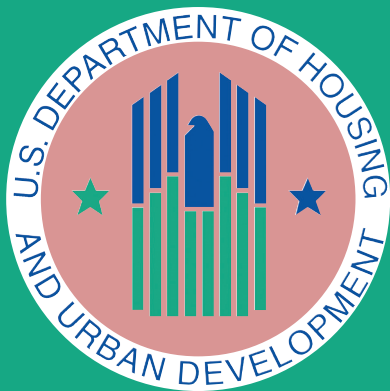


Introducing Innovation into the Home Building Industry



Advice for Innovators and Inventors

September 2007



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



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**Advice for Innovators
and Inventors**

Prepared by:

**Newport Partners LLC
Davidsonville, MD**

Prepared for:

Partnership for Advancing Technology in Housing

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About the Authors

This pamphlet was prepared by Newport Partners LLC. The following staff contributed to the report: Mike Moore, Steve Shrader and Sam Bowles. Newport Partners provides analytical, technical, regulatory, and market research services to clients in the building industry.

Disclaimer

The contents of this pamphlet are the views of the authors and do not necessarily reflect the views or policies of the U.S. Department of Housing and Urban Development or the U.S. Government.

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The residential home building industry is a dynamic and leading indicator 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 very structure of the housing industry is an impediment to innovation. 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. This pamphlet was developed as an output of a study on Technology Transfer that looked at selected innovations and partnerships between inventors and innovators and manufacturers. It contains information gathered through interviews, focus groups, case studies, and independent research. This guide takes an inside look at innovation within the home building industry and provides insights for those who have an invention or innovation that they are looking to commercialize in the housing industry. We refer to this group throughout this document as inventors, and the product as the innovation.

An Industry Overview

The home building industry represents a unique market opportunity for innovators as the housing market represents one of the most significant market segments of the economy. In 2000 the combination of private investment and consumption spending on housing represented 14% of GDP. In spite of the current correction in the housing market, the long-term outlook for housing is strong. Despite the presence of several large national players, the industry is still dominated by small- and medium-sized builders and typified by an industry association that retains a 1,000+ member board. Materials, labor, and building practices differ according to geography; multi-family or single-family; new and remodel; lack of building codes; factory-built, modular, or site-built; production, semi-custom, or custom; and builder size.

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

For the inventor that is new to the home building industry, a wealth of resources are available to assist with understanding industry regulations, opportunities and challenges. Sources of industry information include industry-wide associations that

are dedicated to building systems, products, or the industry as a whole; government research and demonstration programs; and trade journals. A table of some useful resources is listed at the end of this report.

Gross Domestic Product	9,872.9
Gross Private Domestic Investment	1,767.5
Fixed Investment	1,718.1
Nonres Fixed Investment	1,293.1
Nonres Structures	313.6
Nonres Equipment & Software	979.5
Residential Investment	425.1
Share of GDP	4.3%
Share of Gross Private Domestic Investment	24.1%
Residential Structures	415.6
New	363.4
New Housing Units	259.6
Permanent Site	248.8
Single-family Structures	220.7
Multifamily Structures	28.1
Manufactured Homes	10.9
Improvements	102.4
Other	1.4
Brokers' Commissions on Sale of Structures	55.4
Net Purchases of Used Structures	-3.2
Residential Equipment	9.4
Personal Consumption Expenditures	6,728.4
Durable Goods	819.6
Nondurable Goods	1,989.6
Services	3,919.2
Housing Services	958.8
Share of GDP	9.7%
Share of Personal Consumption Expenditures	14.3%
Owner-occupied Nonfarm – Imputed Space Rent	702.7
Tenant-occupied Nonfarm – Rent	209.3
Rental Value of Farm Dwellings	7.7
Other Housing Services	39.1
Residential Investment + Housing Services	1,383.9
Share of GDP	14.0%

Source: U.S. Dept. of Commerce, Bureau of Economic Analysis

Table 1.
Housing Components in GDP – 2000
(billions of current dollars)

Assessing the Market

Once you've gained a comfortable understanding for how the industry functions, drill down to your target market. The first step is determining how your innovation compares to market alternatives in meeting market needs. Once you've gone through this exercise yourself, market studies or focus groups composed of participants who will interface with your innovation can provide invaluable feedback on your innovation's marketability. Key topics to consider include:

