An Industry Transformation Framework for Achieving Sustainability

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ABSTRACT

In regions of the U.S. with prevalent energy efficiency programs, ***Market Transformation*** (MT) has replaced ***Resource Acquisition*** (RA) and its limited objective of saving energy. MT carries the greater goal of creating sustainable change in commerce for energy efficiency (EE) but, despite attempts to address sustainable change through program planning, many of today's market transformation programs are only an incremental step beyond yesterday's resource acquisition programs. This paper briefly examines why, and assesses the limitations of the market transformation framework. Additionally, an alternative framework, ***Industry Transformation*** (IT), is proposed that leads to legitimate paths to sustainable change.[1]

Market Transformation's problems emerge from the model's limited scope which, for most public purpose programs, emphasizes technology supply and defines sustainability as the reduction of market barriers in the building industry. Implementation leads to project-level interventions diffused across numerous technologies, building industry actors, and customer business types, leading to a complex problem involving thousands of potential barriers. Since the MT model does not provide for resolving such complexity, program designers usually resort to their own experience, often acquired from resource acquisition.

Industry transformation has a broader scope that addresses strategic needs of unlike industries (competitive groups) that represent supply (the building industry) and demand (public and private sector entities) for EE. IT focuses on clearly defined industries first, and technologies second, permitting the use of ***Strategic Management*** concepts to analyze industries, and providing a legitimate framework for applying ***Diffusion of Innovations*** theory. Moreover, IT is more intuitive than MT, and clearly defines sustainability as one of three strategic objectives: ***corporate business strategies, codes or standards***, or ***social change***.[2,3]

Market Transformation Framework, Practice, and Implications

Most program managers interpret MT (Eto 1996) as a value chain, in which technologies originate from an upstream actor (e.g., a manufacturer), pass through midstream actors (e.g. architects), and terminate downstream, in a customer's new or retrofit project. This framework causes an emphasis in program design on technologies and projects, similar to RA, and is reflected in most MT program elements: incentives, education, etc. From a simplistic viewpoint, MT proposes, a theoretical model that:

a) defines a market structure through identification of market actors and their roles;

b) identifies barriers to technologies and practices associated with market actors;

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[1] IT may be considered a logical extension of MT, since MT prompted new thinking about public purpose programs in general. It may also be viewed, however, as the successor to MT.

[2] This paper is somewhat California-centric in its special treatment of MT. Although IT stands alone, the authors feel that critiquing MT (the most notable successor to RA) is necessary to defining IT.

[3] Some parts of this paper emphasize new construction since it presents the most complex transformation problem. Retrofit program managers will be able to apply IT to less complex problems.

c) develops sustainability hypotheses that provide a causal link between a potential intervention and a desired market effect;
d) designs measurable interventions that bring about demonstrable change; and
e) validates attribution to the intervention.

Market Structure, Actors, and Barriers

In practice, program managers find MT difficult to implement. A typical planning session includes identifying up-steam, mid-stream, and down-stream actors, and assigning appropriate barriers.[4] For each actor, at least one barrier can usually be identified, so an MT problem involving 10 actors with 14 barriers each, presents the program manager with 140 possible barriers. Without the means to process them analytically, the program manager defaults to previous experience, often attained through experience planning resource acquisition programs. In this approach, overlooking even one significant barrier can prevent the program from reaching its sustainability goals.

An actual MT problem may include thousands of barriers with more than 20 actor groups, and many technologies and practices spanning hundreds of distinct competitive groups across four broad sectors: residential, commercial, industrial, and agricultural. Since neither customer nor building industry groups are homogeneous, targeting specific actors within each group is important. Project uniqueness further complicates the problem.

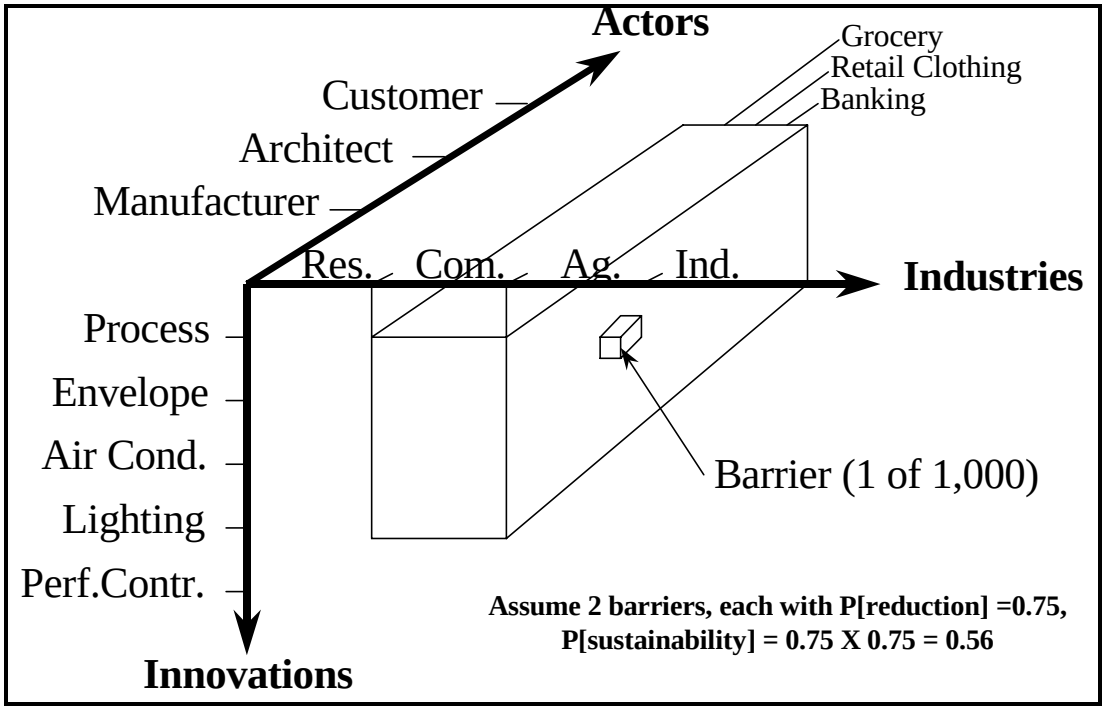

Figure 1. General Market Transformation Problem

[4] Examples of MT barriers include: information & search costs, performance uncertainties, asymmetric information and opportunism, hassle or transaction costs, hidden costs, access to financing, bounded rationality, organization practices and custom, misplaced or split incentives, product or service unavailability, externalities, nonexternality mispricing, inseparability of product features, and irreversibility.

Figure 1 shows a simplified 3-D representation of MT with examples of actors, innovations and industries on each of 3 axes. Assuming a simplified model with only 10 actors, 10 technologies, and 10 industry types, and assuming each transaction to be an independent variable, the outcome is 1,000 barriers. From a ***decision science*** viewpoint, the assumption of independence is subject to debate, but it is fair from the view that standard practice seldom includes integrated design and planning.

Now consider a simple MT problem involving only two barriers, and a probability of 0.75 that each will be permanently reduced. If sustainability requires both barriers to be permanently reduced, the probability of sustainability for just two barriers is only slightly greater than one-half (0.56), assuming independence between variables.[5]

Hypotheses, Interventions, and Attribution

Designing intervention strategies and hypotheses requires one of two general strategies: 1) reducing all barriers related to a technology coincidentally, due to market timing or,[6] 2) focusing on specific problems. Targeting hundreds of barriers at once is not feasible. Focusing excessive resources on one problem introduces issues of fairness with respect to allocation of public dollars, and may not provide a sense of progress for some. The absence of any strategic plan, however, is a fatal flaw, causing indistinct problem definition, ambiguous intervention strategies, and sustainability hypotheses absent of causality.

