Managed Diffusion

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ABSTRACT

In 2005, the California Public Utilities Commission (CPUC) formally recognized codes and standards (C&S) as a resource program, allowing Investor Owned Utilities (IOUs) to claim credit for savings attributable to C&S program efforts.[1] This transition from an information-only to a resource program has a profound impact on the potential for increasing portfolio energy savings. Previously, standards that raised energy efficiency baselines diminished portfolio accomplishments by removing proven measures and products from rebate eligibility. C&S program successes will now contribute large and cost effective savings to the portfolio.

With the removal of disincentives for code adoption, utilities and others have a stake in seeing their voluntary program efforts to conclusion as mandatory standards; thereby creating a closed system that can be optimized with respect to voluntary and involuntary interventions.[2] Voluntary program efforts can be aimed at the most appropriate actors – for example, those who respond well to incentives – for the purpose of commercialization. If followed by adoption into code, the benefits of commercialization can be cost effectively extended to the entire market affected by code. This includes hard-to-reach customers who do not respond to voluntary interventions, but which benefit from protection against high energy bills. A code strategy can also be used to address markets for which transaction costs prevent a voluntary approach.

Many kinds of benefits, including greater portfolio cost effectiveness, can be realized through planning that combines voluntary interventions with codes and standards. This paper explores a managed approach to the process of technology diffusion in which innovations in building and appliance technology are "managed" for the purpose of preparing them for code adoption in the shortest amount of time. In doing so, we first consider the likely effects of energy efficiency diffusion of innovations. Second we propose principles of managing the diffusion of technologies for code adoption. Third, we apply these principles to residential pool pumps, which moved from concept to code in only four years.[3]

A Closer Look at Diffusion of Innovations

In recent years, energy efficiency program managers have increasingly tried to align program activities with various market adopter groups based on <u>Diffusion of Innovations</u> (Rogers, 2005). Emerging technologies managers try to find customers who are innovators when validating new technologies. Efficiency program managers target early adopters and early

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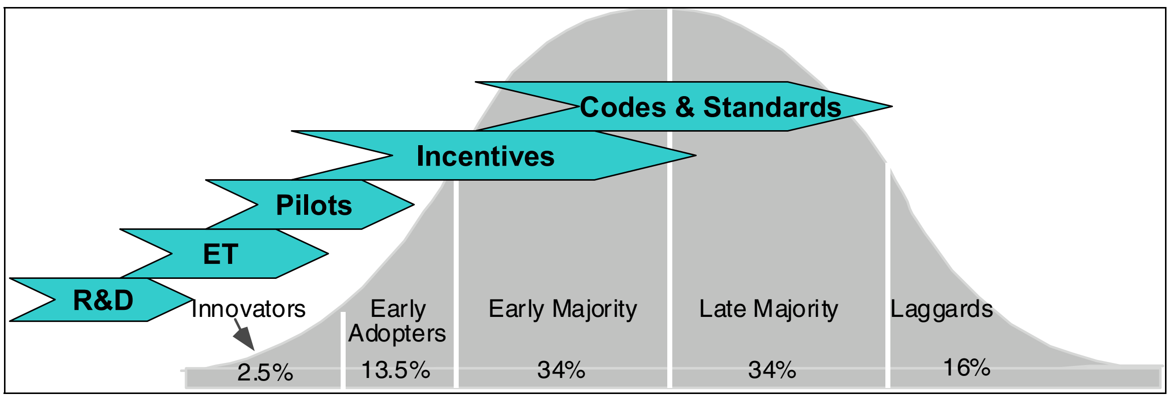
[1] Since its inception in 1998, California's Utility Efficiency Statewide Codes and Standards (C&S) program has been categorized as an "information-only" program, despite significant energy savings generated through its support for enhancements to mandatory building and appliance standards.
[2] "Voluntary" refers to programs – such as incentive programs – for which customer participation is voluntary.
[3] This paper does not discuss the work we have done to change the structure of the standards, such as with TDV and/or alternate compliance methods. This structural support provided by C&S has strategically influenced the goals of Title 20 and Title 24, allowing them to respond to the need for peak kW reduction and management.

majority actors for incentives and educational interventions. Most program managers accept the idea that codes and standards are the appropriate approach for intervening later in a product life cycle, and some consider them to be the only viable exit strategy for voluntary efforts.

