

Bridging the Gap Between Research and Market Acceptance: One State Agency's Commercialization Program

Sam Rashkin, California Energy Commission

Numerous emerging and existing end-use energy efficiency measures have not achieved significant market penetration in spite of impressive cost and performance characteristics. As a result, the ultimate payoff for successful research, development and demonstration is jeopardized. The California Energy Commission is addressing this issue with a new program called the Opportunity Technologies Commercialization Program (OTCOM). California's energy technology development policy report, the *Energy Development Report*, defines "opportunity technologies" as those in California's best interest for a secure and clean energy future. The OTCOM Program targets a subset of opportunity technologies based on their commercial readiness, potential for a meaningful market and ability for collaborative efforts to make a difference. This paper will discuss the OTCOM Program implementation process and results from almost two years of planning experience and initial actions. Therefore, discussion and conclusions are based on experiential knowledge gained from extensive observations and lessons learned rather than theoretical constructs derived from detailed citations and references normally associated with a technical paper.

Introduction

Background

A number of energy saving technologies developed over the past decade have successfully established significant market saturation levels. Examples include low-E windows, vinyl window frames, electronic ballasts and high-efficiency lighting. More typically, however, emerging and existing end-use energy efficiency measures have not achieved meaningful market penetration in spite of impressive cost saving and performance characteristics. For example, cost-competitive technologies such as passive solar heating and cooling, daylighting, waste heat recovery, evaporative cooling and advanced wall panel systems have been commercially ready in some cases well over a decade with extremely poor market acceptance.⁽¹⁾ In other cases, energy technologies originally considered "high efficiency" gained successful market penetration levels but have been superseded by superior technologies.⁽²⁾ For example, high-efficiency ground-source heat pumps are much more efficient than conventional high-efficiency air-source heat pumps, but full market acceptance has not yet developed. The ultimate payoff for successful research, development and demonstration is jeopardized unless we

improve the ability to establish these superior energy technologies in the market place.

California's Energy Commercialization Program

The California Energy Commission is attempting to accelerate the market adoption of energy efficiency technologies with a new program called the Opportunity Technology Commercialization Program (OTCOM). The *Energy Development Report* (EDR), the state's energy technology policy report, defines "Opportunity Technologies" as energy technologies in California's best interest for a secure and clean energy future.⁽³⁾ Criteria for determining opportunity technologies are heavily weighted toward environmental, economic development and diversity benefits. The OTCOM focuses on a subset of opportunity technologies that are selected based on commercial readiness, potential for a meaningful market, and ability for program support to make a difference. The program seeks to meet its goal by facilitating a sustained orderly development process for a subset of these targeted opportunity technologies.

The Sustained Orderly Development Process

The sustained orderly development process makes the vital link between all-to-often segregated research and commercialization efforts. The underlying concept is to build firm, accelerated, long-term market demand necessary to attract capital and invest in research and service infrastructure. “Firm” implies demand assurances are guaranteed by technology buyers; “accelerated” means that this demand will increase progressively to allow industry to develop manufacturing capabilities; and “long-term” means that all commitments will be fulfilled over an adequate time period for industry to achieve cost and performance goals. Although this concept was developed relative to commercialization of renewable electric generation technologies,⁽⁴⁾ it equally applies to end-use efficiency technologies. The process begins with the preparation of detailed development plans that establish firm cost and performance milestones. These plan milestones are used to verify market feasibility and serve as the basis for implementing “firm, accelerated, long-term” demand commitments. The key to this process is to incorporate input from key stakeholders. Stakeholders are defined as interest groups significantly affected by technology development including researchers, industry members and organizations, potential mass-purchasers such as utilities, government organizations, consumer advocate groups, and, in some cases, regulatory agencies. Development plans also need to internalize external costs and benefits to the extent possible when assessing future cost-competitiveness.

