

The Value of the R-2000 HOME Program

An Examination of the Impact of the
R-2000 HOME Program on Canadian Housing and
the Canadian Home Building Industry



Canadian Home Builders' Association

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1.0 INTRODUCTION

The R-2000 HOME Program has operated for more than one and a half decades. Throughout this period, the Canadian Home Builders' Association (CHBA) has participated in the Program with Natural Resources Canada (NRCan).

The origins of the R-2000 HOME Program lie in the “energy crisis” of the mid-1970s, and the subsequent efforts by government and industry to develop houses that were more energy efficient. Notably, over its life-span, the R-2000 HOME Program has produced a broad range of significant benefits beyond encouraging the construction of energy-efficient homes.

The Program has acted as a catalyst for positive change in Canada's home building industry, wide-ranging improvements in the quality of Canadian homes and higher expectations among Canadian new home builders and buyers. The R-2000 HOME Program has also served to strengthen the competitiveness of the home building industry domestically, and played a key role in establishing Canadian housing technology and expertise in world markets.

Today, R-2000 technology provides the home building industry with the capacity to address a wide array of contemporary challenges, from reducing greenhouse gas emissions to providing consumers with healthier, more comfortable and affordable homes.

This paper sets out the CHBA's perspective on the broad range of benefits delivered by the R-2000 HOME Program and provides the home building industry's assessment of the value of this unique undertaking.

2.0 A SUMMARY OF WHAT THE R-2000 HOME PROGRAM HAS ACHIEVED

The R-2000 HOME Program represents a uniquely successful alliance between the federal government and the home building industry across Canada. The Program has succeeded in harnessing the power of the marketplace to achieve wide-ranging improvements in the quality and environmental performance of all new homes built in Canada. This has been accomplished in a manner that addresses Canadian public policy objectives, while meeting the needs of the home building industry and serving the interests of Canadian new home buyers.

One measure of the R-2000 HOME Program's success can be seen in terms of Canada's commitments under the Kyoto Protocol on Climate Change. Based on NRCan and Environment Canada data¹ on GHG emissions, two leading environmental organizations¹ recently concluded that the residential sector is the only sector within Canada's economy that is currently forecast to meet, and exceed, Canada's Kyoto commitments.

Figure One: Greenhouse Emissions by Sector

Sector	Current Projected Change in Emissions 1990 - 2010
Transportation	+26.0%
Electricity Generation	+15.8%
Industrial	+23.1%
Non-Energy Emissions	+12.9%
Residential	-13.0%
Commercial	+26.0%

This achievement reflects many factors, including ongoing fuel switching in existing homes and the steady replacement of older appliances and energy-consuming equipment with new, more energy-efficient models. However, these changes in residential energy use, and the significant

¹ Total 1990 GHG emissions of 654 Mt correspond with NRCan estimates. Sectoral mapping of these emissions corresponds with Environment Canada's model presented in *Trends in Canada's Greenhouse Gas Emissions 1990 to 1995* (TCGGE90-95). The major difference between these data sets is related to GHG emissions from electricity generation. The approach used by Environment Canada, which identifies electricity generation as a distinct activity, is consistent with the recommendations of the Intergovernmental Panel on Climate Change.

reductions in greenhouse gas emissions that will result, are directly linked to the broad impacts of the R-2000 HOME Program on home builders, home buyers and homeowners.

The R-2000 HOME Program has served as a catalyst for a broad range of changes in the home building industry.

- It has provided a solid foundation of building science that allows builders to adopt new technologies, materials and products with confidence.
- It has resulted in the training of more than 10,000 industry members across Canada in advanced design and construction practices.
- It has succeeded in changing public perceptions so that energy efficiency is now seen to be linked to improved comfort, a healthier lifestyle and broad environmental benefits much more than to cost savings.

How did this come about? It is the result of a remarkable combination of public sector research and technology support, and the determination of private home building firms to offer their customers a better product. R-2000 represents a voluntary, market-driven environmental initiative that has worked. While now some 15 years old, this initiative has always been far ahead of its time.

