Designing an ‘optimal’ domestic retrofit program

Abstract:

The United States Better Buildings Neighborhood Program (BBNP) consisted of 41 different versions of thermal retrofit programs with a common structure and objectives. This created a natural experiment in thermal retrofit program design. This paper presents excerpts from a study that used qualitative interviews with program organisers measured against third party program performance data to create a model of 14 program steps and best practice principles that were common to all 41 BBNP grantees. The program steps are presented across five themes. 1) Program design identifies local market features and suitable program structures. 2) Marketing and outreach separates the processes of creating awareness versus personal engagement and Community Based Social Marketing in driving demand. 3) Workforce engagement discusses the role of the program in addressing skills gaps across the supply chain. 4) Financial incentives consider the relative merits of grants versus loans and how to effectively use them in combination. 5) data and evaluation presents techniques for program evaluation and iterative program adjustments. These principles create a template for an ‘optimal’ program model for retrofit programs with stated objectives similar to the US BBNP. The paper the potential and limitations in extrapolating this model to UK retrofit markets.

Keywords:

retrofit; domestic; evaluation; policy

Introduction:

Climate change mitigation efforts must maximise the potential for energy savings in existing dwellings, but systemic barriers hinder retrofit markets (IEA, 2007a) (Fuller, et al., 2010). Despite some progress, the root causes of these barriers remain unresolved, resulting in tremendous untapped potential for energy efficiency in existing dwellings (Sorrell et al., 2004; IEA, 2007b; McKinsey and Company, 2009) (Dowson, et al., 2012) (Gooding & Gul, 2017).

While individual policies have been successful, there is insufficient effort to connect program objectives with theory and evidence based program designs. In short, retrofit programs frequently reinvent the wheel rather than suitably incorporating the past experience of relevant precedents. For example, Fuller’s often referenced report on Driving Demand argued in 2010 that the provision of information and financing alone are insufficient to drive the widespread adoption of retrofit measures (Fuller, et al., 2010). This idea is seldom refuted and yet information and financing were the design principles of the UK Green Deal implemented in 2013.

Failing to incorporate past lessons has been attributed to a lack of evaluation studies (Sorrell, et al., 2004), or the diversity of ‘one off’ program experiences. However, due in part to large scale retrofit programs such as the United States Better Buildings Neighborhood Program (BBNP), there is increasing case study evidence upon which to build a replicable and adaptable model for an ‘optimal’ retrofit program for a given set of program objectives. This paper a qualitative analysis of the BBNP validated against third party performance data to present this model and comment on its applicability to retrofit markets by addressing the following questions: 1) What program steps are common to most successful BBNP retrofit programs? and 2) What are some best practice approaches to these program steps based on the BBNP examples?

This work answers Question #1 and Question #2 using a program theory methodology applied to the BBNP. Based on the BBNP program results, a model is proposed for an ‘optimal’ retrofit program. A closing discussion will explore the extent to which the program structure proposed by this paper can be generalised within US retrofit markets as well as for the UK market.

Literature Review

The barriers to the adoption of cost effective energy efficiency technologies have been well studied for decades (Meier et al., 1983; Jaffe and Stavins, 1994; Levine et al., 1995; Golove and Eto, 1996; Gillingham et al., 2009; McKinsey and Company, 2009). It is uncontroversial to state that both regulations and market-based policies are needed, and that the two are almost always more successful when used together. Indeed, typical policy packages include a combination of both regulatory instruments and market-based tools (Jaffe et al., 2005; IEA, 2007a). The appropriate mix of energy efficiency strategies may vary, and designers must consider the most effective combination of strategies for a particular market at a particular time (Sebold et al., 2001).

The boundaries of the market considered here are the voluntary provision of retrofit services between a homeowner and a contractor. It therefore excludes market-based policies that act outside this central transaction such as trading schemes, auctions, and taxation measures. It also excludes compulsory policies such as building codes, regulatory frameworks, and minimum performance standards. While this boundary is suitable for the study of retrofit program design, this research acknowledges that the barriers to energy efficiency are pervasive, and will not be addressed by a single policy mechanism or financial instrument (IEA, 2007b).

Market-based domestic energy efficiency policies have focused historically on incentivising the participation of homeowners through rebates or behavioural nudges in favour of particular product choices. Such programs are sometimes referred to as demand side management (DSM) programs (Birner and Martinot, 2005). The 1980s and 1990s saw a considerable number of programs demonstrate efficacy in driving installations of specific products such as energy efficient lighting (Johnson, 1997), boilers (Birner and Martinot, 2005), and insulation (Eto et al., 1996). However, the majority of these programs treated energy-using products as standalone items, often targeting short-term energy savings objectives such as kWh savings per year (Birner and Martinot, 2005), and were often not designed explicitly to target the underlying barriers that impede the long-term uptake of energy efficiency products and services (Nadel and Latham, 1998). While targeting kWh savings is the logical objective of an energy efficiency program, early successes in energy efficiency policy were quite limited in light of what seemed technically feasible (Blumstein et al., 2000).

