detail for gaining a general understanding of the emissions reductions from renewable energy installations. For example, by using a basic approach for several of your programs, you will get a useful rough sense of how the programs compare in terms of their emissions impacts. You should therefore only embark on a more complex and costly modeling study when there is a specific reason for doing so—perhaps a regulatory or rule-making requirement.

The various methodologies for quantifying environmental outcomes are described in a helpful, thorough, but sometimes hard-to-follow, chapter in EPA's report on *Assessing the Multiple Benefits of Clean Energy: A Resource for States*.[21] The chapter describes the advantages and limitations of each approach, as well as many specific methods for implementing those approaches. In addition, it identifies and describes many relevant tools, databases, resources, and emissions inventories.

The EPA report also discusses how to go beyond quantifying emissions reductions to pin down the air quality and health improvements that come from those emissions reductions. Although that will rarely be the most important evaluation study for a clean energy agency to undertake, the EPA report provides useful guidance on how to do it.

An extra complication of environmental outcomes evaluations is that it is much easier to quantify the smokestack emissions from power plants, than the indirect emissions caused by building a generating facility or obtaining and transporting fuel. Evaluation studies often ignore those indirect emissions even though they are relevant to a complete environmental accounting of the impact of renewable energy installations. Agencies can leave themselves vulnerable to criticism by ignoring the emissions connected to such things as producing the steel in wind turbines. But the solution to this problem will rarely be to conduct a precise assessment of all the indirect emissions associated with particular facilities, since that would usually be quite costly and complicated. At a minimum, an environmental outcomes evaluation should acknowledge this issue and note that the study looked only at direct onsite emissions. It might also be good to look for and consider referring to any previous studies that have attempted to quantify the indirect emissions from the use of various electricity generating technologies in the state or region.

3.3.1.3 Electric System Outcomes.

Renewable energy installations can benefit the electricity system in ways that are often not recognized or quantified, and that can lower the overall cost of electricity. For one thing, adding renewable energy capacity can reduce the use of high-priced generators at the margin. For another thing, distributed renewable energy systems can reduce several types of costs associated with the local transmission and distribution of electricity.[22]

---

[21] "Assessing the Air Pollution, Greenhouse Gas, Air Quality, and Health Benefits of Clean Energy Initiatives," chapter 4 in US EPA, *Assessing the Multiple Benefits of Clean Energy*, pp. 93-132.

[22] US EPA, *Assessing the Multiple Benefits of Clean Energy* includes a good overview of the various benefits to the electricity system and how to quantify them, but keep in mind that certain of the benefits relate more to energy

It can be difficult and costly to quantify these benefits with precision and may not be desirable to try to do so unless you are undertaking a full cost-benefit evaluation of a program (see section on cost-benefit evaluations below). However, it is worth identifying which types of electric system benefits are likely to accrue from a particular renewable energy program and make sure that your evaluators and key audiences are aware of those benefits. You can also gather information about previous studies that have attempted to quantify those types of benefits. In that way, you can have a rough sense of the likely order of magnitude of each benefit, while keeping in mind those differences in location and timing can make a big difference.

Although it will generally not be an evaluation priority to commission a study solely to quantify electricity system benefits, there are two circumstances in which it may make sense to do so:

1. When there are good reasons to believe that there are unusual and especially noteworthy electricity system benefits associated with a program. For example, a forward capacity market in New England creates some special economic benefits to installing renewable energy generation in Connecticut.

2. When an agency believes it would be useful to undertake a generic analysis of one or more electricity system benefits in their market. An example of such a study is the report that Synapse Energy Economics undertook for the Commonwealth of Massachusetts on *Impacts of Distributed Generation on Wholesale Electric Prices and Air Emissions in Massachusetts.*[23] Additional generic studies by other states would allow comparisons between markets and make it possible to provide quick estimates of the electricity system benefits of renewable energy programs.

Of course, if clean energy agencies emphasize the unacknowledged electricity system benefits of renewable energy, they should not ignore unacknowledged electricity system costs of renewable energy. For example, large-scale wind development can require additional spinning reserve or the construction of additional transmission lines.

3.3.1.4 Economic Outcomes.

To understand a renewable energy installation program's overall economic outcomes is the same as looking at all its direct and indirect costs and benefits. That topic is discussed below in the section on Cost-Benefit Evaluations.

3.3.2 Market Transformation Programs

Some renewable energy programs aim not only to increase the number of near-term installations but to transform the market for a particular renewable energy product, such as photovoltaic modules or highly efficient wood stoves. The goal is to create a market that will ultimately sustain itself without continued support from the program. Such market transformation programs need to

---

efficiency than renewable energy. See chapter 4, "Assessing the Electric System Benefits of Clean Energy," pp. 51-92.

[23] Michael W. Drunsic et al., *Impacts of Distributed Generation on Wholesale Electric Prices and Air Emissions in Massachusetts* (Cambridge: Synapse Energy Economics, 2008). Available at www.synapse-energy.com/Downloads/SynapseReport.2008-03.MTC.Price-and-Emissions-Impacts-of-DG-in-MA.07-080.pdf.

be evaluated differently than installation programs, although the number of installations can be an important indicator of whether the market is on track to being permanently changed.

It is essential for a market transformation program to have a clearly articulated theory of how the market needs to be changed and how the program will contribute to that change. A detailed program logic model is therefore likely to be essential. The specific changes identified in that model can then be used as the key indicators to evaluate.

For example, an evaluation of a solar market transformation program might look to measure whether there has been increased public awareness of the technology, more installations, more certified vendors and installers, increased module availability, reduced prices, improved reliability of the products installed, and more consumer protection measures in place.

To develop such a list of indicators, some market transformation programs identify the barriers to a sustained market for the product. They then target those barriers through the program and evaluate which of the barriers have been reduced over time.

However, markets are not always transformed simply by knocking down some of the specific barriers to greater market penetration. The program therefore needs to have an understanding of how the market works and what is truly necessary to change it permanently. To develop this can require market assessment studies and/or an understanding of some of the general theories of market transformation, such as the diffusion of innovation model. But, in the end, the key point related to evaluation is that an outcomes evaluation of a market transformation program should be based on an assessment of progress towards clearly defined indicators.[24]

3.3.3. Business Development Programs

States have implemented a range of programs to strengthen clean energy businesses and build clean energy business clusters. The outcomes of such programs can be evaluated in a variety of ways, depending upon the purpose and nature of the particular program.

3.3.3.1 Direct Jobs and Other Direct Measurements.

The simplest, and often most relevant, way to evaluate the outcomes of a business development program is to compare the amount of money invested to the number of jobs directly created at the companies that received that investment. This is an appropriate way of judging the success of a business development program given that an increase in the number of jobs is generally one of its primary goals. There are well-established methodologies for how economic development agencies count direct jobs and job years.

Of course, the number of near-term direct jobs may not be a sufficient way to judge whether a program is on track. For example, an agency may choose to invest in small, start-up companies, knowing that it will be many years before those companies are large enough to employ significant

[24] A useful report for program managers working on market transformation programs is Rosenberg and Hoefgen, *Market Effects and Market Transformation*. Although there are differences between energy efficiency and renewables programs, some of the report's advice can be applied to designing and evaluation renewable energy market transformation programs. And there is background information on topics such as models of market transformation.

numbers of people. But in that case, well-chosen program goals and a detailed program logic model can make those expectations clear well before the program is evaluated.

Other direct measurements of the success of a business development program can include how much additional investment the state agency's funding leverages at the time of an investment in a company, the amount of additional non-state funding the company receives in the months and years after the state agency invests, and the agency's rate of return on its investment. Case studies of investments in individual companies can also be useful.

3.3.3.2 Cluster Maps and Industry Censuses.

When the development of a particular business cluster (e.g., a local wind energy industry cluster) is a goal of a program, it is worthwhile to map and assess the growth of that cluster over time. The evaluation can identify which companies are in the cluster, what their financial resources and sales are, how many people they employ, and how the different companies relate to each other. Beyond any evaluation purposes, this information can be valuable to program managers as they carry out the program and can also be useful to the companies in the cluster.

More broadly, a state can produce a comprehensive census of its entire clean energy industry, as Massachusetts did in its 2007 *Massachusetts Clean Energy Industry Census.*[25] Information collected through the census can be useful for determining whether specific business development programs are contributing to the type of economic growth envisioned. But a census will not tell how much of that growth was a direct result of the program, since general economic trends and private sector developments likely play the biggest roles.

If completed before a program begins, an industry census can also be an important part of a market assessment study. Changes can then be charted over time. Whenever it is done, a clean energy industry census is likely to be of great interest to policymakers and the media.

3.3.3.3 Broader Outcomes of Business Development Programs.

Beyond the direct jobs and other direct outcomes at companies that receive state funding, the state's investments have broader impacts on the economy as the money invested and goods produced ripple through the economy. For example, Connecticut Innovations has concluded that, for every dollar it invested in companies in clean energy and other sectors, the state realized $1.97 in net state revenue, the gross domestic product increased by $23.80, and personal income increased by $14.30.[26] But to produce such findings requires using the types of models and tools discussed below in the section on Cost-Benefit Evaluations.

3.3.4 Research, R&D, and Demonstration Programs

[25] Global Insight Inc., *Massachusetts Clean Energy Industry Census* (Westborough: Massachusetts Technology Collaborative, 2007). Available at www.cleanenergycouncil.org/files/Clean-Energy-Census-Report-2007.pdf.
[26] Peter V. Longo, "Connecticut Innovations: A Presentation to Clean Energy States Alliance," April 23, 2010. Available at www.cleanenergystates.org/Presentations/CESA_Presentations/4.23.10/Peter_Longo_CESA_Presentation%282%29.pdf.