There are a number of key characteristics of the R-2000 HOME Program that underpin its success:

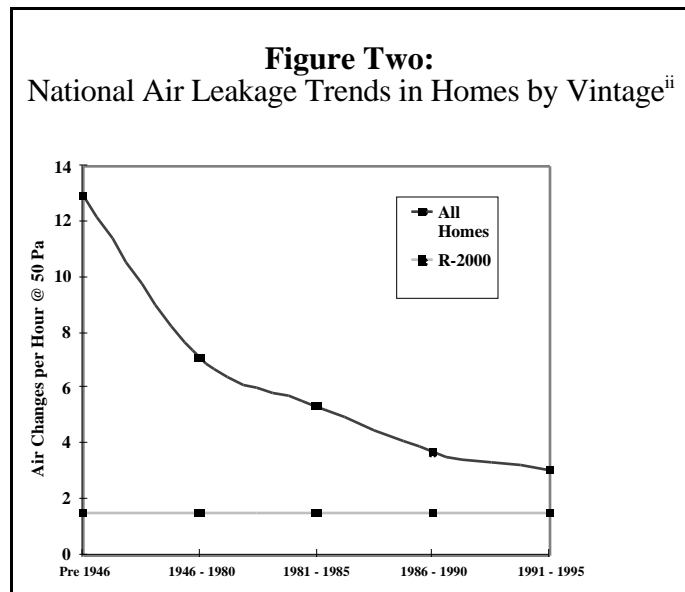
- 1) The Program is voluntary. Builders choose to take part in the Program because they recognize that R-2000 home building technology provides them with a competitive advantage. The R-2000 HOME Program has shown that a working alliance between government and

industry can function effectively, capturing the knowledge and experience of home builders, engaging the entrepreneurial drive of the private sector, and delivering a balance of benefits to consumers, the public interest and the industry.

- 2) The Program is market-driven. The R-2000 Standard has “raised the ceiling” for the construction quality and overall performance of every new home built in Canada. This has occurred because R-2000 technology delivers benefits that consumers want, and are willing to pay for. The Program has shown that Canadian home buyers will support environmental goals on a personal level through their buying decisions.
- 3) The Program is based on education and training that equips builders with the knowledge required to apply advanced design and construction techniques to any home building or renovation project. To date, over 10,000 industry members have taken R-2000 training.

The resulting diffusion of R-2000 design and construction techniques throughout the home building industry has been very extensive. Millions of Canadian homes are more energy efficient, more comfortable and healthier to live in as a result.

Figure Two illustrates the trend towards convergence of R-2000 performance standards with those achieved in conventional houses. Again, it is important to recognize that this trend is being driven by market demand.



- 4) The R-2000 Standard is not static, it evolves over time to reflect technical and market developments. This ensures that the Standard functions as a renewable tool that continually pulls the market forward towards higher quality and performance expectations.

The evolution of the R-2000 Standard is managed by the home building industry with NRCan and other federal departments, and reflects a working consensus and attention to those aspects of the Program that define its technical and commercial viability.

- 5) The R-2000 HOME Program provides the federal government with a practical, low-cost instrument through which to pursue public policy objectives. For instance, there is no regulatory basis to the R-2000 HOME Program and, as a result, no regulatory cost to taxpayers. Quality Assurance measures are required, but are made available on a user-pays basis. This approach is consistent with the new role of government in pursuing economic and social policy objectives.

As well, the Program provides the opportunity to incorporate the research and development outputs of other federal agencies, such as Canada Mortgage and Housing Corporation's Healthy Housing initiative.

- 6) The longevity of the R-2000 HOME Program is a solid indication of its relevance to government, industry and consumers. The R-2000 HOME Program has succeeded in introducing technological improvements in all types of new and existing housing, from custom new homes and renovations to social housing developments.
- 7) The collaborative nature of the R-2000 HOME Program requires extensive consultation prior to the introduction of new technology, practices, products and materials. This has served to ensure that new ideas are tested properly before moving into the marketplace.

3.0 HOUSE AS A SYSTEM: THE FOUNDATION OF THE R-2000 HOME PROGRAM

While the R-2000 HOME Program is recognized for the advances in design, technology and products it introduces to home building, the foundation of the Program is building science and recognition that a house functions as a dynamic system. The *House as a System* approach recognizes that each component and design element in a house contributes to overall performance, and that each component has a potential effect on the functioning of every other component.

