Data Standards Roadmap

Priorities and Actions for Driving Data Standardization in the Residential Energy Efficiency Industry

2017 – 2019

For Industry Review:
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Home Performance Coalition

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Acknowledgements

The Data Standards Roadmap is intended to increase the adoption of the Building Performance Institute (BPI) standard, Home Performance Extensible Mark-Up Language (HPXML), over the next two years; promote the value of data standardization for the energy efficiency industry; and secure funding to achieve the goals and vision outlined in this plan. The roadmap will also help government and private sector actors make investment decisions based on the development and use of data standards. As a result of the planning process, new technologies, partnerships, and research opportunities will be identified and implemented. The roadmap primarily focuses on HPXML; however, HPXML's relationship to other data standards is also discussed.

The roadmapping process is being led by the Home Performance Coalition with support from the HPXML Working Group. In particular, HPC would like to thank the working group members that reviewed and provided input into this document prior to its release: Alice Rosenberg, Consortium for Energy Efficiency; Andy Bardwell, OptiMiser; Dale Hoffmeyer, Department of Energy; Greg Thomas, Performance Systems Development; JJ Augenbraun, EnergySavvy; Michael Atkins, TransUnion; Noel Merket, National Renewable Energy Laboratory; and Robin LeBaron, Pearl Certification.

A full list of HPXML working group members can be found on http://www.hpxmlonline.com/working-group/.

This document is available for download from: www.hpxmlonline.com.

About Home Performance Coalition

The Home Performance Coalition (HPC) is a national nonprofit organization that works in coordination with industry leaders including the Building Performance Institute, Efficiency First, Energy and Environmental Building Alliance, and Home Energy Magazine to advance residential energy efficiency through education and research. HPC maintains offices in Washington, DC and Pittsburgh, PA.

For more information about HPC, visit www.homeperformance.org.

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1.0 Introduction

1.1 The Need for Standardization

In today's existing homes market the electronic exchange of information on energy performance, energy conservation measures, and the physical and operational attributes of a home is often characterized by a lack of common terms, definitions, and two-way feedback systems. This limits the ability of decision-makers to access, aggregate, share, and use data for the design and implementation of residential energy efficiency programs. This also makes it difficult for market actors to understand the drivers of variation in performance, identify investment opportunities, analyze market trends, and project savings from energy efficiency investments.

Data standards, like the Home Performance Extensible Markup Language (HPXML), a data collection and transfer standard published by the Building Performance Institute (BPI), are a powerful solution to some of the most intractable problems facing the home energy efficiency industry.

Data standards are crucial in enabling the quantification of energy savings that result from energy efficiency upgrades that in turn allow for savings guarantees, low-cost consumer finance, and the sale of energy efficiency into energy, capacity, and carbon markets. Data standards are crucial for ensuring that energy efficiency improvements in homes are properly valued in real estate transactions. Finally, data standards are crucial for on-going research into the best methods for making homes energy efficient because the aggregation of standardized data supports comparability and comprehensive, ongoing analysis of program and contractor performance.

The roadmap identifies strategies for supporting a growing and connected energy efficiency industry through the adoption of HPXML and related data standards, such as the Department of Energy's (DOE) Building Energy Data Exchange Specification (BEDES).

1.2 Roadmap Planning Process

The planning process began at an HPXML Working Group meeting at the 2016 HPC National Home Performance Conference & Trade Show. During the meeting, working group members identified a number of important issues for driving standardization in the industry, including the need for:

- Case studies that articulate the value proposition of HPXML
- Reducing industry costs from the standardization of evaluation, measurement and verification (EM&V) data collection and reporting requirements
- Ongoing support for the development and maintenance of HPXML
- Education and outreach to utility program administrators on the benefits of HXPML

A Steering Committee comprised of software developers, program administrators, implementers, government, and other industry partners provided input and direction into the roadmap. The Data Standards Roadmap was also circulated more broadly to industry stakeholders for feedback on the strategies outlined in the roadmap.

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1.3 Vision

Standardized data collection and reporting enables market actors to efficiently obtain high quality, low cost data to make decisions that grow the market for residential energy efficiency products and services.

1.4 Audience

The Data Standards Roadmap is intended to increase the adoption of HPXML over the next two years; promote the value of data standardization for the energy efficiency industry; and secure funding to achieve the goals and vision outlined in this plan. The roadmap will also help government and private sector actors make investment decisions based on the development and use of data standards. As a result of the planning process, new technologies, partnerships, and research opportunities will be identified and implemented. The roadmap primarily focuses on HPXML; however, HPXML's relationship to other data standards is also discussed.

