Stepping Up To Whole House

Gregory Thomas, Performance Systems Development

ABSTRACT

Residential existing building energy efficiency program designs have proliferated over the past several years as attention has shifted to retrofitting existing homes. Designing whole house programs has been particularly problematic and a number of program designs have been attempted. This paper will review a number of program design models created by utilities, states, and Department of Energy Better Buildings awardees and assess the nature of the incentives, applying a taxonomy for incentive description. Publicly posted program descriptions and incentives for 26 residential programs attempting to achieve whole house retrofits were reviewed and analyzed.

A primary consideration for whole house programs is the need to scale up quickly to meet goals set by Total Resource Cost (TRC) test constraints for utility and other programs. This puts considerable downward pressure on requirements for whole house savings depth and rapid market launch. As a result, programs are prevented from investing in training and mentoring of installers and service providers. (Knight, L. & S. Lutzenhiser 2006)

Programs that match up well with the existing marketplace delivery systems find it hard to generate retrofits that could be considered whole house and installations will generally address only the scope of a single trade, HVAC, building envelope, etc.

Using the developed program incentive taxonomy, options for creating programs that pull service providers into offering whole house solutions through a staged incentive process ("stepping up") will be described, and example incentives that fit various stages of the process will be drawn from the program database. Anecdotal examples of programs and service providers making these transitions in delivery type and business model changes will also be provided.

Analysis Approach

The rules for accessing energy efficiency incentives for a total of 26 whole house programs were analyzed and summarized. For the purposes of the analysis whole house programs were defined as programs such as Home Performance with ENERGY STAR which attempt to impact the market for residential upgrades by improving the quality and depth of residential retrofits.

Information was drawn from incentive design inspection of online program websites, the DSire online national incentive database (www.dsire.org), interviews, and from incentives coded into audit software. Incentive design for market transformation programs is typically somewhat experimental and not standardized, resulting in a range of diverse approaches. The survey was designed to focus on creating a broad general understanding of the specifics of incentives and to help establish a consistent program taxonomy in key areas that will be important for the evaluation of relative program effectiveness and market transformation impacts.

Increasing the understanding of the range and impacts of incentive designs, especially for regulators and new program designers, should increase the cost effectiveness of programs and increase the ability of providers of program services (the contractors and auditors) to succeed in serving their clients through these programs.

Incentives Intentions and Impacts

At the most fundamental level incentives are used to stimulate program participation. Incentives provided directly to customers are promoted to create program demand. Incentives provided to program service providers indirectly stimulate demand by encouraging existing and new market actors to recruit program participants.

Market transformation programs have goals that go beyond simple program participation. These programs attempt to change how the market actors interact with each other in ways that can potentially persist past the provision of incentives. Market transformation programs may try to reduce the cost and time to introduce new products or services to market. They may also try to create persistent changes in business process. Incentive dollars are not infinite and programs are additionally constrained by regulatory cost effectiveness tests. These influences combine and create strong pressures to cost engineer incentives so as to achieve market impacts at the least cost. This is where the incentive design process gets interesting.

The essential conflict of rapid program success versus driving deeper market changes has been aggravated by the application of cost tests, such as the TRC that do not measure investments in long term market capacity or long term market demand. Changing the nature and impact of the standard cost tests is not the focus of this paper. Instead the paper focuses on the more immediately attainable goal of identifying and describing incentive approaches and positioning these incentives in a staged portfolio approach to work with a range of service provider business models within the constraints of the current cost test structure. Work on changing the application and design of these tests remains very important.

The inability of the standard application of the cost tests to amortize up front investments in capacity development, such as training and changes to business practices of service providers, makes it especially important to engineer cost effective approaches to achieving these market transformation goals into incentive design.

Incentive designs are also typically constrained by the type and range of available cost effectiveness calculations as described by regulatory "Technical Resource Manuals". These documents are used to set the savings calculation standards at the state level for regulated programs. For example, for regulated programs in states with requirements to use predetermined deemed savings values, the type and value of the deemed savings will have a major constraining impact on the available incentives. States that allow approved calculations according to more open methodologies can support a wider range of incentive design.