Program objectives therefore evolved beyond targeting short term kWh savings towards whole-house retrofits, which focus on the efficiency of the home as a system (York et al., 2013), rather than on the barriers to an individual product or service (Van de Grift and Schauer, 2012). This transition in focus from individual products and services to the home and its occupants as a complete energy-using system represents an important change to the policy landscape over recent decades. The BBNP is an example of the latest generation of retrofit programs which embody the theme of targeting whole house retrofits as part of a broader effort to transform retrofit service markets.

BBNP

Most retrofit programs in the US are operated at the state level by utilities, and funded by ratepayer subsidies rather than public funds. The BBNP however, was created in the wake of the 2008 recession as part of the $840 billion stimulus package called the American Recovery and Reinvestment Act (Recovery.gov, 2015). Of this, $508 million was competitively allocated to 41 state and local programs that the Department of Energy (DOE) determined to meet their stated criteria. It therefore differs from typical retrofit activity in the US in two key ways: 1) states must meet the federal funding criteria and common program objectives, and 2) it is a temporary stimulus with a fixed spending period (Sept 2010 – Aug 2013).

The stated objectives of the BBNP are: 1) to obtain high-quality retrofits resulting in significant energy improvements; 2) to incorporate a viable strategy for program sustainability beyond the grant period; and 3) to fundamentally and permanently transform energy markets to make energy efficiency and renewable energy the options of first choice (DOE, 2009).

Grantee programs followed these stated objectives but were designed, calibrated, and operated to suit the market conditions of their state or community (RIA, 2012). In some cases grantees operated as standalone programs, while others leveraged participation in state utility programs. The fact that grantee programs maintained a common policy framework and consistent reporting requirements make the BBNP the largest known case study for a comparative analysis of energy efficiency program design.

The final impact evaluation of the program concluded that the BBNP was successful against five out of seven stated objectives. This includes upgrading over 100,000 residential and commercial properties, creating over 10,000 jobs, delivering an average savings of at least 15% in energy costs per home upgraded, leveraging nearly $1.4 billion in private sector investment, and creating a lasting market impact with 84% of grantees continuing program elements in the post funding period (RIA, 2015). A breakdown of the total upgrades delivered by each of the 41 grantees is given in Appendix A. This paper identified a cross section of these 41 programs for a more detailed study using the approach described below.

Method

This paper considers retrofit program structure, and the processes which enable the program to best meet its stated objectives.

Program theory can be described as the intended steps through which a program is delivered. A process evaluation considers the qualitative factors in how that program is delivered. It has been argued that a program theory combined with a qualitative process evaluation can highlight key performance measurement points and evaluation issues, improving data collection and usefulness (McLaughlin and Jordan, 1999). This has potential to provide greater explanatory power to evaluations (Weiss, 1997a), particularly for complex programs (Rogers, 2008).

The goal of the research was to study the operation of the BBNP grantee programs individually, and distil the successful principles into a set of program steps that could describe the BBNP process overall and also hold relevance for other thermal retrofit programs.

The program theory for the BBNP was constructed as follows:

1. A program theory was defined based on document analysis. This should document how the program appears to function, not simply how it was meant to function. This was done for all 41 grantees (available as a collective here (DOE, 2015) and individually referenced throughout this paper as appropriate).
2. Based on this model of all 41 programs, a sub section of 11 grantees were selected for detailed study including interviews with program organisers. These were selected to represent a diverse range of factors such as: grant funding level, existing market readiness, population size, and program design.
3. Semi-structured interviews were conducted with credible experts who had first-hand knowledge of both the program’s design and implementation strategies. In each case, the program steps described in Step 1 were found to be broadly correct, and were adjusted when needed.
4. The interviews then focussed on describing the success factors involved in implementing those program steps effectively in their local retrofit markets. These factors are described in this paper as ‘best practice principles’.
5. Finally, this work summarised the themes common to all grantees into a common set of program steps and the best practice implementation factors for delivering those steps under various market conditions. The common program steps are summarised in Table 1, and the best practice principles outlined throughout the remainder of this paper.

Internal and External Validity:

Internal validity requires establishing a causal link between observations and findings. For qualitative studies this often relies on expert opinion or past precedents. This work sought credible interviewees as suitably qualified experts in retrofit program design and delivery.

Internal and external validity were also achieved by triangulating findings with third party evaluations commissioned by the DOE. The interview data for this paper was gathered as part of doctoral research that took place from 2011 to 2014, closely overlapping the timeline for the BBNP itself. The DOE evaluators were unable to share their findings for their work still in progress. Their evaluation reports (released mid-2015) therefore represent an external check on the validity of this paper’s arguments, and help address common threats to internal validity such as selection bias.

The challenges to external validity for this paper occur in two layers, firstly outside the BBNP sample programs but within US retrofit markets, and secondly outside the US retrofit markets altogether. The DOE evaluations address validity across US retrofit markets, but comparing retrofit markets across different countries is subtle. A full exploration of this topic is outside the scope of this paper, however, the discussion will build on the recent findings from work such as (Gillich, et al., 2016) and (Rosenow & Eyre, 2016) on UK retrofit markets, describe suitable boundaries for the findings of this paper, and highlight areas worthy of further study.