State energy funds carry out a wide range of different types of research, R&D, and technology demonstration programs. Evaluation methods can vary widely depending upon the program. For a report for DOE's Office of Energy Efficiency and Renewable Energy, Rosalie Ruegg and Gretchen Jordan examined the methods that various federal agencies use to evaluate research and they found 14 different approaches that could be applied to energy research programs.[27]

For successful evaluation of the outcomes of research, R&D, and demonstration programs—and indeed for successful design of such programs—it is important to have a clear understanding of what the specific outcomes of the program are supposed to be. Those outcomes should be more specific than just saying, for example, that the program seeks to advance research on new solar technologies or to fund demonstrations of cutting-edge marine technologies. The key questions are: why are such things receiving public support and what will be the specific results if the activities are successful?

In the case of demonstration projects, the desired outcomes can range from generating certified performance data, opening up early markets for a technology by making a product visible while it is still in its prototype stage, convincing reluctant partners that a technology is viable, encouraging private sector investment, and providing revenue for early-stage companies to help them pass through the so-called valley of death.[28] R&D programs can have a comparable array of possible outcomes.

This is therefore an area in which a carefully crafted program logic model can be especially helpful. NYSERDA has a wide-ranging research and development program and other states may consider excerpting and modifying elements of its program theory and logic model for their own R&D programs, which are likely to be more narrowly focused.[29]

Here are a few evaluation methods that can be used depending upon the nature of the program and its goals:

- *Peer review and expert judging* have long been mainstays in the research world. When applied in a rigorous manner they can illuminate the quality of research and its relevance.
- *Counting and analyzing citations and other references to a publication* can reveal the dissemination of information and ideas. It is useful to understand how the research funded by your agency ripples through society.
- *Network analysis* can show the relationships among researchers.
- *Surveys* and *case studies* can also be appropriate.

---

[27] Rosalie Ruegg and Gretchen Jordan, *Overview of Evaluation Methods for R&D Programs* (Washington: US Department of Energy Office of Energy Efficiency and Renewable Energy, 2007). Available at www1.eere.energy.gov/ba/pba/pdfs/evaluation_methods_r_and_d.pdf.

[28] The varied roles and potential impacts of demonstration projects are discussed in Chris Hendry et al., *The Uncertain Middle: Innovation Lessons for Low Carbon Energy Technology from Demonstration Projects and Trials* (London: Advanced Institute of Management Research, 2010). Available at http://www.aimresearch.org/index.php?page=the-uncertain-middle-the-role-of-demonstration-projects-and-trials-in-influencing-success.

[29] GDS Associates, *Sector Level Program Logic: SBC Funded Research and Development (R&D) Program* (Albany: NYSERDA, 2007). Available at http://www.nyserda.org/energy_information/ContractorReports/GDS%20Associates/2007%20Reports/Final%20PLM%20R%20and%20D%20Sector.pdf.

Some of the fruits of R&D projects may not become apparent for many years after your agency supports them. It can therefore be useful to go back to long-finished projects to see how things developed over time, so that your agency can capture and take credit for all of its accomplishments. For example, have any of the technologies to which you provided early-stage support been later commercialized in your state, and how big is their current market?

In addition, although it is important to focus most of the evaluation on a program's specified outcomes, research, R&D, and demonstration projects can also have unexpected spillover effects. Evaluators should be encouraged to look for and document those results.

3.3.5 Education and Information Programs

Programs that focus on public education, the dissemination of information, or training can be difficult to evaluate because they may not produce easily quantifiable results. It is especially important that such programs have clearly defined objectives, audiences, information delivery mechanisms, expected effects, and time frames. A diffuse, amorphous education effort will not only be hard to evaluate, but it will be unlikely to have a significant impact. Program managers should make sure that a good program theory is developed for such programs and should strive to identify measureable milestones and indicators wherever possible.[30]

Here are a few thoughts about evaluating education, information, and training programs:

1. Suitable evaluation methods can include surveys, interviews, and focus groups.

2. An initial market assessment study can provide a baseline for measuring the changes produced by the program.

3. Because it can be difficult to measure the quantifiable outcomes of an education or information program, process evaluations can be especially valuable. In that way, you can at least know whether you are implementing the program efficiently and whether your target audience is satisfied with the program.

4. To address the difficulty of measuring the results of these programs, clean energy agencies are well served by sharing information and discussing best practices in these programs. In the program development stage as well as in program evaluation, best practices can be identified and you can ask evaluators to explain why they perceive them to be best practices. Dissemination to other agencies of any conclusions about best practices is highly desirable.

5. Rather than attempt a comprehensive program evaluation of an education or information program, it sometimes makes sense to focus on a specific question that can be measured by evaluators. For example, an agency could ask whether its brochures and website improve end-users' understanding of the advantages and disadvantages of installing a solar hot water system.

[30] Developing a program theory for an education or information program is discussed in TecMarket Works, *California Evaluation* Framework, pp. 235-6. That discussion is part of a chapter on evaluation information and programs that includes relevant information, even though some of it addresses the unique content needs and bureaucratic requirements of utility-administered energy efficiency programs.

6. Sometimes the difficulty and potential cost of trying to evaluate the outcomes of an education or information program reflect a deeper problem with program design. This can especially be the case with small advertising and information efforts without a specific target audience, but which instead claim to be trying to reach "the general public." As the *California Evaluation Framework* notes, "an evaluator may need to contact hundreds of potential readers or listeners to find a few who were exposed to the message and who remember it…" That document warns policymakers and program managers that "if the cost to identify and contact an individual exposed to the program's message is prohibitive," it may mean that the program is having little impact on the audience as a whole.[31] On the other hand, it can be possible for an informational campaign to increase some people's awareness of your agency even though they cannot remember being exposed to a particular message.

3.3.6 Another Approach: Comparisons between States

When program managers and their boards look to measure a program's cost-effectiveness, they often gravitate to commissioning a full-scale cost-benefit evaluation. An easier, less costly way to measure a program's cost-effectiveness is to compare its outcomes with those achieved by similar programs in other states or jurisdictions. It is useful for program managers and others to know whether they are able to achieve more—or less—with a given amount of money than other clean energy programs are able to do. If similar programs in other states have already been evaluated, it can be relatively inexpensive to make comparisons.

Some of the direct outcomes of installation and company support programs are especially well suited to comparative analysis. An agency might compare how many megawatts of solar were installed in different states for each $1 million of public funding or compare how many jobs companies were created for each $1 million. As an example of this approach, one of the most striking and significant findings from the evaluation of New York's renewable portfolio standard (RPS) program was that the program cost much less per megawatt installed than the RPS's in other states when measured by the price of renewable energy certificates.[32]

Of course, there can be many factors beyond an agency's control that account for why a program's costs are higher or lower than those in other states. The comparative data can be a good starting point for an analysis of the reasons for the differences.

3.4 Impact Evaluations

- **The more complicated the program theory and the more multi-faceted the program's route to achieving outcomes, the harder it is to determine exactly which of the program's outcomes would have occurred without the program.**
- **It can be helpful to gather the results from evaluations of similar programs in other states.**

[31] Ibid., p. 237.
[32] Frank Stern et al., *New York Renewable Portfolio Standard Market Conditions Assessment: Final Report* (Denver: Summit Blue Consulting, 2009), pp. 4-104 – 4-109. Available at www.nyserda.org/Energy_Information/Market%20Conditions%20Final%20Report.pdf.

- **Choose experienced evaluators and make sure that they are using the most appropriate research methods and are implementing them in the most appropriate way.**

Impact evaluations seek to take outcome evaluation one step further by determining which of the outcomes can actually be attributed to the program. This is essential to fully assessing the value of a program. If some of the outcomes would have taken place without the program, the program should not take credit for them. Moreover, to the extent that some of the recipients of grants, rebates, or loans were so-called "free riders" who would have acted without the state's financial support, program money was not used efficiently.

On the other hand, a program can have impacts that go beyond its original intended outcomes. For example, a program to encourage businesses to install distributed systems for generating electricity may induce them to use a combined-heat-and-power technology that also saves energy for heating. Such desirable, but unintended, "spillover effects" deserve to be recognized.

Unfortunately, it is not always easy to accurately determine which of the outcomes of a program can be attributed to that program. This is especially true for programs with complex goals and multi-step routes to achieving those goals. Programs that transform a market or educate a broad segment of the public fall into that category.

It is generally easiest to determine impacts for programs involving direct dissemination of program funds to the actors that the program wants to influence (e.g., a solar rebate program or a green schools planning grant program). Energy efficiency evaluators have been doing impact evaluations of those types of programs (e.g., refrigerator rebate programs, grants for major energy-efficiency improvements at manufacturing facilities) for decades and there has been extensive discussion at their professional conferences and in written articles about the best methods for quantifying free riders and spillover effects.

The most common and generally least expensive method is a survey of program participants. The best surveys not only ask direct questions (e.g., how important was the state's solar program in your decision to purchase a solar system?) but also include indirect questions that help gauge the reliability of the respondents' direct response (e.g., what plans, if any did you have to install a solar system before learning about the state's program?; what were the main reasons that you decided to go ahead with purchasing a solar system?). To further increase the reliability of the results, the survey responses can be combined with other data sources, such as interviews with business and trade association representatives.

But even when the evaluators are highly skilled and the survey is well constructed, people's answers may not completely reflect the actual relationship between the program and the respondents' actions. For one thing, if the survey is being done long after respondents' purchase or implementation decisions, they may not remember their decision process accurately.

The imprecision associated with participant surveys tends to underestimate the impact of state renewable energy programs. Because of participants' enthusiasm for renewable energy and desire to be perceived as environmentally responsible, they may tell the interviewer—and actually

believe—that they would have taken action without the state's financial incentives, when that was not the case. In addition, even if participants intended to purchase a renewable energy system without financial support within a year or two after their actual purchase, intervening events could have changed their plans. And they may not be aware of indirect ways in which the state's program has influenced them, such as by motivating a renewable energy installation company to run advertisements that prompted them to become interested in purchasing a system or through educational materials that prompted a neighbor to talk up the benefits of renewable energy.

