

Opening the Door to Home Performance: Motivating Energy Upgrades Through an Online Portal

Robin LeBaron, Pearl Certification

ABSTRACT

This paper explores the potential for an online portal and associated ecosystem to educate homeowners about energy efficiency and home performance improvements, and to motivate them to take action to make their home more efficient. It draws on data from a survey of 252 respondents who have received a Pearl Certification Report and/or signed up for Pearl's Green Door portal to explore whether and how these tools educate and motivate. Both quantitative and qualitative data suggest that exposure to Pearl's technology ecosystem facilitates the home improvement process by increasing homeowners' knowledge and confidence about energy upgrades and that these changes in turn are associated with increased spending on implementation of energy improvements.

Practical Barriers to Energy Upgrades

Opportunities for saving energy abound in the average home: in the attic, walls, crawlspaces, ductwork, and HVAC closets. The National Renewable Energy Laboratory (NREL) estimates have identified cost-effective energy upgrade packages that, if implemented across the stock of detached, single-family residential buildings, would reduce the primary energy consumption of this stock by 24%, and overall U.S. carbon emissions by 4.3% (See Wilson et al 2017: viii.)

The challenge for the energy efficiency industry is that homeowners are not making these improvements at the speed or scale needed to mitigate climate change. Among the industry's most important challenges are finding ways to understand why homeowners do not take advantage of these cost-effective ways to save energy, and motivating homeowners to take action.

Why don't more homeowners insulate their attics, air seal their homes, and purchase high-efficiency HVAC equipment? One theory is that the problem is partly about accessible tools. To improve a home's performance, the homeowner needs to solve the following challenges:

- Determine which improvements to make to address the home's performance problems (energy use, comfort, health, etc.);
- Choose the specific technologies, models, or systems to solve the problem;
- Find contractors from one or more trades capable of making the improvements.

Industry Experiments

The energy efficiency industry has developed several strategies to help homeowners address these challenges. A number of initiatives have focused on providing guidance regarding the selection of technologies and models – the ENERGY STAR program lists qualified products, for example, and the Northeast Energy Efficiency Partnership (NEEP) has developed guides

regarding heat pumps (see Northeast Energy Efficiency Partnership, n.d.). HVAC organizations like Air Conditioning Contractors of America and the National Comfort Institute have attempted to educate the public regarding the value of correct system design and installation. All of these resources can be very valuable for consumers, but they are stand-alone solutions that do not address the building as a whole. They are also distributed among many different websites that often require research to find, which is a particular problem if equipment breakdown requires the homeowner to make decisions quickly.

A second approach, used in several programs funded by the 2009 American Reinvestment and Recovery Act (ARRA) stimulus was the “concierge” model, through which a professional with building science expertise would conduct a thorough assessment of a home, make recommendations, and assist the homeowner in finding a contractor and ensuring that the work was done correctly. This model proved expensive for utilities who subsidized the auditor visit, and it has never gained traction in the unsubsidized market, largely because of expense. Conflict between the energy expert and the contractor regarding work scopes also made this model difficult to implement.

As an alternative to the concierge model, some states and utilities have developed programs to encourage contractors to adopt vertically integrated whole-house business models. These home performance contractors provide a full suite of energy services, from the whole-house energy assessment to both envelope and HVAC services. A small number of home performance contractors continue to provide energy services – often of very high quality – to homeowners. In recent years a number of solar contractors have developed a variation on this model, which involves an assessment for both energy savings and solar potential, followed by efficiency improvements as well as the rooftop solar installation. Contractors with these types of integrated business models are still relatively rare, however: the national Home Performance with ENERGY STAR program notes that 1,500 contractors work in these programs across the country – not all of which are full-service home performance firms (see U.S. Department of Energy, n.d.). In comparison, there are almost 112,000 HVAC firms alone in the U.S. (see IBISWorld, n.d.).

In the years that followed the wind-down of the ARRA stimulus programs, the U.S. Department of Energy explored a “staged retrofit” approach, which would provide homeowners with tools to undertake a comprehensive set of energy improvements over time.¹ Discussions about this approach proposed providing the homeowner with a roadmap for improvements that they could follow according to their interest and as their budget allowed. NYSERDA’s Comfort Home program encourages homeowners to make envelope and duct improvements before replacing HVAC equipment, for example (see Amann et al, 2021). However, there are still relatively few of these programs, and they do not provide comprehensive guidance regarding home improvements.

