Predicting Home Energy Rating and Disclosure Program Impacts for North American Jurisdictions

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ABSTRACT

Asset-based Home Energy Rating and Disclosure (HER&D) requirements have been in place in some countries for over 15 years and are now being implemented or considered in North American cities, states and provinces. We recently reviewed ten international programs and four US programs in order to determine how EU and Australian experiences can be used to predict HER&D program impacts in North America.

This paper begins with an assessment of the ability of HER&D programs to encourage homeowners to invest in energy efficiency upgrades. Based on performance, evaluation and impact data, as well as interviews with program administrators, our research gathered key performance metrics including compliance rates, HER&D retrofit recommendation conversion rates, home valuation, program costs, and secondary economic impacts. From this data two key HER&D impacts emerge:

1. There is a strong correlation between higher-rated houses and increased market value.
2. A significant portion of home buyers implement energy-savings upgrades, following the recommendations contained within HER&D reports.

In long running programs, these two factors, along with growing trust in the HER&D reports and rating, work in tandem to increase the energy efficiency and value of a significant portion of homes.

The paper then identifies key factors that can increase HER&D compliance and impacts, and compares various EU practices to North American home energy rating systems and real-estate sales processes. Finally, we translate these results to estimate the expected costs, benefits and impacts (energy and greenhouse gas (GHG) emissions reductions) of a state or province-wide program in North America.

1: Introduction

Home Energy Rating and Disclosure (or "HER&D") initiatives range in detail and application, but generally are designed to make visible the energy performance of homes to enable markets to act rationally. For the most part, the energy performance of buildings is historically ignored in the home buying and selling process. The idea of HERD initiatives is to provide either operational[1] energy consumption data or asset-based[2] information to allow home buyers to value energy efficiency and to encourage sellers and buyers to upgrade their homes.

[1] Actual energy consumption.

[2] "Asset" ratings provide standardized information based on average occupancy levels, thermostat set-points and weather based on house size, number of bedrooms and location to serve as a reflection of the home's typical energy performance regardless of the behavior of the current occupants.

Europe and the Australian Capital Territory (ACT 2015) have been leaders in initiating HERD efforts and have had mandatory programs in place for more than 15 years (Arcipowska 2014). These have generally been thought to be effective at making real estate markets work better and support broader energy efficiency programs. In the U.S., about a dozen mandatory residential HERD initiatives (IMT 2016) have existed at the local and state levels over the past decade[3] or so.

This paper begins with an assessment of the ability of the studied HER&D programs to encourage homeowners to invest in energy efficiency upgrades. Based on performance, evaluation and impact data, as well as interviews with program administrators, our research gathered key performance metrics including compliance rates, HER&D retrofit recommendation conversion rates, home valuation, program costs, and secondary economic impacts.

It then identifies key factors that can increase HER&D compliance and impacts, and compares various EU practices to North American home energy rating systems and real-estate sales processes. Finally, we develop a model to help planners anticipate the expected costs, benefits and impacts (energy and GHG reductions) of a state or province-wide program in North America.

By gathering evidence of HER&D impacts, costs and benefits from longer running programs this study aims to assist proponents and lawmakers to accurately describe the expected benefits of implementing HER&D program at the state or province wide level.

2: Jurisdictional Scan

The findings presented in this paper are based on interviews with 14 jurisdictions in Europe, North America, and Australia, along with the collection of secondary information available in industry reports, such as the Buildings Performance Institute Europe reviews of European Union (EU) HER&D Programs. Particular attention is paid to the EU programs, which due to their long track record and strong legislative support have generated a valuable pool of performance data and studies that seek to identify the HER&D program impacts.

European Experience with HER&D

"Energy Performance Certificates" (EPCs) were introduced in 2002 as a mandatory requirement for EU member states by the European Commission as part of its Energy Performance of Buildings Directive. To fit national context of member states, the Directive provided some flexibility to adjust to the requirements of the directive (BPIE 2010). Typically, the EPC programs require homeowners to hire a certified assessor to perform an evaluation of the energy efficiency performance of the property before advertising an existing house for sale or rent.

