

Chapter 6

**Government's Role in
Facilitating New Technology**

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FACTORS IMPEDING INNOVATION

U.S. homebuilders have been slow to incorporate state-of-the-art technologies into their production lines for a number of reasons. Without a policy aimed at identifying and removing existing barriers to innovation, they may continue to retard growth in the productivity of this important industry.

The Regulatory Environment

Inconsistent State and local building codes and differing inspection practices are frequently cited obstacles to technological innovation in the U.S. housing construction industry. This regulatory morass prevents manufacturers from achieving the economies of scale needed to justify large investment in sophisticated production facilities. Due to the absence of Federal initiatives in the area, the major codemaking organizations and the homebuilding industry have begun to develop a formal plan of action for an effective national inspection system; details of this consensus State-based proposal will be addressed.¹ The States, of course, argue that control over housing regulation should remain with State and local government.

The General Accounting Office expressed a similar view in its 1982 report, "Greater Use of Innovative Building Materials and Construction Techniques Could Reduce Housing Costs." The report cited "restrictive and inconsistent local building codes" as a major factor impeding "the use of available technological innovations and the development and introduction of new ones."² On the other hand, some

members of the residential construction industry blame the introduction of the national HUD code system for the sharp drop in "manufactured" (mobile) home sales.

In addition to the problem of market fragmentation, industry spokespersons cite the time and money demands involved in complying with current codes. As one housing producer asserts, in the absence of a national—or sometimes even a State—code:

... the factory is forced to deal with local building officials at a city, township or county level. The magnitude of effort needed to deal with so many different agencies and people takes company resources and engineering skills away from more productive activities. And most important, the unending local changes to the building codes create unbelievable difficulty on the factory assembly line.³

This lack of uniformity adds to the expense of technological innovation, making developers of new products "unable to afford the enormous cost of selling the new technology to numerous regulatory officials."⁴ The closest thing to a national approval in the non-' 'manufactured" (mobile) home industry is the "NER" National Research Board approval. An NER can cost up to \$10,000, and has significant limitations. This detailed approval procedure itemizes every aspect of a given technology. Any change requires reevaluation, and adds expense as a result.⁵ A number of States refuse to accept NERs "because they do not include follow-up production line inspections or inplant visits of any kind."⁶ Eleven States have formed a special task force to certify product approval agencies.

¹Council of American Building Officials, News Release, May 1986; and National Association of Home Builders, International Conference of Building Officials, Building Officials and Code Administrators International, Southern Building Code Congress International, Council of American Building Officials, National Conference of States on Building Codes and Standards, "Concept Paper Prepared by the Task Force on Housing," Mar. 25, 1986.

²U.S. Congress, General Accounting Office, "Greater Use of Innovative Building Materials and Construction Techniques Could Reduce Housing Costs" (Washington, DC: Comptroller General of the United States, 1982).

³Ed Starostovic, "Changes in Manufactured Housing and Construction of Non-Residential Modular Buildings in the United States," unpublished paper prepared for the Office of Technology Assessment, 1985.

⁴Ibid.

⁵Ibid.

⁶National Conference of States on Building Codes and Standards, Inc., May 25, 1986.

America's building codes and enforcement systems may not impede technological innovation directly. They seldom forbid the use of newer materials, components, structural forms, designs or processes; when explicit prohibitions do exist, they are of secondary importance. The real point is that the present system detects technological innovation *indirectly*, by creating market fragmentation.

Inadequate Study of Total Building Systems and Information Dissemination

Unlike Japan and Sweden, the United States does not sponsor extensive research on new housing materials, technologies, systems, or fundamental concepts. Generally, research efforts tend to be short term and related to a specific problem, rather than large-scale, well-publicized projects designed to increase overall productivity. Industry analysts agree that this research gap impedes innovation, and that the lack of institutional and financial research support aggravates the problem.

Fluctuations in the Building Cycle

Unpredictable demand for housing mitigates against capital investment in new technologies. Fluctuations in the building cycle discourage home producers from investing in capital-intensive, highly automated production technologies. In fact, one industry analyst notes that "manufacturers have relied on a highly elastic labor supply in lieu of automation. Large fixed investments in automated and mechanized processing equipment would eliminate much of the flexibility that is so vital to success in a seasonal industry."⁷

On the other hand, other industries have begun to employ systems that manufacture a variety of products; this decreases their dependency on specialized markets. Such flexibility within a sophisticated production system would be preferable, from the worker's perspective, to the current cyclical patterns of layoff, bankruptcy, and startup.

⁷Arthur D. Bernhardt, *Building Tomorrow: The Mobile/Manufactured Housing Industry* (Cambridge, MA: The MIT Press, 1980).

HOUSING REGULATION

The Current Regulatory Framework

Four model building codes form the basis for most U.S. housing regulation, with the exception of HUD-regulated "manufactured" housing (mobile homes). The model codes are developed by the International Conference of Building Officials (ICBO), Building Officials and Code Administrators International, Inc. (BOCA), Southern Building Code Congress International, Inc. (SBCCI), and the umbrella organization, the Council of American Building Officials (CABO). These organizations enjoy a broad-based membership, including both regulatory officials and a variety of private sector building and construction professionals. This membership plays a significant role in maintaining responsive, consensus-oriented codes that serve the public interest.

Each model code group publishes a building code, a plumbing code, a mechanical code, a fire prevention code, and other such documents. These codes correspond to the model code package, to avoid con-

flicting requirements for the same condition. New editions of the code appear periodically, in 3-year cycles. The membership conducts annual code change hearings, voting on amendments to the current edition of the code. The approved amendments enter the next edition of the code.

Each model code tends to be regional. Although certain States have adopted one model code exclusively, some overlap exists. The prevailing regional patterns are: the Uniform Building Code (UBC), promulgated by ICBO and used west of the Mississippi; the BOCA Basic/National Building Code, promulgated by BOCA and used throughout the Northeast and Midwest; and the Standard Building Code, promulgated by SBCCI and used in the South. CABO oversees the three. Currently, local governments apply several thousand major and minor variations of these basic codes. There are at least as many inspection systems, with differences in building code interpretations and varying degrees of enforcement. The various fire safety codes and inspection systems that

relate to buildings compound this regulatory complexity.

Thirty-four States have adopted preemptive State codes for modular housing. Those codes cover component housing systems, including panelized homes in 28 States, large components such as “wet cores” in 31, and precut houses in 6. While these preemptive codes reflect significant efforts by States to consolidate codes for industrialized housing, they have not eliminated the problems of diversity and complexity. Twenty-five States prescribe mandatory minimum standards, 7 establish mandatory maximums, and 11 set both mandatory minimums and maximums—“mini-max,” or single mandatory codes. Two of the preemptive State codes are mandatory unless specified otherwise. In one State, a local political jurisdiction may amend the mandatory State code with State approval.

Enforcement systems also vary, both among and within States. Inspections are conducted by State officials in 31 States, by county officials in 8, and by municipal officials in 13. Twenty-three States allow inspections by third-party private firms. Omitted from these figures are the 16 States that do not have building codes for any type of factory-built housing,

This complex regulatory system poses formidable problems for large U.S. homebuilders. The producer must satisfy hundreds, if not thousands, of building codes and inspection systems in order to serve the national market and still abide by the law. Disparities between State transportation codes governing large trucks add to the confusion. A spokesperson from the National Association of Home Builders estimates that a uniform code for modular and panelized homes would reduce costs by 3 to 5 percent.⁸

Producers of modular and panelized homes face other problems. Because the walls of some of these building systems are closed at the factory, certain features cannot be inspected at the final building site. Instead, they must be examined at the factory, which may be located far from the site. These factory inspections replace a significant part of the onsite work that is traditionally done by government building inspectors.

A number of communities around the Nation create de facto building regulation through zoning and

other local codes. Zoning can be employed in ways that “exclude people from the community,”⁹ such as confining “manufactured” (mobile) homes to “trailer parks” in disadvantaged locations, or requiring significant lot or house sizes.

As a result of this situation, U.S. housing producers have been slow to introduce either innovative housing designs or advanced production technologies.

