Residential Fire Sprinklers For Life Safety

An Economic and Insurance Perspective

Prepared for the Orange County Fire Authority, California

February 25, 2001

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Executive Summary

- A review of current economic literature, specifically *elasticity of demand* research conducted by third parties not associated with the stakeholders of this issue, clearly indicates that a 1% increase in the cost of the construction of a new home caused by installing a fire sprinkler system will not cause the potential homebuyer to no longer afford the new home.
- The two decisive factors that dictate what value home at the high limit a potential homebuyer can purchase are the amount of available income for housing and the current mortgage interest rate.
- Fire sprinkler systems can be installed in any value house. Therefore, the potential homebuyer, regardless of the amount of income available for housing, or the mortgage rate, can purchase a new home containing a life safety residential fire sprinkler system.
- There is a propensity for homebuilders to oppose any government mandate that drives up the cost of construction. Homebuilders are speculating what the future sales market will be when they commence construction. The finished product is available for sale many months after construction begins. This forms the foundation for the want to minimize cost drivers when the substantive concern should be changes in the mortgage rates.
- The cost to repair fire structural damage will always be more expensive than water damage caused by fire sprinklers. The potential liability losses from fire will always be greater than the potential water damage losses from fire sprinklers. Recognizing the property and liability savings resulting from the installation of fire sprinklers, all major insurance companies provide for reduced insurance rates for all occupancies including single-family homes.
- To look singularly at and focusing on water damage without analyzing the potential fire losses had the fire sprinkler system not been present is a misrepresentation.
- The many myths shadowing fire sprinkler systems need to be understood. Each fire sprinkler operates independently, not the total flooding of buildings as frequently portrayed in movies. The odds of an inadvertent or accidental discharge of a fire sprinkler have been reported by one national testing laboratory to be in the millions to one.
- Insurance companies consider water damage in the amount of the insurance reduction it provides for various occupancies. Some commercial properties can receive as much as a 75% reduction in its insurance rates. This author receives a 10% reduction for the fire sprinkler system installed in my single-family home. Both these figures were derived after considering water damage repair costs; again fire damage is always greater than sprinkler water damage.
- The National Institute of Science and Technology reports a potential 82% reduction in fire deaths should fire sprinklers be installed in all residential occupancies. Accordingly, the potential owner must be afforded fire sprinkler protection for their family. Those homebuilders who do not install affordable fire sprinklers are at the peril of the legal system as they know or should have known the life safety benefits of residential fire sprinkler systems.

Residential Fire Sprinklers for Life Safety: An Economic and Insurance Perspective

I. INTRODUCTION

The United States has one of the highest fire loss rates of the industrialized world - in both terms of fire deaths and fire losses. This unenviable status has mystified world fire service experts because the solution to significantly reduce the fire death rate is available and affordable. The simple solution to minimize our nation's fire death rate is residential fire sprinklers. But there exists opposition to installing these new technologically advanced residential fire sprinklers because of economic reasons. This paper will focus on the economic concerns of installing residential fire sprinklers with specific focus on ***affordable housing*** and ***insurance rate reductions.*** We will discuss the U.S. fire problem as well as the cost of installing residential fire sprinklers. We will analyze the impact of an increase in the asset price for new housing by discussing the many underlying forces that affect supply and demand of housing. We will also discuss actions that may be taken by local government to make the installation of residential fire sprinklers economically palatable for the homebuilder and the public.

II. LITERATURE REVIEW - THE FIRE PROBLEM

The United States has led the industrialized world in fire deaths and fire losses for decades. Is the U.S. fire problem getting any better? The United States Fire Administration studied the fire death rates of 14 industrialized nations for the period of 1979 to 1992. The United States fire death rate fell 46.3 percent, from 36.3 fire deaths per million population in 1979 to 19.5 fire deaths per million population in 1992 and averaged 26.5 fire deaths per million population during this 13-year period.