This paper’s arguments are validated against a larger scale DOE program evaluation of the BBNP, however the method, analysis, and findings herein are strictly qualitative and should be interpreted as such. The paper does not offer an impact evaluation, nor declare any of the BBNP case studies to be more successful than any other.

[INSERT TABLE 1 HERE]

The program theory in Table 1 is unique to this research and was created specifically to describe the BBNP grantees. While the program steps themselves are common to all BBNP grantees, the ways in which they implemented these steps varied significantly. These program steps are listed in approximate chronological order, though noting that in practice, there is overlap and feedback loops among them.

The argument of this paper is that the 14 program steps described in Table 1 are all essential for properly implementing a domestic retrofit program that has stated objectives similar to those of the BBNP. The remainder of this paper will use the documentary and interview evidence to support this claim.

The program theory organises the program steps into five themes similar to those used by the DOE themselves in defining pillars of retrofit programs (DOE, 2015). These themes are used as a narrative tool to convey the program steps in sensible groups.

Analysis

Program Design

Assess the market: Clearly define the program’s assumptions regarding the status of the market from the point of view of both the homeowner and the participant workforce. The most suitable approach depends on program details. With over 3 million homes in their program area, Illinois commissioned a detailed market segmentation study to hone the scope of their outreach (EI2, 2014). The Washington Kitsap program on the other hand, with only around 100,000 households, elected to rely on the local knowledge and expertise of their program partners [Interview #16].

In each case, the purpose of this step is to determine the barriers that are active at a local level in order to ensure that the program assumptions reflect the actual market conditions. The consequences of basing the design on poor assumptions about the most active barriers are explored in numerous critiques of the UK Green Deal (Rosenow & Eyre, 2013) (Eyre, et al., 2012)(Gillich et al. 2015) (Rosenow & Eyre, 2016).

Choose policy niche: Finding a suitable balance with the pre-existing policy landscape is more complicated than it appears. This is broadly true across building energy policies at the strategic level (Drummond & Ekins, 2016), but this paper argues that it is particularly true at the local level as well. The strength of energy efficiency programs and regulations vary enormously across the US (Eldridge, et al., 2009). Some BBNP grantees occupied relatively barren policy landscapes, allowing their program to take shape in unrestrained ways (e.g. (Cadmus, 2013d)). Most states, however have fairly entrenched utility funded energy efficiency programs whose goals did not always align with the BBNP goals. Utility funded programs are typically called Energy Efficiency Obligations in Europe and Energy Efficiency Resource Standards in the US. Some states such as Washington deliberately aligned their incentives to comparable levels with their utility programs, so as to offer homeowners a more unified face for energy efficiency [Interview #16]. Others tried to use the BBNP funding to leverage participation in existing ratepayer funded utility programs (Arizona). While this is a very logical approach, it was fraught with practical challenges. Donnelly (2013) noted that the difficulties in integrating with existing programs dominated other factors like behavioural interventions, program administration, outreach approaches. Donnelly calculated that instead of the actual conversion rate of 9%, the N2N would achieve 30% had the program been better aligned with the utility incentive structure (Donnelly, 2013).

Program partnerships: Partnerships with other programs and organisations was a critical factor the success of most programs. The need for close communication was also frequently highlighted among interviewees. For example, on the topic of how to work effectively with utility programs the Energise Phoenix Program Manager said:

*“You have to start off with a good working relationship to begin with. The utilities are very sceptical about doing anything with large scale federal programs; they want to keep it separated. So it was done in a partnering way, with separate agreements as to how data will be shared and how data would flow. Communications was key, and with very close coordination, because all of the information has to match.” [Interview #15]*

Efficiency Maine established strong financing partnership that helped the program segue from public funds to maintain the loan program through a private lender in the post-grant period.

Many interviewees highlighted that it was in fact individual relationships that mattered, perhaps more than institutional links. Programs that were able to successfully create networks of personal relationships among organisations were better poised to maintain those relationships in the post-grant period.

Establish management structure and ground network: The network of program employees, volunteers, and partners must be sufficient to drive the demand needed. Many states found that this was not as straightforward as ensuring a high number of staff, but also that staff had suitable qualifications and were well motivated. As noted for Illinois “For outreach, I think we had a great level of staff. These were former political campaigners who had a great deal of experience in how to organise a ground force. It’s not just about the quantity of people it’s about the quality” [Interview #13]. Many such as Illinois, Colorado, and Connecticut did this by subcontracting to local firms. Michigan found that volunteers struggled to be as motivated as the paid organisers (BBFM, 2013a).