Positive impacts from incentive design can include more rapid service provider adoption of enhanced business practices, lower cost of engagement with service providers, lower cost of incentive overhead to service providers, and lower cost of incentive administration. Unintended negative impacts from incentive design can include increased overhead for service providers, consumer confusion on incentive valuation, consumer confusion on incentive overlap, lost opportunities, slower adoption of business process changes, and reduced market demand. (Fuller et al. 2010) Recognizing and avoiding these unintended influences can enhance market transformation impacts and longer term program cost effectiveness.

The alignment of these incentives across a portfolio of programs or within an individual program can also have significant impacts, both positive and negative, on short term and long term program and market transformation impacts. Helping program designers successfully navigate these choices while still meeting regulatory requirements and driving rapid market adoption is a major goal of this paper.

Standard Dimensions of Incentives

Part of the intention of the program incentive survey was to test the application of a basic framework for incentives. This framework is designed to support the staged evolution of business process of program participants towards a whole house services delivery and therefore to increase program participation while not abandoning deeper market transformation impacts for more rapid program success.

Fundamentally, incentives for improving the market based delivery of energy improvements can apply to:

- Improving the efficiency attributes of installed components (exceeding code required minimum efficiency of HVAC equipment, increasing the R value of installed insulation, etc),
- Improving the quality of the installation practices used to install the components (equipment installation standards enforced by quality assurance inspection, training and credentialing of installers),
- Enhancing the performance depth of the installed package of improvements (minimum measures installed, more measures installed, deeper total savings).

Customer information requirements (energy audits) and credentialing of service providers are also common mechanisms for incentive delivery. These also have their own levels of delivery across the surveyed programs.

Efficiency Attribute Enhancement

Efficiency enhancements to installed equipment are among the simplest of incentives to apply and adopt. A classic example of this type of incentive is a furnace or air conditioner rebate which pays out to the consumer or contractor based on selection of equipment that meets a performance standard such as Seasonal Energy Efficiency Ratio (SEER) or Annual Fuel Utilization Efficiency (AFUE), or a threshold rating such as Environmental Protection Agency's ENERGY STAR. Examples of building envelope measures include rebates for the installation of insulation.

As long as suppliers stock the required equipment or insulation, the changes in business practices are typically very limited. The process for selling the enhanced attributes and the installation practices may be all be substantially the same. Similarly the incentive administration process is simple and cost effective. But the market transformation impacts are largely limited to expanding the market for the components. For whole house programs, these types of incentives are typically combined with other incentive access requirements that address installation quality or savings depth. These can include:

- Requiring an energy audit
- Requiring training for service providers

- Imposing quality standards for installation
- Requiring combinations of individual efficiency improvements

Frequently, efficiency attribute enhancements are offered independently of whole house programs and this type of program may have been in existence for a considerable period of time before the whole house program was offered. This means that incentives for the whole house program must be coordinated with preexisting incentives. If the existing rebate structures are to be left in place, adding more rules for access typically means adding more incentive dollars for meeting those additional rules. If the rules are too restrictive or burdensome relative to the dollar value of the incentive, program service providers will make limited use of the new program. The value of incentives that increase the cost of delivering a product or service must be weighed by the contractor against the reduction in customer price competitiveness caused by price increases due to additional material costs, labor costs and increases in overhead from training and employee credentialing.

Energy Audits

Energy audits are frequently used to enhance the delivery of rebate programs. The implementation of energy audits has a wide range of variability among whole house programs. Terminology used by the programs also varies. The survey identified 4 levels of audit being used. The audit types offered were:

- No audit requirement
- Consultative audit - A light walk through audit typically conducted without performance tests such as blower doors, duct blasters or combustion safety. The auditor is generally not selling their own services.
- Comprehensive home assessment – A whole house audit including performance tests. Can be delivered by audit only providers or by contractors offering an integrated service.
- Energy ratings - Inclusion of an asset based energy rating in the audit results.