The results of the assessment, prepared using specialized software, are provided to the homeowner and to a centralized register. Advertisements must include the EPC score when a home is offered for sale or rent. The full report, which typically includes energy efficiency recommendations with available renovation incentives, is provided to prospective buyers.

EPCs generally include an asset ratings of the home along with calculated energy use for standard occupancy, evaluating space and hot water heating, ventilation and lighting. The labels vary in each member state but typically apply a letter grade rating with an A grade indicating the highest energy performing homes

[3] The one exception is New York's Truth in Heating Law that has been in place since 1980.

In 2010, the EU Commission, based on lessons learned over the previous eight years, "recast" the Energy Performance of Buildings Directive introducing additional requirements (Arcipowska 2014) such as mandating the use of labels in all advertising as well as reinforcing quality assurance and compliance measures. Most member states have also implemented minimum energy standards for new homes as well as financial incentives for energy efficiency renovations.

North American HER&D Programs

HER&D Programs in the US have generally been utility bill, checklist or audit/evaluation disclosure mandates, ranging in enforcement with somewhat spotty impacts in most jurisdictions. Most of the work to make energy performance visible with US homes has come from voluntary efforts. RESNET's Home Energy Rating System ("HERS") has been in place since the late 1980s and has issued 1.7 million (Elam 2016) Home Energy Ratings, primarily for new homes. The U.S. Department of Energy (DOE) launched their "Home Energy Score" program in 2010 aimed at existing homes and has already issued more than 39,000 scores by early 2016.

Two US jurisdictions have a mandate for disclosure of energy information at time of sale and several years of experience. In Chicago, the energy bill disclosure has been demonstrated to have a beneficial impact on existing home sales, resulting in quicker sales at a higher portion of the asking price (Elevate Energy 2015) than those that did not report their energy costs in the home sale listing. Austin, Texas has been another success story in which a mandatory HER&D for existing homes has led to increased update of participation in energy efficiency programs (Austin Energy 2016) . However, Chicago and Austin seem to be somewhat unique in terms of being able to mandate energy information at time of sale for residential buildings.

While there have been attempts by advocates to mandate a HER&D in other US jurisdictions, opposition groups, typically led by local Realtor Associations (OREA 2015), have been effective at making the argument that providing energy information may put inefficient homes at a competitive disadvantage and could negatively impact local real estate markets. As a result, some HER&D efforts have worked collaboratively with Realtor groups to promote voluntary programs. More recently some of the home buyer-focused portals (such as Realtor.com, Zillow.com and Trulia.com) are starting to include annual energy cost and ratings to meet this demand. This is an emerging trend that will rapidly change the HERD environment going forward as this information becomes more widely and freely distributed.

3: How HER&D programs create benefit

From the jurisdictional scan results, we identified the key ways that HER&D programs delivered benefits. HER&D programs are intended to reveal the otherwise "hidden" energy efficiency performance of a building, which then allows an informed market to reward better performing buildings. A HER&D audit report can provide information on the current energy efficiency performance of a property, the costs and benefits of potential renovations and future energy efficiency performance if the recommended renovations are applied.

Figure 1 illustrates the HER&D cycle and resulting impacts. The HER&D rating allows potential buyers to compare the energy performance among homes listed for sale. The rating reports also provide homeowners with a list of recommended energy improvements, at a time that they may be considering renovations after acquiring a new property. Further support from incentive and assistance programs may help to increase uptake rates for the HER&D report

recommended measures. With time, the number of homes with energy ratings increases and the HER&D labels may become better recognized and understood by the market, which can further support the program's impact.

