

**Mandatory Sprinkler
Proposals Still
Don't Make Sense**

**CHBA Position Paper Against
Mandating Residential Sprinklers
in Singles, Semis and Townhomes**

**Canadian Home Builders= Association
2005**

1. The Canadian Home Builders= Association

1.1 CHBA and the Housing Industry

The Canadian Home Builders= Association represents more than 7,000 housing sector professionals, who work together on a voluntary basis to advance the industry and improve its products. Its members come from all segments of the housing industry: new home builders and renovators, land developers, trade contractors, manufacturers, suppliers, financial institutions, housing analysts, lawyers, accountants, marketing firms, architects, engineers, planners, technical consultants, and other allied professionals. They range from small companies who work on three or four homes a year, to diversified international firms. CHBA=s activities are centred in three areas:

1. Working to achieve a stable business environment for our members .

CHBA is committed to a fair and competitive marketplace, where all members have the opportunity to operate their businesses profitably.

2. Working to promote and protect the interests of consumers.

CHBA believes that all Canadians have the right to decent, safe and appropriate housing. We also believe that all Canadians have the right to a reasonable opportunity to own a home.

3. Working to support the professionalism of our members.

We believe that skills, experience and integrity are the cornerstones of professionalism. CHBA provides members with opportunities to learn, grow and take pride in what they do.

1.2 CHBA=s Technical Research Committee

CHBA was established in 1943 and quickly moved into the business of improving housing quality. The 1950s saw the construction of the first **AMark Series**@experimental houses – a long-running research project with the federal government=s National Research Council. Since then, CHBA has been involved in many joint research initiatives, where various private and public sector groups have joined forces to investigate new products and processes aimed at improving choice, quality and affordability of Canadian housing.

More than 45 years ago, CHBA recognized the need for a standing body to deal with the growing number and complexity of technical issues facing the housing industry. Its response was to set up the Technical Research Committee (TRC), a national, industry-led meeting place for builders from all regions, governments, housing research agencies, major product associations, universities, trade groups and warranty programs. TRC has contributed to the improvement of housing technology for many years.

1.3 Maintaining Housing Quality Through Codes and Training

CHBA and the TRC have given strong support to the development and adoption of the National Building Code on a provincial basis across Canada, as the most effective way of ensuring an adequate standard of health and safety in buildings. When it is working properly, the code-writing process sets out proven requirements to protect health and safety in buildings – incorporated only after full consideration of their impact on the industry and on consumers.

Sometimes, a new system must be accompanied by retraining of industry forces. CHBA is also an active participant in training through its National Education and Training Advisory Committee, which acts in a similar way to the TRC. The housing industry has been an important factor in the spread of energy efficient and environmentally responsible building practices, through CHBA's involvement in the R-2000 program and EnviroHome initiative. In these programs, builders and other industry members have learned and adopted new technologies – and influenced others – on a voluntary basis and in step with market demand.

A Canadian society has limited resources of capital. If governments are going to mandate where people's money will be spent, they should make very sure it will be used wisely.®

*CMHC Summary Report
Smoke Alarms and Residential
Sprinklers: Costs and Benefits*

1.4 Why Builders Like Innovations

The quality of new housing has improved tremendously in recent decades. This is partly the result of standardized building codes, but the largest cause is the ongoing competition within the industry. The race to attract buyers has resulted in continually improved products and equipment. Builders are constantly looking for new products and services to help convince buyers that their new homes are better than older homes, and better than those of the competition. A good new product can increase builders' potential sales. If consumers like something, industry uses it as a selling point.

Some builders offer residential sprinkler systems as an option on their new homes. For certain customers with a high income and a low risk tolerance, they may be quite attractive. But they are not for everyone.

2. Background

Commercial sprinkler systems have been in use for many years in higher-risk office and industrial buildings, where their primary market application has been protection of property. In the mid 1970s, people started to ask whether sprinklers would also be appropriate for residential buildings.

The National Fire Protection Association in the United States found that the existing commercial systems were not appropriate for residential settings. In housing, water pressures were generally too low to deliver the volumes required by commercial sprinkler heads and ceilings were generally not high enough for commercial spray patterns to be effective. So, researchers developed a new residential fast response sprinkler head. The new sprinkler systems were designed to react much more quickly than commercial heads to the presence of heat. They used typical residential water supply pressures in a different hydraulic pattern to produce broader spray patterns more suitable for residential settings. These new systems became the basis of a new NFPA 13D standard for residential sprinkler systems in one- and two-family homes in 1980. The technology is still undergoing revision.¹

Consumers in general have not embraced this new technology. Since the first residential sprinkler heads were listed in 1980, few if any new home buyers have even asked about having sprinklers. They are considered expensive, especially in relation to the low level of risk.

Few if any new home buyers choose to have sprinklers – or even ask about them. Sprinklers are considered expensive, especially in relation to the low level of risk.

It is fire fighting groups and the sprinkler industry who have mounted a very active lobby to have sprinklers installed on a mandatory basis in new one- and two-family homes. In the United States, for example, the U.S. Fire Administration, the International Association of Fire Chiefs and firms in the sprinkler industry have joined together and lobbied strenuously at the national, state and municipal levels.

Here in Canada, similar groups have made strenuous lobbying efforts at the national level for a number of years.

