



# FINAL REPORT

## ASHRAE AND THE RESIDENTIAL CONSTRUCTION MARKET

Report of Presidential Ad-Hoc Committee  
on the Residential Construction Market

JUNE 2014



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## I. EXECUTIVE SUMMARY

In September 2013, ASHRAE President William P. Bahnfleth created the **Residential Construction Ad Hoc Committee** to investigate the role that ASHRAE has played, could play, and should play with respect to the residential HVAC and construction market. The committee was assigned to report to the ASHRAE Board of Directors (BOD) and was staffed with volunteers who had a good working knowledge of both ASHRAE and the industry. (See Structure and Operation of Committee for more details.)

The committee began its work by looking at the importance of the residential sector, what ASHRAE is already doing in the residential sector, and how ASHRAE's current role is viewed in the residential market. The ad hoc also reviewed the technical capabilities of the Society to identify strengths and weakness with respect to the residential sector.

Although ASHRAE historically has not focused on residential HVAC energy use, the committee found that the residential sector consumes at least as much energy as the commercial sector, and approximately one-fifth of all primary energy in the United States. In addition, because people spend more time in residential occupancies than commercial ones, indoor air quality (IAQ) is more significant in the residential sector. ASHRAE volunteers have extensive knowledge in both energy and IAQ and thus represent one of the largest untapped resources for advancing the arts and sciences of residential HVAC.

Because of the large number of stakeholders already involved in the residential sector, a key part of the ad hoc's work was to run a workshop of those stakeholders to gather their views on ASHRAE's current and potential roles.

The committee found that ASHRAE has extensive and perhaps unmatched technical abilities in the residential area, but it is far from the dominant player in the sector. ASHRAE involvement requires not only focusing the efforts of its own volunteers but collaborating with existing stakeholders.

The ad hoc determined that ASHRAE can take a larger leadership role in the residential sector, a role that both benefits the sector and enhances ASHRAE's mission. Details can be found in the body of the report.

The ad-hoc made a series of recommendations to the ASHRAE Board of Directors that were accepted and referred to ASHRAE Councils for consideration. Several recommendations have already been acted upon.

## **A. Recommendations to Board of Directors**

### **1. Establish a new standing committee on residential buildings**

While there is good expertise within ASHRAE on residential issues, most of the structure and organization of ASHRAE focuses on nonresidential buildings. To manage these new activities and to coordinate the disparate pieces, a standing committee reporting to Technology Council should be formed following normal procedures for new standing committees. Consideration should be given to defining explicit roles (either as committee member or advisory panels) for specific stakeholder classes, such as large builders, and to facilitating stakeholder input, such as through workshops.

The committee should function as the Environmental Health Committee once did in bringing expertise into ASHRAE that did not otherwise participate, as well as prioritizing, enhancing, and coordinating activities under its purview. It is further recommended that the operation of this new committee be reviewed every five years to see if its functions should be changed or deleted.

### **2. Extend the ad hoc committee for one year (Completed)**

The purpose of this extension is twofold: to (1) begin to implement the recommendations of this report, and (2) provide transition and institutional memory to the standing committee recommended above (or whatever other permanent changes are approved by the Board.) Some change in membership of the ad hoc may be appropriate. This ad hoc can also work with Society Rules Committee in effecting necessary rule changes.

### **3. Raise the priority of residential issues for Advocacy Committee (Completed)**

High-performance residential buildings and residential commissioning/performance verification issues are important legislative issues on which ASHRAE can demonstrate leadership. Develop alliances with existing stakeholders in this arena.

### **4. Create a residential strategic plan (Completed)**

Enhancing ASHRAE's position in the market is a strategic decision that requires long-term planning and vision. The Planning Committee should devote specific effort to taking the long-term view. This report can be used to help evaluate changes to strategic positioning.

### **5. Develop stakeholder workshop infrastructure**

The stakeholder's workshop held by the ad hoc was deemed very successful and ASHRAE was credited by the attendees for taking the leadership role. This was essentially a planning exercise that could be done on any topic on which ASHRAE wishes to gather stakeholder input and make strategic decisions. The Planning Committee should logically be the place to hold the institutional memory on how to conduct such a workshop when the need arises.

### **6. Distribute this report (Completed)**

This report represents a significant amount of work and contains valuable information for our members and for those we seek to be members. It is recommended that the report be made available to the public through the ASHRAE website to maximize its contribution toward the desired collaborative outcomes.

## **7. Take a stronger leadership position in the “Buildings” conference series**

ASHRAE is a cosponsor of the topical series of Thermal Performance of the Exterior Envelopes of Whole Buildings (“Buildings”) conferences run by the National Institute of Building Sciences, Building Environment and Thermal Envelope Council (NIBS/BETEC), Oak Ridge National Laboratory (ORNL), and the U.S. Department of Energy (DOE). Because of changes in DOE structure, support for this series has waned, but it represents a potentially powerful collaboration of residential envelope and HVAC principles and practices. ASHRAE should consider adopting this as its own topical conference series supported by the existing partners. The new standing committee could be tasked to provide the technical support needed to enhance its visibility and create a high quality conference.

## **8. Enhance outreach to residential sector at chapter level**

Much of the professional and technical activity in the residential sector is done by other than consulting engineers. Chapter programs, workshops, and other activities would be of interest to this community and would increase attendance and activity at the chapter level. Residential chapter activities would also provide more high-profile opportunities for ASHRAE in the local community. Chapters should be encouraged to work cooperatively with appropriate local groups in, for example, sponsoring joint events or meetings.

## **9. Include Residential Stakeholders in Membership Categories**

The residential sector contains a broad spectrum of technical and professional actors. ASHRAE’s current membership categories do not necessarily recognize the skills and training of the groups with which we may wish to have close collaborations or the individuals who have the skills and knowledge to contribute to ASHRAE. For example, it may be important to determine how to get contractors with technical knowledge more involved with ASHRAE professionally.

## **10. Conduct policy-level review of residential standards**

ASHRAE has been and should continue to be involved in residential standards. On some standards, ASHRAE should lead and bring in collaborators; in others, ASHRAE should contribute. Issues to be considered are in the body of the report and include strategic placement of 90.2, need for zero-energy standards, multifamily standards, existing-home standards, more-accessible users manuals, and standards development in a collaborative environment.

## **11. Develop guideline for residential energy efficiency assessment**

Through Technology Council take the lead in collaboratively developing industry guidelines for residential energy efficiency assessment. A workshop/summit could precede formal development activities, perhaps using the ad hoc’s workshop model more broadly.

## **12. Create residential tools and data resources**

Use the TCs to create research and Handbook information that aids the residential sector. Topics to be considered include a residential data repository, tool kits for performance evaluation, retrofit package guidance, multifamily buildings, etc. In the medium term, the TC structure should be reviewed to determine if there is a need to highlight residential issues. ASHRAE’s bEQ program should be considered for residential buildings.

## II. INTRODUCTION

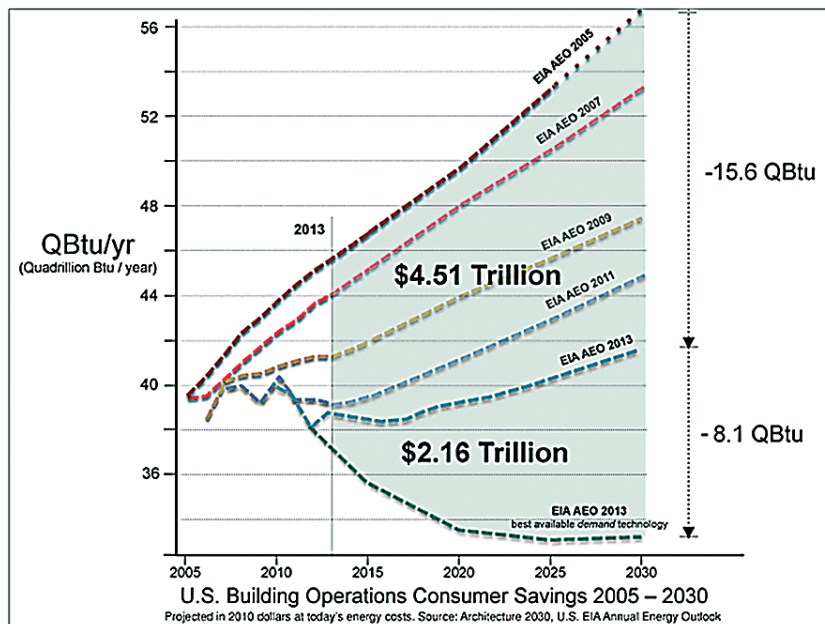
### A. Residential Sector

Different stakeholders define “residential” differently. In the United States, residential is often associated with low-rise, single-family houses. This association is evident in the division in scopes between the International Residential Code and the International Building Code and between the scopes of ASHRAE Standards 90.1, 62.1, 90.2, and 62.2. While a convenient distinction when the scopes of these documents were developed approximately 30 years ago, these divisions may be less appropriate now, given how the industry has evolved. Although no specific definition was adopted by the committee, it became clear that a new definition and the subsequent revision of document scopes could be advantageous to ASHRAE and the industry at large.

Additionally, mid-rise multifamily construction often seems to fall through the cracks and is not adequately addressed in either current residential or nonresidential standards. Although the primary focus of the ad hoc committee was North America, it is important to note that, internationally, a greater percentage of residential structures are multifamily structures. The reevaluation of what is and is not considered residential is critical to understanding ASHRAE's current and future role.

### B. Importance of Residential Sector

In 2013, the residential building sector was responsible for 21% of all primary energy consumption in the United States. The residential sector also accounted for almost 54% of the primary energy used by all buildings in 2013<sup>1</sup>. From economic, environmental, and energy security perspectives, a sector that consumes one-fifth of all the primary energy used by the nation and more than half of all energy used by buildings demands significant attention.



**Figure 1.** Annual Energy Outlook (AEO) projections by the EIA between 2005 and 2013 (Source: Architecture 2030<sup>2</sup>).

<sup>1</sup> EIA, “Annual Energy Outlook 2013” ([http://www.eia.gov/forecasts/aeo/er/early\\_consumption.cfm](http://www.eia.gov/forecasts/aeo/er/early_consumption.cfm))

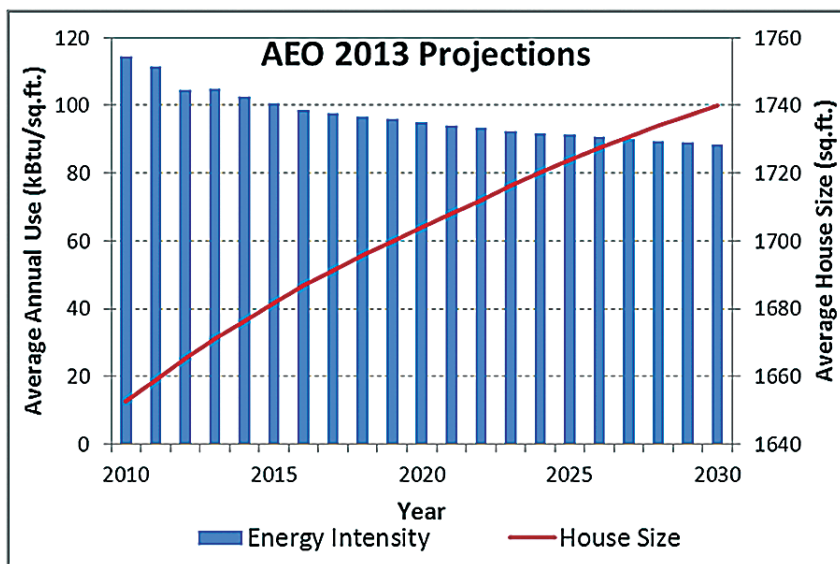
<sup>2</sup> Architecture 2030, June 24, 2013, “2030 E-News.” ([http://architecture2030.org/enews/news\\_062413.html](http://architecture2030.org/enews/news_062413.html))



Architecture 2030, a nonprofit organization founded by Edward Mazria, performed an analysis of the U.S. Energy Information Administration (EIA) Annual Energy Outlook (AEO) data that illustrates the energy, economic, and environment opportunities offered by the building sector. The analysis shows that AEO projections for 2030 building sector energy consumption (residential plus commercial) have consistently declined over the years. Figure 1 shows the Architecture 2030 analysis through AEO 2013 data. The figure also shows the degree to which Architecture 2030 projected that best available technology could further reduce projected energy use compared with AEO 2013 projections. If the Architecture 2030 best technology scenario is realized, 2030 building energy consumption will be reduced by more than 23.7 quadrillion Btu (quads) compared with AEO 2005 projections, or by more than 24% of the total U.S. primary energy consumption in 2013 (96.3 quads). This best technology scenario consumes about 20% less primary energy than the AEO 2013 reference case projection.