A recent astute study of Wisconsin Focus on Energy's biogas program showed the limitations of surveys of program participants. When a survey-based impact evaluation indicated that most of the participants in the biogas program reported that they would have installed a biogas digester on their farm without the program, Focus on Energy asked the evaluator, KEMA, Inc., to carry out a follow-up study to test the results. KEMA compared Wisconsin to two other similar agricultural states, and then considered the extent to which higher market penetration of biogas digesters in Wisconsin could be linked to Focus on Energy's program. The evaluators also carried out qualitative research, including interviews with various market players and experts to gain a more complete understanding of the biogas digester market and Focus on Energy's role in that market. Based on those two approaches, KEMA concluded "that Focus on Energy has likely had impacts on the Wisconsin biogas market not reflected in participant self-reports of program attribution." But, unfortunately, KEMA could not quantify those effects.[33]

In some cases, it may be possible to use statistical methods to come up with a quantitative estimate of program impacts based on comparisons between program participants and non-participants or between a program's geographic focus areas and similar ones elsewhere where there is not a program. However, those methods only work in certain situations, because data is not always available.

Another interesting approach, especially for market transformation programs, is "structured expert judging", in which a panel of marketing experts examines how the market for a product changed over time and then forecast how that market would have changed in the absence of the intervention of the renewable energy program. [34]

You might take the following approach when considering doing an impact evaluation:

1. Consider how easy or difficult it will likely be to pinpoint the share of your program's outcomes that would still have occurred without the program, and how precise an answer you need. For some programs, it may be too difficult or costly to determine an outcome-to-impact ratio with a low margin of error. In those cases, it may be better to develop a very approximate estimate of free riders and program attribution based on discussions with key stakeholders, staff, and experts in the field, or other gross estimation techniques.

---

[33] Bobbi Tannenbaum et al., *Renewable Energy Program: Biogas Supply-Side Study* (Madison: State of Wisconsin Public Service Commission of Wisconsin, 2010), p. 1-3. The report is available at http://www.focusonenergy.com/files/Document_Management_System/Evaluation/biogassupplysidestudy_evaluationreport.pdf.

[34] For information on how structured expert judging has been used with energy efficiency programs, see Rosenberg and Hoefgen, *Market Effects and Market Transformation*, pp. 90-96. Other methods for evaluating the impact of market transformation programs are described on pp. 77-90 and 96-104.

2. Determine whether other states have produced impact evaluations of programs similar to yours and find out what results they came up with for program impacts. Working with an evaluator, consider whether there are reasons to think your program might have an outcome-to-impact ratio outside the range of results from the other states. If your results would likely fall within that range, consider whether you need a more precise answer and therefore need to commission an impact evaluation report.

3. If you decide to do an impact evaluation, choose an evaluator with significant experience with impact evaluations. Discuss the research methods they will use. If they are going to use a survey, assess how sophisticated their survey methodology will be and whether they will supplement it with other research and data.

4. Have the evaluator estimate the margin of error in the results and include a discussion of uncertainties in the report.

5. For those programs for which there have been comparable impact reports in other states, if the end result of your evaluation yields an outcome-to-impact ratio outside the range of results in other states, have the evaluator provide a hypothesis or explanation for the difference. Make sure that you are comfortable with that explanation before publishing the results of the study.

6. If an impact evaluation includes a survey of program participants, try to conduct it as close to the time of the participant's decision as possible to reduce the chance of faulty memories.

7. Have any survey do double duty as a mini-process evaluation. When the evaluator is talking with your program's clients for the purpose of determining which of their actions can be attributed to your program, you can add in a few questions that will help determine their satisfaction with your program and enable you to identify possible program improvements. Even if additional questions are not asked, the participants' answers to program attribution questions will still likely provide interesting glimpses into their attitudes towards your program. Those responses should be examined carefully for relevant impressionistic evidence.

3.5 Cost-Benefit Evaluations

- **Agencies should proceed cautiously before undertaking a major cost-benefit study.**
- **Assessments of benefits and costs usually involve predictions about the future, which inherently introduce considerable uncertainty into the results.**
- **Choose experienced evaluators and make sure you understand and agree with their methodology and assumptions.**
- **Make sure the study results are presented in ways that reveal rather than obscure the assumptions and uncertainties.**
- **Consider commentary by an economist as a low-cost alternative.**

Just as an impact evaluation seeks to take an outcome evaluation one step further, a cost-benefit assessment takes an impact evaluation one step further by weighing the benefits of achieving those impacts against the costs. At first glance, this would appear to be an especially appealing type of

evaluation. After all, wouldn't all program managers want to know if the economic benefits of their programs outweigh the costs? Regulatory and authorizing bodies, such as agency boards and legislative committees, often insist on a cost-benefit study so that they can judge whether to continue a program or adjust its funding level.

Despite the obvious appeal of cost-benefit analysis, this can be the most problematic type of evaluation, because the various research methods all have significant limitations. If one uses an approach that looks only at easy-to-quantify, direct program spending (on the cost side) and the direct savings that the recipients of that spending receive (on the benefit side), many important, but harder-to-pinpoint economic impacts of the program are ignored. Those indirect impacts can include the jobs created when a program causes purchases of renewable energy technologies, the impact of new electricity generation on overall electricity prices, the economic benefits of reduced pollution, and the economic impact of taking money from taxpayers or ratepayers to pay the taxes or fees that fund the program.

To get at those more complicated economic effects requires the use of a quantitative economic model, such as an input-output model, econometric model, or general equilibrium model.[35] But any quantitative model that tries to replicate real-life phenomena in something as complicated as a state economy will inherently be flawed and will yield results with a considerable margin of error. Nevertheless, quantitative analysis using models of the economy should not be rejected as useless, since it remains the best way to understand what happens economically in the real world.

In the case of renewable energy programs, the research task is made more difficult, because the evaluator needs to make projections about future trends as well as quantify past economic activities. It is, of course, impossible to predict the future with total accuracy. Let's take a wind turbine installation program as an example. To calculate the benefits that the turbine owners will derive over the life of the machines, one must estimate the value of the turbines' output over a 25-year period. Yet it is notoriously difficult to predict future electricity prices and it may even be hard to pinpoint the turbine's future electricity generation, because the specific turbine model may not have a long enough track record to predict performance degradation and maintenance needs decades into the future.

The problems with forecasting the future do not end there. For example, how exactly will the money spent by a renewable energy program ripple through the economy, creating a multiplier effect as it gets spent by its initial recipients, and then re-spent? And what will be the value of future avoided externalities when fossil fuel emissions are replaced by renewable generation? In some cases, the introduction of significant quantities of renewable energy can suppress overall electricity prices, because the increased production will reduce the use of high-priced generators at the margin. But it is hard to pin down an exact price suppression number that can withstand close scrutiny. As an illustration of this point, two careful analyses—one completed in 2008 and one completed in 2009—of the projected price suppression impact of New York's renewable portfolio standard in 2010 came up with estimates that ranged from $33 for every megawatt-hour of renewable energy generated to $107 per megawatt-hour. Although the second study offered

[35] A few of the most frequently used models are described and analyzed in Appendix D.

plausible explanations for some of the differences between the two results, it is hard to have total confidence in either result when there is such a large discrepancy.[36]

Because of all these complicated considerations, a full cost-benefit study can end up costing $250,000, although a narrowly focused report that builds on previous analysis can cost as little as a tenth of that. Given the potentially large price tag and the problems associated with cost-benefit evaluations, how might it be best to proceed? Below is a suggested approach that will help you understand the implications of what you receive from an evaluator, increase the usefulness of the results, and help you avoid overselling those results.

a. Think carefully about why you want to undertake a cost-benefit evaluation and consider whether the types of results you will likely receive will truly meet your needs. You can be confident that a good cost-benefit study will identify the different ways in which a program has an impact on the economy and will provide a general sense of the relative importance of those different impacts. However, program managers generally want more than that from a cost-benefit study. You should think carefully about what else you will receive that you will have confidence in.

b. Choose an experienced evaluator who has conducted previous cost-benefit studies for satisfied clients. This will increase the likelihood that you will get a sound report that can withstand critical scrutiny. In your search for an experienced evaluator, you may discover that there is an evaluation firm that already has a subscription to a relevant regional economic model so would not have to pay for that as part of the cost of the evaluation. In addition, an evaluator may already have done some related analysis of the state's economy that could reduce the amount of new work they have to do, and thereby hold down the cost of the evaluation.

c. Make sure you understand the research methods the evaluator will use. Ask the evaluator to explain the advantages and limitations of those methods.

d. Have the evaluator specify and justify key assumptions that can shape report results, especially those assumptions that involve predictions about the future, such as energy prices, equipment costs, energy consumption, and equipment performance. Make sure that you believe that those assumptions are defensible.

e. Ask the evaluator to assess more than one scenario. Even if you agree that a certain set of assumptions about the future represents the most likely scenario, there remains considerable possibility that future events will prove those assumptions wrong. You should therefore encourage the evaluator to consider and produce results for other plausible scenarios. This has not conventionally been done with cost-benefit studies and could increase the budget for the study by at least a modest amount, but it will make the results more meaningful and useful.

---

[36] Frank Stern et al., *New York Renewable Portfolio Standard: Market Conditions Assessment: Final Report* (Boulder, CO: Summit Blue Consulting, LLC, 2009), pp. 4-142 – 4-155. Available at http://www.nyserda.org/Energy_Information/Market%20Conditions%20Final%20Report.pdf. In a recent paper (Frank Felder, "Examining Electricity Price Suppression Due to Renewable Resources and Other Grid Investments," *Electricity Journal* (May 2011), pp. 34-46], Frank Felder explains why it is so difficult to accurately quantify price suppression effects, although his article may overemphasize the potential impact of some relatively minor factors.

