

New Product Adoption in Housing

guide for manufacturers



U.S. Department of Housing and Urban Development
Office of Policy Development and Research



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New Product **Adoption** in Housing

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Prepared for
U.S. Department of Housing and Urban Development
Office of Policy Development and Research

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Overview

The residential home building industry is an important sector of the U.S. economy. Unfortunately, it has not shared the productivity gains experienced by other industries, in part due to a lack of innovation. Government studies and university research indicate that the structure of the housing industry is an impediment to the adoption of innovation. As used in this report, an innovation is a product that is perceived as new by the user.

To help counter this trend, the Partnership for Advancing Technology in Housing (PATH) has funded several studies to better understand the process of innovation in housing. PATH recognizes that innovation is important to the housing industry in making homes more affordable, durable, and energy efficient.

This guide is designed to assist manufacturers in transferring new innovations into the home building industry. Containing lessons learned through interviews, focus groups, and case studies, this guide takes an inside look at today's home building industry and provides tips for manufacturers looking to commercialize an innovation.

An Industry Overview

The home building industry represents a unique market opportunity for product manufacturers as the housing market represents one of the most significant market segments of the US economy. In 2006, the combination of private investment and consumption spending on housing represented 16% of GDP (see Table 1). In spite of the current downturn in the housing market, the long-term outlook for the housing industry is strong. There are interesting trends in consolidation that have the top 10 publicly traded builders taking an increasing large share of the market. However, the industry is still dominated by small and medium sized builders, who possess in-depth knowledge of their individual markets and a focus on small metro and rural areas. Materials, labor, and building practices differ according to geography; type of construction (multifamily, townhouse, or single-family); new construction or remodel; local building code; factory-built, modular, or site-built; production, semi-custom, or custom; and builder size. The National Association of Home Builders Economics Department made the following interesting

observations on trends in the current housing market¹:

- Although consolidation will continue for the biggest builders, the market share of the next tier of builders (No. 21 to 100) isn't growing.
- Small and medium volume builders will continue to dominate smaller metro and rural areas.
- In larger markets, smaller builders will concentrate on "niche markets."
- The overall market will continue to include a very large number of small companies.

Table 1
2006 – Housing Components in GDP (Billions of Dollars)

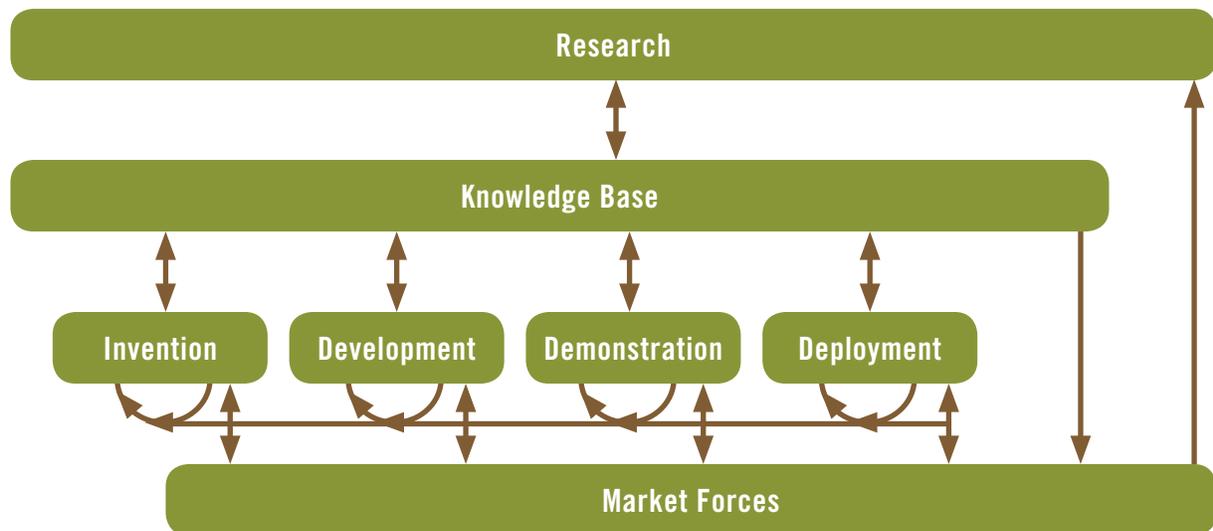
Gross Domestic Product	\$13,194.70
Gross Private Domestic Investment	2,209.20
Fixed Investment	2,162.50
Nonres Fixed Investment	1,397.70
Nonres Structures	405.10
Nonres Equipment & Software	992.60
Residential Investment	764.80
Share of GDP	5.80%
Share of Gross Private Domestic Investment	34.62%
Residential Structures	755.20
New	657.00
New Housing Units	476.40
Permanent Site	469.00
Single-family Structures	416.00
Multifamily Structures	53.00
Manufactured Homes	7.40
Improvements	178.50
Other	2.10
Broker's Commissions on Sale of Structures	101.50
Net Purchases of Used Structures	-3.40
Residential Equipment	9.60
Personal Consumption Expenditures	9,224.50
Durable Goods	1,048.90
Nondurable Goods	2,688.00
Services	5,487.60
Housing Services	1,381.30
Share of GDP	10.47%
Share of Personal Consumption Expenditures	14.97%
Owner-occupied Nonfarm – Imputed Space Rent	1,014.50
Tenant-occupied Nonfarm – Rent	277.00
Rental Value of Farm Dwellings	14.80
Other Housing Services	75.10
Residential Investment + Housing Services	2,146.10
Share of GDP	16.26%