The analysis points out that this level of energy reduction, compared with the AEO 2005 projection, results in \$6.67 trillion in energy cost savings, with \$2.16 trillion in additional savings resulting from the use of the best available current technology. The remaining \$4.51 trillion derives from the difference between the 2005 and the 2013 AEO projections.

The Architecture 2030 analysis also looks at the AEO carbon projections resulting from these energy consumption savings and finds that, while building floor area is expected to increase by 23% between 2005 and 2030, CO<sub>2</sub> emissions are expected to decline, by 7.8% for the AEO reference case and by 29.8% for the best technology case.<sup>3</sup>



**Figure 2.** AEO 2013 projections of residential energy use intensity and average house size.

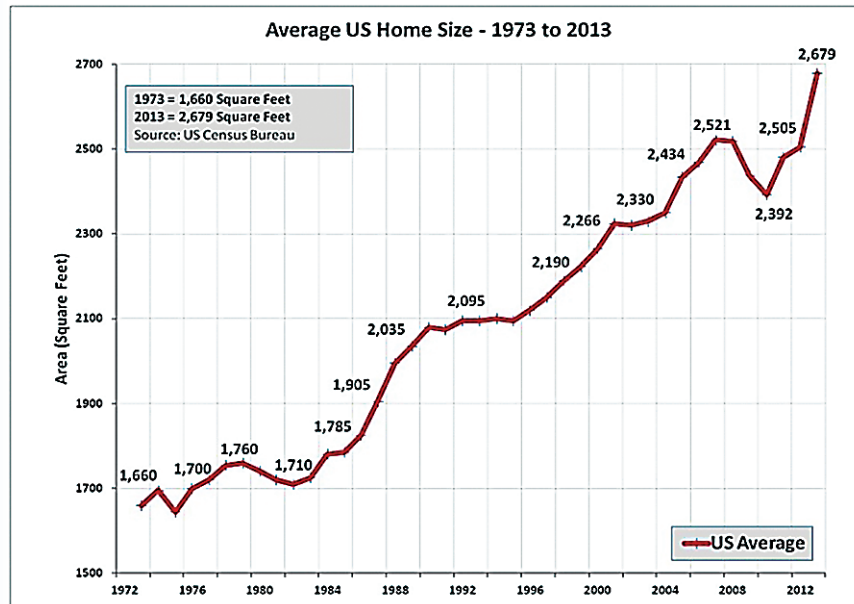
For the residential sector, AEO 2013 data show that there were 115.2 million dwelling units in the Nation in 2010.<sup>4</sup> The projection is that by 2030 this number will grow to 140.6 million, with larger average size than the 2010 average. In spite of this growth, AEO 2013 projects total residential primary energy consumption to be about the same in 2030 as it was in 2010. Additionally, the residential percentage of total U.S. consumption is projected to remain relatively constant at about 21%. As shown in Figure 2, EIA projects

<sup>3</sup> Architecture 2030, May 7, 2013, "2030 E-news." ([http://architecture2030.org/enews/news\\_050713.html](http://architecture2030.org/enews/news_050713.html))

<sup>4</sup> The 2010 "dwelling units" include single-family (71.9%), multi-family (22.4%) and mobile homes (5.7%).

that the increase in residential square footage will be almost exactly offset by increases in residential efficiencies over this time period. AEO 2013 data project that the average dwelling unit will become 22.6% less energy intensive over the next 20 years, making up for their increased number and average size.

Average house size has recovered its upward slope, following a slight downturn during the economic recession (Figure 3). AEO 2013 projects an increase in residential plug loads associated with a continued increase in consumer electronics. Note that growth in the use of plug-in vehicles will also initially register as an increase in residential loads, although not directly associated with the home's energy use.



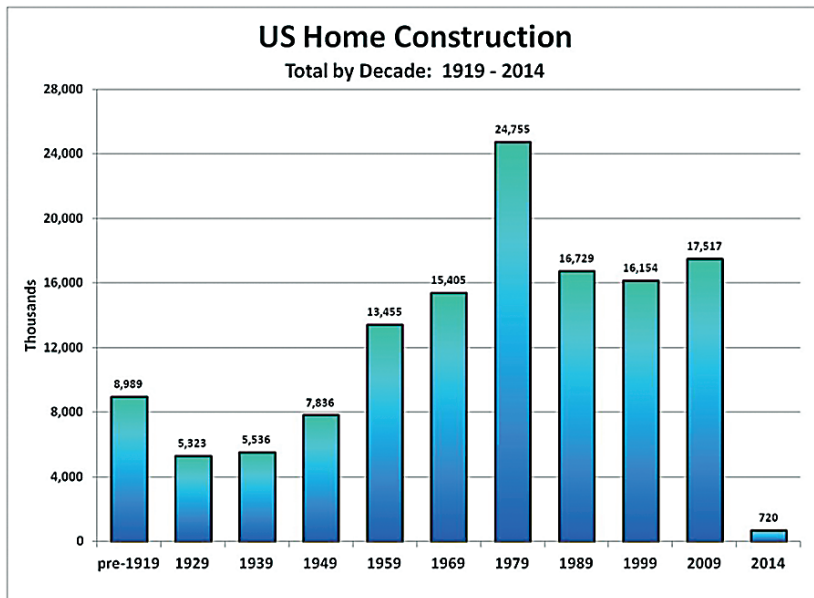
**Figure 3.** Average home size in the United States, 1973 to 2013 (U.S. Census Bureau).

While this improved efficiency may seem promising, much better performances is possible. Most research studies that have examined the cost effectiveness of improvements to existing homes have found that 30% or greater energy efficiency improvements are cost effective with current technology.<sup>5</sup> Based simply on natural replacement of lighting, appliances, and equipment between now and 2030 and modest improvements in envelope air leakage and ceiling insulation, it would not be unusual for pre-1980 homes to be improved by upward of 50% by 2030.

Further, given the inefficiency of many older homes, 30% or greater improvement will often represent more energy savings than a much larger percentage improvement in new homes.

This opportunity in existing dwellings cannot be overstated, especially since over 74% of all existing homes were constructed before 1989—before widespread adoption of model energy codes governing their construction (Figure 4). By almost any standard, most of these homes are likely under-insulated, have poorly performing fenestration, have significant envelope air leakage, need upgrades to all HVAC components and delivery

<sup>5</sup> Fairey, P. and D. Parker, 2012, "Cost Effectiveness of Home Energy Retrofits in Pre-Code Homes in the United States." Report No. FSEC-CR-1939-12, Florida Solar Energy Center, Cocoa, FL (<http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1939-12.pdf>)



**Figure 4.** U.S. home construction by decade. (US Census Bureau and American Housing Survey).

systems, and contain outdated and inefficient lighting systems when compared to today’s basic energy code minimums. These needs define significant opportunity for energy, carbon, peak power, and water savings within the residential sector.

Building and energy codes do not adequately address existing homes in several ways. First, residential remodeling projects are often initiated without building permits, thereby escaping detection by local building inspection departments. This serves as an impediment to quantifying efficiency improvements associated with remodeling. Second, the rate and scope of residential remodeling is closely tied to the cost of money and mortgage equity interest rates. Although the U.S. Census Bureau maintains records of general trends on remodeling—much based on data from do-it-yourself product sales—there is no good quantification of how much remodeling each year actually addresses efficiency improvements, HVAC, and water consumption. Specific industry sectors (e.g., insulation, fenestration, HVAC) report remodeling-related product sales trends within their own industry sector. Another factor affecting the scope and impact of remodeling existing homes is the availability of capital in the form of tax credits, utility rebates, and other market pull programs. The regulatory mechanisms typically associated with market push, such as building and energy codes, federal and state laws, etc., have, to date, had little impact on residential remodeling rates and scope.

The existing building landscape is perceived as both a market transformation need as well as a potential opportunity for leadership. Organizations such as the Residential Energy Services Network (RESNET) and others are seeking to develop tools for rating home energy performance. ASHRAE’s own bEQ program, currently focused on commercial buildings, could set a precedent for greater ASHRAE participation in the residential market to better address existing-building performance-rating needs.

The lack of funding assistance programs for residential energy efficient retrofits and absence of performance-based property valuation are also known impediments to encouraging investments in existing buildings. Programs like Property Assessed Clean Energy (PACE) and federal legislation like the Sensible Accounting to Value Energy (SAVE) Act seek to remove these impediments by providing funding assistance that makes retrofits more affordable (PACE) and promoting home energy ratings in appraisal and mortgage lending practices (SAVE Act).

PACE programs are implemented by local governments and provide up to 100% financing that is repaid by homeowners through property assessments.<sup>6</sup> The SAVE Act legislation, if enacted, would improve federal mortgage underwriting by including a home's expected energy cost savings when determining the value and affordability of energy efficient homes.<sup>7</sup> Both represent opportunities for greater collaboration to promote energy efficiency in the residential market.

For new homes, even greater cost-effective improvements can be achieved with up to 100% *conventional* energy savings under the right conditions. The concept of zero energy buildings (ZEB) or net zero energy buildings (NZE), introduced in 1998, combines very-high-efficiency buildings with on-site power generation in a manner that maximizes the cost effectiveness of both.<sup>8</sup> The concept reduces building loads to the lowest possible cost-effective level and then adds on-site renewable energy generation to meet the much-reduced building load. On a net annual basis, these buildings achieve net zero purchased energy consumption by using the electric grid as an energy storage medium during periods of excess on-site energy production so it can become an energy supplier during periods when on-site energy production is insufficient to meet the load. (Smart-grid integration is an active research area, but outside of ASHRAE's scope.) Community and urban scale design may effect an even larger impact by intermediate aggregation between the individual building and the grid.

The concept of net zero energy buildings has gained enough support as an achievable and proven concept that some codes and standards bodies are now incorporating the concept into energy policy for the future.<sup>9</sup> Residential buildings, especially single-family homes, are particularly well suited to the net zero energy home (NZE) concept, because available roof space is amenable to the goal, with more than sufficient roof area to support photovoltaic (PV) electric generation needs once all cost-effective energy efficiency has been incorporated into the home. The U.S. DOE Challenge Home program includes a Renewable Energy Ready Home (RERH) designation that prepares new homes qualifying under this Challenge Home program to accept the requisite renewable energy technology to qualify them as a NZE in the future. An increasing number of such homes are being constructed in niche markets across the United States each year.

Similarly, there is also an international push toward much greater building energy efficiency and zero energy buildings. The European Commission through its Energy Performance of Buildings Directive (EPBD) in their 2010 recast of Article 9 has stated "Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings."<sup>10</sup>

The ASHRAE Board of Directors is also providing leadership on this issue and has established a vision for net zero or near-zero energy buildings by 2030. Progress on residential building energy efficiency provides an especially appropriate opportunity for achieving progress toward this vision. This vision was also put forth by the Standard 90.2 Standard Advisory Panel in their recommendations to the ASHRAE Board of Directors.

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<sup>6</sup> <http://www.fsec.ucf.edu/en/publications/html/FSEC-CR-1044-98/index.htm>

<sup>7</sup> <http://www.energy.ca.gov/title24/2013standards/>

<sup>8</sup> <http://www.epbd-ca.eu/themes/nearly-zero-energy>

<sup>9</sup> <http://www.energy.ca.gov/title24/2013standards/>

<sup>10</sup> <http://www.epbd-ca.eu/themes/nearly-zero-energy>

## 1. Stakeholders

There are many stakeholders in the residential arena. Even within residential HVAC, there are many stakeholders, of which ASHRAE is only one. ASHRAE will be able to play a leading role only within a context that recognizes and incorporates other key stakeholders. The ad hoc went through an exercise to identify the stakeholders. Several hundred potential stakeholders were reviewed and pared down to the list of invited stakeholders in Appendix A.