For example:

- If the selected most likely scenario projects that electricity prices will increase by 3% a year, how would the cost-benefit calculations be different if electricity prices rise by 5% or do not rise at all?
- If a wind program assumes that the price of new turbines will decline by 5% a year, what difference would it make if the rate of decline is twice that or half that?
- If a PV program assumes that inverters will last an average of 7 years, how would the benefits be different if the inverters last 10 years or need to be replaced after only 5 years?

f. Cost-benefit studies usually require the evaluator to consider the opportunity cost of money and to select a discount rate for that money. For example, in a sample of five state clean energy cost-benefit studies conducted over the past six years, the discount rate used ranged from 3% to 10%. Make sure you understand the reasons for the evaluator's choice of a discount rate. In the final report, ask for an estimate to be included about how the results would be different if a different discount rate had been chosen.

g. Ask the evaluator to look at previous comparable studies in both your state and other states. To the extent that the results are different, have the evaluator explain and justify those differences. For example:

- If your study shows that every $100 million invested in wind energy will directly and indirectly create 10,000 new jobs, but studies in five other states had results ranging from 3,000 to 5,000 jobs, you should receive a convincing explanation for the discrepancy.

h. Make sure you understand what *exactly* the study shows. That requires you to look carefully at the relationship between cause and effect in order to understand why the study produced the results it did. For example:

- A 2009 study assessing whether to initiate a major new solar program in Connecticut quantified the likely costs and benefits of six alternative program models. Overall, the methodology seemed reasonable and the report showed that the societal benefits of all six possible approaches would outweigh their costs, although some of the approaches would be economically superior to others. The report recommended that the state go forward with a comprehensive program incorporating several approaches.[37] However, a close reading of the findings shows that the vast majority of the economic benefits Connecticut would receive from installing solar would come from avoiding costs associated with the electricity that the solar would displace.[38] In other words, anything that displaced that electricity, including the installation of other distributed generation technologies and energy efficiency measures, would also have significant economic

[37] KEMA, *Sustainable Solar Strategy for Connecticut Prepared for the Long-Term Sustainable Solar Strategy Workshop* (Burlington, Mass.: KEMA, Inc., 2009), pp. 1-3 – 1-6, and 2-12 – 2-15. Available at www.ctcleanenergy.com/Portals/0/sustainable%20Solar%20Strategy%20FINAL%20Report%204-8-09.pdf.
[38] Ibid., appendix B.

benefits. Because no analysis was done comparing the costs and benefits of those alternative technologies, some of which may have been more cost-effective than solar, the report did not prove that a large new solar program was economically preferable.

i. As the last example implies, one way to increase the value of cost-benefit studies is to make them comparative—for example, using them to compare the relative economic merits of implementing two different parallel programs or the relative economic results from two of an agency's different programs. Even though there are inherent uncertainties in any cost-benefit study, one can often trust the directional results comparing two studies using similar methodologies and assumptions. For example:

    - In the Connecticut study described above, a solar residential rebate program was found to have economic benefits 2.87 times greater than its costs, while the benefit-to-cost ratio for a solar lease program would only be 1.92. Even though there could be significant uncertainty around the exact numbers, there is no reason to disbelieve the finding that a residential rebate would be *more* cost-effective.[39]

j. When presenting findings to governing authorities, regulators, and the public, avoid implying that the results are more accurate and precise than they are. You can help your audience to see the results as useful tools of greater understanding, rather than as definitive proclamations of fact that they may be tempted to pick apart. For example:

    - Rather than proclaim that a report found the your agency's geothermal program provided $10,126,322 in economic benefits and created 412 jobs, you might suggest that it uncovered about $10 million in benefits and about 400 jobs. If the evaluator ran different scenarios, as recommended above in points 5 and 6, you can present the results as a range that incorporates the different scenarios (e.g., $9-12 million in economic benefits).

3.5.1 A Low-Cost Alternative to a Full Cost-Benefit Evaluation

If you do not have the budget for a full cost-benefit evaluation or are concerned that the inherent uncertainties involved with assessing a particular project do not justify the time and resources of a full study, you can consider a simple low-cost alternative—commentary from the perspective an impartial professional economist.

In this approach, your agency would hire an external economist with significant experience doing cost-benefit evaluations and ask that person to provide commentary rather than an evaluation. The economist would look at relevant data collected by your agency as part of its monitoring program and might ask you to gather some additional data.

The resulting report would not involve modeling but would instead discuss the types of things that the economist knows are important to an economic modeling study, such as the amount of money that gets spent within the state as a result of the program, the role of multiplier effects, and the general impact of distributed generation on peak electricity prices. This can identify the ways in

[39] Ibid., p. 1-5.

which the program is providing economic benefits to the state. Of course, this will not provide you with a bottom line number showing that the program's benefits outweigh its costs, but the commentary can be suggestive and instructive.

Such a report can cost less than $10,000. The Vermont Clean Energy Development Fund recently used this approach.[40]

[40] Tom Kavet, "Economic Overview of Clean Energy Development Fund Expenditures," Memorandum to Vermont Legislative Joint Fiscal Office, March 22, 2011. Available at http://publicservice.vermont.gov/energy/ee_files/cedf/Memo%20-%20Clean%20Energy%20Development%20Fund%20Summary.pdf.

4. Framing and Presenting Evaluations for Audiences outside Your Agency

In many cases, the evaluations produced for your agency will be seen by audiences outside the agency, including the news media, political leaders in the state, clean energy business representatives, and the general public. But agencies rarely focus on those audiences and instead simply post the evaluations on their website where anyone can stumble across them without fully understanding the context or being able to sort through the dense findings.

As part of an effective communications strategy, agencies should develop a proactive outreach plan for each evaluation report when it commences. Here is a suggested approach for doing that:

1. When you are first conceptualizing an evaluation study, identify all the audiences that may see it. Those should include audiences to whom you will intentionally disseminate the report, as well as accidental audiences that may see it on your website or elsewhere. Of course, if the report will solely be used internally within the agency, you do not need to worry about this.

2. Make sure the evaluators understand both the intended and accidental audiences. Brief them on the various audiences' level of knowledge about your agency and clean energy, as well as their attitudes towards your agency and any concerns or pre-conceived notions that may influence how they perceive the evaluation report. Discuss with the evaluators what this could mean for how to frame and write the report.

3. Develop an outreach plan for each key audience. For example, consider whether you should proactively disseminate the report to a certain audience, or whether it is sufficient to make the report available on a website without directly reaching out to the audience about it. In addition, decide whether the report should be accompanied by some contextual information, such as a short description of the evaluated program, a brief explanation of the purpose of the evaluation, or an overview of the agency's overall evaluation strategy and evaluation activities.

4. Decide whether to ask the evaluators to produce collateral material that may be more appropriate for a particular audience than the full evaluation report. For example, the evaluators could produce a slide presentation or a brief paper that addresses a specific concern of an important audience.

5. Make sure that the report or any collateral materials, such as press releases, do not imply that the results are more precise than they are. As noted in early sections of this paper, evaluation reports leave themselves vulnerable to criticism when they exaggerate the precision of the findings.

6. Once you have seen the report but before it has been disseminated, anticipate how different audiences will react to it and what their questions or concerns will be. Then develop responses that you can use if necessary and appropriate.

7. Consider whether there is specific information in the report that could be useful to various stakeholders but that they are not likely to uncover on their own. For example, solar energy installers would not likely realize that an impacts report of your agency's solar rebate program could include survey responses that reveal the PV purchasers' attitudes towards installers' marketing efforts. You increase the value of evaluation studies by searching for and disseminating these sorts of unplanned but useful secondary findings and bits of information.

Beyond planning an outreach strategy for each individual evaluation report, it can be useful to present key audiences with a general case for the value of evaluation. Evaluation can be a significant budget item and stakeholders may not understand why it is important or how it is used. Moreover, by showing beneficial changes the agency has made as a result of particular evaluation projects, you can demonstrate that the agency is spending public money wisely and is taking steps to operate efficiently.

One good way to do that is to produce case studies of specific evaluation projects and their impacts. The Office of Planning, Budget, and Analysis within DOE's Office of Energy Efficiency and Renewable Energy has done this successfully through a case study series. The attractive message of one of these case studies is embodied in its title: "DOE Hydrogen Program Saved Nearly $30 Million by Investing in Annual In-Progress Peer Reviews."[41]

[41] Office of Planning, Budget, and Analysis, "DOE Hydrogen Program Saved Nearly $30 Million by Investing in Annual In-Progress Peer Reviews," *Case Study Series—Demonstrating the Value of Program Evaluation* (DOE Office of Energy Efficiency and Renewable Energy, November 2009). Available at www1.eere.energy.gov/ba/pba/pdfs/eere_finsavingsbrief-final.pdf.

APPENDICES

Appendix A: Developing a Program Theory

The material below, copied from *The California Evaluation Framework,*[42] presents one reasonable way to organize a project's program theory and suggests how to get started on writing it.

Developing a Program Theory

The easiest way to develop a program theory is to start by systematically describing a program in terms of resources, activities, outputs, short-term outcomes, and long-term outcomes:

- *Inputs (resources)* are the elements required by an organization, program, or project to initiate and/or sustain activities. Examples are money, collaborations, skills, and time.
- *Activities* are the program activities that are used to produce the outputs that initiate the causal logic within the logic model.
- *Market actors* are those market actors targeted by the interventions or that play a role in the causal logic of the program theory.
- *Outputs* are the immediate results of the activity. Examples are the number of contacts made, number of brochures printed, number of contractors recruited, and number of audits completed.
- *Outcomes* are the intermediate or once removed consequences resulting from program activities and program outputs. There may be a sequence of outcomes. Outcomes may be unintended or intended but they are not prompted by direct action on the part of the program. Examples are changes in awareness, attitudes, and behaviors, participants referring non-participants to the program, trade publications running articles about efficient equipment and practices, dealers changing their stocking practices, etc.
- *Long-term outcomes (impacts)* are the end-states to be realized. Impacts may take months or years to accomplish and may be influenced indirectly by the intervener's actions. Impacts are the long-term goals of the program. Examples are kWh saved, gallons of water saved, tons of CO_2 reduced, efficient technologies and practices are the industry standard, T-12 fluorescents are difficult to buy, etc.