¹ NAHB presentation at the 2007 International Builder Show.

THE INNOVATION PROCESS

The federal government has studied the reasons why housing is slow to adopt innovation. One such study, *Building Better Homes: Government Strategies for Promoting Innovation in Housing*², authored by the Rand Corporation, developed a new housing-specific model of innovation showing the complex process to commercialization or deployment (see Figure 1).

Figure 1
Model of the Innovation Process



This model is useful in that it indicates the repetitive nature of the innovation process with the need for multiple interactions and feedback. These characteristics clearly have resource implications in terms of both time and money, for bringing a new product to market. Be aware that commercializing a new product is rarely a straightforward process and that “home runs,” innovations expected to be profitable very quickly, are few and far between. Most successful innovations have been carefully thought through and nurtured throughout the process.

Although the commercialization process can be long and expensive, research has shown that money alone is not a good measure of an innovation’s likelihood of success.

“Hardworking R&D teams invest time and money in the wrong projects; manufacturing, marketing, and sales drop the ball on winning products and services, and senior executives and policymakers simply throw more money at research and development in the mistaken belief that it will make a difference.”³

Innovation is fundamental to a company’s competitive advantage, but it is a company’s process of innovation and commercialization, not the amount of money spent, that correlates with success. Collaboration across functional areas (research, manufacturing, marketing, sales, and service) is key, and the absence of collaboration creates risks of failure.

² Rand Corporation, *Building Better Homes: Government Strategies for Promoting Innovation in Housing*, 2003.

³ Booz Allen Hamilton, *Global Innovation 1000*, 2005.

Understanding Your Target Market

In the multifaceted home building market, assessing an innovation's chance of success can be a challenging task. Even a task as simple as identifying the target market, or end user, can be difficult. Options include manufacturers, home owners, contractors, builders, or architects – any one of whom may specify construction products depending on the individual application. Most innovations will enter the market through a specific sector within the home building industry, commonly referred to as a market niche. Identifying the specific target for your innovation's market entry is a key to success. Case studies of industry innovations have demonstrated that understanding and addressing the demands and concerns of the target customer early in the design phase are critical to timely and successful product design and development.

Whether the innovation has been developed in-house or you are licensing from a patent holder, defining your target market is critical. Before embarking on an invention/innovation purchase or proceeding to launch, do your homework. Market studies or focus groups composed of participants who will deal with your innovation can be an invaluable source of information. Key topics to consider include industry norms (what's used now?), price point (what does current technology cost, and at what price would the innovation be accepted?), constructability of the innovation (tools, time, learning curve), durability (shipping, construction, lifetime performance phases), coordinating with trades (e.g., a wall system affects electricians, plumbers, siding installers, insulators, and framers), and perceptions (regulatory/code officials, home owners, trades, home builders). Conducting a thorough market analysis may avoid costly mistakes or prolonged time to market that can result from not understanding how the innovation interfaces with all parties involved in the building process. The value of identifying and addressing customer feedback early in the design phase cannot be overemphasized. Note that it is a good idea to pursue innovation protection through a provisional patent application and non-disclosure agreements before revealing too much proprietary information through focus groups or other market research.

AVOIDING PITFALLS

Both large and small manufacturers often have trouble successfully commercializing an innovation in the housing market. Primary reasons innovations fail include:

- Attempting to transfer an innovation from commercial to residential construction without a clear understanding of the substantial market differences;
- Lack of compatibility of the innovation with the overall systems being used in home building construction;
- Inadequate skills within the labor force; and,
- Inadequate technical assistance during product introduction, leading to installation problems and frustration.

To be successful, developers need to receive a rate of return high enough to recoup the cost of investment quickly. Negative rates of return (losses) may be acceptable for a short period of time so as to gain a first mover advantage.

IDENTIFYING AND ASSESSING MARKET DRIVERS: CODES, PRODUCTIVITY, FUNCTIONALITY

Building codes and regulations constitute one of the most obvious market drivers. Many innovations come to market or gain market share because of changes in building codes. Examples include:

- Hurricane Resistant Glazing – Adopted by the codes for defined areas of the United States in the aftermath of Hurricanes Andrew and Hugo.
- House Wraps – Tyvek® and other house wraps existed before being mandated by the codes but gained substantial market share through code requirements on weather barriers.