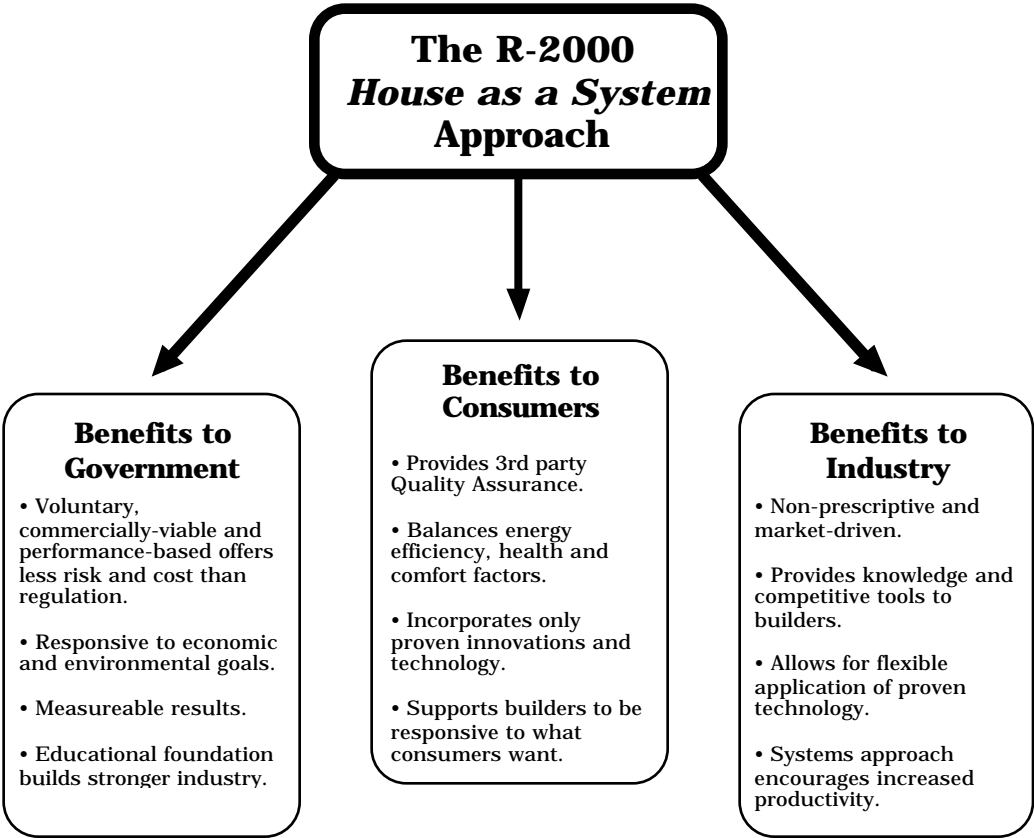
The R-2000 HOME Program has pursued this basic tenet of home design and construction and, in doing so, revolutionized the home building industry. With the *House as a System* approach, Canada's new home builders have moved their industry from 19th century practices into the 21st century. As indicated in Figure Three, this has provided significant benefits to consumers, to the public interest and to the home building industry.

When assessing almost any aspect of the R-2000 HOME Program—from builder training, to material and product R&D, to construction practices—the influence of *House as a System* can be seen. The full impact of the Program is evidenced in the broad diffusion of the R-2000 “systems approach” throughout the home building industry.

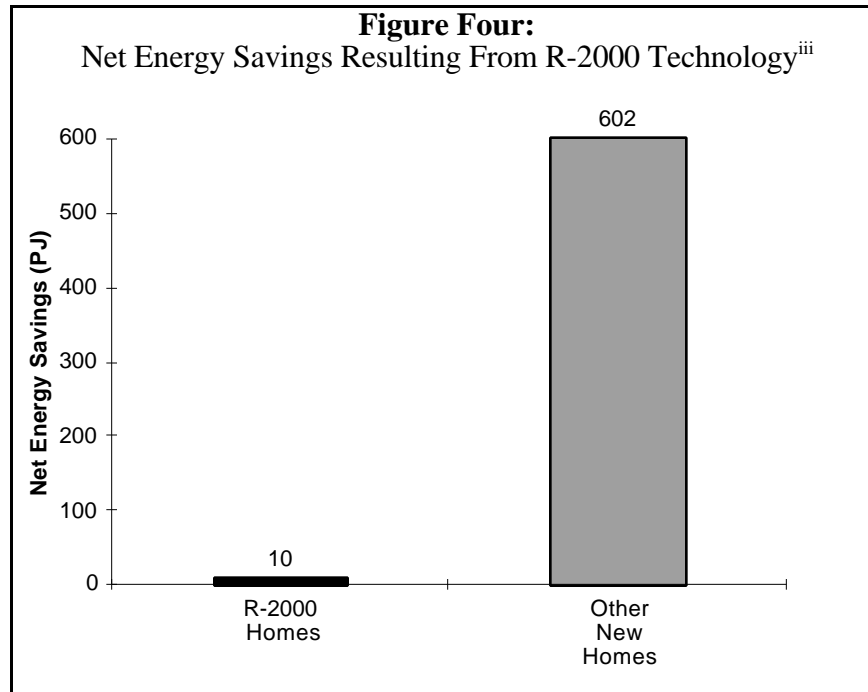
In myriad ways, home builders apply the principles of R-2000 design and construction to every new home built today. While certified R-2000 units represent less than 1% of new home starts, virtually 100% of new homes incorporate key technical and product innovations linked to the Program.