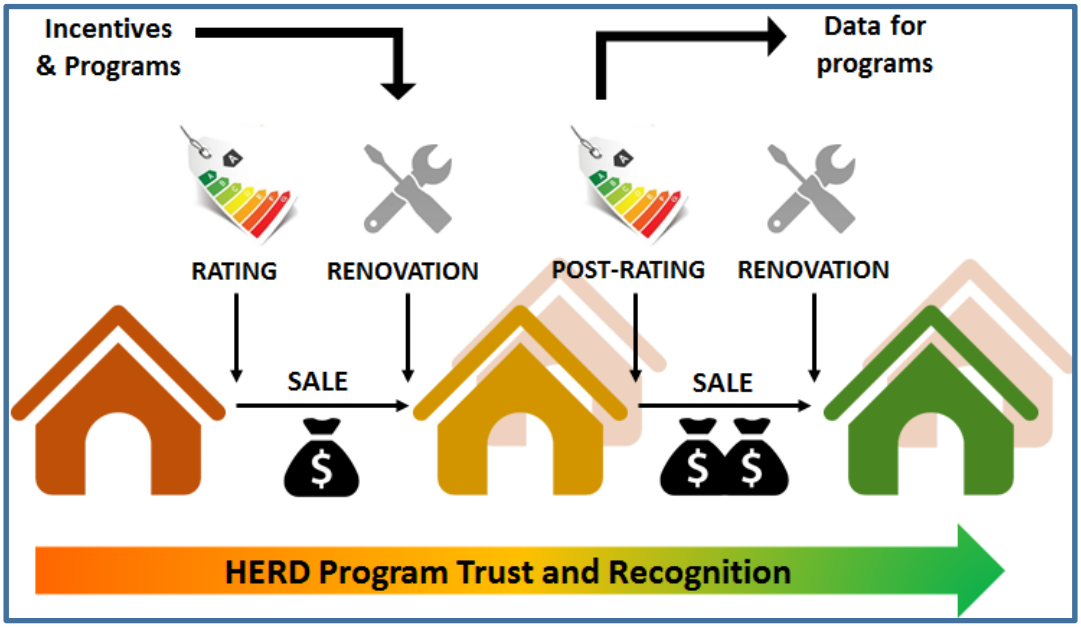

Figure 1: HER&D Impact Cycle (red to green transition indicates improved rating)

Our research found that there is compelling evidence that HER&D programs lead to two direct impacts that help to transform markets and encourage energy efficiency:

1. They increase the value of energy efficient homes
2. They encourage homeowners to implement energy efficiency upgrades.

Moreover, in longer running programs, these two impacts, along with growing trust in the HER&D reports and rating, appear to work in tandem to increase the energy efficiency and value of a significant portion of homes.

HER&D Impact #1: A strong correlation between HER&D performance and an increase in home valuation

Virtually all quantitative studies on HER&D programs demonstrate a positive relationship between better energy performance and increased home valuations. For example, in 2008 sales data of 5,000 homes in the ACT were analysed. On average, for each additional HER&D program star-rating (out of a maximum of six), there was a 3% increase in the house sale price (ADEWHA 2008). Moreover, a 2013 study of nine EU jurisdictions, found that a one-letter HER&D rating improvement (from A through F) is likely to be interpreted by consumers as a significant improvement in energy efficiency, which translates into 2%-6% appreciation in home value (Mudgal 2015).

While a clear correlation exists between homes with higher ratings and an increase in valuation, a precise measure of the impact is affected by a number of compounding factors (IPEEC 2014). First, HER&D ratings may be interpreted a by some buyers as a proxy for the general state of the house, its maintenance level, and its age if these factors are not explicitly stated in the house

advertisement. Second, the studies cited were not able to attribute the specific impacts of HER&D initiatives when part of a broader policy package (including incentives, financing, and minimum energy requirements or energy codes), which makes it a challenge to perform a cost-benefit assessment on a stand-alone HER&D programs. These uncertainties are common in market transformation approaches, and may further highlight the importance of linking HER&D initiatives with other initiatives such as incentives and energy codes.

While the precise measure of HER&D impacts on home values may be hard to separate from other factors, evidence suggests that this impact grows as the program gains trust and traction in the market place. A study of Denmark's program, that has been in existence since 1997, reveals that the impact of the energy label on home sales price increased significantly between 2006 and 2011, revealing a growing impact over the life of the program. (NFE 2013)

HER&D Impact #2: Assessment reports lead to increased home efficiency upgrade rates.

The effectiveness of HER&D programs can be assessed in a variety of ways such as compliance rates or increase in property valuation; however, the ultimate impact of the program must be measured by its ability to encourage improved energy performance. This result is only achieved if HER&D programs can increase the energy efficiency renovation rate.