2.0 Overview of HPXML

2.1 Purpose

HPXML is comprised of two BPI data standards that were published in 2013 to support a growing industry by facilitating communication and the exchange of information and data on residential building and energy performance. The purpose of HPXML is to:

- Standardize terminology and facilitate the collection of higher quality data as a means of tracking and quantifying work being completed across the residential energy efficiency industry;
- Create interoperability between software systems to allow the transfer of residential energy efficiency data across a diverse set of market actors, such as the real estate and financial sectors; and,
- Improve industry efficiency by reducing the costs of data collection and exchange between market actors.

The HPXML Data Dictionary (BPI-2200) standardizes terms and data formats related to the physical attributes and performance of buildings and measures. It defines the data elements necessary to provide a general description of a whole house or single measure energy efficiency upgrade for reporting, rebate and basic quality assurance (QA) purposes. The standard includes several smaller datasets that are being used to standardize data collection and reporting for specific use cases, for example, data required at the completion of a whole-house program.

The HPXML Transfer Standard (BPI-2100) provides requirements for a standard extensible mark-up language (XML) data transfer protocol that can be used to transfer information and data between software systems. The transfer standard is the companion standard to the HPXML data dictionary. Each of the data elements defined in the data dictionary can be transferred using HPXML.

Currently, there are nine utility and state home performance programs using HPXML and six software developers. For a complete list of HPXML adopters, visit www.hpxmlonline.com.

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2.2 Aligned with Industry Standards

HPXML is the most widely used implementation of the Department of Energy's (DOE) Building Energy Data Exchange Specification (BEDES). BEDES is a dictionary of terms, definitions, and data formats created to facilitate the exchange of information on building characteristics and energy use for the commercial, multifamily and residential industries.

HPXML is also aligned with the Real Estate Standards Organization's (RESO) Data Dictionary, which standardizes terms used in Multiple Listing Services (MLS) and other source providers nationwide so that information can be easily shared and understood in the real estate industry.

The benefit of having HPXML aligned with the RESO Data Dictionary and with BEDES is to increase interoperability across industries. Home energy efficiency information, including score and labels, can be auto-populated into MLS. Program administrators that have adopted HPXML can use BEDES to incorporate commercial and multifamily offerings into the same software system.

2.3 Management and Version Control

2.3.1 HPXML Working Group

HPXML has been developed, and is modified and maintained, by the stakeholders who use it, including organizations and individuals from residential energy efficiency programs, software development, government, home performance contracting, and the nonprofit sector.

The Home Performance Coalition (HPC) chairs a national working group of industry experts with oversight from the BPI Data and Modeling Standards Technical Committee using an open and consensus based decision-making process set by BPI. The working group meets quarterly to discuss updates and to vote on new versions of the standards.

Membership and participation in the HPXML working group is voluntary and open to all organizations and individuals interested in HPXML.

2.3.2 Versioning

The HPXML schema follows the Semantic Versioning 2.0 specification. The version numbers follow a pattern of Major, Minor, and Patch (e.g., 2.1.0). The major version number is incremented when the schemas are changed in a manner that is incompatible with previous versions. Examples of changes that require a major version change include renaming elements, removing elements, moving elements, and removing enumerations.

The minor version number is incremented when the schemas are changed in a manner that is backwards compatible with previous versions that share the same major version. In other words, a document created in a previous version of the schema will also validate against the new schema. Examples of changes that require a minor version change include adding elements, adding enumerations, and changing the annotation in the schema for an element.

Technical documentation can be found at www.hpxmlonline.com.

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2.4 HPXML Compliance

Stakeholders that wish to comply with the HPXML Data Dictionary and Transfer Standard shall use HPXML data in all cases in which an HPXML data element is sufficient to adequately represent the person, characteristic, concept or other home-related datum that is being described.

Data can be adequately represented by HPXML if HPXML data elements, singularly or in combination, can be used to describe the person or thing in a way that:

- Could reasonably be understood by other energy efficiency professionals; and,
- Does not result in significant loss of information or create significant risks of miscommunication.

Software developers may validate their HPXML files against the schema and its datasets by uploading files to the HPXML Validator. Sample HPXML files are available on GitHub (https://github.com/hpxmlwg/hpxml).