Figure 1 illustrates the alignment between adopter groups and program types that many industry professionals accept. It emphasizes an orderly handoff from one program type to the next to reduce the risk of market failure. (Eilert, 2004).[4]

Figure 1, however, misses some key points. The market share at which a technology can be adopted into code varies widely.[5] While some technologies have been adopted at 85% market share (LED exit signs) in CA, others have been adopted at a 3 percent market share (dry type transformers), having satisfied the practical requirements of the Warren Alquist Act (Warren Alquist Act, 2005). In 2004, newly adopted appliance efficiency standards (Title 20) included: two speed pool pumps (1% market share), commercial pre-rinse spray valves (10%), very large air-cooled unitary air conditioners (25%), and Tier 1 external AC-DC powers supplies (40%). In 2005, Title 24 Building Energy Efficiency Standards included maximum duct leakage standards for forced air space heating and cooling systems, even though the market share was negligible.[6]

Figure 1. Alignment between Adopter Groups and Program Types



Adapted from TechMktWorks (Based on Rogers)

Figure 2 amends Figure 1 to illustrate the range over which code adoption can occur, and to emphasize the requirements for code readiness in an energy efficiency supply chain. In the context of this paper, "energy efficiency supply chain" means the state of readiness that products and practices exhibit with respect to the five principal prerequisites for successful code adoption in California. In a previous paper, the authors have postulated five principal determinants: reliability, availability, cost effectiveness, stakeholder support, and compliance readiness. (Eilert, 2002). If these are correct, a program that focuses on satisfying these prerequisites will minimize time and cost from research and development to code.

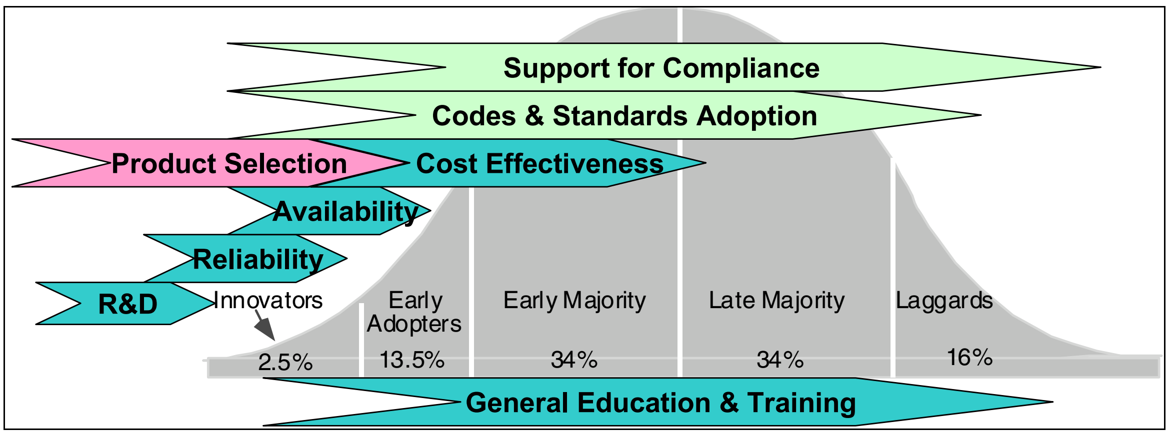
Minimizing time-to-code is important for a number of reasons, including the following: First, the cost of electricity saved through incentive programs is approximately \$0.038/kWh[7] (PG&E, 2006), while the cost to save through C&S is about \$0.0005/kWh[8] (Naaf, 2006).

