

Strategy Guideline: Partnering for High Performance Homes

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January 2013

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Strategy Guideline: Partnering for High Performance Homes

Prepared for:

The National Renewable Energy Laboratory

On behalf of the U.S. Department of Energy's Building America Program

Office of Energy Efficiency and Renewable Energy

15013 Denver West Parkway

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Prepared under Subcontract No. KNDJ-0-40341-02

January 2013

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Definitions

C&P	Commitment and Preparation
HERS	Home Energy Rating System
HVAC	Heating, Ventilation, and Air Conditioning

Executive Summary

When builders choose to increase the energy efficiency and performance of their products, they generally use one of two strategies. The first is “spec and purchase,” which treats energy efficiency and building performance as simply swapping technology measures. In this scenario, purchasing department staffers negotiate pricing on the individual measures that are needed and then hand off the project to the field personnel for implementation. The other strategy is the “systems approach,” where a builder optimizes the performance through design integration and systems trade-offs and synergies, striving to achieve the highest level of energy efficiency and building performance at the lowest cost. A building company that actively manages and supports a “learning organization” and places a high value on customer, trade, and employee satisfaction tends to use a systems approach. One successful strategy for builders to build a learning organization is to create a partnering approach to relationships with trades, vendors, suppliers, and consultants.

High performance homes require a high degree of coordination and significant interdependencies among various systems in order to perform properly, meet customer expectations, and minimize risks for the builder. Responsibility for the key performance attributes is shared across the project team and must be well coordinated. Historically, relationships in the residential construction industry are adversarial, with multiple disconnects and conflicts among the builder, subcontractors, material and product suppliers, and manufacturers. Partnering is a strategy a builder can use to identify and work with all players in the value chain, integrating them to satisfy the end customer in a way that mutually benefits all parties involved.

For high performance homes, these partnerships need to be matured to the next level and be expanded to all members of the project team. In an environment where the builder is the only source of communication between trades and consultants and where relationships are, in general, adversarial as opposed to cooperative, the chances of any one building system failing are greater. Furthermore, it is much harder for the builder to identify and capitalize on synergistic opportunities. Partnering can help bridge the cross-functional aspects of the systems approach and achieve performance-based criteria.

The stages of partnering in residential construction can generally be described as formation, application, and continuous improvement. Critical success factors for partnering include support from top management, mutual trust, effective and open communication, effective coordination around common goals, team building, appropriate use of an outside facilitator, a partnership charter or agreement, adequate resources, progress toward common goals, an effective problem-solving process, long-term commitment, continuous improvement, and a positive experience for all involved. When establishing partnerships for high performance homes, expand those involved to include Home Energy Rating System (HERS) raters, designers, architects, and building officials as appropriate.

This guide is intended for use by all parties associated with the design and construction of high performance homes. It serves as a starting point and features initial tools and resources for teams to start collaborating to continually improve the energy efficiency and durability of new houses.

1 Introduction to Partnering

1.1 What Is Partnering?

The Construction Industry Institute website summarizes a report by the Partnering Task Force of Construction Industry Institute (1991) that defines *partnering* as “A long-term commitment between two or more organizations for the purposes of achieving specific business objectives by maximizing the effectiveness of each participant’s resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based on trust, dedication to common goals, and an understanding of each other’s individual expectations and values.”

Historically, relationships in the residential construction industry have been adversarial, with multiple disconnects and conflicts among the builder, subcontractors, material and product suppliers, and manufacturers. Partnering is a strategy a builder can use to identify and work with all players in the value chain, integrating them to satisfy the end customer in a way that mutually benefits all parties involved.

1.2 Who Are the Partners?

Traditionally trade contractors are the primary focus of partnering. High performance home solution sets also require the participation of others, including designers, architects, engineers, Home Energy Rating System (HERS) raters, and building officials. These partners are integral to how well the end product performs and meets the builder’s internal standards and performance targets. However, they are not typically considered part of the “trade base.” These partners can offer valuable insight and can supply data on the successes and challenges of implementing various high performance home strategies, and they can facilitate streamlined inspections and verification processes.

Designers, engineers, and architects can be involved in conducting *root-cause analyses*, developing action plans, documenting corrective activities, and developing field implementation and training tools such as step-by-step installation details or overall systems coordination drawings. Designers should be informed of internal actions to prevent recurring problems that should be eliminated at the design phase.

Root-Cause Analysis

—A way to determine the factor that created a problem in a product (i.e., house) or process.

HERS raters have a wealth of information related to a building’s tested performance and may be able to assist with documenting recurring building performance issues, transferring best practices from other builders, and furnishing ongoing data on key building performance metrics.

A proactive dialogue with local building officials can give them insight into the code and building science rationales behind the strategies being implemented in the field. Taking this step also can proactively prevent building officials from issuing stop-work orders because they are unfamiliar with certain construction practices used in high performance homes, such as advanced framing or conditioned crawlspaces.

2 Partnering as a Means of Achieving High Performance Homes

Once a company makes the decision to adopt a systems approach to deliver high performance homes,¹ partnering can become a very powerful tool to reduce costs of implementation, avoid risks, and ensure that performance targets are met.

2.1 Spec and Purchase Versus Systems Approach

When builders choose to increase the energy efficiency and performance of their products, they generally use one of two strategies. The first is “spec and purchase,” which treats energy efficiency and building performance as simply swapping technology measures. In this scenario, purchasing department personnel negotiate pricing on whatever individual measures are needed. The project is then handed off to field personnel for implementation. Generally speaking, a spec and purchase approach does not lead to a house that is fully optimized from a cost/performance perspective.

Spec and purchase is the dominant strategy in the industry today. Reasons for this include the legacy organizational structure that many building companies have and the way codes and some energy efficiency programs set prescriptive requirements for energy and other building features by using simplified tables and “builder option packages.”

Figure 1 documents a typical process of spec and purchase within a builder’s operations.

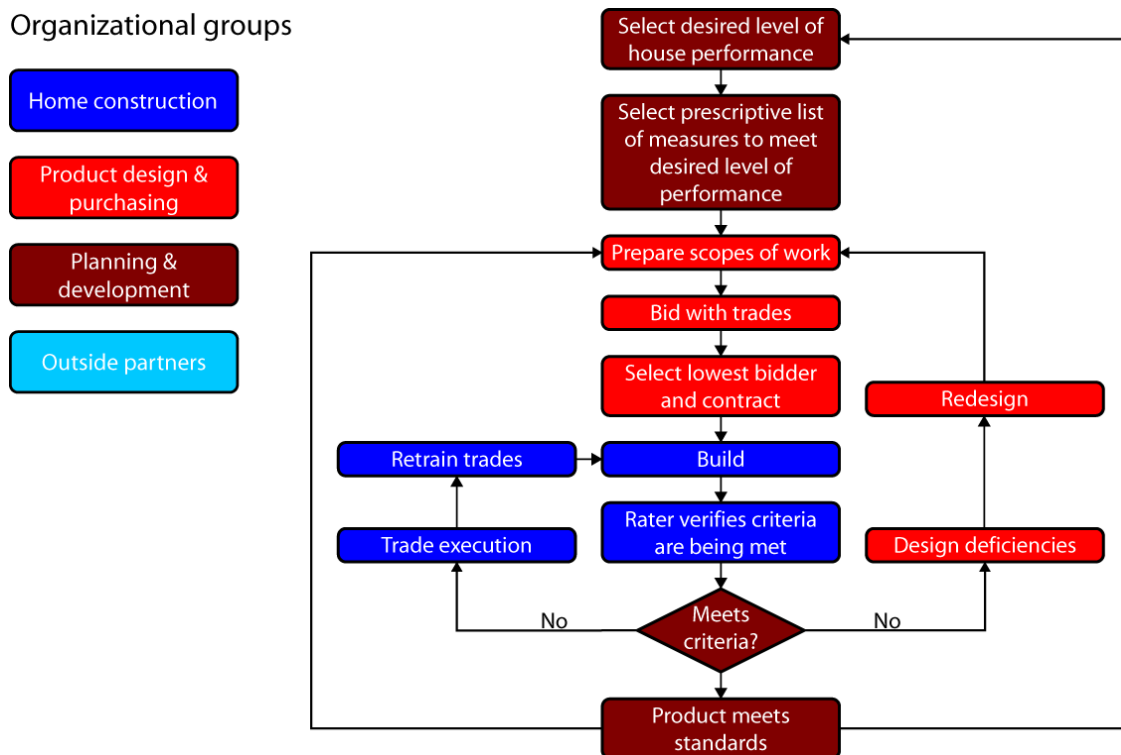


Figure 1. Typical spec and purchase process

¹ For the purposes of this strategy guideline, high performance homes are defined as meeting systems-based performance criteria such as those given in Appendix A.

The other strategy is the “systems approach,” in which a builder optimizes the performance through design integration and systems trade-offs and synergies, striving to achieve the highest level of energy efficiency and building performance at the lowest cost.

Integrated design (see Figure 2) is one example of a systems approach process that involves many partners.