By providing a reliable analytic framework within which to design and construct homes, this system has allowed home builders to move well beyond the requirements of building codes in key

Figure Three



areas such as energy performance, indoor comfort and air quality control. This effect is illustrated in Figure Four which compares the net life-cycle energy savings attributed to R-2000 homes and those attributed to the diffusion of R-2000 technology in all other new homes built between 1981 and 1995.



As Figure Four shows, the real impact of the R-2000 HOME Program goes well beyond those homes certified under the Program.

Similarly, the full extent of the R-2000 HOME Program's impact on home building is found in the broad range of benefits for consumers, the home building industry and public interest. These benefits can be summarized in the following way:

- 1) For consumers, the R-2000 HOME Program has had, and continues to have, a profound and positive impact on the quality of Canadian housing. The Program is responsible for bringing about significant improvements in the comfort, healthfulness and energy efficiency of all new homes built in Canada to the broader benefit of all Canadians. The

R-2000 Quality Assurance system is also becoming increasingly valuable to new home buyers.

- 2) For industry, the R-2000 HOME Program has played a central role in expanding the technical capabilities of Canadian home builders and in increasing their competitiveness both domestically and in international markets. Further, for building product manufacturers, it has enhanced the domestic market for innovative products and materials and created new export market opportunities.
- 3) For government, the R-2000 HOME Program has provided a unique and successful model to achieve public policy objectives. It demonstrates the viability of an industry alliance based on voluntary, market-driven change. Today, there is broad recognition within both industry and government that this is often the most cost-effective and efficient approach to addressing a wide range of public policy issues. The R-2000 HOME Program provides valuable lessons on how to make such initiatives work.

4.0 R-2000'S HISTORICAL CONTEXT

A great many things have changed since 1981 when the R-2000 HOME Program came into existence. Today, the importance of the Program is defined by an array of pressing issues and concerns—the need to reduce greenhouse gas emissions, the importance of good indoor air quality, the value of building homes in a more environmentally-responsible manner.

The history and evolution of the Program point to many more remarkable achievements.

4.1 The Public Policy Environment

At the time the R-2000 HOME Program was conceived, the public policy environment was quite different than it is today. For example:

- The “oil shock” of the late 1970s continued to resonate through both government and industry. Inflation, in large measure fueled by escalating energy costs, was rampant. Economists predicted that energy prices would continue to rise at a brisk pace. Security of energy supplies concerned government.
- A program based upon government and industry working together was quite novel. Previous federal initiatives in the area of energy conservation had involved either short-term grant programs aimed at consumers, regulation of energy prices or product regulation.
- Federal actions in the housing industry had traditionally focused on stimulating demand for housing to achieve growth in the general economy. Social housing expenditures and consumer housing incentives were used periodically to “kick start” the economy in times of slow economic growth.

- House design and construction practices were based on post-war technology which aimed at building homes faster, not upgrading their energy performance and comfort. Aside from the use of labour-saving materials, such as plywood and roof trusses, home building was largely based on techniques and practices introduced early in this century.
- Up to this time, virtually all changes in material use and construction practice resulted from prescriptions laid out by the National Building Code. Industry adoption of innovations was a function of regulatory compliance rather than a response to market demand.

The R-2000 HOME Program was initiated against this public policy backdrop. Viewed from this perspective, it is clear that the Program was a bold experiment that offered challenges to both the federal government and the home building industry.

- The Program’s goal was to commercialize a broad range of new technologies and practices, based on sound building science, in an industry dominated by small companies that are sensitive to risk.
- In an industry accustomed to seeing change come through prescriptive measures laid out in various regulations, the R-2000 HOME Program was to be entirely voluntary. Home builders would build R-2000 Homes because they chose to, not because they had to.
- The Program set out to achieve this goal through collaboration between industry and government, rather than by way of direct regulation or market intervention.
- The “levers” to be used by the Program were education and technical training for home builders, provision of third-party Quality Assurance of the R-2000 “product” and promotion of the benefits of R-2000 Homes to consumers.

Quite simply, the R-2000 HOME Program set out to change fundamentally the way Canadian housing was designed and constructed, and demonstrate the viability of a new approach on the part of government . This was to be achieved by equipping home builders with innovative technology, improved knowledge and skill and a better new home “product”. Most importantly, the R-2000 HOME Program set out to harness, rather than manipulate, the power of the marketplace. In this regard, it represented the first real example of public/private partnership as it is defined today.