[4] For example, incentive programs that promote new technologies prior to validation increase the risk of rejection.
[5] Neither does the amount of time in the market seem to determine successful adoption.
[6] Verified duct leakage was a proven energy efficiency measure as result of Utility and 3rd Party programs.
[7] This value represents the estimated levelized cost for PG&E's portfolio during 2006 - 2008.
[8] This value is based on net savings from the pool pump example – which are a small fraction of gross statewide savings - for standards that were adopted by the CEC in 2005, and is derived using CPUC-approved methods

Second, the impact of delaying a major standard – by a three-year code cycle, for example – can decrease real benefits to society by more than 40 percent since the entire 20 – 30 year savings stream from adoption must be discounted. Third, funds can be invested in new innovative technologies that would otherwise be used to continue rebating code-ready technologies.

Figure 2 also shows the addition of compliance support activities after code adoption. This addition is a consequence of a significant increase in the number, scope, and rate of change of standards in recent years, for both Title 20 appliance and Title 24 building efficiency standards.[9] Support for compliance improvement efforts is now an essential part of completing the market transformation process, sometimes even after spending millions of dollars to commercialize and adopt a measure into code.

Figure 2. Energy Efficiency "Supply Chain"



Adapted from TechMktWorks (Based on Rogers)

Principles of Managing Diffusion for Code Adoption

Managed Diffusion for code adoption requires preparation for both adoption and compliance**,** implying a long term plan focused on selected measures. Preparation for adoption, in turn, requires planning activities with respect to achieving objectives in each step of the energy efficiency supply chain, from development to adoption, such that all the adoption and compliance prerequisites are met. As shown in Figure 2, substantial overlap in activities between steps is needed to satisfy objectives.

This paper considers these issues from the perspective of a pilot program that overlays and supplements other programs in a portfolio at each step of the supply chain.[10] Many of the activities described herein are already conducted in one program or another, but not in an organized, consistent manner. An organized approach to preparing for code adoption will improve the likelihood of adoption, minimize impacts on incentive programs since adoption is the planned outcome, and maximize benefits. As code upgrade cycles reduce the number of

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(referred to as the E3 calculator) for determining cost effectiveness of incentive programs. Efforts to secure adoption of similar standards levels in other states tend to have a lower cost per kWh, since they generally copy California without requiring new analysis.

[9] The 2001 and 2005 upgrade cycles produced more code changes than previous cycles. PG&E and others have become increasingly concerned about likelihood that compliance may be much lower for the new standards.

[10] This approach allows incentive and other programs to focus on making savings goals.

code-ready measures for future proceedings, greater coordination between activities will become increasingly important to maintain a flow of new code-ready measures.

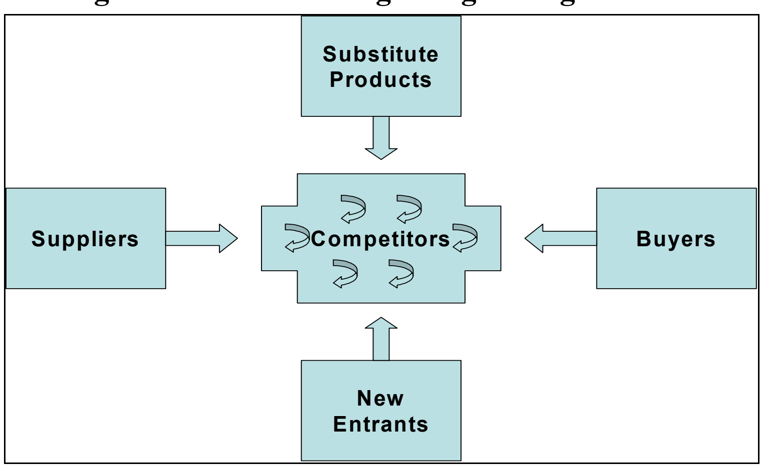
Product Selection

The first element of a Managed Diffusion pilot program is product selection. Products are first screened with respect to their potential overall cost-effective energy savings contribution to the utility energy efficiency portfolio. Once promising candidates are identified, further screening is used to identify good candidates to enter the energy efficiency supply chain, concluding with code adoption.[11]

Before investing program dollars in a new innovation, a program manager should understand the competitive disposition of product and supplier with respect to other industry actors and products. An otherwise promising candidate for Managed Diffusion may be abandoned if its competitive position is untenable.