## C. Charge to the Committee

ASHRAE has for many years been engaged in various ways with the residential construction market, for example, through residential standards for energy conservation (90.2) and ventilation (62.2). However the impact of ASHRAE on this market has been limited. This committee is formed for the purpose of defining a path forward that will provide direction to the Society on how it can contribute most effectively to the improvement of the performance of residential buildings.

The charge to the ad hoc committee is as follows:

1. Review the current structure of the residential construction market as it relates to ASHRAE participation, focusing primarily on the US and Canada, but not excluding some consideration for other global markets.
2. Review ASHRAE's current activities specifically directed toward residential construction and analyze their effectiveness.
3. Review ASHRAE's ability to support the residential market in a broad sense – standards, research, professional development, publications, design guidance and tools, etc. The committee should consult with all ASHRAE Councils and others as needed.
4. Identify key stakeholder organizations within the industry to develop and engage them in discussions to identify ways in which ASHRAE can productively support and enhance the quality and performance of residential construction. The committee is authorized to conduct a stakeholder workshop at an appropriate point in its deliberations.
5. Formulate recommendations for ASHRAE's future involvement in residential markets with an indication of necessary collaborations and with proposed timing of such actions. Recommendations may focus externally (e.g., work with some stakeholder organization or group of organizations) as well as internally (e.g., form a Multidisciplinary Task Group or Technical Committee).
6. Formulate recommendations for the future work of this committee; i.e., should it terminate at the end of the 2013-14 year, continue with ongoing work in 2014–15, or continue with a modified agenda such as consideration of markets outside the United States and Canada.
7. Submit a progress report to the Board of Directors at the 2014 winter meeting and submit a final report no less than two weeks prior to the 2014 Annual Meeting.
8. Support as requested the 2013–14 strategic planning effort being led by Society Planning Committee.

The committee reports to the Board of Directors. It is authorized to meet by conference call and in conjunction with Society Winter and Annual meetings and to conduct one stakeholder workshop as described above.

**Chair:** Max Sherman; **Members:** Craig Drumheller, Philip Fairey, Paul Francisco, Paul Haydock, Jeff Inks, David Lee, Neil Leslie, Chris Mathis, Harry Misuriello, Dan Pettway, Don Stevens, Iain Walker, Tom Werkema, Theresa Weston, William Bahnfleth (BOD Ex-Officio, nonvoting), Steve Comstock (staff liaison, nonvoting), Mark Weber (staff liaison, nonvoting)

## D. Structure and Operation of Committee

In order to carry out the Presidential charge, the committee was organized into task groups to allow different functions to proceed in parallel and to minimize the time that the entire ad hoc had to meet. The task groups, their objectives, and their members are listed below.

### 1. TG1: ASHRAE Residential Activities

What structural parts of ASHRAE are predominantly residential? What residential products (e.g. standard, research, publications, etc.) has ASHRAE produced? How are residential problems addressed?

- Prepare summaries suitable for committee use, inclusion in the final report, and ASHRAE public relations.

*Leslie (Chair), Werkema, Pettway, Stevens, Comstock, Weber*

**Completion Date:** December 1, 2013

### 2. TG2: Residential Stakeholders

Who are the residential stakeholders more broadly? With whom does or should ASHRAE work? What are their interests? Whom might ASHRAE invite to a workshop and why?

- Prepare a summary of residential stakeholders including both those who interact with ASHRAE and those who don't. Indicate who ASHRAE should interact with, including organizations and, where known, suggested representatives. This will be used in the final report as well as to invite stakeholders to a workshop.

*Drumheller (Chair), Lee, Haydock, Walker, Mathis*

**Completion Date:** December 1, 2013

### 3. TG3: ASHRAE's Residential Market Position

Who uses ASHRAE products and why? How is ASHRAE viewed by the industry? What role do we fill?

- Prepare a summary of how ASHRAE is viewed in the Residential Market. What are the ways ASHRAE could be viewed? Identify potential market positions ASHRAE could have. This will be useful as a chapter in the final report and a visioning exercise for the workshop.

*Fairey (Chair), Francisco, Misuriello, Inks, Weston*

**Completion Date:** January 5, 2014

#### 4. TG4: Stakeholders Workshop

Conduct a one-day workshop with 50 to 100 stakeholders to get their views on what ASHRAE should do. Present results from Task Groups 1 to 3, but mostly have stakeholders provide input and encourage discussion.

*Mathis (Chair), Leslie, Drumheller, Fairey, Comstock*

**Completion Date:** February 2014

#### 5. TG5: Developing Collaborations

Based on previous TG efforts, evaluate which collaborations should be expanded or initiated, and make recommendations on how that might be accomplished.

- Prepare a set of supported recommendations prioritizing collaborations and other external interactions that will facilitate ASHRAE's effectiveness in the residential market.

*Weston (Chair), Drumheller, Lee, Pettway, Mathis, Inks, Misuriello, Haydock, Weber*

**Completion Date:** April 23, 2014

#### 6. TG6: ASHRAE Structure and Organization

How can ASHRAE be more responsive to the residential market? What, if any, organizational changes are needed to be more responsive? Does this ad hoc need to continue?

- Prepare a set of supported recommendations for changes that should be made to ASHRAE's structure, organization, or other internal activities that will facilitate ASHRAE's effectiveness in the residential market.

*Walker (Chair), Werkema, Leslie, Francisco, Fairey, Stevens, Comstock*

**Completion Date:** May 10, 2014

#### 7. TG7: Final Report

Summarize findings of the ad hoc committee.

- Combine all work of task groups into final report with recommendations. Report to BOD.

*Sherman (Chair), Leslie, Drumheller, Fairey, Mathis, Weston, Comstock*

**Completion Date:** June 15, 2014

### III. ASHRAE'S CURRENT ROLE IN RESIDENTIAL MARKET

#### A. Activities

##### 1. Summary of ongoing and completed activities

ASHRAE's structural parts that may have a predominantly residential focus include technical committees (TCs), standard and guideline project committees (SSPCs, SPCs, and GPCs), and standing committees. A large fraction of ASHRAE TCs have at least an opportunity to produce residential products and address residential problems. However, only four of ASHRAE's 103 TCs and task groups (TGs) have a predominantly residential focus. ASHRAE TC activity with a predominantly residential focus appears to be decreasing since 2005.

Twenty-four standing standard project committees (SSPCs), SPCs, and GPCs are currently developing or reaffirming standards intended at least in part for residential applications. This indicates a significant amount of standards development and revision activities for the residential market by ASHRAE. However, only 6% of ASHRAE standards and guidelines sold between July 1, 2010, and June 30, 2013, were targeted to the residential market.

Numerous chapters in the four ASHRAE Handbook volumes are intended at least in part for residential applications. These chapters illustrate the breadth of coverage and potential impact ASHRAE can have in residential markets. Whether the potential impact is realized depends on several factors, including relevance and timeliness of the information, scope of coverage, ease of use, and stakeholder acceptance.

Residential-specific *ASHRAE Journal* articles and *ASHRAE Transactions* papers represent only 1% of the total published by ASHRAE. This is a clear indication of the high bias of ASHRAE membership interests and expertise toward nonresidential markets.

Relative to other markets served by ASHRAE, there is a small level of ASHRAE research devoted to the residential market.

While a small subset of ASHRAE members may be heavily invested in addressing residential market problems, the vast majority of ASHRAE members worldwide (99%) are primarily interested in nonresidential markets. This membership bias cuts across all ASHRAE member industry segments.

##### 2. Identification of gaps

ASHRAE products that address the residential market have traditionally focused on establishing minimum performance requirements (including some that may be considered by others to be "me-too" products) and cross-cutting information that can apply to both residential and commercial markets. At no time in the past decade has ASHRAE published residential information that would imply beyond-minimum performance requirements or a stretch energy efficiency goal. This gap provides an opportunity for ASHRAE to significantly increase its relevance and impact in residential applications by providing guidance and performance requirements for high-performance residential buildings, including the newly joined effort on ICC 700 and steps to implement the recommendations of the Standard 90.2 Standards Advisory Panel.



## B. Positioning in Residential Market

### 1. Current role in residential industry

ASHRAE is principally viewed as a large-building engineering society with its primary focus on commercial building interests. Recent analysis by ASHRAE staff has shown the following trends with respect to ASHRAE's residential market position:

- Only 1% of the technical articles and papers published in *ASHRAE Journal* and *ASHRAE Transactions* between 2007 and 2013 have been specific to residential buildings.
- Only 4% of chapters in *ASHRAE Handbook–Fundamentals* are specific to residential buildings.
- About 6% of ASHRAE standards and guideline sales are useful for the residential market.
- Recently, 42.5% of AHR Expo visitors serve the residential market as opposed to 83.4% who serve the commercial market.
- About 38% of *ASHRAE Journal* readers respond that they are interested or extremely interested in residential articles in HVAC&R publications.
- Only 4% of ASHRAE members selected Residential & Small Commercial Applications as their first, second, or third technical interest choice on their 2011 membership renewal form.

The following ASHRAE standards and publications directly address the residential market:

- *ASHRAE Handbook–Fundamentals* is highly regarded in engineering circles as the “standard of care” for sound energy engineering methods and principles. It provides the basis for many of the calculations and algorithms used by software directed at the residential market, including tools designed to calculate residential energy code compliance and home energy ratings, which require calculating space-conditioning loads.
- Standard 62.2 and Guideline 24 have recently gained expanded market position, being adopted by the U.S. Environmental Protection Agency (EPA) and DOE high-performance building programs, in California's Title 24 residential building code, and in many weatherization and retrofit programs. The EPA/DOE Home Performance with ENERGY STAR® program (HPwES) for existing residential retrofits also uses Standard 62.2.
- Standard 140 is used by RESNET for accreditation of Home Energy Rating System (HERS®) software tools and accreditation of federal income tax qualification software tools. It is also used by some code authorities having jurisdiction (AHJs) to certify residential code compliance energy simulation software tools. However, the residential portion of Standard 140 (Section 7) uses fairly outdated reference results that are now surpassed by more recent simulation software tools like EnergyPlus™. These Section 7 reference results should be updated to further reduce variance across compliant residential software simulation tools.
- Standard 90.2 has had no residential market position to date. However, the 90.2 SSPC has been given a revised charter by ASHRAE leadership to become the “leadership standard” for energy-efficient residential construction

with an immediate goal of 50% greater efficiency than the 2006 IECC. To address this charter, SSPC 90.2 has recently decided that 90.2 would become a performance standard with a performance compliance path and that all prescriptive compliance paths developed under the 90.2 Standard would satisfy the performance criteria.

- Standard 189.2 was initiated in 2013 to become a new residential “green” standard. Considering concerns about duplication of ANSI standards, and after discussions with relevant stakeholders, ASHRAE chose to withdraw the standard and become a co-developer of ICC/ASHRAE 700-2015, National Green Building Standard with NAHB and ICC. This effort will provide ASHRAE with a unique partnership in a standard that has been in the field for more than six years, with more than 33,000 units certified to it. The ASHRAE name will help bring additional technical credibility to the standard, and the standard will help bring the ASHRAE name into the residential industry. Questions that remain regarding development of this new standard include the following:
  - ▷ Whom will this standard serve in the residential space?
  - ▷ What are RESNET, ENERGY STAR, Passive House, and the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) not doing that ASHRAE should be doing in this space?
  - ▷ Will this standard prove to be burdensome and conflicting in this space?

ASHRAE's relationship with the residential construction industry is not especially strong. In some cases, ASHRAE provides valuable engineering data and procedures (e.g., the ASHRAE Handbook–Fundamentals), but in other cases the residential construction industry gains little or nothing from ASHRAE. Much of the industry makes productive use of ASHRAE products, but does not engage in real collaboration to develop those products. There are, however, specific entities working in the residential construction marketplace who rely on ASHRAE standards and the Handbook and could help bring ASHRAE closer to the residential construction marketplace through inter-organization collaboration. That said, to a very large extent, these entities equate ASHRAE with Standard 62.2 and little more. The following is a listing of residential construction industry entities, their scopes, and some of their perceptions regarding ASHRAE's role in the residential market.