- Ground Fault Circuit Interrupters – Adopted to prevent accidental electrocution.

The International Code Council (ICC) offers over a dozen codes that may apply to a jurisdiction depending on local adoption. The International Residential Code (IRC), applicable to detached one- and two-family dwellings and townhomes up to three stories in height, and the International Building Code (IBC), applicable to all other new construction, are the general codes pertinent to the residential building industry. Code approval is the first step toward market acceptance of an innovation, but the battle for regulatory approval doesn't always end there. For example, air admittance valves (AAV), an innovative plumbing system component that eliminate the need for a vent pipe and roof penetration, are approved within the 2003 IRC. However, these valves have historically faced opposition by local code officials, who often prohibit them due to lack of product familiarity.

If your innovation does not meet code approval in its current state, consider design refinements that will result in compliance, or propose changes to the relevant ICC Code. For breakthrough innovations, the ICC Evaluation Service provides a process by which manufacturers can submit testing data that will allow for the development of a technical report which becomes a public document. The ICC Evaluation reports then can be used by manufacturers as evidence that their product meets code and regulatory requirements. From start to finish, an evaluation report can take 18-24 months. Code changes can take equally long or longer time frames. Both processes can be time and resource intensive and may severely constrict an innovation's chance for success. The code requirements and processes need to be understood early on. As dull as they are to read, codes are living documents that are under constant revision and maintenance. By paying close attention to codes and other regulatory requirements you are less likely to have unexpected delays or resistance in a product launch.

Building codes define the minimum building practices and systems. Some products and systems installed in homes only meet these minimum standards. Thus, if your project exceeds code requirements, it must bring an enhanced value such as productivity improvements or added

functionality. Productivity improvements are those that decrease the cost of inputs or increase cost effectiveness through reduction in labor or time. Functionality improvements generally are those that increase livability, comfort, health, or durability. Recognizing where your product fits is key to market positioning. Some products may improve both productivity and functionality, such as the Lightning Switch® described below. This case study also highlights the importance of understanding building codes.

UNDERSTANDING BUILDING CODES

International Residential Code (IRC)

- Applicable to detached one- and two-family dwellings and town homes to three stories in height.
- Functions as a single source for all building and systems within its scope.

International Building Code (IBC)

- Applies to all commercial and residential buildings not covered by the IRC or International Existing Building Code.
- Commonly references other regulatory codes, such as the International Plumbing Code, the International Mechanical Code, and the International Energy Conservation Code.

Also, be aware that individual states may adopt and amend the I-Codes to satisfy state-specific standards for building that can arise from durability initiatives or energy efficiency goals. See www.iccsafe.org for more information.

Case Study: Meeting Multiple Market Drivers

TECHNOLOGY SUMMARY

The Lightning Switch® is a versatile technology that can be used on pretty much anything you want to turn on or off. Based on NASA space technology developed at the Langley Research Center in Hampton, Virginia, the patented Lightning Switch® combines the function of conventional wired switches with the flexibility and convenience of wireless remote controls. It holds tremendous potential for making retrofit projects much quicker, more cost effective, and less disruptive to the building occupants. In terms of new construction, the benefits include eliminating wiring, removing the shock hazard that a normal hard-wired switch poses, and providing great versatility in configuring 3-way and 4-way switch setups or any other configuration that the user could need.

The Lightning Switch® permanently controls lights and appliances without the installation of any new wires. For rewiring projects, labor savings alone (compared to conventional rewiring) can amount to \$200 or more per switch. Receivers can also be plugged into outlets, and the light fixture or other device is then plugged into the receiver. This allows the user to change switch configurations to their outlets without having to rewire.

CURRENT STAGE OF DEVELOPMENT

The technology has been commercialized and the product has new distributors. There continue to be code issues with the use of this product, which need to be resolved. This emphasizes the importance of paying attention to codes. For example, there have been issues as to whether a wireless switch satisfies the code requirement for a switched outlet or fixture in each room in a dwelling. Section 210.52 of the National Electric Code (NEC) requires 1 switchable outlet or fixture per room. Building inspectors are concerned that the wireless system might not be permanent. Therefore, rooms installed with wireless switches might not satisfy the requirement for switchable outlets or fixtures and result in a safety hazard. A key point in this issue is the definition of a "switch." NEC does not define a "switch" in a way that would exclude the Lightning Switch®. However, it has been interpreted that a "switch" basically means a traditional hard-wired switch – which is the position stated by some electrical inspectors. In every code, local inspectors have the final say.