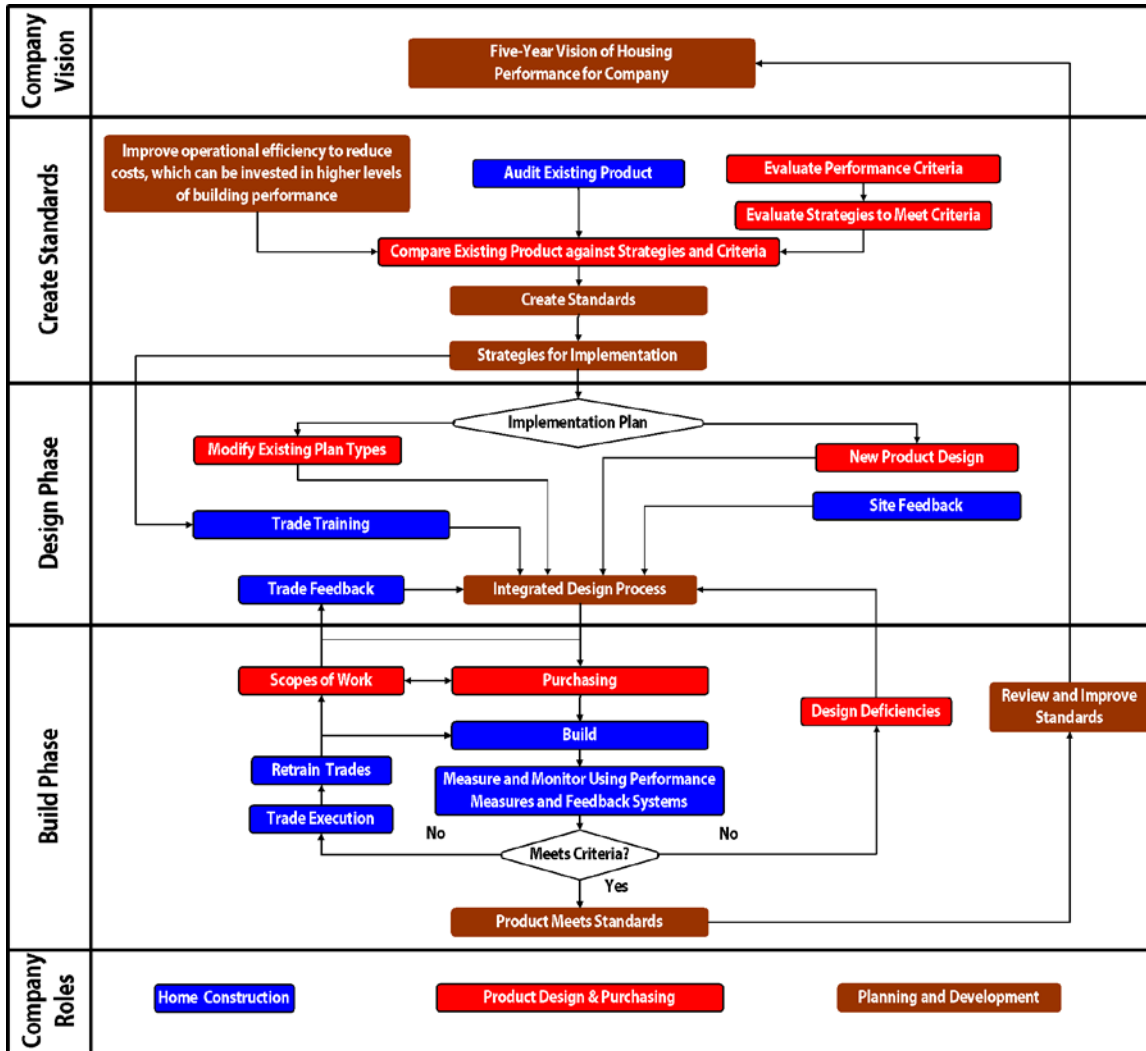


Figure 2. Integrated design process

The systems approach concept is the basis of the technical strategy to achieve significant energy savings. In this approach, the building team looks at the rated efficiency of components, the overall system performance, and whole-house interactions. Table 1 presents key systems strategies for cold climates.

Table 1. Typical Cold-Climate Systems Approach Design and Cost Trade-offs^a

Feature	Cost Addition	Cost Reduction
Advanced framing: 2 × 6 boards @ 24 in. on center instead of 2 × 4 boards @ 16 in. on center		●
Insulating sheathing replaces majority of oriented strand board sheathing	●	
ENERGY STAR windows	●	
Savings on duct system		●
Savings on air-conditioning system, ~1-ton reduction		●
Airflow retarder system	●	
No poly vapor barrier		●
Controlled ventilation system	●	
Direct-vent gas water heater	●	

^a Adapted from Pettit et al. (2009).

Figure 3 shows general systems interactions.

		Key Features of a High Performance Home									
		Bulk Water Management	Advanced Framing	Increased Insulation	Better Windows	Building Air Tightness	Ducts in Conditioned Space	Sealed Combustion Equipment	Right-sized Heating and Cooling Equipment	Controlled Ventilation	Efficient Lighting
Key Risks and Interactions	Less energy consumption means less energy flow across building enclosure which means lower drying potential in building assemblies, which increases risk of structural damage or mold if water gets in	●	●	●	●	●				●	
	Building airtightness changes house pressures, and can cause IAQ, comfort, and combustion safety issues					●	●	●		●	
	Venting for sealed/power vented equipment must be located appropriately (no interaction with snow, wind, or ventilation)	●						●	●		
	Right-sized equipment will not satisfy occupant comfort requirements if thermal enclosure elements do not meet performance specifications		●	●	●	●			●		●
	Right-sized equipment requires greater attention to duct design and installation to assure occupant comfort						●		●		
	House tightness/ventilation/duct system design can change pressures in rooms with doors closed, may cause comfort problems or increase air leakage in specific rooms					●	●		●	●	

Note: IAQ, indoor air quality.

Figure 3. Features, risks, and interactions in a high performance home

A building company that actively manages and supports a “learning organization” and places a high value on customer, trade, and employee satisfaction tends to embrace a systems approach. One successful strategy for builders to build a learning organization is to create a partnering approach to relationships with trades, vendors, suppliers, and consultants.

2.2 Get Your Own House in Order: The Role of the Leadership Team and the Building Company in Partnering

In *Quality Assurance Strategy for Existing Homes: Final Quality Management Primer for High Performing Homes*, Taggart and colleagues (2012) outline seven steps for adopting quality management as part of implementing a high performance home strategy within a home-building company. The sections that follow discuss some of these steps and the actions that can be taken to support the implementation of partnering.

2.2.1 Assess and Prioritize Company Needs

When identifying core internal processes to implement a high performance home strategy, breaking down departmental and functional silos will help to ensure an integrated approach. Bring marketing and sales, design and purchasing, construction, and customer care into a multidisciplinary project team for the development, design, construction, sale, and occupancy of high performance homes. Operationally, a building business is an interconnected set of processes, not a series of isolated blocks of activity with the minimum amount of overlap to get the job done.

Figure 4 shows a series of high-level operational processes that take place in a home-building company. These operational processes involve input from a variety of sources within the company. These functions occur in all companies, regardless of whether they build to code minimums or to a high performance standard. When implementing a high performance home strategy, cross-functional communications can help with the following:

- Disseminating necessary information to the customer during the sales process
- Ensuring that the homes are designed to incorporate buildable solutions that will achieve the company’s high performance home standards and meet customer needs
- Making sure the appropriate level of documentation is created to allow site supervisors and trades to succeed in the field
- Reducing long-term warranty items and associated risks.

Detailed descriptions of some of the activities associated with implementing a high performance strategy and the interactions in a company between different functional areas from Figure 4 are shown later in this report (see Figure 5 and Appendix A).

Learning Organizations

—Organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together (Senge 1990, p. 4).

Planning and Development	Product Design and Purchasing	Marketing and Home Sales	Home Construction	Customer
Company Analysis	Market/Consumer Research	Market/Consumer Research	Permits	Customer Relations/ Communications
Market Evaluation	Initial Design	Marketing Plan/ Positioning	Scheduling	Service Requests/ Resolution
Vision/Program Definition	Value Engineering	Promotional Campaign	Contractor Relations	Customer Satisfaction Surveys
Land Acquisition, Development, and Construction	Budgeting/ Development	Options and Upgrades	Home Construction	First-Year Warranty
Governmental Approvals	Final Design	Model Homes	Inspections	Ongoing Warranty
Financial Pro Forma	Specification	Sales Team Development	Customer Communications	
Team/Resource Coordination	Scopes of Work	Realtor Program/ Relations	Closing/Home Handover	
	Bidding/Contracts	Sales/Design Center		
		Customer Financing		
		Customer Education/ Communications		

Figure 4. Activities associated with production homebuilding by organizational area

Here are some examples where organizational silos can create challenges with implementing a high performance home strategy:

- The design team creates a product that does not facilitate cost-effective implementation of the company’s performance goals.
- High performance measures are purchased and applied to the house as if they were a coat of paint or a granite countertop, as opposed to a set of interrelated systems with inherent synergies and trade-off opportunities.
- Customer satisfaction and warranty issues (e.g., comfort complaints, water management, mold, material failure resulting from fluctuations in humidity, and condensation on windows) are dealt with only after closing and are not traced back to high performance strategies that might solve them.
- Customers receive inconsistent messages from different departments about the company’s high performance home product and strategy.