Weaknesses of Project Level Interventions

Infrequency of contact. Figure 2 illustrates the relationship between a building customer and a building industry provider, each engaged in competition in ***independent industries***. The customer may be part of any industry: computer manufacturing, retail clothing, banking, etc. The building industry contact, perhaps a developer, represents an entire cadre of building industry actors supplying the building. Contact between the two industries around a new building project may be infrequent. Indeed, several years may pass between projects if the customer company is growing slowly, and there is little prospect that the same decision makers are involved. This situation may approximate even large, rapidly growing companies with continuous new construction and rehabilitation, due to promotions or high personnel turnover.

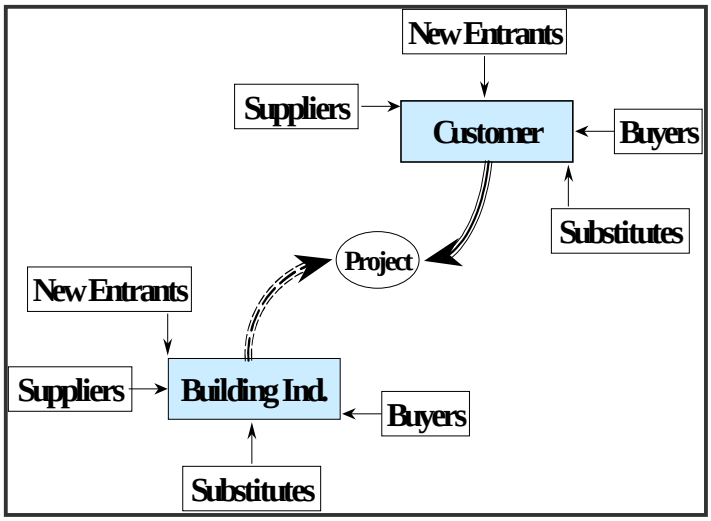

Figure 2. The Project as the Intersection between Two Independent Industries

[5] Neither program managers nor policy makers know, for sure, that they can permanently reduce market barrier.

[6] A functioning value chain requires that all elements work concurrently.

The consequent lack of continuity necessitates constant re-education of customers for each project, and constitutes a significant barrier to persistent customer demand. Lack of customer knowledge eliminates customer demand even at the facilities level, typically the first line of surrender to energy efficiency sales.

Poor communication channels. Most companies are engaged in competitive industries, and corporate decision makers are focused on primary competitive concerns: the relative bargaining strengths of suppliers and buyers that impact margins and operations, and the threats of new entrants or substitute product or services (see Figure 2). Site selection and gross energy costs create factor advantages for a corporation, so strategic decision-makers scrutinize them. However, EE incentives are not commonly communicated in ways that "speak to" core business needs, so neither EE nor project level incentives are significant in the minds of most corporate decision makers. This communication oversight limits the potential impact of customer incentives on corporate behavior.

Concentration on supply. Poor communication equates customer incentives to an emphasis on technologies and suppliers, specific to individual projects, at the expense of broader customer demand. Yet the overwhelming majority of PGC funds are invested, either directly or indirectly, in project-level interventions. Ultimately, the supply for EE products and services is conditional on customer demand, so ignoring demand prevents any chance of achieving sustainability. Although some continuing supply interventions accidentally find their way into demand common practice, these interventions have, in the past, created an undesirable dependence that inhibits productive exit strategies.

Conflicting Signals from Policy Makers

Program mangers are the focal point for transformation efforts. They are responsible for: a) translating policy objectives into program intervention strategies that change market behavior; b) designing implementation strategies; and c) delivering programs and results. Program managers must balance both market and policy signals, and if these factors cannot be reconciled, both the program and program manger fail.

Conflicting signals from policy makers (driven by conflicting needs) only make matters worse. Short-term public funding requires near-term success to support requests for future funding. But industries usually evolve over decades, and none change substantially within one or two years, the time-horizon presented to program managers.[7] While some policy makers are interested in MT's sustainability objective, an inherently difficult-to-measure, long-term objective, others remain focused on near-term benefits that are easily measured. The need to balance conflicting objectives is evident in program design, in that, most programs are unfocused with respect to MT and RA. Some program elements "look like" attempts to conform to the MT model, while others "look like" RA and satisfy the need to forecast near-term cost effectiveness. Even individual program elements may reflect both signals and, as a consequence, lack effectiveness with respect to either goal.

Implications of analysis. (1) Although MT provides a rigorous, high-level framework, the output of MT process is very complex, and there is no methodology for processing the

[7] Time horizons are inferred from requirement to file benefit/cost ratios with an implicit constraint to exceed "one."

information. (2) Although MT's objective of sustainability is justified, the requirement for predefined "walk-away" strategies, absent in either RA or MT, prevents formation of sound hypotheses and intervention strategies. (3) Weaknesses of project-level interventions indicate a resolute need to shift away from rebates, technologies, projects and the general emphasis on supply, toward customers and demand creation. (4) The general confusion over RA and MT obligates policy makers and administrators to consider new frameworks for conceptualizing and organizing social marketing for energy efficiency. (5) Assuming public purpose program objectives continue to include both sustainability and short-term cost effectiveness, aligning public policy with program design requires clearly separating MT efforts from RA efforts (at least at a program element level, and probably at a program level), and adopting a portfolio approach to program design.

Paths to Sustainability

Developing paths to sustainability requires defining walk-away conditions, or exit strategies, in advance of program development.[8] Exit strategies serve as both valid ***sustainability hypotheses*** and as guides to the program manager. Three such strategic objectives that are consistent with both rational behavior and sustainability, are characterized as follows:

1. **Corporate Business Strategy:** As a corporate business strategy, sustainability of EE is certain inasmuch as corporations embrace it on a voluntary, competitive, or core value basis in long-term business planning. Since most businesses tend to behave in their economic self-interest, companies adopting EE as competitive strategies can drive the supply and demand for EE innovations.
2. **Code or Standard:** As a code or standard, sustainability of EE is certain inasmuch as codes and standards affect a particular building or process. Since national, state, and municipal codes and standards may be considered "permanent" and affect the majority of market actors under their jurisdiction, changing codes and standards is automatically very effective.
3. **Social Change:** As a cultural value, sustainability of EE is certain inasmuch as secondary cultural values evolve slowly, and the populace is educated and enabled by the market to act on this value.[9] Since social change commonly evolves slowly (over decades), establishing EE as a social norm may be considered the most enduring type of transformation.[10]

Increasing the number of corporations that adopt corporate EE strategies increases commerce in EE as voluntary change. Upgrading Codes and Standards supporting EE products and services increases commerce as involuntary change. Social change towards a more energy efficient society supports both voluntary and involuntary change.

[8] This requires recognizing when an intervention may be discontinued with certainty of persistence.

[9] Marketers have almost no chance of changing core cultural values.

[10] Note the qualitative difference between these hypotheses and examples of those found in current MT programs (after paraphrasing). (1) Educated consumers demand more EE. (2) Supplier training increases availability of EE. (3) Customer incentives increase demand for EE.

Other walk-away strategies may exist. Breakthrough technologies that disrupt competition might become sustainable after being popularized through a simple RA effort. This is difficult to imagine though, except for industrial or agricultural processes. Moreover, strategic managers often suppress meritorious breakthrough technologies, to manage product introduction for maximum profitability. Investing in a successful EE start-up company would provide a valid walk-away strategy, but this may be considered a subset of the corporate business strategy.

The Path to Corporate Business Strategies

Delineating the path to corporate business strategies requires understanding how and why innovations are adopted, and understanding how to determine a customer's competitive needs. Insight into these subject areas comes from two well-developed fields of study: Diffusion of Innovations (Rogers 1995),[11] and Strategic Management (Porter 1998).

Diffusion of Innovations (DOI)

Diffusion of innovations depends on: (1) an innovation (new technology, practice, or idea) (2) communication channels through which information is exchanged (mass media or interpersonal), (3) the time required for the innovation diffusion process to reach adoption or rejection (knowledge→ persuasion→ decision→ implementation→ confirmation), and (4) a social system of interrelated units (a village, consumer groups, company employees, etc.).