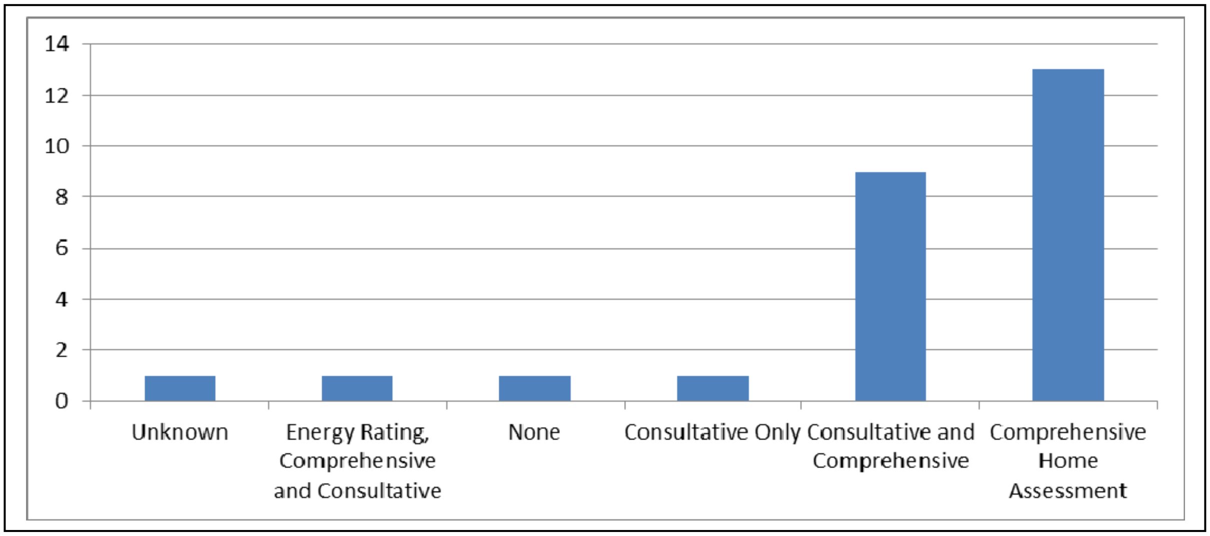
There were variations in the combination of audits offered across the surveyed programs. These variations were:

- No audit
- Unknown audit type
- Consultative audit only
- Comprehensive home assessment only
- Consultative and Comprehensive (two tiers)
- Energy Rating, Comprehensive and Consultative (three tiers)

Other programs could be offering audits uncoordinated with the whole house program in the case of the comprehensive only assessments and this would be undetected by the survey. A number of these types of audits were detected through review of the program funder websites. Almost 40% of the programs surveyed were offering at least two tiers of energy audits simultaneously (Figure 1.). This typically leads to a differentiation of incentives depending on the type of audit selected.

Audits are delivered by different parties with different motivations. Consultative audits are more frequently delivered directly by auditors under the employ of the program, potentially without the credentialing required for market based audit delivery. Their motivations will vary depending on the method of payment and any audit sales incentives they may receive such as payments for the subsequent conversion of their audit to sold jobs. These audits may be offered to consumers free or at a fixed low price.