- HVAC contractors and trades represent the closest natural residential construction alignment with ASHRAE's core mission of excellence in HVAC engineering design and construction. Their trade association, the Air Conditioning Contractors of America (ACCA), provides substantial expertise, technical manuals and American National Standards for residential and small commercial HVAC applications. ACCA publishes and maintains the industry standard design manuals on residential load calculation (Manual J), duct system design (Manual D), zoning (Manual Zr), and equipment selection (Manual S); each ANSI-recognized. In addition, ACCA promulgates American National Standards on quality installation (ANSI/ACCA 5 QI-2010), on field verification (ANSI/ACCA 9 QI-2011), on home evaluation and performance improvement (ANSI/ACCA 12 QH-2011), and on residential maintenance (ANSI/ACCA 4 QM-2013). ACCA also maintains important contractor

accreditation programs designed to improve the knowledge, skills, and abilities of HVAC contractors and trades. ACCA is an ANSI Accredited Standards Developer (ASD) that references and uses a number of ASHRAE documents and standards within its publications, including Standards 55, 62.2 and *ASHRAE Handbook–Fundamentals*.

ASHRAE's historical concentration on large-building HVAC systems has made most residential contractors and associated trades believe their talents, knowledge, and interests have no place within ASHRAE. If ASHRAE is to strengthen its position in the residential market and make greater contributions to residential building performance, ASHRAE must identify ways in which to increase interaction with residential contractors. This can range from joint programs and publication development with ACCA to conferences that would foster interaction between residential contractors and the large building community and could include examination of the ASHRAE membership grade criteria.

Further comments from stakeholders among HVAC contractors and trades include the following:

- ▷ ASHRAE too oriented to engineering and large systems—provides no real assistance with issues faced in the field by non-engineer technicians—“not contractor friendly.”
  - ▷ ASHRAE Standard 62.2 is too complicated for field practitioner understanding.
  - ▷ Partnerships with ASHRAE could be valuable, but institutional memory problems exist, causing hesitancy on the part of residential organizational partners.
- Home builders construct our residential buildings but typically have very little or no interaction with ASHRAE. As many parts of the residential construction marketplace, including contractors and their trade associations, energy efficiency opt to sell energy efficiency and green building rather than minimum code compliance, an opportunity for greater collaboration between ASHRAE and these individuals, firms and groups is possible. A recent agreement between the National Association of Home Builders (NAHB), ASHRAE, and ICC to co-develop the National Green Building Standard should help raise the profile of ASHRAE within the building community as well as have the potential to create a better relationship between NAHB and ASHRAE.

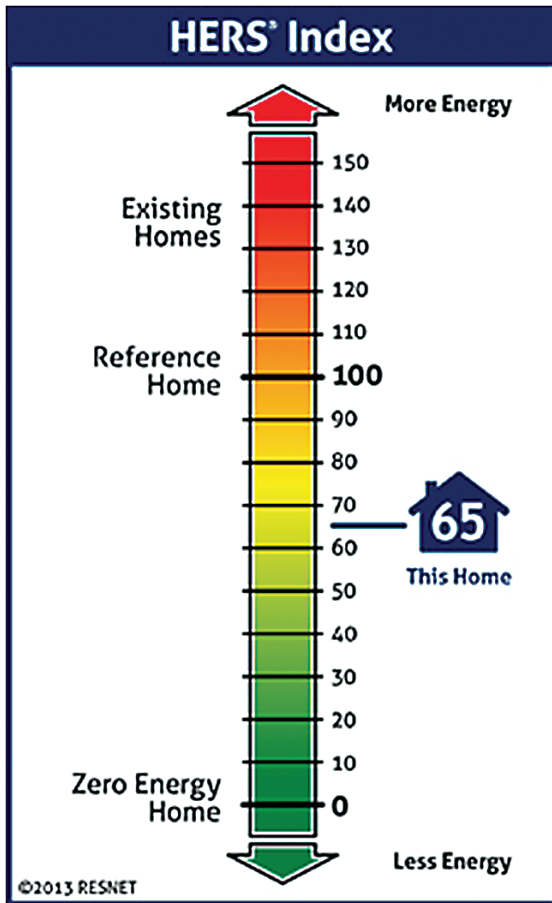
Further comments from stakeholders among home builders include the following:

- ▷ ASHRAE is not a familiar name to smaller builders.
- ▷ ASHRAE Standard 90.2 is irrelevant to typical residential construction practice.
- ▷ There is no ASHRAE focus or “direct line of support” for building contractors.
- ▷ ASHRAE Standard 62.2 is being adopted and referenced by many standards and beyond-code programs.

- Residential designers as a profession have little or no connection to or interaction with ASHRAE. Their profession is focused predominantly on the artful organization of the spaces and amenities of a home design, sometimes at the expense of sound indoor environmental quality and energy engineering. Further comments from stakeholders among residential designers include the following:
  - ▷ Residential buildings are generally not designed by architects or engineers.
  - ▷ Large builders (500 homes/year or more) use in-house designers.
  - ▷ Insufficient influence.
  - ▷ Education opportunities for residential designers exist, especially with respect to high-performance and net zero energy homes.
- Large production builders are sophisticated business enterprises with strong technical, marketing, financing, and purchasing positions in the residential market. In many regards, it is these large production builders who are leading the residential paradigm shift from minimum code compliance to maximum cost-effective overall performance in the residential marketplace. Since its founding just a few years ago, the Leading Builders of America (LBA) has developed influential partnerships with diverse interests in the residential construction market. Most of its membership has signed MOUs with RESNET pledging to market their homes using the HERS Index score. LBA also collaborated with the Natural Resources Defense Council (NRDC), a seemingly unlikely environmental activist partner, to advocate for IECC code reform that will allow home energy ratings to qualify for code compliance in the 2015 IECC.
- Residential Energy Services Network (RESNET) is a nonprofit membership association for home energy rating professionals. Its Home Energy Rating System (HERS<sup>®</sup>) Index score (see Figure 5) is now widely used in the residential market to measure home energy performance. More than 128,000 new homes were reported as HERS rated in 2012. In 2013, that number jumped to more than 218,000 new homes. According to RESNET's website, the HERS Index score has also been incorporated into provisions of at least 147 local energy codes. In addition, the recently approved 2015 IECC includes provisions that allow a home's HERS score to qualify it for energy code compliance. RESNET also maintains a strong quality assurance program through a cadre of accredited Quality Assurance Providers, who are responsible to RESNET for ensuring the quality and consistency of home energy ratings.

<sup>11</sup> <http://www.resnet.us/hers-index>

<sup>12</sup> [http://www.resnet.us/professional/main/Hers\\_index\\_and\\_energy\\_codes](http://www.resnet.us/professional/main/Hers_index_and_energy_codes)



**Figure 5.** HERS Index for home energy rating (RESNET).

Further comments from RESNET stakeholders include the following:

- ▷ RESNET is an ANSI ASD that references and uses ASHRAE.
- ▷ Standard 62.2 and the ASHRAE Handbook within RESNET Standards.
- ▷ Training and certification programs for home energy raters and quality assurance programs fill important residential market needs.
- ▷ RESNET programs are heavily leveraged by DOE and EPA in beyond-code EPA ENERGY STAR and DOE Challenge Home programs.
- ▷ HERS ratings are increasingly used

by AHJs as an alternative code compliance method and the Energy Rating Index (ERI) methodology has been adopted as an alternative compliance method in 2015 IECC.

- ▷ Large builders increasingly use ratings as marketing tools– “selling maximum efficiency rather than minimum compliance.”
- Building Performance Institute (BPI) develops standards for energy efficiency retrofit work. Through these standards, BPI develops professional credentials for both individuals and companies involved in residential energy retrofits. BPI is an active component of the DOE/EPA Home Performance with ENERGY STAR (HPwES) program, which delivers home energy retrofits through partnerships with utilities and local governments across the United States.

Further comments from BPI stakeholders include the following:

- ▷ BPI is an ANSI ASD that references and uses ASHRAE Standard 62.2 in BPI standards.
- ▷ Training and certification programs for contractors and trades fill important residential market needs, especially in the home retrofit market.

- Federal agencies such as EPA and DOE maintain high-performance new home programs that are pushing the construction market. These beyond-code programs have a substantial impact on both the new home marketplace and the advancement of residential energy codes: they act to “condition the marketplace” with advanced products and services that create homes more efficient than minimum codes require. DOE and EPA also operate energy efficiency programs aimed at the existing home retrofit market through their Home Performance with ENERGY STAR (HPwES) program. Additionally, the U.S. Department of Housing and Urban Development (HUD) is responsible for promulgation of the energy codes that govern factory-manufactured mobile homes. With the possible exception of ASHRAE Standard 62.2, which is integral to both the high-performance and retrofit programs of DOE and EPA, these federal agencies do not depend on ASHRAE in the operation of their residential energy programs.
- Other organizations
  - ▷ Air-Conditioning, Heating, and Refrigeration Institute (AHRI) comprises significant players in equipment rating procedures and standards (ANSI/AHRI 210/240-2008 is American National Standard for performance rating of unitary air conditioners and air source heat pumps).
  - ▷ International Building Performance Simulation Association (IBPSA) members are stakeholders who should be considered.

## 2. Identification of gaps

The following list of potential gaps was identified:

- Education of the residential construction industry
  - ▷ Code officials
  - ▷ Institutional barriers
  - ▷ Change code every three years
- Potential new industry partners (where the market is going)
  - ▷ NAHB and LBA
  - ▷ Multifamily developers
  - ▷ New urbanism infill
- Information for residents as operators
  - ▷ Understandable information
  - ▷ Moisture management in residences
  - ▷ Verification of retrofit savings
- Consideration of residential scope in ASHRAE TCs

Given the number of organizations working in the residential sector and the fact that at least one ASHRAE standard has garnered substantial residential market penetration (not counting ICC 700), the potential exists for ASHRAE to fill important gaps and reach a wider audience. The challenge for ASHRAE is to identify those areas that are important but not being addressed by others, rather than reinventing other organizations’ “wheels,” and deliver products that are useful to those delivering efficiency, health, and safety in residential buildings.

## IV. RESIDENTIAL STAKEHOLDERS

### A. Analysis of Stakeholders and their Roles

#### 1. Relationship to market and industry

ASHRAE, as a society, has evolved over the past 40 years by broadening its focus from heating, cooling, and refrigeration to include environmental stewardship and the built environment. In doing so, ASHRAE has attracted a number of new stakeholders beyond its original core.

#### 2. Relationship to ASHRAE

ASHRAE has a long history of high-profile involvement and impact in the commercial HVAC industry and more recently the commercial built environment. However, its attempts to make an impact in the residential industry have met with varying degrees of success.

ASHRAE has done well in providing technical expertise to the residential industry through *ASHRAE Handbook—Fundamentals* and developing technical standards for equipment and refrigerants. Stakeholders such as HVAC industry and building science researchers consistently find value and participate in developing ASHRAE's products geared toward these interests.

In the realm of residential code-intended standards, ASHRAE has had less success. The residential ventilation standard, 62.2, has had some acceptance in beyond-code programs, and pieces of the standard have been excerpted and incorporated in building codes, but it has met fairly strong resistance to its adoption by stakeholders who have, for the most part, not participated in the ASHRAE standard development process. The residential energy standard has had virtually no impact on the industry, either directly or indirectly. Of late, it has attempted to shadow code rather than provide leadership, which has reduced motivation for its adoption.

### B. Potential Interactions

#### 1. Gaps

When dealing with standards designed to be enforceable as law, the stakeholders are often polarized. Committee members typically participate for either of two reasons: (1) as materially interested parties working to protect/promote their industry's market share or (2) indirectly affected groups working to accelerate the impact of the standard. Under these circumstances, the committee makeup can become philosophically out of balance and will result in a standard that either will not achieve the purpose of the standard or will not be a practical solution for the industry.