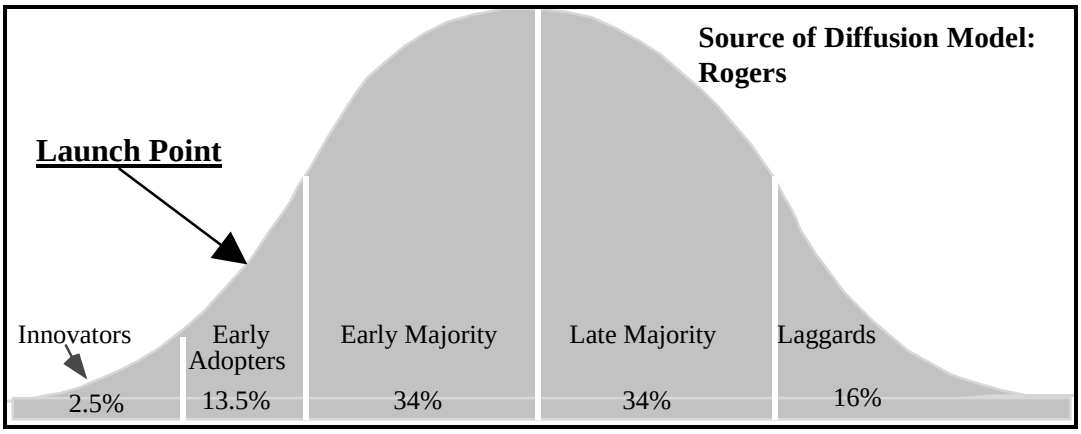

Figure 3. Idealized Model for Diffusion of Innovation

The social system. Structure exists within a social system to the extent that members of a social system are not homogeneous. Figure 3 (Reed, 1995) depicts an idealized structure in which a social system's population is normally distributed into adopter groups. *Innovators* constitute an outlying, venturesome group that has a lot of exposure to mass media, has the financial resources to tolerate risk, and actively seeks out new innovations.[12] *Early Adopters* are a more integrated part of the social system and are the system's opinion leaders, in that; they are respected in determining the suitability of innovations. *Early Majority* adopters are deliberate in their willingness to adopt new innovations, but interconnect through personal

[11] Diffusion of Innovations is rooted in social science but has been used in many different fields, including marketing, where models have been developed to predict adoption rates for innovations.

[12] Innovators are seldom market share leaders.

networks, so their decision process is longer than that of Early Adopters. *Late Majority* decision makers are skeptical and may adopt innovations out of economic necessity. *Laggards* use the past as a point of reference, and possess no opinion leadership.[13]

Key insights from DOI. (1) One of DOI's critical insights emerges from the idea of a launch point for innovations within a social system, usually (but not always) occurring before a 20 percent level of adoption. Once achieved, little additional promotion is required, as further diffusion is self-generated.[14] (2) DOI is more a social process than analytical. Although mass media is an effective channel for creating awareness-knowledge, interpersonal channels are more effective in persuading an individual to adopt new innovations.[15] A potential adopter in the early majority, for example, would likely seek input from an early adopter. (3) As a social marketing platform, DOI describes change agents in the diffusion process as professionals from outside the social system, usually with advanced degrees, who can communicate complex issues and solve problems. (4) Change agents are critical to early parts of the diffusion process, and numerous encounters are common between change agents and innovators (and, to a slightly lesser extent, early adopters). (5) Although change agents are usually heterophilous from their typical client, many agents are assisted by aids that are homophilous with respect to clients.

Strategic Management

Using DOI as social marketing platform for EE requires mapping the model's essential elements into a regime that program mangers can deal with.[16] This begins with disassembly of the MT problem into supply and demand, and clear identification of roles. *Private and public companies* are the source of demand for commercial buildings and their systems, with the private sector involved in the overwhelming majority of business. This group also includes speculative developers and property managers that lease buildings to a variety of tenants. Individuals create most of the demand for homes.

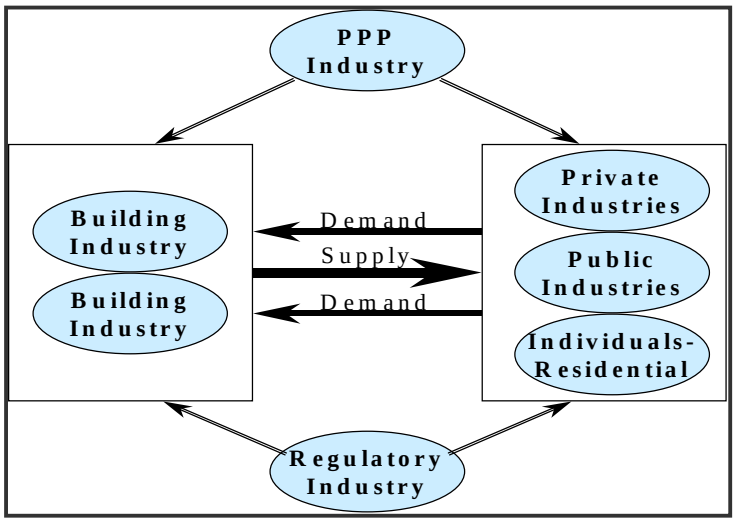

Figure 4. Building Industry Roles

[13] Not all distributions are normal.

[14] The idea of critical mass holds for non-interactive innovations, as early adopters influence peers to the point where an innovation is self-sustaining.

[15] Although technical or scientific studies are not immaterial to the decision to adopt or reject and innovation, most people look to others of similar socioeconomic status within the social system, who have already adopted.

[16] A direct overlay (see Figure 1) is clearly impossible. Communication between distinct customer industries is nonexistent. Similarly, within the building industry, there may be little or no communication between lighting designer and a banker. Neither do innovation suppliers communicate regularly.

The *building industry* is the source of supply for buildings and EE in buildings. Building industry representatives may induce temporary demand for EE through sales, but they do not provide primary demand. This group includes site consultants, landowners, commercial and residential real estate agents, developers, bankers, general contractors, builders, materials/equipment suppliers, architects, and mechanical and electrical designers.

Public Purpose Program representatives are change agents for EE as a component of supply and demand of buildings, and include: the California Public Utilities Commission, the California Energy Commission (CEC), utility administrators and implementers (consultants, contractors, equipment vendors, third-party providers, etc.).

The *regulatory industry* includes the CEC (T20 and T24), DOE (codes), and ASHRAE, ARI, IES (standards), etc. From a social marketing view, this group simply provides another form of intervention—involuntary.

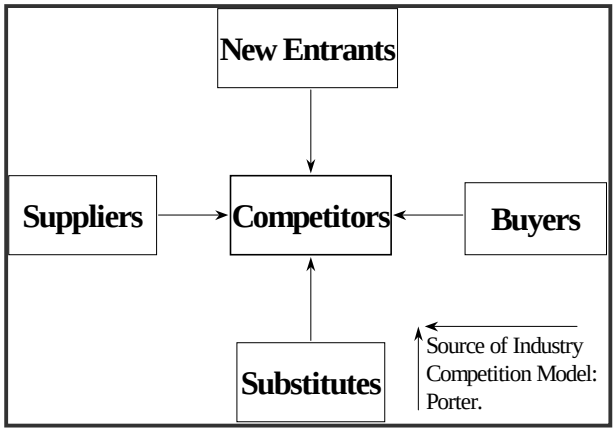

Figure 5. Industry or Competitive Group

Definition of "industry." Industry transformation is based on the definition of an industry as a competitive group, and the forces that lead to varying competitive strategies (Figure 5). Distinguished from industrial process, it refers to the generic definition more common to strategic managers including: (1) a group of competitors around a specific product or service (e.g. retail banking services, computer disk manufacturers, refrigerated warehouse, etc.); (2) component suppliers, customers; (4) new entrants; and (5) potential substitutes (Porter 1998).