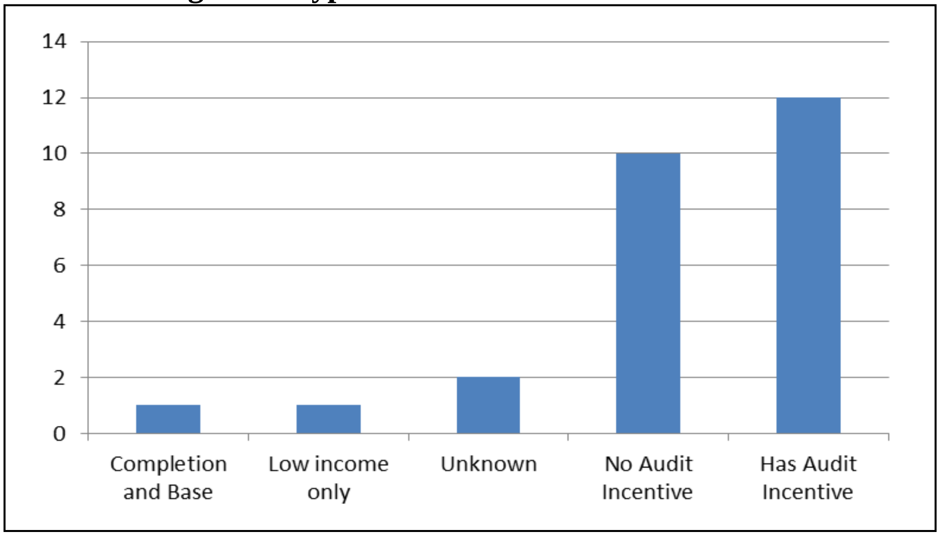
Figure 1.Type and Counts of Audits



Comprehensive audits are exclusively delivered by independent service providers in the surveyed programs. All programs of this type supported a fee for this type of audit, some using a set fee and others using a fee set by the service provider. Incentives may be offered to consumers or service providers in a range of methods. These include (Figure 2.):

- Payments to providers or consumers for a portion of the audit fee (Has Audit Incentive)
- Payments to providers or consumers only after a qualified installation performed by credentialed installers and subject to quality assurance inspection (No Audit Incentive)
- Income dependent subsidies for audits to reduce up-front cost of audit (Low Income)
- Combination of up-front audit subsidy with post-install subsidy (Completion and Base)

Figure 2. Type and Count of Audit Incentives



The installation of low cost measures may be combined with the audit or required as part of a more comprehensive installation. Consultative audits sponsored by utilities frequently use the installation of low cost measures to provide a cost benefit justification for a service that may or may not lead to actual whole house retrofits. Low cost measures such as compact fluorescent light bulbs and low flow shower heads are installed or provided at time of audit to boost program cost benefit performance as contractors typically do not adequately financially benefit from the installation of these measures and therefore do not include them in their proposals.

Requiring service providers to conduct an energy audit before proposing installation has a significant impact on business operations due to the sunk cost. The reduction of the risk to the service provider of this sunk cost is a major reason many programs turn to audit incentives. Programs also perceive that the initial cost of the audits will be a barrier to adoption. In practice, with the right incentive designs, this audit cost barrier is a temporary condition. In New York State, the NYSERDA Home Performance with ENERGY STAR program has a requirement of a comprehensive home assessment but no market price for the assessment with audit incentives delivered only after the installation is complete. This has meant the service providers can use other mechanisms to pre-qualify customers before offering them reduced cost or no cost audits. Typically this means a financial pre-qualification of the customer and a requirement to have both decision makers present for the audit. If the closing rate from the pre-qualified audits is high enough, the service provider can market a below market rate audit leveraging the profits from subsequent installations. The reduction in audit price becomes a cost of installation sales. This is a serious complication for companies that only deliver audit services and not installations, but from the program's perspective this is focusing incentives on the homes most likely to do a retrofit.

Many programs in the early stages of development do not have service providers with the business and marketing systems set up to support below market prices for audits and will tend to use audit cost reduction incentives that are not installation dependent to reduce audit cost. As a temporary incentive this could help develop service provider audit capacity and experience but as a long term incentive it can reduce the funds going to homes and service providers that actually do retrofits.

Offering an audit as part of all cost estimates is a big step for existing contractors. Existing contractors have crews to keep busy and starting to charge customers for cost estimates that include comprehensive audits can dramatically reduce deal flow. Startup companies have an easier time designing a marketing and business process to this requirement. One way that existing companies have addressed this issue is to set up a sister company that is exclusively focused on selling whole house jobs using comprehensive audits to set work scope. Isaacs Plumbing and Heating of Rochester NY is a good example of this approach. Customers of the existing company who express an interest in an audit and whole house retrofit are funneled to the sister company. Customers arriving directly at the sister company are pitched the audit as the first step of the whole house approach.