¹ In the late 1990s, problems surfaced where some units and configurations were not providing enough water to effectively suppress fires. UL test standards for sprinkler head performance were made more stringent, and the standard for water delivery was redefined (0.05 gallons per minute per square foot). These new standards took effect in 2002. A number of products did not qualify for relisting. In the same period, there were some significant recalls of problematic sprinkler heads.

However, the groups overseeing Canada's model codes have determined that one- and two-family homes do not pose sufficient risk to justify installing sprinklers.

As a result, fire fighting groups and sprinkler industries have moved the focus of their attention to provinces and individual municipalities.

Canada's national housing agency, the Canada Mortgage and Housing Corporation, has published a number of research studies and reports on fire experience and fire protection in Canadian houses. The major ones are:

Analysis of the Costs and Benefits of Installing Fire Sprinklers in Houses

Phases 1 and 2, prepared by A.T. Hansen and R.E. Platts, Scanada Consultants Ltd. for CMHC, Ottawa, 1989

The Costs and Benefits of Smoke Alarms in Canadian Houses

Phase 3 of above, prepared by A.T. Hansen and R.E. Platts, Scanada Consultants Ltd. for CMHC, Ottawa, 1990

Smoke Alarms and Residential Sprinklers: Costs and Benefits (Summary Report)

Summary report prepared by Rowena E. Moyes for CMHC, Ottawa, 1991

Costs and Benefits to Municipalities of Mandatory Residential Fire Sprinklers

Summary report prepared by Arencon Inc., Architects + Engineers, with the assistance of Clayton Research Associates Ltd., Graham Harmsworth Lai & Associates Ltd., and J.G. Henderson & Associates for CMHC, Ottawa, 1998

Directed Research Evaluation Report

Report and case studies prepared by KPMG Consulting Ltd. for CMHC, Ottawa, 2001

Canadian Housing Fire Statistics

Report prepared by Ken Richardson Fire Technologies Inc., in collaboration with Fuller Information, for CMHC, Ottawa, 2004

Not one of these studies has concluded that the benefits of mandating residential sprinklers justifies the costs.

AThe projected number of lives that would be saved does not justify the necessary expenditure required to install these (sprinkler) systems in all new houses.@

*Report of the Joint Task Group on
Mandatory Installation of
Sprinklers in Houses
(for the model National Building Code)*

3. Facing Choices

Every serious injury or death is heart wrenching. Whenever one occurs, each one of us immediately looks for ways to prevent anything similar from happening again.

But we quickly find ourselves facing difficult questions. Is it possible to prevent further deaths? How many? What are the real risks? What are the real costs – monetary and otherwise? Are other things more effective – or more urgent? How much should governments intervene in how their citizens must spend their money? On what basis? How much risk does there have to be to justify mandatory requirements? What expense level is OK, and what is too much?

In the case of residential sprinkler systems, the answer has been clear.

The risks are low and falling.

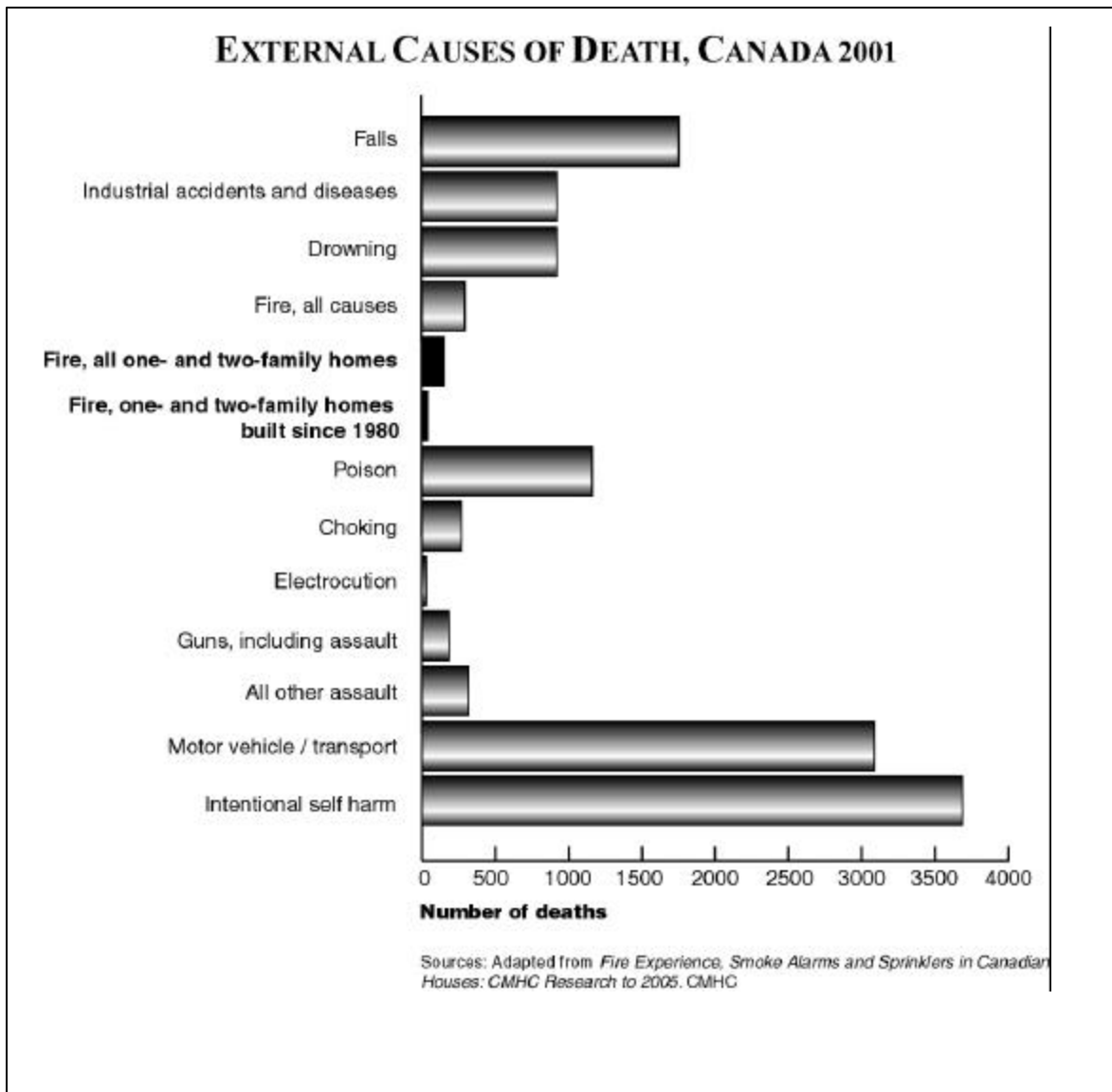
Sprinkler systems are expensive.