Competitive setting. Industries are analyzed by considering the relative bargaining strengths of groups that influence competition. If suppliers are numerous and present no threat, the competitor is in a strong negotiating position and may drive a supplier's margins down. If there are many competitors producing a single product, buyers may force prices down by shopping wisely. New entrants and substitute products represent other threats to market share and profit. Generally, competitive issues dominate corporate decision-making.

Key insights from strategic management. (1) Both supply and demand are required for sustainable commerce without public support. (2) From a customer demand perspective, a new building or EE project is important only as it relates to the customer's competitive conditions. (3) Programs that aim at sustainability as a primary objective must conform to a specific industry's competitive conditions and requirements. (4) Dissimilar industries (e.g. big box retail and disc drive manufacturers) do not communicate with each other, so large incentive programs that provide an "umbrella" for incentives and design support, without industry focus, have almost no chance of achieving sustainability. (5) Persistent demand by customers for EE as an idea, technology, service, or practice, requires linking EE to a corporate business strategy. (6) Diffusion of Innovations theory does not apply to sectors

(e.g. commercial buildings) since a sector typically includes many different competitive groups.

DOI, Strategic Management, and Program Development

Customer demand. Identification of a viable customer social system is a prerequisite to planning customer program interventions, and the industry (or competitive) setting satisfies this fundamental requirement. The industry provides a skeletal communication framework, especially if the industry has an active professional organization, and an analysis platform for determining strategic interventions. Industry competitors communicate regularly around issues of common interest, and most industries contain structure, in that there are clear leaders and laggards with respect to innovation. This structure is the result of competition (e.g., product differentiation versus cost, or other strategies), which forces companies to naturally segment into market niches (technical superiority, service, value, etc.).

Within the industry framework, the normal (or bell-shaped) curve represents a population of competitors within a single industry, for example the companies engaged in pharmaceutical manufacturing, retail clothing, etc. (Figure 6). Demand for an EE innovation within an industry is not simply a matter of interest; price, risks, and other factors determine the level of demand. As a social marketing problem, there are significant efficiencies (or leverage) to be gained from selecting the most appropriate adopter for a particular intervention. Generally speaking, however, the costs to change behavior, through voluntary response to market-based programs, increases from left to right.

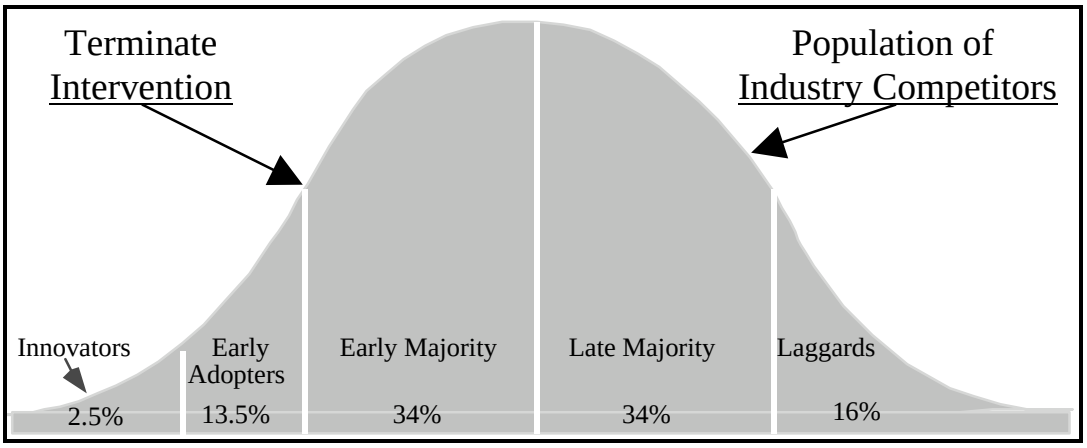

Figure 6. Population of Competitors in a Single Industry

The program manager's objective is to persuade a critical mass of competitors to adopt an innovation (or EE in general) as a direct or implied corporate business strategy. Critical mass is usually (but not always) achieved after 15-20 percent of adopters (industry competitors) have accepted a new innovation. Beyond critical mass, interventions become more of an RA effort, or are based on a desire to accelerate adoption for eventual inclusion into code. Once critical mass is achieved, interventions may be discontinued with confidence of persistent customer demand.

Customer interventions. Within the industry setting, the two most important types of interventions are those that: a) facilitate industry communication to increase diffusion, and b) leverage public investment through competition (Figure 7). Either matching the intervention

to the appropriate adopter group, or providing information that compares competitors with respect to EE performance, (or both) creates leverage.

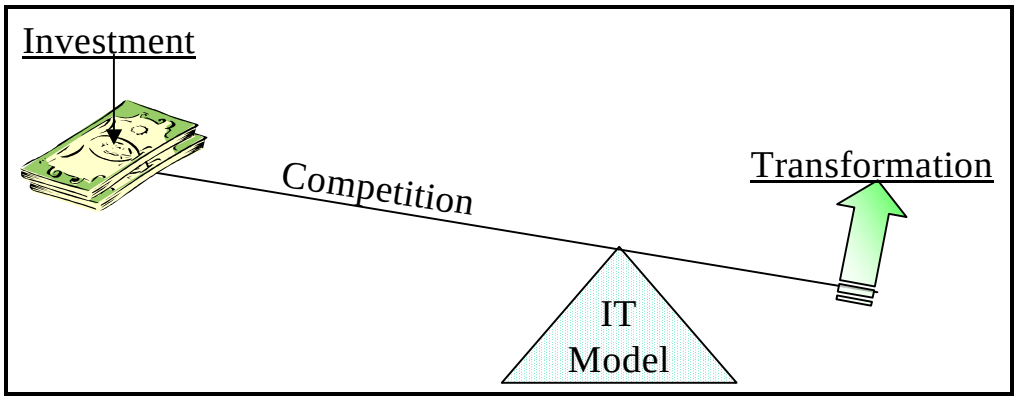

Figure 7. The Use of Competition to Leverage PGC Funds

Industry-level, communication and strategic interventions include the following.[17]

(1) Promote or create interpersonal forums that increase contact among early adopters, and between early adopter and early majority groups. Industry conventions, where early adopters present case studies, will increase early majority adoption. Moreover, industry leaders are more influential than are change agents in influencing early majority actors.[18]

(2) Support industry associations, industry Web sites, and industry periodicals with information and educational materials. Industry professional associations are credible source of information, likely to influence innovators and early adopters.

(3) Assist industry associations and organizations in making EE part of their mission. This could begin by funding business plans focused on eventual self-sufficiency.

(4) Develop information that demonstrates competitive advantages through EE, for example, EE indices through industry comparative performance or benchmarking studies.

(5) Develop industry-specific information that "speaks to" strategic decision-makers. For example, establish a clear link between reliability and commissioning for manufacturing industries. Improve educational materials that demonstrate increased worker productivity with daylighting in the commercial sector. Translate EE savings into appropriate financial indices (cost of goods sold, life cycle costs, etc. for business unit vice presidents) and pro-formas (cash flow forecasts, property value forecasts, etc., for speculative developers). Link indoor air quality to EE in the residential sector.[19]

(6) Support existing standards that are meaningful to industry competition (e.g., ISO 14000) or create new competitive standards (e.g., provide credible 3rd party verification of environmental claims—global warming or chemical emissions).

(7) Identify innovators that seek and use new information, and use the Internet (possibly "push" technology) to provide periodic communication of new innovations.

(8) Engage in joint industry planning, and develop industry-specific RFP's that call for jointly developing demonstration projects. These might be large ($1 million per industry)

[17] These contrast project-level interventions.

[18] Imagine spending $100,000 on a rebate versus supporting a well-planned industry conference. Which would serve to drive an innovation further up the adoption curve?

[19] The communication effort is significant and this list is but a few examples.

and require significant matching funds. RFP criteria would reflect specific industry transformation needs, and require engagement by specific groups.