The HUD Code System

The HUD regulatory system for “manufactured” (mobile) homes represents the only uniform national building code and enforcement system for factory-produced housing.¹⁰ Consequently, this 10-year-old “HUD code,” which replaced and adopted large sections of an earlier voluntary code system developed by the industry, serves as a model against which others may be measured.]]

Due to the establishment of this system, a uniform national building code for “manufactured” (mobile) homes now exists throughout the United States. Approximately 400 manufacturing plants in 24 States are currently inspected by a system that involves State agencies, third-party private inspection firms, a national monitoring contractor, and HUD. HUD administers the program with a small staff of Federal employees, at minimal cost to the Federal Government. Covering the program’s cost are inspection fees—up to \$75 per transportable unit—paid for by the manufacturers, and ultimately by customers.

⁸ Stephen Seidel, “Housing Costs and Regulations Confronting the Regulator Maze” (New Brunswick, NJ: Center for Urban Policy Research, 1978), p. 174.

¹⁰ The Minimum Property Standards for One and Two Family Dwellings, used to approve federally guaranteed mortgages and in other Federal housing programs, is another type of national building code and enforcement system, administered by HUD. This system has existed since the 1930s, much longer than the HUD code system for “manufactured” (mobile) homes. However, this system relies heavily on other codes and enforcement systems. It was not designed to address the unique problems of factory-produced housing, especially on the inspection side, nor did it replace other building codes and inspection systems of the same buildings. Until recently, it included some features of building codes, but also included site and building designs, and other acceptability criteria not usually covered in building codes. Also, the Federal dimension of the Act has been weakened by recent legislation that allows for the substitution of functional State and local codes for national standards.

⁹ Bernhardt, op cit.

⁷ General Accounting Office, op cit.

Problems of the HUD Code System

Congress will need to examine the HUD code system if alternative regulatory schemes for factory-built housing are to be considered. Various problems that surround today's HUD code homes may become more pronounced if this regulatory scheme is "stretched" to cover other categories of manufactured buildings, or to serve higher income markets where owners may be more critical.

The Potential for a Conflict of Interest.—The existing HUD code system creates the appearance of a conflict of interest on the part of design and construction inspectors, since fees and services are negotiated directly between manufacturers and HUD-approved private firms. The housing manufacturers themselves hire both the third-party firms that assess home designs against HUD code standards—Design Approval Primary Inspection Agencies (DAPIAs)—and those firms that conduct in-plant inspections during the construction of approved designs—Production Inspection Primary Inspection Agencies (IPIAs). The manufacturer pays these firms, and also has sole discretion over future rehiring decisions. Currently, 8 private firms do over 90 percent of the design approval work, and about 35 percent of the in-plant inspections, for the Nation's "manufactured" (mobile) homes. State government agencies, acting as exclusive inspectors, conduct the remaining design approvals and in-plant inspections, which has given rise to other problems.¹²

PIAs must meet rigid HUD criteria to avoid conflicts of interest, but whether HUD can ensure that these criteria will continue to be met is uncertain. Some members of the "manufactured" (mobile) home industry would like to modify the existing system by eliminating the exclusive right of States to act as IPIAs. At the same time, they would like to maintain Federal preemption of State and local codes that, in many cases, are more stringent than the Federal standards. If Congress wishes to ensure effective national regulation of the industry, HUD's statutory authority in these areas will need to be strengthened and made more consistent.

¹²U.S. Department of Housing and Urban Development, *Fifth Report to Congress On the Manufactured Housing Program* (p. 51) illustrates performance problems of State agencies and private firms through 1982. Although HUD has not yet published data for subsequent years, other information indicates continuing problems as well as improvements since that time.

While there are similarities between the functions served by IPIAs and certified public accountants, IPIAs are not subject to many of the certification requirements faced by CPAs. Both are charged with serving the public interest; however, CPAs—unlike IPIAs—are subject to rigorous preliminary examinations, as well as to professional and State regulation. The threat of removing a CPA's certification provides the public with protection against default.

It is important to note that the concept "potential for a conflict of interest" is used to avoid the need to prove impropriety. Certain public individuals must not only be above criminal behavior, but should avoid situations where the public trust and confidence would be shaken by even the possibility of illicit financial considerations. For example, judges cannot vote on cases when they own stock in a corporation that is before the court, even if there is no suggestion of individual venality. The IPIA/DAPIA system, however, does not guarantee that a conflict will not arise; for example, the system allows a regulated party to discharge an inspection agency.

Various administrative remedies may reduce the incentives for abuse. HUD, rather than the manufacturer, could set and collect inspection fees. Manufacturers and private inspection firms could be required to sign 2- or 3-year contracts for services, giving the firms more independence from their employers. Firms might be permitted to do engineering design and drawings, or design approvals, or in-plant inspections, but not all three. The Federal enforcement agency could assign Federal inspectors, or select private inspection firms, in cases where monitoring indicated frequent violations of minimum standards. As matters now stand, only IPIA's have the authority to pull Federal labels for noncompliance with HUD standards; the government can act only to counter an imminent safety hazard. Technically, HUD can inform the IPIA or the manufacturer that a unit failed to conform with a code requirement, but whether steps have been taken to use this authority in a meaningful way has not been demonstrated.

This is not to suggest that private firms cannot perform responsible inspections; the advantages of non-governmental inspection systems will be discussed later in this report. Nevertheless, the potential for a conflict of interest is built into the present system. Existing monitoring and enforcement practices pro-

vide insufficient protections against the potential for abuse. The steps described above suggest some ways in which enforcement might be improved.

Responsibility for Compliance With Codes.—The HUD code system clouds responsibility for compliance with national standards. The regulations do not require that the consumer be notified as to whether the “manufactured” (mobile) home complies with the standards. The manufacturer must certify to the dealer or distributor that the structures meet the code,¹³ but the approved label for retail units provides no such assurance. This consumer label states:

As evidenced by this label No. ABC 000001, the manufacturer certifies to the best of the manufacturer’s knowledge and belief that this manufactured home has been inspected in accordance with requirements of the Department of Housing and Urban Development and is constructed in conformance with the Federal Manufactured Home Construction and Safety Standards in effect on the date of manufacture.¹⁴

The label certifies inspection, but not compliance beyond a good-faith effort.

Homebuyers have limited recourse without an express guarantee. In fact, certain State laws may be of no help to the consumer, since the manufacturer may avoid State regulations in excess of Federal statutory requirements. While consumers may pursue remedies involving repair of minor defects, the legal framework seems to prevent States from acting on their behalf, which would constitute an alternative regulatory structure.

HUD does not permit “false” advertising, which would imply HUD endorsement of a “manufactured” (mobile) home. Indeed, HUD has issued a categorical denial of responsibility:

Any assertion that the Department directly or indirectly approves the construction or sale of any mobile home or that the Department inspects mobile homes is false, except in the rare case where a mo-

mobile home has actually been inspected by an employee of the Department. Even in those cases the Department has not approved the home.¹⁵

The recent Varig Airline case confirms that under HUD regulations, the Department cannot be held responsible for failure to ensure proper inspection.

Failure To Require Full Compliance With All Standards.—HUD regulations and enforcement mechanisms also fail to assure that every home complies with all HUD code standards. The present HUD code system requires inspections by State agencies or third-party private firms of a sampling of homes in a manufacturer’s production line. Each home is inspected in at least one stage of production, and the number of production stages varies; the current Acceptable Quality Level (AQL) list includes 174 inspection items. Furthermore, HUD has not prescribed uniform test procedures to assure compliance with its performance standards.

Complete data have not been compiled on non-compliances with HUD standards. However, HUD’s contractor, the National Conference of States on Building Codes and Standards (NCSBCS), conducts monitoring inspections of each manufacturing plant at least twice a year. These inspections aim at evaluating the manufacturers’ internal quality control systems, as well as the performance of State agencies and third-party private firms that do in-plant inspections.