Where meaningful market opportunities exist, the development plans would proceed to identify long-term market purchase or other commitments by which all stakeholders share risks and rewards. For example, technology users, such as utilities, could commit to accelerated purchase levels; industry could make early cost sacrifices such as offering products at or below cost for the first purchase commitments; regulators would need to approve commercialization path life cycle costing practices that allow utilities to purchase energy technologies at a greater cost than conventional options in the present to achieve a preferred cost-competitive technology option in the future; and government energy organizations could develop incentives and/or other forms of support.

During the implementation process, the sustained orderly development plan must be continually evaluated and revised in response to actual developments. Specifically, each established milestone functions as an “off-ramp” point whereby commitments can be terminated or reconfigured if the research community and industry are not successful meeting stated goals. In these cases, cost and performance objectives have to be revised and market

worthiness reconsidered. Ultimately, the sustained orderly development process would terminate if technologies cannot be successfully commercialized.

OTCOM “Tools”

At the beginning of any program development process, it is critical to understand the implementation “tools” available. This allows for realistic expectations regarding program capabilities. Three primary implementation “tools” were identified for the OTCOM: information, brokered projects and collaborative.

Information

Information that fills critical gaps is essential to effective commercialization. Gaps will include credible cost, performance and reliability data; technology acquisition guidelines and supplier listings that reduce transactions costs; valuation of full energy and non-energy (improved profits, comfort, utility) benefits; assessments of externality costs and benefits; and market assessments that form the analytical framework for sustained orderly development plans. To be considered for OTCOM projects, information must:

- fill gaps in existing information;
- be appropriate for target audiences in both the level of detail and content;
- give decision-makers the bases for making decisions;
- accurately portray all aspects of energy technologies, including limitations; and
- be prepared with an eye for potential abuse.

Project Brokering

Project brokering, as the term is used here, brings key stakeholders together to resolve one or two critical elements needed to make projects a reality. This approach is used to resolve situations where stakeholders with technically and commercially feasible projects fail to get beyond the discussion stage. A sample application includes past Commission efforts bringing the solar industry and California Department of Corrections together to develop solar process heating projects of mutual interest. Brokered projects offer numerous benefits by building key decision-makers’ confidence; reducing high transaction costs to improve economics; developing innovative financing options; and bringing together parties with resources, but low propensity to risk. The following criteria have been identified for OTCOM brokered projects:

- there must be a clear understanding of project requirements relative to key “bottlenecks”;
- there must be a well-defined role for the Energy Commission to play; and
- there must be a written commitment by all stakeholders to follow up with their responsibilities. ,

Collaborative

Collaborative provide an alternative to the win-lose prospect of many adversarial proceedings by having stakeholders meet cooperatively to solve their common problems, set goals and obtain mutual gain. Specifically, collaborative activities have the potential to resolve institutional barriers; provide greater assurance of regulatory acceptance; reduce risk to utilities as early adopters; promote acceptance of commercialization path life cycle costing; and provide mechanisms for sustained orderly development. The following criteria have been identified for OTCOM collaborative projects:

- the commercialization “problem” must be definable and must be one that can be significantly addressed through cooperation of key stakeholders;
- key stakeholders must exist who are significantly impacted by the “problem” or have an interest in the “problem”;
- participating stakeholders must have significant influence over possible actions to mitigate the “problem”;
- key stakeholders must be willing to commit to active, long-term support; and
- one stakeholder must be willing to provide leadership.

OTCOM Program Implementation Process

The OTCOM recognizes that technology commercialization cannot happen through the efforts of a single state or with the resource limitations of a single program. Thus, the vision developed for the OTCOM is a limited number of technology-specific collaborative that lead to coordinated long-term commitments necessary for sustained orderly development. As a result, the first implementation action involved identifying a set of targeted technologies for the program. Ten targeted technologies (see Table 1) were identified based on the following criteria:

- identification as an “opportunity technology in the Energy Commission’s EDR;

- current or near-term commercial availability, at least for niche markets;
- meaningful California market; and
- need for support based on degree of existing or planned commercialization activities at other government, utility and industry organizations;
- reasonableness of costs to implement collaborative efforts; and
- likelihood that stakeholders will be willing partners.