#### 2. Conflicts

Independent of technical merits, stakeholders who feel they are underrepresented in the process are often critical of the end product and influence the national model code and local adoption processes by discouraging ASHRAE standards in lieu of other codes/standards where their stakeholder groups, in their eyes, were more fairly represented. This is often true of the construction and code enforcement stakeholders.

### 3. Synergies

Stakeholder balance and industry partnering in the standard development process will increase acceptance and influence of ASHRAE products in the residential industry. ASHRAE can passively participate in such synergies, but it can also help to create them.

## V. STAKEHOLDERS WORKSHOP

### A. Description of Workshop

On February 19–20, 2014, ASHRAE's Residential Ad Hoc Committee convened a workshop to assist in better understanding the residential building industry—its trends, needs, and challenges. Over 70 stakeholders representing over 50 organizations and a diversity of interests met and discussed an array of topics, sharing their insights and observations about the residential buildings marketplace, as well as discussing possible ways for ASHRAE to better participate in that marketplace.

#### 1. Logistics

The workshop was organized to take place over a day and a half, with the remainder of the second day reserved for the ad hoc committee to meet, discuss the workshop comments and inputs, and make plans for subsequent ad hoc committee actions and reporting. Members of the committee and ASHRAE staff were distributed among the six breakout groups to assist in record keeping and to encourage participation by all attendees.

#### 2. Invitees and attendance

Task Group 2 developed a list of potential residential industry stakeholders to invite to this workshop. More than 120 potential participants were identified. (See Appendix A, Stakeholders) The committee had contacts with many of the stakeholder groups and associations. Many were already ASHRAE members, had direct member ties, or had some past affiliation or familiarity with ASHRAE. Many of the invitees had no direct connection to current or past ASHRAE activities. Several ad hoc members and staff sought to identify the names of particular people in association management (or serving other key stakeholder functions) to invite to the workshop. Of the invited stakeholders, 80 registered for the workshop and 67 actually attended. The committee was extremely pleased with the number of participants and the diversity of interests represented. The list of attendees and their constituencies are shown in Appendix B.

It should be noted that about 12 of those that registered did not attend the workshop. Several invitees wished to attend but were unable because of the limited advance notice (approximately one month) and previous commitments. It should also be noted that participation by several key, prioritized stakeholders was not obtained, including the following (among others):

- Residential mortgage and finance community (e.g., Fannie Mae, Banking)
- Residential realtor community (NAR, etc.)
- Residential property casualty insurers, (IBHS, etc.)
- Environmental nonprofits (EDF, WWF, Sierra Club, etc.)
- Utility regulators (NARUC, FERC, etc.)
- Health organizations (American Lung Association, etc.)



These nonparticipants are noted simply to reemphasize that this was the first such residential stakeholder workshop sponsored by ASHRAE, and that future workshops may require additional time and effort to properly reach all of the targeted stakeholders.

## **B. Key Observations and Points Raised**

Generally, the workshop stakeholders confirmed a variety of known needs in research and standards development, further informed the committee about key trends in residential building performance (energy, water, durability, IEQ, etc.), and identified numerous opportunities for potential stakeholder collaboration with ASHRAE. Key messages and takeaways include the following:

### **1. Attendance exceeded expectations**

Committee members had considered that 50 attendees would be a huge success; actual attendance was almost 80. Many noted that “never” had there been such a diverse collection of people focused on the residential buildings topic all together in one place. (See Appendix B.) This evoked a few important observations:

- a. Invitees took ASHRAE seriously. Many invitees came, and most engaged strongly in the process.
- b. Attendees recognized that, even behind the scenes (Handbook, research, etc.), ASHRAE has long been an important participant in the residential marketplace—just not a particularly high-profile participant. Several noted that ASHRAE had often provided the content upon which others built their high-profile activities and standards.
- c. ASHRAE should consider its role as “convener”. Many attendees noted that this was the first time this diverse collection of interests had ever been in the same room, and spoke of ASHRAE's potential leadership role as a convener of interests. Several participants expressed the hope that ASHRAE would build upon the success of this event. Others noted that this might set the stage for future partnership and leveraging opportunities.

### **2. Some important constituencies were not reached**

A few critically important stakeholders were not represented. This may have been caused by scheduling conflicts and/or late notice, but it may also speak to relationships that ASHRAE needs to foster for future or similar convening efforts.

If ASHRAE is going to become a meaningful participant in the residential buildings landscape, certain relationships should be developed and strengthened. These include, but are not limited to the following groups:

- a. The mortgage and financial community
- b. The appraisal community
- c. The property insurance community
- d. The realtor community
- e. The environmental health community
- f. The utility industry
- g. Nongovernmental organizations focused on residential building concerns
- h. State and local government agencies and planning entities, including governors, mayors, city planners, housing authorities, water authorities, etc.

## C. Consensus Items

Even with the diversity of interests represented in the workshop, the list of priorities and recommendations were remarkably similar and the identified needs fairly focused. Key priorities identified included the following:

- a. Standard 90.2. If ASHRAE is going to develop 90.2, “make it meaningful” was the message. Although the term “meaningful” was not well defined, the standard must include truly meaningful metrics of energy performance. It must become a standard that others will reference and use. Lagging behind the IRC will not do it. Messages repeatedly voiced were as follows:
  - “Clean up the mess that currently permeates the residential building energy performance landscape.”
  - “Make others tell the truth about home performance.”
  - “Clear up the confusion regarding code loads and whole-building performance.”
  - “Better quantify duct and envelope leakage for energy ratings”, etc.
- b. The energy-water nexus was of concern to all participants. Several noted that this was an area where ASHRAE leadership could deliver great value.
- c. Multifamily housing. ASHRAE could play a lead role in addressing several needs related to multifamily housing. Many noted that the codes governing multifamily construction are sometimes unclear and inconsistently applied. Examples of items contributing to this chaos included the following:
  - The building code has a different set of boundary conditions for multifamily construction than the energy codes. Who is a reliable technical source to answer these questions? IBC vs. IRC? 90.1, 90.2, 189.1? When? Where?
  - Standards 90.1, 90.2, and 189.1 are internally conflicted regarding multifamily issues.
  - Standards 62.1 and 62.2 share some of the same internal conflicts. Which leakage matters—unit or whole building? Why are the requirements for public spaces in multifamily buildings different from those for residential spaces? What are the ventilating implications? Air leakage implications?
  - LEED and other beyond-code programs struggle with low-rise versus high-rise performance objectives and definitions.
  - Many existing buildings that need efficiency upgrades are multifamily.
  - A large portion of new construction is multifamily.
  - Worldwide, there is an ever greater need for codes, best practices, testing, and general performance guidance regarding multifamily structures.
- d. Existing buildings. Attendees acknowledged that, regarding energy, peak power, and water use, existing buildings are the major consumers. However, there was no consensus on specific actions except that ASHRAE should lead on this topic.

## D. Additional Items

Several additional items were often discussed without emergence of a clear consensus or specific conclusions. They are summarized here to assist in developing future plans/ actions regarding ASHRAE participation or leadership.

- a. Residential green. Several acknowledged that there was significant confusion within the residential green building landscape. Some said that ASHRAE should “stay out of this mess” (too many players, no meaningful metrics, ratings systems versus normative language, etc.). Others suggested an opportunity for ASHRAE leadership.
- b. Valuation. Many acknowledged the challenge of proper economic valuation for both old and new buildings, and especially regarding energy efficiency and performance. Who will lead the valuation efforts with meaningful standards and metrics of performance? How can we better educate and inform the mortgage industry and valuation professionals regarding meaningful metrics of residential building performance?
- c. Utilities. Several acknowledged that ASHRAE could play a leadership role in helping to shape important residential building performance messaging for utilities. While there was no particular consensus on the topic, there was widespread acknowledgement of need regarding energy performance metrics used in utility programs, the importance of measured data following retrofits, basic code compliance support from utility channels, and related utility topics.

## E. Feedback

Following the workshop all participants were surveyed by staff using web-based survey tools. The survey attempted to capture additional perceptions from participants regarding the value of the workshop and ASHRAE’s role in the residential building space. Sixteen (16) of the attendees responded to the web survey. The results of the web survey are summarized here.

### Questions and responses

1. How satisfied were you with the workshop structure and organizational characteristics?

**Average Rating: 3.56 out of 5**

2. How satisfied were you with the size of the workshop (70 persons)?

**Average Rating: 4.38 out of 5**

3. How satisfied were you with the opportunity to speak and be heard at the workshop?

**Average Rating: 4.19 out of 5**

4. How satisfied were you with the breadth of stakeholder representation?

**Average Rating: 3.81 out of 5**

5. How satisfied were you with the overview provided about ASHRAE activities?

**Average Rating: 3.67 out of 5**

6. How satisfied were you with the workshop breakout sessions?

**Average Rating: 3.38 out of 5**

7. How satisfied were you with the process of consolidating and delivering the breakout groups' comments and perspectives?

**Average Rating: 3.13 out of 5**

8. What did you think about the workshop length (1.5 days)?

**Answers: 62.5% just right, 31.3% too long, 6.3% too short**

9. What could ASHRAE have done to make the workshop more valuable to you?

**Comments: (12 respondents)**

- Nothing
- Provide more information on current residential programs and codes that are being adopted.
- More open dialogue regarding ASHRAE's intentions regarding advancing participation in the residential construction energy efficiency and sustainability realm.
- I felt there was too much ASHRAE self-promotion for anyone's benefit.
- General:
  - ▷ need to work harder to get production builders in the room.
  - ▷ need more up-front on "state of the industry": what are the problems (cost, quality, time,...) so we could focus on what real solutions look like.
  - ▷ too little time (a presentation, instead of the ASHRAE advertorial) on context: industry trends, demographics (crafts, population at large).
- A template for delivery to the larger group. The sharing with the group was different for each presenter and I felt that it was difficult to grasp overall themes.
- Issue notes/proceedings into some sort of brief report.
- Potentially additional contextual information leading up to the meeting. I wasn't exactly sure the purpose until we were there. The first morning set the stage well.
- Include more end users and product manufacturers.
- Spend more time talking about specific goals, then high-level possibilities.
- I think it would have been helpful to have had a background document to digest before the meeting -- accounting the history of residential construction, HVAC & energy-related history & progress, known challenges (technical, process, regulatory, political), etc. And then ask the question, where do we go from here? I think this might have given everyone a common and more informed starting point. But, at the same time, this could cause a more narrowed and less free-flowing discussion.

- (1) Used a professional facilitator(s). (2) Established a clear, focused goal(s). (3) Provided clear written questions/statements for each group to respond to. (4) Provided a better mechanism to capture comments from individuals at the breakout group and whole group level.
- Possibly, one or two more breakout groups in the morning. Too much time spent hashing over the same things. I would have rather had the opportunity to interact with one or two more different groups of stakeholders.

10. What do you hope is realized from the workshop?

**Comments: (14 respondents)**

- New direction and activities related to the standardization of building design requirements for residential construction
- A plan for ASHRAE to collaborate and cooperate with other major organizations such as ACCA.
- ASHRAE does not need to reinvent the wheel in terms of residential energy efficiency.
- ASHRAE its highly committed volunteers can play a more positive role in advancing energy efficiency and sustainability in our country's residential construction market.
- Fish or cut bait. Recognize that ASHRAE's traditional approaches aren't working. Thus, if ASHRAE wants to play in this industry it must do something different. One path (which I favor) is the roadmap to new, compelling, approaches to assuring quality and efficiency, using the lessons Deming started and others have used to invent quality and reduce costs in so many other industries.
- I hope that there is a push to engage local ASHRAE chapters in this discussion. While it is important for the national players to talk about the direction, the local chapters will know how possible it will be to get involved in the local residential industry. I would like to see similar regional or state discussions.
- A residential roadmap? Some of the ideas get sponsored and come to be...
- A clear vision for if/how ASHRAE can/will/should be involved in the residential space, and clear understanding of what ASHRAE should avoid doing given other existing efforts that do not need duplication.
- That ASHRAE seriously consider the wide range of input provided, not just what was presented by the breakout group presenters, who tended to present the results from their own lens.
- Simple and inexpensive residential energy standard that does not require energy simulation or modeling. An alternative to IECC.
- That ASHRAE identifies a handful of specific goals that align well with their current organizational mission and move the residential industry forward.
- Better understanding of needs, opportunities, and challenges to effect positive change
- A clear direction for 90.2
- No specific goals.