One of the best ways to develop a program theory is to start with the long-term outcomes and work backwards to resources. Essentially, the process is one of repeatedly asking the same question, if "Z" is a long-term outcome…, what is required to produce "Z." It is then a matter of writing the causal relation in the form of a statement: "Y" will cause "Z." One then backs up and asks what will cause Y and continues until one has described the required activities and resources.

One can then reverse the order and edit the statements until one has a sequence of causal statements that describe how the program works….

[42] TecMarket Works, *The California Evaluation Framework: Prepared for the California Public Utilities Commission and the Project Advisory Group* (Oregon, Wisc.: TecMarket Works, revised edition 2006), p. 33-4. Available at http://www.tecmarket.net/documents/California%20Evaluation%20Framework%20Jan%202006.pdf. Note that the evaluation framework was developed for energy efficiency rather than renewable energy programs.

Appendix B: Sample Program Logic Model

NYSERDA produces and publishes thorough reports on the logic models for many of the agency's programs. These reports, many of which are available at the NYSERDA website at www.nyserda.org/Energy_Information/evaluation.asp, can give other states a good understanding of the issues to consider when developing a program logic model.

Figure 1 on next page shows the program logic diagram for the report on the Clean Energy Infrastructure Program.[43] Like the other NYSERDA reports, the one on that program includes much more than just the diagram. It is 16 pages long and here is how the authors describe different sections into which it is organized:[44]

1. Problem/Issues and Stakeholders (Context): Describes the problem(s) the program is attempting to solve, or issues it will address and the regulatory and stakeholder environments (context) within which the program is working.

2. Program Objectives: Describes, at a high level, the program's ultimate purpose and targets.

3. Program Resources: Identifies the dollar, manpower and partnership, etc. resources the program is providing.

4. Program Activities: Describes the various research, product development, demonstration and commercialization progress support activities and strategies being delivered through the program.

5. Outputs: Describes the anticipated immediate results associated with program activities.

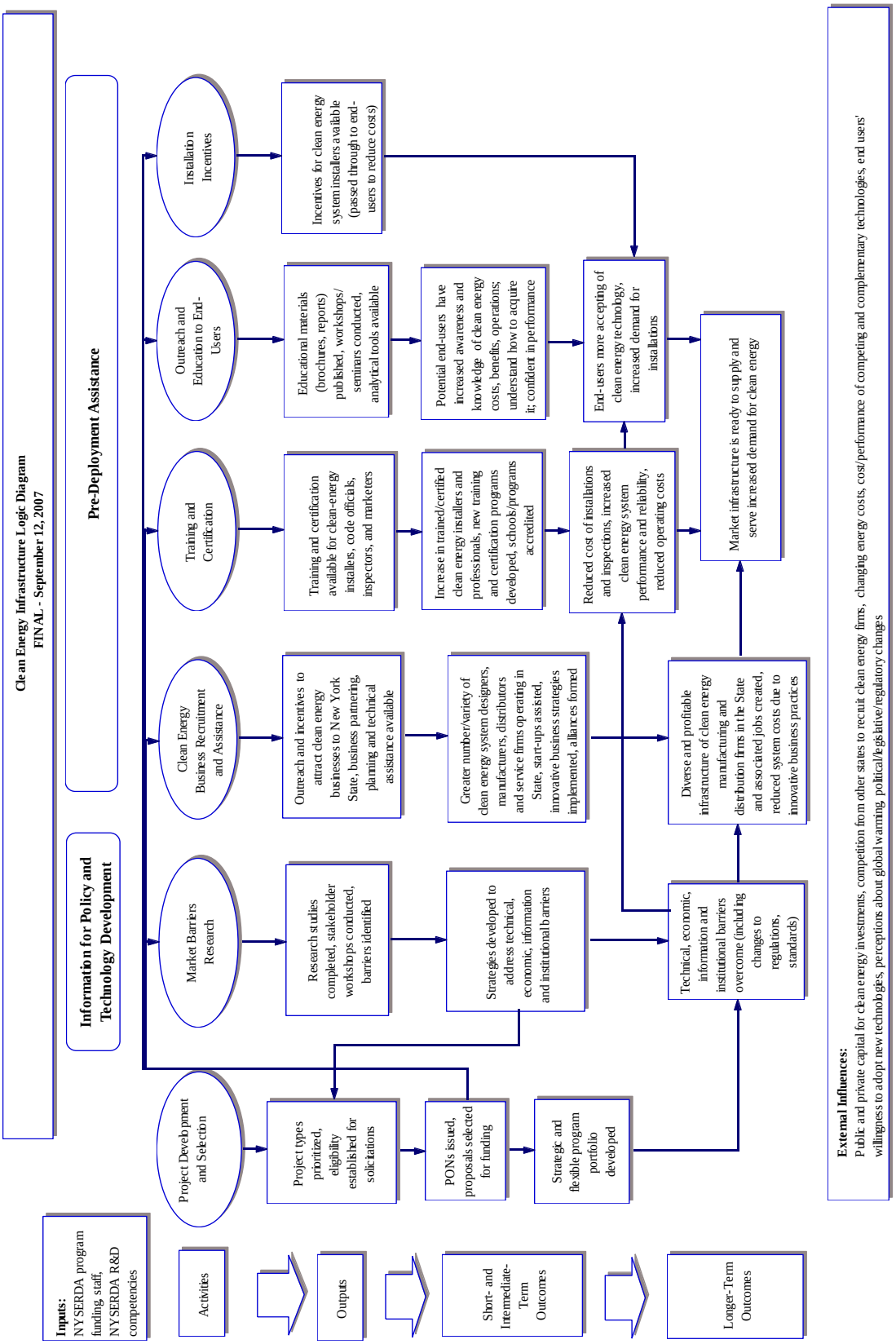
6. Outcomes: Describes what is expected to be achieved in the near, intermediate and longer term.

7. Assumptions: Describes assumptions about how program activities and outputs will lead to the desired near, intermediate and longer-term outcomes.

8. Non-Program Influences: Describes factors outside the program that may drive or constrain the achievement of outcomes.

[43] GDS Associates, Inc., *Program Logic Model Report: Clean Energy Infrastructure Program* (Albany: NYSERDA, 2007), p. 13. Available at http://www.nyserda.org/Energy_Information/ContractorReports/GDS%20Associates/2007%20Reports/Final%20PLM%20Clean%20Energy.pdf.
[44] Ibid., p. 1.

Figure 1. NYSERDA Clean Energy Infrastructure Program Logic Diagram



Appendix C: Possible Evaluation Questions

The following list of questions, copied from the *EERE Guide for Managing General Program Evaluation Studies,*[45] shows the wide range of questions that could be asked through a program evaluation study. Of course, this list is not exhaustive and may not fully cover the issues raised by your programs.[46] It is presented here to help stimulate your thinking about evaluation goals and questions.

General-to-Specific Evaluation Questions

Introduction

Once evaluation objectives are established, the research needs to be framed into general and specific questions that can be the specific subjects of the research planning and evaluation effort. General questions are derived from the evaluation objectives. Each general question implies certain specific research questions that represent it. The specific questions are questions that are capable of being answered through data collection and analysis. The following sets of general and specific questions are grouped by type of evaluation:

- Needs/market assessment
- Process or implementation
- Outcome
- Impact
- Cost-benefit.

These general and specific questions are offered as examples of the kinds of questions addressed by the different types of general program evaluations.

A. Needs/Market Assessment Evaluation

General Question 1: What additional customers and markets could be served?

a. What are the currently underserved populations and market segments that could benefit from the program?
b. Are there additional delivery channels that could be used to reach the target populations?

General Question 2: What do customers need that is not currently being provided?

a. What gaps currently exist in the services available to target populations?

[45] Harley Barnes et al., *EERE Guide for Managing General Program Evaluation Studies: Getting the Information You Need* (Washington: US DOE, 2006), Appendix 4, pp. 4-1 – 4-6; available at www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf.

[46] A different, even longer list of questions geared specifically to the impact of technology deployment programs is available in John H. Reed at al., *Impact Evaluation Framework for Technology Deployment Programs* (Washington: US DOE Energy Efficiency and Renewable Energy, 2007), pp. 5-1 – 5-14; available at www1.eere.energy.gov/ba/pba/pdfs/impact_framework_tech_deploy_2007_main.pdf.

b. What specific tools and services are needed by customers that are not provided by the program?

General Question 3: What is the market baseline?

a. What are the key market segments?
b. Who are the key market actors and how do they interact?
c. What is the current extent of market penetration for the program's targeted technologies?
d. What is the nature and magnitude of current market barriers to the greater use of technologies or practices promoted by the program?

B. Process or Implementation Evaluation

General Question 1: Is program design and organization adequate?

a. Are program goals too high? Too low?
b. What populations and market segments are being served, and through what delivery channels?
c. Is it easy for customers to join or participate in the program?
d. What motivates customers to participate?
e. Are program delivery strategies consistent with customer motivations?
f. Do marketing materials emphasize benefits that have high value for customers?
g. Do the characteristics of the available tools and services allow for their easy adoption?

General Question 2: Is the program producing the outputs it was intended to produce?

a. What is the level of awareness of energy efficiency and renewable energy opportunities in target populations?
b. Are customers participating at expected levels? Are some customer groups participating more than others? Why?
c. Which tools and services are being used? By what groups? At what levels? Are some tools and services under-utilized? Over-utilized? Why?
d. To what extent are customers satisfied with the program?
e. What are the key contextual and organizational factors that influence customers' use of the program's tools and services? What is the magnitude of those influences?

General Question 3: Are resources reasonable relative to the objectives?

a. Are the resources assigned to the various program components adequate to achieve desired objectives?
b. Is the program leveraging funds effectively? How could additional resources be leveraged?
c. Are detailed program expenditure records maintained?