2.5 Continued Growth

The HPXML Data Dictionary is designed to grow with the industry. Recommendations for adding new or changing existing data elements or enumerations are vetted on the HPXML GitHub repository. Recommendations can also be sent by email to hpxml@homeperformance.org with the following information:

- Name: Create a name for the data element or enumeration you feel best describes the term.
- Definition: Write a comprehensive definition of the data element and include references if necessary.
- Data Type: Include your recommended data type and maximum field length.
- Enumerations: If your recommended field is a pick-list, please include enumerations. Enumerations may also need a definition.
- Justification: Please provide a reason the data element is important to your energy efficiency program or market.
- Duplication: Review the dictionary thoroughly to ensure you are not duplicating an existing data element or enumeration. Concepts can be expressed in a number of ways and rather than adding additional data elements or enumerations, we can use this recommendation to better define existing elements.

3.0 HPXML Standard Datasets

One of the areas in which data standardization holds the greatest promise is in data collection and reporting. If different energy efficiency programs all agree to collect the same (or very similar) data for the same use cases, such as the data reported by the contractor when the initial audit is conducted or the final job and test-out results are reported, information technology (IT) costs could be reduced significantly across the country.

Software vendors would be able to use the same reporting template, with only minor modifications, for multiple programs. Standard datasets would also greatly facilitate cross-program comparability as well as support research efforts and accurate quantification of savings for other uses.

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HPXML includes four standard datasets that program administrators can adopt to standardize data collection and reporting for several use cases, including:

- Transfer of project data from third-party energy modeling or data collection tools to a program management database; and
- Export energy efficiency project data, including the DOE's Home Energy Score, to local MLS.

Each of the datasets specifies a number of required data elements that can be collected at specific points during the implementation of a residential energy efficiency program. Below is a summary of the datasets, followed by a discussion in the next section of the benefits of adopting HPXML.

3.1 Audit

The audit dataset is designed for use by Home Performance with ENERGY STAR® or other whole-house programs that require auditors to submit energy audit results and a proposed workscope to the program for review. The dataset describes the baseline building with a proposed work scope. Required fields include data on the home's existing characteristics, health and safety needs, recommended improvements, and savings predictions.

The audit dataset was established through a consensus process of three geographically diverse existing whole-house programs, and is intended to meet the needs of most programs.

Programs that wish to adopt the audit dataset may download the Data Selection Tool (http://www.hpxmlonline.com/tools-resources/data-selection-tool/) for guidance on the required data fields. Software developers may visit GitHub for an example of an HPXML audit file.

3.2 Upgrade

The upgrade dataset is designed to facilitate the transfer of information on completed whole house retrofits from contractors to Home Performance with ENERGY STAR® or other whole house programs.

The upgrade dataset describes the baseline building (e.g., the pre-upgrade condition of the home, with proposed measures) with a completed work scope (e.g., description of installed measures, with modeled or predicted energy savings). The upgrade dataset was established through a consensus process of three geographically diverse existing whole-house programs, and is intended to meet the needs of most programs. Programs that offer more diverse incentives may need to add HPXML data elements to meet program needs.

Programs that wish to adopt the upgrade dataset may download the Data Selection Tool for guidance on the required data fields. Software developers may visit GitHub for an example of an HPXML upgrade file.

3.3 Home Energy Score

The Home Energy Score (HEScore) is similar to a miles-per-gallon rating that helps homeowners and homebuyers understand how much energy the home is expected to use. The HEScore also provides information on how to make the home more energy efficient.

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The Home Energy Score Translator (https://hpxml.nrel.gov/validator/) was developed by the National Renewable Energy Laboratory (NREL) to generate HEScore inputs from HPXML files. The translator is available open source as a stand-alone script. It is also incorporated into the HEScore API. By using this translator, software developers can leverage their investment in HPXML to provide HEScore functionality with minimum development cost.

3.4 Home Performance Certificate

BPI-2101-S-2013 Standard Requirements for a Certificate of Completion for Residential Energy Efficiency Upgrades (Home Performance Certificate) is a BPI standard that creates a bridge between the energy efficiency and real estate industries. The Home Performance Certificate standardizes data about a home's energy efficient features that is presented to real estate agents via MLS systems, appraisers and underwriters.