4.2 The R-2000 Strategy and The Market Environment

Reflecting the economic and public policy conditions of the late 1970s, the market advantage of R-2000 Homes was initially seen to be in the substantial energy savings provided to consumers:

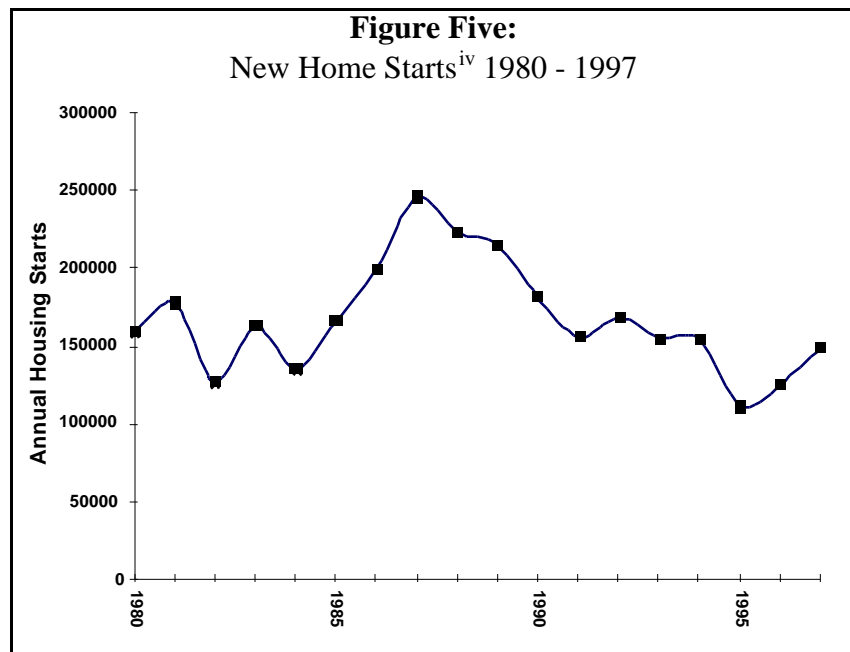
- R-2000 Homes required only half the energy of conventional homes at an incremental cost of approximately 2% to 6%.
- Given that energy costs were rising and the general level of inflation was high, direct energy savings would allow R-2000 home buyers to recover the extra capital cost of their homes quickly. During the early years of the Program, pay-back periods of three to four years on the incremental cost of R-2000 Homes were anticipated.

Other advantages of R-2000 construction and Quality Assurance, such as reduced drafts, less interior noise and active interior ventilation, were viewed as secondary to energy efficiency and cost savings. As a result, these benefits initially received less emphasis in Program marketing materials.

Energy prices, which were forecast to provide the market impetus for the R-2000 HOME Program, did not follow their projected path. Instead, the real cost of energy has declined steadily since the R-2000 HOME Program was established.

A second factor that affected the Program has been the cyclical nature of housing markets. As shown in Figure Five, the industry has endured numerous ups and downs over the life of the R-2000 HOME Program.

Since home building firms are generally small and sensitive to risk, these market conditions would not seem to encourage investment in new technology and production of a product for which no ready market existed.



Given the market profile

initially defined for R-2000 Homes, it might have been expected that, in the face of declining energy costs and turbulent market conditions, the initiative would have been abandoned by the mid-1980s. However, this was not the case. The federal government remained committed to the Program and, if anything, the R-2000 HOME Program gathered momentum in the face of these factors. It is instructive that this occurred for reasons not fully anticipated when the Program was conceived, but which have proven to make the R-2000 initiative far more broadly-based, beneficial and enduring.

5.0 WHAT THE R-2000 HOME PROGRAM HAS ACHIEVED

Today, the technologies and construction practices introduced by the R-2000 HOME Program permeate every aspect of the home building business.

This positive outcome has resulted from four significant developments:

- Today, home builders have a much greater understanding of building science than they did in 1981. This provides them with the much greater capacity to innovate, which is reflected in all aspects of the design and construction process.
- The home building industry's involvement in the R-2000 HOME Program led to the creation of efficient procedures for developing, evaluating and diffusing technical innovations. This process has proven reliable and has avoided the pitfalls of ad hoc technical change experienced by home builders in other countries. The industry and government have the ability to collaborate in identifying technology needs, and then efficiently developing and commercializing new products, materials and practices.
- Among both home builders and consumers, high levels of energy efficiency in new homes are now viewed as a "given". As a result, high energy efficiency in new homes is market-driven and consistently exceeds what is required by applicable building codes. To a significant extent, R-2000 "energy efficient" construction is now seen by home builders and consumers as simply being an aspect of "good" construction.