Marketing and outreach

Design marketing and outreach strategies: Community Based Social Marketing (CBSM) is the approach of using local networks and trusted messengers to address barriers at the level of the social group (McKenzie-Mohr, 2011). While programs in the UK are using small pilot programs to test CBSM, it was more common practice across the US. Among the most critical factors in calibrating CBSM techniques is treating marketing and outreach as two distinct steps in driving demand (RIA, 2012)(Gillich et al 2016). Previous work has distinguished between the idea of marketing as creating awareness, versus outreach as personal engagement (RIA, 2012) (Gillich, et al., 2016). These studies have found that BBNP grantees used traditional approaches such as print media and television to generate interest in the programme, but that converting interest into actual retrofits required a more personal approach to outreach, typically centred on CBSM strategies (see e.g. (EI2, 2014)). While the details of each strategy varied based on the target market, both large and small state programs demonstrated the efficacy of using a trusted messenger to drive personal relationships with homeowners and engage with their barriers on an individual level.

Engage homeowners: Whereas the previous section describes the strategic approach, this research found that implementing the engagement strategy should be measured as a separate program step. The focus was not on whether CBSM worked in concept, but rather on how to calibrate the operational details so that it worked well in practice.

The Illinois EI2 program implemented separate strategies for marketing and outreach. They used their initial market assessment to identify target groups and calibrate a marketing strategy specifically to them. Once the brand was established, EI2 transitioned to a community based outreach approach relying on Energy Impact House Parties organised by local field organisers and local contractors. Hosts were provided with a free home energy assessment ($99 value). Attendees could have their homes assessed for $99 or have the opportunity to host their own party and receive the assessment for free. From August 2012 to September 2013 the 20 field organisers held 1440 one-on-one meetings, over 1000 community meetings, helped customers complete 2,399 assessments, to which they directly attribute 1277 retrofits (EI2, 2014). “We found that people didn't want to sign up using the website. The energy house party model was great for showing people through the whole process and answering their questions. Having boots on the ground helped the process to take off virally" [Interview #13].

Donnelly (2013) refers to this as delivering multiple customer touch points and it was one of the ideas that were fundamentally incorporated into the design of the CBSM outreach strategy of the Connecticut N2N program. The program designed strategies based around reaching out to community groups such as libraries, faith-based groups, community and civic groups, schools, local businesses, social service agencies serving the elderly and low-income residents, municipal leaders, and community leaders. Strategies included educational workshops, tabling at local events/meetings, neighbourhood canvassing, lead-by-example campaigns with community leaders, word of mouth, social media, and contractor co-marketing. The program also made use of established behavioural nudges such as social norms, default framing, competition, and goal setting (Livingston et al., 2012).

The idea of fostering local connections was fundamental to creating a trusted community outreach network. This principle was well implemented by NeighborWorks in creating the Vermont program. "NeighborWorks is an established group. You can't just lift it and put it anywhere, it's built on the shoulders of a community based social services agency. They previously provided other advice and household services, and only recently incorporated energy efficiency." [Interview #7]

## Workforce engagement

Design a strategy to engage a skilled workforce:

The role of workforce engagement has long been acknowledged (Fuller, et al., 2010) and is becoming an increasingly studied aspect of retrofit program design (Donnelly, 2013) (Gillich, et al., 2016). Contractors have no incentive to participate in the program in and of itself. The program must sufficiently incentivise their participation compared to a business as usual scenario. Just as there are barriers to homeowner participation, there are barriers that inhibit changes to contractors’ business models as well. Many of these might be self-correcting in the presence of sustained long-term demand for thermal retrofits; however the program’s objectives are best served by actively addressing these barriers within the program timeframe.

The program must consider a qualitative cost benefit balance from the point of view of the participant workforce. The primary benefits to the contractor of participating in the program include a higher profit margin per job, a higher volume of jobs, or the benefits of subsidised services such as training that would normally incur expense. The perceived costs to the contractor are the added administrative burden that program participation incurs compared to traditional home contracting work, as well as the increased perception of risk or uncertainty. In many cases, thermal retrofits require a new set of skills and a new vocabulary for which the contractor may have a less predictable profit margin.

Consider a simplified example of this qualitative cost benefit exercise. The Colorado program brought the perceived costs of participation for contractors to near zero by using program funds to create an Energy Advisor role. The Energy Advisor served as a trusted messenger for homeowners, and also helped contractors reduce the program’s administrative burden by guiding them through the application process. [Interview #17]

Colorado noted that projects financed through loans cost an average of $10,000, compared to $3,500 for those that relied on rebates and self-financing. This became a considerable selling point for contractors, who helped encourage homeowners to carry out larger projects. Colorado also helped deliver higher volumes of jobs to contractors through customer referrals using a preferred contractor pool [Interview #17]. The program kept a list of participant contractors who had maintained performance standards on previous jobs.

Note that many other states also used contractor referrals to drive workforce participation, for example the Connecticut N2N program did this with some sophistication using their live research dashboards tracking contractor progress through different projects and allocating new leads in a calibrated manner [Interview #1] (Donnelly, 2013).

Communication:

The Energy Advisor experience in Colorado demonstrated that communication is a critical factor in leveraging workforce participation. The program must develop an ongoing communication strategy to continually keep the workforce informed about the program benefits and structure. If the program wishes to transform the workforce in any fundamental way, the benefits of participation must be reinforced. Some programs such as Illinois accomplished this through workshops [Interview #13], while other states such as Maine with a less centralised population used webinars to communicate with contractors on a regular basis [Interview #6].