PARTNERSHIPS

Lightning Switch® takes good advantage of partnership opportunities. It has a strong relationship with a manufacturing partner in Taiwan. They also use UPS Trade Direct to ship their products from the manufacturer in Taiwan to the distributor in the United States. Lightning Switch® hopes to achieve their goal of a 1-2 day shipping time to the distributor by using UPS Trade Direct and the UPS domestic delivery system. They also have identified target markets in Western Europe, South Africa, Argentina, Chile, and Uruguay. Lightning Switch® plans to use UPS Trade Direct to ship products to these target markets as well. This partnership with UPS will help them reach a wider international market, in addition to allowing them to use their manufacturer in Taiwan, while still maintaining a fast supply chain to their distributors.

Another possible group of partners is electronics manufacturers. Lightning Switch® is examining the possibility of installing receivers in products such as lighting fixtures or other electronics. This would allow consumers to buy products that are already set up to work with the system and require no further product installation. Lightning Switch® is also exploring partnerships to integrate their product with a variety of systems applications such as HVAC, plumbing, and security systems.

LESSONS LEARNED

There is a more marked benefit in commercial building and housing retrofits than in new residential buildings because the wireless systems reduce the need for an electrician. However, this may change if the company achieves a more ubiquitous integration into other products such as lighting fixtures and mechanical systems. Also, as mentioned above, there may be local code issues to overcome, but the versatility of the technology makes adapting to code much easier than a less flexible innovation.

CONCLUSION

Lightning Switch® is an award winning (winner of the 2006 International NOVA Award), innovative technology that changes the way we think about building renovation, electrical wiring methods, and wireless controls of electronic devices. It addresses both the key drivers of efficiency and functionality. The company has done its research in identifying markets. The product has been well received and the company is likely to find multiple additional applications in the future.

LOOK FOR MARKET OPPORTUNITIES

Understanding what is happening in the housing market can help you focus on key opportunities. For example, many industry experts believe that a market downturn is the best time to introduce a new product.

The best time to advance innovation is during a housing recession when builders are looking for something to make their product distinctive. When the housing market is booming, builders are likely to be resistant to innovations that might slow down their standardized processes. To be successful, innovations must be sensitive to market timing.

—PD&R Study, *Overcoming Barriers to Innovation in the Home Building Industry*, 2005

If your innovation includes environmental features, look at “Code-plus” programs as a strategy for marketing your innovation. These programs often focus on energy efficiency, durability, indoor air quality, or “green building” – the practice of installing environmentally responsible and sustainable building materials and products. Most current green building programs, such as LEED for Homes and NAHB’s Green Home Building Standard, award points to different products and systems based on their perceived environmental impact. At the heart of most green building programs is the EPA’s Energy Star qualification. Affordable innovations that assist builders in meeting these programs’ objectives stand to capitalize on one of today’s fastest growing segments of home building – the green building market. A recent survey has found that the primary reason home buyers would be motivated to purchase a green home is the knowledge of the health benefits associated with these homes, pointing to market demand for greener, healthier products.⁴

COMMUNICATING PRODUCT FEATURES

Give thought to how to quantify and communicate the lifecycle cost and benefit of your innovation. If energy prices continue to climb with increasing global demand and more restrictive environmental regulations, the door for home energy-conserving innovations will continue to widen. Gas, electric, and water utility rates and regulation may have a make-or-break effect on your innovation, so pay close attention to these as you look for market entry points. Though limited in duration, utility and government tax incentives and subsidies can sometimes provide sufficient opportunity to bring an innovation to market. Understanding and communicating how your innovation fits into this market are critical to selling the innovation.

THE COMMERCIALIZATION TIMELINE

One common mistake made by manufacturers is underestimating the time required to commercialize a new product. At a roundtable discussion held at the 2007 International Builders Show in Orlando, Florida, with various housing-industry-related manufacturers and innovators, discussants agreed that commercializing a new technology takes 5-6 years when everything goes as planned. Even with “home run” innovations (innovations expected to be profitable very quickly) the minimum time required to introduce a new technology to market is 3 years. Although these guidelines are fairly consistent rules of thumb, individual experiences can vary significantly based on the following:

- complexity of the product being commercialized;
- source or ownership of the innovation;
- qualifications and testing required; and,
- market’s readiness to accept the new product.

Market Timing: Sometimes you just need to wait!

Infinia, a small company based in Washington State, developed a long-life Stirling engine for the space industry. In a textbook case of tech transfer, Infinia has partnered with a Japanese firm to integrate their engine into a residential micro combined heat and power unit (mCHP) that can function as a mini-power plant for the home – providing space heating, water heating, and electricity. Infinia’s engine is energy efficient, has low maintenance needs, operates quietly, and has the potential to serve as backup power during grid failures. Micro CHP units are finding great success in Japan and Europe where regulatory incentives and a favorable natural gas to electricity price ratio are driving the market.