11. Would you be willing to participate in future events where ASHRAE convenes residential industry stakeholders?

**Answer: (14 respondents) Yes.**

**Comment:** If folks are willing to consider how to invent a better future with a real role for ASHRAE.

12. What recommendations do you have for specific ASHRAE actions needed following this recent residential industry stakeholder event?

**Answers: (14 respondents)**

- Realistic (economical: cba-based) outcome (performance)-based (energy target type standard to be cutting edge in advancement of energy conservation in all types and sizes of residential buildings.
- A decision of what to do about 90.2 and 189.2, the residential building standards.
- Provide input and technical expertise into other residential codes/programs, rather than spend ASHRAE staff and member resources on a “me too” type of code/program.
- ASHRAE leadership must express greater openness regarding its intentions moving forward. Those intentions are not evident by the “actions” of reorganizing SPC 90.2 in the last few years and forming SPC 189.2.
- (1) Learn more about the industry, and trends operating now and in the near future (see Q9).  
(2) Think harder about what ASHRAE can do to help leverage change toward designed-in and built-in quality and efficiency.  
(3) Identify research needs and a path.
- Think locally and involve individual chapters. It would be helpful for them to be aware these conversations are happening. Also, it would be an opportunity to see what each region needs. What is needed in the Northwest is completely different than the Southeast. What is needed in Florida is different than Mississippi.
- Keep up the good work!
- The idea of a multifamily-specific energy code is something I think ASHRAE should look into further and discuss with states, DOE, etc. to determine if that would add value or if it is not needed.
- (1) ASHRAE should develop an ANSI standard that is competitive with IECC residential because of the shortcomings in the IECC process.  
(2) ASHRAE should consider making recommendations for the most energy-savings retrofits in the existing residential market.  
(3) ASHRAE should incorporate resiliency in their residential products. Items (2) and (3) are important because of the long life of residential structures.  
(4) ASHRAE should encourage use of mechanical equipment above federal minimum requirements.  
(5) ASHRAE should encourage separate metering of electric and gas service in multifamily residences as a means of educating the consumer to reduce energy use.  
(6) ASHRAE should develop tools to help ensure that existing residential energy codes are enforced.

- Create one simple energy standard for all buildings (e.g., 90.1 should include all resi[dential] buildings).
- I would prefer to spend less time on high-level visioning and more time on specific tasks that can be accomplished.
- May need to prioritize/rank the needs identified at the workshop—what items have the greatest potential impact to improve residential building performance, deliver better product to consumer, provide greater benefits to providers/producers, etc.
- Start over again incorporating the above recommendations.
- Definitely more awareness of 90.2. I believe this can be done without any fundamental changes.

13. Other comments you would like to share?

**Comments: (7 respondents)**

- I hope this effort served as a good start for new activities and direction within ASHRAE.
- ASHRAE adds value with MOT and standards such as 62.2.
- There is clearly a void in this segment that could be effectively filled by ASHRAE. However, time is running out for ASHRAE to establish a clear direction and a firm commitment to it.
- Thanks for convening, and a very stimulating event.
- Glad you had representation from many diverse stakeholders.
- How is ASHRAE tackling the problem of code adoption and enforcement? Why develop a standard that is not used much if at all? This problem is not just for resi[dential] but for 90.1 as well.
- I'm glad that ASHRAE is initiating this conversation. They have an important role to play in the residential arena.

## VI. DEVELOPING COLLABORATIONS

The workshop provided much information to the committee in terms of collaborative opportunities. The committee used this information to determine which collaborations would best facilitate the ASHRAE's effectiveness in the residential market and which were of lesser value.

### A. High-Priority Collaboration Recommendations

The following collaborative opportunities were identified for further development.

#### 1. Standards development

The sustainability and energy efficiency standards arena for residential construction, especially single-family homes, is currently quite crowded, so collaboration among players is vital. ASHRAE has a unique technical capability to contribute to this effort.

ASHRAE has initiated collaboration in this area with the recently announced joint development with ICC and NAHB of the National Green Building Standard. Additional collaborative projects in this in standards are as follows:

- Standard for rigorous performance path for energy efficiency compliance. This may include a conversion of the current 90.2 standard. Potential collaboration partners are RESNET, ICC, and ACCA, in addition to the current IES partnership. ASHRAE is the best source of technical information to fuel this project.
- Zero Energy/Advanced Energy Design Guide for residential construction. This would require collaboration with the DOE's Building America program, NAHB, and the NIBS High Performance Building Council. Separate guides for single family, multifamily and existing homes would be preferable.
- Standards for multifamily residential construction. Portions of the multifamily market are covered under Standard 90.1, and other portions are covered under Standard 90.2, but overall the segment is underserved. ASHRAE has an opportunity to work with ICC and a number of standards-developing organizations, including ASTM and RESNET, to lead the industry with standards focused exclusively on multifamily construction.

#### 2. Development of guidelines for residential energy efficiency assessment

ASHRAE has the opportunity to lead industry development of the guidelines that would serve as the basis for appraisals. There are a number of industry activities in this area, but they are dispersed and not currently working together. The first step would be for ASHRAE to convene a summit inviting a wide range of stakeholders including utilities, the appraisal industry, mortgage providers, the insurance industry, the real estate industry, HUD, DOE and NAHB. Based on the response to the stakeholder workshop conducted by this ad hoc committee, the industry would be receptive to ASHRAE being the convener of such a summit. Other collaboration opportunities include cross-industry projects to develop the methodology for an assessment standard and working in both the public (HUD) and private sectors to demonstrate the viability of energy efficiency inclusion in appraisals.



### 3. Education

Education was cited as a need across all stakeholders and across all aspects of the market. ASHRAE has the technical depth and stature to lead the development of residential curriculum relating to performance-based energy code, comfort, indoor environment control, and moisture performance of buildings. Partnering with the DOE's Building America program and existing industry education programs, such as EEBA Houses that Work, on curriculum content is recommended. Collaboration on disseminating education is critical. Collaboration should occur on both a national and local level (through local chapters) with groups targeted to address the following specific stakeholders:

- a. Designers are a primary education target, especially for advanced energy and sustainable residential design. Potential collaboration could be with the American Institute of Building Design (AIBD), the American Institute of Architects Custom Residential Architects Network (AIA-CRAN), and the NAHB.
- b. The regulatory community and code officials are another primary education audience, focusing on performance method energy code compliance. This community is best served on a local level, so incentivizing regional and local chapters to partner on education with local building officials organizations and state energy offices.
- c. Contractors and the trades need education, but can most effectively be reached through media that has not traditionally been used by ASHRAE, including but not limited to short online videos. ASHRAE chapters could partner to conduct workshops on a regional or local level.
- d. Consumer education is critical to the ultimate acceptance of sustainable and energy efficiency measures in the residential segment. ASHRAE can once again act as a industry convener with a summit or series of workshops on consumer education and outreach.

### **B. Collaboration Opportunity Deemed to Be Less Attractive**

Certification of residential professionals, including home inspectors, commissioning agents, etc., was discussed. Because certification of professionals in the nonresidential industry is in a fledgling state at present, the committee's recommendation is that residential professional certification be delayed until nonresidential professional certification is better understood.

## VII. ASHRAE STRUCTURE AND OPERATIONS

### A. Identify Barriers to Affecting Change

At the most basic level, ASHRAE is faced with a “chicken or egg situation.” Without structures within ASHRAE to support and promote residential issues, ASHRAE will not have the support of membership from the residential building industry. Conversely, until there are significant contributions from the residential market, there will be no way to support structural changes related to the residential market. Therefore, it falls to this ad hoc committee or a similarly constituted body to give ASHRAE the initial push to create changes in structure and organization that encourage members of the residential part of the industry to join ASHRAE and contribute their knowledge and experience.

### B. Evaluate Changes to Strategic Positioning

Successful expansion into the residential market will require expansion of ASHRAE’s membership to include members who are involved in residential construction. Therefore, a key question from potential new members that ASHRAE needs to answer is the following: what does ASHRAE offer that I want/need for my business? ASHRAE needs to identify questions/issues currently not satisfied in the residential market.

To be more responsive, ASHRAE needs to understand what the residential market is looking for and have something to offer. To do this requires knowledge of what challenges the residential market is facing and the creation of entities that can help to provide answers to these questions.

The following issues were raised at the residential workshop as places where ASHRAE could add content to attract new members from residential community.

#### 1. Education

ASHRAE already has resources such as ASHRAE Learning Institute (ALI) for educating ASHRAE members. This could be extended by finding experts to speak on residential issues and administer this through ALI.

#### 2. Resources

ASHRAE provides printed resources such as standards, guides and the Handbook. Residential material could be added to these resources and marked to residential users. There is also the opportunity to provide more nonprinted resources, such as smartphone apps that could be used in the field. These apps could allow sophisticated engineering analyses that ASHRAE experts provide to be used by a wide audience. The complexity of the calculations and analysis would all be hidden inside the app and the user would just use a simple interface to input appropriate information and be given guidance. In some arenas, such as ASHRAE Standard 62.2, this service is already being provided by the industry. In the future, in other applications there is an opportunity for ASHRAE to create its own apps. This is a way for ASHRAE to reach a much wider audience in the residential industry beyond designers and engineers.

### **3. Finances**

The financial considerations in residential construction can be very different from those of larger buildings, as are the agencies involved (e.g., Fannie Mae and Freddie Mac). ASHRAE could provide leadership and technical support to the financial agencies most relevant for residential construction and also act as an advocate for financial instruments and/or changes in financial legislation and regulation that lead to high-performance residential construction.

### **4. International**

The U.S. residential market is highly inwardly focused and does little outreach to the international community. ASHRAE could use its position as an international organization to coordinate residential activities globally. The experience and knowledge of its international members could be used to help the U.S. residential industry on an array of technical issues that are currently not addressed in the United States. Several U.S.-based organizations are attempting to expand into overseas markets, and ASHRAE could be of great service to these organizations both technically and as advocates. ASHRAE can lead with its experience regarding differences in culture, construction, technology, and occupant expectations.

### **5. Commissioning**

Commissioning is currently rare in the residential market but increasingly becoming a necessary component, for several reasons, including ensuring code compliance, ensuring as-designed performance, and for better home ratings (e.g., RESNET/HERS). Particularly as houses become higher-performance systems, it is more critical that the house as a whole as well as its individual components are performing as intended. Therefore, commissioning is becoming essential. ASHRAE's experience with commissioning processes and techniques could be used to support the advancement of residential commissioning.

### **6. Handbook**

The current volumes of the ASHRAE Handbook has some sections and chapters relevant for the residential industry. There is other information already existing within ASHRAE publications that could be added to the Handbook and the current Handbook information could be updated to better reflect the current state of the industry. The Handbook content could be rearranged, or another Handbook volume created, to bring all the residential sections together. ASHRAE could reach out to other published material for potential added content for the Handbook (possibly in joint publication arrangements), e.g., with Home Energy magazine, or the EEBA builders guides. These efforts require coordination between the Handbook Committee, ASHRAE staff, and potential reviewers and contributors to the Handbook.

### **7. Integration**

ASHRAE is recognized as a leader and an organizer by the residential constituents. ASHRAE should act as an integrator to help the highly diverse residential industry pull together. One approach would be to form an interdisciplinary committee (see notes in summary above) structured like the Environmental Health Committee that brings together all the current residential experts already within ASHRAE. Formation of this committee will

demonstrate ASHRAE's commitment to residential issues and serve as a beacon for attracting new people to ASHRAE, either to become members of or serve as consultants to this committee. This committee may be viewed as a transitional body that acts as a booster for residential issues and as a recruitment tool. Once a critical mass of residential expertise has been assembled, it may be dispersed to committees more focused on individual residential issues. This committee should include members from government (e.g., DOE, EPA, Department of Defense [DOD], HUD), the major production builders, NAHB, AHRI, major equipment manufacturers, various state entities (e.g., California Energy Commission, New York State Research and Development Authority [NYSERDA]), major utilities, Consortium for Energy Efficiency (CEE), raters, auditors, appraisers, inspectors, real estate, code inspectors, building departments, financial institutions (e.g., banks, mortgage lenders, Fannie Mae, Freddie Mac), etc.