Figure 3 presents a relative bargaining strength model of industry competition in which a group's bargaining position depends on others (Porter, 1998). In a competitive industry, the relative bargaining strength will shift from competitors to suppliers if supply is controlled by relatively few sellers. Likewise, if there are few competitors relative to buyers, product or service prices are likely to be higher than if the situation was reversed. Growing industries accommodate new entrants more readily than a mature industry. Substitute products will put downward pressure on price. Innovative products and services may cause industry disruption if product introduction is successful. Successful introduction, in turn, may depend on who launches the product, for example, an established competitor or a new entrant.

Figure 3. Relative Bargaining Strength Model



Adapted from Porter

Most competitive industries for products that feature energy efficiency will be segmented into at least two groups, one focused on low cost as a competitive strategy, and the other focused on product differentiation through efficiency. The objective of energy efficiency programs and services is generally to support the differentiation.

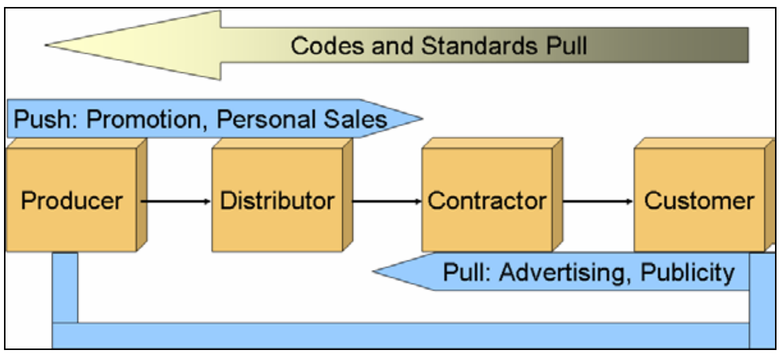
[11] Screening occurs within the context of market potential studies that inventory opportunities with respect to technical potential, market potential, and economic potential under different scenarios.

Industry analysis is not only important for product selection, but plays an essential role in helping to determine what tactical program interventions will be most effective. For example, an energy efficiency code-driven intervention, perhaps occurring early in the adoption cycle, would be effective for the "low cost" market segment, while a "resource acquisition" intervention would be most effective for the high efficiency differentiated product.

Product selection also requires a basic knowledge of the market channels (Kotler, 1988). The generalized market channel shown in Figure 4 includes a manufacturer, a wholesaler, a contractor, and customer.[12] Products are moved through the channel through push strategies, pull strategies, or a combination of the two. Manufacturers often use advertising and publicity during the early phases of a product life cycle, followed by promotion and personal sales.

Potential interactions between the manufacturer market channel strategies and energy efficiency programs must be considered. Customer education and audits, incentives, and branding constitute pull strategies. Builder and upstream incentives examples of push strategies. Push and pull strategies interact around contractors and suppliers. Adoption into code provides pull on the entire market channel.

Figure 4. Market Channel for Appliances



Adapted from Kotler

In the case of buildings, the market channel includes the builder and local governments. For owner-occupied nonresidential buildings, the channel also includes the customer.[13]

Reliability

Requirements for code adoption are similar to those for incentive programs: the risks of premature failure must be very low, and design professionals must be capable of designing lighting and building systems that are comfortable and otherwise meet the needs of customer. During the early part of a product's life cycle, qualitative aspects of reliability are more important than quantitative metrics such as mean time to failure. Prior to code adoption, however, quantitative metrics as expressed through product warranties increase in value.

In California, the statewide Emerging Technology (ET) program conducts activities to validate the technical feasibility and reliability of new energy efficiency products. Primary validation activities include test and evaluation installations at customer sites with appropriate monitoring and reporting. These installations uncover reliability problems before products become fully commercialized.

[12] There will, of course, be many variations for specific to each industry for appliances, buildings, etc.
[13] Once again, variations on this model will exist.