A number of jurisdictions have performed surveys or other studies to determine the influence of the HER&D audit recommendations on the behaviour of buyers. Our research indicated that in jurisdictions where HER&D report recommendation uptake and influence were assessed (typically through participant surveys), between 12% and 37% of home buyers undertook energy efficiency improvements, or included more improvements than they had originally planned, as a result of the HER&D report findings.

Table 1: Assessments of HER&D conversion rates

HER&D Jurisdiction	Portion of buyers influenced by HER&D report recommendations when making renovations
Austin, TX	12% (first year of program) (ACEEE 20011)
ACT, Australia	15% (Energy Consult 2006)
France	37% (ADEME 2012)
Portugal	17.5% (ADENE 2015)
The Netherlands	22% (Murphy 2014)

These results indicate that there is evidence that HER&D audits encourage homeowners to undertake energy efficiency upgrades that they would not have otherwise pursued. It is again noted that many of these jurisdictions have financial incentives to support energy efficient measures and these programs are highlighted in the audit reports. However, these studies do not include homeowners who may have undertaken energy improvement prior to listing the home, with the goal of increasing their HER&D score in mind.

Key Observation: There is little evidence that HER&D ratings change home purchase decisions

Studies in Europe suggest that energy costs are not a key factor in home buying decision-making. Home buying is an infrequent, group-based, multi-criteria decision, and as a result a survey of European buyers indicate that the cost of energy is not one of the top five most important

purchasing factors during these early periods (Backhaus 2011). Thus we recommend that HER&D programs be promoted as tools to encourage homeowners to pay more for better performing homes, and to be informed as to what energy fixes are needed for poorly performing homes.

Further Benefits: HER&D programs play a key role in market transformation strategies

HER&D programs both benefit from, and provide benefit to, other market transformation and energy efficiency initiatives by providing an accurate inventory of building stock energy efficiency features. Beyond allowing the market to value energy efficient homes and identify efficiency improvement opportunities, HER&D programs offer a range of other benefits including:

1. Improvement and assistance with enforcing building and energy codes
2. Supporting the design and evaluation of other energy efficiency programs
3. Estimations of potential GHG reductions and cost savings from housing stock

Examining the collective results from the jurisdictional scan, we conclude that through these benefits HER&D programs can help transform markets, support other energy efficiency programs and improve residential housing stock performance.

4: Keys to HERD Program Success

Our study revealed that HER&D programs typically face a range of challenges that may hinder their uptake and impacts. Over the past 15 years, HER&D programs have improvised strategies to overcome these challenges and improve program results. The three central challenges reported by HER&D program administrators interviewed for this study were:

1. Achieving policy enactment and acceptance
2. Encouraging widespread compliance
3. Increasing conversion rates for recommended energy efficiency improvements

Based on our interviews with HER&D program administrators, and evidence found in industry reports, we have identified successful approaches that have been applied to meet these challenges, which together may form a body of HER&D implementation best practices.

HER&D Challenge #1: Achieving policy enactment and acceptance

Our study found that HER&D programs are most commonly, and likely most effectively, implemented in two steps, starting with enacting enabling legislation. The legislation should simply provide key dates and targets for HER&D requirements to come into force, but avoid setting out HER&D program implementation details, such as the rating system description and potential penalties.

Then, once the legislation is in place, a HER&D implementation authority is typically mandated to design the program in consultation with key industry stakeholders and the public. The program design includes details on the rating system, as well as the rollout schedule, non-compliance penalties, communications strategies, quality control effort, etc.

By focusing stakeholder consultation around the implementation plan, rather than the enabling legislation, our findings suggest that it decreases the chances that the legislation will be blocked by special-interest groups, instead focussing public and industry consultation around designing the most effective program and tools to achieve the HER&D requirements and provide value.