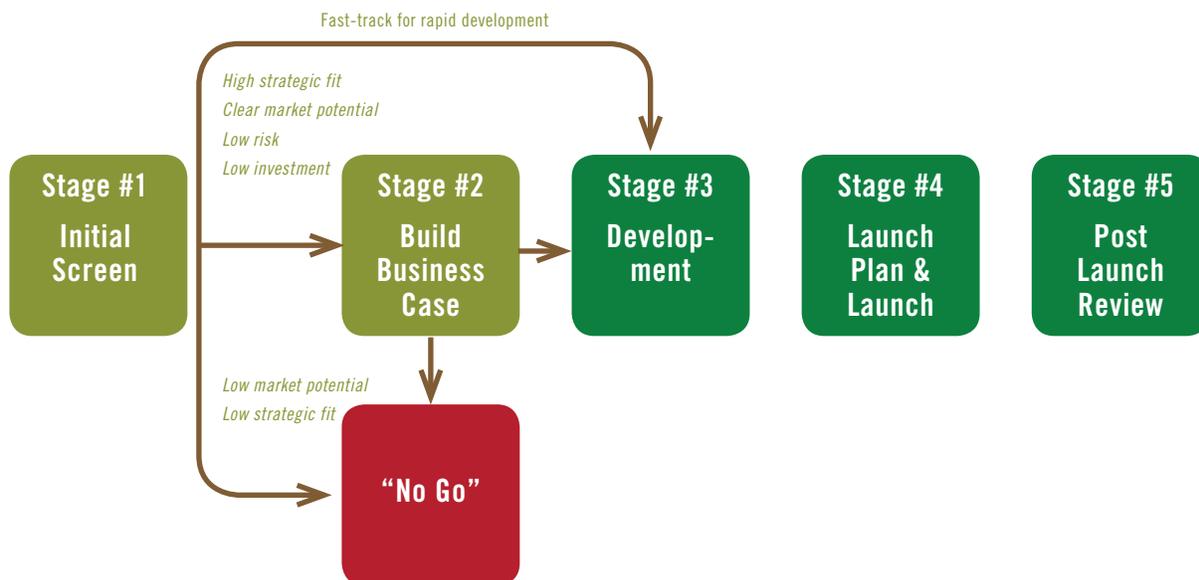
⁴ Robert Charles Lesser & Co. (July 17, 2007). Building Green TV and RCLCO Reveal that Health is the Most Powerful Motivator for Consumers to Build or Buy a Green Home. http://www.rclco.com/pdf/Jul172007521_Press_Release_RCLCO_and_Building_Green_TV.pdf

For example, Leviton, a leading North American innovator and producer of electronic products is often able to bring products from concept to production in 6 months, while the Lawrence Berkeley National Laboratory's Environmental Tech Division has been working on research, development and commercialization of its innovative product, the Integrated Window and Wall System (IWWS), for over 14 years. In this instance, the disparity in the length of the commercialization process can largely be attributed to two factors: the Leviton innovations are often line extensions of previously commercialized products within previously commercialized systems, while the IWWS is an innovative new concept requiring modifications to building processes; and, manufacturer innovations are motivated by competitive forces and a return on investment whereas a government laboratory research innovation serves a public purpose or research purpose and may not be driven by profit or schedule.

It is important to fully evaluate your market research and analysis to most accurately predict the length of time required for commercialization of your specific product. The staged-gate development process is commonly used by manufacturers (Figure 2). The chart below presents the stages that you should pursue as you proceed with the commercialization process. The typical staged-gate process tracks decision-making regarding development of a particular idea from "initial screen" to "post-launch review."

Figure 2 Staged-Gate Development Process

Source: *Winning at New Products: Accelerating the Process from Idea to Launch*; Cooper; 2001



Developing Partnerships

Some companies license technology or create partnerships with researchers or inventors rather than, or in addition to, inventing in-house. Manufacturers employ several approaches for gathering innovations or inventions, including partnering with universities, which we explain in more detail below. Methods for acquiring innovations from external sources include:

- International companies with similar business practices may have innovations they are interested in licensing to gather market share;
- International companies with complimentary but not direct competitive products may license the use of their technology;
- Companies with a particular need for innovation in a certain product area may actually put out a request for procurement, either directly or through a third party;
- The federal government often promulgates new technologies. For example, NASA created the Innovative Partnerships Program (IPP) to assist companies interested in commercializing NASA technologies. The IPP's goal is to leverage technology through investments and technology partnerships with industry, academia, government agencies, and national laboratories.
- College and university technology transfer offices often have a wealth of innovations and technological developments. It is the objective of these offices to further the commercialization of the innovative technologies developed by the school's faculty and students.

Issuing Solicitations for Research Projects

Some manufacturers are able to acquire innovations by soliciting them from various established research firms. For example, Dow Chemical Company has had success in hiring NineSigma, an innovation sourcing company, to solicit proposals for various innovative technical methods to meet several specific technical needs.

