Economic Incentives of Residential Sprinklers for Homeowners

FST381 Analytical Approaches for the Fire and Emergency Services

Professor John Glass

Submitted by Jesse Leonard

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Abstract

This paper will attempt to identify whether or not residential sprinklers are cost effective. It will look at the potential savings in the event of a fire compared to the initial cost of installation. While no new data will provided, there is already an extensive amount of research into this topic. By compiling the already existing data, a more comprehensive analysis should be possible. If an economic incentive to install residential sprinklers can be proven, this should add even more appeal for homeowners considering their purchase.
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**Background and Significance**

Fires are incredibly damaging events that pose great risk to health, safety, and property. Because of this, an entire industry of fire protection has grown steadily over the last two centuries. One of the greatest technological breakthroughs was the invention of the sprinkler system. This ingenious piece of equipment was designed to prevent fire damage and spread by expelling water through piping. Initially these systems were only used in speciality occupations. However, sprinklers were so effective they began to be used in more and more buildings and were seen as a large asset to insurance companies and fire departments. Eventually, sprinklers would become mandatory for many building types under the various building codes and fire codes around the world. However, until recently, North America has not seen the residential occupancy as a place that needs sprinklers.

This has changed as more and more associations and professionals within the fire protection industry and fire services rally behind the benefits of residential sprinklers. Research, testing, and case study analysis has shown residential sprinklers to be effective at protecting life, minimizing property damage, and alleviating municipal costs for aid. These factors have caused many to demand mandatory sprinkler ordinance for all new residential occupancies, something builder associations have been notoriously against. The argument from the builders is that the installation adds too much to the price of a new home. Cost is an extremely motivating factor in any decision making process but this is especially true in the instance of home owning. Therefore an in depth review of residential sprinkler cost is beneficial to further understanding the issue. If it can be shown that the cost argument is not true, and residential sprinklers are economically feasible, the other factors will stand on even better ground.
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**Introduction**

Most communities in North America still do not have legislation making residential sprinklers mandatory. Until this happens, the final decision will come down to individual homeowners. Everybody wants to provide the greatest level of safety for themselves and their family. Unfortunately there are economic roadblocks that limit the extent of this safety. And so, this paper will try to answer a simple question: are sprinklers a cost-effective purchase? That is to say, are they likely to save a homeowner enough money that they warrant installation? There are many other reasons to want sprinklers inside the home but placing a dollar value on peace of mind or life safety can be difficult. Costs on the other hand, are cut and dry. It is for this reason that this paper will stick to a question of investment and savings.

This simple question will be answered by reviewing existing case studies. The fire protection industry has carefully followed several communities and municipalities that adopted residential sprinkler legislation over the last few decades. By closely monitoring these example areas it is possible to extrapolate data. The more case studies, which mean more data, the better researchers can compile an analysis. By extracting cost-benefit data from multiple case studies one can create a range of values that a homeowner is likely to fall within.

The key components this paper will look at are the costs in fire damage to non-sprinklered residential homes and the costs in fire damage to sprinklered homes of comparable value. If the savings in damage for sprinklered homes exceeds the cost of installation than it is reasonable to say that sprinkler installation is cost-effective. Beyond this, researchers can also determine other figures like ratio of loss and rate of return on investment (RROI) which will be explained later on.
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Case Studies

Despite the lack of continuous residential sprinkler ordinance throughout North America, several communities and municipalities have been proactive with their fire protection initiatives. Prince George, Maryland; Bucks County, Pennsylvania; Scottsdale, Arizona; and Vancouver, British Columbia have all adopted residential sprinkler requirements within their respective jurisdictions. As the years have gone on, the data has continued to flow into the fire service and fire protection community allowing for an understanding of the effects of the ordinance. However, in order to fully understand the data it is important to contextualize each area.

Bucks County is an area of Pennsylvania consisting of several municipalities. A report published by the Home Fire Sprinkler Coalition (HFSC) used six different municipalities for producing their data: “Each is located in the central portion of the County, and has undergone significant growth since the 1980s. The jurisdictions range from rural to suburban, with and without public water service.”\(^1\) Geographically speaking, “Bucks County comprises roughly 608 square miles [1575 km\(^2\)] of land and 15.8 square miles [41 km\(^2\)] of water. There are approximately 626,000 residents within 23 boroughs and 31 townships”\(^2\). The fire data for the HFSC report follows the county from 1988 until 2010.

Prince George is another county of diverse nature. It is close to the same size as Bucks County with roughly 500 square miles (1295 km\(^2\)) but consists of more development having “a mixture of light industrial, retail, residential and institutional structures”\(^3\). However, it still has significant rural areas towards the southern third of land with development being concentrated in the northern two thirds. The HSFC report on Prince George’s County states “the average

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\(^1\) Communities with Home Fire Sprinklers: The Experience in Bucks County, Pennsylvania (Jakubowski, 2011) p. 3
\(^2\) Communities with Home Fire Sprinklers: The Experience in Bucks County, Pennsylvania (Jakubowski, 2011) p. 6
\(^3\) Benefits of Residential Fire Sprinklers: Prince George’s County (Weatherby, 2009) p. 5
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population in the County from 1992-2006 was 846,000 residents\textsuperscript{4}. The fire data for the county consists of the fifteen years between 1992 and 2007.