Although not intended for this purpose, the NCSBCS data developed from these semiannual inspections suggest the frequency of noncompliance of all units produced in HUD-inspected factories. Manufacturers often learn of NCSBCS visits in advance, and prepare accordingly; as a result, nonconformance identified through such inspections may underestimate the actual figure. Data provided to OTA by HUD for December 1984 through May 1985 indicate that most homes produced during that period failed to conform to one or more AQL items, averaging 3.6 non-conformances per inspection (see table 13). Another breakdown of NCSBCS data, for November 1984 through March 1985, indicates that 8 percent of all nonconformances related to AQL items in planning and fire safety, 55.5 percent to construction, 16.9 to electrical items, 11.3 percent to thermal items, and 8.1 percent to plumbing items.

¹³Section 616 of the National Manufactured Housing Construction and Safety Standards Act states:

Every manufacturer of manufactured homes shall furnish to the distributor or dealer at the time of delivery of each such manufactured home produced by such manufacturer certification that such manufactured home conforms to all applicable Federal Construction and Safety Standards.

143282 .362(c)2(c), p. 253.

¹⁵U.S. Department of Housing and Urban Development, *Fourth Annual Report to the Congress on Mobile Homes*.

**Table 13.—Compliance With Acceptable Quality List
(December 1984-May 1985)**

Percent of AQL items in compliance	Percent of units in the specified compliance range
95-100	30.1
90-95	30.1
85-90	23.6
80-85	9.8
<60	6.5

SOURCE: U.S. Department of Housing and Urban Development.

Although this record appears to be poor, the present HUD code system does protect the public from “imminent safety hazards” that present “imminent and unreasonable risk of death or serious injury”; it does guard against major defects which occur when a series of homes exits the production line; and it does initiate a consumer complaint process, operated by HUD and by State administrative agencies who can respond without Federal enforcement authority.

However, the Federal system provides limited protection for the individual purchaser whose home fails to comply with the standards. HUD addresses consumer complaints from States that have not established administrative agencies for the HUD “manufactured” (mobile) home program. Although the purchaser may go to the courts, he bears both the expenses of this action and the burden of proof. Except for health and safety problems, such as formaldehyde emissions from plywood and particle-board materials, court action has little use or effect in the present HUD code system. Furthermore, most HUD code “manufactured” (mobile) homes are sold to lower income purchasers, who tend to avoid the costs of litigation.

The experience of the HUD code system raises questions that may affect the formulation of industrywide regulations for all categories of residential construction. Even the existing HUD regulations may need review, in light of newly available information; although HUD’s data for estimating nonconformances in production, and for evaluating regulatory performance, need improvement, Department statistics do indicate a number of important issues. For example, production defects can now be detected, counted, and reported. What levels of quality, what standards, and what degrees of conformance should be considered acceptable? How should the regulatory system employ the data for enforcement? Should fac-

tory production involve inspection of production lines rather than of individual units, as is done for site-built housing?

Weakness of Remedies and Penalties for Non-compliance.—HUD may lack the legal authority to enforce full compliance with certain code standards. Under HUD regulations: “A manufacturer. . . shall correct, at its expense, any imminent safety hazard or serious defect that can be related to an error in design or assembly of the manufactured home.”¹⁶ HUD has interpreted this congressional enabling legislation to mean that it cannot require manufacturers to bring defective homes into code compliance, unless “unreasonable risk of injury or death” exists. According to this interpretation, questions of durability, quality, and amenity remain outside HUD’s jurisdiction. On the other hand, the HUD code’s “Statement of Purpose” calls upon HUD to improve the quality and durability of manufactured homes.¹⁷ Federal legislation may be needed to resolve this double standard.

Formal rulemaking guidelines dictate attempts to increase inspections, and steps to disqualify Primary Inspection Agencies for improper or insufficient inspections—or for improper awarding of Federal labels—are complex and protracted. Moreover, under the preemption section of the statute,¹⁸ States may not enforce the Federal construction and safety standards more stringently than the Federal Government. Still, some States have used their business licensing or registration laws to enforce the HUD code standards when HUD has failed to require compliance.

Inadequate Provisions for After-Factory Inspections.—The present HUD code system emphasizes in-plant inspections, an important area of code enforcement for all types of industrialized housing. However, the present HUD code system lacks an efficient framework for after-factory inspections. Through no fault of either the manufacturer or the manufacturing process, many “manufactured” (mobile) homes with Federal labels fail to meet HUD standards on arrival at their final destination. Units may be altered or damaged at dealerships, where they are stored and shown to customers; or, the

¹⁶3282.406.

¹⁷Title VI, Section 602.

¹⁸3282.11.

rigors of transportation from factories to dealer lots and from dealer lots to final building sites may decrease quality, especially when units are transported along uneven country roads. The problem of “torque,” or the twisting of the entire unit, can arise if the home does not rest on a level foundation at the final site. “Tie-downs” to foundations, connections between double-wides or multiple units, and utility hook-ups pose additional problems at the building site.

The after-factory inspection process depends on State and local regulatory systems. Under HUD regulations, dealers may not sell units that have failed to meet HUD code standards. However, many State and local agencies do not conduct visual inspections of units on dealer or buyer lots; when inspections are made, reporting and followup are minimal. NCSBCS has developed a voluntary consensus standard for “siting” of units, but although CABO and NCSBCS have developed code language for this purpose¹⁹—which may or may not be used—a Federal onsite system of inspections or enforcement does not exist.

Lack of Incentives for Improving Durability and Quality.--The HUD code program was designed to improve durability and quality, along with safety. While the safety record of “manufactured” (mobile) homes has improved, it is still less than that of site-built housing; also, it is difficult to show that durability and quality have been addressed. Furthermore, while some manufacturers satisfy HUD code standards with ease, the regulatory system for “manufactured” (mobile) homes does not recognize differences in quality. As a result, many producers build down to minimum safety, rather than up to minimum quality standards.

The implications of this extend to energy costs, which are higher in HUD code homes than in those that satisfy the requirements of Title V of the Farmers Home Administration (FmHA). A recent study conducted for the Department of Energy revealed that if FmHA energy standards were used instead of HUD’s Title V standards, energy consumption of most units would be reduced by 37 to 46 percent. HUD’s own Title II-E standards, which apply only to “manufactured” (mobile) homes on a permanent

foundation, would improve energy performance by 4 to 23 percent.²⁰

A proposal to establish quality grades within categories of industrialized housing offers a solution to this problem, and will be addressed in this report. The marketplace, rather than market advantages created by government regulations, would then determine the levels of quality that home producers could offer to informed or affluent customers.

The Role of Federal Oversight. -In general, the “manufactured” (mobile) housing industry supports the preemptive Federal standards that currently guide all U.S. “manufactured” (mobile) homes, while HUD would like to grant more control to the marketplace, and to State and local standards. Also, HUD and the industry have differing views on enforcement procedures; many industry representatives would like to see less Federal oversight, as well as the elimination of the States’ right to act as exclusive inspection agencies. Many States, however, have expressed concern over proper levels of inspection, and worry that a weakening of the preemptive Federal system could aggravate problems.²¹ The States have assumed some blame for the present situation; they are now developing recommendations on how to improve the State role in national housing regulation reforms.²²

Criteria for a New Regulatory System

The following sections of this report suggest possible alternatives to the present system of housing regulation in the United States. First, however, a set of criteria is presented, against which such proposals could be judged. Throughout the discussion, the phrase “a national system of building codes and inspections” is used generically to imply a high degree of national consolidation and organization. A national system may be legislated or operated by the Federal Government, by State or local governments, or with the regulatory participation of third-party private firms. It may be a single consolidated system for the entire country, or a national organization

²⁰Pacific Northwest Laboratory, “Impacts of Alternative Residential Energy Standards,” November 1985, p. 9.2.

²¹Combined Meeting of the NCSBCS Regulatory Affairs Committee, State Manufactured Building Administrators, and State Building Officials Subcommittees, Arlington, VA, Apr. 23, 1986.

²²NCSBCS, May 1986, op. cit.