The Home Performance Certificate also facilitates the flow of information and data about a home's energy efficient characteristics from an issuing program into the real estate value chain (e.g., into MLS systems and to appraisers via documents such as the Appraisal Institute's Residential Green and Energy Efficiency Addendum).

BPI – 2101 – compliant certificates serve to confirm the achievement that a home energy upgrade (HEU) was successfully completed or individual energy conservation measures (ECM) successfully installed, and may provide details about the nature of the upgrade. These certificates may also serve as a tool in home resale transactions, in several ways. They may be attached to an MLS listing sheet and shown to the buyer and buyer's agent as a demonstration of the home's relative energy efficiency and/or related attributes, which may increase the home's market value. Appraisers and underwriters may also use them as a source of information about characteristics of a home related to energy consumption and energy savings.

All of the HPXML data elements that are defined in BPI – 2101 are aligned with terms in the RESO Data Dictionary and with the Appraisal Institute's Residential Green and Energy Efficient Addendum. This alignment facilitates the auto-population of local MLS. There are several pilots in progress to test the auto-population of MLS with HPXML project data, including the Northeast Energy Efficiency Partnerships' (NEEP) Home Energy Labeling Information Exchange (HELIX) and Build it Green's Green Registry in California.

Arizona Public Service and Salt River Project currently are issuing a BPI – 2101 – compliant Home Performance Certificate to homeowners that complete the Home Performance with ENERGY STAR® program. The New York State Energy Research and Development Authority (NYSERDA) and Energy Upgrade California® Advanced Home Upgrade are considering adopting the standard.

4.0 Value of Data Standardization

4.1 Reduce Administrative Costs

Utility and state program administrators that have adopted the Audit and Upgrade HPXML datasets have been able to reduce administrative costs associated with data collection and entry; project review; incentive processing; reporting; and quality assurance. One year after implementing an HPXML – compliant software environment that helped streamline online reporting, rebate approval and QA processes, the APS Home Performance with ENERGY

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STAR® program reduced quality assurance administrative labor by 50 percent.[1] Participating Arizona home performance contractors also reduced administrative labor by 31 percent per project, leading to a 50 percent increase in contractor satisfaction with the program.

The NYSERDA Home Performance with ENERGY STAR® program also has been able accelerate project approval times, minimize data entry errors, and reduce the number of staff manually reviewing projects after implementation of an HPXML – compliant software environment. NYSERDA reduced project approvals times from eight days to minutes for 90 percent of its projects by building automated data checks into its program software. This allowed contractors to receive project approval while on-site with the customer, greatly increasing the likelihood of having a customer move from the energy audit to completed project.

Because programs that are using HPXML are receiving standard data from participating contractors, data checks can be built into the program administrator's software that automatically screen for outliers. HPXML – compliant energy modeling tools working across jurisdictions also are able to incorporate automated data checks into the tool, allowing contractors to confirm program eligibility prior to transferring information to program administrators. Automated validation reduces submission errors, speeds up approval times, and adds value to the software tool.

4.2 Reduce Software Development Costs

Although the initial effort of bringing software tools into compliance with reading and writing HPXML may be significant, using a standard data format allows developers to maintain one extraction and translation layer (ETL) for clients rather than writing an ETL for each program that asks for a method of collecting data about homes and measures.

This is significantly less expensive for developers and their clients rather than building a system from the ground up, even when programs ask for some customization in data exchange. If programs adopt a standard HPXML dataset, for example, the Audit or Upgrade dataset, then implementing HPXML for a program becomes even more cost-effective because the software developer does not need to add a new data exchange.

For example, EnergySavvy was recently able to implement their workflow automation software with HPXML for a utility in the northeast in less than five months because the utility adopted the HPXML standard datasets for its home performance program with little customization. About 20 percent of EnergySavvy's time during this set-up period was spent on implementing HPXML. EnergySavvy estimates that without HPXML, it would have taken the company between eight and ten months and possibly longer, to build a similar data collection system from the ground up.

While not every HPXML data exchange will be applicable to every program because of differences in state or local reporting requirements, adopting the data standard is more cost effective than building a new system for each client.

1 See Case Study: Improving Arizona Home Performance https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/Improving%20Arizona%20Home%20Performance%20-%20Case%20Study.pdf

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HPXML-compliant software tools also may take advantage of the economies of scale data standardization provides to drive innovation in the software market. Many of the data collection tools in the market today offer a wide range of software capabilities for clients, allowing them to customize the sales process for customers, collect data through mobile based applications, and export HPXML files directly to program administrators.