WORKING WITH COLLEGES AND UNIVERSITIES

Colleges and universities are a valuable source of innovative building-related technology, and it is important to understand the schools' motivation and typical processes when considering commercializing one of their innovations. Most larger, research-oriented colleges and universities have created Technology Transfer Offices (TTO) tasked with managing the relationship between the schools' innovators and commercial industry. These offices face the interesting challenge of furthering various objectives, including promoting the schools' critical missions of education, research, and service while pursuing maximum financial return for both the university and the product's creator. TTOs have many different customers with often conflicting objectives. TTO customers include faculty, university administration, governing boards, taxpayers, and private businesses. The TTO will usually represent the university's staff as they seek to commercialize their innovations. When TTOs are involved they generally manage the process from the time that the innovator begins to consider commercialization of the innovation until the time that the technology is licensed to a third-party developer or developed by a newly created start-up organization.

Once the decision is made to solicit interest in commercialization from a third-party developer, a non-confidential summary is sent to companies that are likely to be interested. Usually, this is a one-page brochure describing the innovation. If a company expresses interest, they will be asked to sign a secrecy agreement to protect patent rights prior to the receipt of any confidential information from the university. If the company remains interested after reviewing the confidential information, an agreement with the company is negotiated. This can be a letter of intent, an option, or a license. In conjunction with any one of these alternatives, a research agreement may be negotiated to continue to work on the invention at the university. Most university inventions are in the earliest stages of product development and require further research and development before they are ready for the marketplace. Due to the limited development of many university innovations, there is often a high level of risk in licensing the development of their innovations

without a thorough evaluation of the technology's level of development. Be sure to fully evaluate the extent of research to date and consider the stage of development when negotiating the licensing agreement.

COMMON UNIVERSITY AND TTO CHARACTERISTICS AND EXPECTATIONS

Several characteristics and expectations that are typical of TTO staff and university innovators are important to know when negotiating a potential commercialization partnership. TTO staff and university innovators often have unrealistic expectations of research opportunities, income, public utilization, and fame. University innovators have usually dedicated significant time and effort to the product and therefore have significant personal investment in the success of the product. It is important to keep this in perspective as you negotiate license terms in order to temper unrealistic expectations and avoid problems down the road.

Also, it is important to keep in mind that universities vary in how they pursue product development of new inventions. Some universities focus on regional economic development, some focus on academic renown, while still others gauge the success of their research programs by the number of patents granted and the extent of product penetration into the market. Universities that focus on regional economic development may not support an idea unless it holds promise for creating jobs regionally. Universities that focus primarily on their academic prominence are more likely to put more effort into the development of the product and the theories surrounding it than bringing the product to market. When working with these universities it is important to reassure the university that the commercialization of its technology will only further build the economic reputation of the university. Still other TTOs are measured on their success in obtaining patents and by how many innovations are transferred to the market. Some common numerical measures include the number of patents filed, the number of license agreements executed, and the success of new companies formed. Secondary metrics include revenues from license fees, royalties, and cash from equity investments paid to the academic institutions, as well as the number of products successfully introduced to the market. It is essential to understand the

form of development process a research university employs in order to implement the most suitable approach to market production.

FINANCIAL RESOURCES

There are several federal and state programs that provide funding to support development of innovations in the housing industry. Federal programs and processes can be easier to navigate and less restrictive than state programs because they are typically thought to be more accessible and not as onerous and restrictive as the state grant programs, although state programs with significant funding are also available if you are willing to put in the extra work. Examples of state energy programs that offer grants are the New York State Energy Research and Development Authority (NYSERDA) and the California Energy Commission (CEC). Both can have high cost of entry (e.g., time, resources) and may have restrictions based on business size, ownership, and location. Some programs may require royalties to be paid as well. National-level funding opportunities are available specifically for housing-industry-related innovations through the U.S. Department of Housing and Urban Development among other resources.

For small manufacturers, the government runs programs that can be very helpful in providing financial support for new technologies. The Small Business Innovation Research Program (SBIR) and the Small Business Technology Transfer Program (STTR) are government-sponsored programs that encourage small businesses and researchers to explore their technological potential by providing incentives to research and develop new technologies. Funding from both the SBIR and STTR programs is available through various government agencies. Both the SBIR and the STTR are 3-phase programs structured as follows:

- **Phase I: The Start-Up Phase:** In this phase, small businesses are eligible for awards of up to \$100,000 for approximately 6 months of exploration of the scientific and technical merit or feasibility of an idea or technology.
- **Phase II: R&D Work:** In this phase small businesses are eligible for awards of up to \$750,000, for use over as many as 2 years with the intent of expanding the results of Phase I. During this time, the R&D

work is performed by the researcher and he or she will evaluate the potential opportunities for commercialization of the technology.

- **Phase III: Technology to Market:** The Phase II innovation moves from the laboratory into the marketplace. Unfortunately, there are no SBIR or STTR funds available to support this effort. The small businesses and researchers must find funding in the private sector or other non-SBIR/STTR federal agency funding.