Product selection for the Managed Diffusion pilot program is conducted in parallel with screening for emerging technologies. Reliability assessment for Managed Diffusion will include reviewing the results of ET validation. Additionally, assessment of more mature technologies that have not passed through the ET program is necessary prior to code adoption, since reliability is somewhat independent of maturity and level of efficiency. If necessary, Managed Diffusion includes more extensive verification of reliability or remedial planning.

Availability

The primary objective is to establish multiple supplier channels to support future commercialization and adoption efforts. Additional requirements for managed diffusion include evaluating supply relative to demand for products or services, given code adoption. For example, manufacturers and suppliers of appliances are contacted to determine the risk of disruption, relative to a high level of compliance. Builders, designers, contractors, and building officials are contacted to assess compliance readiness for buildings relative to code requirements that may include alternatives for prescriptive requirements. If supply is adequate, education and training are provided as appropriate to prior to and after adoption. Otherwise, additional time and other activities are required to increase availability.

Ideally, a technology or concept emerges from basic research or from insight into how a market gap can be filled with a product that meets the energy efficiency needs of utilities without legal constraints on development.[14] Design contests, perhaps through reverse auctions or other methods, may be used to attract multiple suppliers to participate in product development.[15] From a Managed Diffusion perspective, requests for proposals must include the criteria required for handoff to the next step in the supply chain so that potential suppliers know that validation installations will occur. Knowledge of future support is required to attract risk capital to the product design effort.

Managed Diffusion is accomplished by selecting specific industries in which to introduce selected technologies, and identifying specific opinion leaders and change agents. Change agents are employed to recruit and work with opinion leaders on a variety of tactics designed to convince them to adopt a new innovation. Tactics include education, incentives and other interventions that complement market channel conditions. Other adopter groups will follow based on incentives.

There are also many products already established in the market for which little validation or commercialization is needed. A good product based on mature energy efficiency components is often stuck in a small “boutique” market, not due to technological challenges, but because of challenges in manufacturing, distribution and trade acceptance. For example, existing push or pull strategies may be insufficient to overcome the incremental cost for energy efficiency.

Innovations that have crossed the ET chasm, but have failed to respond to promotion, are prime targets for Managed Diffusion, since these opportunities carry significantly less risk and fewer issues to manage than those that begin immediately after R&D. Managed Diffusion for these opportunities begins with assessing the gaps, if any, with respect to other prerequisites for code adoption, and responds accordingly. Technologies that have been trapped in the supply chain for a substantial period of time have frequently met the objectives for cost effectiveness, reliability, and availability, and have sufficient stakeholder support to go directly into code. For

[14] Concerns over legal constraints highlight the need for strong publicly funded research.
[15] It is important that there be multiple winners.

example, dry type transformers failed to diffuse even with industry standards and availability from multiple manufacturers; however, they were adopted with negligible market share and support from trade group representatives.

Cost Effectiveness

Lifecycle cost effectiveness is achieved through statewide programs that offer incentives to offset the incremental cost premium for efficiency products. Increased commercial activity, in turn, pays for expanding supply and related infrastructure. As volume increases, the cost to produce and install should decrease even though reduced costs may not be passed on to the customer. Education and training required to conduct effective outreach and achieve program goals are conducted concurrently.

For Managed Diffusion, life cycle cost effectiveness is based on mature market costs rather than current costs. The mature market assumption is based on the notion that codes and standards have a commoditizing effect on high cost products and services differentiated by energy efficiency performance. Empirical evidence supports the idea of commoditization as shown when the adoption of the SEER 10 federal standards for central air conditioners did not result in price increases as predicted by the industry.

Managed Diffusion also provides sustained program outreach to opinion leaders to ensure support for future code adoption. General education and training efforts are reviewed to assess additional needs relative to future code adoption. Additional education and training are funded as necessary to ensure designer and contractor readiness when codes become effective. More strategic activities such as establishing procurement guidelines for large public and private institutions provide additional support for future code adoption proceedings.

Compliance Readiness

After selecting a measure for Managed Diffusion, an overall education and training plan is developed that is carried out during development of infrastructure and availability, during code adoption proceedings, and after adoption. A needs assessment is carried out for each group in the market channel to develop specific education and training plans. Planners must take into consideration issues of interest timing; for example, some groups may not be interested until after adoption.