General Question 4: What are initiatives that are likely to enhance program results?

a. Are there barriers that reduce awareness of, or participation in, the program? How can existing barriers be reduced or eliminated?
b. What could be done to increase the use of the program's tools and services?
c. How can the program better reach and serve non-participants? Hard-to-reach populations?
d. What are participant and non-participant recommendations for enhancements to program process and content?
e. Are there areas for improvement in the program's administrative functions (e.g., marketing, recruitment, record keeping)?

General Question 5: How can the program be modified to perform its activities at less cost and still achieve goals?

a. Which delivery channels are working well (or not working) to achieve program objectives at minimal cost? How do these delivery channels operate?
b. How can the effectiveness of the delivery channels be increased?
c. How can costs of administrative functions be reduced without adversely impacting program services?

C. Outcome Evaluation

Quantify Savings

General Question 1: How much energy and money have been saved - directly and indirectly?

a. How much energy and money were saved by participants for the entire program?
b. How much energy and money were saved by participants for individual program components/activities?
c. What are unaccounted-for "secondary" benefits (e.g., persistence, replication, delayed implementation, spin-offs)?
d. What key contextual and organizational factors are related to the achievement of energy and money savings? What is the strength of those relationships?

General Question 2: What are the non-energy benefits?

a. What were the nature and magnitude of non-energy benefits associated with the entire program?
b. What were the nature and magnitude of non-energy benefits associated with individual program components/activities?
c. What key contextual and organizational factors are related to the achievement of non-energy benefits? What is the strength of those relationships?

General Question 3: What unexpected outcomes have occurred, if any?

a. What were the nature and magnitude of any program-related results that were not intended?
b. What key contextual and organizational factors are related to the achievement of unexpected results? What is the strength of those relationships?

Market Effects or Market Transformation

General Question 1: Are targeted markets showing signs of changing?

a. Are there market changes or effects associated with the entire program (e.g., changes in business willingness or ability to produce, distribute, or service new technologies)?
b. What changes or effects are associated with individual program components/activities?
c. How has the behavior (e.g., purchase and management decision-making and practices) of targeted actors changed over the life of the program?
d. What network effects have occurred?
e. What key contextual and organizational factors are related to the achievement of market changes? What is the strength of those relationships?

General Question 2: What is progress toward desired long-term outcomes/exit strategy?

a. What are the nature and magnitude of any external replication effects that have occurred?
b. What are the nature and magnitude of any network and spin-off effects (e.g., new businesses and technologies)?
c. How effective has the program been in reducing market barriers?

General Question 3: Have sustainable markets been created?

a. Have market actors continued new practices and behaviors over time?
b. What are the effects of the program on the system specification and sales practices of market actors who received program tools or services?
c. What key contextual and organizational factors are related to the achievement of sustainable markets? What is the strength of those relationships?

D. Impact Evaluation

General Question 1: What are the verified quantified outcomes that are attributable to the program?

a. What would have caused the observed outcomes if it were not the program? What proportion of the measured outcomes were caused by the program?
b. What is the direct impact on customer awareness and knowledge that can be attributed to the program?
c. What are the energy efficiency/renewable energy actions taken by program participants compared to actions taken by non-participants?
d. What is the direct impact of the entire program on energy and money savings?

e. What is the direct impact of individual program components/activities on energy and money savings?
f. What is the direct impact of the overall program on non-energy benefits?
g. What is the direct impact of individual program components/activities on non-energy benefits?
h. What is the magnitude of replication, persistence, network, spillover, and other observed effects that can be attributed to the program?
i. What unintended results were directly caused by the program?
j. What key contextual and organizational factors are responsible for the measured net impacts? What is the strength of those causal relationships?

E. Cost-Benefit or Cost-Effectiveness Evaluation

General Question 1: What are the benefits and costs of the program's past activities?

a. What are the retrospective benefits and costs associated with the program as a whole?
b. What are the retrospective benefits and costs associated with individual program components/activities?

General Question 2: How do program benefits and costs compare to each other?

a. Are the benefits from the program greater than program and customer costs?
b. What is the benefit-to-cost ratio (using one or more different perspectives, such as "participant" or "societal")?
c. Which delivery channels are working well to achieve program objectives less expensively, and why?

Appendix D: Description of Models Used in Cost-Benefit Evaluations[47]

Evaluators usually use a model of the economy when undertaking a cost-benefit assessment. This appendix discusses three models that are frequently used in studies of renewable energy's impact on the economy—IMPLAN, JEDI, and REMI. Other models have been developed for particular states, such as ILREIM for Illinois, but they tend to be similar in approach to one of the three models discussed below. All of them attempt to apply mainstream (neoclassical) economic theory using mathematical equations and economic data.

IMPLAN

IMPLAN is an input-output model that was developed by the US Forest Service and is now marketed as a commercial software package by an independent company, the Minnesota IMPLAN Group. Input-output analysis is the most popular analytical approach for measuring economic impacts.[48]

Like other input-output models, IMPLAN divides the economy into a large number of industry and commodity sectors, in this case the 528 standard industrial classifications. It then tracks the flow of money—inputs and outputs—between them. A portion of the input (i.e., purchases) of one industry will appear as an output (i.e., sales) of another industry. For example, steel is an input of the wind industry, but is also an output of the steel industry. The input-output model measures how a change in one part of the economy will ultimately affect other parts based on these purchasing and selling relationships.

The main source data for of all such models in the United States is the Industry Economic Accounts, especially the Annual and Benchmark Input-Output Accounts, produced by the Bureau of Economic Analysis (BEA), which in turn depends on data from other federal agencies. BEA produces tables that summarize at the national level which industries produce and consume which commodities (including services). BEA updates its national accounts every five years.

These tables are then "regionalized"; using each region's own industry mix and other information. This regionalization would ideally be based on a survey that asked every individual business about its suppliers and major clients. The responses would then be added up by industry. Because such a survey is not practical, IMPLAN and the other input-output models use non-survey techniques that rely on various regional data sources, including its industry mix.[49]

IMPLAN calculates local "multipliers," which show how changes (jobs, earnings, or sales) in one industry ripple through other industries in a regional economy. For example, a jobs multiplier of 2.1 for the photovoltaic industry in a state means that a change of 100 jobs in the PV industry would lead to a total change of 210 jobs (2.1 x 100) in the whole regional economy

IMPLAN is relatively inexpensive and is easy to work with. But as a model of a regional economy it has considerable limitations, especially when trying to measure changes extending far into the

[47] This appendix draws on research by research assistant Benjamin Amankwata.
[48] For an extended guide to input-output analysis, see M. Henry Robison, *Input-Output Guidebook: A Practical Guide for Regional Economic Analysis* (Moscow, ID: Economic Modeling Specialists Inc., 2009). Available at www.economicmodeling.com/wp-content/uploads/emsi-io-guide-1.pdf.
[49] *Ibid*., p. 7.

future. Most importantly, input-output models are static and do not consider the inherent changes over time in a dynamic economy. For example, IMPLAN assumes that there are no supply constraints and that the relationship between industries is constant. In other words, the model would not have projected the mid-2000s situation where increased demand for photovoltaic panels led to rapidly rising silicon prices. The model also simplifies geographic differences by using national data that assumes that products are made the same way in all regions, even though such factors as wage rates, land costs, energy prices, transportation costs, and water scarcity could encourage a particular industry to use different inputs in one part of the country than another. In addition, the model looks at a state or region as a whole and places impacts either entirely inside or outside the region, even though there could be significant variations. For example, the model does not recognize that more of the money spent on home construction in a border community may slip out of state than in a town in the center of the state.[50]

JEDI

Jobs and Economic Development Impact (JEDI) is based on IMPLAN and focuses specifically on energy projects. There are JEDI models for wind, concentrating solar, PV, biofuels, coal, and natural gas projects. These models were developed by the National Renewable Energy Laboratory (NREL) as "user-friendly tools that estimate the economic impacts of constructing and operating power generation and biofuel plants at the local and state levels."[51]

In the case of a wind farm, for example, JEDI "estimates the number of in-state construction jobs" and looks at three categories of economic impacts: (1) project development and onsite labor impacts; (2) local revenue, turbine, and supply chain impacts, and (3) induced impacts, which are changes in household spending as income increases because of the wind farm.[52]

The models operate in Excel and are easy to use. They include default values that NREL chose based on interviews with project developers, state tax representatives, and others in the electric power industry. But model users can replace the default values with project-specific data on such things as construction costs, equipment costs, maintenance costs, and financing. They can also adjust the proportion of project spending that is purchased locally in order to reflect project-specific realities.

JEDI has the same limitations as other input-output models, but it is also limited to looking at the positive job and other economic impacts of projects. It cannot be used to analyze the negative impacts on the economy of taking money from ratepayers or taxpayers to pay for the financial incentives that make an energy project possible. In other words, JEDI can estimate the benefits of a project, but not the costs. For this and other reasons, JEDI is most useful for understanding the types of positive impacts a project or program will likely have and for making comparisons between projects or programs.

---

[50] Some of the limitations of IMPLAN are discussed in a presentation by Doleswar Bhandari and Jeffrey Mitchell, "Regional Economic Impact Analysis: Simplifying Assumptions to Manage a Complex Task" presentation at the University of New Mexico Bureau of Business and Economic Research Data Users Conference, November 6, 2008; available at http://bber.unm.edu/presentations/Mitchell.pdf.

[51] NREL's JEDI website: www.nrel.gov/analysis/jedi; accessed April 24, 2011. The site includes information on the JEDI methodology and sample publications that have used the models. The models are available for free downloading.

[52] About JEDI models: www.nrel.gov/analysis/jedi/about_jedi.html; accessed April 24, 2011.

REMI

The REMI model is maintained and distributed by a private organization, Regional Economic Models, Inc. It incorporates aspects of four major modeling approaches: input-output, general equilibrium, econometric, and new economic geography.

Each of these methodologies has distinct advantages as well as limitations when used alone REMI's integrated modeling approach makes it more robust than an input-output model like IMPLAN. For example, the economic geography aspects of REMI incorporate the spatial dimension of the economy. That allows the model to consider such things as the different transportation costs and specialized labor costs for businesses in different locations. The general equilibrium properties of the model incorporate the relationships between such variables as tax policies, regional prices, and competitiveness.