(9) Create new industry-based organizations that entail a change in "market" structure, perhaps new industry-focused EE non-profit organizations. Something radical may be the shortest path to sustainability.

(10) Work towards industry-targeted tax credits that link competition to EE.

Customer intervention strategies. Interventions should be tailored to meet the needs of those receiving most attention: innovators and early adopters. Several intervention strategies for achieving critical mass emanate directly or indirectly from DOI and strategic management. (1) Target top officials in an organization's hierarchy (there will be exceptions to this). (2) Shape individual perceptions of the innovation—desirability, inevitability, etc. (3) Direct mass media towards innovators. (4) Increase contact between change agents and industry leaders—attend industry events, conduct interactive roundtable discussions, and engage in joint industry planning. (5) Conduct demonstration projects with innovators, since they communicate less with the early majority (and possess less opinion leadership) than do early adopters; risk of rejection is reduced if the demonstration fails. (6) Conduct exemplary (showcase) projects and support case study development for early adopters—opinion leadership provides leverage for investment. (7) Provide incentives for exemplary (showcase) projects. This would not constitute a rebate program, but would assist early adopters in setting higher internal corporate standards. (8) Reduce communication barriers by employing change agent aids (sales agents) that have industry experience and personal relationships. (9) Introduce to groups likely to adopt at once—chain stores, local governments, etc. (10) Employ strategic management firms to assist with communication.

Building supply. A prototypical new project begins with a developer as the prime mover, who puts together various input factors to satisfy customer demand. (As prime movers, developers or design-builders are the competitors in Figure 5.) A group of *professionals* including surveyors, architects, and engineers (structural, electrical, mechanical) are then hired to locate improvements, design the project, and assure its soundness. General contractors are the focal point of several million workers in the U.S. construction industry, and coordinate sub-projects through *trade groups.* Subcontractors include: excavation, concrete, rough carpentry, finish carpentry, electricians, plumbers, roofers, and suppliers of assorted appliances. Investors (individuals, corporations, and institutions) are directly connected to user-oriented demand, but have a completely separate need—cash flow.[20]

One way to map DOI into supply is through professional and trade groups, but there are so many groups and chapters that this strategy may not be feasible. Additionally, there is a need to integrate these groups, rather than treat them separately.

A regional mapping is more appropriate and, as such, the normally distributed population (in Figure 6) represents building industry suppliers within a metropolitan or municipal statistical area. Building supplier companies tend to be regionally focused, due to

[20] From an EE viewpoint, most buildings may be viewed as manufactured products, since integrated design is not common practice. As such, the major difference between manufactured and site-built buildings is whether the product goes by manufacturers on an assembly line, or whether manufacturers go by a stationary product.

project orientation and regional variations. Regional economics, local governments, planning commissions, etc., have a large effect on projects. Communication within regions is common among individuals and groups that repeatedly partner on successive projects.

Since supply is conditional on demand, the primary supplier objective is less dependent on reaching critical mass than it is reactive to fulfilling customer expectations, translated through developers & design builders. The secondary objective, to support adoption of technologies and practices into code, is discussed further below.

Supplier interventions and strategies. Most previously described customer interventions and strategies are appropriate for suppliers. Additional interventions more specific to suppliers include the following.

(1) Develop regional change agent centers that would emphasize industry business needs more than technology. Ideally, change agent centers would be staffed by both business and technical specialists, and be directed by investors (at least bankers), developers, builders, and vice presidents of companies from representative industries in the region. Business plans for change agent centers could provide for eventual self-sufficiency.
(2) In conjunction with change agent centers, encourage communication between building professional associations and trade groups, and deliver RA (rebates) regionally.
(3) Support community change agent centers as part of local government initiatives, perhaps in conjunction with "energy efficiency stores."
(4) Leverage competition by engaging building suppliers in benchmarking or comparative performance studies that anonymously compare developers within a region.
(5) Support efforts to link EE to the building appraisal process. This would include creating regional building databases as well as education.

Linking Supply and Demand

EE's fundamental problem is that it is merely a financial construct. As such, it lacks the physical utility expected from, say, a copier or Internet service. Customers and suppliers reflect this abstractness through an endemic lack of interest in EE. Such abstractness, coupled with performance uncertainty, creates a degree-of-believability problem (or risk) for potential buyers of EE products and services. This risk is managed either by outright dismissal of project proposals or by discounting benefits in cash flow models.[21]

In concept, performance contracting is a "perfect" solution.[22] It inevitably exposes hidden utility, communicates it in the right language (financial), and provides risk management. Performance contracting is sufficiently important that improvements to the existing state of performance contracting merit exploration by a joint task force of public and private sector representatives. Many previously described industry interventions and strategies would apply. Specific intervention topics would include the following.

(1) Support the creation of a new construction performance contracting industry. With proper guidance and support, this incipient industry may be molded such that lessons learned in the retrofit industry are not repeated. New construction performance contracting would be introduced through specific industries beginning perhaps in the

[21] The problem of abstractness is matter of degree. Lighting retrofits are easy to understand and, hence, easier "sell" than, for example, the concept of integrated design for a new building.

[22] Other "linking" interventions include targeted information, commissioning, etc.

public sector where long-term investments are accepted, or in the school industry (and others) where customers are regularly engaged in retrofit performance contracting.

(2) Promote performance contracting between profit centers within large companies that have adequate technical expertise, through education and demonstration projects. These efforts would also educate customers should they decide to outsource such services.

(3) The long-term problem of credibility should be addressed. Part of this could be addressed through positive techniques (awards and other forms of recognition). Industry associations might provide an Internet service that links a potential customer to a recommendation service, or to an anonymous site for customer feedback. There may be several other creative ways to support good energy service companies.

(4) "Cream skimming" might be addressed through incentives that target specific markets or systems, not currently part standard industry practice. These efforts would serve to broaden the scope of activities. Additionally, public sector change agents might partner with energy service companies to do demonstration or exemplary projects.

Program Planning for Industry Transformation

Program planning for IT is a hierarchical process in which industry level, diffusion requirements are considered first, followed by competitor needs. The objective of examining industry needs is to understand whether the essential elements of DOI are in place to support the diffusion process. The objective of examining customer needs is to understand standard practice, and assist the program manager through an analysis that is "out-of-the-box" and out of one's comfort zone.

(1) Industry selection. Implementing IT begins by identifying industry targets within the sector of interest: residential, commercial, industrial or agricultural. Scoping or demographic studies are completed based on selected industry criteria: size, growth-rate, energy as a percent of cost of goods sold, etc. These studies provide statistics and trends for ranking industry groups (SIC2 level). After ranking, industry group data are then sorted to identify specific industries of interest.

(2) Industry characterization. Selected industries are then characterized, to provide information for completing planning for each industry. Characterizations are completed through research of public data, interviews with industry representatives, and interactive industry roundtable discussions. Examples of diffusion process requirements include:

a) innovator needs—are they receiving good information;
b) early adopter needs—are there educational channels; and
c) early majority needs—do interpersonal forums exist.

Industry interventions. Developing industry interventions is relatively straightforward. Table 1 shows examples of a one need and one possible intervention for three adopter groups.

Table 1. Industry Diffusion Intervention Map (not intended to be complete)

DOI Group	Need	Intervention
Innovator	information about new interventions	increase change agent activity
Early Adopters	education of EE benefits	targeted information
Early Majority	forum for interaction	support conferences

Customer Interventions. The customer intervention map is completed such that each need is mapped into a single intervention, to maintain causal linkage. Customer interventions do not include non-strategic, project-level interventions. After identification, interventions are ranked; budgets and timelines are added as appropriate. Consider Table 2.