2.2.2 Creating a Culture of Quality

The success of adopting a high performance home strategy in an organization starts and ends with the leadership team. Company leadership guides the vision, direction, strategy, and especially the culture of the organization. Leadership actions and behaviors create the culture and the disciplines required to design, market, build, and sell high performance homes. Leaders who successfully implement high performance homes make it a core part of their business across the entire organization and do not relegate it to one department.

Many builders consider the overall performance of a house to be a function of the individual parts and pieces that make up the end product. In reality, a house is a complex set of interrelated systems with individual parts that rely on one another to yield the desired performance results. This same concept holds true for the company that builds high performance homes. The company is a set of independent “parts,” but to deliver quality and building performance, all those parts must be seen and work as an interrelated system. Sustained success is virtually impossible if only one part of the company is delegated to “do that high performance homes thing.”

A parallel concept in a building company would be to delegate the goal of improving customer satisfaction to one department. Past National Housing Quality Award winners (Sickel 2005; National Association of Homebuilders Research Center 2011) have shown that the entire home-buying process influences customer satisfaction and that every member of the organization must be involved. Unless delivering high performance homes becomes one of the key cultural goals of the organization, supervisors and trades may not realize the importance of the work they do, the sales team may not discuss the benefits of a high performance home with buyers, and customer care may feel the brunt of unmet expectations.

2.3 High Performance Home Features and Partner Responsibilities

Responsibility for the key performance attributes shown in Figure 3 is shared across the project team and must be well coordinated. Figure 5 shows key partners and potentially affected partners for the main performance attributes.

		Key Features of a High Performance Home										
		Bulk Water Management	Advanced Framing	Increased Insulation	Better Windows	Building Airtightness	Ducts in Conditioned Space	Sealed Combustion Equipment	Right-sized Heating and Cooling Equipment	Controlled Mechanical Ventilation	Efficient Lighting	Efficient Appliances and Load Control
Partners	Architect	●	●				●			●	●	
	Structural Engineer		●	●			●					
	Excavation	●										
	Foundation	●	●									
	Damp-proofing	●										
	Framing		●	●		●	●		●	●		
	Roofing	●										
	Drainage Plane	●			●	●		●		●		
	Windows	●	●	●	●	●			●			
	Exterior Doors	●	●	●		●						
	Siding	●	●		●			●				●
	Gutters	●										
	HVAC	●	●	●	●	●	●	●	●	●	●	●
	Plumbing	●				●	●					●
	Electrical	●				●	●	●		●	●	●
	Insulation		●	●		●			●			
	Air Sealing		●			●						
	Drywall		●	●		●	●				●	●
	Finish Carpentry		●	●								
	Paint					●					●	
	Appliances											●
	Landscape	●										

● Key Partner ● Potentially Affected Partner

Figure 5. Partners who are involved in various high performance home features

3 Application of Partnering

Building Partnerships: How to Work with Trade Contractors by Whitten (1999) and the article “Trade Partner Councils Pay Off for Home Builders” by Jaresek (2010) give good general overviews of partnering. For high performance homes, the partnerships described by these authors need to be matured within the context of a learning organization and expanded to all members of the project team. In an environment where the builder is the only source of communication between trades and consultants and where relationships are, in general, adversarial instead of cooperative, the chances of failure in any one building system are greater. In addition, the builder’s ability to identify and capitalize on synergistic opportunities is impeded.

By extrapolating on work by Cheng and Li (2001) and Anvuur and Kumaraswamy (2007) in the commercial construction industry, the stages of partnering in residential construction can generally be described as formation, application, and continuous improvement. To mature partnering relationships, a number of critical success factors have been identified by Chan and coauthors (2004). Figure 6 shows where these critical success factors apply equally across all stages and where they have a greater impact in one stage compared to another.

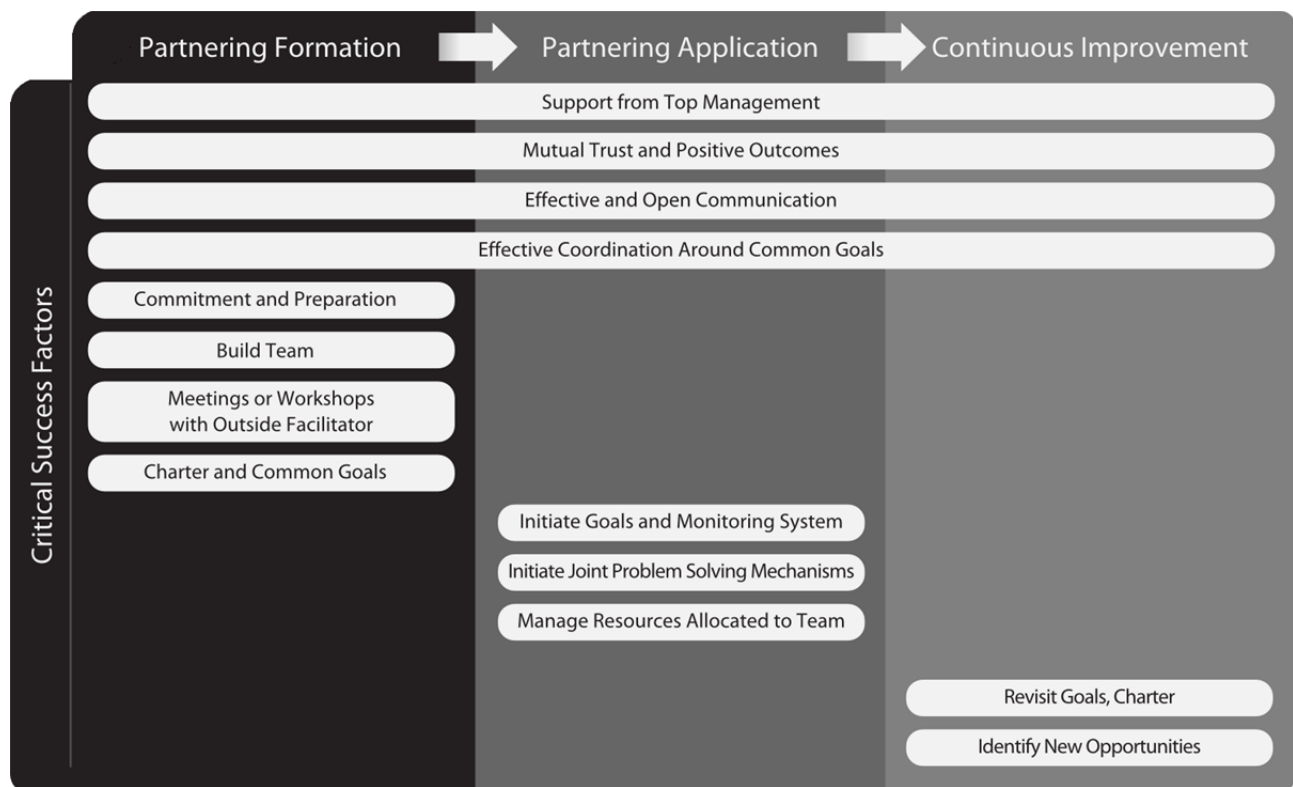


Figure 6. Application of critical success factors as a function of partnering stage

The following stages from Figure 6 are discussed next, with references or resources included where appropriate.

3.1 Partnering Formation

3.1.1 Commitment and Preparation (C&P)

- Ensure that the leadership team has embraced high performance homes as a core strategy. Appendix B contains examples of high performance home criteria.
- Align the internal organization behind a core high performance strategy. Select an internal team to champion partnering relationships, and empower that team through a charter. Appendix C presents an example company charter.
- Identify areas where the builder is creating challenges, frustrations, and increasing costs for trade contractors and other partners, and develop systems and strategies to eliminate those issues or minimize their impact.
- Develop two-way feedback and communications systems to identify strengths, weaknesses, and areas of improvement for the company and partners. Appendix D gives examples of feedback systems and best practices for feedback.

3.1.2 Team Building

- Identify the key stakeholders who should initially participate in the partnership.
- Use feedback tools and process improvement activities identified during the C&P phase to develop open communication practices and mutual trust.

3.1.3 Charter and Common Goals

- Develop a charter with key stakeholders. This effort is led by the team responsible for partnering relationships. Appendix E contains an example of a partnership charter.
- Set team goals and expectations, and document them in the charter to give all partners a common purpose.
- Develop measurements and include them in the charter to track whether the goals are being met. Mechanisms to actually measure the achievement of goals must be included in the two-way feedback mechanisms developed in the C&P phase. Appendix F gives examples of high performance metrics.

Partnership Charter

—A document created by the partnering group to establish a common vision for the work that will be done and to make specific commitments and record specific responsibilities.

3.1.4 Meetings and Workshops

- Hold meetings and workshops if necessary to support team building, resolve issues identified in the C&P phase, and develop the partnership charter.
- Consider bringing in an outside facilitator, who might be useful in these meetings to help diffuse past adversarial relationships and bring a level of objectivity to the process.