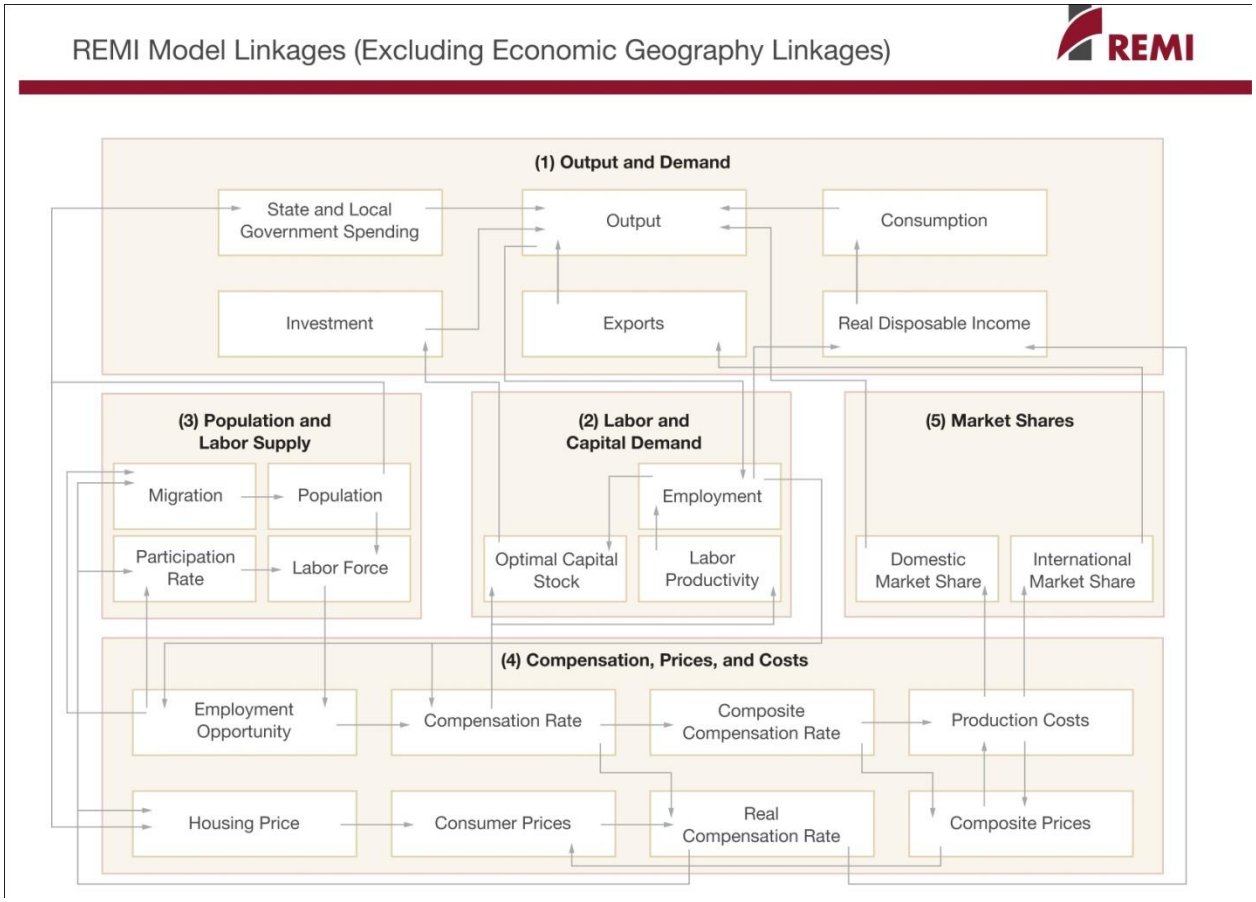
The REMI model is customized to each region of the country using historical economic data going back to 1990 provided by the US Bureau of Economic Analysis, the US Bureau of Labor Statistics, and the Census Bureau. Users can input changes to consumption, employment, output, income, productivity, fuel costs, production costs, wage rates, and other variables. The output variables include employment, compensation, wage and salary disbursements, relative cost of production, productivity, imports and exports, and output.

REMI consists of five blocks: (1) output and demand, (2) labor and capital demand, (3) population and labor supply, (4) compensation, prices, and costs, and (5) market shares. The relationships between the five blocks are captured in Figure 2.[53]

The main disadvantages of REMI compared to IMPLAN are that it is much more expensive and is more difficult and complicated to use. It is important that the lead analyst be an experienced evaluator with considerable experience using REMI.

[53] www.remi.com; accessed June 7, 2011.

Figure 2. REMI Model Linkages



Appendix E: Reference Works

Barnes, Harley et al. ***EERE Guide for Managing General Program Evaluation Studies: Getting the Information You Need***. Washington: US DOE, 2006. This guide offers a clear step-by-step approach for how to plan, design, and manage a program evaluation. Although the recommended approach is sometimes overly bureaucratic and aimed at particular federal program management needs, there is much useful information, some of which is reproduced in the appendix to this report. Available at www1.eere.energy.gov/ba/pba/pdfs/evaluation_mgmt_guide_final_2006.pdf.

Horowitz, Paul. ***Glossary of Terms: Version 1.0.*** Lexington, Mass.: Northeast Energy Efficiency Partnerships, 2009. This thorough glossary of evaluation-related terms and acronyms was produced in conjunction with the Regional Evaluation, Measurement and Verification Forum of the Northeast and Mid-Atlantic states. It covers terms commonly used by evaluators as well as terms related to energy efficiency and demand-side management, many of which are also relevant to renewable energy. Available at http://neep.org/uploads/EMV%20Forum/EMV%20Products/EMV-F%20Glossary%20of%20Terms%20and%20Acronyms%20-%20Final%20March%202009.pdf.

Khawaja, M. Sam and Bob Baumgartner, "Uncertainty," in *Model Energy-Efficiency Program Impact Evaluation Guide.* Washington: National Action Plan for Energy Efficiency, 2007, pp. Appendix D-1 – D-11. This relatively technical article provides an overview of the various factors that contribute to uncertainty in evaluating energy efficiency programs and it explains how uncertainty can be handled in an evaluation. Much of the discussion is relevant to renewable energy evaluation. Available at www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf.

Rosenberg, Mitchell and Lynn Hoefgen. ***Market Effects and Market Transformation: Their Role in Energy Efficiency Program Design and Evaluation***. Oakland: California Institute for Energy and Environment, 2009. Although there are differences between energy efficiency and renewable energy programs, some of this report's advice can be applied to designing and evaluation renewable energy market transformation programs. The sections on "Models of Market Effects and Market Transformation" (2.3) and "Assessing Program Attribution" (6) are especially useful. Available at http://uc-ciee.org/energyeff/documents/mrkt_effts_wp.pdf.

Schiller, Steven R. et al. ***Model Energy Efficiency Program Impact Evaluation Guide: A Resource of the National Action Plan for Energy Efficiency***. Washington: National Action Plan for Energy Efficiency, 2007. Although much of the document focuses on matters specific to energy-efficiency evaluation, some of it is relevant to renewable energy programs, including the introductory section on basic principles of impact evaluation and the sections on calculating avoided emissions and determining free ridership. Available at www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf.

Tannenbaum, Bobbi et al. ***Focus on Energy Evaluation: Standard Calculation Recommendations for Renewable Energy Systems***. Madison: Tetra Tech, Inc., revised edition 2010. This report for Wisconsin Focus on Energy describes methods for calculating the performance of various small-scale renewable technologies. Those methods can be adapted to other states. Available at

www.focusonenergy.com/files/Document_Management_System/Evaluation/standardcalculationrecommendationsCY10_evaluationreport.pdf.

Taylor-Powell, Ellen et al. ***Enhancing Program Performance with Logic Models: An Online Course.*** Madison: University of Wisconsin—Extension, 2002. This online course provides beginners with an accessible introduction to logic models and how to use them in program planning and evaluation. It describes a variety of logic model formats. Available at www.uwex.edu/ces/lmcourse/#.

TecMarket Works et al. ***The California Evaluation Framework: Prepared for the California Public Utilities Commission and the Project Advisory Group.*** Oregon, Wisc.: TecMarket Works, revised edition 2006. This lengthy, comprehensive manual was produced to provide the California Public Utilities Commission with a consistent methodology for evaluation the state's energy efficiency and resource acquisition programs. Although some of the manual applies only to the specific needs of those programs, is aimed at evaluators rather than program managers, and emphasizes a highly bureaucratized approach, it also includes much useful advice on a wide range of different types of evaluations. It can serve as a valuable reference work for other states. Available at www.tecmarket.net/documents/California%20Evaluation%20Framework%20Jan%202006.pdf.

US Environmental Protection Agency. ***Assessing the Multiple Benefits of Clean Energy: A Resource for States***. Washington: US EPA, 2010. This report talks about four different types of benefits from installing clean energy and describes ways to conduct evaluations of them. At times, it is overly complicated and hard-to-follow but it includes much relevant information. Available at www.epa.gov/statelocalclimate/resources/benefits.html.

W.K. Kellogg Foundation. ***Logic Model Development Guide***. Battle Creek: W.K. Kellogg Foundation, updated edition 2004. This detailed guide from one of the key organizations promoting the use of logic models is useful to program managers who need to write logic models and use them to identify appropriate questions for program evaluations. Available at www.wkkf.org/knowledge-center/resources/2010/Logic-Model-Development-Guide.aspx.

Appendix F: Representative Evaluation Reports

The following renewable energy program evaluation reports could be useful for program managers to examine. These are by no means the only high-quality reports that have been produced, but they are good examples of their types. They include features and approaches that are applicable to other states.