The choice should be left to individuals.

4. Fire risks are low and falling

4.1 Fire is a relatively low risk for Canadians

To answer the question of whether governments should intervene in people's choices, it's important to assess the level of risk. The chart below is taken from Canada Mortgage and Housing Corporation's recent research and development highlight booklet: *Fire Experience, Smoke Alarms and Sprinklers in Canadian Houses: CMHC Research to 2005*.² It shows the number of deaths in Canada from various causes. Fire, especially in one- and two-family homes, is one of the lowest.



²

Referred to later in this position paper as “the *CMHC Research to 2005* research highlight”.

“For the individual new home buyer, it may make more sense to invest in a fire extinguisher, or a monitor system for the children’s play and sleep areas, or a personal emergency alarm for an elderly parent – or even swimming lessons – than a residential sprinkler system.”

Smoke Alarms and Residential Sprinklers: Costs and Benefits (Summary Report)
CMHC

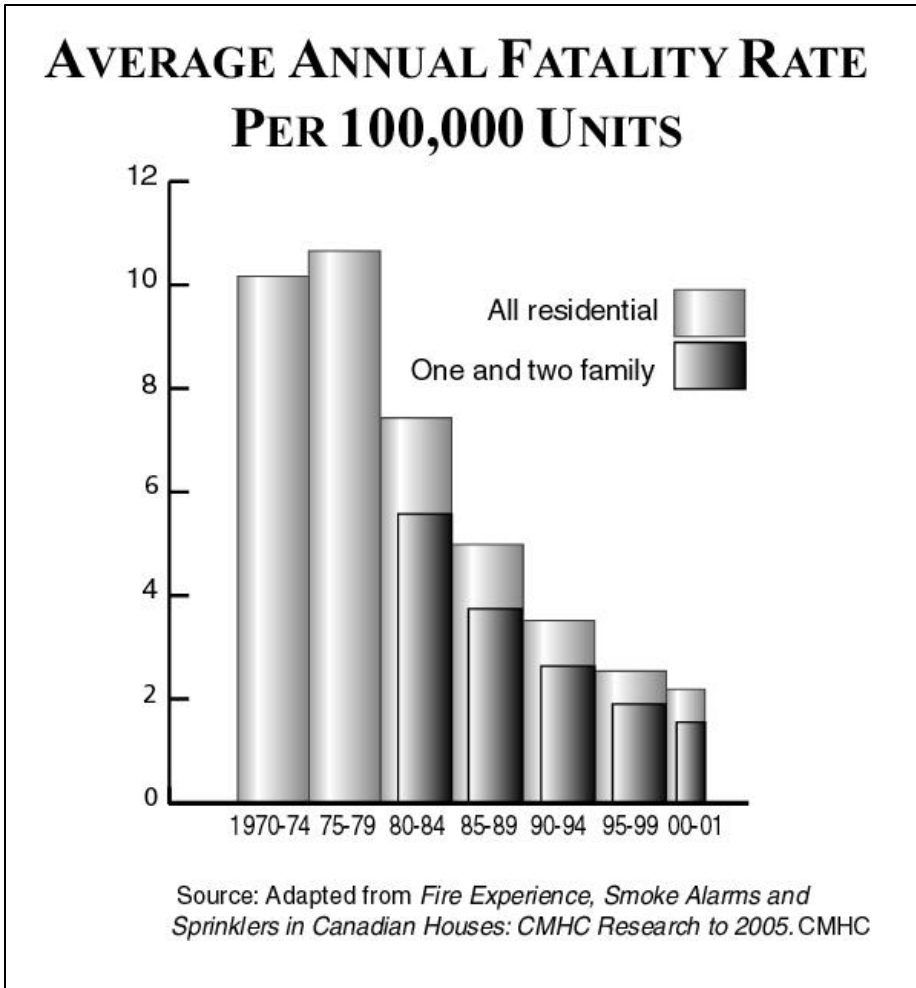
4.2 Risks are still falling

Canada used to have a relatively high level of fires (fire incidence). It also had a relatively high level of fire deaths, injuries and property damage. However, all of those are falling. The 2004 CMHC report *Canadian Housing Fire Statistics* looked at this issue in several different ways. It looked at residential fire experience on the basis of total population and total number of residential units. In both cases, it found the rate of fires, deaths, and injuries had fallen significantly over the two decades from 1980 to 1999.

“For one- and two-family dwellings, based on five-year moving averages, the fire incidence rate per 100,000 units has dropped 60 per cent, the fire death rate 68 per cent, the fire injury rate 37 per cent, and the fire damage rate per unit has dropped 39 per cent.”

Canadian Housing Fire Statistics
CMHC

The report also looked at fires in one- and two-family homes. Those figures had fallen even more dramatically. And they continued to drop into 2001, as pointed out in the *CMHC Research to 2005* research highlight.



4.3 Smoke Alarms are extremely effective

It is commonly agreed that the largest single factor in reducing deaths and injuries in residential fires has been smoke alarms. An inexpensive, easy-to-use technology, smoke alarms have been required in new houses since the early 1980s, and in existing houses in many areas since the mid to late 1980s.

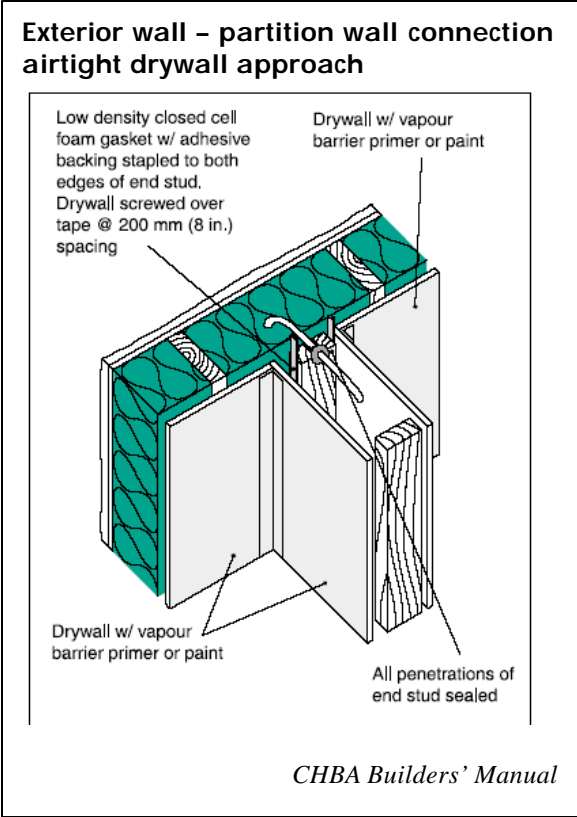
“In looking at the changes to residential units that could have resulted in increased fire safety, the (regulatory) requirements for smoke alarms ... and the accompanying public information campaigns, constitute the single most determining factor.”

Canadian Housing Fire Statistics
CMHC

4.4 Modern houses are better protected

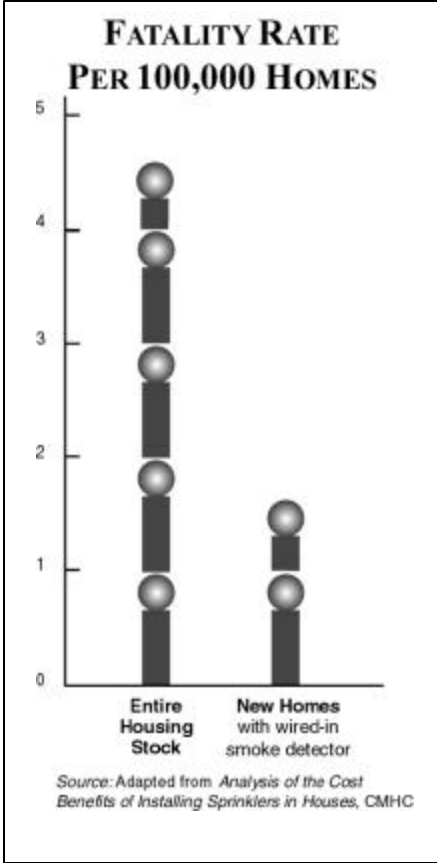
In new houses, smoke alarms are connected to the main wiring, and do not depend on batteries. Other contributing factors in houses built over the past 25 to 30 years have been numerous: introduction of provincial building codes based on the regularly updated model

National Building Code of Canada; improved safety standards for electrical equipment and in-house wiring in the Canadian Electrical Code; new approaches to fire separation and protection in townhouses, especially in attic spaces; more attention to sealing for energy efficiency which also improves fire safety; more stringent standards for walls and openings close to the lot line, etc.



Some proponents of fire sprinklers have tried to claim that houses don't "stay new" for very long. But these improvements in the construction of modern buildings don't disappear after the first few years. They last as the building ages.

Because of all these improvements in new houses, the 1989 analysis of costs and benefits for CMHC estimated that new houses were already at least 3.5 times as safe as the general stock of housing.



4.5 Other factors also contribute

Beyond the house itself are several factors all acting to reduce fire risks. These include improved fire safety standards for mattresses, bedding, furniture, children’s sleepwear, matches, lighters, electrical appliances, lights and equipment, as well as fire department education programs aimed at children and adults.