4.3 Enhance Home Value

Making energy efficiency improvements visible in the real estate transaction is critical for enhancing the market value of energy efficient homes. The most efficient way to ensure information on energy efficiency is visible in the real estate transaction is through the auto-population of MLS.

To facilitate the auto-population of home sale listings, HPXML will be updated to remained aligned with the new versions of the RESO Data Dictionary and with the Appraisal Institute's Residential Green and Energy Efficient Addendum. The objective of the Addendum is to standardize communication about high-performing homes for lenders and appraisers.

There are several pilots underway to test the auto-population of MLS with HPXML project data, including the NEEP's HELIX and Build It Green's Green Registry in California. Software developers may also use the Home Energy Score Translator to generate HEScore inputs from HPXML files.

NREL also is working with the Residential Energy Services Network (RESNET) to create a single engine for generating Home Energy Ratings (HERS) using HPXML.

4.5 High Quality Research and Analysis

Collecting standard data improves data quality and allows programs to complete ongoing analyses to identify performance trends, and improve EM&V. Programs can provide program evaluators with measurably cleaner, more complete datasets, which may reduce data management costs. Programs may also share data regionally or nationally to identify trends; improve benchmarking; share best practices; and aggregate performance data to better understand product, program, or loan performance.

The DOE has invested resources to enable the import of HPXML files into national databases such as the Building America Data Portal to increase the industry's access to information on residential energy efficiency (see Appendix B for more information). Software developers also are leveraging large, aggregated datasets to develop tools that may be able to more precisely estimate and predict energy savings based on customer, contractor, or housing characteristics.

5.0 Barriers to Standardization

Data standards, like other standards, are more valuable the more broadly they are used. Every time an energy efficiency program implements HPXML, transactional costs fall for firms already using the standard. Software vendors can provide a rich set of data about a whole-house upgrade to programs using HPXML at very little additional cost because they have already made the initial investment to design software to support the data

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standard. For the energy efficiency industry to realize the full benefit of HPXML, it is crucial that more programs and other users adopt the standard.

This roadmap addresses several barriers that may limit HPXML from being more broadly adopted by the market, including:

- The value proposition of HPXML is unclear to utility program administrators;
- HPXML is viewed as difficult and expensive to implement; and,
- Programs operate in different regulatory environments which makes standardization difficult.

Below is a brief description of each barrier, followed by a discussion of strategies for overcoming these barriers in the next section.

5.1 Value of HPXML is Unclear

For HPXML to be broadly supported by industry stakeholders, the value proposition of the data standard must be clearly defined, recognized and repeated. Many of the initial program administrators that adopted HPXML understood the potential value of the standard and had a clear vision of how the standard would work. However, even these programs struggled to explain the value of HPXML in clear, non-technical terms to their partners.

It will be important to create a "story" that demonstrates how savings can be achieved through data standardization to multiple industry stakeholders that are in a position to support data standardization including utilities, implementers, contractors, and state regulators. Case studies will also be important to demonstrate the economic impact of data standardization to industry stakeholders.

5.2 HPXML Perceived as Expensive to Implement

Most home performance and energy efficiency programs rely on third-party vendors to handle information technology needs. Although program administrators may understand the benefits of HPXML, they are concerned about the potential hassle and expense of making their existing or new system HPXML-compliant.

Over the last two years, multiple tools and resources have been developed to assist program administrators and software developers reduce the costs of implementing HPXML (see Appendix A). These tools include an Implementation Guide, HPXML Validator to test software compliance with the standard, Data Selection Tool, and website. HPC has also advertised the data standard widely, helping programs understand what is involved in implementation, identifying strategic opportunities such as the creation of new business cases or major overhauls of data architecture, and providing support and advice as needed.

It will be crucial for this work to continue to maintain momentum in standards adoption. It also will be crucial for potential adopters to leverage the work and experience of existing standards' users, for example, by adopting the HPXML standard datasets and procuring HPXML-compliant software. Case studies should also be created to demonstrate the cost-benefit ratio of implementing HPXML not only for program administrators and software developers, but also for home performance contractors that collect data for programs.

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5.3 Lack of Uniform Data Requirements Make Standardization Difficult

The use of HPXML enables access to the same well understood terms and data structures that are used for data retrieval, driving economies of scale in the administration, finance, and evaluation of energy efficiency programs. But differences in reporting requirements across states, particularly data collected for the evaluation of programs, makes data standards expensive to implement as well as negates many of the benefits that standards provide to the industry.