To be eligible for funding under the SBIR program you must be an American-owned, independently operated, for-profit business with fewer than 500 employees, and your principal researcher must be employed by the business. To be eligible for funding under the STTR program, you must be a small business that meets all the requirements of the SBIR program or a qualified non-profit research institution. Though there is no size limit for non-profit research institutions, to be eligible, non-profit research institutions must be located in the United States, a non-profit college or university, a domestic non-profit research organization, or a federally funded research and development center. Further information regarding the SBIR and STTR programs is available on the U.S. Small Business Administration website at www.sba.gov/SBIR.

The U.S. Department of Energy (DOE) is arguably the most active user of SBIR grants for housing innovations. Each year, DOE issues an invitation to small businesses to apply for SBIR Phase I grants.

One of the attractions of the SBIR program is that the government does not expect to recoup any return on its investments. The program recognizes that small businesses and entrepreneurs are substantial sources of innovation. In a 1982 study, it was found that small businesses had 2.5 as many innovations as large ones. The program seeks to provide enough capital to allow small businesses entrepreneurs to compete on the same level as their larger counterparts.

PowerLight Corporation – An Example of a DOE SBIR Success

PowerLight created a roofing tile system that significantly reduces roof deck temperatures through passive means. The product can also integrate photovoltaic cells to produce electricity. This innovation offers building owners two ways of lowering energy costs: by generating environmentally friendly solar energy for the building and by reducing the air conditioning load. For more information on this product, please visit www.powerlight.com.

Another government program available to support the commercialization of technology is the Technology Innovation Program (TIP) administered by the National Institute of Standards and Technology (NIST). The TIP supports, promotes, and accelerates innovation in the United States through high-risk, high-reward research in areas of critical national need. TIP has the agility and flexibility to make targeted investments in transformational R&D that will ensure our nation's future competitiveness through sustained technological leadership.

The TIP provides help for companies in financing their projects in order to help bolster industry and bring about new technologies. The TIP bridges the gap between the research lab and the marketplace. Through their relationship with the private sector, TIP provides a springboard for new technologies by providing funding for research and development that is likely to benefit industry but would be unlikely to be funded by commercial industry due to high competitive pressures. Because technologies change so fast, many companies are forced to make short-term decisions to keep pace with the market. The TIP focuses on a broader perspective, attempting to uncover projects that will benefit the entire nation for the long term.

Certain things set the TIP apart from other government research and development programs. The TIP establishes its research priorities by focusing on areas of critical national need that demand government attention because the magnitude of the problem is large and the societal challenges that need to be overcome are not being

addressed. There are strict cost-sharing rules involved with the TIP as well. Single small- and medium-sized companies and joint ventures must share at least 50 percent of the yearly total project costs (direct plus all indirect costs). Large firms are not eligible to apply for TIP funding. In addition, the TIP doesn't fund product development, so all development costs are incurred by the company.

A title to any invention arising from a TIP-funded project is required to be held by a for-profit company, or group of companies, incorporated or organized in the United States. Although universities, government laboratories, independent research organizations, and other non-profit organizations cannot retain the title to patents, they can receive payments from the company or companies holding the title patent. The title to any invention created with TIP funds cannot be transferred or passed, except

to a company organized in the United States, until the expiration of the first patent obtained in connection with the invention.

Though there are significant funds available through government entities, researchers often need to seek outside sources of funding to complete the R&D and marketing necessary to result in development and ultimate commercialization of their technology. The level of information required by investors will vary according to their familiarity with the subject matter as well as their commitment of capital. Funding may also be often available through colleges and universities.

OTHER RESOURCES

Table 2 below identifies some resources, depending on the innovation, that provide economic data, market research, industry background, or consulting in the area of commercialization.