(Figure 1). This study also shows that while the United States has shown remarkable improvement in its fire death rate during this period, so have the rest of the industrialized nations. The U.S. fire death rate is over *five* times that of Switzerland, the nation with the lowest rate of all the countries considered in the study (Trends, 1997)

Average Fire Death Rate by Country

(1979-1992)

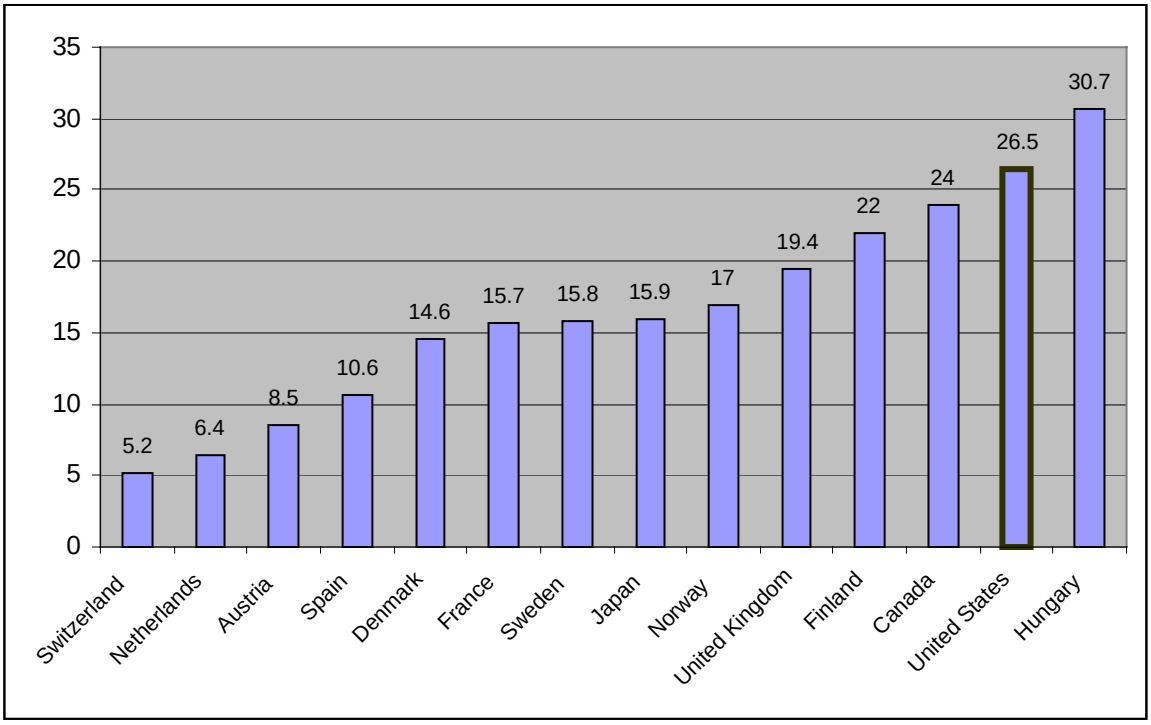

Figure 1. Source: *Fire Death Rate Trends: An International Perspective*

The U.S. fire death rate reduction has largely been attributed to the use of smoke detection devices in residential occupancies. However, smoke detection technological advances also contributed to the international fire death rate reduction still keeping the U.S. with its high fire death rate country status. The Consumer Products Safety Commission estimates that 88 percent of U.S. households have at

least one smoke detector (Smoke Detector, 1994). Technology has made smoke detection devices affordable and reliable when properly maintained. Disturbing is the report that in 14.8 percent of residential fires resulting in death the smoke detector failed to operate largely because of poor battery maintenance (Fire, 1997). But even more disturbing, smoke detectors did, in fact, operate in 19 percent of fires in which a death occurred. This is most disturbing since there is widespread belief that an operating smoke detector is a near failsafe fire safety device. In some of these cases, the detector may have gone off too late to allow the victim ample time to safety exit or the victim may have been too inebriated or feeble to react. (Fire, 1997)

What has the fire services so mystified is the reality that these fire deaths can be ***reduced by an estimated 82%*** if new technology residential fire sprinklers were installed along with the smoke detectors (Ruegg, 1984). Using the 10-year average of U.S. fire deaths from 1985-1994 of 5,770 fire deaths per year, an 82% reduction means that over 4,700 people a year during this period would have survived the fire (Fire, 1997).