Table 2. Customer Intervention Map [not intended to be complete]

Customer Needs	Attributes	Value Proposition	Potential Intervention
1. lower operating costs	1. percent COGS	1. new technology	1. RFP for joint industry Demo. project
2. productive learning	2. SAT scores	2. labor productivity	2. targeted information - daylighting
3. speculative resale value	3. profits	3. energy efficiency	3. translation of EE into pro-formas
4. product differentiation	4. political goodwill	4. environmental goodwill	4. 3rd party verification
5. first to market	5. market share	5. none	5. none
6. reliability	6. low risk	6. dependable system	6. commissioning

a) customer needs are identified and include: operating costs, quality, risk avoidance, product differentiation, service differentiation, first to market, plant flexibility, cash flow, profit margins, share price, etc.;
b) attributes (how each need is quantified or qualified) are identified, for example: raw materials, depreciation, labor, or energy as percents of costs-of-goods-sold, revenue loss for each hour of down time, etc.;
c) potential EE value propositions are identified: resource productivity, labor productivity, environmental mitigation potential or goodwill, reliability, health, sales, etc.; and
d) potential interventions are based on understanding the project or new building construction cycle, and existing tools, practices, products and services.

Industry Transformation Implementation

Experience. Many components of IT have been implemented in one form or another,[23] but not within the context of a practical implementation framework that leads to sustainability. In 1999, however, PG&E's Industrial and Agricultural New Construction program was based on a prototype of the IT framework.[24] Program activities included industry comparative performance studies, industry roundtable discussions, and industry focused outreach. These activities continue in 2000.

The program employs industry leads that coordinate industry planning and project activities, and conduct industry-focused communication and outreach. Industry roundtable discussions have provided a dynamic, engaging forum (where none existed previously) for communication between industry competitors, change agents, and building suppliers. The change agent/aid model is very effective for both "opening doors" and conducting meaningful work. Industry leaders are especially interested in performance studies that provide anonymous, but industry-specific, comparative performance information. Such

[23] The reader may often find himself thinking, "I am already doing some of this." This is expected, in that, the IT framework provides a way to organize many existing (and some new) activities.

[24] A complete, multiyear plan has not been completed due to inadequate funding and policy constraints.

information compares standard practice to best practices and shows competitors how they "stack up" with respect to one another. This work has already motivated logical phase-2, industry-focused work. Perhaps most important, and somewhat unexpected, is the development of a functioning, effective relationship between change agents and customers, beyond the sterile, superficial relationships formed through project-level interventions. This subtle, but extremely important, issue is important to successful joint efforts between change agents and customers, to reduce barriers to persistent customer demand and sustainability.

Strategic considerations. There are some important considerations to remember when working in the various sectors. Each sector will have industries with significantly different characteristics, and while similar industries (and industries that require planning coordination between material or parts suppliers and industry competitors) may be grouped,[25] dissimilar industries must be treated separately. The size of the "box" that defines an industry must be decreased until an industry's competitive group can be recognized as in Figure 5.

Sector notes. Within the ***industrial sector*** (mostly manufacturing companies), the degree to which process and facility are integrated varies, but given the direct link between technology and the "bottom line," decision makers are usually comfortable with technical issues. This sector is therefore less dependent than are other sectors on supplier services, and internalizes EE decision-making. Many companies determine project specifications and fund projects internally, and deal directly with design-build firms. As such, energy service companies have little success in this sector. Public purpose program, change agents may find that "hands off" interventions (e.g. targeted information) are most appropriate, especially for industries that have rapidly evolving products. Since production stops (and in some industries, product is ruined) when electricity fails, linking EE to reliability is the highest priority; this issue merits a large investment of PGC funds. Translating EE into cost-of-goods-sold, as both reductions in direct cost and amortized capital cost, is a minimal requirement to having an effective conversation with an owner or vice president of operations.

The ***commercial sector*** is comprised of industries even more diverse than those found in industrial sector (e.g., retail clothing has few competitive issues in common with legal services), and there is less affinity to technology. As such, commercial customers are "weak" with respect to the building industry. Interventions, directly with customers, are appropriate for demonstrating relationships between EE and business interests. Specifically, the importance of labor productivity increases relative to that in the industrial sector, and the relationship between EE, increased comfort and productivity, merits a large investment in PGC funds. Such information would provide an educational and intervention platform for developing persistent customer demand, even if it lacked rigorous statistical significance. Since speculative building is prevalent in the commercial sector, there is no substitute for change agents adopting the language of finance to describe interventions, if necessary through specialized change-agent aids.

The ***residential sector*** has fewer industry types (approximately four) than either commercial or industrial sectors, and large, conventional builders dominate it. Although individual buyers may be interested in EE homes, they are geographically diffused and exert no demand or purchasing power over builders engaged in developing entire subdivisions.

[25] We haven't tried this yet, but we know that "proximity" to similar industries causes "information bleeding."

Materials and labor suppliers likewise exert no force. This situation, without strategic intervention, leaves EE to the will of developers and builders with little interest in it. Cities, however, can concentrate demand and serve as a proxy for EE buyers through planning and building departments, such that developers' behaviors may be changed. If enough cities adopt general and specific plans that include energy efficient homes, within a contiguous supplier region, a "permanent" market can be established. PG&E is developing this strategic approach to create a walk-away strategy for branded homes in California.

The ***agricultural sector*** is similar, in the diffused nature of its demand for EE, to the residential sector. In another way, however, it is very different in that neither developers nor builders dominate it. Most transactions occur directly between agribusiness suppliers and the end user and, since there is no group (except cooperatives in a minor way) equivalent to cities that can concentrate demand, interventions must be focused through suppliers on agribusiness innovators and early adopters.

The Path to Codes and Standards (C&S)

C&S are a mixed blessing. They provide the public with a semblance of safety and security and give designers a framework to assure their work is consistent with commonly accepted practice. In the case of energy, C&S provide assurance that long-lived buildings include measures that appropriately balance initial investment and life-cycle utility cost savings. Conversely, standards complicate the design and building process, limit flexibility, and often dictate investment that does not directly add to factors that are highly valued by prospective owners. Regardless of the pros and cons, once enacted, codes and standards are sustainable to the extent that they are actually implemented in the field.

Most professional organizations and trade associations utilize consensus processes to consummate their work, so standards are never very innovative. Similarly, codes must undergo a public review process where any and all can assert that proposed measures are non-economic, risky, or unreasonably disruptive to business.

The path to C&S is an arduous, long-term one. For innovative, new technologies and practices, optional or exceptional methods must be developed, presented, reviewed, and adopted. Since such methods are optional, the public review process is simplified. For regular or mandatory measures, many criteria must be met. A critical mass of politically influential key stakeholders must judge opportunities to be: cost-effective, (2) reliable, (3) easily available, and (4) field verifiable.

C&S objectives. As an effective sustainable end-point for industry transformation, efforts to improve codes and standards are highly merited. Due to decreasing propensity to adopt new innovations, the cost to transform adopters increases from left to right in Figure 8. Since, the overwhelming majority of PGC funds are directed at market-based efforts, diffused across many industries and sectors, and since late majority adopters and laggards respond less to market-based programs than do early adopters (EA) and early majority (EM) adopters, most PGC funds terminate with EA and EM groups. From a tactical viewpoint, approximately half of the transformation effort is left to relatively minor investments C&S activities.