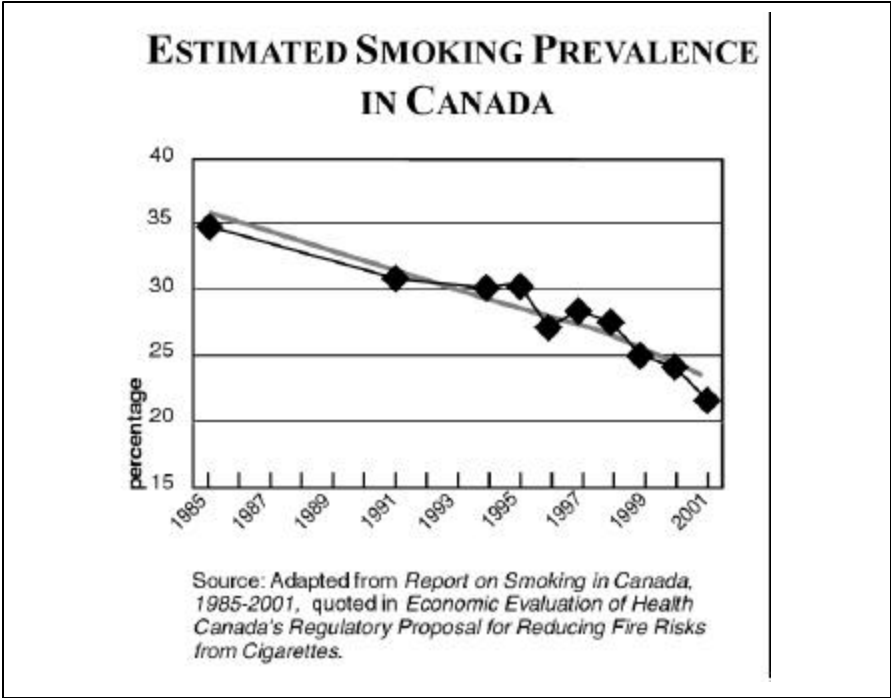
4.6 Sprinklers in new houses wouldn’t save a lot more lives

As noted above, newer houses are already 3.5 times as safe as older ones. The 1989 cost-benefit analysis estimated that putting sprinklers into all new one- and two-family homes might save 0.779 lives per 100,000 new units per year. That is an extremely small impact.

But what happens when the risks themselves drop?

For example, an economic analysis for a new Health Canada regulation on cigarette ignition notes that cigarette smoking is already in decline, and cigarette-caused fire deaths might well drop dramatically over the next few decades. Research quoted in the report (chart below) shows a relatively steady annual decline in smoking prevalence since 1985.

“Linear regression analysis suggests that if this trend were to continue, smoking prevalence would approach zero in 2039,” the report says, “... (and) it is reasonable to anticipate that fire losses attributable to cigarettes would also decline.” As a result, the potential benefits of any new regulation aimed at reducing related fire losses would also be reduced.



How does this affect sprinklers? If fewer people are at risk, then fewer people will be saved through the introduction of mandatory sprinkler regulations. But the same number of people will still have to pay to install and maintain them. And since those costs are still the same, the cost per life saved – already very high for residential sprinklers – goes up.

4.7 The impact of new cigarette regulations is still to come

As of October 1, 2005, Health Canada’s new “Cigarette Ignition Propensity” (CIP) regulation will require all cigarettes manufactured or imported for sale in Canada to have a reduced likelihood of igniting upholstered furniture, mattresses, bedding, garbage, etc. Canada is apparently the first country to have a national standard to reduce the fire risk of cigarettes.

Estimated Annual Reduction in Fire Fatalities and Injuries Due to the New CIP Requirement for Cigarettes			
	Current Fire Losses	Anticipated Reduction	
		Scenario 1	Scenario 2
Fatalities Per Year	53	36	18
Civilian Injuries Per Year	176	120	60
Fire-fighter Injuries Per Year	51	35	17

*Source: Economic Evaluation of Health Canada's
Regulatory Proposal for Reducing Fire Risks from Cigarettes*

Smokers’ articles – largely cigarettes – have been identified as the largest single cause of fire fatalities in Canada. It is estimated that the new CIP requirement will save between one third and two thirds of the fatalities related to smokers’ articles. Every year, that means saving 18 to 36 lives, and avoiding 77 to 155 injuries. For comparison, that is the equivalent of up to one quarter of the number of fire deaths reported in all one- and two-family houses³ in Canada in 2001 – the last year for which country-wide figures are available.

³ This includes all one-and two-family houses, in both urban and rural areas, with regular and volunteer fire departments, municipal and well water, new and older homes, with and without wood burning appliances, and with and without working smoke alarms.

5. The costs are substantial

5.1 Costs to the individual

In 1989, per square foot costs for a 1,940 square foot (total sprinklered area, including basement) side-split home in an urban location would range from \$1.43 (plastic piping) to \$2.37 (copper). The cost in rural locations would be higher: \$2.47 and \$3.67, respectively.

In 1998, typical installation costs averaged \$1.70 per square foot for singles, semis and townhouses (and \$1.45 per square foot for apartments). In this case, costs to sprinkler a single family home with a total sprinklered area of 2,000 square feet would total \$3,400.

Sprinkler system costs today appear quite similar. A quick poll of firms early in 2005 found that total cost estimates for 2,000 square feet sprinklered area including basement ranged between \$3,000 and \$4,000. Costs included the sprinkler system and associated piping (virtually always plastic), upgraded intake pipe, changes in other construction, schedule accommodation, etc. Larger houses would be more expensive overall, but would generally cost somewhat less per square foot. Smaller houses generally would cost more per square foot. For renovation projects the costs can be much higher.

Every \$1,000 increase in the price of an entry level new home means at least 6,000 potential first time buyers can no longer qualify for its mortgage.

In addition, there will be some costs for regular inspection and maintenance. In some municipalities, there may be extra charges to hook up to or increase municipal water supply size. In rural areas, sprinkler system costs will increase by \$2,000 to \$3,000 for a pressure tank system.

Sprinkler proponents downplay the costs, sometimes leaving the impression that all new home buyers can afford to spend another few thousand dollars with no difficulty. But, if sprinklers are made mandatory, they will be mandatory for entry level homes and rental units, as well as high end ones.

People struggling to save a five per cent downpayment will find the extra cost of sprinklers is a significant expenditure. So will those looking to buy an inexpensive older house to redo. For groups hoping to make new affordable rental units available, there may be a significant hardship.

Every increase in costs means some people on the margins will no longer be able to buy or rent a new home.

Home buyers with more discretionary income shouldn't be forced to spend it on sprinklers either. It is not appropriate to compare buyers' choice not to buy sprinklers with their decision to buy upgraded carpets or cabinets. People make many decisions about how to protect their family's safety. They choose a package of measures targeted to their family's needs and activities – in areas outside the home as well as in it. These can include better car safety, swimming lessons, emergency phones or beepers, and any number of other options with good cost-benefit ratios.

Just because they are not choosing to spend money on sprinklers does not mean they are not choosing to spend money on safety.

What level of fire protection will people have if they have to stay in existing accommodation with fewer safety features?

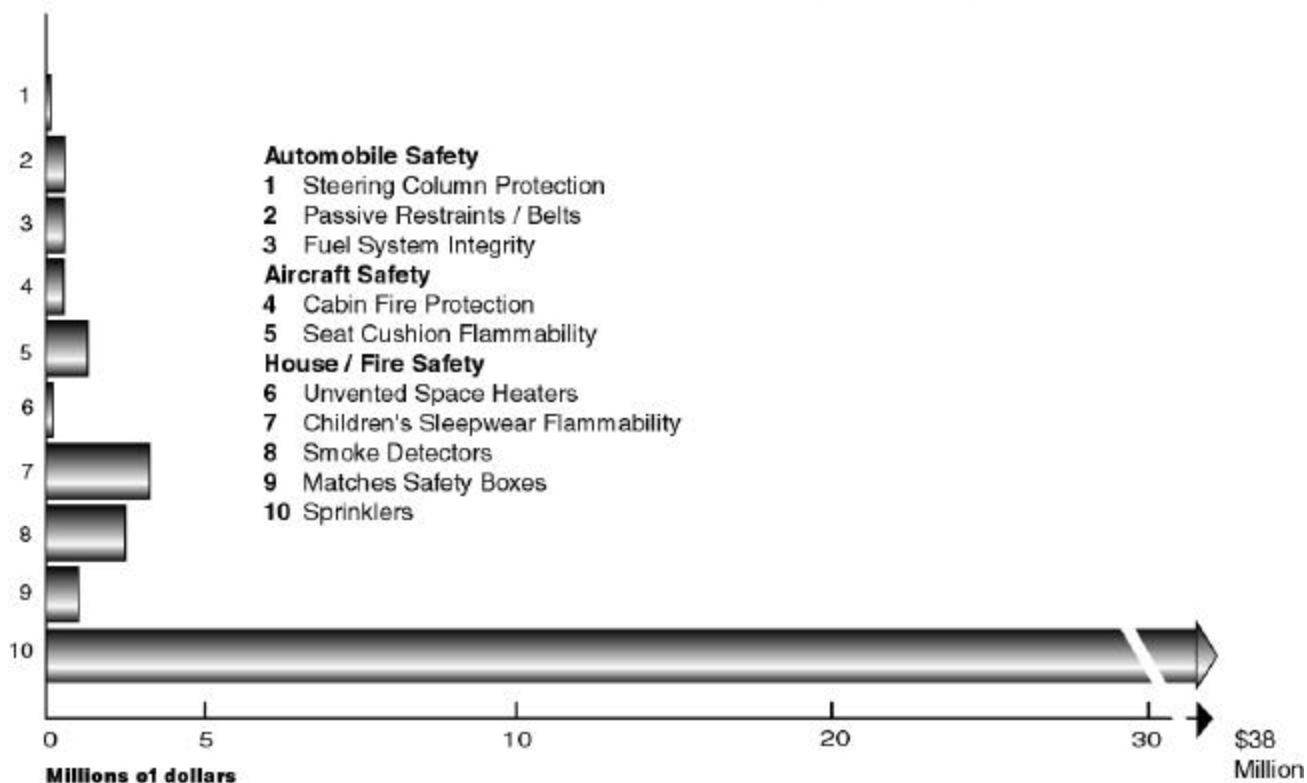
5.2 Costs to Society

CMHC's original 1989 cost/benefit study analyzed the total impacts of requiring residential sprinklers in all new one- and two-family houses. It calculated total costs and total savings, including reduced risk of occupant and firefighter injuries, reduced property damage, reduced indirect costs (including costs for temporary shelter, missed wages, demolition expenses, legal expenses, transportation, etc.) and reduced fire service costs. Subtracting the benefits from the costs gave an annual cost per household.