### **8. Bridging the gap between high-rise and low-rise multifamily**

Currently, ASHRAE already has a strong presence in high-rise multifamily construction. ASHRAE needs to bridge the gap between high-rise and low-rise. Some internal collaboration on this topic is already happening; for example, the coordination between ASHRAE Standards 62.1 and 62.2 will make 62.2 applicable to all residences and separate out other ventilation requirements into Standard 62.1.

### **9. Advocacy**

Because of its highly diverse nature, the residential high-performance community (including both energy efficiency and indoor air quality), does not have a strong legislative voice. ASHRAE already has a presence in Washington, D.C., and could expand its efforts to cover issues relevant to the residential industry (e.g., supporting the SAVE Act and the Shaheen/Portman bill that focuses on existing home improvements.).

It was suggested at the residential workshop that ASHRAE could be a great advocate for verification of performance to help pull the industry up that first step to quality construction.

### **10. Water**

The issue of water use from both an energy (heating DHW and embodied energy in the treatment and supply of water) and conservation/sustainability perspective is an issue that is seen as very important by the representatives of the industry at the workshop. However, it is poorly understood and rarely acted on in any consistent manner by the industry as a whole. ASHRAE could use its capacity as a neutral and technically proficient entity to host a forum on hot water to encourage the development and use of best practices and to provide a solid technical basis for resolving water use issues. This activity should be undertaken in collaboration with other entities also investigating hot-water use, such as the American Council for an Energy-Efficient Economy (ACEEE).

### **11. Provide industry leadership**

Technical areas in which the residential industry needs leadership are identified in the list below. ASHRAE can provide this leadership, but because of the limited number of ASHRAE members with the required knowledge and experience, recruitment of new members will be necessary to accomplish all of the listed tasks. The general theme of these items is the need to pull together all the expertise in this area and condense it into information that is easy to use for contractors, utility programs, and energy agencies.

- Develop the net zero energy (or net zero ready) home standard. Revisions to the purpose and scope of Standard 90.2 would make it the ideal candidate. Such a standard does not yet exist, yet the market is moving in this direction. This represents a great opportunity for ASHRAE to have “ownership” of this area of residential construction that is currently not served. It is advisable for ASHRAE to act quickly, because other standards agencies, as well as state energy code bodies, are moving toward this as a target for home performance.
- Manage a residential data depository. This would require working with industrial partners who are not currently directly associated with ASHRAE, such as utilities and Google. This opportunity is ideal for ASHRAE because of its dominant position currently in the nonresidential market; that position could be expanded and built upon to include the residential market.
- Develop guidance on the best ways to ventilate in compliance with Standard 62.2. This topic came up at the residential workshop. Residential contractors often simply want to be told what to do rather than being told to comply with a standard. In some ways, this is already covered by Guideline 24, but the industry would like to see something even simpler. Guideline 24 is more of a “better than minimum” document, so it is not really the compliance guide. Instead, a document that addresses the variety of conditions that may be encountered in a home and how different ventilation strategies could be preferred depending on these conditions could be of great value to the industry.
- Develop guidance on how best to retrofit homes. As with the guidance above for compliance with Standard 62.2, the need here is to be very specific about what to do in a particular home. Most current guidance is very general in nature and requires considerable thought and expertise. There is a need to tailor specific guidance to specific home styles and climates.
- Guidance on disaster resistance/resilience. This is a relatively new area for consideration in home design and construction but is of increasing interest. The industry needs guidance on homes that are more flood resistant or can remain habitable for several days when utilities fail. This has a strong connection to low energy use (or zero energy homes) particularly on the second topic. An example of this in the area of resilience can be found at <https://www.ashrae.org/news/2014/organizations-announce-commitment-to-promote-resilient-buildings>
- Look for leaders who might want to revolutionize the industry, and support them. For example, getting away from “craft” and finally having the industrial revolution have an impact on construction; going towards a more factory-built approach with more quality control/assurance.
- Develop tools that allow for residential measures to be appropriately valued beyond simple energy use. For example, consider home value, risk of default, health, resource use, etc.

There was also a general concern that ASHRAE should not duplicate existing industry efforts just to become involved. For example, becoming a joint sponsor of ICC 700 has now been determined to be more productive than having a separate stand-alone standard.

## C. Determine Needed Changes to Society

ASHRAE's Planning Committee should consider creating an outline of what the Society is going to do to increase its residential impact over, for example, the next ten years.

The Planning Committee should use the Residential Ad Hoc Report as the basis for developing this long-range plan.

The biggest structural change is the potential to substantially change membership to include more members from the residential sector. It is unlikely that ASHRAE can achieve a great deal without input from new members, particularly those with significant influence, such as those involved with ICC codes, EPA, RESNET, major builders, NAHB, and the mortgage/lending industry. Previous sections of this report outlined various issues that ASHRAE could address to attract new membership. These issues should be brought under one umbrella to have the focus needed to attract new members. A good way to do this would be to form a standing Residential Committee, similar to EHC, that covers any and all aspects of the residential sector. While in the short term this may drag members who have a residential focus away from other ASHRAE efforts, it is needed for any long-term structural change. An alternative might be for ASHRAE to form independent task groups (constituted similarly to this residential ad hoc) to address the individual possible action items identified in this report, if there are particular areas that need rapid action beyond the scope or capabilities of a single, overarching Residential Committee.

The residential market, both in new construction and HVAC technology, is rapidly modernizing, especially in terms of communication. Most leading HVAC manufacturers are already strongly involved in ASHRAE. To ensure leadership in the residential sector, ASHRAE also needs to modernize in the same direction. As an organization, at the highest levels, connections are needed to the leading high-tech innovators, such as Google, NEST, Tesla, and others. Acquiring and analyzing data will change how homes are built and lived in. As a technical organization, there is an opportunity for ASHRAE to be a leader and innovator in how all these data will be used in homes. This is a new area for ASHRAE, but will be essential in the future, particularly if ASHRAE is to interest the best and brightest young engineers. For example, ASHRAE could develop an app that connects contractors to day laborers and could provide apps for chapters to give away to local contractors, builders, etc. To do this requires ASHRAE to invest resources in reaching out to the high-tech community, providing opportunities for bright, young, connected people through development of standards, apps, etc. that are applicable to these new opportunities.

At the chapter level, ASHRAE needs to support outreach to local contractors, builders, code officials, architects, and custom and production home developers to encourage them to contribute to ASHRAE. To do this, ASHRAE needs to offer something that they want and should provide the opportunity for them to contribute. Building on the above—standards, guides, apps, etc. that relate to smart, interconnected homes—needs to start as soon as possible.

At a higher level, such as the ASHRAE BOD, connections must be made to the industry leaders in this area. Similar to the chapter level, ASHRAE needs to show that (1) it has knowledge and technical ability that the high-tech industry can use, (2) ASHRAE is going to be leading the standards that determine what smart homes look like and how they operate, and (3) the high tech industry will have opportunities to collaborate and

work with ASHRAE to define their markets. ASHRAE needs to become the place that these industries come to get answers about homes (this applies also to the rest of ASHRAE).

On the publications front, one possibility is to change to the way ASHRAE deals with its publications. Standards could be given away for free and then ASHRAE could charge for apps, guidelines, and simplified compliance information. To quickly create material to attract new residential members, source material could be obtained through partnerships with other publications, such as Home Energy, Green Builder, or possibly some of the more technically sound online blogs. ASHRAE sponsorship of articles or blog sites would expose potential new members to ASHRAE and show that ASHRAE shares their interests.

## **D. ASHRAE Structure and Operation Recommendations**

### **1. Create a high-level standing committee**

Form an intradisciplinary committee, structured like the Environmental Health Committee that brings together all the current residential experts already within ASHRAE. Formation of this committee will demonstrate ASHRAE's commitment to residential issues and serve as a beacon for attracting new people to ASHRAE, either to become members of or serve as consultants to this committee. This committee may be viewed as a transitional body that acts as a booster for residential issues and as a recruitment tool. Once a critical mass of residential expertise has been assembled, it may be dispersed to committees more focused on individual residential issues. This committee should include members from government (e.g., DOE, EPA, Department of Defense [DOD], HUD), the major production builders, NAHB, AHRI, major equipment manufacturers, various state entities (e.g., California Energy Commission, New York State Research and Development Authority

[NYSERDA]), major utilities, Consortium for Energy Efficiency (CEE), RESNET, BPI, raters, auditors, appraisers, inspectors, real estate, code inspectors, building departments, financial institutions (e.g., banks, mortgage lenders, Fannie Mae, Freddie Mac), etc.

### **2. Create policy directives to show more leadership.**

Change the mandate and objectives of existing residential activities to show ASHRAE's strength in taking leadership positions and not replicating existing information in the residential market. Examples could include the following:

- a. Revising the purpose of ASHRAE Standard 90.2 to be the net zero energy buildings standard. Such a standard does not yet exist, yet the market is moving in this direction. This represents a great opportunity for ASHRAE to have "ownership" of this area of residential construction that is currently not served. It is advisable for ASHRAE to act quickly on this, because other standards agencies, as well as state energy code bodies, are moving towards this as a target for home performance.
- b. Developing process standards and/or guideline documents that detail methods to integrate the disparate entities within the residential process to ensure quality.
- c. Developing tools that can be used to assess the value of residential energy and non-energy measures beyond simple energy (and perhaps water) costs.
- d. Assuming leadership of ASHRAE/BETEC "Buildings" conference series to make it a full ASHRAE topical conference.

### **3. Create technical group on multifamily buildings**

Form a committee or multidisciplinary task group (MTG) to investigate multifamily residential issues that include energy use, indoor air quality, and building and equipment design. Multifamily buildings are currently poorly served by the residential market and represent an opportunity for ASHRAE to provide leadership. Multifamily residential buildings have a greater connection to current ASHRAE membership than single-family buildings, because they often have integrated building services and building designers. In addition, their construction process is more familiar to ASHRAE members than for single-family construction.

### **4. Create an advisory body for large builders**

Reach out to large builders and have a way for them to connect with ASHRAE. Major builders are already making bulk purchases from other ASHRAE members, and these connections should be encouraged to recruit builders. In addition, the larger production builders are already leading the way in improved home performance, and this represents a great opportunity for ASHRAE to connect with and support the market leaders.

## **E. Disposition of Ad Hoc Committee**

The ad hoc committee has completed its charge by delivering this report to the Board of Directors and does not need to be extended for its current purpose. The structural changes recommended above, however, cannot be implemented instantaneously or without a champion. It is, therefore, recommended that this ad hoc committee be extended for an additional year with a new charge of effecting the implementation of those items approved by the Board and overseeing the recommended activities until the new structure is operational. The membership of the committee should be reviewed to determine whether changes are necessary to achieve the new charge. Because the transition will primarily affect Technology Council, the ad hoc committee should report to Technology Council.



## VIII. CONCLUSIONS AND LESSONS LEARNED

- The majority of ASHRAE members are not professionally involved in the residential sector, but ASHRAE benefits from the participation of leading professionals.
- ASHRAE has produced and continues to produce significant technical output that supports the residential industry, even if ASHRAE itself is not marketing this information directly.
- Many residential stakeholders make good use of ASHRAE technical outputs; thus, ASHRAE has made a major, albeit indirect, impact on the market.
- ASHRAE has a good reputation in the residential industry; this allowed ASHRAE to conduct a very productive workshop with many important stakeholders participating.
- This model of a focused workshop should be considered in other areas where ASHRAE wishes to facilitate strategic discussions. This is not a recommendation specific to the residential market, but rather a broader tool for ASHRAE to use in future planning efforts.
- ASHRAE can be more productive in the residential market, but in many cases it must do so collaboratively. There are significant synergies to be had in working with existing stakeholders.
- ASHRAE needs to make some structural changes to enable it to take more of a leadership position in the residential market.
- This (or another) ad hoc, reporting to Technology Council, should be tasked to oversee any operational transitions.