The benefits gained through R-2000 "energy efficient" design and construction techniques are recognized as extending far beyond energy savings. These benefits include increased indoor comfort, improved air quality, a healthier home, reduced home maintenance and greater

durability. R-2000 Quality Assurance also has growing value to home buyers. While low heating costs are part of this mix of benefits, they are not a dominant part.

Assessing the value of the R-2000 HOME Program rests on one central question: to what extent can the Program be credited with causing these very positive changes? From the home building industry's perspective, virtually all of these developments are closely linked to the R-2000 HOME Program. This causal relationship can be clearly demonstrated in three key areas:

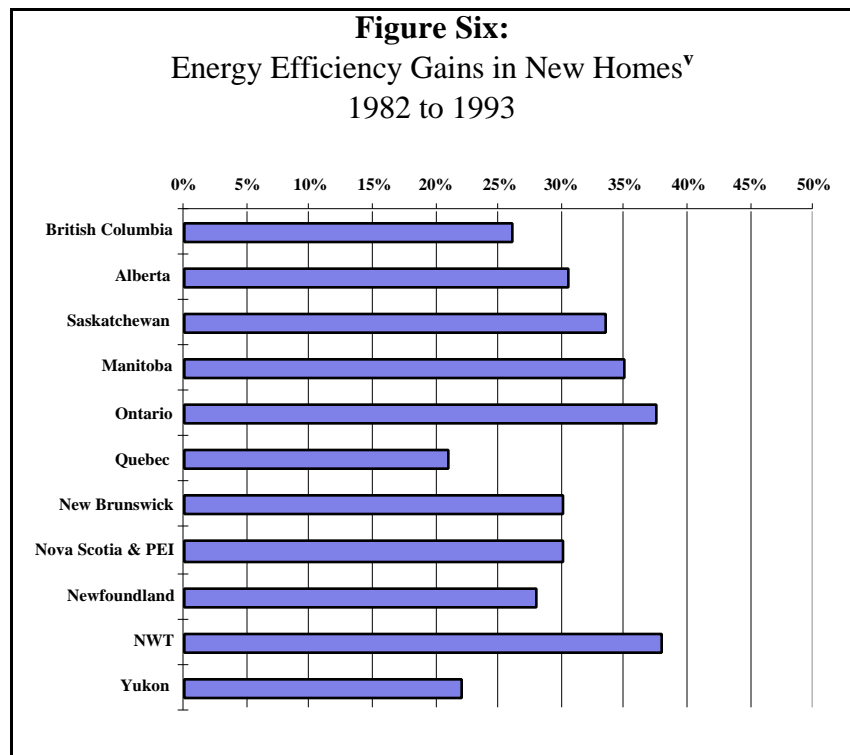
- 1) Energy efficiency gains in new housing
- 2) The strengthening of Canada's housing system
- 3) The professionalization of the home building industry

5.1 Energy Efficiency in New Housing

Since the inception of the R-2000 HOME Program, the energy efficiency of new homes built in Canada has improved tremendously. As shown in Figure Six, Canadian homes built in 1993 required between 21% and 38% less energy than homes built in 1982.

This comparison is between the average home built in 1982 and 1993. R-2000 Homes delivered additional energy savings beyond these average values.

In relation to the entire housing stock, this



substantial gain in energy efficiency represents an average 7.5% reduction in energy use for all homes, more than 80% of which were built before the Program was initiated. As documented by NRCan, this has resulted in a 6% decrease in the energy intensity of the residential housing sector.

Accepting that increased energy efficiency in the “average” new home is a reliable indicator of overall changes to design and construction practices, what served to trigger these changes? From the home building industry’s perspective, virtually all of these changes have been directly linked to, and largely dependent on, the R-2000 HOME Program.

During the period in question, energy consuming household equipment became more efficient and building practices improved well beyond regulatory requirements. Without the influence of the R-2000 HOME Program, these developments either would not have taken place, or would have taken significantly longer to occur.

It has always been the CHBA’s view that the R-2000 HOME Program, representing the “leading edge” of home building technology, stimulates incremental improvement in all new homes built.

This results from three main factors:

- 1) Increased skill levels within the industry, reflecting an improved understanding of building science and R-2000 builder training.
- 2) Accelerated commercialization of new materials, products and systems “proven” through the R-2000 HOME Program.
- 3) Increased consumer demand for the wide range of benefits related to R-2000 design and construction techniques.