Then, that net cost per household was multiplied by the reduced risk of fatality, to come up with a total cost of saving one life.

The study went out of its way to give sprinklers the benefit of the doubt. Even so, the total net cost of installing sprinklers in enough houses to save one life added up to a minimum of \$38 million - and could rise to \$95 million in rural areas where water must be pumped from wells.

MANDATORY REGULATIONS, COST PER LIFE SAVED



Source: Adapted from *Analysis of the Cost Benefits of Installing Sprinklers in Houses*. CMHC

Fire Service Costs

In 1998, an unanswered question was the net impact on fire service costs if municipalities required sprinklers in all new residential developments. Proponents argued that, if sprinklers were made mandatory, the demand for fire services would drop and the municipality could reduce costs. CMHC commissioned the report *Costs and Benefits to Municipalities of Mandatory Residential Fire Sprinklers* to provide an impartial assessment, technically justified on economic grounds. It looked at changes in costs in five municipalities and one First Nation.

The study found some potential for cost savings to municipalities – if people were willing to accept longer response times from their fire fighting services, and to rely primarily on other services for response to other emergencies. These include fighting fires in all other building types, in vehicles, and "outside" (grass fires, etc.), as well as rescue operations, emergency medical treatments, and dealing with hazardous materials.

However, any savings impose significant costs on new home buyers. “In each of the cases studied,” the report concluded, “potential savings to the municipality would be less than the additional costs for the installation of sprinklers.” To assess the influence of system costs, the study prepared a second calculation which assumed sprinkler installed costs could be reduced

by half. Even if that could be done, it said, “in no case would the results be switched such that the savings would outweigh the costs.”

Municipal cost savings for fire protection services ... are considerably less than the related additional costs which would be incurred for the installation of sprinklers in the new housing.[@]

Costs and Benefits to Municipalities of Mandatory Residential Fire Sprinklers
CMHC

This study was reviewed in 2001 as part of an evaluation of directed research at CMHC. The evaluators confirmed the study methodology, incorporated discussion of risk to life, injury and property loss, and used recent cost figures and Canadian data to estimate fire risks in new, sprinklered and unsprinklered single family and multiple dwelling housing stock. Then, they estimated the costs and benefits of mandatory sprinkler regulations on new single family dwellings in Manitoba and all new residential dwellings in Ontario.

Assuming very high sprinkler effectiveness figures, they found that NOT requiring sprinklers in those two provinces alone would save a minimum of \$415 million of what most Canadians would be expected to see as unwarranted expenditure. If the National Research Council’s lower estimate of sprinkler effectiveness was used (60%), the savings increased to \$734 million.⁴

5.3 *Costs may not decrease further*

Economies of Scale? - Proponents of sprinklers say that costs for sprinkler systems could be reduced if the systems were made mandatory for all new houses, because of economies of scale. However, economies of scale will only apply to such manufactured components as the sprinkler heads themselves. The largest part of a sprinkler system is actually plumbing and on-site work – neither of which offers economies of scale.

More Flexible Standards? – We have already seen the impact of acceptance of plastic piping, which has been positive for sprinkler costs. However, some of the declines in cost figures quoted in the US appear to have related to a gradual erosion in test standards for sprinkler heads over the 1990s. By 1999, it became obvious that some units and configurations were not providing enough water to effectively suppress a fire. Test standards for UL product listings were made more stringent and the standard for water delivery added a

⁴ The purpose of this report was to estimate the impact of CMHC research. Its authors attributed only part of the full impact (25 per cent in Manitoba and 40 per cent in Ontario) to the research program. The “attributable portion” figures shown in the report itself were \$158 million and \$278 million, respectively.

measure of area – a minimum of 0.05 gallons per minute per square foot. The new requirements took effect in 2002. They meant an increase in the minimum pipe sizes for some projects. Also, a number of sprinkler heads did not qualify for relisting. At about the same time, there were some significant recalls of malfunctioning sprinkler heads. Water supply costs remain an issue, especially (but not only) in non-urban areas.

Insurance Reductions? – In 2005, insurance industry representatives seem to be as focused on possible increased damage from mold and/or water if sprinklers malfunction as on offering reductions for possible decreased damage due to fire. A few very publicized and very expensive mold-related court awards in the US have pointed out that damages from mold may be far more extensive than those from fire.

5.4 *“Once they’re in they’re fine”*

Sprinklers depend on owner maintenance and understanding – they can quite easily be disabled by simple acts such as painting over the heads.

How well will owners and tenants maintain their sprinklers? Nobody really knows. The NFPA 13D standard recommends that all valves be checked monthly, and maintained or replaced as necessary. Sprinkler heads should also be checked visually for damage or obstruction.

Obstructions are a great concern. For example, a home owner who paints over a sprinkler head while redecorating may actually clog the openings and prevent it from functioning during a fire. Wall or ceiling hangings, large pendent light fixtures, hanging planters and wall units/cupboards may all interfere with the sprinkler's spray pattern, making it far less effective.

Who will be liable for damages if a residential sprinkler doesn't perform properly? Or if it discharges – whether there's a fire or not – and that causes a serious mold problem? The sprinkler manufacturer? The home builder? The installer? The regulator?