Software developers have typically absorbed most of the costs associated with coding and debugging unique measure validation rules for programs, but variation also creates an economic burden for contractors that are responsible for collecting project data for programs. Some larger contractors may have one or more staff dedicated to data entry, and because of the nature of the work, may have additional costs associated with employee churn.

The DOE's Uniform Methods Project and NEEP's EM&V Methods Standardized Reporting Forms are two important initiatives that have been designed to standardize how energy savings are calculated, and reported to environmental regulatory staff. These initiatives should be promoted and aligned with HPXML as an important strategy for reducing administrative costs.

6.0 Strategies for Increasing HPXML Adoption

This section discusses the strategies for increasing the use of HPXML and other data standards in the home performance and energy efficiency industries. The strategies discussed below may address one or more of the barriers discussed in the previous section.

6.1 Develop Clear Explanation for Stakeholders on Value of HPXML

6.1.1 Identify Business Cases for HPXML

It is important to develop a compelling story in clear, non-technical language about the benefits of data standardization to contractors, programs, trade allies, and utilities, to make adoption of HPXML a priority. The Home Performance Coalition (HPC) in uniquely positioned to develop and promote the benefits of standardization to stakeholders because HPC does not sell or endorse a particular software product or service.

HPC will speak with utility program administrators across the country to better understand how HPXML can improve the cost-benefit ratio of their program, as well as identify potential issues with adopting the data standard. Administrators of whole-house programs that are not yet implementing HPXML will be targeted first, followed by utilities that jointly administer a residential energy efficiency program in their state.

6.1.2 Develop Case Studies that Demonstrate Impact

Case studies are an effective way to communicate the economic benefits of data standardization. The Department of Energy's Home Upgrade Program Accelerator is funding the development of several case studies with accelerator partners that have adopted HPXML and made additional workflow improvements to streamline data

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collection and processing. A case study on Arizona Public Service is available on www.hpxmlonline.com. The DOE Accelerator plans to release case studies on NYSERDA, Build It Green, and Enhabit in 2017.

6.2 Ensure HPXML Remains Updated and Coordinated with BEDES

6.2.1 Regularly Convene Working Group

The HPXML Working Group is the primary forum for keeping HPXML updated and aligned with other industry standards. HPC will continue to convene the working group quarterly to vet issues associated with HXPML implementation, vote on version changes, and discuss strategic issues associated with standards development. The release of HPXML version 3.0 is planned for later in 2017. This version will include major improvements on how health and safety measures are described within the standard and will be aligned with other BPI healthy and safety standards. Additional improvements to the standard will be identified and discussed over Github, the primary forum for suggesting changes to the standard.

6.2.2 Work with DOE to Maintain Standards Alignment

HPXML is the most widely used implementation of residential BEDES, therefore it is important that the two standards remained aligned. HPC will continue to work with the Lawrence Berkeley National Laboratory (LBNL) that oversees the development of BEDES to ensure the standards remain aligned whenever there is a version change. Mapping of HPXML to BEDES can be downloaded from https://bedes.lbl.gov/related-applications. When the HPXML online data dictionary is completed in 2017, users will be able to map to the BEDES data dictionary.

6.3 Facilitate Automatic Population of MLS

6.3.1 Align HPXML with RESO's Data Dictionary

The RESO Data Dictionary standardizes terms used in hundreds of MLS' nationwide so that information can be easily shared and understood in the real estate industry. "Green" terms in the RESO Data Dictionary are aligned with BEDES. To facilitate the auto-population of MLS with energy efficiency information and data, HPXML version 3.0 will be mapped to RESO's data dictionary. This mapping will include terms that are used in MLS to describe energy related improvements, as well as terms that are used to describe contact information of homeowners and contractors. Contact information currently is described differently in HPXML and the RESO Data Dictionary.

There are several pilots underway to test the auto-population of local MLS that will benefit from this mapping including HELIX and the Green Registry in California.

6.3.2 Update and Expand the Use of the Home Performance Certificate

The Home Performance Certificate is a BPI standard that creates a bridge between the energy efficiency and real estate industries. The Home Performance Certificate standardizes information about a home's energy efficient features that is presented to real estate agents (via MLS systems), appraisers and underwriters. It also facilitates the flow of information into local real estate listings.