The R-2000 HOME Program has acted as a catalyst for a broad range of changes affecting the home building industry.

If the R-2000 HOME Program had not been in place, it is difficult to see how most of the advances in new housing achieved over the last decade and a half could have come to pass. Certainly, in such a scenario, the process would have been far more ponderous, haphazard and prone to error. Without a doubt, it would have been far less effective.

5.2 Strengthening the Canadian Housing System

Another important achievement of the R-2000 HOME Program has been its contribution to building a strong housing system in Canada. It is no accident that experts from around the world come to our country to study the housing industry—Canada has an enviable reputation for the quality, variety, affordability and performance of our homes.

This has come about because of broad-based collaboration between industry and government in all aspects of housing from technology development to financing. The R-2000 HOME Program has served as a bellwether for such collaboration.

The benefits that accrue from this approach to housing are various, and not always obvious. The more obvious benefits include higher quality homes that are more affordable and more accessible to more consumers. The less obvious benefits involve a range of misadventures that our housing system has avoided.

Introducing new technology into housing is not without its risks. In the absence of solid building science, a proper research and development process and rigorous testing, mistakes can be expected to occur. The potential impact of such mistakes is staggering—housing represents the largest single purchase made by most Canadians and their most significant personal asset. Unlike

other industries, “product recalls” are not a feasible option in the housing business. Since the introduction of R-2000 housing technology in Canada, no significant problems have been reported with any aspect of this technology. Simply put, R-2000 technology was developed through a rigorous process, based on industry/government collaboration, and it works.

This experience is in sharp contrast to that of the US, which is beset with dozens of major housing system, material and product failures involving tens of billions of dollars in losses to consumers and builders. The fact that we are not faced with the same magnitude of quality and performance problems in Canada is one of the less recognized benefits of the R-2000 HOME Program.

It is also notable that the US has relied on regulations and expensive government incentives to improve the energy efficiency of new homes. This direct government intervention in, and manipulation of, the marketplace has come at a cost—the leveling of the marketplace and hindering of private sector product innovation.

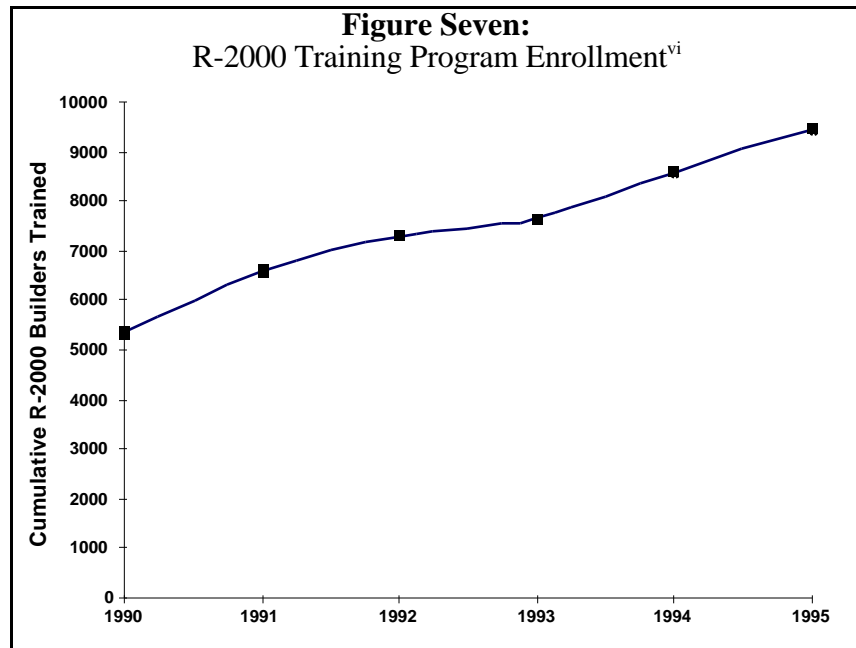
5.3 The Professionalization of the Home Building Industry

Another benefit of the R-2000 HOME Program not well-recognized outside of the home building industry is the effect this program has had on the competitiveness and efficiency of our industry. During the time Canadian new homes were achieving an average one-third improvement in energy efficiency, the home building business was also undergoing wholesale transformation. In part, this came about because of changes in economic and market conditions, but it also reflected the impacts of the R-2000 HOME Program.

The focus of this transformation has been the “professionalization” of our industry. Today, home building is a complex business. Home builders are business managers who require a broad range of skills to produce high quality homes and deliver high quality services efficiently.