¹⁹NCSBCS, May 1986, op. cit.

comprised of subsystems for different types of manufactured buildings, for manufactured buildings that meet certain criteria, for different code-setting or inspection functions, or for different multi-State geographic regions,

In order to remove regulatory impediments to residential construction and its related industries, a modified national code and inspection system might be evaluated against the following criteria:

1. *Does the system apply to all categories of industrialized housing and modular nonresidential buildings?* Those buildings that contain closed components, factory-made to fit and function together, could be emphasized.
2. *Does the system facilitate market aggregation?* Under a relatively uniform framework, firms may anticipate the codes and enforcement systems that factory-built homes must satisfy within a large geographic area. Uniformity would also enable manufacturers to achieve economies of scale from factory production-line systems. Ideally, with appropriate adjustments for climatic and other features, such as energy requirements, wind and snow loads, and seismic requirements, a unit produced anywhere in the United States could be used nationwide.
3. *Does the system include reliable and consistent enforcement, to protect manufacturers, dealers, and contractors from subjective or arbitrary interpretations of codes?* This would protect the public from the consequences of code violations.
4. *Does the system reduce costs and administrative burdens associated with regulation?*
5. *Does the system leave as much control as possible in the hands of local regulatory authorities?* Regional or national codes need not undermine well-designed State or local codes. Instead, the new regulatory mechanism could be built on successful State and local experiences.
6. *Does the system constitute part of a coherent housing policy that provides Americans with the highest quality at the lowest cost?* This would require programs that protect consumers while encouraging industrial innovation and entrepreneurship.

Alternative Regulatory Systems

Historically, the writing and enforcement of building codes in the United States have been performed by the same unit of government. In contrast, the very nature of industrialized housing invites a separation of these functions. How and by whom codes are written may differ from where and by whom codes are enforced. Moreover, although the codes themselves have received the most attention—resulting in four national model codes—the Nation's fragmented code enforcement system poses a larger impediment to the development of the industry. Consequently, initial alternatives for a national system relate to the enforcement function.

Local factors also enter into play. Until the 20th century, most housing construction was a function of commerce within States. Traditionally, Congress has deferred to State, county, and municipal desires in such matters. As a result of technological developments in recent years, housing has entered the realm of interstate commerce. Some industry experts believe that a Federal system would bring the regulatory function in line with the current residential construction process. On the other hand, this would tend to dilute local control, and might provoke opposition from State and local building officials and their related constituencies.

The following discussion describes four categories of alternatives: systems in which the Federal Government has lead role; in which the State Government has lead role; in which private organizations have the lead role; or cross-cutting strategies, which may combine all or any of the three. These alternatives do not represent complete or detailed designs of regulatory systems. Rather, they should be viewed as generic possibilities, which hold the potential to develop new systems.

Systems Administered by the Federal Government

An Expanded HUD Code System.—The HUD code system might be expanded in its present form, making it a federally preemptive, national system that would cover other categories of industrialized housing and related nonresidential modular buildings. This would require congressional legislation.

Under this alternative, the system could grow stronger through legislative or administrative modifications. Along these lines, the NCSBCS has developed an improved system of quality control and compliance evaluation for HUD, in consultation with industry representatives; the system is now in review. These and other administrative steps may improve compliance with the HUD code for durability and quality features of “manufactured” (mobile) homes.

Alternatives to HUD Code Regulation.—The present HUD code system could be enlarged to cover other categories of industrialized housing and related nonresidential modular buildings, but would be altered in one or all of the following ways:

- Congress might create an independent Federal commission, board, or administrative agency to regulate manufactured buildings covered by the Federal system, replacing HUD’s responsibilities in this area. Or, HUD’s regulatory functions might be assigned to another existing agency. In either case, HUD would retain the broader responsibilities for affordable housing and would participate in code setting, but would not supervise code enforcement.

It is difficult for any Federal agency to regulate its own constituency. At present, HUD encourages construction of minimum purchase-price housing, and regulates construction—which may mean increasing housing costs. This alternative would separate the developmental and regulatory functions in residential construction, making it similar to the areas of nuclear power, transportation, and environmental protection.²³

- A Federal system might preempt State and local regulations for all industrialized housing and related construction, but could be limited in several ways. The system could cover all factory-built homes and related nonresidential modular units that are shipped across State lines, removing impediments to interstate commerce.

²³Responsibilities for promoting and regulating nuclear power are divided between the Department of Energy, and the independent Nuclear Regulatory Commission; responsibilities in the field of transportation are divided between the Department of Transportation, and the independent National Transportation Safety Board; and environmental responsibilities are divided between the Departments of Energy and Commerce, and the Environmental Protection Agency.

Or, such a system might include only integral manufactured building systems with closed construction, such as HUD code “manufactured” (mobile) homes; certain modular homes, commercial modular buildings, or panel systems; or large closed components such as “wet cores”—all of these products must be inspected in the factory. State or local governments would still conduct onsite inspection of factory-made buildings when the site and the factory are in the same State, for “open” manufactured building systems and for large “open” components.

A recent proposal for Federal regulation of appliances, supported by both appliance manufacturers and environmental groups, illustrates this principle. The proposal calls for certain Federal standards to preempt several State and local guidelines, creating a more uniform code system that would benefit both producers and consumers.

- In order to ensure the successful implementation of any alternative to HUD code regulation, Congress might strengthen the language of the statute that guides the present system. A federally based system for all categories of industrialized housing could foster technological research and development by guaranteeing consistency in Federal standards.

For example, the statutes could specify HUD’s role concerning energy standards. HUD is now in the process of amending the code’s thermal energy requirements. These guidelines were introduced by HUD, and may soon undergo HUD-initiated changes, even though the original statute did not give specific regulatory authority over energy to the Department.

Incentive Systems.—The Federal Government might adopt a “carrot and stick” approach to encourage States to establish a uniform national code. Such a nonregulatory incentive system for industrialized housing and related nonresidential construction could rely on Federal financing or mortgage guarantees, direct funding to State or local governments, government purchasing, or tax incentives. The incentives need not be new or special subsidies, but could be based on contingent approvals that would allow participation in existing Federal programs. The Federal Government already operates numerous programs that benefit homebuilding, espe-

cially those that guarantee or supply credit through the Federal Housing Administration, Veterans Administration, Farmers Home Administration, Government National Mortgage Association, and other such agencies.

The HUD-administered Community Development Block Grant program could serve as another non-regulatory incentive. Builders might qualify for grants only if their homes satisfied quality standards established by an organization like NCSBCS. This option would also encourage States to adopt standards that resemble a national code, so that their home industries could qualify for Block Grant funds.

Sweden maintains a particularly effective incentive system. Only those homes that meet stringent performance standards are eligible for the Swedish equivalent of FHA or VA housing subsidies. As a result, the performance characteristics of most new homes exceed those prescribed by statute, especially with respect to energy. This system created such high levels of thermal performance that energy standards could be increased without affecting most construction methods.

These incentives, combined with reliable inspection systems, might persuade State and local governments to bring their codes for manufactured buildings in line with a single, national model code, and they might convince State and local governments to accept industrialized housing and related nonresidential modular buildings produced and inspected in other governmental jurisdictions. This would tend to encourage capital-intensive research, since companies would not have to satisfy a myriad of local codes in order to introduce new technologies to several parts of the country.

The underlying principle exists in two current Federal programs. The interstate highway program transfers funds to the States, contingent on their compliance with federally accepted roadway standards, and conditions like the 55 miles-per-hour speed limit and the 21-year-old minimum drinking age. And the Minimum Property Standards (MPS), administered by HUD, constitute a powerful nonregulatory incentive system; mortgage approvals depend on conformance with certain standards. This ties improvements in technology to the financing process, although other HUD-approved regulation tends to negate such a

connection.²⁴ Also, many previous Federal programs have transferred funds to State and local governments, subject to specific requirements and conditions.

Voluntary Systems.—Under this alternative, manufacturers could select between making their housing subject to Federal approval under a Federal preemptive system, to otherwise applicable State or local government regulations, or to a combination of the two, depending on the type of housing involved.

The Nation's banking system illustrates the principle behind this alternative. The Federal Reserve System gives banks the choice of being either federally or State-chartered, subject to different requirements and regulations. Savings and loan associations may also take advantage of this option.