The Vermont NeighborWorks program placed particular emphasis on building a relationship with the workforce and cultivating that trust over time (Gillich, et al., 2016). The idea of maintaining open lines of communication applies not only to facilitating dialogue between the program and the workforce, but also among the contractors themselves. Vermont created an environment that combined competition with collaboration and strengthened the brand of energy efficiency retrofit work overall.

*“At first, the group meetings were tense; the contractors viewed each other as competition. Now they are requesting more of them, they are lasting longer; they are bringing information and experiences to share. I think the group meetings were paramount to all of our success with the contractors. Now they're learning from each other they share equipment, they share staff, tips.” [Interview #7]*

Generate skills:

The importance of developing a skilled workforce is non-controversial, and numerous studies have argued that programs should develop technical skills training for the participant workforce (e.g. (Fuller, et al., 2010) (Retrofit Report, 2009) (Janda & Parag, 2013) (Donnelly, 2013). Many BBNP grantees also found success in emphasising non-technical skills training (RIA, 2012) (EI2, 2014).

The Efficiency Maine HESP program used sales training to increase their conversion rates from 10% to 60% over the course of six months (Efficiency Maine, 2012c). Similarly, Connecticut introduced marketing and behavioural science training alongside a series of other small changes to their outreach strategy and their conversion rate doubled within two months (Livingston et al., 2012).

The state of Colorado went a step further by distinguishing between three types of training for contractors: technical, sales, and financing. The program facilitated the provision of sales and financial training to aid the contractors in selling the financial products which were outside their core area of expertise. Colorado therefore demonstrates the fundamental way in which these program steps are interconnected and the program must simultaneously create the benefits of additional jobs, larger projects, and create the training opportunities to deliver those projects, all while communicating these benefits to the workforce.

## Financial incentives

Reduce the upfront cost barrier:

Of the programs studied in this work, nearly all that tracked homeowner motivations found that the cost of a retrofit was cited as the top reason for non-participants, and the availability of a rebate or financing was given among the top reasons for those that did participate (see e.g. Mulholland et al., 2013). Programs are therefore correct to include financial incentives for the retrofit measures that they are targeting. However, when asked how the program decided the type and level of the financial incentive, nearly all respondents stated that they were set through trial and error, typically using other programs in the area as guidance, and then fine-tuned over time. The DOE post-program evaluation retrospectively found that offering incentives on the order of 25% of project costs was a strong success factor (RIA, 2015).

This section will discuss two elements of this fine-tuning. 1) the balance between incentivising the assessment versus the upgrade, and 2) the balance between using program funds towards grants versus loans. The ‘correct’ package of financial incentives varies considerably by location and over time in a given location. This section attempts only to describe trends based on the experiences of the BBNP grantees.

Assessments are primarily about marketing, while retrofits are about sales. All barriers, and not least the cost barrier, are more active at the retrofit stage than they are at the assessment stage. However, if the cost of the assessment is too high, it will prevent customers from entering the process at all. A sub-group of 12 BBNP grantees found no relationship between the level of the assessment subsidy and the program uptake, stating instead that other program factors were paramount (Cadmus, 2013d). They in fact found that the level of the subsidy sometimes had negative effects in perturbing price signals. One program found that when their subsidy was reduced, the demand for retrofits evaporated, with homeowners blaming the high cost of the unsubsidised measures, even though the remaining subsidies were still higher than the rebates being successfully offered in neighbouring states. (Cadmus, 2013d)

The BBNP Michigan Saves program took a scientific approach to deciding its subsidy levels by conducting a series of 58 iterations in which they systematically varied the levels of rebates for assessments and upgrades among other program factors (BBFM, 2013a). They found that not surprisingly, both the assessment and upgrade rates increased with higher rebate levels. More critically, they found that the highest conversion rate occurs using the combination of a low assessment rebate and a high upgrade rebate.

The relationship between grant and loan programs is more subtle still. Data from Efficiency Maine in Table 2 summarises the pre-BBNP Home Energy Savings Program (HESP - grant), as well as the BBNP funded Property Assessed Clean Energy (PACE - loan) and Residential Direct Install (RDI - rebate) programs. The data suggest that the HESP grant program and the RDI direct install rebate deliver more savings and have higher benefit to cost ratios than the PACE loan program. However, they also have considerably higher levels of public expenditure, and the levels of market activity were more likely to fade along with the funding (Gillich, 2013).

[INSERT TABLE 2]

## Data and Evaluation

Flexibility:

It was found throughout the investigation of the BBNP grantees that the most consistent factor in successful program design was the ability of the program to respond to local market conditions in a flexible way. If a proper system was in place to iteratively improve the program then all other program flaws were addressable. Program flexibility is made up of three distinct program steps in delivering iterative improvements: (1) Collect data, (2) Evaluate, (3) Program adjustments.