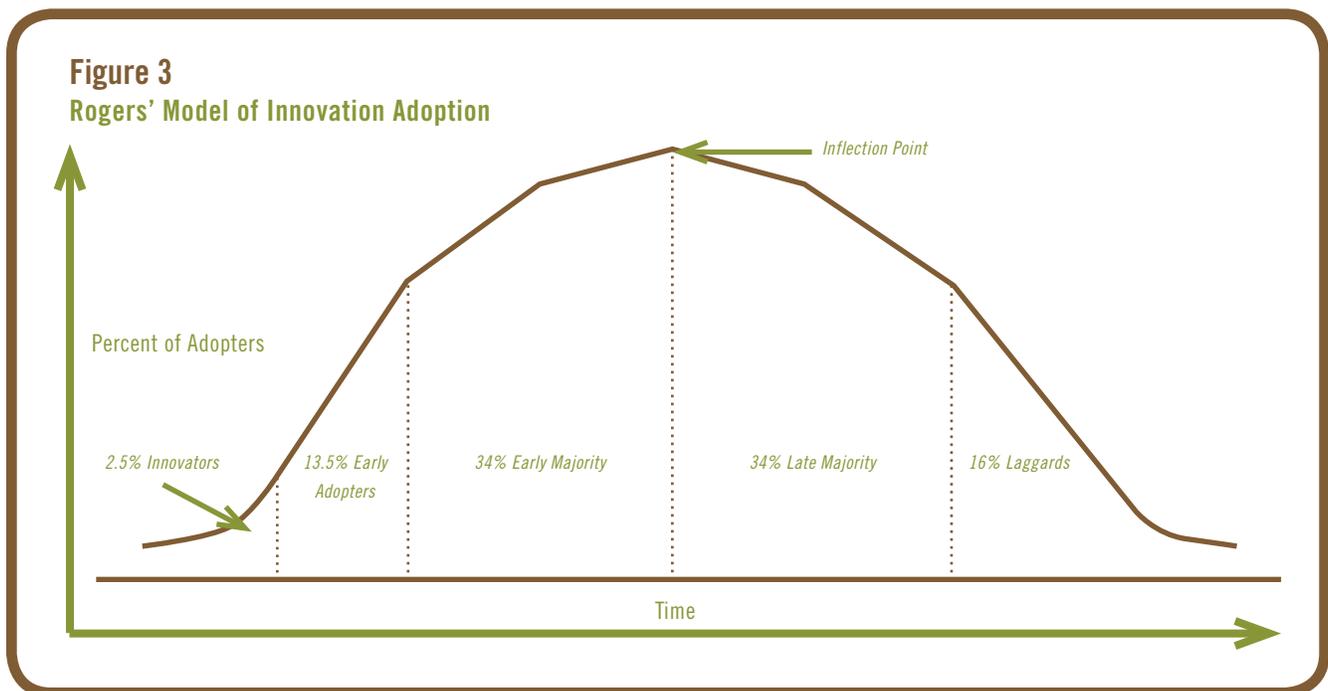
Table 2
Resources for Further Information

Organization	Industry Sector	Type of Resources Available	Website
Department of Housing and Urban Development	Federal Government Agency – Housing	Research on Innovation and Technology Transfer, American Housing Survey	www.hud.gov www.huduser.org
National Association of Home Builders (NAHB)	Industry Association	Economics Data on Housing Market	www.nahb.org
Joint Center for Housing Studies	Academic	Economics and Industry Research	www.jchs.harvard.edu
New York State Energy Research and Development Authority (NYSERDA)	State Government Agency – Energy	Research, Energy Efficiency	www.nyserda.com
International Code Council	Building Codes	Building Codes Product Evaluation Service	www.iccsafe.org

REACHING THE MARKET

Housing innovations fail to successfully penetrate the market for several reasons. First, failure in the commercialization process arises when an innovative idea that doesn't fit well with current market trends. Failure may also result from errors in implementing the commercialization plan. Once you have done your homework and feel that the innovation offers productivity and/or functionality advantages, and you have ensured that the innovation is currently accepted by respective codes or have a plan for code acceptance, you will still need to market the products to specific segments of the construction industry. It is important to identify and target the appropriate housing segment (single-family custom, multifamily townhouse, etc.) or geographic niche.

Much has been written on adoption of innovation generally, and it tends to follow (with some variations in categorization, terms, etc.) the model put forth by Everett Rogers shown in Figure 3.⁵



Late majority, laggards, and non-adopters behave in the bandwagon effect, while innovators, early adopters, and early majority adopters represent truly innovative behavior. With the strategy of focusing on innovators and early adopters, you need to identify specifically who this group is for your product innovation. From within the home building industry generally, the types of home building firms most likely to be early adopters are:

- Modular builders and multifamily builders
- Single-family custom home builders
- National and regional builders⁶

Further refinement is necessary based on your specific innovation. For example, if the innovation deals with a mold problem, you might focus on hot, humid climates within the early adopter categories. If the innovation is a new panel system designed to save time in the field, a focus on single-family custom builders and national and regional builders may make more sense, particularly in areas with labor problems.

After targeting the market segment, you need to decide on a distribution strategy and develop an informed message that allows a builder to easily understand the innovation as well as the costs and benefits. These steps often are best accomplished through market research.

⁵ Everett Rogers, *Diffusion of Innovations* (Fifth Edition ed.) 1995. New York

⁶ PD&R Study, *The Diffusion of Innovation in the Residential Building Industry*, 2004.

Conclusion: Five Steps to Increase Your Chances of Success

1

Do your homework on the housing market and identify where your product fits.

2

Identify the market driver. Does it meet a code requirement? Does it increase productivity or add value through increased functionality?

3

Understand code implications. Does it conform to applicable codes? Will it need an evaluation report or code change for acceptance?

4

The process you employ in commercialization is more important than the spending. Make sure the entire team is onboard and that good collaboration takes place across functional areas.

5

Develop targeted messages specifically for your identified markets.