Codes and standards that expand the scope of standards require additional planning. These include numerous standards for new appliance standards in California, some which are potentially challenging with respect to compliance, such as consumer electronics. Examples of building standards include outdoor lighting and cool roofs.

Codes for which compliance requires contractors to properly assemble components on site require special attention. Examples include site built fenestration and duct systems. In these situations, the pilot program manager must weigh benefit of pull from codes on the supply chain against the potential for disruption.

Code Adoption and Stakeholder Support

When supply infrastructure is developed to the point where it can support the increase in business caused by code adoption, codes and standards enhancement (CASE) studies are initiated to determine if products meet the lifecycle cost effectiveness and other criteria required by the California Energy Commission (CEC). CASE study results are presented during public proceedings. Sustained advocacy includes participation in all workshops and hearings, additional research and analysis in response to CEC and 3rd party stakeholders, coordination with other advocates, private meetings to address specific issues, and support for developing code language and related manuals.

Stakeholder support is an underlying objective of all Managed Diffusion activities, and a subset of stakeholders will support code enhancements if Managed Diffusion objectives have been met prior to adoption hearings. Some industry groups (frequently trade associations), however, will oppose any attempt to set energy efficiency standards based on free market principles or their commitment to represent all members of their industry, including those focused on lowest selling price as their primary competitive strategy.

Transition to Code

The transition from voluntary programs to code is important for a number of reasons. In addition to superior portfolio cost effectiveness and greater benefits to society, early adoption presents an opportunity to leverage the pull of codes on the market channel. The need to comply with codes at a definite time in the future – usually one year after adoption – motivates supply chain actors to prepare. Managed Diffusion takes advantage of this leverage by providing education and training programs.

If measures are adopted with effective dates two or three years hence, as is often the case for appliance standards, incentive programs are designed prior to adoption hearings, when additional future support can strengthen efforts to adopt strong codes. After adoption, the need for future compliance assures vigorous program participation; in particular, more than would be expected without the pull of code.

Transitioning to code as soon as possible will almost always be the correct decision.[16] From a diffusion perspective, adoption captures the benefits to society that would otherwise be paid for by continuing incentives; these are costly relative to code adoption. More importantly, code adoption captures the savings from end users that do not respond to voluntary programs, and this is almost always the majority of the market.

A three-year delay in the effective date of the two speed pool pump standard - or one code cycle, from 2008 to 2011 – would have decreased estimated net benefits to California by $600 million (Naaf, 2006).

Pool Pump CASE Study

There are 1.5 million private, residential, in-ground swimming pools in California, representing an aggregate, non-coincident demand of 3,000 MW, or 6 of California's 240 power plants. This constitutes a premier opportunity for reducing demand, improving electric system reliability, saving energy, and lowering operating costs.

Prior to 2001, swimming pool pumping had not been addressed by utility energy efficiency programs in California due to a lack of information on products' relative energy efficiency and concern that a swimming pool program would be adversely perceived as a subsidy for the affluent who can afford pools.

[16] Extreme cases of non-compliance, such as those presented by reliance on contractors for assembly of building components, may produce exceptions.

Product Selection

In early 2000, the CPUC asked the California utilities for program proposals that would have an immediate and significant effect in helping to minimize the threat to electric system reliability resulting from California's widely publicized power shortage. Products found in residences (air conditioners, refrigerators, lighting, home office & entertainment, etc.) were evaluated with respect to their:

- Demand reduction/energy savings technical improvement potential
- Market potential
- Economic viability
- Speed of implementation
- Likelihood of cost-effective energy/demand reduction, with minimum risk of failure

Of all products considered, air conditioners and swimming pool pumps offered the highest technical improvement potential for demand reduction. The demand reduction of pool pumps exceeds that of air conditioners and the energy savings are greater too, due to much longer hours of operation. Time switches to control time and hours of pumping are installed on virtually all pools. For those pumping on-peak, time switches offered an immediate opportunity for demand reduction through reprogramming to pump off-peak. High efficiency, capacitor start / capacitor run, and permanent split capacitor motors, as well as 2-speed motors were listed in manufacturer's catalogues and readily available.