In some programs, a consultative audit is used to educate and prequalify customers for direction into the whole house program where they will receive the comprehensive audit. This requires considerable coordination between the consultative and comprehensive audit approaches and has met with varying degrees of success in improving sales conversions to whole house retrofits relative to the cost impact of the additional program funded visit. Programs confronting requirements for rapid growth have also used consultative audits as a way to more quickly go to market with less investment in training and changes to service provider business process while the service provider infrastructure expands. As seen in the Figure 1, 9 of the 26 programs surveyed use both consultative and comprehensive audits, which shows that this model is significant and worthy of further study.

Service Provider Credentialing

Service provider credentialing allows programs to differentiate the program's service providers from the rest of the marketplace. This helps the program's market partners to market the program and helps the program set higher standards for quality with some expectation that the service provider will actually have the training to meet the minimum quality level without incurring the high costs of providing quality assurance. (Thomas, Knight & Scruton 2004)

Programs can credential service providers internally or externally. Internal service provider credentialing occurs when a program funder or program implementer reviews credentials independent of any external credentialing agency. This may include years in business, financial condition, etc. More typically whole house programs use some degree of external credentialing for their service providers such as requirements for staff certifications or accreditation of company operations.

A range of primary national credentialing mechanisms were identified in the survey:

- Building Performance Institute Staff Certification - Individual competence is tested through written testing and in field verification of skills. This may be combined with an internal program credentialing of the participating company.
- Building Performance Institute Company Accreditation - In addition to certification of individuals, companies are required to demonstrate quality management systems and to make commitments on the quality of installed work. This is significant for external credential management since customers sign contracts with companies, not with the individual employees. Contractual responsibility for quality of work and the financial ability to repair failures lays with company not the employee. This accreditation requires multiple BPI certifications in addition to the corporate review and commitment and is at a

higher level of expense and business process change than simply requiring staff certification. The BPI Accreditation includes company level field quality assurance operated by BPI where random jobs are visited. (BKi, PSD 2000)

- RESNET Energy Rater Certification - RESNET certification has been focused on the energy rating and energy audit until recently. Where programs are focusing on audits by third parties, this certification has been used as an option.

BPI certification is the most prevalent certification required by the programs surveyed with 66% using this credential. BPI Accreditation and an option of choosing BPI Certification and or RESNET Rater Certification each represent 15%. In addition to requiring credentials, field mentoring of early jobs is also frequently required by programs for service providers signing up for program participation in order to verify that work quality and comprehensiveness goals are being met. Programs most often provide their own field quality assurance or supplement the BPI quality assurance where significant incentives are involved.

Additional certifications have been locally developed to support program coordination across incentive tiers. An example of this approach was the PA Home Energy program. Access to a rebate program and lower cost loans for equipment was limited to contractors who went through a state sponsored one day "Introduction to Home Performance" class with an exam and certificate. This credentialing requirement for participation in a loan program different program with fewer requirements and lower incentive levels than the parallel whole house program had a significant impact on the whole house program. The cost of educating and recruiting new contractors to the whole house program was reduced by requiring the broader base of contractors to learn about the installation quality and incentive benefits of home performance on their own dime while qualifying for the rebate and equipment loan programs. Personal relationships were established between program service provider recruitment staff and the trained contractors.

The recent development of the RESNET EnergySmart Contractor certification and providership offers an additional option for external service provider credentialing. This process has been referenced as a "dual path" to credentialing and quality assurance along with the BPI Accreditation option in national incentive legislation. This would allow contractors to select a process that allows for an integrated delivery of energy audits (more efficient) still subject to third party quality assurance, or the use of the third party auditor (less efficient but easier to add onto existing business process) and then to get quality assurance from a RESNET EnergySmart QA provider. These are side by side options in the proposed tax credit and rebate legislation.