In short, although the energy efficiency industry has developed a number of innovative approaches to ease the challenges of making efficiency upgrades, none have yet achieved anything close to the level of success necessary to support a large-scale change in homeowner behavior.

¹ One of the first discussions of the potential for a staged upgrade approach can be found in LeBaron and Saul-Rinaldi 2013.

Supporting Upgrades with Online Resources

Given the significant challenges that confront a homeowner interested in making energy upgrades, and the relative scarcity of solutions, Pearl Certification has developed a technology-based strategy for providing homeowners with the resources they need to make energy efficiency and home performance improvements, with the goal of driving these sorts of projects at a scale which will meaningfully reduce carbon emissions from residential buildings.

Pearl Certification, as its name suggests, certifies high-performance homes: homes with features that make homes more healthy, comfortable, and energy and water-efficient, and that generate renewable energy. Pearl issues a certification report to owners when high-performance features are installed, or when a homeowner requests a certification inspection. The certification report, and supporting marketing materials, are designed to be used at the time of sale to showcase the home's high-performance features. Third-party studies have shown that Pearl Certified homes consistently sell for a premium of between 3% and 5.5% more than comparable, non-certified homes (see Fincham 2022).

In 2020 Pearl launched an integrated solution designed to help homeowners address the challenges that are frequently barriers to energy efficiency home improvements. Pearl's approach was anchored by an online portal, Green Door, which serves as a repository for a homeowner's certification report, and provides a rich set of educational resources, including tailored home improvement roadmaps. Because home improvement projects are often not top of mind for homeowners, Pearl engaged homeowners through a monthly newsletter, which consolidated blog content posted approximately once a week on Pearl's website. Pearl's website also contains extensive educational resources about home improvements and points the homeowner to Pearl's Green Door portal.

It was anticipated that homeowners would find Pearl in two ways: either by receiving a Pearl Certification Report from a contractor, or through a web search and engagement with Pearl's website. In either case, the homeowner would be encouraged to create a Green Door account, which would be linked to their home's address. Once in this ecosystem, the homeowner would receive a regular email newsletter from Pearl (with the option, of course, to opt-out).

Green Door was designed to be a living record of the home. Home improvement contractors that work with Pearl submit data that populates both the owner's certification and Green Door account with the same information about the improvements they have made. Multiple contractors can submit information about the home, which increases the information in the homeowner's Green Door account and enables updated and more detailed certification reports to be issued. Homeowners can also enter information about improvements they make, using a verification process that ensures the information is accurate.

Both Green Door and the certification report display information about the home's energy efficiency features by grouping them into five categories: building shell; heating and cooling; baseload; home management; and electric vehicles and renewables. Green Door and the certification report also store and make visible information about how well energy efficiency measures were installed – if an HVAC system has documentation indicating that it was installed according to Manual J protocols, or was performance-tested, this information will be stored and showcased in the certification report.

Green Door uses Pearl's energy efficiency scoring system, which assigns points to energy performance measures that are above average efficiency – defined as Federal minimum standards when relevant. The system is designed to be gamified: Green Door provides a prominent display of the home's points, as allocated between building shell, heating and cooling, baseload, and

building management. The more improvements are made in the home, the more points the home gets; with enough points the home reaches a silver, gold, or platinum level.²

Green Door enables homeowners to develop Home Investment Plans. It lists recommended improvements, which are generated based on generic recommendations for homes in that specific climate zone and modified according to information about the home that is recorded in Green Door (e.g. vintage, primary and secondary fuels, and existing energy efficiency features). The recommendations come with descriptions of the home features and advice regarding things to watch out for in the installation process – the recommendations about air conditioning, for example, briefly describe the difference between variable and single-stage systems and the benefits of load calculations. The model shows how many more points the home would accumulate as different improvements are made. This plan can function as a roadmap for making improvements over time.