The OTCOM has been structured in three parallel phases to achieve this vision: “seed” actions, strategic assessments and collaborative (see Figure 1).

“Seed” Actions

It was felt from the programs’s inception, that it was critical to implement a series of initial actions before the completion of a detailed planning process. The purpose of these initial actions was to capture available opportunities that would be lost during planning; to develop critical experience with the fundamental program tools described above; to “jump start” the program with immediate high-impact projects and near-term results, and to provide “seeds” for future collaborative. Potential projects were identified based on program staff’s first-hand knowledge of partnership opportunities, networking with the research community, networking with utility contacts and reviewing projects supported by other Energy Commission research and commercialization programs. The criteria used to select actions were high probability of success, transferability, visibility, shared contributions from other sources, and need for Energy Commission support.

Strategic Assessments

Although the “seed” actions served a number of important immediate program needs, a much more rigorous and systematic planning approach was necessary to provide an analytic framework for sustained orderly development. This phase of OTCOM implementation serves this need by developing detailed strategic assessments for each of the targeted technologies. One of the first steps in this assessment process has been the preparation of a national survey of existing and planned commercialization programs. This purpose of this survey is to identify potential collaborative partners, gaps in support and successful efforts for the OTCOM to build upon. The survey effort primarily focused on commercialization efforts at other state and local government organizations since large government programs, national research laboratories and utilities research organizations publish their own detailed program

Table 1. Targeted Technologies for the OTCOM Program

- **Evaporative Cooling**
Direct/indirect systems for residential and small commercial applications
- **Medium Temperature Active Solar**
Systems using medium temperature solar collectors such as parabolic troughs or evacuated heat pipe collectors for either desiccant dehumidifier or absorption chiller commercial cooling applications, or industrial process heating applications
- **Passive Solar Space Heating and Cooling**
Residential applications
- **Daylighting**
Commercial applications
- **Advanced Wall Systems**
High efficiency wall panel systems, without thermal bridging, for residential applications
- **Thermal Energy Storage**
Residential and commercial applications
- **Advanced Gas-Fired Water Heaters and Process Heaters**
Systems such as condensing water heaters for commercial applications and radiant ceramic fiber burners for industrial applications
- **Geothermal Heat Pumps**
Ground-source and water-source heat pumps in residential and commercial applications
- **Fuel Cells for Stationary Applications**
Phosphoric acid and molten carbonate fuel cells for cogeneration applications in the commercial and industrial sectors
- **Photovoltaic Systems**
High-value photovoltaic applications leading to cost-effective grid-connected and bulk power applications

plans listing their activities and utility demand-side management efforts are extensively surveyed by the Electric Power Research Institute.⁽⁵⁾

While the survey was being implemented, OTCOM staff also facilitated stakeholder focus group meetings for each of the targeted technologies. The purpose of these meetings was to build a consensus among key stakeholders on the most critical barriers constraining the use of each technology and to identify prioritized actions that could effectively address these barriers. The results of these meetings were used to begin the collaborative process.

The final component of this strategic assessment phase entails technology-specific market assessments that are being prepared by a consultant. These assessments will first develop baseline forecasts of “business-as-usual” mar-

ket saturations without commercialization support. The assessments then identify the sensitivity of market penetration to four key drivers: (1) awareness, (2) cost-effectiveness, (3) externality costs (environmental, employment and energy security/diversity), and (4) environmental/regulatory factors. Lastly, the assessments will forecast potential market saturations if the most critical drivers are significantly addressed with effective commercialization support. The results of these assessments will also be used as input to support the collaborative decision-making process.