The present HUD code system operates in a similar manner, although the advantages offered by Federal approval make it impractical for manufacturers to have the "manufactured" (mobile) homes inspected at the State or local level. Producers of both HUD code "manufactured" (mobile) homes and modular homes better illustrate the idea of choice. The latter now fall under State or local regulations. With the "choice alternative" in force, a manufacturer could select the code and enforcement system that best corresponds to the structure being built.

Currently, the Federal Government confers competitive economic advantages to building manufacturers by preempting State and local government regulations—primarily because of benefits stemming from market aggregation. Given these advantages, and the potential advantages of a Federal inspection label for factory-built homes, the Federal Government might set and enforce high-quality standards. This could encourage industry development under a manufacturers' choice alternative.

²⁴In response to complaints of unfair competition from private sector certification groups, HUD has instituted a fee for certification of new technology in its "Technical Suitability of Products Program." Although HUD's charges remain lower than those of the private sector organizations, their presence has led to a decrease in the number of innovative construction programs available to the American marketplace, since developers have less incentive to introduce new technologies.

State Government-Based Systems

Three State government-based systems, in which State governments have the leading role, are discussed below. State regulators contacted by NCSBCS “showed fairly equal support for all three systems.”²⁵

Multistate Compacts.--Multi-State compacts, or interstate compacts, are congressionally approved agreements among or between States. Congress sets the rules for any such multi-State arrangement, and State legislatures may vote to enter such compacts only with congressional consent. Having joined, a State may withdraw only under rules established by Congress. The regulatory or operating authority of the compact depends on the nature of the congressional mandate. Over 200 multi-State compacts have been enacted in the United States, for such diverse purposes as water allocation, transportation and port development, corrections, education, forest fire protection, health, motor vehicles, radioactive waste disposal, pest control, planning and development, public works, recreational parks, civil defense and disaster, and welfare.

Historically, compacts have been bilateral, regional, and national in scope. Until the 1920s, most were agreements between two States. The next generation of compacts dealt with regional problems, such as the Colorado River Compact that embraced seven States. The first national agreement was the Interstate Compact for Supervision of Parolees and Probationers, established during the 1930s. Functional compacts, or multilateral agreements that did not rely on regional identification, developed in the 1930s as well; the Interstate Compact to Conserve Oil and Gas was open to all oil-producing States. Compacts also began to serve regulatory purposes; New Jersey and New York enacted the Tri-State Sanitation Compact in 1935 and 1936, respectively, joined by Connecticut in 1941. The Ohio Valley Sanitation Compact represented an early regulatory agreement for a river basin region. Since World War 11, the proportion of regional and national compacts has increased relative to bi-State agreements.

Multi-State compacts create a legal regulatory framework between or among States, and employ constitutional powers at both Federal and State levels. They offer two direct advantages to the ap-

plication of Federal regulatory authority. First, initial State participation is voluntary. Second, while the States give up individual sovereignty for the larger purposes or programs, the agencies that administer such compacts are controlled by the member States. The Federal Government may play a role, but in a subordinate capacity.

Multi-State compacts offer the following advantages for the regulation of industrialized housing:

1. Multi-State compacts would establish reciprocity among States, so that manufactured buildings produced and inspected in one State could be accepted by another.
2. Multi-State compacts could serve as an intermediate preemptive system, superseding the authority of individual States but under the auspices of a federally based preemptive system.
3. Since State codes tend to follow regional groupings, compacts might be created for a limited number of regions across the country. Contiguous or nearby States may reach agreements with one another more easily; most manufactured buildings move regionally, not nationally, because of transportation costs. Also, multi-State compacts might differ according to regional considerations like climatic conditions or market preferences.
4. Multi-State code enforcement for industrialized housing and manufactured commercial buildings might rely on existing State agencies and systems, instead of spawning additional bureaucracy.

The Federal Government might provide incentives for States to join multi-State compacts. Federal financing or mortgage guarantees and other contingent approvals have been described for a nonregulatory Federal incentive system in a previous section. Another kind of incentive involves the Federal Government as an equal partner in the compacts. An enlarged HUD code system, or a modified system of Federal administrative agencies, could have preemptive regulatory authority over manufactured buildings produced in or shipped to States not belonging to multi-State regulatory compacts, encouraging States to join such agreements. In this way, the Federal Government's activities would tend to diminish over time. The Abandoned Mine Reclamation Program illustrates this principle: once a State develops a feder-

²⁵NCSBCS, May 1986, *op cit.*

ally approved program for mine reclamation, it assumes full control of the program.

Special Regional State Legislation Allowed by Congress.—The recent Supreme Court decision of June 10, 1985, *Northeast Bancorp, Inc., et al. v. Board of Governors of the Federal Reserve System, et al.*, suggests an alternative that resembles the multi-State compact. The court held that since Congress had authorized States to determine what banks could operate within their borders, States were not obliged to accept all banks. The New England States limited approval to regional banks, excluding New York.

The ruling in favor of this policy has important implications for the housing industry. Citing this as precedent, Congress could pass a Federal statute allowing for regional reciprocal cooperation by States in the area of manufactured buildings. This differs from the concept of a multi-State compact, since no regulatory authority would be established.²⁶ Rather, States would cooperate with one another based on their respective market needs. For example, a State might declare that if other States accepted its own inspection and certification standards, it would respond in kind. This would enable States to limit agreements to nearby “acceptable” States, which hold similar views on codes and code enforcement.

Essentially, such an agreement would represent a lesser form of the multi-State compact in manner, geographic extent, and strength of commitment. However, while this would improve geographic market aggregation by regionalizing the manufactured building industry, it would tend to impede the development of a national system.

Non-Federal Negotiated Agreements.—This alternative involves agreements negotiated between State or local governments, or between a State or local government agency and a private third-party inspector or manufacturer. There is no Federal participation, and agreements need not be accompanied by specific legislation. Such arrangements may be made on a case-by-case basis, and do not require association with a statutory system.

²⁶Although Article I, Section 10.1 of the U.S. Constitution holds that “no state shall enter into any treaty, alliance, or confederation” without congressional approval, associations that do not legislate actual regulatory power—as was the case with *Northeast Bancorp*—have been permitted.

A broad spectrum of formal and informal agreements are covered by this alternative. At one extreme, construction that is not covered by HUD codes—in particular, modular housing and modular nonresidential buildings—could be regulated by ad-hoc arrangements made at the discretion of public officials. State or local governments could agree to accept units that have been produced and inspected in a different jurisdiction. Such negotiated agreements may employ third-party private inspectors, or State inspectors situated close to the factories.

At the other extreme, reciprocal legal arrangements among States for the acceptance of manufactured buildings other than HUD code “manufactured” (mobile) homes can and are now being developed without Federal assistance. Eleven States report some type of agreement with one or more States. Florida, Georgia, and South Carolina will soon conclude a reciprocity agreement, and may be joined by Louisiana, Mississippi, North Carolina, Tennessee, Texas, and Virginia.

Developments within States have facilitated State reciprocity. Many States have begun to confront the problems of manufactured buildings other than HUD code homes, and have consolidated codes and enforcement systems already. Although differences remain both between and within States, 34 different statewide codes preempt local government standards for modular buildings; 28 States have adopted such codes for packaged panelized buildings systems; 31 preempt local standards for large closed components like “wet cores”; and 5 cover precut homes. On the enforcement side, 31 States use State inspectors for manufactured buildings, 21 use county or municipal inspectors, and 23 use third-party inspectors.²⁷

In the absence of more complete solutions, negotiated agreements have allowed State and local governments to combat the regulatory problems presented by industrialized housing, especially those relating to factory construction. However, this type of governmental oversight presents problems of consistency, and abuses have been reported. Assuming that the manufactured building industries will continue to enjoy sizable growth, negotiated agreements would be the weakest of all State-based alternatives. Such agreements may be easy to implement,

²⁷NCSBCS, unpublished data.

but uniformity over a large multi-State region is difficult to achieve and may not stand the test of time.