It was frequently noted across BBNP grantees that data collection and reporting was a resource intensive challenge. Every grantee program maintained extensive records and gathered a considerable volume of data through the BBNP process. This data served two, often non-overlapping purposes, firstly to report back to the DOE for quality assurance purposes, and secondly internal data for the purpose of monitoring program progress and making adjustments.

Data collection methods varied significantly by state. Some used basic spreadsheets, some used cloud-based services that allow the database to be coordinated between program actors, and still others commissioned third party evaluations of the program overall.

One program manager with a background in database management had the following suggestions about data requirement guidelines for energy policies [Interview #13]:

1. Develop a relational database in a program such as Access. Spreadsheet based systems are insufficient.
2. Clearly define the metrics to be measured at the program outset and design the data collection and management tools around that. Collecting too much information stretches resources and leads to data fatigue. Before adding something to the database ask “Is this really necessary?”
3. Construct a simple and user friendly interface that can be easily taught to new users.
4. In addition to the program actors who can use the database, train and maintain at least one staff member whose core responsibility is the operation and maintenance of the database itself.

Program sustainability:

The core BBNP goal of using a temporary stimulus to drive a permanent market transformation is extremely challenging. Most grantees approached this challenge by aiming to create products or processes that can be transitioned or used by other parties once the stimulus is over. As noted above, 84% of grantees were successful in doing so (RIA, 2015).

Most programs did not receive post-BBNP funding to continue their operations in full. Typically portions of the program, such as the data dashboards in Connecticut, or the phone help line in Illinois would be adopted by another program, often funded by a utility effort. In some cases portions of the program were funded either through the collections of fees of folded into other taxes. One such example is the Colorado Energy Advisor role, which was deemed very useful in uniting homeowners and contractors and guiding them step by step through the process. When the BBNP grant ended, the Energy Advisor role was resubmitted for competitive bid, this time funded through city tax revenue. In still other cases, such as Maine, the program was able to continue operating largely unchanged in the post-BBNP period, due to the way in which it built a loan program slowly over time and by creating partnerships with private lending institutions.

Discussion and Policy Implications

This section will discuss the main findings across the five themes used in this paper: program design, marketing and outreach, workforce engagement, financial incentives, and data and evaluation. It will summarise key best practice principles that could inform future retrofit policy design. In order to explore the external validity of the findings of this paper, comparisons will be made with UK retrofit programs, particularly the recent Green Deal (GD).

Establishing external validity for a program theory across different countries is a subtle topic, the full exploration of which is outside the scope of this paper. Instead, limited comparisons will be made with the UK for several reasons. The US and the UK have similar approaches to balancing the use of regulatory and market-based instruments to drive domestic retrofits. They have similar demographics and sets of barriers facing the ‘able to pay’ sections of the retrofit markets. And finally, they have both recently implemented national scale retrofit programs, the BBNP in the US and the GD in the UK, with similar stated objectives and operating structures (Gillich, et al., 2016). While there are considerable differences between the two countries, particularly in the building stocks, a comparison at the conceptual level presented by this paper is nonetheless useful to highlights areas worthy of deeper study.

Program Design: This theme calls for a clear definition of the program assumptions based on either a market segmentation study or close knowledge of the market through program partnerships. This market assessment should include a survey of the existing policy landscape and ensure that not only are there no conflicting incentives, but that programs are mutually reinforcing. When using a national scale program template, this this must be mapped onto local market conditions, with particular emphasis on identifying the on-the-ground resources necessary to effectively deliver the program.

The BBNP allowed state and local programs to calibrate most aspects of their program design to local circumstances so long as it delivered energy savings of 15% across the portfolio (measured as the deemed pre versus post retrofit energy costs) . The GD was designed assuming that the upfront cost barrier was dominant. While this was undoubtedly a factor, it is not equally true across the entire country. The more granular approach of the BBNP identified barriers at the local level and calibrated program designs accordingly. The BBNP structure also allowed grantees the flexibility to use program funds across all of the program themes below, while the GD funding was almost exclusively restricted to financial incentives.

Marketing and Outreach: Programs should distinguish between marketing to create brand awareness and outreach to drive participation. A strong consensus has arisen around the effectiveness of personal engagement through CBSM strategies and trusted messengers. This is sufficiently well accepted that the more pressing questions surround how to calibrate outreach to a particular market. The BBNP case studies showed that diversity is key, and that outreach strategies should develop over time and encourage multiple customer touch points.

Critically, the BBNP allowed grantees to spend a portion of their program funds driving demand through active engagement campaigns at the community level. The GD and many other UK retrofit programs fund the installation of measures only, and rely on economic self-interest to drive demand. CBSM programs have been successful at the pilot level in the UK (see e.g. (DECC, 2014)), and should be given more policy focus.

Workforce Engagement: While programs were often able to drive demand for energy efficiency, there is generally less understanding of the barriers facing the workforce. Engaging the workforce must consider at least qualitatively the cost benefit balance from the point of view of the contractor. Since they have no incentive to participate in the program in and of itself, the program must ensure the benefits outweigh the perceived costs compared to a business as usual scenario.