Scottsdale is a suburban city within Arizona that also adopted sprinkler legislation around the time as the other counties in 1986. The HFSC released its initial report on Scottsdale with 10 years of data but has since released additional information for a 15 year study. Unlike the county reports, Scottsdale follows a much smaller and localized population and area. The original HFSC ten year report describes the city as primarily suburban, encompassing “an area of 182.5 miles and supports a rapidly expanding community with a current population of 174,490”\textsuperscript{5}. It must be noted that the Scottsdale data only goes up to 1996 for the ten year study and 2001 for the fifteen year study, significantly earlier than the county reports.

In the interest of making this analysis more broad, it also includes the Canadian city of Vancouver, British Columbia. Unlike the other communities, Vancouver is a major city of significant means and development. It is the third most populous city in Canada and has some of the most expensive real estate. It adopted residential sprinkler ordinance in 1990 and has been tracked by fire protection and fire service professionals ever since.

**Fire Loss in Sprinklered vs. Non-Sprinklered Residences**

If residential sprinklers are as effective as claimed, these studies should show that homes with sprinklers were able to control the fire and protect the property. A simple way to evaluate this is through cost assessment. If homes with sprinklers have lower property losses than non-sprinklered homes, the installation is working. Furthermore, the two values can be compared to show just how much sprinklers would save a homeowner.

\textsuperscript{4} Benefits of Residential Fire Sprinklers: Prince George’s County (Weatherby, 2009) p. 5
\textsuperscript{5} Automatic Sprinklers: A 10 Year Study (Ford, 1997) p. 9
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Over the twelve years covered in the Bucks County report they averaged $14,000 in losses for sprinklered homes and $179,896 for unsprinklered homes. These residencies are described as “one- and two-family dwellings”\(^6\). This makes for a savings difference of $165,896 between non-sprinklered and sprinklered homes.

Prince-Georges County saw significantly lower values with an average loss of $4,883 in sprinklered homes and $9,983 in non-sprinklered structures. These structures are described as “single-family/townhouse” units\(^7\). This makes for a savings difference of $5,100 between non-sprinklered and sprinklered homes.

In the latest 15-year data it states that Scottsdale averaged $2,166 in fire damages to a sprinklered home and $45,019 in fire damages to a non-sprinklered home\(^8\). However, this non-sprinklered data only includes fires from the years 1998-2001. This could be misleading because the sprinkler ordinance had already existed for 12 years, making the number of unsprinklered residences significantly lower. A more accurate value may be from the 10-year report which lists non-sprinklered single-family dwelling units as having an average loss of $9,571 per fire\(^9\). Using the data from both studies, it makes for a savings difference of $7,405 between non-sprinklered and sprinklered homes.

A Toronto Fire Services report from 2007 uses Vancouver statistics. It states that Vancouver averaged $1,065 in losses for sprinklered homes and $13,937 in unsprinklered homes. This makes for a savings difference of $12,872\(^{10}\). Interestingly, a 2002 report from the National Fire Academy (NFA) presents different figures for the city. This paper states values per

\(^{6}\) Communities with Home Fire Sprinklers: The Experience in Bucks County, Pennsylvania (Jakubowski, 2011) p. 4
\(^{7}\) Benefits of Residential Fire Sprinklers: Prince George’s County (Weatherby, 2009) p. 8
\(^{8}\) Scottsdale: 15 Year Report (Home Fire Sprinkler Coalition, 2010) slide 3
\(^{9}\) Automatic Sprinklers: A 10 Year Study (Ford, 1997) p. 33
\(^{10}\) Use of Residential Sprinklers in New Housing Projects (Toronto Fire Services, 2007) p. 5
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$1,000 of property using an average of $666 in losses for a sprinklered home and $8,910 for a non-sprinklered home\textsuperscript{11}. This translates to a savings of $8,244 per fire incident. Because the Toronto report is more recent it is assumed to be more accurate. Interestingly however, when applied as a ratio of loss, the two data sets are almost identical.

Figure 1

These loss values range a great deal from report to report so sometimes it is useful to see the data from a better comparison. One helpful analysis is the ratio of loss. This is simply the number of dollars that would be lost in a non-sprinklered home compared to a sprinklered home. It is calculated by dividing the non-sprinklered fire loss value by the sprinklered fire loss value.

\textsuperscript{11} Is Establishing A Residential Sprinkler Ordinance Right For The City Of Ogden? (Owens, 2002) p. 11
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When done with the Toronto and NFA values for Vancouver it calculates a ratio of loss of 13.09 and 13.38 respectively. Interestingly, Bucks County, which reported significantly higher values than the other reports, still ends up with a ratio of loss at 12.85. This means that even if the method of calculation varied in the Bucks County report, it still has a comparative difference that is close to the values of Vancouver. Using the combined Scottsdale values of $2,166 and $9,571 there is a ratio of 4.42. Prince George’s County comes in at the lowest ratio of loss with only 2.04.