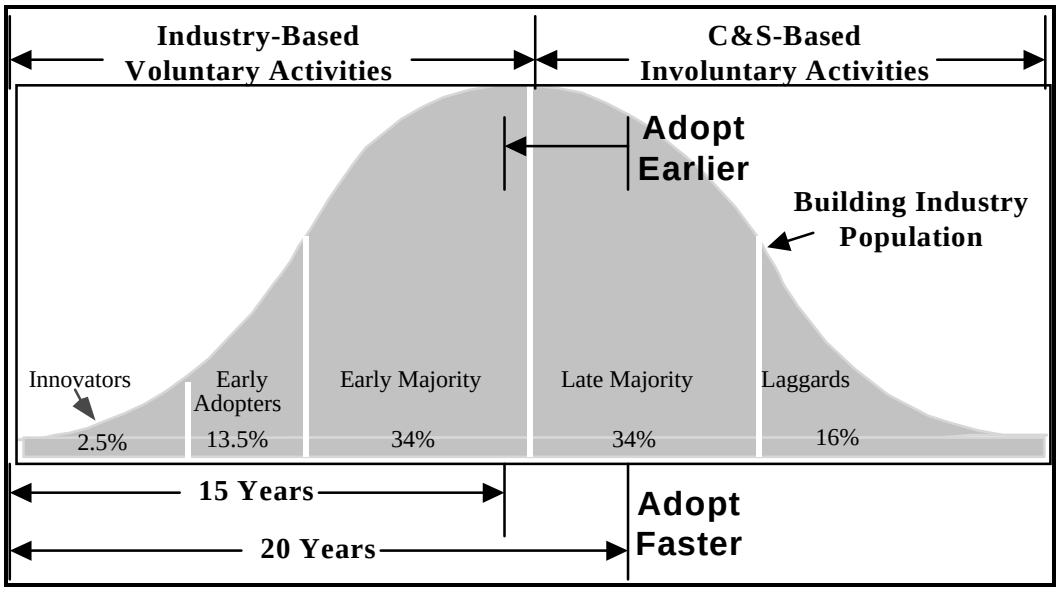

Figure 8. Codes & Standards Objectives

Code change activities have traditionally entailed an opportunistic process with respect to code enhancement selection, in that, action is taken on whatever technology or practice seems "ready" for inclusion. This is, in effect, a passive approach that "sweeps up" the "crumbs" left over from large investments in RA and MT. The C&S industry must be transformed from being passive to that of being strategic or planned. This would enable:

(1) earlier adoption in the diffusion process, perhaps shifting adoption from the late majority into the early majority;[26] and

(2) faster adoption to reduce the number of years from R&D to adoption.

Achieving these objectives would reduce the average PGC investment/innovation required to reach code.

Current C&S interventions. Achieving ***earlier adoption*** may be accomplished through relatively straightforward interventions.

(1) Producing creditable and unbiased arguments in support of selected code enhancement initiatives (case studies) directly improves the likelihood of earlier adoption. These studies objectively evaluate and document stakeholder criteria described above.

(2) Depending on the measure or practice under consideration, "political" issues may be major determinants of success; so consistent support for informal consensus building and formal public process improves the likelihood of earlier adoption. Supporting the public review process is, therefore, very important and involves diplomatic presentation, full involvement, compromise, and agreement building among key stakeholders. Additionally, it involves "being at the table" during public hearings. The advocacy role (counterforce) is necessary and uniquely suited to PGC-funded administrators as change agents, independent of the formal adoption process and the building industry. Additionally, the need to link C&S to market-based activities may require that the PGC administrators be funded to directly engage in C&S support activities. To maintain

[26] The implicit assumption is that the C&S industry conforms to DOI theory, i.e., there are leaders.

simplicity, Figure 9 shows only a few of the many forces on a building code change in California.

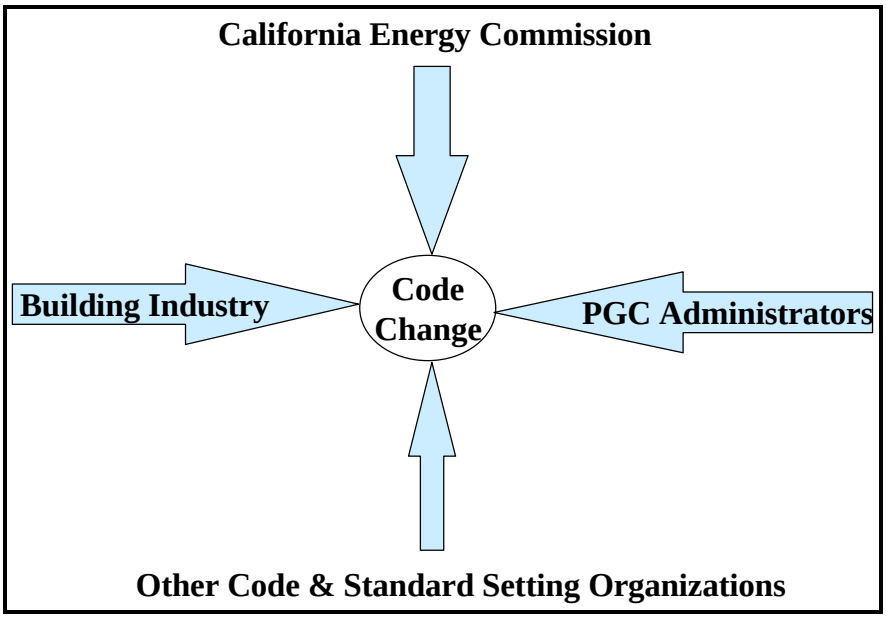

Figure 9. Code Change Forces

(3) Developing and maintaining consistent working relationships with building industry, manufacturers, etc., increases the likelihood of earlier adoption.

Emergent C&S interventions. ***Faster adoption***, to reduce the time between R&D and code change is challenging, but the potential benefits are large. Nationwide, several billion dollars might be required to achieve the market share required to support a passive C&S approach. Even a mildly successful, proactive, strategic effort would save many millions of dollars.[27]

The first step towards integrating C&S with voluntary interventions is to align program incentives with near-term C&S objectives. More generally, however, integrating C&S with market-based activities requires a long-term perspective for planning and implementation, and the creation of new processes to maintain continuity.

Figure 10 charts a prototype plan for California, assuming that PGC funds are extended for 10 years, beginning in 2002. It presumes that an innovation is ready for demonstration, and assumes that emerging technology experts, program managers, and code adoption authorities have agreed on which innovations merit the highest priority for funding. The example in Figure 10 is illustrative in nature, and would be developed and modified to fit different technologies, stages of development, target code procedures, etc.

(1) ***Customer demand transformation*** is a group of tasks aimed at creating sustainable demand for an innovation in a number of selected industries (as described previously).

(2) ***Diffusion support activities*** would ensure that diffusion could actually occur within selected industries and would include various industry-based interventions that support education and communication.

(3 & 8) ***Technical and economic verification*** would be accomplished through joint (supply and demand) demonstration projects with innovators.

[27] Consider T8 lighting, for example.

(4 & 9) ***Industry diffusion and adoption*** would be accomplish through educational activities including, but not limited to, exemplary projects that inform the customer (specifically, the companies business decision makers) as to how the EE investment affects the "bottom line." In each industry, 10-20 % of industry competitors (early adopters) would be targeted for such interventions through a self-selection process. [This should not be interpreted as requiring a demonstration project for each adopter; joint projects and/or good communication would suffice in some industries.] ***Exemplary project support*** would include interventions that assure supply, given persistent demand. [If necessary, program elements would include linking interventions (performance contracting, industry roundtable discussions, commissioning, etc.).