3.2 Partnering Application

3.2.1 Initiate Goals and a Monitoring System

- Begin work toward the goals, and implement a monitoring system, working with the partnering team. Use data collected to determine if results are improving and progress is being made toward the goals.

- Use the partnering framework to introduce the concepts and key goals and to receive feedback when initiating a new high performance strategy.

3.2.2 Initiate Joint Problem-Solving Mechanisms

- Use quality tools and strategies such as brainstorming, mind mapping/relationship diagrams, and root-cause analyses using fishbone diagrams, Pareto charts, and flowcharts as found in Tague (2005) and Revelle (2004).

3.2.3 Manage Resources Allocated to the Team

- Optimize the value of time associated with partnering. Use feedback and communication tools to review measurements and progress toward the goals, and create action plans to achieve those goals.
- Evaluate scheduling and how high performance criteria might have an impact on the schedules of all partners. Appendix G lists some scheduling issues to consider.

3.3 Continuous Improvement

3.3.1 Revisit the Goals and Charter

No business remains static. As business conditions, external forces, or other factors influence the business, revisit high-level goals, develop stretch goals, and amend team or partnership charters as necessary.

3.3.2 Identify New Opportunities

- Identify new opportunities to continually improve as goals are achieved.
- Identify the next level of energy performance that could be achieved by the team.
- Identify new technologies or systems that are coming to market and should be explored.

3.4 Importance of Stages and Critical Success Factors

Table 2 summarizes the stages, the critical success factors, and the associated high performance strategy issues.

Table 2. Stages and Critical Success Factors for Partnering

Stage or Factor	Importance	High Performance Strategy Issue
Support from top management	Partnering must be a part of the overall company culture. This relates to both employees and external partners. If the company is not committed to “win-win” agreements, partnering will ultimately fail.	To be relevant to all partners, leadership must see high performance as a corporate priority and a core company culture.

Stage or Factor	Importance	High Performance Strategy Issue
Mutual trust	<p>All parties involved in partnering must trust each other. This trust can take time to build, especially if previous relationships were primarily adversarial or “win-lose.” Setting overall performance goals and having partnership charters or agreements can help establish a framework of trust.</p>	<p>For high performance to succeed, all partners must rely on each other. All systems interact in the house, and many partners have specific responsibilities for the overall success of various system strategies, such as airtightness or proper performance of the thermal enclosure. Figure 5 shows how different systems strategies affect various partners.</p>
Effective and open communication	<p>All parties must be able to speak freely without fear of retribution. Honestly identifying and discussing issues, options, and strategies will ultimately yield the best synergistic solutions.</p>	<p>New solutions to achieve performance goals can be discussed and evaluated if open and effective communication exists among partners.</p>
Effective coordination around common goals	<p>All parties in the partnership must be focused on the common goals and must be coordinated to effectively achieve them. Historically, the builder has been the center point of this coordination. In a strategic partnership, such coordination may evolve so that the builder facilitates, but may not be specifically responsible for, all interteam coordination and communications.</p>	<p>The sequencing and activities for various high performance features can require new schedules and coordination or might require that certain trades undertake additional scopes of work. Additional inspections and tests might need to be scheduled at appropriate times to ensure compliance with overall company performance goals. Appendix G discusses the scheduling impacts that need to be considered and planned when adopting a high performance home strategy.</p>
Team building	<p>High performance homes have a high level of interdependence among building systems to function properly. To achieve this, project participants must realize their responsibilities to other team members and understand how their actions affect others.</p>	<p>Training that shows the interdependencies in high performance housing can help all partners realize their role as part of a team.</p>

Stage or Factor	Importance	High Performance Strategy Issue
Outside facilitator	To minimize the potential for conflicts, it can be valuable to bring in an outside facilitator when initiating a partnering strategy to help create a team mentality and to minimize the potential for the trades to view this as another “price bashing” exercise.	When embarking on a high performance home strategy, engaging a third-party consultant can be useful. The consultant can help facilitate the team in setting initial goals and realistic building performance criteria and help identify technical barriers and solution sets. In this way, all parties can participate and learn, with no one member having to be the expert.
Partnership charter or agreement	One mechanism that can support a partnering strategy is a partnership charter or agreement. Sample company and partnership charters and issues to consider are discussed in appendices C and E, respectively.	Goals for high performance homes can be included in a partnership charter signed by all team members.
Adequate resources	All parties to the partnering agreement must commit to furnishing resources to effectively participate and achieve the common goals. At the same time, the team must evaluate and clarify how much time is realistic and necessary to achieve the goals. “Meetings for meetings’ sake” must be avoided.	Additional resources from all team members will be needed for analysis, discussion, prototype creation, refinements, and agreement on new solutions to meet high performance home criteria.
Progress toward common goals	Measuring progress toward goals for all partners is critical. Examples of measurement metrics for high performance homes and how they relate to different partners can be found in Appendix F.	Measurement and tracking of partner performance and high performance metrics can yield data on successes and opportunities for improvement. The results can also indicate when the company might be ready to evaluate moving to the next level of energy efficiency. See Appendix F for suggested metrics that can be tracked at various stages in the high performance strategy implementation process.

Stage or Factor	Importance	High Performance Strategy Issue
Effective problem-solving process	One key rationale for partnering is to identify issues that cause waste in the entire process. The team must establish a fair, realistic process for identifying and solving problems, both individually and as a team. Quality tools such as brainstorming, mind mapping/relationship diagrams, root-cause analyses using fishbone diagrams, Pareto charts, and flowcharts as discussed in Tague (2005) and Revelle (2004) can be helpful in establishing root causes.	High performance strategies can create seemingly odd interactions, as shown in Figure 3. Having a robust team problem-solving process that includes root-cause and building-science-based analyses can help troubleshoot existing customer satisfaction issues and prevent potential unintended consequences from adopting a high performance strategy. Risks for measures and strategies can be discussed proactively to avoid potential problems.
Long-term commitment	Partnering for sustained success requires long-term commitment from all partners. This does not preclude periodic revisiting of costs and value, but lowest price bidding sets up an adversarial relationship that cannot be reconciled in a partnering arrangement.	Continuity of team members can support accelerated achievement of long-term high performance goals and can enable faster incremental and large-scale changes to strategy as market conditions change (e.g., new energy codes, changes in above-code program standards).
Continuous improvement	All parties must be aligned to continually improve toward the common goals of the partnership. This includes recognizing that the level of energy performance achieved today will continually need to be examined and that new opportunities to adopt new systems and technologies will need to be evaluated in a practical and systematic fashion.	Once the team fully understands the overall performance goals, new solutions can be collaboratively developed to improve performance and reduce costs.

Stage or Factor	Importance	High Performance Strategy Issue
Positive experience	Partnering must have a positive outcome for all parties. This should occur at both a business level and a personal level. All parties should see the opportunity for business improvement through the partnering process and should experience improved execution on all projects.	If all partners are not winning, the high performance home strategy ultimately will not succeed.

4 Conclusion

The critical success factors for partnering include the following:

- Support from top management
- Mutual trust
- Effective and open communication
- Effective coordination around common goals
- Team building
- Appropriate use of an outside facilitator
- A partnership charter or agreement
- Adequate resources
- Progress toward common goals
- An effective problem-solving process
- Long-term commitment
- Continuous improvement
- A positive experience for all involved.

A commitment to partnering by a building company choosing to deliver high performance homes increases the likelihood for company success. The consistent delivery of high performance homes requires a high degree of coordination because, to perform properly, meet customer expectations, and minimize risks for the builder, these homes must have significant interdependencies among various systems. Responsibility for the key performance attributes of high performance homes is shared across the project team, and a partnering approach to relationships with trades, vendors, suppliers, and consultants enables this sharing through a cooperative environment built on mutual trust and common interests.

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Appendix A: Operational Processes and Activities

Table 3 illustrates the major phases of a generic home-building company’s operations, along with the key work activities for each phase. Note that not every builder undertakes the same set of activities within each phase or in the order shown. This table is a working tool that can be adapted specifically for each home-building company. It gives an overview of each major phase of the process, the work activities in each, some best practices for achieving high performance homes, the lead and support team players, and possible business metrics for measuring success.

Table 3. Major Phases and Key Work Activities in a Generic Home Builder’s Operations

Planning and Development						
		1		2		3
		Company Analysis		Market/Consumer Research		Company Vision/ Program Definition
High Performance Best Practices		Assess Current Business Situation		Evaluate Market/Conduct Regional Study		Define Short- and Long-term Vision for Company
		Benchmark Company Against Industry		Analyze Competition		Define Goals, Company Culture, Markets, and Customers Served
		Investigate Home Performance Certification Programs		Survey Customer Values		Describe How High Performance Fits with Vision and Goals
		Test Current Homes’ Performance		Analyze Current Product Offering		Set Energy Efficiency/ High Performance/ Green Strategies and Criteria (“Performance Criteria”)
	Functional Area	Lead	Support	Lead	Support	Lead
	Leadership	X			x	X
	Marketing		x	X		x
	Land Acquisition / Development		x		x	x
	Design		x		x	x
	Purchasing		x		x	x
	Sales		x		x	x
	Construction		x		x	x
	Customer Service		x		x	x
	External Partners		x		x	x
Business Metrics to Measure Impact of High Performance Program		Competitor/Industry Benchmarks		Consumer Perception of Company Relative to Quality, Environmental Responsibility, and Energy Efficiency		

Note: “X” indicates lead responsibility; “x” indicates support responsibility.