- ⦿ Ease of use: installation tools, time and learning curve; maintenance; interfacing with trades and other critical players (e.g. a wall system must interface with electricians, plumbers, siding installers, insulators, and framers); disposal
- ⦿ First and life cycle cost: shelf price, cost of installation, maintenance costs
- ⦿ Performance and maintenance: durability (shipping, construction, and lifetime performance phases), impact on resources (e.g. energy and water efficiency)
- ⦿ Safety and security: regulatory compliance; perceptions of relevant parties
- ⦿ Environmental impact: current and anticipated regulatory compliance; life cycle analysis of environmental impacts from material sourcing through product disposal ("cradle to gate" analysis)
- ⦿ Overall perceptions: regulatory/code officials, home owners, trades, home builders

Realize that the home building industry is slow to adopt new technologies and that first costs are often king. The further a technology departs from

market familiarity or lowest first costs, the more challenging market adoption will be. Conducting a thorough market analysis can help 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 on in the design phase cannot be overemphasized. Note that it is a good idea to pursue innovation protection through a provisional application for patent and non-disclosure agreements before revealing too much through focus groups or other market research.

Identifying and Assessing Market Drivers: Codes, Productivity, Functionality

Building codes and regulation constitute one of the most obvious forms of 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 in the aftermath of Hurricanes Andrew and Hugo for defined areas of the U.S.
- ⦿ House Wraps – Tyvek and other house wraps existed before being mandated by the codes but gained substantial market share through code requirements on infiltration
- ⦿ Ground Fault Circuit Interrupters – Adopted to prevent accidental electrocution

The International Code family (I-Codes) has over a dozen codes that may apply to a jurisdiction depending on local adoptions. The International Residential Code (IRC), applicable to detached one- and two-family dwellings and town homes 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 towards market acceptance of an innovation, but the battle for regulatory approval doesn't always end there. For example, air admittance valves (AAV), innovative plumbing system components that eliminate the need for a vent pipe and roof penetration, are approved within the 2003 IRC. However, these valves have a history of code official opposition at the local level, where jurisdictions sometimes 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. The alternatives are seeking code approval of an individual product through the I-Codes Evaluation Service or proposing a code change to the I-Codes themselves. Potential business partners will want to be aware of how your innovation relates to the code. Knowing and designing within code boundaries early on in the design process can be a prudent path for some innovations, or understand that innovations that fall outside of the code may require additional time and financial resources. As dull as they are to read, codes are a living organism – under constant revision and maintenance, and inventors need to be aware of their influence on innovation.

Building codes define the minimum building practices and systems. Despite defining a

minimum practice, products and systems that just meet code continue to account for the majority of product installations in homes. Thus, if your product is beyond code, 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 provide increased durability. Recognizing where your product fits is key to market positioning. Some products may result in productivity improvements as well as functionality improvements.

Understanding Building Codes

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

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.

Look for Market Opportunities

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.

PATH Report on
Overcoming Barriers to Innovation,
April 2005

Understanding what is happening in the housing market can help you focus on key opportunities. For example, many industry experts believe that a housing market down cycle is actually the best time to introduce an innovation. If your innovation includes environmental features, look at “code-plus” programs as an approach to marketing your innovation. These programs often focus on energy efficiency, durability, indoor air quality, or “green building” – the practice of environmentally responsible and sustainable building. Most current green building programs, such as LEED for Homes and NAHB’s Green Home Building Guidelines, 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.¹

Market Timing: Sometimes you just need to wait!

A small company out of Kennewick, Washington, Infinia developed a long life Stirling engine for applications in 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 (CHP) that can function as a mini-power plant for the home – providing space heating, water heating, and electricity. The unit possesses the advantages of being energy efficient and very quiet to operate while having the potential to act as a backup power source 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. Unfortunately, the U.S. market for mCHP will continue to be constricted until market incentives are established.

1 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.

Communicating Your Innovation's Advantage

The results from your market assessment will be the key component for how you communicate the advantages of your innovation. Give thought to how to quantify and communicate the lifecycle cost and benefits of your innovation. Communicating cost comparisons between highly innovative systems and their market alternatives can be very challenging. For example, it may be difficult for a builder to conceptualize how cost effective it is to specify a wall system that incorporates insulation, framing, and electrical wiring versus a traditional wall system where these costs are spread over various trades. Realize that products with higher or unknown first costs will be a harder sell, but that productivity or functionality improvements may be sufficient to make your product marketable. Regardless of your innovation's application, understanding and communicating how your innovation fits into the market are critical to selling the innovation.

The Commercialization Timeline

One common mistake made by inventors 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, a consensus was reached that commercializing a new technology takes 5-6 years when everything goes as planned. Furthermore, participants agreed that the minimum time required to introduce a new technology to market is 3 years. Although these guidelines have been found to be fairly consistent and repeatable rules of thumb, individual experiences can vary significantly based on the complexity of the product being commercialized, the source or ownership of the innovation, the qualifications and testing required, as well as the market's readiness to accept the new product.

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 (LBL) 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 LBL IWWS is an innovative new concept (sometimes referred to as a breakthrough innovation)

requiring modifications to building processes; and, manufacturer innovations are motivated by 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. In this way, government laboratory innovations and university innovations are similar.

Protecting Your Innovation

The introduction of a new, patentable innovation requires intellectual property protection to prevent copying of ideas and to allow manufacturers the appropriate ability to control the technology. Patents are an integral part of preparing for partnering with manufacturers, as they grant the patentee the right to prohibit others from manufacturing their patented innovation. Patents are granted only to innovations that can be shown to be novel, useful, and non-obvious. Before applying for the right to protect your innovation, initiate a patent search to determine if your innovation might be patentable. The University of Texas provides an excellent on-line tutorial for this process (see Table 2), or you can always hire a professional.

Once you've determined that your innovation is marketable and patentable, and before you embark on a lengthy and expensive patenting venture, consider applying for temporary, but effective intellectual property (IP) protection rights through the U.S. Patent and Trademark Office (U.S. PTO). The U.S. PTO offers a "provisional application for patent", which is affordable and requires minimal effort to file. Afterwards, if market feasibility assessments are promising, you can then pursue

longer term IP protection rights, through applying for a design patent or utility patent. It's a good idea to enlist a patent lawyer to review or produce this application for you. Cursory options for IP protection rights are given below.

Provisional Application for Patent: For many inventors, the first step in the patenting process is filing a provisional application for patent. Filing a Provisional Application for Patent provides a quick, inexpensive way to share your idea with potential partners without fear of others stealing your idea and leaving you without legal recourse. Upon filing a provisional application for patent, you have 12 months to apply for a utility patent. Innovation protection begins with filing the provisional application, but the clock doesn't start running on the utility patent's 20 year term until the application for the utility patent is filed. Further, the provisional patent legally permits an innovator to use the words "patent pending," showing that the innovation is legally protected from the infringement of others.

Once you've further established your innovation and identified its intended application, you will likely want to consider applying for a utility patent or design patent. Prior to entering a partnership with an inventor, manufacturers often require that the innovation have a strong utility or design patent able to resist infringement. Without the operational freedom provided by a patent, many manufacturers will not pursue a partnership. For detailed information on any of the following, refer to the U.S. PTO website (www.uspto.gov).

Utility Patent: If your innovation addresses the functionality of an object, then a utility patent is probably right for you. Obtaining and maintaining utility patents is more expensive than filing a

provisional application for a patent, but a utility patent protects the rights to the product's specific physical characteristics and its applications for a period of 20 years.

Design Patent: Design patents address the appearance of an article. If the object's appearance is original and is a significant component of its marketability, consider filing for a design patent. If acquired for your innovation, a design patent provides the right to protect the appearance of an innovation for up to 14 years.

Patent Cooperation Treaty International Application: The Patent Cooperation Treaty (PCT) application process was established to simplify obtaining international patents in participating countries. If your market assessment concludes that opportunities for commercialization exist in international markets, the U.S. PTO and World Intellectual Property Organization (www.wipo.int) provide resources to help you pursue international protection. International patents can be very expensive to pursue but could also produce valuable returns.

Other tools that support IP protection include trademarks to protect an innovation's name or symbol; copyrights to protect software or multi-media works; and trade secrets to protect an innovation's formula or composition. If your innovation will achieve a large market share, these tools could be as important as patenting.

Developing Partnerships or Venturing: It's Your Decision

Once you have conducted the necessary market research, developed an understanding of the pressures of the regulatory environment, evaluated the expectations of your potential customer and done your homework on the competition, you have set the stage for the commercialization of your innovation.

The decision whether to license your product to an established manufacturer or to establish a start-up business to commercialize and manufacture your product yourself is one that has a significant impact on the success of your product in terms of both market penetration and realized financial rewards. In this section you will find guidelines for selecting which route to take for your product as well as information about what to expect as you undertake each route.

Commercializing Your Invention through Venturing

Many inventors choose to form start-up companies to commercialize their product when they feel they have sufficient funding and that they are the best suited to undertake the task. This is sometimes referred to as "venturing." Some of the benefits of venturing include:

- ⦿ It is likely the more exciting and challenging approach;
- ⦿ You have greater control over how the technology is commercialized and eventually managed; and,
- ⦿ There is far greater potential for rewards, both financially and in a sense of achievement.

The challenges are significant, but with the right approach—which involves thorough research and planning and being open to learning from the experience of others—success is definitely achievable.

When establishing a start-up company it is necessary to establish an appropriate team. The team must be able to both innovate and transfer technology. An effective team should include people of a technical background, legal counsel and market research professionals.

The scope and strength of the marketing team will vary based upon the business plan and level of innovation. As a manufacturing business, your start-up company will need to either retain marketing functions or partner with others to continue market research and monitoring. The marketing team must be able to clearly identify a market need, effectively communicate the value of the innovation, and establish distribution channels or distribution partners. Your needs from your legal counsel will vary based on your business plans and your product, but it is important to have expert legal resources for ongoing patent and contractual issues. Your team may be formed using existing employees, by hiring new employees or through subcontracting. Your team will need to further establish relationships and partner with

subcontractors for the provision of raw materials as well as for final product distribution. For further guidance on the manufacturers' side of the commercialization process refer to the HUD Publication *New Product Adoption in Housing: Guidance for Manufacturers*.

The next steps are developing a baseline understanding of the commercialization process as well as planning and implementing patent protection of the intellectual property rights associated with the innovation. You will need both a commercialization plan and a business plan.

Licensing Partnerships

There are a number of reasons that inventors may decide to license their technology. These include:

- ⦿ Historically low level of success for new business start-ups (though this history does not have to apply to your venture if you plan and prepare properly);
- ⦿ Need for appropriate equipment and facilities;
- ⦿ Need for much more capital than would be required for licensing;
- ⦿ The investment of time and effort required to start and operate the business, secure and manage needed resources, etc.;
- ⦿ The challenge of overcoming barriers to market entry, often in industries that do not welcome new entrants; and,
- ⦿ Likelihood that you, the technology innovator, will have little time for additional new technology R&D if you also undertake the commercialization.

By numbers alone, the disadvantages of venturing tend to outweigh the advantages. But venturing is not about the number of hurdles you'll have to overcome. Instead, it is about your desire—and more importantly, your commitment—to successfully build a business around your technology.

Inventors that elect to license the commercialization and manufacture of their products to a third party decide to do so for a variety of reasons. Typical benefits to the establishment of these types of relationships include:

- ⦿ improved efficiency,
- ⦿ brand/name recognition,
- ⦿ product similarities and synergies, and
- ⦿ resource pooling.

Manufacturers' experienced in the business of commercializing can often offer significant efficiency advantages over those of inventors new to commercialization and mass production. In effect, this path takes advantage of economies of scale as inventors can concentrate on innovating and manufacturers can concentrate on commercializing. There is often significant benefit to partnering with established manufacturers as brand or company name recognition helps to ease the market's natural resistance to new products. For example, a new home heating technology carried under a name such as Carrier or Lennox would have a much higher chance of market acceptance than the introduction of the

same technology under a new and un-proven corporate identity. In some cases, partnership with a manufacturer will make sense due to the innovation's degree of similarity to other products and due to the fact that many innovations are sold as components of larger subsystems.

Take for example, Perfect Glaze, a hurricane resistant sealing for window glazing developed by the National Starch and Chemical Company. Once the sealant was developed, the National Starch and Chemical Company decided to contract with TruSeal Technologies, a supplier of various glazes and sealants, for the marketing and distribution of their product. This alliance has proven very beneficial because TruSeal is the leading supplier of glazes and sealants for 7 of the 10 largest window manufacturers in the nation. With an established distribution system for products similar to Perfect Glaze, TruSeal has been able to help Perfect Glaze achieve a larger market share at a faster rate than otherwise possible.

Resource pooling is a significant reason to partner with manufacturers as most inventors have limited financial and labor resources at their disposal. Manufacturers that have a vested interest in the success of your product, such as a manufacturer that makes a subcomponent of your innovative system, will have strong motivation to promote the success of your product. The pooling of financial and labor resources increases that likelihood of success above the level that either partner would have had individually.

Case Study: Purfect Glaze – Hurricane Resistant Sealing for Glazing

Technology Summary

This product class is relatively new and was created to limit the damage to buildings caused by hurricane force winds and impacts. Building codes such as the International Residential Code and the Florida Building Code now require window systems to meet extremely rigid standards for design pressure and impact resistance. Florida provides some exceptions for sunrooms and the IRC provides exceptions for windows with protection from wood structural panels. Despite these exceptions, performance requirements have continued to increase in this area and drive opportunities for innovative products.

By using Purfect Glaze to bond glass to framing, window manufacturers have been able to meet the impact resistance requirements of code-referenced standards. Besides improving product performance by using Purfect Glaze, manufacturers can also benefit from reduced production time, improved production efficiencies, and total cost reduction.



Technology Source

National Starch and Chemical Company developed Purfect Glaze. The company is based out of Bridgewater, NJ. National Starch manufactures three types of warm-applied sealants for windows and doors. The Purfect Glaze sealant is available for general application and high-strength use.¹ National Starch and Chemical Company, with sales of over \$3.5 billion, is part of a larger group, Imperial Chemicals Industries (ICI), and has substantial resources for technology development.

¹ National Glass Association: Window and Door (www.windowanddoor.net)

Current Stage of Development

Despite its significant size and influence, the National Starch and Chemical Company is not well known in the window industry. Recognizing this, they have strategically partnered with TruSeal Technologies, Inc, who is a leading supplier of warm-edge, insulating glass sealant spacers for windows and doors for the world market. TruSeal will market, sell and distribute the sealant to window manufacturers in the United States.

Based in Beachwood, OH, TruSeal has been in the insulating business since the late 1960's and offers a wide variety of insulating glass spacer technologies and accessories that meet the demands of insulating glass fabricators. TruSeal is the preferred supplier for 7 out of 10 of the largest window productions in North America.²

Purfect Glaze has incorporated well with TruSeal's product line. TruSeal now offers three types of Purfect Glaze (G, H and SA). Purfect Glaze G is a high green strength sealant specifically formulated for back-bedding IG units. The Purfect Glaze H is a high, ultimate strength back-bedding sealant specifically formulated to pass impact resistance standards. Purfect Glaze SA is formulated for high green strength in glazing applications of larger IG units such as patio doors and large picture windows.²

² Tru Seal Technologies (www.truseal.com)

Lessons Learned

Commercialization can happen smoothly when a product meets a clear need. With the changes in building codes from wind events and hurricanes, glazing came under increased pressure to improve. Safety issues are also a huge benefit of these adhesives and sealants. When incorporated with glazing, the adhesives are a good product for impact and hurricane resistance because they absorb shock and are more flexible than mechanical attachments. Furthermore, Purfect Glaze promises improved production efficiency and reduced costs for the manufacturer. Thus, Purfect Glaze addresses the needs of multiple customers – from manufacturers to home builders to home owners.

TruSeal was a good choice for the manufacturing of Purfect Glaze's hurricane resistant seal because the product incorporated well with TruSeal's product line. The partnership allowed Purfect Glaze to reduce its time to market as well as increase market penetration through developing a relationship with a well recognized distributor within its target market.

Manufacturers' Expectations

Before contacting manufacturers it is essential that you understand what manufacturers expect of innovators. Since there are usually several inventors in the market striving for commercialization of their product, it is important that you be fully prepared to provide the necessary information. Most manufacturers will request specific information from inventors before they will meet with them in an effort to prevent the wasted time of meeting with an unprepared innovator. Manufacturers will also expect that the product be appropriately patented (as described above) and that the product be one that fits closely within the manufacturers segment of the housing market.

Most manufacturers will expect you to have prepared both technical and market research data. Before approaching a manufacturer you should have technical performance data as appropriate for your innovation. Manufacturers will also expect preliminary information regarding the expected cost to manufacture, utilize and maintain the product. Although not all manufacturers will expect market research from innovators, most expect a minimum of preliminary market research. Market research is valuable for inventors to be able to estimate the value of their technology. However, many large manufacturers recognize that some small inventors do not have this information due to limited resources. This is usually compensated

for by manufacturers conducting their own market research before agreeing to commercialize a product. As an inventor, be sure to conduct appropriate market research to ensure that you are contacting the right manufacturers and that your product fits well with their currently established product line and/or target market.

It is common for inventors to be cautious of partnering with large manufacturers, but don't let caution get in the way of commercial success. Small innovators often require confidentiality agreements from manufacturers that are too restrictive to allow the manufacturers to share necessary information across divisions. Be sure to protect your intellectual property rights through the appropriate utility or provincial patents, but when possible, avoid overly restrictive confidentiality agreements that hinder the process.

Be prepared that often manufacturers are either looking for "home run" ideas, those that are expected to be profitable quickly, or "breakthrough" ideas that are novel and serve the purpose of bringing innovation into the company's market place. A manufacturer will need to spend considerable resources bringing the invention or innovation to market. Licensing the technology is just a part of the bigger piece.

Figure 1 represents an approximate breakdown of how some companies view the innovation cycle.²

² BTI Report

Business Unit “D” Product Development Process	Approximate Costs (%)
Exploratory Phase	
Gate 1: initial idea screening Stage 1: objectives definition and idea assessment	5%
Gate 2: feasibility review Stage 2: detailed project investigation	15%
Development Phase	
Gate 3: project authorization Stage 3: development	60%
Gate 4: development review Stage 4: validation and testing	10%
Industrialization Phase	
Gate 5: launch approval Stage 5: product launch	10%
Post Launch Review	

Figure 1. Breakdown of Innovation Cycle

Typical Contracts

When negotiating a contract with a potential partner it is important to pay close attention to the structure of the licensing agreement, which will vary depending upon the stage of development of the innovation as well as the innovation’s marketability. You will likely need to enlist the help of a licensing expert and legal counsel due to the complexity of license contracts. However, your initial considerations for the license structure should address the following:

- ⦿ **Exclusivity:** Consider licensing by region, end-use, or market to allow for optimum market penetration. For example, Infinia licenses their Stirling engine to multiple markets. This has enabled them to partner with manufacturing leaders in Asia and Europe to increase commercialization overseas, while their North American license remains available as the market matures.
- ⦿ **Payments:** Upfront fees, maintenance fees and continuing revenues or royalties
- ⦿ **Flexibility:** How will the license address industry, corporate and product changes?
- ⦿ **Liability:** Liable parties, extent of liability, etc.
- ⦿ **Protection:** Trade secrets, patent enforcement rights
- ⦿ **Incentives for Development:** Your payments are going to be tied to the innovation’s successful commercialization, so ensure that the contract is structured to encourage this. Options include annual licensing fees and establishing and requiring milestones be met to retain a license.
- ⦿ **Expectations:** Manufacturer licensees typically receive the lion’s share of sales profits due to the risk they assume. As an inventor who is licensing an innovation, expect the licensee to pay out royalties of 0.5% - 25% of net sales depending on the innovation’s stage of development and its ability to stand alone. (e.g. Is it a small component of a larger system or a full system unto itself?) Upfront and annual payments vary widely according to the innovation and the size of the licensee and may take the form of equity ownership in a small or start-up company.
- ⦿ **Termination:** Clearly define conditions of termination that will both protect your interest and encourage commercialization.

Resources

The commercialization of your innovation is an extensive and costly process that can often be overwhelming to an inexperienced and financially constrained inventor. Fortunately, there are several resources available for your use for your financial and other reference needs.

Financial Resources

There are several federal and state programs that have funding available targeted for the support of innovations in the housing industry. Federal programs and processes can be easier to navigate and less restrictive than state programs. They are known 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 sometimes available specifically for housing industry related innovations through the U.S. Department of Housing and Urban Development, the National Science Foundation, and the Forest Products Laboratory among other resources. Specific to promising energy-saving ideas and innovations, the Department of Energy offers financial and technical support to inventors and businesses through its Inventions and Innovation (I&I) Program. I&I selects technologies to receive grants through a competitive process. The Small Business Innovation Research Program

and Small Business Technology Transfer Program are also sources of funding (see sidebar).

Although there are significant funds available through government entities, inventors 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. Incubator programs through universities, government, or private sector non-profits offer another source of support that has become widely accessible. In fact, the National Business Incubation Association reports that the U.S. had 1,115 incubation programs as of 2006. Most of these programs are run by non-profit organizations with funding from economic development organizations, but there can be large differences between incubation programs and their target entrepreneurs.

Before you enlist the services of an incubator, determine if it's a good fit. What is their success rate? How long do innovators generally spend in the program (typically 3 years or less³)? What is their experience in your particular industry and with products similar to your innovation? What level of support will be provided?

Local incubator programs can provide valuable assistance to entrepreneurs in the earliest stages of business development and innovation commercialization through services related to securing and managing loans, providing introductions to angel and venture capital investors, and developing materials necessary to communicate the value of your venture. The level of information required by investors will vary according to their familiarity with the subject matter as well as their commitment of capital.

3 www.nbia.org

Small Business Innovation Research Program (SBIR)/ Small Business Technology Transfer Program (STTR)

The SBIR and 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 including the Department of Defense, the Department of Energy and the Department of Health and Human Services. Both the SBIR and the STTR are 3-phase programs structured as follows:

- Phase I: the startup 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: In this phase the Phase II innovation moves from the laboratory into the marketplace. Unfortunately, there are no SBIR or STTR funds available to support this phase. 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 and independently operated, for-profit business with less 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 meeting all the requirements of the SBIR program or a qualified non-profit research institution. Although there is no size limit for non-profit research institutions, to be eligible non-profit research institutions must be located in the U.S., be a non-profit college or university, a domestic non-profit research organization or a federally funded R&D center. Further information regarding the SBIR and STTR programs is available on the U.S. Small Business Administration website at www.sba.gov/SBIR.

Other Resources

For your other industry-related research or data needs Table 2 identifies some useful resources.

Industry Sector	Organization	Type of Resources Available	Website
Academic	Advanced Technology Development Center	Support for Entrepreneurs	www.atdc.org
Academic	Joint Center for Housing Studies	Economics and Industry Research	www.jchs.harvard.edu
Academic	National Collegiate Inventors and Innovators Alliance	Business Planning, Commercialization Plan	www.nciia.org/r_primer.html
Academic	University of Texas	Patent Search Tutorial	www.lib.utexas.edu/engin/patent-tutorial/index.htm
Building Codes	International Code Council	Building Codes Product Evaluation Service	www.iccsafe.org
Federal Government	Department of Energy	Inventions and Innovation Grants	www1.eere.energy.gov/inventions
Federal Government	Department of Housing and Urban Development	Research on Innovation and Technology Transfer Annual Housing Survey	www.hud.gov www.pathnet.org
Federal Government	National Science Foundation	Venture Capital	www.nsf.gov/eng/iip/sbir
Federal Government	USDA Forest Products Laboratory	Research, Venture Capital	www.fpl.fs.fed.us
Non-Profit	SCORE	Business Advice and Training	www.score.org
Publisher	Nolo	Legal Counsel	www.nolo.com
Publisher	The Licensing Journal	Licensing	www.aspenpublishers.com
State Government	California Energy Commission	Research, Venture Capital	www.energy.ca.gov
State Government	New York State Energy Research and Development Authority	Research, Venture Capital	www.nyserda.org
Trade Association	InventNet	Support for Entrepreneurs	www.inventnet.com
Trade Association	Licensing Executives Society	Licensing	www.lesi.org
Trade Association	National Association of Home Builders (NAHB)	Economics Data on Housing Market	www.nahb.org
Trade Association	National Business Incubation	Links to Start-up Support	www.nbia.org

Table 2. Helpful Resources for Inventors

Conclusion: Six 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? Is it more affordable than market alternatives? Does it increase productivity? Add value through increased functionality?
3. Apply for a patent or otherwise protect your innovation.
4. Understand regulatory implications. Does it conform to applicable codes? Will it need an evaluation report, or code change for acceptance?
5. Be realistic. If you are looking to partner, understand that the manufacturer will be taking on most of the risk and funding needs, so be realistic on how much revenue to expect in return. If you have chosen to commercialize the invention yourself, prepare a detailed business plan and budget.
6. Seek outside support in preparing your commercialization plan. There are plenty of resources available.

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The Partnership for Advancing Technology in Housing (PATH) is dedicated to accelerating the development and use of technologies that radically improve the quality, durability, energy efficiency, environmental performance, and affordability of America's housing.

PATH promotes innovation through three key strategies:

- Identify and reduce barriers that impede innovation, including regulatory barriers. PATH analyzes and prioritizes existing barriers to provide recommendations for overcoming them.
- Disseminate information to speed the development and adoption of advanced building technologies. To encourage broader diffusion of innovations, PATH provides unbiased, easily accessible information to consumers, builders and manufacturers.
- Advance housing technology research and foster development of new technology. PATH research focuses on the innovation process and aims to institutionalize sustained investments in housing with public and private funding.