Proposals of NAHB and the Building Code Associations. -As noted earlier, the National Association of Home Builders, NCSBCS, CABO, BOCA, ICBO, and SBCCI have agreed on principles for a State-based regulatory system that would affect codes and inspection systems throughout the country. They are now in the process of converting these proposals into a formal regulatory system with adequate funding. The system would be based on the following guidelines:

- One of the three major model building codes would be adopted by the States. Local jurisdictions could not make amendments.
- States would enforce the regulations that applied to factory-produced housing, and local jurisdictions would oversee codes for site-built housing.
- The selected model code would be mandatory for all factory-built housing, and for all site-built housing constructed in jurisdictions that use building codes.
- Amendments to the codes would be reviewed “through channels currently used for the model building codes” and “the States would establish a uniform procedure for evaluating and approving new products, design concepts, and construction techniques.”
- States would agree to reciprocity agreements for all industrialized buildings.
- Education and training would be provided for builders, building trade workers, and regulatory officials .28

Private Responsibility Systems

Private companies and associations play a substantial role in governmental processes for regulating the U.S. housing industry. This participation takes various forms, such as developing consensus standards, establishing model buildings codes, and testing materials.

The American system resembles a gigantic voluntary regulatory scheme, considering the number of private organizations that participate. An estimated 1,800 private American companies manufacture components for homes, and many of these help to

develop consensus standards for their products that are later incorporated in building codes. Private firms and industry representatives do much of this work through organizations like the American National Standards Institute and the American Society for Testing and Materials. Industrial trade associations also implement consensus standards, and, as noted, the three major model building codes come from the nongovernmental organizations and CABO.

In addition, numerous profitmaking and nonprofit laboratories test materials, products, and buildings. Underwriters Laboratories, Inc., a private nonprofit firm, occupies a unique position in the industry. The approval of electrical items by Underwriters, or by a laboratory of equal stature, stands as a legal and practical prerequisite for government approval.

Application of Private Regulation. -Private responsibility systems raise questions of accountability: who is responsible, how, and to what extent? Are there any models or examples of effective private responsibility systems that can apply to residential construction, especially in matters of enforcement?

In response to these questions, European systems of private assurance deserve analysis. Belgium has a strong private liability law, under which architects and builders are held responsible for 10 years in matters of building safety and durability. SECO—roughly translated as the “Bureau of Control and Proofing of Building Safety and Construction”—is a nongovernmental engineering consulting organization that tests and inspects all types of structures. Government approvals require SECO inspections; insurance companies also call for SECO inspections as a prerequisite for issuing policies to builders and owners. SECO divides its attention between municipal authorities and the private sector—builders, manufacturers, insurance companies, and building owners. SECO’s work includes laboratory testing, reviews of designs and plans, onsite and factory inspections of buildings and components, and plans and reviews of quality control systems. The firm handles approximately 90 percent of all such activities in Belgium, and Belgian courts interpret “good practice” consensus standards developed by SECO. In turn, SECO is legally liable for the advice and approvals that it gives.

Similar systems exist in other countries. In France, several nongovernmental organizations operate like

²⁸CABO News Release, May 1986

SECO. Local governments or councils in Great Britain and Sweden are legally liable for the inspections made under their auspices. A British law passed in 1984 provides for home liability, and enables the government to accept inspections performed by properly bonded private firms.

More investigation of the effectiveness and problems of European systems is needed. However, these models do suggest possibilities for a "private responsibility" approach in this country, where most government entities have not been legally liable for codes and inspections made under their auspices. Congress might choose to make them liable, in order to make codes and inspections more effective. Under this approach, codes would continue to be set through official government processes, but the enforcement system could be made private in cases of liability transfer. Several ways to implement this approach are described below:

1. Manufacturers' and dealers' warranties could be required on all industrialized housing and non-residential modular buildings. New Jersey maintains such a mandatory requirement, and several other States are considering the option.
2. Mandatory inspections could be conducted by third-party law firms. The government could license the firms, but payment would come from the various involved parties, following the European model: manufacturers, dealers, contractors, government entities, homeowners, and other building owners. The private inspection firms would issue inspection certificates and affix approval seals that certified full code compliance for manufactured units. Like certified public accountants, they would be bonded and insured as a requirement for licensing, and would be legally liable for their advice on code compliance during inspection.
3. Because they provide liability coverage and building insurance after construction, private insurance companies might become more involved in setting qualifications and requirements. In effect, they would perform a private regulatory function based on risk assessment. Insurance coverage could be required as a matter of law, and companies could set competitive premiums. Currently, U.S. insurance companies engage in loss prevention activities for commercial buildings only; in Switzerland, com-

panies that issue any form of fire insurance require annual inspections and maintenance of heating systems.

4. Private financing institutions, like private insurance companies, could take a more active role in performing a private regulatory function. Compliance with code standards does affect loan risks and marketability of buildings, of obvious importance to private financing institutions. Consequently, in addition to requiring insurance, financing institutions may set specific guidelines for those seeking credit for mortgage financing, or construction loans for manufactured buildings. HUD's Minimum Property Standards, used to approve federally guaranteed mortgages, illustrates this principle.

Cross-Cutting Strategies

A single code for all types of industrialized housing might not be technically realistic or desirable. Further study is needed. Alternatives to a single code could accommodate the different categories of housing, and could set grades of housing within categories.

Labeling.--In the United States, appliances are rated for energy efficiency, meats receive quality grades, cars, automobiles are given gasoline mileage ratings, and truck and automobile tires have grade ratings. Housing could adopt a similar system, rating health and safety, durability, and quality.

Manufacturing building regulations mandate "acceptable" minimum health and safety standards. Acceptable minimums indicate the absence of absolute levels, even in health and safety of buildings. For example, differences exist in fire protection—wall materials have distinct interior surface flame spread times, and placement and enclosure of furnaces, number of smoke detectors, number and distance to exits, and exit capacities all differ according to local conditions.

Housing grades may be based on other factors: durability, quality, amenity, and operating or life-cycle costs. HUD has already demonstrated the feasibility of establishing grades through the potential for evaluation of quality, livability, and durability in "manufactured" (mobile) homes.²⁹

²⁹U.S. Department of Housing and Urban Development, *Sixth Annual Report to Congress On Manufactured Housing Program*.

There are three approaches to grading homes within categories. First, each key attribute of a house might be rated, with the cumulative result given to the home purchaser. Second, minimum acceptable levels of each attribute might be established for each grade of house. A "Grade A" house would have certain features, a "Grade B" house might be lower, and so on. Third, a house might be graded only for minimum standards of health and safety. Higher grades of homes would carry stickers, demonstrating compliance with selected standards of durability, quality, amenity, and operating or lifecycle costs.

Such improved information about building quality would allow banks to estimate the market value of the structure more accurately. Also, it would permit banks to project potential operating costs, such as energy, for use in qualifying individuals for housing loans. Both features would facilitate the operation of housing markets, and would encourage greater construction quality without prescription.

The establishment of categories of factory-built homes, together with grades within such a system, would yield two important benefits. This market-based solution would allow market forces, and not statutory regulation, to govern supply and demand. Also, it would create incentives for producers to "build up" in order to satisfy better-informed consumers.

Other Models.—Japan maintains national standards for certifying building components. The Japanese Ministry of Construction provides group insurance and a "Better Living" label for housing components that meet specified standards. The Ministry publishes the standards in the Japanese equivalent of the Federal Register, and invites firms to apply for certification. Applications must include detailed design drawings and test results, and are reviewed by a 25-member certification commission composed of consumers, members of "local public organizations," and technical experts in housing components. Certification must be renewed every 3 years.

By June 1985, 541 companies had received certification for 1,417 products in 31 categories. These categories include hot water systems, ventilation units, gas appliances for kitchens, gas leakage alarm systems, solar energy systems, bathtubs, "housing information systems," and even mailboxes, front

door units, door locks, window sashes, handrails, interior doors, kitchen cabinets, "master television antennas," and more. Products that carry the "Better Living" label receive two types of insurance: product warranty insurance, which covers costs associated with replacement of a defective component; and product liability insurance, which covers claims resulting from injury or property damage attributable to a failed component.³⁰

The French "Agreement" system, where a single national private corporation makes comprehensive technical investigations and certifies building innovations, has been adopted with variations in over 10 countries. The "Agreement" organization assesses likely performance of factors not covered by existing building codes. Its recommendations encompass the design, manufacture, assembly, and installation of products. It also conducts research on testing methods and quality control for manufacturing and building erection procedures.