The new RESNET EnergySmart Contractor option has yet to be used in a program. It has potential as a prescreening credential for equipment incentives (it is a one day training and test similar to the PA Home Energy training described above) and an approach for engaging contractors who don't want to change their business process while they are still learning about the whole house contracting business model and still want to access incentives on an intermittent basis. It is anticipated that comprehensive audit delivery through this system will be more expensive than using a contractor integrated approach such as BPI. But there may be business model risk reductions, such as reduced up-front costs for training and equipment, that could result in adoption on a permanent or temporary basis by some contractors. This mechanism could act as a point of entry for more service providers into the whole house programs similar to the staged incentives.

Installation Quality Enhancement

Rebates for equipment and installation of insulation do not provide any assurance of quality unless complemented with installation specifications and a quality assurance process that can inspect to the standards.

Inspection of installation quality is a program cost that can be managed in part by requiring participating installation contractors to demonstrate skills and knowledge prior to being able to access incentives that require meeting advanced quality installation standards. Advanced standards typically require passing performance tests from installation for such elements as refrigeration charge, HVAC system airflow, air leakage reduction and duct leakage reduction. As noted previously, Building Performance Institute certifications are most often used to pre-qualify individual's skills in performing these tests.

The survey assessed this feature set by evaluating which programs identified installation incentives that required some sort of contractor credential and completion of a performance based test such as a duct blaster test in order to verify installation quality. This performance tested work is completed without the requirement of an energy audit up front.

Access to performance based incentives represents an opportunity to expand the range of available incentives that promote performance testing while reducing the degree to which contractors need to change their business practices and therefore reducing their risk.

Deemed savings methods can complicate this approach. The number of programs that have been evaluated that assess the influence of performance tested installations relative to non-performance tested installations is very small. This makes the assignment of additional savings and therefore additional incentive dollars to quality assured, performance tested installations very difficult. Improved coordination between evaluators and program designers and the tagging of the quality jobs in data collection would help to establish deemed savings that differentiate between high and low quality installs, instead of simply using the average.

Measure Depth

Measure depth incentives attempt to encourage consumers to invest more deeply and service providers to propose more comprehensive and diverse scopes of work. This is the core of the whole house approach. Measure depth increases the opportunity to create synergistic benefits from combining envelope with HVAC improvements as well as to integrate energy improvements with non-energy benefits such as comfort, health, combustion safety, and building durability.

Measure depth and integration with non-energy benefits, central to the home performance customer value proposition, can be at odds with the goals of utilities constrained by the TRC. Measure depth is a disincentive when evaluated by the TRC as additional efficiency improvements are increasingly subject to diminishing returns. Customer value propositions that integrate non-energy benefits with efficiency are also a problem for programs evaluated by the TRC. Consumer investments in efficiency and non-energy related improvements are evaluated using the total cost of the project while only receiving credit for the energy benefits. This has been a major problem for the implementation of whole house programs in the regulated context. The cost tests make it difficult for contractors to offer expanded integrated work scopes that address customer concerns outside of efficiency and still offer access to incentives.

Despite these disincentives whole house programs continue to expand across the country. The sense that these programs are needed to move the market and provide broad consumer value creates advocates within utilities and the regulators.

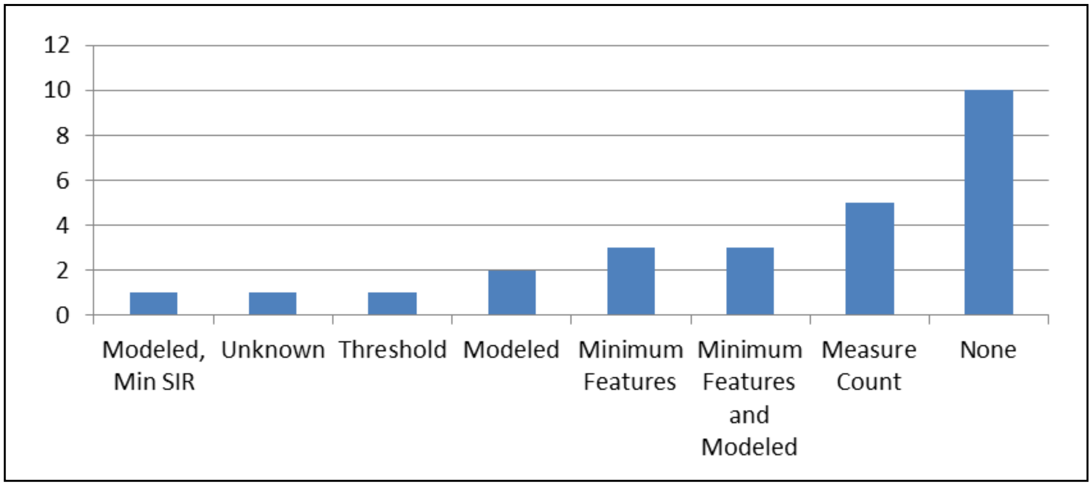
Incentives to encourage measure depth vary widely in their implementation across the surveyed programs. The approaches were (Figure 3.):