Public trust in the accuracy of the score label and the quality of the recommendations depend on the competence and the professionalism of the assessors, and thus most programs include quality control mechanisms. In most the EU programs, assessors must demonstrate they satisfy minimum requirements for education and/or professional experience (university degree and/or 2-6 years' experience) as well as completing a training program and a mandatory exam demonstrating theoretical and practical competence. In Austin, audits must be performed by auditors certified by Residential Energy Service Network (RESNET) or by Building Performance Institute (BPI). In ACT, an energy efficiency rating must be performed by an accredited ACT House Energy Rating Scheme assessor, using a thermal performance software package (ACT 2013).

Programs typically include quality control processes, often through reviewing a random sample of rating reports either through a simple audit process (automatic and manual verification of EPC based on data provided by the assessor) and other a detailed audit that requires a review of property documentation and/or a site visit by a third-party expert.

In the ACT, quality control is recognized as a tool to enhance industry and community confidence in HER&D ratings. Their quality control process requires periodic assessment of a set of standard house plans across all assessors as the basis for comparative analysis, and a random checks of ratings completed by individual assessors. The ACT has added the right to revoke an assessor's license, which has helped improved the overall quality of the rating reports.

HER&D Challenge #2: Encouraging widespread compliance

Many programs reported challenges in encouraging compliance with HER&D requirements, and in response a range of strategies have been applied with varying success. First, most jurisdictions applied a phase-in of HER&D requirements, which provided the following benefits:

1. Allows the implementing authority to develop administrative capacities to meet growing HER&D assessments demand.
2. Gives time to validate the energy audit system and make any needed changes before rolling out to the entire market.
3. Focuses on easier-to-reach market segments, or segments that have more to gain from HER&D first, such as older homes with poor energy performance. This helps to ensure that the first HER&D experiences are positive, and generate success stories to build trust in the program.

Second, our study suggests that encouraging compliance requires carrots, not just sticks. Successful programs encourage compliance through multiple channels, offering services that assist homeowners and agents with compliance, or even rewarding it. Specific strategies to encourage and track compliance include:

- Require time of advertisement disclosure but perform compliance check at time of sale. This will reduce enforcement expenses to the implementing authority, and will capture private sales as they pass through the deed transfer process.
- Conduct an advertising campaign to build recognition of HER&D and communicate its value to homeowners and buyers.
- Establish a friendly "Help Desk" to reduce friction for sellers, agents and buyers. In addition, an on-line interactive platform can also provide immediate feedback to people. For example, in Ireland, the help desk responds to 3000 emails/phones calls a month (Lewis 2012).

- Look for opportunities in the entire home ownership cycle. Homeowners can benefit from HER&D reports whenever they consider carrying out renovations.
- In the initial months or years the program should issue homeowners and agents with warnings or reminders rather than penalties. Penalties, once handed out, run the risk of creating negative stories but may be used to greater affect once the program has gained trust and recognition.

HER&D Challenge #3: Increasing conversion rates for energy efficiency recommendations

Finally, while a high compliance and recognition rate may help influence prices to favour energy efficient homes, HER&D programs can increase their impact by encouraging uptake of the energy efficiency recommendations in HER&D reports.

In 2011, the UK noted that its audit report at the time was well suited for energy experts but did not meet buyer/renter's needs, and was likely not influencing consumer choices as much as anticipated (Lainé 2011): In response they improved their HER&D reports by:

1. Using energy bills as basis for comparing energy performance (instead of GHG or kWh),
2. Informing consumers of the costs and benefits of recommended energy improvements.
3. Advising consumers on available incentives and how to access them.

Our research found that in order to get the most impact out of HER&D policies, many EU jurisdictions link them with other programs. Examples include:

- Home energy retrofit incentives and financing programs (15% of homeowners in Portugal who didn't do retrofits mentioned they lacked the financial capital to pursue them) (ADENE 2015)
- Including indications of what incentive programs are available in the HER&D audit report. For example, to improve retrofit rates, promotion of the available energy efficiency rebates were added to the Austin Energy website and utility bills.
- Establishing minimum energy standards for new homes (to pull the market toward higher expected performance)
- Information hubs to connect contractors to homeowners seeking improvements. At the time the study was conducted Portugal was developing an information hub to link homeowners to energy efficiency contractors (Request2Action 2015). This generates market information for the contractors, and helps streamline the homeowner renovation process.
- Social marketing to encourage people to add energy efficiency renovations to their plans.