The BBNP grantees did this through leveraging larger jobs through financing programs, offering a greater volume of jobs to suitable contractors through referral pools, and through the provision of technical and non-technical training. Sales and marketing training proved beneficial for many programs since contractors were often being called upon to sell products that were outside their existing expertise, even financial products. Sales training also helps clearly distinguish between the program's strategies for marketing assessments and selling upgrades.

Best practice BBNP programs also created communications strategies to engage with contractors on an ongoing basis. This direct contact gave them vital knowledge of how the local workforce operated and where there program could most usefully allocate its resources. The GD struggled with workforce engagement. The program sought whole house retrofits, which is advisable in theory, but didn’t sufficiently engage with the structure of the UK workforce. Contractor roles are typically fragmented, and each seeks to minimise their time spent on a given job as well as their own exposure to risk, regardless of the consequences for another contractor working on the same building afterwards (Killip, et al., 2013).

The BBNP found that an ‘Energy Advisor’ role serving as an intermediary between the contractor and the homeowner was a frequently successful way of bridging these information gaps. Such intermediaries have been shown to be effective in other retrofit markets as well (Killip, et al., 2013), and more study should be given to quantifying the impacts of energy advisors for the policy overall.

Financial Incentives: The upfront cost barrier is likely still the most significant factor in most thermal retrofit markets studied. As noted, a subsidy in the order of 25% of project costs was a common success factor for BBNP grantees, but applying this subsidy effectively is subtle, and requires careful calibration both by location and over the duration of the program. Subsidies are commonly misused as a tool for driving demand as quickly as possible. Best practice BBNP grantees instead used subsidies as tools to maintain steady demand, and slowly increase that demand predictably over time.

Rebates are useful for driving demand, but should not over-incentivise the assessment at the expense of the upgrade. Rather the homeowner should likely bear some cost for the assessment to filter less serious customers and limit the disruption to price signals. Rebates and grants can be cost effective and deliver significant savings in the short term, but the effects largely disappear when the rebate is discontinued. Loan programs take time to gain traction, but can play a key role generating a more long term market change. Rebates can be used to leverage participation in loan programs.

The GD was designed as cost neutral financing framework, and the only rebates were available through limited supporting programs such as the Green Deal Home Improvement Fund (GDHIF) and Green Deal Communities (GDC). These were delivered in separate funding blocks and created fits and starts in activity rather than a steady and predictable demand (Rosenow & Eyre, 2016).

The GD interest rate is often cited as a barrier to its uptake. The BBNP offered a wide range of financing options, some of which had interest rates as high as the GD at ~7%.

Data and Evaluation: Data management was under-resourced by most programs. Programs struggled to anticipate the data demands and recorded large volumes of data without sufficiently tying the variable being measured to the evaluation objectives. Program flexibility is critical. Every program adjusted outreach and incentives in response to market conditions. Doing so requires careful data gathering, critical evaluation, and iterative program adjustments. The GD was not very effective at using interim evaluations to adjust the program design (Rosenow & Eyre, 2016).

Beyond simply measuring the BBNP against its stated objectives, the DOE evaluation itself was used as a program design tool. The data gathered through the program was used to seed a comprehensive database to guide future efforts (DOE, 2015). The data available through the GD is sparse by comparison, and left the UK with large gaps in knowledge about the state of the building stock and what constitutes effective retrofit program design in the UK. The Each Home Counts review addressed some of these gaps (Bonfield, 2016), but in considerably less detail than its US counterparts.

Conclusion

This paper presented a set of program steps created around the objectives of the US BBNP. Any 'optimal' retrofit program design must be calibrated to local circumstances. This paper clearly does not present a comprehensive solution, however, neither does it present an isolated set of guidelines without application beyond the BBNP and US retrofit market. In theory, this paper offers a relevant template for any retrofit program with a similar set of stated objectives to the BBNP. The links between US and UK retrofit markets have been explored in past studies (Gillich, et al., 2016). The discussion in this paper suggests that most of the program steps and best practice principles employed by the BBNP could have been useful to the UK GD. The themes of program design, consumer outreach, and financial incentives have been particularly targeted as inadequate for the GD (Rosenow & Eyre, 2016). This suggests that the program theory proposed by this paper has relevance for UK markets and its external validity deserves further study.

Finally, a closing thought should be given to defining suitable program goals in the first place. Many have noted that a sustained demand for retrofit services is essential for any market based solution. The program goals should consider how this is best achieved. This paper and others have shown that simply providing grant funding is a cost effective way of driving demand, however it will create fits and starts as funding levels vary. If a program were designed in such a way as to maintain activity over time, for example as part of a long term infrastructure renewal program, then it is possible that many of the factors noted in this paper could be self-addressed through natural market forces. If on the other hand, the next iteration of UK retrofit programs follows past trends (e.g. the Green Deal model), then the program structure described by this paper is highly relevant to improving the potential for public funds to create a lasting transformation of thermal retrofit markets in the UK.