- Minimum Features - Requires that buildings after treatment meet minimum prescriptive characteristics similar to code compliance
- Modeled, Minimum Savings to Investment Ratio SIR - Requires that savings be modeled with building energy simulation software and meet minimum savings values as well as minimum savings to investment (cost effectiveness) standards
- Threshold - Savings must exceed a threshold using a simplified reporting mechanism which varies deemed savings based on billing data disaggregation
- Modeled - Calculation of savings and variation of incentive based on building energy simulation calculation. May require calibration of pre retrofit simulation to actual pre energy bills.
- Minimum Features and Modeled - Requires that the building meet minimum prescriptive features and the savings be modeled for reporting.
- Measure Count - Requires a minimum set or number of measures to be installed. Measures may also be scored and a minimum score required to reach incentive levels.
- None - No incentives for depth.

It should be noted that while modeled savings potentially create the most flexibility for incentive determination, they represent the most complex incentive to implement for the service provider and one of the most complex to manage for the program implementer. This is due to the complexity and variety of the simulation tools currently in the market. Reducing the complexity of the simulation tool is an option but removes some of the desired flexibility of incentive determination and may be at odds with the interests of third party audit approaches that sell detailed audits.

Another issue in modeled determination of incentive complexity is granularity. Depending on a simulation for the determination of savings should be done in larger increments of savings, such as 5% bins. A finer granularity makes incentive determination very noisy and therefore more difficult to manage. The coarsest granularity is a threshold. For example, a greatly reduced calculation methodology can be used to determine if total savings exceeds a fixed value. Noise around the threshold point resulting in not achieving the incentive can be resolved by the contractor adding a small improvement.

Figure 3. Type and Count of Measure Depth Incentive



The granularity of a modeled savings based incentive also contributes to complexity of the modeling process for the service provider who is looking to optimize incentives available and increases the oversight requirements for program implementer who is verifying the submitted simulation models. Standardized approaches for model verification are emerging including the Building Performance Institute 2400-S-2011 Standard (BPI 2011) describing the process for model calibration to existing energy bills and the conversion of that model to producing standardized energy savings estimates. This approach uses the operational energy of the building to limit pre retrofit assumptions and decreases both model error and gaming.

Measure count incentives for depth work well with the performance based installation approaches. Increases in incentive value tied to increases in the number of measures installed create a voluntary influence to expand installed measures without requiring changes in business model when the measure counts are organized by trade. This has been used in programs in Pennsylvania.

Loans. Loans can be directly used as an incentive through interest rate reductions or can be provided in combination with other incentives as a mechanism to enhance access to incentives by further reducing first cost barriers. Interest rate variations have been used in loan programs tied to measure depth and installation performance testing, creating stages of incentives by measure depth and service provider credentialing.

Climate Impacts. The type of improvements required to meet a savings threshold based on a percentage of total energy usage varies with climate. Heating climates generally find it much easier to meet total use reduction thresholds than cooling or mixed climates. This is due to two effects. First, heating energy use is a higher percentage of total energy use in heating climates than cooling energy use is in cooling climates. Therefore percentage reductions in heating energy use go farther to meet reduction goals. There is also the increased need to address non-temperature dependent loads, such as water heating and lighting, in mixed or cooling climates. This is more difficult for individual trades to accomplish. HVAC contractors would rather focus on heating and cooling and insulation contractors would rather focus on the building envelope than having to address areas such as lighting or water heating in order to meet the percentage reduction in energy use that is required to earn an incentive.