Experience has shown the value to linking HER&D programs to other initiatives and incentives to drive conversion rates. However, as HER&D becomes increasingly recognized and trusted, some jurisdictions have pulled back some incentives, allowing the mature HER&D programs to continue more or less on their own.

5: Expected costs, benefits and impacts of state or province-wide HER&D in North America

A fundamental question raised by HER&D policy is how to assess the program costs and benefits. In order to provide insights into this question we propose a framework that proposes which perspective to apply to conduct the analysis, and which costs and benefits to include. Our research considers reported results from a range of jurisdictions with HER&D program experience.

HER&D: Cost-Benefit Analysis Boundaries

The perspective selected for the cost-benefit analysis defines the boundaries within which the benefits and costs will be accounted for. Typical utility energy efficiency programs evaluate cost-benefit either from the utility's perspective (costs incurred and benefits accrued to the utility system), the participant's perspective, and sometimes the societal perspective, where costs and benefits are considered across the broader community. In all cases, careful considerations should be taken to ensure a balance view is applied, where all costs and benefits are accounted for (Dunsky 2015). Considering that energy savings, costs and benefits are shared between different parties and accrue over time, we recommend using a societal perspective to assess the full suite of costs and benefits, including an analysis of future costs and savings.

Accounting for HER&D benefits

HER&D benefits are first and foremost related to the energy savings generated by increased energy efficiency retrofit activities (including GHG reductions and related non-energy benefits). There are also a range of market transformation impacts that can be accounted for, including increased energy literacy and access to energy consumption information. Moreover, economic impacts may be readily quantified through accessible data (direct energy and non-energy impacts, and to a lesser extent increased property value and macro-economic impacts.) Our study indicates opportunities to assess these benefits, and where they can be appropriately included in a cost-benefit analysis for HER&D programs.

Energy Impacts: While there is limited information available on the specific direct energy impacts of HER&D policies, many jurisdictions have a long standing history of whole-home residential retrofit energy efficiency programs, with evaluated results that can be used to assess the per-home average energy savings derived from the retrofit activity as a result of HER&D. In order to use utility program data for a HER&D cost-benefit analysis, the analyst needs to assess the similarity between HER&D and utility retrofit programs and account for any significant departure in the analysis. For example, utility programs that require an asset-based energy rating that includes retrofit recommendations, and cover a comprehensive package of measures may provide the most appropriate source for estimating HER&D program inspired retrofit impacts.[4]

From a societal perspective, the indirect energy related benefits should also be accounted for, and these typically include quantifiable environmental benefits (such as GHG emissions reductions) and non-energy impacts (such as increased comfort, reduced noise, reduced operation and maintenance costs and others[5]).

Additional Benefits: As discussed previously there exist a strong correlation between HER&D performance and an increase in home valuation. While the precise correlation between HER&D ratings and valuation is not conclusive and will likely vary between different markets,

[4] It should be noted however, that in the jurisdiction where the analysis was performed, it was only possible to capture the impact of measures implemented between the pre and post retrofit audits. Thus some additional impacts may result from measures carried out after the post-retrofit HER&D audit is complete, as a result of information provided through the HER&D report. An assessment of measure-level energy savings instead of per-home energy savings may be useful in determining future impacts.

[5] The precise quantification of non-energy impacts is not part of this analysis, and the authors recommend to rely either on values specific to jurisdictions, or apply multiplication factors on the energy savings benefits to account for those.

this additional benefit can be accounted for in the analysis, although only from the participants' perspective (within the societal perspective, this is a transfer between the buyer and the seller). Moreover, the analysis must separate out the portion of the home valuation impact that is attributable to the energy bill savings, from the valuation attributable to the home rating itself, in order to avoid double counting benefits. Experience elsewhere indicates that this impacts grows overtime, and this factor should be captured, with a modest impact in the first years of the HER&D, increasing to its full value over a number of years.