High efficiency motors offer 8 to 12% demand reduction and efficiency improvement opportunities. Due to the pool system hydraulic effects, 2-speed motors operating on low speed for twice as long to filter the same volume of water theoretically offer an 88% demand reduction and 75% energy savings opportunity. The peak kW savings for the high efficiency pool pump motor is estimated to be 1.5 kW. The peak savings for the 2-speed pool pump motor is estimated to be 0.3 kW. Pool pumps are found in 9 percent of California residences, and pumping demand is estimated to be 2 kW throughout the late spring, summer, and early fall.[17] Pool pumping on-peak coincidence is estimated to average 40%.

The swimming pool timer switch reprogramming is virtually no-cost, while the high efficiency and 2-speed motors carry cost premiums of $50 and $100, respectively. The 2-speed motor does require a 2-speed controller (time switch), which costs about $200, bringing the 2-speed incremental cost to $300 (for motor only replacement).[18] High efficiency and 2-speed motors were readily available in the market, but enjoyed relatively little market penetration due to a lack of interest in high efficiency and disdain for 2-speed products on the part of many pool contractors. Implementation speed was thought to be quick if the necessary education and incentives were offered. It also seemed that this product might move quickly through resource acquisition (rebates) to code.

[17] Air conditioning tune-up programs and/or high efficiency new products are estimated to provide 1 kW of demand reduction opportunity for each home. Central electric air conditioning is found in 41% of California residences. Air conditioning is temperature sensitive and is estimated to present an average 3 kW demand on the hottest days.

[18] Improvements to central air conditioning systems are relatively expensive – several hundred dollars for tune-ups and up to a thousand dollars for premium EER compressors with evaporator coil changes.

Managed Diffusion Planning

Since high efficiency pool pump alternatives were already available, planning entailed evaluation of alternatives relative to each stage of the energy efficiency supply chain.[19] Reliability was thought to be high, as high efficiency and 2-speed products had been in the market for years, but due to lack of experience among pool contractors, were rarely used. Efficient products were generally available from manufacturers, but inventory was limited at wholesalers and virtually non-existent at retailers due to low demand. Cost effectiveness was extremely high as the 88% demand reduction and 75% energy savings potential of the 2-speed motor came at an incremental cost of well less than $500 at retail, with annual energy cost savings to the pool owner in the range of $500 to $700!

Technical and market related obstacles included: a) the absence of a widely accepted standard definition of pool pump energy efficiency, b) a need for test procedure development and, c) opposition by pool maintenance contractors who seemed to be strongly opposed to 2-speed motors. Pool contractors who operated on precedent and practices learned in the trade were vocal and highly opposed to the 2-speed standard, while those few who had experience with 2-speed were silent. The pump manufacturers and motor suppliers were silent. Previous experience with appliance efficiency regulation indicated that compliance was not a problem; however, precautionary intervention seemed prudent.

Managed Diffusion Plan

With the favorable screening outcome for this opportunity, a product plan was developed for the residential market. It called for:

- An immediate incentive program oriented towards influencing many of those currently pumping on-peak to switch to off peak hours.
- A longer term program effort directed at educating the trade and offering incentives for high efficiency single speed and 2-speed pumps.
- A state appliance standards code effort involving the preparation of a Codes and Standards Enhancement (CASE) report and associated advocacy with the industry and the California Energy Commission.
- A compliance enhancement effort to educate the industry and contractors about what the energy standards require.
- A product development / emerging technology effort involving assessing the commercial pool opportunity as well as the encouragement of better, variable speed pumping products and other swimming pool-related opportunities, including plumbing, filters, heaters, automatic cleaning equipment, lighting, etc.