The advent of the R-2000 HOME Program, which brought thousands of home builders back into the classroom, played a decisive role in making this a reality. The R-2000 HOME Program established ongoing education as a business priority for builders by demonstrating its concrete benefits. It introduced many home builders to the use of computers as an aid in the design and cost-control of home construction. It served to strengthen a close and ongoing collaboration between housing researchers and home builders.

As shown in Figure Seven, home builders continue to take advantage of R-2000 training programs. By the end of 1995, this training had involved nearly 10,000 industry members.



Perhaps the strongest evidence of the benefits resulting from this process are seen in the wholesale diffusion of R-2000 technology into mainstream housing. The R-2000 HOME Program taught home builders how to evaluate and apply new design and construction techniques. Today, they are putting these lessons to work with every home built, everywhere in Canada.

In addition to these diffused benefits, R-2000 technology continues to serve as a leading edge new home product. Across Canada, EnviroHome projects, which are based on the R-2000 Standard, generate tremendous consumer interest and media coverage. The benefits promoted through these projects go far beyond energy efficiency, but they are all tied to the R-2000 “package”. The fact that housing technology, that is now some 15 years old, is still attracting strong media coverage in communities across Canada says a great deal about the enduring value of the R-2000 HOME Program.

6.0 THE CONTINUING IMPORTANCE OF THE R-2000 HOME PROGRAM

After 16 years of operation, it is appropriate to examine the continued relevance of the R-2000 HOME Program to industry, the public interest and Canadian consumers. Is the Program continuing to act as a catalyst for progressive change within the industry? Does this initiative address the public policy issues and industry priorities of today? Do consumers continue to benefit from the R-2000 HOME Program?

From the standpoint of the home building industry, the answer to these questions is clearly “yes”.

In terms of today’s policy and economic environment, the R-2000 HOME Program continues to offer distinct and significant benefits:

1) It Can Help Canada Meet its Obligations Under the Kyoto Agreement

Because the R-2000 Standard represents the leading edge of commercially-viable practice in housing, it serves to raise the standards demanded by the marketplace and fuels a process of continual, incremental improvement in the quality and performance of new homes. This provides the impetus for technological developments that can further reduce greenhouse gas emissions from new housing, and also provides a sound technical basis for efforts aimed at upgrading the energy efficiency of older homes.

2) The R-2000 HOME Program Offers a Viable Alternative to Regulation

The full impact of the R-2000 HOME Program on Canadian housing proves that voluntary, market-driven approaches can work. This provides a sensible alternative to regulation and avoids the considerable expense, dislocation and risk that regulation brings with it.

3) The R-2000 HOME Program Reduces the Risk of “Ad Hoc” Upgrading

Throughout the world, the home building business is constantly seeking out and applying new technology. In Canada, advances are supported by rigorous building science and collaborative industry/government initiatives. This reduces the likelihood of serious technological mistakes, with their attendant remedial costs, significantly. It is a proven approach for supporting innovation. It produces more results with less risk to industry and consumers.

4) The R-2000 HOME Program Represents an Established Method for Achieving Results

Particularly in the aftermath of the Kyoto Agreement, there is a growing abundance of theories about what actions developed nations must take to address environmental issues. The R-2000 HOME Program is not theoretical—it is well-proven. Based on the R-2000 HOME Program, the home building industry has already achieved significant energy efficiency improvements. This approach continues to work well. The alternatives are neither proven or costed, nor assured of success.

5) The Marketplace is Embracing R-2000 Technology

The continued success of initiatives such as EnviroHome show that, if anything, consumer interest in homes featuring energy efficient, healthy and comfort-enhancing technology is growing. This means that R-2000 technology is likely to be more successful today than at any other time since the Program was launched.

6) R-2000 Has the Endorsement of the Private Sector

Home builders understand and support the approach pioneered by the R-2000 HOME Program. The mechanisms required to maintain and improve the Program, such as CHBA's National Technical Research committee, are in place and working. A 17 year investment in knowledge and infrastructure has created a valuable level of trust and collaboration between home builders and government officials. While this initiative can no doubt be further improved, it already represents a unique asset.

DATA SOURCES

ⁱ *Canadian Solutions: Meeting Our Kyoto Commitment*, David Suzuki Foundation and the Pembina Institute, April, 1998

ⁱⁱ CANMET, Energy Technology Centre, *Air Leakage Characteristics of Canadian Housing Stock*. Ottawa. October 1996

ⁱⁱⁱ Values derived from R-2000 Evaluation, ARA Consultants et al, NRCan, 1995

^{iv} CMHC

^v R-2000 Evaluation, ARA Consultants et al, NRCan, 1995

^{vi} Ibid.