Green Door also provides a search function that enables homeowners to find high-quality contractors. Contractors in Pearl’s network, and contractors that belong to other networks that advocate for high professional standards, like the Air Conditioning Contractors of America (ACCA), are included in the search function.

Green Door provides a range of other tools to make the energy improvement process easier, including:

- A rebate finder that makes it easy for homeowners to identify ways to access public funds to reduce the installation cost;
- Document storage so that homeowners can keep track of improvement-related documents, including the documents necessary to claim the Federal energy efficiency tax credit;
- A real estate agent search feature that homeowners can use when they sell their home.

One of the challenges of supporting homeowners through the energy improvement process is that many homeowners do not focus on home improvements for long periods of time, and as a result may not remember where or how to find resources when they need them, or even that these resources exist. To address this challenge, Pearl sends a monthly email newsletter to all homeowners who have created a Green Door account. The newsletter, which incorporates information from blog posts that Pearl publishes, is intended to make homeowners aware of energy efficiency solutions and to remind them of how to find Green Door and other resources. Homeowners who land on the Pearl website can find similar resources on the pages dedicated to homeowners.

This ensemble of tools – the Pearl Certification Report, the blogs and Pearl website, the email newsletter, and Green Door – are designed to work together synergistically to educate and motivate homeowners to make energy efficiency improvements. They are referred to in the remainder of this paper as the “Green Door ecosystem.”

Survey Research on Homeowner Behavior

The goal of the Green Door ecosystem is to increase the pace of home energy upgrades by making it easier for homeowners to undertake these projects. To test the efficacy of this

² For examples of the ways that gamification can drive behavior, see the meta-review of literature on the impacts of gamification in the health care field by Damaševičius R et al.

approach, Pearl retained [KSV](#), a firm experienced in researching energy- and behavior-related issues, to conduct a survey of users of the Green Door ecosystem, with the goal of determining whether and how the Green Door resources were changing the ways that homeowners thought about and implemented efficiency projects.

In November 2024 Pearl conducted a preliminary online survey to assess whether there was any evidence that Green Door was influencing homeowner thinking and behavior, and whether the expense and resource commitment of a larger study was warranted. Invitations to conduct the survey via SurveyMonkey were sent to approximately several hundred homeowners who had a Green Door account and had recently logged into and conducted some basic activity like recording a new improvement or conducting a search. Twenty-seven homeowners completed the survey, which consisted of thirty-one multiple-choice and open-ended questions. The results suggested that engagement with Green Door was both increasing homeowners' understanding of the value of energy-efficient home upgrades, and motivating them to take action. On the basis of these findings, Pearl decided to proceed with a larger survey.

In January and February of 2024, a 56-question SurveyMonkey survey was sent to six thousand owners of Pearl Certified homes and Green Door users. The questions included five questions about the homeowners' demographics, four questions about how and why the respondents had initially engaged with Pearl and/or with Green Door, and six questions about how they had subsequently engaged with the Green Door ecosystem. Thirty-nine questions asked how the respondents prioritized and approached home improvement decisions before and after their exposure to Pearl and Green Door. Two final open-ended questions asked respondents to describe the influence of Pearl certification and Green Door on their homeownership experience.

A total of 252 homeowners responded. Of these respondents, a relatively small group of 21 identified themselves as having created a Green Door account, but not yet having a Pearl Certification of their home. Fifty-nine respondents reported that they had created Green Door accounts and had Pearl-certified homes. The remaining 172 respondents reported that they had Pearl-certified homes, but were not active Green Door users. The assumption of the study was that each of these respondents had had some opportunity to learn about energy improvements through the components of the Green Door ecosystem, including the Pearl Certification reports, the monthly email newsletter, the Pearl website and blogs, and Green Door itself.

Survey Results

The 272 respondents lived in 32 states. California was the most represented (43 respondents), followed by Arizona (35). Nevada (17), New Jersey (17), and Maryland (14) rounded out the top five home states. Their responses suggested a stationary population: almost 60% had lived in their homes for six years or more, while only 6% had moved in less than a year earlier. Only 8% indicated that they planned to move within the next three years.