Dozens of energy rating systems have been developed in the United States. For example, California Utilities began rating new homes in the late 1970s, providing builders with discounts on utility connection charges if their structures met minimum standards of electric energy efficiency. The program succeeded in attracting consumer interest in energy efficiency, but some building officials found the California rating systems "difficult to enforce"³¹ due to their relative complexity.

Several other types of systems exist. Austin, Texas, has a "five-star" rating system for new houses. The Western Resources Institute has organized builders, bankers, insurance companies, and realtors into a coalition that provides an "Energy Rated Homes" label for units sold in western Washington; this project is designed to operate by industry consensus, not government intervention.³² Appraisals leading to a rating are conducted much like standard appraisals.

The State of Florida has combined energy rating with a "minimum standards" approach. New homes, residential additions, or significant renovation must satisfy a minimum standard for energy efficiency,

³⁰Government of Japan, Ministry of Construction, Housing Production Division, *Quality Housing Components Certification System, 1985*.

³¹NCSBCS, May 1986, *op. cit.*

³²Jay Luboff, private communication, February 1986.

which varies between three “climatic zones”; beyond this threshold, houses receive grades that indicate future performance. However, as with the California Utilities model, effective enforcement has been difficult to achieve, especially in rural areas with low levels of construction.

Presently, California is considering a statewide energy rating system. The California State Building Code mandates stringent energy-efficiency requirements for new homes, which made obsolete the State standards set by the electric utilities and which led to the abandonment of utility-based labeling programs. The California code requires builders to submit certification plans prior to approval. A computer-based analysis then determines whether the proposed structure meets minimum levels of energy performance. Since the computer-based analysis applies to all structures receiving code approval in California, labels with the number of “points” scored can be supplied at no additional cost to the builder. In two demonstration municipalities, the State Energy Commission has established a rating scale for existing residential structures of 1 to 6, where 1 indicates the highest level of energy efficiency. Were this system applied on a statewide level, most existing homes would receive relatively poor scores, illustrating the benefits of purchasing a new home and aiding builders as a result.

Also, banks have been encouraged to consider energy costs when reviewing a borrower’s ability to pay. Standard rules call for an owner to pay no more than 28 percent of his or her annual income for principal, interest, taxes, and insurance (PITI), but many lenders have abandoned this standard in the face of skyrocketing housing costs. California loan offices, for example, now allow PITI to reach 32 percent of a buyer’s income. If a label allowed lenders to project the energy bills associated with a home purchase, the rules could be extended to include PITI + E, or expected annual energy bills. This would permit lenders and borrowers to integrate operating costs into purchasing decisions with greater accuracy. However, few lenders have moved to consider such quality features as energy efficiency, and the Fed-

eral Government has been slow to use its power as a secondary lender to encourage similar considerations. The Federal Home Loan Mortgage Corporation (“Freddie Mac”) does account for energy efficiency when a borrower is on the borderline of the PITI equation; the Federal National Mortgage Association (“Fannie Mae”) allows for an increase of two percentage points—28 to 30, for example—in the mortgage payment-to-debt ratio, if the home satisfies certain energy requirements; other agencies have not yet followed suit. Freddie Mac has indicated that if projected energy costs could be specified with greater accuracy, then the agency would consider including them as a loan determinant.

Other Measures

Four additional options were identified as potentially important, but were not investigated in detail:

1. Mandatory training and examinations for certification of inspectors might be required for all building inspectors. Enhancing the skills and professional qualifications of inspectors will improve code enforcement. The model code agencies and NCSBCS already offer training and examination systems, and 10 States require inspectors of manufactured buildings to take examinations for certification. In fact, most States “strongly endorsed the need for mandatory training and certification examinations for inspector and third-party personnel.”³³
2. Design approvals for manufactured buildings might require reviews and signatures from registered engineers.
3. Improved quality control of factory production-lines for manufactured buildings could be achieved, perhaps borrowing and adapting techniques from other industries.
4. Consumer participation in code-setting for manufactured buildings could be improved, and consumer complaint and appeal processes short of lawsuits could be facilitated.

³³NCSBCS, May 1986, *op. cit.*

FOSTERING TECHNOLOGICAL INNOVATION

Many housing experts urge the U.S. Government to play a more active role in promoting fundamental building research. They claim that without such study, the U.S. residential construction industry will become increasingly vulnerable to foreign competition, and American homebuyers will continue to receive less than their money's worth. The argument concludes that because even the largest housing firms cannot or will not conduct basic research, the Federal Government must make the kind of long-term commitment that has succeeded elsewhere. Sweden's Council for Building Research, for example, spent \$39 million on research in 1983, more than three times as much as HUD, despite the fact that Sweden's residential construction industry is approximately one-twentieth the size of its American counterpart. The U.S. Government does support such research in health and agriculture, both of which are based on small establishments that lack the resources to conduct independent research. However, even the 100 large companies that produced 25 percent of all housing units in 1985 did not make significant investments in research. It may be time to reevaluate the historical "laissez-faire" approach to housing research.

Research funds from the private sector, including both individual firms and trade and professional associations, have been inadequate in the past, and a change in this trend seems unlikely. Most large U.S. homebuilding firms do not maintain a research budget, which implies a lack of industry confidence in the cost-effectiveness of technological innovation, at least in the short run. Professional associations of architects and builders, like the American Institute of Architects, conduct some research, but their budgets are minute in relation to the size of the industry as a whole.

Trade associations do sponsor useful research. For example, the NAHB Foundation, Inc., has developed a research house to demonstrate advances in conventional construction techniques, has instituted certification programs for manufacturers of building products, and conducts economic and regulatory analysis for public and private groups. Nevertheless, compared with the resources available to other U.S. industries of a similar size, this construction research program is, at best, limited.

As for public funding, historically small agency budgets have decreased even further. Still, several agencies do sponsor relevant research, including the Department of Agriculture through its Forest Products Laboratory, the Commerce Department through the Centers for Building Technology and Fire Research at the National Bureau of Standards, the Department of Housing and Urban Development, the Department of Energy, the National Science Foundation, and the National Institute of Building Sciences. However, due to poor coordination of these activities, research efforts have remained fragmented and have fallen short of their potential.

HUD has not promoted aggressive policies for basic housing research. A 1982 GAO report states that since 1974, "HUD has funded only one project which demonstrated (in one geographical area) the cumulative cost saving potential of a wide combination of innovative technologies."³⁴ Some industry representatives assert that HUD's research serves to back up or justify a proposed building regulation, and is seldom made public in any case, although HUD's "Joint Venture on Affordable Housing"—initiated in several cities in 1982—has achieved limited success.

Recognizing the need "to encourage all sectors of the building industry to devise voluntarily a more efficient way of introducing technology into housing and building,"³⁵ Congress established the National Institute of Building Sciences (NIBS) in 1974. NIBS was designed to spearhead new housing-related research for the industry, a goal that has not yet been achieved. This stems from the specific mandates that accompany NIBS funding, as opposed to funding for the kind of long-term, basic research that enabled Japan to develop its ceramic building material. In 1979, NIBS issued a report that identified "the regulatory environment" as the major constraint on research, development, and demonstration projects. The Institute attributed its own sluggishness to encourage new technologies to a shortage of financial resources.³⁶

³⁴General Accounting Office, *op. cit.*

³⁵Public Law 93-383

³⁶"A Study of Existing Processes for the Introduction of New Products and Technology into the Building Industry" prepared by The Ehrenkrantz Group for the National Institute of Building Sciences, 1979

Summarizing its review of HUD and NIBS as of 1982, the GAO observed that “the statutory authority given to HUD and the National Institute of Building Sciences to encourage the development and use of innovative technology in homebuilding has been receiving only limited attention by HUD and the Institute.”³⁷ Neither agency appears ready to promote research and development of new homebuilding technologies or materials unless funds are earmarked specifically for this purpose.