Collaborative

Individual demonstration projects, informational materials and sporadic incentives associated with past government energy programs have not proven to be a successful

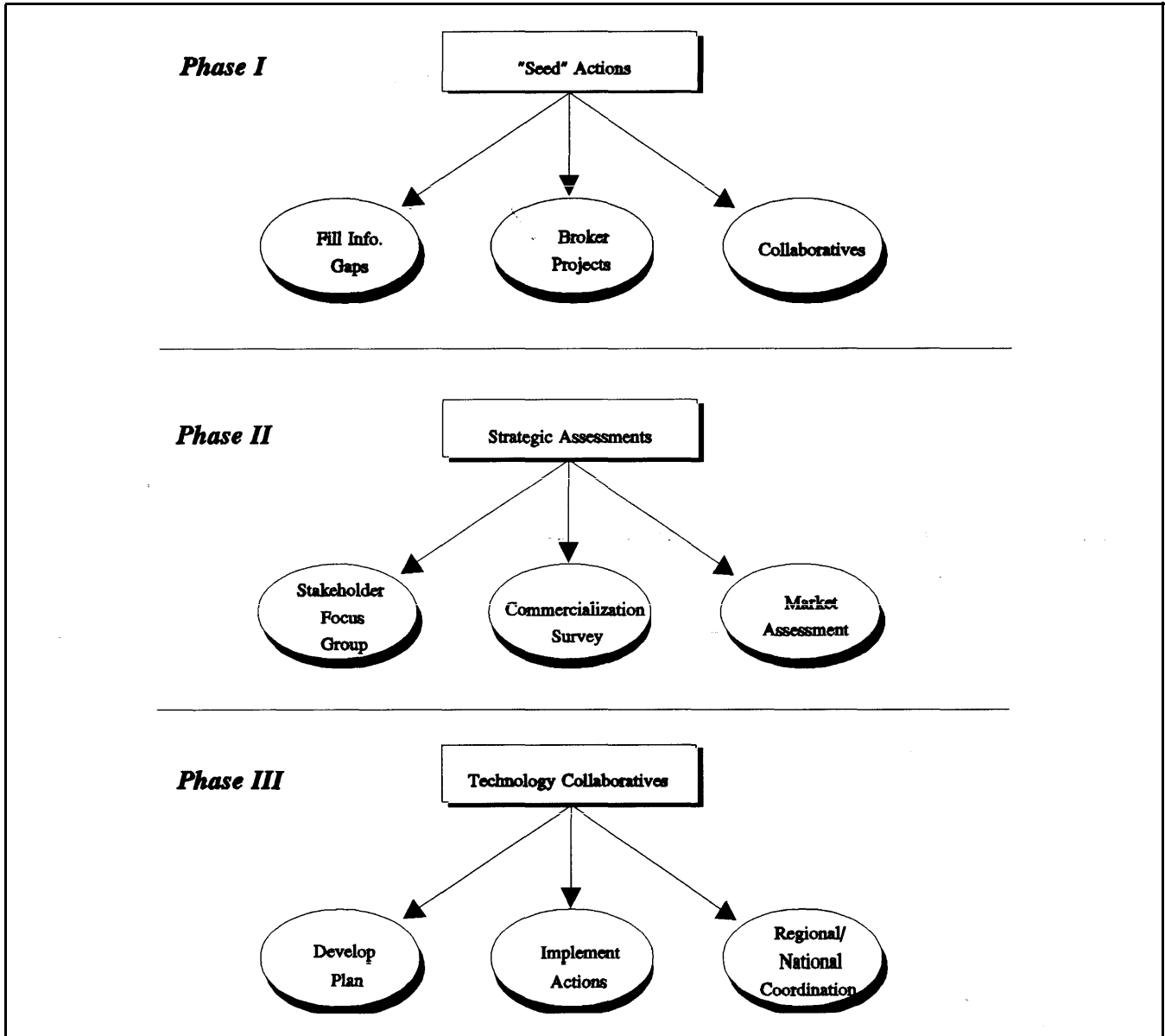


Figure 1. OTCOM Program Implementation Process

approach to achieving energy technology commercialization. In an attempt to build upon this important lesson, the OTCOM has instead chosen to emphasize technology-specific collaborative that effectively coordinate long-term support at regional and national levels.