Planning and Development (continued)							
		4		5		6	
		Land Planning/ Acquisition/Development		Governmental Approvals		Financial Pro Forma	
High Performance Best Practices		Define/Plan for Solar Orientation Use Performance Criteria as a Part of Competitive Advantage for Land Acquisition		Position High Performance Housing as an Aspect of the Approvals Process		Assess Cost Impacts of High Performance Homes (Construction-related Costs and Organizational Cost of Change) Evaluate Cost Trade-offs (Construction and Operational)	
Functional Area		Lead	Support	Lead	Support	Lead	Support
Leadership			x		x	X	
Marketing							x
Land Acquisition / Development		X		X			x
Design			x		x		x
Purchasing							x
Sales							x
Construction			x		x		x
Customer Service							x
External Partners			x		x		x
Business Metrics to Measure Impact of High Performance Program		Change in Land Opportunities Because of High Performance Commitment		Speed of Land Entitlement		Key Financial Performance Indicators	

Planning and Development (continued)

7

**Land Planning/
Acquisition/Development**

High Performance Best Practices	Create Detailed Program Plan with Specific Guidelines, Timeline, Criteria, and Best Practices Develop Corporate Roll-out Strategy and Communication Mechanisms Assemble Trade/Expert Council Plan Departmental/Team Incentives Define Implementation Approach with Internal and External Team Develop High Performance Home Customer Care Process	
Functional Area	Lead	Support
Leadership	X	
Marketing		x
Land Acquisition / Development		x
Design		x
Purchasing		x
Sales		x
Construction		x
Customer Service		x
External Partners		x
Business Metrics to Measure Impact of High Performance Program	360° Assessments, Trade Council Feedback	

Product Design and Purchasing							
		1		2		3	
		Market/Consumer Research		Initial Design		Optimum Value Engineering	
High Performance Best Practices	Survey Consumers Asking about High Performance Features		Hold Team Integration Sessions		Evaluate Designs for Constructability, Cost Trade-offs, and Trade Input		
	Assess Local or Regional Green Building or Energy Efficiency Initiatives Driving Consumer Awareness		Integrate Performance Criteria		Look for Improving Quality of Product at Same Costs		
				Hold Systems Design Integration/Team Sessions		Conduct Energy Modeling Analysis	
				Ensure HVAC Design Integration			
Functional Area		Lead	Support	Lead	Support	Lead	Support
Leadership							
Marketing		X			x		
Land Acquisition / Development							
Design			x	X			x
Purchasing			x		x	X	x
Sales			x		x		
Construction			x		x	X	
Customer Service			x		x		x
External Partners			x		x		x
Business Metrics to Measure Impact of High Performance Program		Customer Value of High Performance Housing in Marketplace		Cost of Design Process Five-year Retained Earnings		Cost of Design Process Five-year Retained Earnings	
		Comparison of Selling Price for High Performance Features and Other Amenities Against Others in Same Market					
		Sales Volume of Competition Against Their Energy Efficiency Package					

Product Design and Purchasing (continued)

4 5 6

Budgeting/Development Final Design Specification

High Performance Best Practices	Ensure Trades Understand and Are Pricing for Cost Trade-offs, Warranty Reductions, and Quality Initiatives		Ensure Documentation Includes Enough Detail to Adequately Describe Construction Sequencing, Proper Assembly, and Other Aspects Needed for Trades and Field Supervisors to Achieve Performance Criteria Coordinate with Construction on Specifications and Purchasing on Scopes of Work Hold Code Review with Permitting Officials		Select Products to Achieve Cost and Performance Criteria Accept Product Substitutions Only If They Meet Performance Criteria		
	Functional Area	Lead	Support	Lead	Support	Lead	Support
	Leadership						
	Marketing		x				x
Land Acquisition / Development							
	Design		x	X			x
	Purchasing	X			x		x
	Sales						
	Construction		x		x	X	
	Customer Service		x		x		x
	External Partners		x		x		x
Business Metrics to Measure Impact of High Performance Program	Trade Profitability Rework and Warranty		Rework and Warranty Job Cost Variance Trade Feedback Cycle Time		Rework and Warranty Job Cost Variance Trade Feedback		

Product Design and Purchasing (continued)

		7		8	
		Budgeting/Development		Final Design	
High Performance Best Practices		Ensure Scopes Clearly Describe (Words/Pictures) the Performance Criteria and How They Are Expected to Be Implemented by Trades Describe Interaction of Trades with Respect to Performance Criteria Define Inspection Protocols/ Measurement		Verify Bids Meet Performance Criteria Contract for Transitional Pricing – Taking into Account the Cost of Change for the Trades and Anticipated Benefits from Implementing High Performance Approach Confirm with Construction That a Transfer of Information Process from Construction to Field and from Subcontractor Pricing to Field Implementation Is in Place	
	Functional Area	Lead	Support	Lead	Support
	Leadership				
	Marketing		x		
Land Acquisition / Development					
	Design		x		
	Purchasing	x		x	
	Sales				
	Construction	x			x
	Customer Service		x		x
	External Partners		x		x
Business Metrics to Measure Impact of High Performance Program		Rework and Warranty Job Cost Variance Trade Feedback Cycle Time		Rework and Warranty Job Cost Variance Trade Feedback	

Marketing and Home Sales							
		1		2		3	
		Market/Consumer Research		Marketing Plan/ Positioning		Promotional Campaign	
High Performance Best Practices		Evaluate How Performance Criteria Compare to Others in the Market Learn Buyer Response to Messaging Relative to Performance Criteria Compare Messaging Against Other Local, Regional, and National Builders		Define How Homes Meet Consumer Needs and Desires Relative to Performance Criteria Develop Marketing Message Relative to Performance Criteria		Integrate High Performance Messaging into Promotional Campaign	
Functional Area		Lead	Support	Lead	Support	Lead	Support
Leadership					x		x
Marketing		x		x		x	
Land Acquisition / Development							
Design			x				
Purchasing					x		x
Sales							x
Construction			x		x		x
Customer Service							
External Partners			x		x		x
Business Metrics to Measure Impact of High Performance Program		Technical and Marketing Evaluation Comparing to Others in Market and Industry Leaders Consumer Surveys		Public Perception Referrals Rate		Sales Traffic Mystery Shopper	

Marketing and Home Sales (continued)

4 5 6

Options and Upgrades Model Homes Sales Team Formation

High Performance Best Practices	Determine If a Further Upgrade Package from High Performance Platform Is Appropriate, Working with Construction and Purchasing		Design Model Homes and Associated Marketing to Tell Story of High Performance Approach (e.g., Cutaways, Silent Salesmen, Interactive Displays)		Focus Training on High Performance Aspects	
Functional Area	Lead	Support	Lead	Support	Support	Lead
Leadership						
Marketing	X		X	X		X
Land Acquisition / Development						
Design		x			x	
Purchasing		x			x	
Sales		x			x	
Construction		x			x	
Customer Service		x			x	
External Partners		x			x	
Business Metrics to Measure Impact of High Performance Program	Options and Upgrade Profitability		Traffic to Closing Ratios		Mystery Shopper	

Marketing and Home Sales (continued)

7 8 9

Realtor Program/ Relations **Sales/Design Center** **Customer Sales/ Financing**

High Performance Best Practices	Train Realtors on High Performance Homes and Product Differentiation		Create Sales Center Displays of High Performance Home Aspects Create Design Center Displays of High Performance Home Aspects		Negotiate Better Financing Options for High Performance Homes with Preferred Lender	
Functional Area	Lead	Support	Lead	Support	Lead	Support
Leadership						
Marketing		x		x		x
Land Acquisition / Development						
Design				x		
Purchasing						
Sales	x		x		x	
Construction				x		
Customer Service						
External Partners						x
Business Metrics to Measure Impact of High Performance Program	Realtor Leads Ratios				Percentage of Buyers Closing Using Preferred Financing	

Marketing and Home Sales (continued)

10

Customer Education/ Communications

High Performance Best Practices	Hold Monthly or Bimonthly Prospect and Contracted Buyer Sales Dinner with High Performance Home Presentation Reinforce High Performance Features During All Customer Contact Touch Points High Performance Home Orientation in Sales/Design Center	
--	--	--

Functional Area	Lead	Support
Leadership		
Marketing		x
Land Acquisition / Development		
Design		
Purchasing		
Sales	x	
Construction		
Customer Service		
External Partners		

Business Metrics to Measure Impact of High Performance Program	Realtor Leads Ratios	
---	----------------------	--

Home Construction							
		1		2		3	
		Permits		Scheduling		Contractor Relations	
High Performance Best Practices		Provide Any Code-related Documentation Pertaining to High Performance Approach		Ensure Transfer of Information from Design/ Purchasing to Field		Train Trades on High Performance Systems Verify Trade Skill; Evaluate If New/Additional Trades Are Needed Share Feedback with Purchasing on Trade Performance	
Functional Area		Lead	Support	Lead	Support	Lead	Support
Leadership							
Marketing							
Land Acquisition / Development							
Design							
Purchasing					x		x
Sales							
Construction		x		x		x	
Customer Service							
External Partners			x		x		x
Business Metrics to Measure Impact of High Performance Program		Speed of Permitting		Cycle Time		Trade Rework Duration of Trade Relationships	