A Common Incentive Data Language

Another aspect of incentive management is the coordination of incentives across programs. In an era with more and more public parties (multiple overlapping utilities, states, municipal governments, and the federal government) coming to the table with energy incentives, the coordination of these incentives has a cost to programs and service providers and the risk of confusion for their customers. There has been a sustained effort over the past several years to create a common data language (XML or Extensible Markup Language) for describing building characteristics, performance test results and retrofit descriptions. The Home Performance XML effort has been coordinated by the Building Performance Institute. (BPI 2012) Participants include program implementers, software providers and the National Renewable Energy Lab among others. These are many of the components necessary for creating a common description language for incentives. As software vendors modify their code to support the range of incentives, thereby reducing the cost of incentive management, elements of a common incentive language emerge. Table 1 provides example incentive equation variables from an incentive data management system used in whole house programs.

Table 1. Sample Variables for Incentive Description in Software

Energy Type Name, $/kBtu	Insulation depth post, depth pre
Minimum savings percent, dollar amount	Insulation level post
Utility Name, Min. savings %, $ amount	Value of CFM Reduction required
Min., Max., Energy Star Required	Required Energy Type
Required Energy Type	Utility Name
Fuel type name, Utility name	SEER value
Duct Leakage percentage	ACH Value

These example variables are used in equations to calculate incentive across a wide range of incentive types. Automation of incentive determination of at time of audit can reduce audit and program costs and improve conversion of audits into installations.

Closing Summary

The process of designing incentives to support the goals of whole house programs can be improved with greater knowledge of the range of options and both the intended and unintended impacts of program participation and incentive design options. It is clear that programs nationally are experimenting with a range of participation and incentive designs. Given that the interactions of a wide variety of variables in determine program success, clearly describing the system variables that influence will be an important part of determining best practices that can make the replication of program success less of an art and more of a science.

Greater knowledge and shared experience in incentive design will also lead to greater standardization of incentive approach with increases in program cost effectiveness. Additional research, incorporating a standard typology of incentives together with an analysis of program production and an analysis of program overhead costs, for consumers, providers and program implementers, is critical to understanding the impact of these program design variables on production and cost effectiveness. The ability to describe programs and incentives in a common terminology will also help support the use of standardized data taxonomies such as Home Performance XML. The end goal is the more programs being successful and an overall reduction in the cost of program overhead and incentive costs. This analysis and continual improvement is critical if we are to truly make the energy efficiency industry efficient.

References

BKi (Bevilacqua-Knight, Inc.) and Performance Systems Development, Inc. 2000. Whole House Contractor Team Accreditation: Development of a Feasible Model and Implementation Process. California Energy Commission, P400-00-013CR.

Building Performance Institute. 2012. "Home Performance XML" https://hpxml.nrel.gov/wiki/Download. Malta, NY. Building Performance Institute.

Building Performance Institute. 2011. "Standardized Qualification of Whole House Energy Savings Estimates" http://bpi.pnl.gov/attachment.php?attachmentid=91&d=1307385433 Malta, NY. Building Performance Institute.

Fuller, M., C. Kunkel, M. Zimring, I. Hoffman, K. L. Soroye, and C. Goldman. "Driving Demand for Home Energy Improvements" LBNL-3960E. September 2010

Knight, R. and L. & S. Lutzenhiser. August 2006. "Why Comprehensive Residential Energy Efficiency Retrofits are Undervalued," Proceedings of the 14th Biennial ACEEE Summer Study, American Council for an Energy Efficient Economy, Washington, DC.

Thomas, G. and R. Knight & C. Scruton. August 2004. "Charting the Home Performance Contractors Territory" Proceedings of the 14th Biennial ACEEE Summer Study, American Council for an Energy Efficient Economy, Washington, DC.