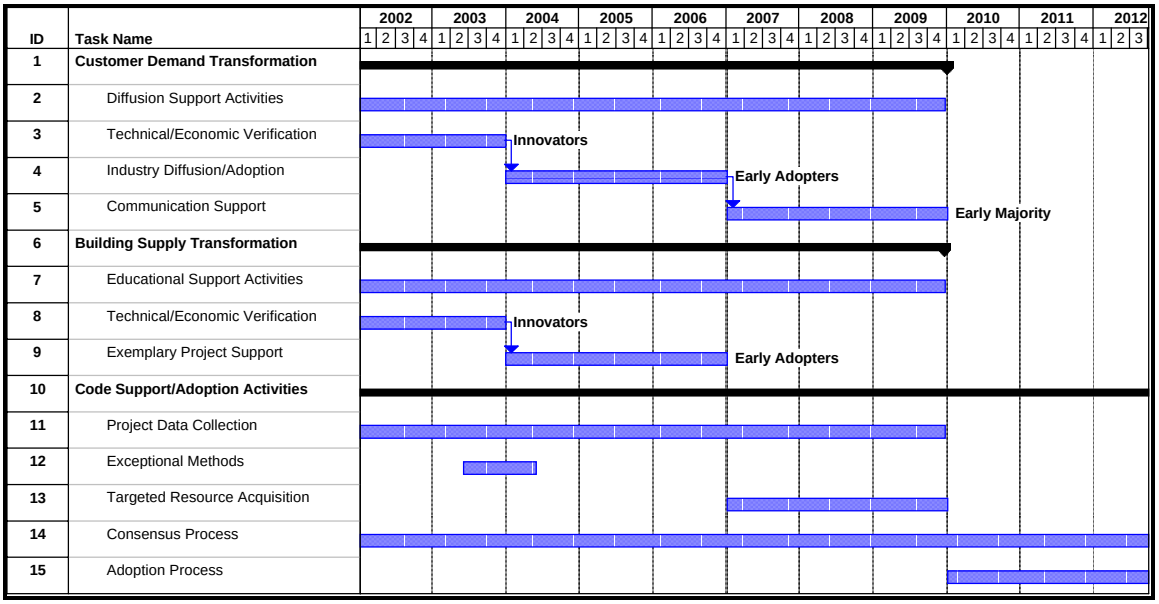

Figure 10. Prototype Plan for Integrating C&S and IT Activities [not complete]

(5) ***Communication support*** for extending adoption into the early majority would include case study development, support for forums at which industry leaders present information to early majority adopters, etc. Assuming critical mass is achieved, interventions could cease, unless accelerated adoption is required for faster adoption into code.

(6) ***Building supply transformation*** entails a group of activities that focus on regional groups of building industry suppliers.

(7) ***Educational support activities*** would include regional change agent centers focused, in part, on general integrated design education, regional procurement issues, outreach, regional-specific business issues, etc.

(10) ***Code support and adoption activities*** comprise a set of interventions focused on supporting code change adoption requirements.

(11) ***Project data collection*** would consist of defining data requirements for eventual code adoption, and creating and maintaining a database of all related projects.

(12) ***Exceptional methods*** (if applicable) would be pursued early in the diffusion process to support new construction efforts. For program managers, this task would provide a program baseline. For private sector builders, the exceptional method would provide for legitimate building compliance documentation, a significant issue for small firms.

(13) ***Targeted resource acquisition*** would be an optional intervention, depending on whether accelerated adoption where required to achieve product or service availability targets, or cost-effectiveness objectives, prior to a specific adoption proceeding. By thoughtfully including stakeholder criteria into project and outreach efforts, emphasizing wider exposure to builders and suppliers, the cost of this task may be reduced.

(14) The ***consensus process*** intervention highlights the need to maintain good working relationships with, and proactively engage, the building industry, manufacturers, building code officials, etc.

(15) ***Adoption process*** interventions comprise the previously described, "current C&S interventions."

Code compliance interventions. Increasing compliance may be achieved through code simplification, training of enforcement personnel, and supporting performance credits. Discussion of these issues is beyond the scope of this paper except to point out that an IT approach to compliance would improve training efforts. Linking code officials to region change agent centers (if they existed) would also be helpful.

The Path to Social Change

While perhaps a more effective transformation driver than either corporate business strategies or C&S, social change is in many ways an enigma. If one were to ask members of the public (or design professionals) if they are supportive of environmental protection, conservation of natural resources, and energy efficiency, almost certainly the answers would be "yes." Why then do professionals in the energy efficiency field see so much opportunity for improvement? The answer is multi-faceted, but simply stated; it is a matter of education, preoccupation, lack of opportunity, and the failure of change agents in the DOI model.

Take a residential and personal case for example.[28] Recycling has been successful in California because of legislative mandates and the educational and administrative efforts of California's Integrated Waste Management Board. Homeowners understand the connection between the strategic solid waste disposal problem and the recycling opportunities provided by local waste management services. In contrast, the relationship between energy use and air emissions is complicated and obscure. Few, however, understand the relationship between their choice in the purchase of refrigerators and the chances of the U.S. meeting its commitment to the International Treaty on Global Climate Change.[29]

Social change can evolve from a number of different sources, including changes in the ecosystem (which can cause the loss of natural resources or widespread disease); technological change (epitomized by the Industrial Revolution, which created a new social group, the urban proletariat); population growth and other demographic variables; and ideological, economic, and political movements (www.britannica.com).

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[28] Commercial and industrial cases are more complicated, but can be inferred by the knowledgeable reader.

[29] Home appliance (space heaters, air conditioners, water heaters, refrigerators, swimming pools, spas, etc.) energy use is even less clear in many consumers' minds. Clearly, most people know that turning off lights and lowering the thermostat in winter saves energy, but few would be able to rationally conclude that paying $14.95 for a compact fluorescent lamp is worthwhile at $.14/kWh electric energy.

There are a number of theories for social change beyond the scope of this paper, and they should be examined prior to investing public dollars. Having done so, social change interventions may include some (or a combination) of the following.

(1) ***Education.*** In California, the legislative debate concerning 10 years of public funding for energy efficiency, coupled with political support (at all levels) for improving school education, presents a genuine opportunity for developing a large-scale, clear, consistent, creditable, and actionable educational program beginning in elementary schools.

(2) ***Premium efficiency products Internet site.*** Presuming that a long-term program could be amassed to sufficiently educate new members of society, the Internet could be used increasingly to link technology-savvy customers to EE products and services. Such a channel might be Web based, real or virtual, and be devoted to fulfillment, beginning with appliances. It would feature impartial advice to help shoppers find the best solutions to their purchasing decisions. Should this practice become sufficiently disruptive for the major markets, they would adapt to stock the newly competing products.[30]

(3) ***Mass media communications.*** Mass media, sponsored by creditable sources, could be used to draw the attention of social innovators to global warming→climate change→energy efficiency→websites. Global warming is only one of many possible motivators. Energy efficiency would be translated through appropriate "information carriers," for example comfort. Over the next 10 years, EE websites might become truly engaging.[31]

The path to social change is difficult, but a concerted effort over the long-term would provide sufficient education for meaningful response, and facilitate making the implementation of properly focused social values actionable.

General Considerations

(1) As in any other industry, the public purpose program, industry population is distributed over various adopter groups. If some variation of the IT framework were to be seriously considered, it's success would depend on identifying innovators and early adopters to start the process. Forcing adoption by the entire industry would fail.

(2) IT could be introduced as part of a program portfolio. Minimum benefit/cost ratios could be achieved through short-term, low-risk, mostly-RA efforts. Funds for IT could be allocated appropriately over the three sustainability exit strategies: corporate business strategies, codes and standards, and social change.

(3) Policy considerations (specifically, how "buckets" of money are defined), administrative needs, and related organizational issues would merit thoughtful planning. Sustainability efforts require long-term vision and planning, so the degree to which transformation efforts are disaggregated should be scrutinized. Linking R&D to IT activities, and IT to C&S activities requires funding for coordination and engagement in joint projects.

(4) An industry focus eliminates boundaries between new construction and retrofit programs.

(5) IT might simplify some measurement and evaluation issues, if one accepts the initial proposition that achieving critical mass within an industry is the first step towards

[30] Premium efficiency products are scarce, difficult to get, and costly, as contractors (who largely specify furnaces, air conditioners, and water heaters) and retailers alike tend to favor middle-of-the road products. An easy alternative distribution channel for premium efficiency products is needed.

[31] Such efforts might benefit from an event marketing approach, similar to that for Earth Day.

sustainable change. This could be easily measured, as could changes in code and standards or social change.

(6) Although IT constitutes a significant shift in design and implementation of PGC-funded EE programs, most of the basic skills are already in place. A shift to IT would not constitute retraining the entire public purpose program industry.

(7) IT would be fairer and more robust than RA or MT. Industry level interventions affect the entire population, not just the early adopters and early majority.

(8) This paper presents a framework for which only a small part of the development has been presented. Further development requires additional input from experts in strategic management and diffusion of innovation, codes and standards, and social change.

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