Home Construction (continued)							
		4		5		6	
		Home Construction		Inspections		Customer Communications	
High Performance Best Practices		Support on Building Science Areas Ensure Consistency (Quality Assurance/Quality Control)		Monitor/Verify Built Performance Implement/Capture Measurement Data		Train Customer Service on New High Performance Program	
Functional Area		Lead	Support	Lead	Support	Lead	Support
	Leadership						
	Marketing						
Land Acquisition / Development							
	Design						
	Purchasing		x				
	Sales				x	X	
	Construction	X		X			x
	Customer Service				x		x
	External Partners		x		x		
Business Metrics to Measure Impact of High Performance Program		Trade Rework Cycle Time Cost Variance		Building Performance Measurements Third-Party Verification			

Home Construction (continued)

7

Closing/Home Hand-over

High Performance Best Practices	Educate Customers on High Performance Home Features	
Functional Area	Lead	Support
Leadership		
Marketing		
Land Acquisition / Development		
Design		
Purchasing		
Sales	X	
Construction		x
Customer Service		x
External Partners		x
Business Metrics to Measure Impact of High Performance Program	Customer Survey Zero Defect Closing	

		Customer Care					
		1		2		3	
		Customer Relations/ Communications		Service Requests/ Resolution		Customer Satisfaction Surveys	
High Performance Best Practices		Reinforce High Performance During Entire Home Customer Care Process		Track Service Jobs Using High Performance Metrics and Building Science for Root-Cause Analysis		Ensure Survey Mechanisms Evaluate High Performance Aspects of Customer Satisfaction	
Functional Area		Lead	Support	Lead	Support	Lead	Support
Leadership							
Marketing			x				
Land Acquisition / Development							
Design							
Purchasing							
Sales			x		x		
Construction			x		x		
Customer Service		x		x		x	
External Partners			x		x		
Business Metrics to Measure Impact of High Performance Program				Building Science-related Service Calls Building Science-based Root-Cause Analysis		Short-term Customer Satisfaction Long-term Customer Satisfaction	

Customer Care (continued)

4 5

First-year Warranty Ongoing Warranty

High Performance Best Practices	Implement High Performance Aspects of Home Customer Care Process Track Warranty Jobs and Root-Cause Analysis		Track Warranty Items Using High Performance Metrics and Building Science for Root-Cause Analysis	
Functional Area	Lead	Support	Lead	Support
Leadership				
Marketing				
Land Acquisition / Development				
Design				
Purchasing		x		x
Sales				
Construction		x	X	
Customer Service	X			x
External Partners		x		x
Business Metrics to Measure Impact of High Performance Program	Building Science-related Warranty Jobs		Building Science-related Warranty Jobs	

Appendix B: High Performance Strategy Resources

As a building company moves toward high performance housing, defining exactly what “high performance” means is important. Doing so will improve internal communications and foster a common understanding; it will also enable every employee in the company to communicate the message to customers, trades, and others on the outside. Creating an overarching theme might be useful (e.g., “We build safe, durable houses that are 30% or more energy efficient than code with guaranteed comfort for our customer.”). Such messaging, though, must be substantiated by clearly defined metrics associated with the actual performance of the houses. In addition, it must be used by all departments.

A good set of company standards will document the climate-related issues being addressed by the thermal enclosure and mechanical systems, including the following:

- Rainfall and wind–water management
- Heating and cooling degree days
- Humidity profile
- Vapor control/enclosure drying strategy.

The standards also should explicitly state the interrelationships and strategies the builder is implementing related to the high-level systems. For example, the standards should describe in a narrative format how the building enclosure is to control heat, air, and moisture; how the mechanical systems are to be integrated; and the overall minimum levels of performance for the entire house using the HERS Index. The standard can also document why the company has taken this approach. Reasons include past failures, calculated future risk avoidance, or a response to customer input (past issues or stated needs). This set of standards can be integrated in the checklists for the product design and purchasing functions to help enable a quick review of critical factors throughout the various stages in the design process (schematic, design development, and construction drawings). It can also be integrated as a part of the development of the scopes of work, step-by-step procedures, and other construction documentation.

For standards for high performance homes, visit the following online sources:

- Builders Challenge:
http://www1.eere.energy.gov/buildings/challenge/pdfs/bcqc_version_1_3_060408.pdf
- Energy & Environmental Building Alliance Criteria:
http://www.eeba.org/bookstore/cat-Builders_Guides-4.aspx
- ENERGY STAR Homes:
http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_2011_comments
- Environments for Living:
<http://www.environmentsforliving.com>

- International Green Construction Code:
<http://www.iccsafe.org/cs/igcc/pages/default.aspx>
- ICC-700-2008 National Green Building Standard:
<http://shop.iccsafe.org/national-green-building-standard-icc-700-2008.html>
- LEED for Homes:
<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2135#2008>
- Local and regional green building programs:
<http://www.pathnet.org/sp.asp?id=20978>

Appendix C: Company Charter Example

<Company Name> Team Charter for: Partner Relationship Building Team

Team Mission/Vision
<p>To develop and establish a dynamic team environment between <company name> and its <trade, supplier, design, testing, and inspection> partners. This environment will focus on pride in accomplishments by valuing individual talents and contributions. The team will focus on earning the respect and support of each partner in addition to encouraging all <company> employees to share and participate in developing and growing partner relationships. The mutual goals of these relationships are to build and deliver high performance homes, gain improvement in operating efficiencies, and develop continuous quality systems.</p>
Team’s Responsibility
<ol style="list-style-type: none"> 1. Establish and maintain our partners’ understanding of our energy and building performance standards and goals. 2. Create and maintain integrated strategies for partner input on design, products, methods, systems, and strategies to achieve our energy and building performance standards and goals. 3. Empower the trade partners to find satisfaction by excelling in their crafts. 4. Establish camaraderie and strengthen the awareness of the interconnected responsibility shared by all of our partners. 5. Develop and maintain trust between the partners and <company>. 6. Put ethics before profits. 7. Review and improve our production systems and work with our partners to improve efficiencies and productivity while creating a defect-free product and meeting our energy and building performance standards and goals. 8. Educate our trade partners on the concept that they build one home at a time for one customer a time to achieve unparalleled quality. 9. Educate our trade partners that it is everyone’s responsibility to exceed customer expectations and to delight our customers.

Team Performance Outcomes/Measures/Time Frame

- Conduct regularly scheduled <e.g., monthly> meetings with other partners, and recognize the successes of the partners.
- Invite the partners to participate in pre-walk-through inspections.
- Identify and follow up on all opportunities for improvement generated from each meeting with resolutions.
- Receive feedback from our trade partners on how <company> and the partners can achieve customer satisfaction together.
- Partners enforce the use and accuracy of each other’s site readiness survey, hot-spot checklist, and scope of work.
- Create benchmark energy and building performance metrics per house. Maintain or improve key metrics on a quarterly basis.
- Develop benchmarks for customer satisfaction and maintain or improve key metrics on a quarterly basis.
- Share building and energy performance and customer satisfaction data with partners. Work with partners to identify areas for improvement, and support change to implement improvement.
- Conduct a partner survey of <company> every <12> months to measure the partner satisfaction of <company>.

The team’s beginning date:		
Team Sponsor:		
Review Group:		
The team’s outcomes will be completed by:		

Team Customers and Expectations/Needs

<i>Internal <company> Customer</i>	<i>Customer Expectations/Needs from Our Team . . .</i>
Leadership Team	Collect data and recommendations. Keep communication open.
Purchasing	Attend regularly scheduled partner meetings. Gather input from the partners on ways to reduce annual cost increases and improve efficiencies.
Design Estimating	Feedback on all plans for accuracy and level of information Attend regularly scheduled partner meetings.

Construction	<p>Manage regularly scheduled partner meetings.</p> <p>Compile and distribute monthly energy and building performance metrics reports to the partners.</p> <p>Guide the partners on the pre-walk-through process so the trades will improve their processes and reduce defects.</p> <p>Conduct annual scope-of-work reviews with each partner.</p>
Customer Service	<p>Actions are taken on monthly 30-day and 11-month defect reports.</p>
<i>External Customer</i>	<i>Customer Expectations/Needs from Our Team . . .</i>
Partners	<p>Solicit monthly feedback on opportunities for improvement.</p> <p>Correct scopes of work, construction documents, and site readiness and hot-spot checklists.</p> <p>Collect monthly feedback on improvement suggestions, energy and building performance metrics reports, and customer satisfaction.</p> <p>Design trade development programs to align with energy and building performance criteria.</p>
Customer (Home buyer)	<p>Enjoy a seamless experience whether in contact with <company> employees or our partners.</p>
Team Leadership/Membership	
Leader	
Members Required	

Charter Approval			
Charter Approved on:		Approved by:	

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

CHARTER FOR <Describe the group for which this charter is relevant>	
TEAM RESPONSIBILITY <Describe the high-level goals/activities for which this team will be responsible >	
OUTCOMES AND MEASURES <Describe desired outcomes from the team and how the outcomes will be measured against the goals>	
START DATE	
SPONSOR	<Generally for partnering, the CEO or president of the building company would be the person authorizing the existence of this group>
COMPLETION DATE	<In general, these are ongoing and would not have a specific completion date>
EXPECTATIONS/ NEEDS	
Customer <What internal and external customers are the recipients of the actions by the team members?>	Expectations/Needs from Our Team . . .