While the installation of fire sprinklers have become more widespread in commercial structures, not so for residential occupancies where 71% of all our fire deaths occur (Fire, 1997). One reason the installation of fire sprinklers in residential occupancies is not so wide spread is concerns about the cost. *Homebuilders frequently argue that increased costs chase away or limit the pool of potential buyers, a myth dispelled by and is the main focus of this paper.*

The national model building codes allow for construction tradeoffs when fire sprinkler systems are installed. Tradeoffs such as reduced fire resistant ratings,

travel distance extension thereby allowing less stairways, increases in the size of the area requiring fire stopping, and a multitude of other tradeoffs provide cost savings to the developer when buildings are designed with fire sprinklers and these tradeoffs used (SBC, 1997). The Florida Legislature in 1993 passed a law requiring all new buildings three stories and above to be built with fire sprinklers installed. While it took some developers time to adjust their construction plans and specifications to include fire sprinklers and take advantage of these building code allowed tradeoffs, today this progressive law meets with little opposition because the construction cost savings far out weigh the added expense of installing the fire sprinkler. In most cases, the building can be built at a much lower cost per square foot with the fire sprinkler system and taking advantage of the code allowed tradeoffs, and often the dollar cost savings per square foot of construction is substantial (Advantage, 1997). Recent statistics from the National Fire Protection Association shows impressive results of installing fire sprinkler systems in residential occupancies. The fire death rate per thousand fires in hotel and motel occupancies is 1.6 in fire sprinkler equipped properties and 9.1 in hotels and motels with no fire sprinklers (U.S. Experience, 1998). With fire safety problems controlled in new high-rise or three-story and above structures thus minimizing the potential for large loss of life from a single fire, the focus now turns to one- and two-family dwellings.

While our nation's fire service is most interested in *retrofitting* residential fire sprinklers in existing homes, the political reality of making this happen, coupled with the increased cost of retrofit verses new construction makes the enactment of retrofit fire sprinklers ordinances for existing single-family homes not a viable option. But the

installation of fire sprinklers in new constructed homes must be considered. The National Association of Home Builders reports that from 1985 to 1997, 13,704,000 new homes were built in the U.S. This averages to 1,054,000 homes per year during this 13-year period (Characteristics, 1997). This means that if affordable fire sprinkler systems could be installed in these new single-family homes, over one million families each year will receive the superior life safety protection features provided by residential fire sprinklers.

The construction tradeoffs allowed by the building code in three-story and above new construction property make fire sprinkler systems affordable, actually a cost savings in almost all cases. Cost savings from these construction tradeoffs do not hold true for the one- and two-family dwelling. There simply are not enough construction tradeoffs available in the national building codes to offset the cost of installing fire sprinklers in the one- and two-family dwelling. However, insurance savings help recover the cost of the system in the long-run.