Figure 2

One can also produce an average ratio of loss by combining all values and dividing by four. This calculates an average of $11.09 lost in a non-sprinklered fire for every dollar lost in a sprinklered fire.
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Cost of Sprinkler Installation

Unfortunately, one shortfall of the HSFC reports is that they fail to provide the average cost of installing a sprinkler system per residential home. They do provide an average cost per square foot but this is only useful if one can also determine the average size of a home in the area. Alternatively, a 2007 report from the National Institute for Standards and Technology (NIST) provides a “best guess estimate” of installation costs for three different residential home sizes: a colonial, town, and ranch house\textsuperscript{12}. The NIST report averages these building types as $2,076 for a colonial, $1,895 for a townhouse, and $829 for a ranch home\textsuperscript{13}. Unfortunately the NIST averages are based on American national values so they are only a rough estimate for each individual area, especially Vancouver as it is actually Canadian.

Cost Savings in the Event of a Fire

It is possible to create a rough estimate of savings by comparing the dollar difference in losses between sprinklered and non-sprinklered residences and comparing it to the NIST averages for installation.

<table>
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<tr>
<th>City</th>
<th>Average Savings</th>
<th>NIST REPORT 2007</th>
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<tbody>
<tr>
<td>Bucks County</td>
<td>$165,886</td>
<td>Type</td>
</tr>
<tr>
<td>Prince-George’s County</td>
<td>$5,100</td>
<td>Colonial</td>
</tr>
<tr>
<td>Scottsdale</td>
<td>$7,405</td>
<td>Townhouse</td>
</tr>
<tr>
<td>Vancouver</td>
<td>$12,872</td>
<td>Ranch</td>
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This data can be used to calculate how much a homeowner would save in the event of a fire by installing a sprinkler system. The case study reports show that there is a varying savings

\textsuperscript{12} Benefit-Cost Analysis of Residential Fire Sprinkler Systems (Butry, Brown, and Fuller, 2007) p. 18
\textsuperscript{13} Benefit-Cost Analysis of Residential Fire Sprinkler Systems (Butry, Brown, and Fuller, 2007) p. 18
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value by having sprinklers. Taking these savings values and subtracting the installation costs produces a net savings in the event of a fire. That is to say, it creates a value of “worth” for having the system. Even though a system can cost several thousand to install, it earns it back and more if a fire were to occur.

Figure 3

Once again, the Bucks County values skew the data considerably but overall there is a clear trend for thousands of dollars in savings. No case study, regardless of installation type, shows any negative values. This means that in all cases a residential system proves cost effective. In fact, the lowest savings (Prince-Georges with a Colonial) still produces over three
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thousand dollars in savings during a fire event. This is more than double the installation cost and something homeowners need to consider.

Conclusion

Even without the cost-benefit savings analysis, homeowners should consider sprinkler installation due to the ratio of loss. Prince George’s County, the case study with the least discrepancy between sprinklered and non-sprinklered losses, shows a ratio of loss at 2.04. This means that even at the very bottom end of savings, homeowners will cut their losses in half by having sprinklers. And the likely savings are much higher with an overall average of 11.09. The divide in loss is clear when one looks at all the data. In the event of a fire, a lot of money is saved by having residential sprinklers.

This ratio of loss is further supported by the cost savings analysis. These figures demonstrate that the initial installation cost is greatly outweighed by the potential fire losses. A net gain can be seen in every housing type for every single case study. It is without question that there is an economic incentive to installing residential sprinklers in homes.

There are some shortcomings to these calculations. Ideally, the installation data should come from the same reports as the fire loss values. Additionally, it can be assumed there is less to lose in a ranch home as opposed to a colonial so the average fire loss values may not be completely applicable. Then there is also the fact that these values come from different years and, in Vancouver’s case, different countries. However, these all occurred in a relatively close time frame and the U.S. to Canadian exchange rate is very similar. This report deals with averages and therefore the figures should not be taken as exact. Despite this, there is no data anywhere within this paper that comes close to suggesting residential sprinklers are not a
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worthwhile investment for homeowners. Exactly how much they save can still be debated but it should be concluded that they will save money (or at least pay for themselves) in all instances. Residential sprinklers should be seen as a way for homeowners to lower their losses in the event of a fire. This also provides peace of mind that goes beyond a simple dollar value.

Professionals in fire protection and emergency services should use this data to convince the public of residential sprinkler benefits. Other reports have demonstrated the value of sprinkler ordinance at the community level and its benefit to insurance as well as emergency services. These are also important reasons to install residential sprinkler systems. Surely by convincing homeowners of the cost savings they will receive it will help sway public opinion to enact sprinkler ordinances. Hopefully in the future more and more communities will take after the initiative of Prince George’s County, Buck’s County, Scottsdale, and Vancouver.
References