TEAM MEMBERS	
Leader <Name, Company, Signature, Date>	<The leader can be anyone in the partnering team. The leader does not need to be the sponsor or an employee of the building company. Leadership can rotate among members over time.>
Members <Name, Company>	
APPROVAL	
Approved on: <date>	By: <The sponsor should approve the charter to demonstrate top management support>

Name <Team member name and signature>

Date

Name <Team member name and signature>

Date

Name <Team member name and signature>

Date

Appendix D: Feedback Systems and Best Practices

Feedback can be gathered in any number of ways and at many stages. The following is a list of suggested points where feedback can be collected and the type of mechanism that might be useful.

- **Activity:** Feedback can be given before, during, and at the end of any partner's activity. This can take the form of job ready, job in progress, and job complete checklists. Hot-spot checklists are also a way to give feedback.
- **System:** This type of feedback reveals information on the integrated function of a system that may or may not be the work of several trades. The airtightness of the house is a system that can be measured, and, through analysis, individual trade work can be identified to make a house tighter. Similarly, the overall airtightness of a heating and cooling system is within the purview of the HVAC trade and can be measured after rough-in to determine whether it meets the performance criteria. Typically, this feedback is based on performance testing as opposed to a visual observation.
- **House:** Whole-house feedback is generally a calculation of the integrated function of the house or the certification of the building under an energy efficiency or green program. Where such programs are pass/fail, generating and tracking scalar metrics (such as the HERS Index or the number of points to achieve a certification by program category) is valuable. This approach identifies positive or negative trends or weighs trade-offs over time as new systems or technologies come to market. Customer satisfaction is another form of house-based feedback. This category represents the integrated sum of all of the customer's experiences through the purchase, construction, and first year of ownership of a house.
- **Community:** Data aggregated by community can be used to evaluate the performance of site supervision at the builder level. If trades are geographically distinct, certain crews or companies work on only specific communities. In this way, trade performance can also be evaluated.
- **Partner:** Partners can give feedback to a company through a survey. Generally, such a survey is implemented by a third party to allow for anonymous responses, to help build trust, and to encourage honest feedback. The building company should also give ongoing feedback to trades based on activity, system, or house level information that is collected and annual feedback on overall performance.
- **Best practices for feedback:** Measure, analyze, and act. If feedback is given but is never reviewed, analyzed, and acted on, those supplying the feedback will not take it seriously, rendering the process useless. It is only through consistent collection, analysis, and action that the feedback process holds value.
- **Checklists:** Only key activities that are vital to success should be included on checklists, and over time, checklists should not focus on the "100% correct" items but only on those items that have been identified as hot spots. For example, if testing has demonstrated consistent compliance with the company airtightness standard, specific

items for each trade related to air sealing might not be necessary. Having detailed checklists is useful as a training tool when bringing new employees on board or when specific programmatic requirements must be met.

- Surveys: Anonymity is valuable when conducting surveys because the purpose is to get honest feedback. Partners can be wary of such honesty if the feedback is negative and they fear retribution.

Appendix E: Partnership Charter Example

Team Charter for: Partnering

Team Mission/Vision
<p>To develop and establish a dynamic team environment by creating a partnership connecting <company> and <trades, suppliers, designers, and testers and inspectors>. This environment will focus on pride in accomplishments by valuing individual talents and contributions. The team will focus on earning mutual trust, respect, and support, and will encourage each other to share as well as participate in developing and growing relationships. The mutual goals of these relationships are to build and deliver high performance homes, gain improvement in operating efficiencies, and develop continuous quality systems.</p>
Team’s Responsibility
<ol style="list-style-type: none"> 1. Understand and achieve <company’s> energy and building performance standards and goals in every house built or project undertaken. 2. Provide input on design, products, methods, systems, and strategies to achieve <company’s> energy and building performance standards and goals. 3. Empower all partners to find satisfaction by excelling in their crafts. 4. Establish camaraderie and strengthen the awareness of the interconnected responsibility shared by all partners. 5. Put ethics before profits. 6. Develop and maintain mutual trust and respect. 7. Review production systems and work together to improve efficiencies and productivity while creating a defect-free product and meeting our energy and building performance standards and goals. 8. Recognize that we all build one home at a time for one customer a time to achieve unparalleled quality. 9. Perform our work in recognition that it is everyone’s responsibility to exceed customer expectations and to delight our customers.

Team Performance Outcomes/Measures/Time Frame

- Participate in regularly scheduled <e.g., monthly> meetings with other partners and recognize the successes of the partners.
- Participate in pre-walk-through inspections as appropriate.
- Identify opportunities for improvement, work together to develop solutions, and follow up on all suggestions with resolutions.
- Provide and receive feedback on how we work together to achieve energy and building performance goals, operational efficiencies, and customer satisfaction.
- Use and verify the accuracy of our own and each other’s site readiness survey, hot-spot checklist, and scope of work.
- Maintain or improve key energy and building performance metrics per house on a quarterly basis.
- Maintain or improve key customer satisfaction and operational efficiency metrics on a quarterly basis.
- Use building and energy performance and customer satisfaction data to identify areas for improvement and support change to implement improvement.
- Respond to a partner survey of <company> every <12> months to measure the partner satisfaction of <company>.

The team’s beginning date:		
Team Sponsor:		
Review Group:		
The team’s outcomes will be completed by:		

Team Customers and Expectations/Needs

<i>Partners</i>	<i>Customer Expectations/Needs from Our Team . . .</i>
Planning and Development	Collect data and recommendations. Keep communication open.
Product Design and Purchasing	Participate in regularly scheduled partner meetings. Use input from the partners on ways to reduce annual cost

	<p>increases and improve efficiencies.</p> <p>Create accurate plans with the appropriate level of information.</p> <p>Give timely feedback on all redline items.</p>
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Marketing and Sales	Supply correct product and system information on features and benefits to enable appropriate communication to the customer.
Home Construction	<p>Manage regularly scheduled partner meetings.</p> <p>Collect and distribute monthly energy and building performance metrics and defect reports to the partners.</p> <p>Guide the partners on the pre-walk-through process so the trades will improve their processes and reduce defects.</p> <p>Conduct annual scope of work reviews with each partner.</p>
Customer Care	Provide 30-day and 11-month defect reports.
Trades	<p>Participate in regularly scheduled meetings and provide opportunities for improvements.</p> <p>Perform according to the scope of work.</p> <p>Identify areas of improvement to <company> in the scope of work.</p> <p>Use the site readiness and hot-spot checklists to verify work by others is complete and that our work is complete for the next partner.</p> <p>Self-inspect work to ensure compliance with scope of work and the building and energy performance standards.</p> <p>Build each home as if it were your own.</p>
Home Energy Rater	<p>Provide input to the design team on overall energy performance during the design phase.</p> <p>Verify that houses are meeting overall energy and building performance standards using visual inspections and performance testing.</p> <p>Give partners key metrics on energy and building performance to support the team and identify opportunities for improvement.</p>
Designers	Use input from other partners and the company energy and building performance standards to develop designs that meet customer requirements.
<i>External Customer</i>	<i>Customer Expectations/Needs from Our Team . . .</i>
Customers	Give feedback on all positive and negative experiences.

Team Leadership/Membership	
Leader	
Members required	

Charter Approval			
Charter Approved on:		Approved by:	

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Team Member

Date

Appendix F: High Performance Metrics

Using Performance Measures and Feedback

Many builders rely on their rater to administer energy efficiency certification (e.g., ENERGY STAR, Environments for Living, and green certifications); however, few builders actually break down, report, and analyze the data that are collected for certifications. A typical HERS rating or performance path includes insulation and other thermal enclosure component inspections; building airtightness measurements; HVAC distribution system airtightness testing; and HVAC system commissioning. Some programs include other building performance and durability verifications, such as the proper installation of water management features and ventilation system performance. In many cases, this information is given to the builder in a pass/fail format. These data, however, are incredibly rich and, if analyzed, can yield trends and opportunities for improvement. In addition, the information can give the organization the means to determine when to pursue the next level of performance.

These data can also be used for root-cause analyses when there are long-term warranty requests. Many of these inspections or performance tests result in information not only on the energy efficiency of a house but also on long-term durability and comfort issues. HVAC systems with airflows that barely pass the inspections can lead to occupant discomfort more readily than those that pass the criteria by a wide margin. Houses that require rework to pass may have a higher likelihood of long-term customer complaints. This information can help identify needs for training and enhancing trade skills or transferring best practices from one trade to another within a particular area (e.g., HVAC installation).