The manufacturers of fire sprinkler products have spent many dollars on new innovative technology in an effort to make the installation of residential fire sprinkler systems in these small dwellings affordable. The invent of residential quick response fire sprinklers has resulted in a significant reduction in the water volume and pressure needed to successfully control a fire meaning less water, smaller pipes, thus, lower costs (FYI, 1996). In Germantown, Tennessee, one fire sprinkler contractor is installing residential fire sprinklers in these single-family homes at a cost of $0.84 per square foot (Security, 1998). This amounts to an average slightly over a 1% increase in construction costs. In Altamonte Springs, Florida, Steve Randall, Chief Building

and Fire Official, reports that a new technology fire sprinkler system was installed at a cost of $0.38 per square foot or well under 1% of the construction costs (Altamonte, 1998). ***Assuming that there are no impact fees or other governmentally imposed taxes, fees, or other cost drivers that will escalate the cost of the fire sprinkler system, a 1% increase in the cost of construction appears to be an appropriate measure of the impact of installing residential fire sprinklers in new homes.*** Still, with this minor cost adjustment, homebuilders typically object to the added cost of the residential fire sprinkler system because they erroneously suggest that the added cost means a decline in the pool of potential buyers.

While this paper focuses on economic issues, it is appropriate to discuss externalities that also act as a barrier to the installation of fire sprinkler systems. Some developers, whose reliance on subcontractors to complete a new home in a timely basis, are reluctant to add another subcontractor to the list of people they must coordinate. They argue that conflicting work schedules of subcontractors and the need for one to complete work before another trade can begin its work is a substantive issue and adding another subcontractor exacerbates an already bad situation. Security Fire Protection, a progressive Memphis sprinkler contractor, has developed a solution to this subcontracting dilemma. Once the electrical contractor has placed its last wire in the attic space, the fire sprinkler installer shows up at the job site at 5:00 PM and by the next morning, the bulk of the fire sprinkler system is installed. The dry wall contractor simply cuts out a hole for the fire sprinkler drop in the same manner as they would prepare the walls for an electrical outlet. Later the

fire sprinkler installer will return to adjust the fire sprinkler drops and finalize the installation, activities that typically take a couple of hours (Security, 1998).

III. LITERATURE REVIEW - THE ECONOMIC ISSUES

The substantive issue facing the Orange County Fire Authority is the challenge from builders who argue that the cost of adding fire sprinklers in residential occupancies is causing a decline in affordable housing. It is my understanding that the Orange County Fire Authority has adopted an ordinance requiring residential occupancies 6,000 square feet and larger to be protected by a residential fire sprinkler system and that this square foot threshold was established after evaluation of its first responding unit's fire suppression capability. Surely the builders are not arguing that the added cost of the fire sprinkler system is chasing away potential buyers of a 6,000 square foot single-family home? Not many people can afford a single-family home of this size. Thus, the builders must be arguing that a 1% increase in construction costs is chasing away potential condominium or townhouse buyers. And the bigger the building, the greater the savings from construction trade-offs allowed by the code. How significant is a 1% increase in construction costs on the demand for new housing? To answer this question, we will investigate the basic forces underlying the supply and demand for housing – ***prices, demographic changes and population shifts, income, cost and availability of credit, the cost of rental housing, and consumer preferences*** (Smith, 1969). We will be reviewing current literature in the field of elasticity of supply and demand for many of these underlying factors. First, it is important to understand the complexity of the housing market in an economic perspective. At the time the homeowner buys a home,

condominium or a townhouse, the transaction is best labeled as an investment in a particular asset, *housing stock.* During the time after occupancy, it is possible to define the consumption of housing services including many variables like the annual cost of debt, the opportunity cost of equity in the house, depreciation and maintenance, and the effect of homeownership upon tax liabilities. Thus, recognition of this dual nature of housing - *housing is both an investment good and a consumption good* - is essential to understanding the market for owner-occupied housing (Follain, 1992). The cause and effects of the price of housing is a more complex issue than for an ordinary consumption good because one must consider that housing is both a consumption and an investment good.

A. Price. Price impacts both the supply and demand for housing and both are time sensitive. The focus of this paper is to determine if a minor increase (1%) in the price of a new home, condominium, or townhouse has a *substantive* impact on the ability of the homebuilder to sell new housing stock, ***the demand for housing.*** Price-elasticity of demand is defined *as the percentage change in new home sales divided by the percentage change in price.* