
**FEDERAL STRATEGIES FOR PROMOTING
INNOVATION IN HOUSING**

Over the past 100 years, significant innovations have occurred in the housing industry. Despite these accomplishments, industry characteristics and participant motives can present challenges to the innovation process that likely reduce and slow the industry's rate of innovation.

This report has shown that the federal government has long recognized both the benefits and challenges associated with innovation and has invested in R&D, passed laws to facilitate technology transfer, and created federal programs to support and accelerate innovation in this industry.

It is precisely because the benefits of innovation are so great and because the need for innovation continues today that this report proposes strategies to improve innovation within the existing industry rather than calling for reforms that will be difficult or impractical to implement.

STRUCTURING STRATEGIES TO IMPROVE INNOVATION

This report closes by proposing strategies that the federal government can use to improve innovation. These strategies are organized according to the innovation model presented in Chapter Two. Shown below, this model can be thought of as having four primary components as labeled on the right of Figure 6.1: research, knowledge base, the ID3 pipeline, and market forces.

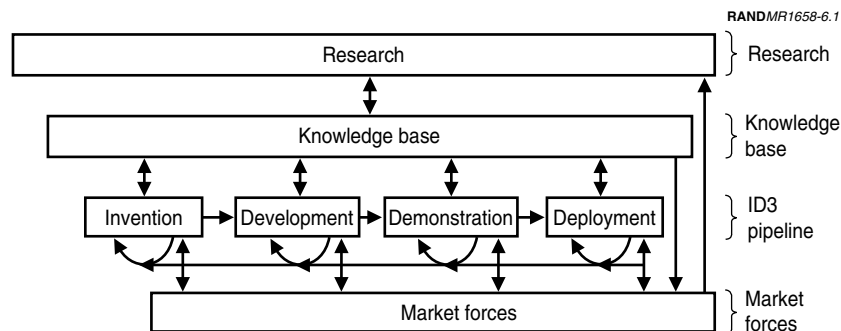


Figure 6.1—Key Components of the Housing Innovation Process

Since each component of the innovation process has unique needs and difficulties, this report proposes four sets of matching strategies:

- enhance research activities,
- strengthen the knowledge base,
- support the ID3 pipeline, and
- improve market linkages.

In the following sections, these strategies are presented and we explain how each could potentially strengthen the corresponding component of the innovation process. In most cases, the strategies are similar to existing government policies, programs, or investments, although they may be new to housing or used in a different capacity than at present.

In general, these strategies focus on adding support to missing or poorly functioning aspects of the housing innovation process. By helping to build the missing infrastructure, these efforts can help increase the rate of innovation and the resulting benefits.

These strategies are not listed by hierarchy, order of importance, or priority for implementation. Furthermore, they are not likely to be equally effective or cost-effective. That said, these strategies and, more generally, this report's systematic discussion of innovation should help the housing industry's many participants candidly and

constructively consider ways to increase innovation within the existing structure and characteristics of the industry.

ENHANCE RESEARCH ACTIVITIES

Sustained Research Support

Federal government agencies should continue to support research, especially basic and exploratory research, because such research is generally high risk, expensive, and difficult to appropriate the benefits from. Furthermore, given that the housing industry, especially its many small and medium-sized firms, has limited funds available for investing in R&D, the portion available for basic research is exceptionally small. Therefore, the federal government has a critical role in investing in basic research to expand the knowledge base that underlies the entire innovation process.

STRENGTHEN THE KNOWLEDGE BASE

Support Networking Across Horizontal and Vertical Boundaries

Network building has long been recognized as critical to innovation. A recent affirmation of networks and the government's role in promoting them can be found in a 1998 report by the Committee on Science of the U.S. House of Representatives (1998):

One of the strengths of the U.S. research and development system has been its ability to harness various sources of innovation in U.S. society—the private sector, universities, and public laboratories. The U.S. government has helped to bring this about by adopting policies and programs designed to encourage networking among the various sectors.

Given the importance of such networks, the federal government could expand network building across the horizontal and vertical fragmentation that characterizes the industry. Conferences, symposia, roadmapping, and other collaborative events can be designed to provide opportunities for close interaction between the practitioners of homebuilding and the scientists and engineers who work in the research divisions of various sectors. These exchanges can

help competitors, collaborators, suppliers, consumers, and regulators communicate, educate, and build bridges across disciplines and interests.¹ For example, the government can use its resources, technical capabilities, and influence to bring parties from upstream or downstream segments together to strengthen their connections.² Alternatively, the government can work with existing associations and state and local networks while also helping to create a longer-term, self-supporting network.

Coordinate Government Efforts

Government departments and agencies fund research and programs to pursue their individual missions and goals. In doing so, they inevitably duplicate the funding of some research while unintentionally neglecting others. Although competing efforts can sometimes be desirable, they may also illustrate where better coordination within and across government agencies could help bridge knowledge gaps, minimize waste and redundancies, and maximize the leveraging of resources.

The need for increased coordination is not limited solely to the federal government. Many state governments have created science and technology promotion offices since the mid-1980s, and an increasing number of states have a science and technology component in their economic development plans. In fact, by 1995, state governments collectively spent more than \$3 billion on R&D activities, with about 80 percent funding research at state universities.³ As a result, improving federal coordination with state and local governments including code officials could accelerate the diffusion and adoption of innovations. Finally, coordination with local government could also be beneficial because building codes, zoning regulations, and insurance rates are regulated at the state and local levels. If coordination could draw these participants into the innovation process (and into the innovation decisionmaking process) earlier, an innovation could have a better chance of being successfully deployed.

¹In some cases, participating firms must be careful to avoid antitrust violations.

²Popper et al. (1998).

³Jankowski (1999).

Search and Disseminate Information on Relevant Federal R&D

In FY 1999, the federal government invested roughly \$236 million in more than 500 housing-related R&D projects. Although some participants in the housing industry can dedicate time to learn about some or perhaps even all of these projects, most cannot. Efforts to increase awareness of this body of research and to make gaining such awareness easier can be particularly valuable. However, even efforts focused solely on housing will miss the potential for spillover technologies from other parts of the construction R&D portfolio, or even from areas further removed. A recent publication and spreadsheet⁴ can aid these efforts. The RaDiUS database,⁵ in particular, can help one search the entire federal R&D portfolio. However, varying degrees of time and effort are still required to obtain, search, and find information of interest.

To facilitate this discovery and sharing of knowledge among those in the larger housing community, governments could consider regularly preparing and disseminating pre-searched and pre-sorted information while making tools (such as RaDiUS) more widely known and accessible. This could also ensure that the results of government-funded research are adequately documented so that the key aspects of the project can be found quickly and shared with others.

Support Education and Training

Education and training are critical to the creation, adoption, and diffusion of innovations. A workforce that is literate and able to think, analyze, and apply new solutions to problems can more effectively create and adopt innovations. Such a workforce might also be better empowered to benefit from and accept innovations.

One may argue that industry should fund the education and training of its workers, but a government role—although not necessarily a federal government role—might be necessitated by two characteris-

⁴Hassell et al. (2001). The report and the corresponding Excel spreadsheet can be downloaded from www.pathnet.org/resource/radius.html.

⁵For more information on RaDiUS, see www.rand.org/radius.

tics of the industry. First, most homebuilders are small and lack the resources to invest in improving the skills of their workers. Second, employment is highly mobile and subcontracting is prominent. For these reasons, homebuilders have few incentives to invest in improving the skills of workers who may or may not work with them again in the future and whose knowledge and skills could soon benefit a competitor.

Hence, one or more levels of government may want to support such efforts (either through direct expenditures or through tax incentives), at least when there is a clear public benefit to such training.

SUPPORT THE ID3 PIPELINE

In addition to supporting research and the sharing of knowledge, the federal government should consider strengthening the core steps of the technology development process, namely, invention, development, demonstration, and deployment also known as the ID3 pipeline. Relevant strategies include improving technology transfer, increasing incentives to perform R&D, and supporting development, demonstration, and deployment.

Support Exploratory and Applied Research for Technology Transfer

Beyond identifying and disseminating information on completed R&D projects, the federal government could also increase support for exploratory and applied research on how existing technologies could be transferred to housing applications. At present, there is only limited support for these activities. A government-wide initiative could bring together participants from industry, government, and academia to identify technologies in the federal R&D portfolio and to transfer them to the housing industry.

An additional strategy for expanding technology transfer would be to create or expand housing-related innovation programs similar to the Small Business Innovation Research (SBIR) programs. At present, federal agencies that receive over \$100 million annually for external R&D are required to have SBIR programs to fund exploratory and applied research for technology transfer. Expanding these programs

where they exist or creating them where they do not could help promote innovation within the largest component of the homebuilding industry.⁶

Modify the Research and Experiment Tax Credit for Small Firms

As currently formulated, the research and experiment tax credit provides a tax incentive for firms to increase their R&D investments. However, this incentive applies only to R&D that is conducted beyond a base amount. For this reason, this tax credit is more effective at expanding R&D programs at large firms than at helping to establish them at small firms. Reviewing the structure of this tax credit could determine if it could better address the needs of small firms, thereby providing another boost to the ID3 pipeline.

Support Development and Demonstration

Beyond research, technology transfer, and invention come development and demonstration. Unfortunately, both of these activities are costly and high risk and offer no guarantee of commercial success. As a result, funding such activities can be difficult, especially for (1) high-risk innovations, (2) small firms, and (3) innovations that produce public benefits but limited benefits to industry participants.

For these reasons, the government could create cooperative efforts between firms and government laboratories, enable the formation of industrial consortia to share costs, or even provide cost-shared support. Such efforts would help good ideas move beyond invention and early-stage development. They could highlight the existence of an innovation, demonstrate the soundness of a technology, provide opportunities to evaluate performance, and stimulate industry interest in commercial production. Finally, these efforts could provide information to help inform decisions about compliance with codes and standards.

⁶Although HUD does not have an SBIR program, the agency is very active in supporting small businesses through its regular procedures. In addition, within HUD, PATH Technology Development Grants are available to, but not dedicated to, small businesses.

Explain the Regulatory Process to Innovators

For an innovation to be accepted by the regulatory system, at a minimum it must be tested, certified, and evaluated. Once an evaluation report is prepared, these early steps may seem easy relative to educating code officials throughout the country about the product. Similarly, changing the model code (and ultimately state and local codes) so that it explicitly allows an innovation can be an even more difficult task. Although each of these steps can be expensive individually, they become more so the longer they are put off because of lack of understanding or bad planning. The government could improve the ID3 process by helping to communicate the importance of these issues to innovators early on (or even providing technical assistance) so that they better understand how the process works.

Provide Technical and Standard Development Support

The government could also expand its efforts to provide technical support to the housing industry, especially by working to link the human and physical assets of the national laboratories and their manufacturing extension programs with the needs and interests of housing innovators.

In addition, innovations are often not accepted until their benefits can be measured and reliably demonstrated. Developing standards to measure performance and reliability is another area where the government could play an important role.

Public Procurement

In those cases where the government is a potential customer for an innovation, it should consider directly purchasing the innovation. The need to spend taxpayer dollars responsibly dictates that prices be reasonable, but large and sustained purchases by the government can help lower the cost because of the lower risk and long-term commitment. Although government regulations currently require awarding purchases to the lowest bid, the government could consider giving preferential treatment to the use of innovative materials, products, or services. For example, during the construction or rehabilitation of public and military housing, the government could

require that light fixtures meet certain energy-efficiency standards. Similarly, federally supported public housing authorities or the federal Weatherization Assistance Program could provide the government with an opportunity to use its purchasing power.

IMPROVE MARKET LINKAGES

Finally, the government can also help promote innovation by improving the linkages among market forces and all other components of the innovation process. Candidate strategies include collecting and analyzing data on market trends, monitoring the performance of innovations, creating linkages among currently independent markets, and creating incentives for end users.

Help Identify Market Trends and Opportunities

The federal government could expand its efforts to identify, analyze, and increase awareness of market trends and opportunities. This is especially true when the rate of innovation is slowed by information barriers, market failures, and externalities. Through credible data collection, analysis, and dissemination, the government could increase awareness of market trends and the opportunities for innovation and ultimately help the private sector focus on finding innovative solutions to public problems. Although federally supported efforts may overlap those of the private sector, government efforts could focus on opportunities related to correcting externalities and increasing the provision of public benefits.

Support Product Performance Monitoring and Evaluation

The federal government could also help monitor and evaluate the performance and adoption of innovations. As noted in Chapter Four, many industry participants stress the need for more reliable information to help assess the potential applications, costs, and benefits of innovations.

Reward Important Innovations with Valuable Recognition

The federal government could also recognize firms and individuals responsible for important housing innovations. Although not federally sponsored, current examples include the Innovative Housing Technology Awards jointly awarded by *Popular Science* magazine and the NAHB Research Center.⁷ A similar though different approach is that of EnergyStar, which allows highly energy-efficient products to use the EnergyStar label to increase the recognition of their products.

However, these existing awards may not target areas most in need of technological change. New recognitions and awards could target areas needing improvement such as water conservation, peak load management, or regulatory streamlining. The federal government might also work in partnership with state and local governments, research institutions, professional and industry associations, and non-profit organizations both to identify technology needs and to evaluate innovations worthy of recognition.

If implemented, such awards might accelerate innovation for several reasons. First, recognition and awards, as marks of excellence, might increase the visibility and credibility of innovations and their innovators and help innovators to secure additional funding for further R&D, commercialize production, or boost sales. Second, they might increase a firm's focus on R&D investment and encourage further improvement. Third, awards might increase confidence in an innovation and people's willingness to adopt it. Fourth, they might send a signal to regulators, industry associations, producers, and retailers, prompting them to examine the innovation and find ways to expand its application or share in the market.

Create Linkages Among Markets

Next, the federal government can play a role in creating linkages among markets that are currently independent. Today's economy is characterized by many different markets for capital, commodities, and managing risk. Linking these markets and allowing them to in-

⁷Phillips (2001, p. 72).

teract easily and at low cost not only provides profitmaking opportunities, but it also helps increase technical and economic efficiency. However, this is only possible once the institutional infrastructure is in place to link markets and the transaction costs are low enough to justify the extra effort. Although improved economic efficiency can sometimes be a sufficient justification for federal involvement, cases where linking markets can reduce externalities and increase public benefits are particularly appropriate for federal involvement. In so doing, externalities can be internalized and market forces can lead to more efficient outcomes.

Examples of creating linkages among independent markets include the following:

- Link residential investments in energy efficiency and renewable energy to the market for traditional air emissions permits (e.g., sulfur dioxide and nitrogen oxides) as well as the small but growing international market for greenhouse gas “emission reduction credits.”⁸
- Securitize the value of emissions permits or reductions for the life of a mortgage so that the reductions can help finance investments in energy efficiency of renewable energy sources; this could benefit the homeowner, the builder, or a third party.
- Rigorously measure and demonstrate that innovations can reduce the risk of natural hazards and use that information to change how insurers approach innovations for which there are no actuarial data; this would help increase the demand for innovations that reduce insurance costs.

Create Financial Incentives for End Users

Finally, to help new markets grow, the government could consider subsidizing the use of innovations, particularly if the innovation

⁸The United States does not currently have a domestic program to manage greenhouse gas emissions, but there is an active if currently small market for greenhouse gas emission reduction credits. The principal market participants are firms seeking to hedge their risks against long-term regulation or those seeking to be even partly compensated for reducing emissions today. For more information, see the Greenhouse Gas Brokerage of Natsource’s web site at www.natsource.com.

could reduce an externality or increase the provision of public benefits. Whether the subsidy is direct or indirect (e.g., a tax credit), it would help increase the use of an innovation. The government might give a higher tax credit to homeowners who use innovations that have a small foothold in the market or those that support priorities in the National Construction Goals, just as it does with the wind production tax credit and the alternative fuel vehicle tax credits.

Furthermore, state and local subsidies could be combined with federal subsidies. This is especially relevant if using an innovation could provide state- or local-level benefits such as reduced water consumption or reduced peak electrical load.

CONCLUSIONS

The strategies the federal government can use to promote innovation presented in this report were based on a systematic examination of what could improve innovation in housing. As a result, this report has suggested how each strategy can supply the infrastructure needed to more fully support the research, knowledge, technology development, and market forces needed for successful innovation. Although each of these strategies is potentially beneficial, for several reasons the strategies should be viewed as a menu of options available to the federal government:

- These strategies are representative, not exhaustive. As a result, other instruments may be more effective or appropriate.
- Even though each strategy can potentially play an important part in creating a better functioning innovation process, not all strategies may be needed.
- This report has neither analyzed nor speculated on the cost-effectiveness of individual strategies and, as a result, cannot suggest the optimal combination of these strategies.

Thus, although this menu cannot tell decisionmakers what to do, it does provide a useful structure for citizens, industry participants, and government officials to discuss innovation, learn from past efforts, and consider new efforts that can work within the existing industry rather than seek to change the industry.

For example, this report can be used as a conceptual framework for federal, state, and local policymakers to consider how different agencies and levels of government can cooperate, coordinate, and leverage their activities to better support the innovation process. It can also be used by public-private partnerships to help each sector better understand and complement the other. Finally, it can also be used to improve existing programs or to create new programs or policies to fill holes and complement other programs.

In closing, it is important to realize that using this framework alone will not ensure a better functioning innovation process. The programs themselves must also prepare and execute solid management plans that specify goals, measure performance, and adjust strategies as conditions change and the effectiveness and cost-effectiveness of each becomes apparent.⁹ Thus, this report does not independently provide the answer to how to increase the rate of innovation in housing, but it does show how a better understanding of the innovation process and the housing industry can be used to improve the ways in which innovation occurs in the housing industry.

⁹See the large and growing body of work on the Government Performance and Results Act, including those by the U.S. General Accounting Office.