The respondents as a group were relatively older and relatively affluent, not entirely surprisingly, since they were all homeowners. Eighty-five percent reported annual household incomes of more than \$75,000, and 64% reported being 45 years or older. At least some respondents represented younger and lower-income households: 5% of respondents reported annual household incomes of less than \$50,000, and 16% were less than 35 years old.

Table 1: Respondents by Income

Table 2: Respondents by Age.

	Total A
BASE: All Respondents	252
Less than \$75,000	38 15%
Under \$10,000	1 0%
\$10,000 to \$14,999	0 -
\$15,000 to \$24,999	1 0%
\$25,000 to \$34,999	8 3%
\$35,000 to \$49,999	5 2%
\$50,000 to \$74,999	23 9%
\$75,000 or more	214 85%
\$75,000 to \$99,999	16 6%
\$100,000 to \$149,999	53 21%
\$150,000 to \$199,999	51 20%
\$200,000 or more	50 20%
Prefer not to answer	44 18%
Mean (\$) ('000)	138.79
S.D.	54.38
S.E.	3.77

	Total A
BASE: All Respondents	252
'18-44 (Net)	83 33%
'18-24 years	0 -
'25-34 years	16 6%
'35-44 years	67 27%
'45 or older	162 64%
'45-54 years	58 23%
'55-64 years	40 16%
'65-74 years	49 19%
'75 or older	15 6%
Prefer not to answer	7 3%
Mean	52.65
S.D.	13.43
S.E.	0.86

Homeowners who were not active Green Door users were primarily engaged with Pearl through the actions of a contractor who sent them a Pearl Certification report. Green Door users, however, were required to take the extra step of setting up an account and logging in. More than half of these 80 respondents (42, or 53%) were motivated by a desire to access their Pearl Certification report. However, most reported additional reasons as well. Learning about rebates and tax credits and accessing home improvement information in Green Door that could enable qualification for tax credits, were cited as motivations by 48% and 39% of respondents, respectively. Learning about how to make home performance improvements, and which improvements to prioritize, were motivating for 39% and 29% of respondents. Thirty-three percent wanted to record improvements they had made, and 23% wanted to use Green Door to set up or track maintenance issues. Taken together, this evidence suggests that significant numbers of Green Door users were interested in making, funding, tracking, and maintaining improvements when they set up their accounts. The question is whether this interest translated into action.

Table 3: Motivation for Opening a Green Door Account

	Total
	A
BASE: User Of The Green Door App At Q1	80*
Wanted to have a quantitative assessment of home performance	21 26%
Wanted to improve home performance (e.g., improvements to the overall comfort, health, and energy efficiency of your home)	31 39%
Wanted to learn which home improvements to prioritize	23 29%
Wanted to be connected to a network of contractors and real estate professionals	9 11%
Wanted to make my home's sales listing (or eventual listing) more attractive	15 19%
Wanted to find rebates or tax credits for my home improvements	38 48%
Wanted to access my Pearl Certification	42 53%
Wanted to access home improvement data for tax credits	31 39%
Wanted to connect to a specific contractor or real estate agent	1 1%
To keep track of the home improvements I've made	26 33%
To keep track of maintenance schedules on the equipment in my home	18 23%
To discover available rebates on home performance solutions	31 39%
A neighbor, family member, or colleague suggested it or inspired me to look into it	0 -
Other	2 3%

Many of the questions in the survey asked respondents how they prioritized different types of home improvements before and after engaging with the Green Door ecosystem (i.e. the Pearl Certification Report, the newsletter, the website, and/or Green Door). The preliminary study had indicated that homeowners valued energy efficiency improvements more after exposure to the education that the Green Door ecosystem provided. Interestingly, however, this finding did not appear in the larger study, which showed perceptions regarding all home improvement-related subjects changing relatively little before and after engagement with Pearl.

Homeowner's confidence about efficiency improvements did shift significantly after exposure to the Green Door ecosystem. Respondents were asked "How would you have rated your confidence level in choosing which home improvement investments would be worth the cost?" on a five-point scale from "extremely confident" to "not at all confident." The responses indicated that only 33% had been "extremely" or "very" confident prior to exposure to Pearl, but 59% experienced this level of confidence after engaging with Pearl. Conversely, homeowners who were "slightly" or "not at all" confident fell from 15% to 8%.

Tables 4 and 5: Confidence in Identifying Cost-Effective Improvements: Before and After Exposure to the Green Door Ecosystem

	Total A
BASE: All Respondents	252
Top 2 Box (Net)	83 33%
(5) Extremely confident	17 7%
(4) Very confident	66 26%
(3) Moderately confident	132 52%
Bottom 2 Box (Net)	37 15%
(2) Slightly confident	30 12%
(1) Not at all confident	7 3%
Mean	3.22
S.D.	0.85
S.E.	0.05

	Total A
BASE: All Respondents	252
Top 2 Box (Net)	149 59%
(5) Extremely confident	28 11%
(4) Very confident	121 48%
(3) Moderately confident	84 33%
Bottom 2 Box (Net)	19 8%
(2) Slightly confident	15 6%
(1) Not at all confident	4 2%
Mean	3.61
S.D.	0.82
S.E.	0.05

Respondents also indicated that their knowledge of home performance improvements had increased since exposure to the Green Door ecosystem. Interestingly, the jump in respondent knowledge did not appear to be as significant as the jump in respondent confidence. Nonetheless, 15% of respondents reported that exposure to the ecosystem had increased their knowledge significantly, and a further 53% said it had increased their knowledge slightly. Perhaps predictably, only one respondent indicated that their knowledge had decreased slightly, and one indicated it had decreased significantly since engaging the Green Door ecosystem. It is challenging to hypothesize how this decrease in knowledge occurred: perhaps the respondents believed that the information they encountered through Green Door and Pearl was somehow inaccurate, although there is no other evidence in the survey to substantiate this.

Table 6: Knowledge of Home Performance Improvements After Exposure to the Green Door Ecosystem

	Total A
BASE: All Respondents	252
Top 2 Box (Net)	171 68%
(5) Increased significantly	37 15%
(4) Increased slightly	134 53%
(3) No change	79 31%
Bottom 2 Box (Net)	2 1%
(2) Decreased slightly	1 0%
(1) Decreased significantly	1 0%
Mean	3.81
S.D.	0.69
S.E.	0.04

The survey responses suggested that increased confidence and knowledge led to action. Almost exactly two-thirds of respondents reported that they had made some energy efficiency improvement since being exposed to the Green Door ecosystem. Just over a fifth of the 221 homeowners who answered the question (22%) reported adding insulation, a similar number (21% of respondents) had installed an air conditioner (unfortunately the study did not specify whether the unit was central or window), and a similar number (22% of respondents) had installed solar panels. Smaller proportions had made efficiency improvements like installing a new furnace or water heater, new appliances, air sealing the home, and getting an energy audit.

Table 8: Improvements Made Since Exposure to Green Door Ecosystem

	Total
	A
BASE: Total Answering	221
Replaced or upgraded your home's insulation	48
	22%
Replaced your appliances with ENERGY STAR models	25
	11%
Installed solar panels	49
	22%
Installed a heat pump	30
	14%
Installed an energy efficient air conditioner	46
	21%
Installed a high-efficiency furnace or boiler	38
	17%
Replaced your home's water heater	31
	14%
Installed LED lights	34
	15%
Replaced your home's windows	14
	6%
Had your home air sealed	30
	14%
Had a home energy assessment/ home energy audit	30
	14%
None of the above	75
	34%

These responses do not address the issue of motivation: that is, respondents did not necessarily make these improvements solely because they engaged with the Green Door ecosystem. However, given the way in which this engagement boosted homeowner knowledge and confidence, it is reasonable to assume that it played a role in some of these decisions.

Indirect evidence for this hypothesis comes from the fact that two-fifths of respondents indicated that their spending on home performance had increased since their exposure to the Green Door ecosystem: 14% indicated a significant increase, and 28% indicated a slight increase. Fifty-five percent indicated no change, and only 4% indicated a decrease. Again, these findings do not conclusively prove that Green Door exposure was responsible for this change, but it is reasonable to hypothesize that it was influential.