Report Title: ***Assessment of the New Jersey Renewable Energy Market***
Author: Summit Blue Consulting, LLC
Renewable Energy Agency: New Jersey Board of Public Utilities
Date: 2008
Length: 148 pages
Purpose: Provide recommendations for New Jersey's clean energy programs based on an assessment of the renewable energy market in the state and the status of different renewable energy technologies.
Description: This is a good example of a comprehensive market assessment study for a state clean energy agency.
Where Available:
www.njcleanenergy.com/files/file/NJ%20RE%20Mkt%20Assmt%20Svc%20Rpt%20Vol%201%20FINAL%203-24-08.pdf

Report Title: ***Connecticut's Economic Benefits from CCEF Small Solar and OSDG Programs***
Author: Economic Development Research Group, Inc.
Renewable Energy Agency: Connecticut Clean Energy Fund
Date: 2009
Length: 56 pages
Purpose: Measure the economic impacts of investments in distributed generation. Evaluate the cost effectiveness of continued investment in clean energy by the state of Connecticut.
Description: This well-organized report presents the results of an economic impact analysis and a cost-benefit analysis. Using the REMI model, the report presents the change in the number of jobs, income, and gross state output that it attributes to renewable energy spending. The various costs and benefits analyzed are explained clearly. The report is strong in the comprehensiveness and diversity of its analytical approach. Among its weaknesses, the report uses generic attribution rates estimated by KEMA and an assumption that each project uses its estimated capacity and full generation potential for the installation's useful life. If these estimates, which are not based on Connecticut-specific data or experience, turn out to be significantly off, the results of the study might be flawed.
Where Available:
http://edrgroup.org/attachments/-01_CT%20Economic%20Benefits%20from%20CCEF.pdf

Report Title: ***CPUC California Solar Initiative 2009 Impact Evaluation: Final Report***
Author: Itron, Inc. and KEMA, Inc.
Renewable Energy Agency: Southern California Edison and California Public Utilities Commission
Date: 2010
Length: 632 pages
Purpose: Assess the outcomes and impacts of the California Solar Initiative (CSI).

Description: The report examines CSI-funded solar systems that were operational in 2009. Detailed data related to all of these systems is analyzed in myriad ways.
Where Available:
http://www.cpuc.ca.gov/NR/rdonlyres/70B3F447-ADF5-48D3-8DF0-5DCE0E9DD09E/0/2009_CSI_Impact_Report.pdf

Report Title: ***The Economic and Environmental Impacts of Clean Energy Development in Illinois***
Author: Energy Resources Center (University of Illinois at Chicago)
Renewable Energy Agency: Illinois Department of Commerce and Economic Opportunity
Date: 2005
Length: 156 pages
Purpose: Measure the economic impacts of investing in energy efficiency, renewable energy, and other clean energy power generation in Illinois.
Description: This report is a good example of a state assessment of a range of clean energy options in order to help develop an overall state energy plan. It presents a thorough economic impact analysis of potential clean energy investments using ILREIM, an Illinois-specific economic model. The economic impacts are expressed in the net change in jobs, the net change in total economic output, and the net change in income for state residents. This report provides a good example of how to present critical facts and assumptions used in arriving at the final numbers. There is also a very detailed explanation of the variations in project cost between projects (solar, wind etc.), over time and also across uses (domestic, industrial etc). The report is presented in a clear and cogent fashion that makes for easy interpretation and fact checking.
Where Available:
http://www.erc.uic.edu/PDF/Clean_Energy_Development.pdf

Report Title: ***Economic Overview of Clean Energy Development Fund Expenditures***
Author: Kavet, Rockler & Associates, LLC
Renewable Energy Agency: Vermont Clean Energy Development Fund
Date: 2011
Length: 6 pages
Purpose: Describe and comment on the grants, tax credits, loans, and other expenditures made by the Clean Energy Development Fund
Description: This brief report takes a low-cost, alternative approach to a full-fledged evaluation. The author, part of a firm with significant experience doing cost-benefit evaluation and input-output modeling in Vermont and elsewhere, worked with the fund to develop a database of all of the Fund's expenditures by category. The report presents those expenditures by type (e.g., grant, loan), technology, and geographic location. It provides commentary on the ways in which the expenditures benefit the state.
Where Available: http://publicservice.vermont.gov/energy/ee_files/cedf/Memo%20-%20Clean%20Energy%20Development%20Fund%20Summary.pdf

Report Title: ***Evaluation of Energy Trust of Oregon's Solar Programs: Solarize SE Southeast Portland and Solar Energy Review***
Author: Cadmus Group, Inc.
Renewable Energy Agency: Energy Trust of Oregon

Date: 2010
Length: 51 pages
Purpose: Gauge the effectiveness of two of Energy Trust of Oregon's major solar programs and determine participant satisfaction with those programs and with the Energy Trust.
Description: This is a well-done, straight-forward, process evaluation that provided the Energy Trust with a lot of useful information and recommendations for improving the agency's programs. It relies heavily on interviews with the recipients of the Energy Trust's funding and project support.
Where Available:
http://energytrust.org/library/reports/101101_SolarizeSE_Process_Eval.pdf

Report Title: ***Focus on Energy Evaluation, Renewable Energy Program: Biogas Supply-side Study***
Author: KEMA.
Renewable Energy Agency: Focus on Energy (Wisconsin)
Date: 2010
Length: 35 pages
Purpose: Assess the extent to which biogas activity in Wisconsin can be attributed to Focus on Energy's grant programs and outreach activities.
Description: This report is relevant to states interested in understanding the attribution issue and alternative methodologies for assessing attribution. It uses two different approaches to understand the role of Focus on Energy's biogas activities on consumers' decisions to install biogas systems in agricultural settings. Careful detailed quantitative comparison of Wisconsin with other states takes into consideration variables like farm size and suggests that market penetration is higher in Wisconsin than elsewhere. Analysis of 19 in-depth interviews with a range of participants provides a full picture of the Wisconsin biogas market in comparison to two comparable states. The report explains why a previous evaluation that relied only on a survey of purchasers of biogas systems may not have given enough credit to Focus on Energy's education and outreach efforts. Despite all the sound, interesting research that went into the report, the authors are not able to come up with precise quantitative findings about attribution and their final conclusion is vague and general.
Where Available:
http://www.focusonenergy.com/files/Document_Management_System/Evaluation/biogassupplysidestudy_evaluationreport.pdf

Report Title: ***Focus on Energy Evaluation, Renewables: Impact Evaluation January through September CY09***
Author: KEMA
Renewable Energy Agency: Focus on Energy (Wisconsin)
Date: 2009
Length: 109 pages
Purpose: To determine the percentage of program-tracked outcomes (demand and energy offset) that is attributable to the Wisconsin Renewables Program.
Description: In this well-written and well-organized report, KEMA completed participant surveys and engineering reviews to calculate overall realization rates, the percentage of program-tracked outcomes that were caused by and attributable to the program. As part of the study, field engineers examined a representative sample of installations to verify gross energy generation and extrapolated to the remaining projects. Phone interviews were conducted with representatives of

95 installations. A noteworthy aspect of the report is a clear presentation of all key assumptions and a sensitivity analysis of how the results would be impacted by changes or errors in these assumptions. The participant survey, which is reproduced in the appendix, could be easily adapted to other states. All the detailed responses of the survey respondents are also included in the appendix, and they show the range of information a program can glean from a phone survey.

Where Available:

http://www.focusonenergy.com/files/Document_Management_System/Evaluation/renewablesimpactevaluationjanthrusepcy09_evaluationreport.pdf

Acknowledgments

I want to thank the many people who helped me as I was researching and writing this report.

Mark Sinclair, the Executive Director of CESA, came up with the idea for this report and provided me with advice along the way.

Several experienced evaluators made time for me to interview them and provided valuable insights:

- Gretchen Jordan, Principal Member of Technical Staff at Sandia National Laboratories
- Vivian Kan, Associate Economist at Regional Economics Models, Inc.
- Thomas Kavet, President of Kavet, Rockler & Associates, LLC
- Lisa Petraglia, Director of Economic Research for the Economic Development Research Group, Inc.
- Bobbi Tannenbaum, Principal at KEMA

Many representatives of CESA members provided me with information and advice. I especially want to thank:

- Lise Dondy, former President of the Connecticut Clean Energy Fund
- Sandra Fromm, Supervisor in the Public Interest Research Division of the California Energy Commission
- Carole Nemore, Energy Analysis Project Manager at the New York State Energy Research & Development Authority

Benjamin Amankwata served as a research assistant, analyzing previously conducted evaluations of renewable energy programs.

Three people carefully read a draft of the report and provided me with valuable feedback and useful suggestions:

- Anne Margolis, Project Director for CESA
- Elaine Prause, Renewable Energy Senior Program Manager at the Energy Trust of Oregon
- Don Wichert, Director of Renewable Energy Services at the Wisconsin Energy Conservation Corporation

Maria Blais Costello, Program and Grants Coordinator for CESA, handled final production.

Because I did not always listen to the advice I received from these people, they are not responsible for any problems with the report, even though they very much helped to improve it.

Warren Leon
Senior Advisor
Clean Energy States Alliance
June 2011

Clean Energy States Alliance (CESA) is a national nonprofit coalition of public clean energy funds and programs working together to develop and promote clean energy technologies and markets. CESA provides information sharing, technical assistance services and a collaborative network for its members by coordinating multi-state efforts, leveraging funding for projects and research, and assisting members with program development and evaluation.

Many states and other sub-national entities across the U.S. have established public benefit funds to support the deployment and commercialization of clean energy technologies. Though these clean energy funds, states, cities, counties, and municipalities are investing billions of public dollars each year to stimulate the technology innovation process, moving wind, solar, biomass, and hydrogen technologies out of the laboratory and toward wider use and application in business, residential, agricultural, community and industrial settings. Public clean energy funds are pioneering new investment models and demonstrating leadership to create practical clean energy solutions for the 21st century.

www.cleanenergystates.org

Clean Energy States Alliance

50 State Street, Suite 1
Montpelier, VT 05602
Phone 802.223.2554
Fax 802.223.4967
Email cesa@cleanegroup.org
Web www.cleanenergystates.org