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[INSERT TABLE A1]

[INSERT TABLE A2]

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Award Amount and Reported Upgrades by Recipient (Through 9/30/2013) |   |   |   |   |   |   |
|   | BBNP Summary Report | Inferred |
| Ricipient | Total Grant Awarded | Single Family Homes | Multi-Family Homes | Commercial | Total | Program Cost per Retrofit |
| ADECA, AL (SEP)  | $3,013,751 | 518 |   |   | 518 | $5,818 |
| Austin, TX  | $10,000,000 | 1,728 | 1,837 |   | 3565 | $2,805 |
| Boulder County, CO  | $25,000,000 | 2,851 | 5,388 | 1,713 | 9952 | $2,512 |
| Camden, NJ  | $5,000,000 | 158 |   | 94 | 252 | $19,841 |
| Chicago Metro Agency for Planning  | $25,000,000 | 3,489 | 2,689 | 7 | 6185 | $4,042 |
| Commonwealth of MA (SEP)  | $2,587,976 | 413 |   |   | 413 | $6,266 |
| Connecticut Innovations, Inc.  | $4,171,214 | 1,314 |   |   | 1314 | $3,174 |
| CSG, Bainbridge Island, WA  | $4,884,614 | 928 |   |   | 928 | $5,264 |
| Eagle County, CO  | $4,916,126 | 540 | 1,286 |   | 1826 | $2,692 |
| Fayette County, PA  | $4,100,018 | 805 |   | 5 | 810 | $5,062 |
| Greater Cincinnati Energy Alliance  | $17,000,000 | 1,461 |   | 23 | 1484 | $11,456 |
| Greensboro, NC  | $5,000,000 | 369 | 498 | 16 | 883 | $5,663 |
| Indianapolis, IN  | $10,000,000 | 1,164 |   | 9 | 1173 | $8,525 |
| Kansas City, MO  | $20,000,000 | 2,703 |   | 106 | 2809 | $7,120 |
| Los Angeles County, CA  | $30,000,000 | 3,913 | 580 | 273 | 4766 | $6,295 |
| Lowell, MA  | $5,000,000 | 441 | 23 |   | 464 | $10,776 |
| NYSERDA  | $40,000,000 | 16,749 |   |   | 16749 | $2,388 |
| Omaha, NE  | $10,000,000 | 1,360 |   | 43 | 1403 | $7,128 |
| Philadelphia, PA  | $25,000,000 | 1,968 | 204 | 3 | 2175 | $11,494 |
| Phoenix, AZ  | $25,000,000 | 276 | 227 | 561 | 1064 | $23,496 |
| Portland, OR  | $20,000,000 | 3,199 |   | 55 | 3254 | $6,146 |
| Rutland, VT  | $4,487,588 | 620 |   |   | 620 | $7,238 |
| San Antonio, TX  | $10,000,000 | 1,807 |   | 37 | 1844 | $5,423 |
| Santa Barbara County, CA  | $2,401,309 | 57 |   |   | 57 | $42,128 |
| Seattle, WA  | $20,000,000 | 1,814 | 767 | 57 | 2638 | $7,582 |
| Southeast Energy Efficiency Alliance  | $20,000,000 | 3,585 | 1,553 | 26 | 5164 | $3,873 |
| St. Lucie County, FL  | $2,941,500 | 209 |   |   | 209 | $14,074 |
| State of Maine  | $30,000,000 | 9,130 | 2,682 |   | 11812 | $2,540 |
| State of Maine (SEP)  | $4,538,571 | 589 |   |   | 589 | $7,706 |
| State of Maryland  | $20,000,000 | 987 | 653 | 7 | 1647 | $12,143 |
| State of Michigan  | $30,000,000 | 6,094 | 113 | 84 | 6291 | $4,769 |
| State of Michigan (SEP)  | $4,994,245 | 47 |   |   | 47 | $106,261 |
| State of Missouri  | $5,000,000 | 48 |   |   | 48 | $104,167 |
| State of Nevada (SEP)  | $5,000,000 | 408 |   |   | 408 | $12,255 |
| State of New Hampshire  | $10,000,000 | 808 | 365 | 66 | 1239 | $8,071 |
| Toledo-Lucas Co. Port Authority (OH)  | $15,000,000 |   |   | 67 | 67 | $223,881 |
| Town of Bedford, NY  | $1,267,874 | 193 |   |   | 193 | $6,569 |
| Town of University Park, MD  | $1,425,000 | 204 |   |   | 204 | $6,985 |
| VDMME, VA (SEP)  | $2,886,500 | 327 |   |   | 327 | $8,827 |
| WDC, WA (SEP)  | $2,587,500 | 549 |   |   | 549 | $4,713 |
| Wisconsin Energy Efficiency Project  | $20,000,000 | 1,747 | 1,458 | 225 | 3430 | $5,831 |
| TOTAL  | $508,203,786 | 74,493 | 21,330 | 3,547 | 99370 | $5,114 |
| \*Note that some program results were validated since the creation of this breakdown. Current program total exceeds 119,000 upgrades (ref to Website https://energy.gov/eere/better-buildings-neighborhood-program/accomplishments) |  |  |  |  |  |  |