Table 9: Times When Content from Green Door Ecosystem is Most Often Engaged With

	Total
	A
BASE: All Respondents	252
When looking for inspiration for the next project	40 16%
When actively planning a home improvement project	74 29%
When thinking about selling my home	23 9%
To review history of past home improvement projects	64 25%
To find a contractor	22 9%
Other	29 12%

Respondents were asked when they engaged with the Green Door ecosystem most frequently. The answers indicated a broad range of uses. The most common response, made by 29% of respondents, was “when planning a home improvement project,” which supports the theory, discussed above, that exposure to the Green Door ecosystem influenced the spending on improvement projects. Twenty-five percent indicated they used the ecosystem (presumably both Green Door and the Certification Reports) to review past improvement projects. Nine percent used the Green Door ecosystem to search for a contractor, and nine percent used it to position the home for sale – presumably a large proportion of the total respondents who sold during this period, given that so few indicated interest in selling.

Further evidence that Green Door drove action comes from the open-ended responses to the survey questions. Respondents were asked, “How would you say Pearl/Green Door has changed the way you view your home?”. Responses included comments that illustrated how the ecosystem increases knowledge and confidence and leads to action, including:

- Information easily available
- Easier to identify other improvements and what will make the largest impact
- Helped think more how to make things more efficient.
- Helped think more how to make things more efficient.
- It has gave me confidence on taking the steps to improve my home
- just gave me a clear path to see what type of improvements are available for my home.

Also, importantly from the perspective of Pearl’s mission, several respondents indicated that exposure to the Green Door ecosystem also made them more aware of the fact that home performance improvements should increase the home’s value:

- Only when it comes to how much my home is valued and how much more I hope it will be when I begin to sell.
- I see it as a way to add value.
- Belief that I will be able to monetize efficiency and renewable energy investments when I sell

Many respondents, by contrast, indicated that “It has not changed my behavior,” “not much,” and “it hasn’t.” These comments reflect the fact that significant numbers of respondents indicated that the Green Door ecosystem did not substantially change their understanding or action.

The second open-ended question asked: “What is the greatest value you’ve gotten out of Pearl/Green Door?” provided further evidence that the ecosystem drives behavior, with responses like:

- Knowledge about potential improvements and information about logistics and potential ROI
- Provided more info to my home and plan for next project
- A easy to understand score of my home's 'Greeness'
- It gives me another way to research.
- really gave me a new way to look at home improvements, not only to add more value to my home but also ways to save money with different improvements.

Again, the potential re-sale value was mentioned by a number of respondents:

- Eventually, being able to show improvements to potential sellers, however this is decades down the road.
- Seeing value of improvements
- Understanding the impact of home improvements on value.
- Certification as a hallmark for a significant increase in this house's value.

The value of information about rebates and tax incentives was selected as the most valuable feature of the ecosystem by a number of respondents:

- Getting the tax rebate info
- Reminder about potential tax credit.
- The tax rebate calculator is nice.

The responses “not much value,” “I’m not sure yet. I haven’t really used it much,” and “None I just get spam emails,” provide confirmation that the study dealt with a population of real human beings with different perspectives, and a reminder that the Green Door ecosystem will benefit many homeowners, but it cannot be expected to help everyone.

One interesting finding qualifies the indications that Pearl’s tools are changing behavior and supporting energy improvements. As discussed earlier, Green Door enables homeowners to create a Home Investment Plan. However, only 6% of the respondents indicated that they had created one. This may be due to challenges using Green Door’s planning tools, or to the fact that it is not sufficiently accessible in Green Door: more research is needed to understand the lack of use of this planning tool.

Conclusions

Taken together, the multiple-choice responses to the survey strongly suggest that exposure to the Green Door ecosystem shifted respondents' minds and actions. Significant proportions of respondents reported that after engagement with the ecosystem:

- Their confidence in identifying cost-effective improvements increased;
- Their knowledge of home performance improvements increased;
- They used the ecosystem when they planned improvement projects;
- They made efficiency and renewable improvements;
- Their spending on home performance improvements increased.

The open-ended questions further support this conclusion: many homeowners expressed appreciation for the guidance regarding improvements, as well as citing other benefits such as the potential for increased resale value.

Further research should be undertaken to understand:

- Which components of the Green Door ecosystem respondents are using;
- Specifically how the ecosystem helps planning and action;
- How more homeowners could be supported in developing Home Investment plans.

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