The "Diffusion of Innovation" Results

The "Beat the Peak" timer switch program was implemented late in the summer of 2000. A $20 incentive was offered through direct mail to known pool owners for setting their pool pump operating hours to non-peak times. About 1/3 of the 60,000 to whom the incentive was

[19] Product development was complete for the technology, but efficient pool pumps remained "stuck" in the marketplace due to competitive conditions.

offered actually returned the rebate form and received the rebate. By pre and post random telephone survey, the evaluators believe that almost all of the respondents who took the money operated their pool pumps off-peak. In other words, non-compliance was very low. A 30 MW on-peak demand reduction was inferred from the interviewees' self-reports of pump operating hours. While not as persistent as other measures in the product plan, this effort did offer short-term on-peak demand reduction for less than $150/kW, and managed to call pool owners' attention to their pools relative to the state's electrical crisis.

The swimming pool pump program was implemented in mid 2001. It increased pool owner and contractor awareness through direct mailings, educated contractors through classes and demonstrations at trade group meetings, and offered $75 and $300 rebates for high efficiency, downsized single speed pumps, and 2 speed pumps, respectively. To date, over 200 classes/demonstrations have been done and 4,500 private residential pool owners have participated in this program, saving 1,400 kWh and 1.5 kW per 2-speed pool pump conversion.

Advocacy for improvements to state appliance standards began in mid 2002. A CASE study was prepared, incorporating industry comments, and was presented during the CEC's appliance standards proceedings. Industry was mostly silent throughout the proceeding, resulting in the unopposed adoption of the standards. Standards with an effective date of January 1, 2006 were proposed for high efficiency pool filtration pump motors (capacitor start / capacitor run, and permanent split capacitor), an efficiency test procedure, a listing requirement, labeling of pump HP and motor maximum HP. Standards with an effective date of January 1, 2008 were proposed for 2-speed motors. Proposed standards were adopted by the California Energy Commission with gross statewide savings estimated to be 1,500 GWh/year and over 300 MW/year after full replacement.

The pool industry had not previously been subject to energy efficiency regulations, so considerable confusion has followed the standards' adoption. This is now being addressed by an extensive communication effort by the utilities and stakeholder associations. The code requirements are being clarified and the utilities are helping to facilitate the industry's development of voluntary national efficiency standards. There is also an ongoing effort to work with pool contractors on the field installation details of 2-speed and variable-speed pumping systems, so they will be ready for the standards implementation in 2008.

The 2008 effective date for two-speed residential pool pumps provided an opportunity to leverage the pull effect of code on industry. As predicted, interest in information, education, trade related training, and incentives to bring the market up to code levels by the effective date, has increase substantially relative to pre-adoption. The more innovative pool contractors welcome the new code, as it will eliminate competition from low-cost, inferior efficiency products, and make it easier for them to "sell" more efficient equipment.

New efforts and innovation were stimulated by code adoptions. Informational compliance enhancement discussions are now underway with the International Aquatic Foundation, which is working to implement voluntary efficiency-related standards throughout the U.S., as well as with trade groups. Pilot programs run in late 2005 have identified significant opportunities in the commercial pool market for variable speed pumps, which have been developed in parallel with this product plan. Investigation into efficient pool heating, lighting and automatic cleaning systems is currently underway.

Summary

Managing diffusion of innovations with an objective to adopt into code as soon as possible will increase portfolio cost effectiveness and improve the transition from voluntary programs to code adoption. Portfolio savings are increased through a long term coordinated plan to satisfy prerequisites for successful adoption, thereby achieving potential as fast as possible and at minimum cost. Since the transition to code is planned, incentive program managers can prepare accordingly.

The next step is to apply principles of Managed Diffusion to other innovations. Listed below are potential candidates that the authors believe merit investigation.

- Incandescent General Service A-Lamps
- Electronic Self-Ballasted Ceramic Metal Halide Lamps for commercial retail use
- 25 Watt linear T8 fluorescent lamps
- Photocells for outdoor lighting control featuring ultra precision control
- Externally illuminated sign lighting (billboards) featuring horizontal burn pulse start metal halide lamps
- Flat screen computer monitors for high usage applications, such as call centers
- Office (cube) occupancy sensors to control plug loads for office workers who are often away from their desks
- Permanently wired standby loads such as LED emergency egress lighting
- Small volume storage gas water heater designed for the replacement market, achieving a 30% increase in efficiency above Title 20 minimum efficiency

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