There are other performance issues. For example, there is the possibility of accidental discharge, or leaking pipes and heads. There is a question of whether water supply will be adequate on a continuing basis. Without a guaranteed water supply at the necessary pressure, sprinklers cannot function. Plastic pipes cannot be drained and left cold in the winter. When sprinklers must be put into unheated spaces, expensive antifreeze systems are the only option. Some of those solutions pose piping compatibility problems.

Finally, sprinklers may not be able to respond adequately to some fire situations. "Research seems to indicate that even quick response sprinklers will not start up before smoke and

carbon monoxide reach fatal concentrations if the fire starts in a closed unsprinklered room or closet, the CMHC summary report on smoke alarms and sprinklers says. If a fuel container or a flammable couch suddenly flares up, the person holding the container or sleeping on the couch may not be saveable. A fire which starts in an attic space or closet, or inside the wall cavity, cannot be extinguished by sprinklers installed to NFPA 13D, although they can help protect rooms and halls for a certain length of time.

6. There are some higher-risk situations

The *Canadian Housing Fire Statistics* report pointed out that some groups and housing types face risks which are much higher than the general population. The chart on the next page, taken from the *CMHC Research to 2005* research highlight, shows those risks in relation to the equivalent experience of one- and two-family homes. The first bar, for example, shows that fire incidence in First Nations' one- and two-family homes is 2.4 times the rate for one- and two-family homes across Canada:



Reducing the high injury and death rates in these situations would definitely help improve Canada's fire experience. The question is how.

In some cases, moving people from substandard or overcrowded housing may be the best option.

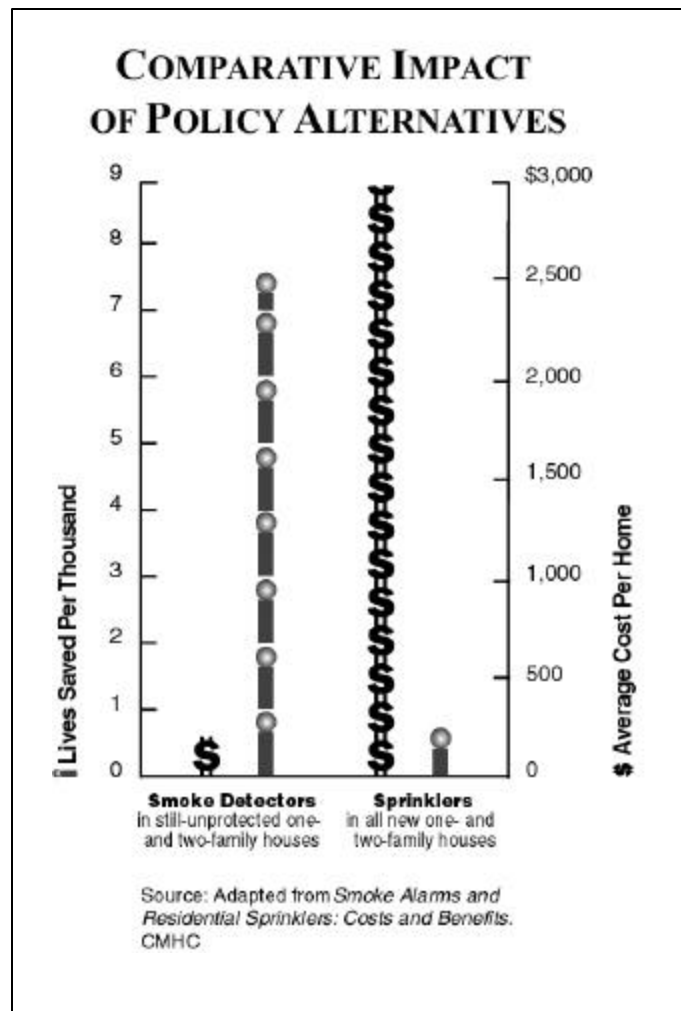
For homes in rural areas without regular fire services, sprinklers may be appropriate. But these homes often pose the most serious difficulties for that technology, because of limited water pressure in wells.

In some cases, it may be enough to make sure that smoke alarms are present and functioning.

The fatality rate in houses without functioning smoke alarms is estimated to be 13 per 100,000 per year – very close to 10 times that of new housing.

Putting two basic battery-operated smoke alarms into unprotected houses would cost about \$40 to \$80 – and reduce fatalities by an estimated seven lives per 100,000 houses per year. A more extensive system with four alarms might cost \$80 to \$160 – and reduce annual fatalities by 8.5 lives per 100,000 per year.

The societal costs would be nil – smoke alarms would more than pay for themselves in reduced property damage alone. In comparison, spending \$3,000+ per new house for a sprinkler system might reduce fatalities by an estimated 0.78 lives per 100,000 per year – at a net cost to society of at least \$38 million per life saved.



7. Conclusion – The choice should be left up to individuals

For the vast majority of Canadians in newer houses, the risk of fire is actually relatively low. And the cost of residential fire sprinklers relative to those risks is very high. If people want to install this technology, that should be their choice. But imposing the high costs of mandatory sprinklers through regulation cannot be justified on an economic or risk basis.

CMHC, Canada's national housing agency, has conducted a number of serious studies of residential sprinklers for new one- and two-family homes.

Not one of those studies has concluded that the benefits of requiring sprinklers justifies the costs.