The collaborative process proceeds for each technology directly after the focus group meetings with a “kick-off” meeting. The most critical function of this meeting is to screen the stakeholder participants relative to the collaborative criteria discussed earlier. If these criteria cannot be met, the collaborative process does not proceed any further. Based on current OTCOM goals, it would be considered a very positive result if efforts involving the original ten targeted energy technologies lead to at least three successful collaborative.

For those technologies where the criteria are met, the collaborative process will proceed modeled after a very successful photovoltaic technology collaborative that has been in place over a year-and-a-half as a “seed” action. This process involves using the “kick-off” meeting to initiate three main functions. First, members of the collaborative begin preparation of a commercialization plan, or “road map.” The purpose of this plan is to lay out a sustained orderly development process for collaborative implementation. Second, a consensus approach is used to identify and begin implementation of the most critical actions identified in the focus group meeting as well as new actions developed during the meeting. Often, implementation involves setting up special subcommittees that will address specific problems and report back to the full group with recommendations. Lastly, efforts must be

made to begin regional and/or national coordination as most appropriate. Typically, this coordination effort will involve working with existing consortiums and forming new alliances.

Following the “kick-off” meeting, long-term commitments come into play as participants must meet their obligations preparing portions of the plan and addressing specific actions so that all activities move forward on a timely schedule. Progress meetings are held on a regular basis to share information, make consensus decisions on all action items and delegate new action assignments as needed. At each of these meetings, it is imperative to verify stakeholder commitments. As long as stakeholder commitments can be confirmed, the collaborative process will continue until the sustained orderly development plan objectives are met.

OTCOM Program Status

The OTCOM program is still a very new program, only a year and a half old. To date, ten “seed” actions have been selected and are in various stages of implementation. These actions involve all three of the program “tools”, a diverse range of partners and highly leveraged funding support. Current program funding constraints have not made it possible to encumber monies allocated to the implementation of first-year collaborative projects before this final phase was fully underway. A so-called “interim process” has been developed to capture these funds. The interim process implemented fast-track support for a subset of three targeted technologies: (1) evaporative cooling; (2) medium temperature active solar; and (3) passive solar homes. Thirteen interim actions are currently being developed by expediting focus group and collaborative “kick-off” meetings.

The strategic assessment process is also at various stages of implementation. The commercialization program survey is complete, and stakeholder focus groups have been completed for all OTCOM targeted technologies, except photovoltaics which went directly into the collaborative process as a “seed” action. Detailed market assessments have only begun for the three interim process technologies. These first set of assessments are being used to test the market assessment methodology before applying it to all of the targeted technologies.

Finally, the collaborative process is fully underway with photovoltaics as just indicated. All of the other technologies are in the early stages of the collaborative process.

OTCOM Program Results

“Seed” Actions

Approximately \$10 million worth of project participation has been leveraged with \$.3 million first year funds. Specific results include:

- Information projects underway are addressing the needs of end-use section decision-makers. They include an *Evaporative Cooling Consumer Guide* that will significantly reduce the transaction cost for early adopters; *Industrial Energy Efficiency Applications Case Study* that will quantify compelling non-energy benefits important to industrial facility decision-makers; and *Quantification of Non-Energy Benefits for Passive Solar/Efficiency Technologies* that will feature a wide array of under-valued non-energy benefits for residential and commercial buildings.
- Brokered Projects are leading to solar process heating at California prison facilities, solar hot water at a state training facility and an important upgrade for one of the most successful active solar cooling projects in the nation.⁽⁶⁾ These projects have demonstrated that OTCOM program support can be an effective catalyst for large multiple facility solicitations. These projects have also demonstrated the ability for brokered projects to generate enough demand for manufacturing economies of scale that significantly reduce cost and drive the commercialization process.
- Collaborative efforts are being led by the “photovoltaics for Utilities” (PV4U) initiative. This collaborative is serving as the lead for 12 other states that have joined a State Working Group Alliance. Coordinated leverage at the national and state levels is leading to a six-year, 50-megawatt commitment nationwide for utility mass-purchase of photovoltaic systems. As part of this commitment, the U.S. Department of Energy is contributing \$18 million in first year funding with plans for similar funding each of the remaining six years. The California collaborative has also proven to be extremely effective mitigating institutional issues. Relative to Southern California Edison’s Off-Grid PV Pilot Program, the collaborative process was effective leveraging the California Public Utilities Commission to waive a costly and time consuming regulatory proceeding that made this utility PV project possible. Other more limited collaborative efforts have been used for the *Evaporative Cooling Consumer Guide* and a west coast solar hot water test facility.