Preparation of a comprehensive list of priorities would help to increase Federal support for housing-related research. Previous sections of this report have discussed the need to integrate such research into a program that considers the performance of an entire residential structure, in the areas of construction, energy efficiency, safety, and comfort. In light of this situation, a list of research priorities might include the following:³⁸

1. *Analytical tools that could facilitate the design of low-cost structures.* For example, most existing computer models for evaluating heating and cooling costs are difficult to use, and are not tied to advanced building design systems. As a result, few architects or builders employ such techniques.
2. *Advanced manufacturing technologies, including a variety of numerically controlled production systems,* which have been developed for other manufacturing industries and could be adapted for use in factory and field housing construction. New standards and communication protocols have accompanied the introduction of these innovations into other sectors, and the residential construction industry may need to repeat this process.
3. *Analytical tools for determining the effect of building design decisions on energy consumption;* present techniques for this purpose are inadequate. Improved estimates for building performance in all types of warm-weather climates are needed. Most existing methods cannot project the effect of different design alternatives on peak electric loads of residences, and energy costs in many southern areas depend more on peak electric loads than on total energy consumption. Also, more efficient analysis of the implications of different window locations, shadings and glazings, patterns of moisture penetration, noise propagation, and heat exchange could be developed.
4. *Simplified and accurate methods of energy labeling, and improved techniques for projecting energy costs.* Financial institutions could employ this data in order to gain a better determination of a borrower’s ability to repay a mortgage loan. The present system estimates the principal, interest, taxes, and insurance on a home, and measures this against a borrower’s expected annual income; adding projected energy costs would provide for a more accurate equation.
5. *Improved data on the actual performance of different energy efficiency strategies and construction techniques.* Current information on lifetime operating experiences for different systems, especially for residential construction, is poor; maintenance costs of industrialized housing cannot be compared with conventional construction techniques. For example, performance of insulation, sealants, and other materials is not well documented, and the durability of residential retrofits is poorly understood. Differences between the predicted performance of structures and the actual field experience need to be clarified.
6. *Improved techniques for characterizing the performance of residential appliances,* making the estimates of performance for these items match actual field experience with greater accuracy.
7. *Techniques for integrating residential electric systems with utility dispatch systems.* Controls on individual appliances could also be improved.
8. *Technologies of a variety of building components.* Examples include glazing materials, high-efficiency lighting, water heaters with flue-gas condensation, heat-fired—or gas-powered—heat pumps, integrated appliances, and components like compressors and refrigerants.
9. *Controlled interior air quality,* which may become a critical public health issue, particularly

³⁷General Accounting Office, Op. cit.

³⁸See National Institute of Building Sciences, “Building Technologies Research Agenda: A Technical Report,” May 1985; a report entitled “Third Edition of a National Program Plan for the Thermal Performance of Building Envelope Systems and Insulating Materials,” Building Thermal Envelope Coordinating Council, is in preparation. See also E. Hirst, et al., *Energy Efficiency in Buildings: Progress & Promise* (Washington, DC: American Council for an Energy Efficient Economy, 1986),

where significant amounts of radon from soil or groundwater have been introduced. Also, more study of interior air pollution is needed—especially of the sources of this factor, and of possible techniques for mitigating its effects.

10. *Industry standards and tests*, which could permit rapid, inexpensive analysis of the performance and safety of new components and systems.

Some industry analysts advocate the creation of a quasi-governmental corporation to test and certify new building technologies for construction. A single approval source for innovations in building technologies could marshal public and private support for innovative development, especially to confront problems of technology transfer. Consensus standards and model code organizations represent existing industries, known product-lines, and current technologies, and tend to resist technological change. Also, because new technologies do not assure certainty in performance characteristics, there is justifiable market resistance to unproven innovations. Homeowners prefer not to gamble with an enormous lifetime investment.

Consequently, one approach calls for existing institutions to continue code setting for older, proven technologies, while a new, quasi-public corporation would test, approve, and promote newer building technologies. Such an institution would serve as a prestigious, unbiased source of information, whose recommendations would be accepted by other institutions.

The Center for Building Technology at the National Bureau of Standards performs a similar function, conducting research for the development of testing standards. The Center acted much like the proposed “quasi-public corporation” in its involvement with Operation Breakthrough. Another example is the relationship between the Federal Food and Drug Administration (FDA) and the National Research Council (NRC) of the National Academy of Sciences. The NRC’s independent scientific reviews of pharmaceuticals provide the basis for actions by the FDA.

Stabilizing the Building Cycle

Variable housing construction rates in the United States impede long-term planning and heavy investment in capital equipment and worker training, and

discourage long-term technological research. Two million housing units were started in 1978, as opposed to under a million in 1982.³⁹ Large investments in production equipment can prove financially ruinous during periods of low housing demand, as in the case of U.S. Home (see ch. 2). A strategy for evening the fluctuations in the housing cycle may encourage greater capital investment on the part of the building industry. This discussion does not intend to provide a comprehensive review of this complex but important subject, but several options have been suggested for stimulating short-term housing demand (see box B).⁴⁰

Concerning the potential result of such policies, GAO observed that:

Past housing stimulus proposals have generally been thought to be inefficient because of a variety of leakages arising from: (1) credit diverted to purposes other than housing; (2) windfalls to sellers; (3) purchases by buyers who receive the subsidy but who would have bought without it at roughly the same time; (4) purchases by buyers who would have bought later but move up their purchases. However, the last group, those who move up their purchase decision, are really doing what a stimulus proposal attempts to do—moving forward consumer decisions to buy at a time when housing is in a slump and reducing demand during the next upswing in the economy. These consumers may also **buy** more expensive housing than they otherwise would have, which would tend to create more jobs and help the homebuilding industry. Whether or not a stimulus program which would result in moving consumer decisions is desirable depends heavily on the economic outlook. If strong recovery is anticipated it may prove helpful to shift starts forward. If only a weak recovery is anticipated, shifting starts may yield an even weaker recovery. The extent of these leakages have been heavily debated.⁴¹

³⁹U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States*, 1984, p. 743.

⁴⁰U.S. Congress, General Accounting Office, “Countercyclical Stimulus Proposals for Single-Family Housing,” Washington, DC, 1982, pp 7-8.

⁴¹*Ibid.*, p. 6.

Box B.—Short-Term Stimulus Proposals for Home Ownership

A. Temporary Interest Reduction.—The government could provide interest subsidies during the first 5 years, holding interest to a point below some target rate. Assistance could be limited to low-income households, or to relatively inexpensive housing. Legislation introduced by Senator Richard Lugar would offer subsidies to purchasers of new single-family housing by cutting 1.5 to 4 percent off of mortgage rates if market rates were above 12.5 percent.

B. Permanent Interest Reduction.—The government could provide permanent interest subsidies to low-income families for the purchase of new housing. The 1974 Brooke-Cranston Emergency Home Purchase Assistant Act "Tandem," suggested using the Government National Mortgage Association to subsidize interest rates up to 4 percent below any market rates over 11 percent. Sweden supports most new housing in this way. Since the subsidies can only be applied to homes that meet certain standards of quality, this policy encourages quality construction without prescriptive regulation.⁴²

⁴²L. Shigger, A. Meyers, and H. Kaitz, *Coming In From the Cold: Energy-Wise Housing in Sweden* (Cabin John, MD: Seven Locks Press, 1985).

C. Home Buyer Tax Credit.—Homebuyers, regardless of income, could be made eligible for income tax credits when buying newly built or substantially renovated homes. The credit would equal 5 percent of the purchase price, but would not exceed \$5,000. Such a legislation would resemble the Tax Reduction Act of 1975.

D. Mortgage Interest Tax Credit.—Mortgage institutions that allocated at least 50 percent of all new investment to housing could receive a Federal income tax credit of 2 percent of their entire mortgage interest income. This would encourage additional mortgage investment.

E. Tax-Exempt Mortgage Revenue Bonds.—Homebuyers could finance low-cost mortgages with tax-exempt State and local bonds. However, the 1980 Mortgage Subsidy Bond Act limited the scope of this process. Certain changes might increase demand for interest-free mortgage payments; for example, all homebuyers could be eligible, as opposed to first-time purchases, or the price of eligible housing could increase from 90 to 120 percent of the average area purchase price.