The certificate is currently being used by APS and SRP, and is being considered by other programs as a method for documenting home energy upgrades for use in the real estate transaction. To maintain alignment with the new

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versions of the RESO Data Dictionary and the Appraisal Institute's Residential Green and Energy Efficient Addendum, HPC and Elevate Energy, co-chairs of the BPI working group that oversees the development of the standard, will publish an updated version in 2017.

HPC will also conduct outreach and education regarding the nature, uses and benefits of the Home Performance Certificate to energy efficiency programs, trade and industry groups, and federal agencies by presenting at conferences, brownbag presentations, and/or webinars. HPC will also provide technical assistance to energy efficiency programs that have adopted the standard to ensure its proper understanding, use, and integration of the certificate's data into MLS.

6.3.3 Support DOE's Home Energy Information Accelerator

The DOE's Home Energy Information Accelerator is a collaborative of realtors, appraisers, programs, national nonprofit organizations, and government. The Accelerator provides an important forum for driving standardization and the transfer of information and data between the energy efficiency and real estate industries, and should continue to be leveraged as a source of experimentation and information.

Partners are working to expand the availability and use of reliable home energy information at relevant points in residential real estate transactions. National partners, including HPC, work to overcome barriers of accessing and using reliable energy information, as well as provide data standards and technical assistance. State and local partners are developing strategies to create a sustainable pipeline of reliable energy information on local housing stock. They are also implementing a method for the automated and streamlined transfer of voluntary home energy information into the MLS for use by real estate professionals, including agents and appraisers. More information on the Accelerator can be found here: https://betterbuildingsinitiative.energy.gov/accelerators/home-energy-information.

6.4 Standardize How Energy Efficiency Improvements are Defined and Validated

6.4.1 Develop Typology of Energy Efficiency Measures

A subcommittee of HPXML working group members has been formed and is being tasked with evaluating the need for standardizing how measures are defined and validated in HPXML. This typology could be used by programs to standardize how energy efficiency improvements are characterized and integrated into Technical Resource Manuals (TRM) to standardize the inputs to engineering algorithms and savings protocols.

6.4.2 Support Common Evaluation Methods and Reporting

An initial strategy for standardizing how energy savings are calculated and reported will be to leverage the DOE's Uniform Methods Project and NEEP's EM&V Methods Standardized Reporting Forms. HPC will work with the DOE and NEEP to determine the goals and scope of the project.

6.4.3 Publish an EM&V Standard Dataset

The development of a standard dataset associated EM&V is an important priority because it will generate additional cost savings and promote program adoption of data standards. HPC will work with stakeholders to determine the need for and scope of a standard EM&V dataset. One of the key lessons learned from the development of previous standard datasets is that incorporation of contractors into the stakeholder process from

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the beginning brings an important perspective to the effort and has the potential to increase contractor support and buy-in to program reporting requirements.

6.5 Educate and Engage Stakeholders on the Value of HPXML

6.5.1 Target Outreach to Programs Likely to Adopt HPXML

Efforts to identify and engage residential energy efficiency programs likely to adopt data standards should continue. The current strategy of reaching out to programs through national organizations should be continued. Target organizations would include NASEO, the Edison Foundation Institute for Electric Innovation, the Consortium for Energy Efficiency (CEE), and ACCA, and possibly also associations of manufacturers and software developers, as well as key regional organizations such as the six Regional Energy Efficiency Organizations (REEOs). A peer-to-peer strategy of program administrators that have successfully implemented the data standards should also be supported through the DOE's Home Upgrade Program Accelerator.

6.5.2 Identify and Engage Stakeholders to Promote Broad Adoption

Efforts to continue to identify actors that are positioned to promote broad adoption of the data standard, and reach out to them to encourage adoption, should continue. Efforts to build general awareness of HPXML should be continued through periodic news articles, press releases issued at major milestones, social media strategies, and public speaking engagements at national and regional conferences and other meetings. Adoption of data standards by key stakeholders such as software developers, program implementers, or EM&V contractors could significantly advance use of the standard. Environmental state regulators, contractors, and trade allies could also significantly advance use of data standards by advocating for their use to offset costs of complying with a rule.