Strategic Assessments

The facilitated focus group meetings have provided valuable insight: (1) establishing various degrees of stakeholder buy-in early in the OTCOM development process; (2) identifying the most important program opportunities; and (3) developing a network for future partnerships.⁽⁷⁾ The results of these focus groups are being published by the Energy Commission in a single volume.

On a parallel track, the OTCOM survey has resulted in a comprehensive commercialization programs data base. Moreover, the survey process revealed high interest in this data base because it fills an important gap in information relative to compiled national, state and local government commercialization programs. Therefore, this survey will be published by the Energy Commission and distributed nation-wide. The technology-specific market assessments are still being finalized by the consultant and will also be published when complete.

Collaborative

The primary results are from the PV4U collaborative discussed under "seed" actions. All other collaborative have completed, or are in the process of completing, their "kick-off" meetings. Thus, the OTCOM is still in a screening process determining the initial technology-specific collaborative.

Conclusions

The guiding principles of the OTCOM program are its limited focus on targeted technologies, recognition that extensive stakeholder input is critical from the beginning of the planning process, and a heavy emphasis on technology-specific collaborative that can lead to regional and national coordination. Early results indicate that this approach can effectively develop sustained orderly development plans, implement necessary long-term commitments for mass-purchases and reduce or eliminate critical institutional barriers. Thus, the program concept appears to be moving towards its stated objective of increasing market penetration. As a result, the research community is encouraged to actively participate in this and other collaborative efforts during the technology development phase to create an effective bridge between research and commercialization.

References

1. *Energy Technology Status Report (ETSR)*, November 1992, Sacramento, California, California Energy Commission.

2. *Emerging Technologies to Improve Energy Efficiency in the Residential and Commercial Sectors*, January 1993, California Energy Commission (CEC), Sacramento, California.
3. *Energy Development Report (EDR)*, December 1992, California Energy Commission, Sacramento, California.
4. Aitken, Donald W. "Impact of Sustained Orderly Development on Costs of Renewable Electric Energy Technologies." Response of the Coalition for Energy Efficiency and Renewable Technologies to California Energy Commission. November 1, 1991 "Notice and Order for Resource Assumptions Hearings."
5. *1992 Survey of Utility Demand-Side Management Programs*. Final Report, May 1993. Electric Power Research Institute (EPRI), Palo Alto, California.
6. Misemer, Philip, "Demand-Side Management Impacts of Evaporative Cooling and Solar Absorption Air Conditioning", 1993 Ozone Safe Cooling Conference, Washington, D.C., October 18-19, 1993.
7. Proceedings from California Energy Commission Opportunity Technology Commercialization Program focus group meetings (OTCOM):
Evaporative Cooling; Irwindale, California; October 26, 1993.
Active Solar Cooling; Sacramento, California; November 10; 1993.
Solar Industrial Process Heating, Sacramento, California; December 9, 1993.
Passive Solar Heating and Cooling; Sacramento, California; February 1, 1994.
Advanced Gas Combustion; Diamond Bar, California; March 14, 1994.
Daylighting; San Francisco, California; May 4, 1994.
Advanced Wall Systems; Sacramento, California; May 22, 1994.
Thermal Energy Storage; Sacramento, California; June 7, 1994.
Geothermal Heat Pump; Sacramento, California; April 13, 1994.