## APPENDIX A. STAKEHOLDERS

Task Group 2 (TG2) developed a list of potential residential industry stakeholders to invite to this workshop. This list is not meant to suggest that there are no other organizations or entities in the residential construction market with whom collaboration would be beneficial. The over 120 potential participants identified represent organizations or entities with which members of the Ad Hoc Committee currently interact or have personal knowledge. Many representatives of these organizations or entities were already ASHRAE members, had direct member ties, or had some past affiliation or familiarity with ASHRAE. Many of the invitees had no direct connection to current or past ASHRAE activities. Several ad hoc members and staff sought to identify the names of particular people in association management or serving other key stakeholder functions to invite to the workshop.

TG2 decided to focus on stakeholders with broad representation, such as associations, rather than on individual residential building industry companies. It was felt that, for this level of desired input, the broader association and agency representation was more appropriate and would also serve to avoid any technology-specific or product-specific issues that could otherwise arise.

Table 1 shows the list of invited stakeholders and their organizations. Selection was based on personal contact with or knowledge of the organization or entity by an Ad Hoc Committee member. Note that several stakeholders were represented by ad hoc committee members (*shown in italics*).

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**Table 1.** List of Invited Stakeholder Organizations

Air Barrier Association of America	American Propane Gas Association
Air Conditioning Contractors of America	American Public Gas Association
Air Conditioning, Heating & Refrigerating Institute	American Public Power Association
Air Quality Management District	American Society of Appraisers
Alliance to Save Energy	American Society of Civil Engineers
American Architectural Manufacturers Association	American Society of Mechanical Engineers
American Association of Residential Mortgage Regulators	American Wood Council
American Chemistry Council	APA the Engineered Wood Association
<i>American Council for an Energy-Efficient Economy</i>	Appraisal Institute
American Gas Association	Architectural Engineering Group
American Institute of Architects	Army Corps of Engineers
American Institute of Building Design	Asphalt Roofing Manufacturers Association
American Insurance Association	Association of Collegiate Schools of Architecture
American Iron and Steel Institute	Association of Energy Engineers
American Lung Association	Association of Home Appliance Manufacturers
American National Standards Institute	Association of Licensed Residential Architects
	ASTM International

Building Codes Assistance Project	ICF International
Building Enclosure Councils	Illuminating Engineering Society
Building Owners and Managers Association	Indoor Air Quality Association
Building Performance Institute	Indoor Environmental Standards Organization
Building Science Corp	Institute for Business and Home Safety
California Energy Commission	International Association of Building Officials
Canadian Wood Council	International Association of Lighting Designers
<i>Carrier Corporation</i>	International Code Council
Canada Mortgage and Housing Corp.	Kellen Company
Concrete Foundations Association of North America	<i>Lawrence Berkeley National Laboratory</i>
Consortium for Energy Efficiency	Leading Builders of America
<i>DuPont</i>	Masonry Alliance for Codes and Standards
Edison Electric Institute	<i>MC2 Mathis Consulting Company</i>
Elevate Energy	Midwest Energy Efficiency Alliance
Energy Efficient Codes Coalition	National Conference of State Legislators
Energy Foundation	North American Technical Excellence
Environmental Defense Fund	National Air Duct Cleaners Association
Exterior Insulation Manufacturers Association	National Association of Certified Home Inspectors
Federal National Mortgage Association	<i>National Association of Home Builders</i>
Federal Emergency Management Agency	NAHB Research Center
Federal Energy Regulatory Commission	National Association of Home Inspectors
<i>Florida Solar Energy Center</i>	National Association of Manufacturers
Foam Sheathing Committee, American Chemistry Council	National Association of Realtors
<i>Gas Technology Institute</i>	National Association of Regulatory Utility Commissioners
Glass Association of North America	National Association of Residential Property Managers
Green Builder Coalition	National Association of State Energy Officials
Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)	National Association of the Remodeling Industry
Home Energy	National Center for Healthy Housing
Home Innovation Research Labs	National Concrete Masonry Association
Home Ventilating Institute	National Electrical Contractors Association
Integrated Building and Construction Solutions (IBACOS)	National Electrical Manufacturers Association
	National Fenestration Rating Council

National Fire Protection Association	Residential Landlords Association
National Frame Buildings Association	Responsible Energy Code Alliance
National Home Furnishings Association	Restoration Industry Association
National Institute of Building Science	Sheet Metal and Air Conditioning Contractors National Association
National Institute of Science and Technology	Sierra Club
National Insulation Association	Society of Building Science Educators
National Kitchen and Bath Association	South-central Partnership for Energy Efficiency as a Resource
National League of Cities	Southeast Energy Efficiency Alliance
National Lumber & Building Material Dealers Association	Southface
National Multi-Housing Council	Southwest Energy Efficiency Partnership
National Renewable Energy Laboratory	Spray Polyurethane Foam Alliance
National Roofing Contractors Association	Steel Framing Alliance
National Rural Electric Cooperatives Association	Structural Building Components Association
National Society of Professional Engineers	Structural Insulated Panel Association
National Tile Contractors Association	The Brick Industry Association
National Wood Flooring Association	The Gypsum Association
Natural Resources Defense Council	The Vinyl Siding Institute
Net Zero Coalition	Tile Council of North America
North American Insulation Manufacturers Association	Treated Wood Council
North American Wholesale Lumber Association	<i>University of Illinois at Urbana-Champaign</i>
Northeast Energy Efficiency Partnership	U.S. Air Force
Northwest Energy Efficiency Alliance	U.S. Army
Oak Ridge National Laboratory	U.S. Department of Energy
Pacific Gas and Electric Company	U.S. Department of Housing and Urban Development
Pacific Northwest National Laboratory	U.S. Environmental Protection Agency
Passive House Institute US	U.S. Green Building Council
Plumbing-Heating-Cooling Contractors Association	Washington State University
Polyiso Insulation Manufacturers Association	Water Quality Association
Portland Cement Association	<i>Window and Door Manufacturers Association</i>
Residential Energy Services Network	Wiss, Janney, Elstner
Residential Heating Ventilation Contractors Association	World Resources Institute

## APPENDIX B. WORKSHOP ATTENDEES AND AFFILIATION

(Note: ad hoc committee members and ASHRAE staff shown in italics)

(80 Registrants, 67 Attendees)

**Table 2.** Attendees, Titles, and Representation

<b>Name</b>	<b>Job Title</b>	<b>Company</b>
<i>Mark Ames</i>	<i>Senior Manager, Federal Government Affairs</i>	<i>ASHRAE</i>
Steve Baden	Executive Director	RESNET
Kenneth Bland	VP, Codes and Regulations	American Wood Council
Mike Blanford	Research Engineer	U.S. Dept. of Housing and Urban Developmt.
Neil Burning	VP Construction, Codes & Standards	National Association of Home Builders
Scott Chamberlain	Program Manager	Office of the Depty. Asst. Secty. of the Army
<i>Steve Comstock</i>	<i>Director of Publications and Education</i>	<i>ASHRAE</i>
Jay Crandell	Engineer	ARES Consulting
Laverne Dagleish	Executive Director	Air Barrier Association of America
Martina Driscoll	Architect	Wiss, Janney, Elstner Associates, Inc.
<i>Craig Drumheller</i>	<i>Construction, Codes &amp; Standards</i>	<i>National Association of Home Builders</i>
<i>Philip Fairey</i>	<i>Deputy Director</i>	<i>Florida Solar Energy Center</i>
William Fay	Executive Director	Energy Efficient Codes Coalition
Michael Fischer	Director of Codes & Regulatory Compliance	Kellen Company
Asa Foss	LEED Residential Technical Development	US Green Building Council
Charles Foster	Representative	Edison Electric Institute
<i>Paul Francisco</i>	<i>Research Engineer</i>	<i>University of Illinois at Urbana-Champaign</i>
Allan Fraser	Senior Building Code Specialist	National Fire Protection Association
Dean Gamble		U.S. Environmental Protection Agency
Henry Green	President	National Institute of Building Sciences
<i>Paul Haydock</i>	<i>Project Engineer</i>	<i>Carrier Corp.</i>
Glenn Hourahan	Sr. Vice President	Air Conditioning Contractors Assoc.
Marshall Hunt	Customer Energy Solutions, HVAC & Motors	Pacific Gas & Electric Company
<i>Jeff Inks</i>	<i>VP Codes &amp; Regulatory Affairs</i>	<i>Window &amp; Door Manufacturers Assoc.</i>
Michael Jouaneh	Manager – Sustainability & Energy Standards	Lutron/IES
Vimal Kapoor	President	The Building Inspector of America
David Karmol	Vice President, Federal & External	International Code Council
Paul Karrer	Project Manager for National Advocacy	Building Codes Assistance Project (BCAP)
Maria Kingery	Board Member	Green Builder Coalition
Carol Kurlancheek	Architectural Engineering Institute	American Society of Civil Engineers
Eric Lacey	Chairman	Responsible Energy Codes Alliance

Nicholas Lang	Manager, R&D Laboratory	National Concrete Masonry Association
Daniel Lapato	Director of Government Affairs	American Public Gas Association
<i>David Lee</i>	<i>Program Manager</i>	<i>U.S. Department of Energy</i>
<i>Neil Leslie</i>	<i>R&amp;D Director</i>	<i>Gas Technology Institute</i>
Peter Ludwig	Director of Building Retrofits	CNT Energy
<i>Chris Mathis</i>	<i>President</i>	<i>MC2 Mathis Consulting Company</i>
Charlie McCrudden	Sr. VP of Government Relations	Air Conditioning Contractors of America
Nancy McNabb	Manager, Building & Fire Codes & Standards	National Inst. of Standards & Technology
Steve Mickley	Executive Director	American Inst. Of Building Design
<i>Harry Misuriello</i>	<i>Visiting Fellow</i>	<i>American Council for an Energy-Efficient Economy</i>
Rebecca Morley	Executive Director	National Center for Healthy Housing
Ron Nickson	V.P. of Building Codes	National Multi-Housing Council
Mark Nowak	Codes consultant	Steel Framing Alliance
<i>Dan Pettway</i>	<i>Society Vice President</i>	<i>ASHRAE</i>
Jerry Phelan	Codes and Standards Advocate	Bayer Material Science
Russell Pope	Vice Chair	Home Ventilating Institute
David Roberts	Senior Engineer / Group Manager	National Renewable Energy Laboratory
Steve Rosenstock	Senior Manager, Energy Solutions	Edison Electric Institute
Aniruddh Roy	Engineering Manager, Regulatory Affairs	Air-Conditioning, Heating, & Refrigeration Institute
Harvey Sachs	Senior Fellow	American Council for an Energy-Efficient Economy
John Scharl	Civil Engineer	ACSIM
Jonah Schein	Technical & Certification Coordinator	U.S. Environmental Protection Agency, WaterSense
<i>Jodi Scott</i>	<i>Communications Manager</i>	<i>ASHRAE</i>
<i>Max Sherman</i>	<i>Special Adviser, Residential</i>	<i>Lawrence Berkeley National Laboratory</i>
Don Stevens	National R&D Manager	Panasonic Eco Solutions North America
Stephen Szoke	Senior Director	Portland Cement Association
David Terlizzi	Manager, Technical Services	Heating, Refrigeration and Air Conditioning Institute of Canada
Douglas Tucker	Senior Facilities Energy Engineer	U.S. Air Force
Martha VanGeem	Principal Engineer	Masonry Alliance for Codes and Standards
Christopher Wagner	Program Manager	National Association of State Energy Officials
<i>Iain Walker</i>	<i>Scientist</i>	<i>Lawrence Berkeley National Laboratory</i>
<i>Mark Weber</i>	<i>Assistant Manager of Standards</i>	<i>ASHRAE</i>
Lauren Westmoreland	Energy Codes Manager	Southeast Energy Efficiency Alliance
<i>Theresa Weston</i>	<i>Research Fellow</i>	<i>DuPont</i>
Jerry White	Designer	J & E Consulting Group
Larry Zarker	CEO	Building Performance Institute