Another positive impact of HER&D is increased investments in energy efficiency retrofit activities, and related macro-economic impacts. A recent study quantified the incremental impacts of energy efficiency investments on GDP and job creation (Acadia Center 2015). While these are significant benefits from a public policy perspective, it is not typically feasible to capture the associated costs, and therefore they cannot be included in a comparative cost-benefit analysis.

Assessing HER&D Program Direct and Societal Costs

The costs involved with HER&D programs are typically more easily tangible and thus simpler to assess than the benefits. These include home energy assessment costs, energy efficiency retrofit cots, and HER&D and efficiency program costs.

Home energy assessment costs have a dramatic impact on the HER&D program cost/benefit ratio, since all homeowners covered by HER&D will incur these costs, while only those implementing energy efficiency retrofits will generate benefits. Successful programs need to balance affordable assessments with encouraging upgrades that deliver real energy savings. Similar to the benefits analysis, information to assess other cost categories should be readily available through utility energy efficiency program experience.

Forecasting HER&D Program Impacts

The final component of the cost-benefit analysis lies in the projection of home sales impacts and energy efficiency retrofit activity as a result of HER&D. In order to forecast the retrofit activity as a result of HER&D, the following factors should be considered:

- Housing stock vintage that impact the potential for energy efficiency retrofits, which influences the likelihood a homeowner will act on upgrade recommendations;
- Incentive programs available to address market barriers to energy efficiency; and
- Expected compliance rates, based on the effectiveness of the compliance mechanisms in place and expected volume of HER&D exceptions.

These factors, used in consideration of the results from jurisdictions with HER&D program experience (where 12% to 37% of home buyers have been influenced by the HER&D report to engage in energy efficiency retrofit activities, as discussed above) can be used to forecast the retrofit activity. Considering the number of assumptions having a direct impact on the retrofit activity forecast, scenarios exploring the breadth of reasonable values for those assumptions should be explored.

For home sales impact, local real estate organizations or other economic actors can provide residential home forecasts, which can be combined with HER&D program experience from analogous jurisdictions, where available.

6: Conclusions - Key Take Aways

Overall our study of HER&D program results from 14 jurisdiction concludes that HER&D programs can be expected to deliver two key impacts. First, there is a strong correlation between HER&D rating scores and home values, which suggests that HER&D programs are successful in helping the market value energy efficiency. Second, upgrade recommendations from HER&D reports increase the likelihood that homeowners will implement energy efficiency measures, which leads to improved energy performance in the housing stock over time.

In summary while HER&D ratings do not likely influence home buying decisions (in terms of which property to purchase), they appear to provide information that encourages homeowners to upgrade the energy performance of their homes during post-purchase renovations. Moreover, HER&D programs play a key role in market transformation strategies by providing an accurate inventory of building stock energy efficiency features and allowing the market to value energy efficient homes.

To succeed HER&D programs must address three central challenges reported by HER&D program administrators:

1. Achieving policy enactment and acceptance:
2. Encouraging widespread compliance
3. Increasing conversion rates for recommended energy efficiency improvements

To improve the chances of success we recommend a few key strategies:

1. Focus stakeholder consultation around the HER&D implementation plan, rather than the enabling legislation, to decrease the chances that the legislation will be blocked by special-interest groups.
2. Promote HER&D as a tool to encourage homeowners to pay more for better performing homes, and to inform what energy fixes are needed for poorly performing homes
3. Link HER&D programs to other initiatives and incentives to drive conversion rates.

Once a HER&D program is developed for a given jurisdiction, forecasting impacts will require establishing valid estimates of the compliance and conversation rates, and estimating the resulting energy savings and renovation costs from analogous home-retrofit incentive program results. However, assessing the costs and benefits from a HER&D program that is part of a larger energy efficiency policy and program framework is complex, and in these cases it may be best to view HER&D as part of a broader market transformation effort. Where HER&D is a stand-alone program the cost-benefit assessment will be simpler, but the results may disappoint.

By identifying the key HER&D impacts, the recipe for a successful program, and providing a framework for assessing costs, benefits and impacts, this study aims to provide HER&D proponents and lawmakers with a tool to forecast the potential for HER&D programs in a variety of North American jurisdictions.

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