Some of these performance measurements can be leading indicators of other issues surrounding customer satisfaction, such as the following:

- Comfort
- The impact of airtightness and duct performance on customer comfort (comfort and utility bills)
- The impact of insulation quality and levels on customer satisfaction (comfort and utility bills)
- HVAC basic measurements, which confirm airflow and system performance (comfort and utility bills)
- Building durability (long-term repair risk)
- Airtightness verification to determine the movement of warm moist air, which can cause mold, rot, or decay, through the building enclosure
- Water intrusion testing to verify window/door installation (e.g., ASTM E110)
- Indoor air quality
- Fresh air ventilation airflows.

When implementing a high performance strategy, collecting and analyzing various key metrics related to achieving the strategy can be helpful. A number of possible metrics can be tracked, all of which can be used for different purposes. Different metrics are used at different times. They can be grouped by the phase of integration of the high performance strategy within the organization: adoption, sustained implementation, and continuous improvement:

- **Adoption:** This phase is the initial transition to a comprehensive systems approach (e.g., Builders Challenge, ENERGY STAR version 3, Environments for Living). This period may last from three months to more than one year, depending on the volume of production, sophistication of trades, level of internal and external team training, feedback mechanisms, resources and materials available to support the transition, and the company culture.
- **Sustained implementation:** This time period follows adoption, where the desired strategy is being executed consistently.
- **Continuous improvement:** In this phase, opportunities for improvement are identified. Teams are formed to capitalize on these opportunities and to develop a plan to implement solutions. This plan is the basis for the activities to take place in the adoption phase.

Different departments might be in different phases at the same time. For example, the company as a whole might be at the sustained implementation level of executing a high performance home strategy with existing plan types that have not been developed using an integrated design process. At the same time, the design group could be in the adoption phase as they create and refine a new set of plans using the integrated design process for the first time. Simultaneously, the sales staff can be in the improvement phase, working on the next generation of strategies to market and sell the high performance features of the builder's product. Table 4 shows how often data collection could occur for metrics based on the phase of implementation.

Table 4. Recommended Frequency of Data Collection for Metrics Based on Phase of Implementation

Metric	Phase		
	Adoption	Sustained Implementation	Continuous Improvement
HERS Index	100%	15%	100%
Building airtightness	100%	15%	100%
HVAC system tightness	100%	15%	100%
Percentage of reinspections to pass thermal enclosure checklists	100%	NA	100%
Specific thermal enclosure checklist failures	100%	100% of units inspected	100%
Percentage of reinspections to pass rater HVAC checklists	100%	NA	100%
Specific HVAC checklist failures	100%	100% of units inspected	100%
Percentage of reinspections to pass rater water management checklists	100%	NA	100%
Specific water management checklist failures	100%	100% of units inspected	100%
Costs by department	100%	100%	100%
Cycle time	100%	100%	100%
Warranty items by high performance strategy area	100%	100% of units inspected	100%

Table 5 shows a list of and the importance of possible metrics that can be used in the adoption phase, and Table 6 shows possible metrics and their importance for the sustained implementation phase.

Table 5. Adoption Phase

Metric	Importance
HERS Index	This is an aggregate numeric indicator of whole-house energy efficiency that allows quick understanding of where homes are with respect to an energy efficiency goal.
Building airtightness	This is a specific measure of a key attribute that affects comfort and durability in a home—an attribute that is “invisible.”
HVAC system tightness	This is a specific measure of how much air is escaping from the HVAC system that was intended for delivery to a specific space.
Percentage of reinspections to pass thermal enclosure checklists	This checklist verifies that insulation systems have been installed properly and that other thermal enclosure components are being installed as required by ENERGY STAR. If reinspection is needed to pass this checklist, it indicates that the trades and site supervisors are not fully versed in the proper installation methods and strategies needed to build a high performance enclosure.
Thermal enclosure checklist failure items	Tracking the specific items that fail at the first inspection by the HERS rater will indicate improvement opportunities to undertake in the improvement phase.
HVAC checklist failure items	Tracking the specific items that fail at the first inspection by the HERS rater will indicate improvement opportunities to undertake in the improvement phase.
Percentage of reinspections to pass rater HVAC checklists	This checklist verifies that the HVAC trades have installed the HVAC system properly and that the HERS rater has verified key aspects. If the rater needs to reinspect to pass this checklist, it indicates that the HVAC trade and site supervisors are not fully versed in the proper installation methods and strategies needed to design and install a high performance HVAC system.
Percentage of reinspections to pass rater water management checklists	This checklist verifies that the water management system has been installed properly as verified by the HERS rater. If the rater needs to reinspect to pass this checklist, it indicates that the trades and site supervisors are not fully versed in the proper installation methods and strategies needed to achieve acceptable water management strategies for high performance homes.
HVAC checklist failure items	Tracking the specific items that fail at the first inspection by the HERS rater will indicate improvement opportunities to undertake in the improvement phase.

Metric	Importance
Costs by department	Implementing a high performance home strategy involves all aspects of the building company’s people, departments, outside trades, and suppliers. Ultimately, the decision to move to high performance homes should yield financial benefits or a competitive advantage to the company. Some costs might increase, but others should decrease. Cost increases should be expected for construction documentation, construction, and inspections. Cost decreases should be expected with the first-year warranty, long-term defect repairs, customer satisfaction, and positive referrals. Setting up cost-tracking systems early (if they do not already exist as part of the operational dashboard) can help evaluate the effectiveness of adopting a high performance approach and can supply ongoing data for making operational decisions.
Cycle time	During the adoption phase, cycle time will likely deviate as the trades are learning and consistently applying new systems and techniques. Additional inspection by the HERS rater could also add time to the schedule. These data can be used in the sustained implementation and continuous improvement phases to look for improvement opportunities.
Warranty items by high performance strategy area	A high performance strategy should reduce warranty items related to water intrusion and comfort. Tracking these items will verify that the high performance strategy is working and might lead to price renegotiations with key trades if their warranty work has decreased significantly and warranty work is part of their scope of work. These measures can also be correlated to customer satisfaction scores.

Table 6. Sustained Implementation Phase

Metric	Importance
Warranty items by high performance strategy area	If warranty work has decreased significantly, the possibility for price renegotiations with key partners might exist if warranty work is part of each partner’s scope of work.
Water management checklist failure items	Once in sustained implementation, these failures will likely result from a change in trades or new crews who are unfamiliar with the specific construction methods needed to achieve the high performance strategy.
Thermal enclosure checklist failure items	Once in sustained implementation, these failures will likely result from a change in trades or new crews who are unfamiliar with the specific construction methods needed to achieve the high performance strategy.
HVAC checklist failure items	Once in sustained implementation, these failures will likely result from a change in trades or new crews who are unfamiliar with the specific construction methods needed to achieve the high performance strategy.

Metric	Importance
Costs by department	Evaluating the metrics that were tracked from adoption will reveal opportunities for improvement. Are there system trade-offs that should be more aggressively pursued? Are the cost reductions in specific areas being achieved? The full impact of some issues could take several years to become apparent (e.g., the elimination of historical systemic water management failures that might appear only three to five years after closing).
Cycle time	Analyzing the days deviating from the schedule will indicate whether systemic issues are arising with specific high performance systems implementation. These areas could be the focus for additional training or could necessitate evaluating staffing levels with partners.

Metrics for the Improvement Phase

The improvement phase is very similar to the adoption phase. In the improvement phase, however, a new set of performance standards is being implemented. As with any change, these new standards must be monitored for compliance, as well as to identify failure points and refinement to ensure success.

Appendix G: Scheduling Implications

One aspect of profitable building is the ability to consistently meet predefined schedules for trades. The intent is to eliminate dry runs, rework, and delays caused by incomplete items at key inspection points and project handoff from trade to trade. During the implementation of a high performance home strategy, a mature partnering relationship can help to identify potential scheduling impacts, summarized in Table 7, on new inspection and performance verification activities that take place during construction.

Table 7. Scheduling Impacts

Construction Stage or Performance Verification	Trades Affected	Inspector	Possible Delays
Foundation: Below-grade water management	Excavator/foundation installer	Building official, site supervisor, trades	Rework to achieve proper drainage, capillary breaks; possible building official concerns about full vapor retarder under slab and grade beams
Above-grade water management	Drainage plane/siding installer, window and door installer, roofer	Rater, building official, site supervisor, trades	Rework to address improperly installed drainage plane and flashing materials
Thermal bypass checklist	Framer, insulator, air sealing trade	Rater, building official, site supervisor, trades	Rework of thermal bypass checklist items; stop-work order to resolve building official's concerns about insulation/vapor control strategies
Insulation and other thermal enclosure component inspection	Insulator, window and door supplier/installer, framer	HERS rater, building official, trades	Rework or stop-work order to achieve appropriate grade certification for insulation installation (RESNET Grade 1, 2, or 3) or to correct window/door specifications to achieve overall energy performance targets
Building airtightness	Insulator, air sealing trade, drywall installer, painter	Rater, trades	Rework to meet maximum air leakage targets to comply with builder standards
Duct tightness and HVAC system performance	HVAC installer	Rater, trades	Rework of installation to meet overall performance targets (e.g., duct tightness, system airflow, refrigerant charge, and temperature rise)

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DOE/GO-102013-3593 • January 2013

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