6.5.3 Develop and Promote Materials that Reduce Costs of Implementing HXPML

HPC currently hosts an HPXML website, and supports the maintenance of the HPXML Implementation Guide and the HPXML Toolbox, which is managed by NREL. HPC will maintain these resources that are designed to educate and assist programs and software developers with implementing HPXML. HPC will also continue to provide technical and logistical support to DOE's Home Upgrade Program Accelerator by assisting with case study development. There are several new projects underway that are expected to be completed in 2017, including:

- Development of an online HPXML data dictionary that will enable users to easily search hundreds of HPXML fields, map to BEDES and RESO data dictionaries. The dictionary will automatically update when changes to the XML schemas are made.
- Update and transfer of HPXML Implementation Guide from Home Performance with ENERGY STAR® website to www.hpxmlonline.com. The Guide is in the process of being updated. Once updates are approved by DOE (who funded the creation of the Guide), the Guide will be available as a PDF on the HPXML website.

7.0 Implementation of Roadmap Strategies

This roadmap serves as a guide for increasing data standardization in the residential energy efficiency industry and for promoting the broad adoption of HPXML. The strategies outlined in this roadmap will be implemented over the

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next two years (2017-2019) by HPC and its partners. The strategies outlined in this roadmap will also be used to secure funding for HPXML so that work on the data standard can continue.

Appendix A: HPXML Tools and Resources

A number of tool and resources exist to help software developers, programs, and other stakeholders understand the value of HPXML and how to implement the standard.

HPXML Website

The Home Performance Coalition hosts a website that has information, tools, and resources on HPXML and its business cases. The website is: www.hpxmlonline.com.

HPXML Implementation Guide

The HPXML Implementation Guide provides detailed information to programs and software developers on how to implement HPXML.

HPXML Data Selection Tool

The HPXML Data Selection Tool was created to assist program administrators in identifying the required data associated with HPXML use cases. The tool is a Microsoft Excel worksheet that can be downloaded from the HPXML Implementation Guide website. Users have the option of selecting one or more use cases from a dropdown menu. Once the use case(s) have been selected, the list of required fields with HPXML path will populate the sheet.

HPXML Toolbox

The HPXML Toolbox provides a set of tools for software developers to validate and inspect their HPXML formatted data. Users can upload their HPXML files and check these file against the HPXML schema and its four standard datasets. The validator returns specific error messages with feedback on missing elements. There is also a searchable tree view of HPXML data to assist with navigating and inspecting errors. Validation is available through a website or an API that can be incorporated into HPXML data transfer workflows.

HEScore Translator

The Home Energy Score Translator generates HESCORE inputs from HPXML files. The translator is incorporated into the HEScore API. By using this translator, software developers can leverage their investment in HPXML to provide HESCORE functionality with minimum development cost.

Home Upgrade Program Accelerator

In May 2015, the DOE launched the Better Buildings Home Upgrade Program Accelerator for residential energy efficiency program administrators. This Accelerator is designed to increase the overall effectiveness of programs by leveraging data management strategies that minimize costs. The Accelerator supports the use of HPXML as a tool for achieving its goals and is working with Accelerator partners to provide assistance with adopting HPXML.

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Github

The working group uses Github as a forum for tracking changes to the HPXML schemas (including debating and resolving issues). The HPXML schema documentation resides on GitHub as well as links to HPXML resources.

Appendix B: HPXML-Supported Databases

Building America Data Portal

The U.S. Department of Energy's (DOE) Building America program has been a source of innovations in residential building energy performance, durability, quality, affordability, and comfort for 20 years. This world-class research program partners with industry (including many of the top U.S. home builders) to bring cutting-edge innovations and resources to market. In an effort to make research data from the Building America program more available to the public and to better track and quantify the impact of Building America, the National Renewable Energy Laboratory (NREL) has developed a Data Portal to catalog and archive the research. Many of the datasets have house characteristics data standardized and available in HPXML, which allows for more crosscutting analysis between projects.

Home Energy Labeling Information Exchange

Northeast Energy Efficiency Partnerships (NEEP) is managing a project to support the market valuation of energy efficient homes. The Home Energy Labeling Information Exchange (HELIX), currently under development, will be a publicly accessible database that will serve as a conduit for transferring HEScore data into local multiple listing services. This database leverages the data standards created in the residential energy efficiency (HPXML) and real estate (RESO) sectors. HELIX will facilitate the consistent and widespread use of HEScore across the seven states that are participating in the project, with the long-term goal of increasing the value of energy efficient homes. States that are participating in the project include: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

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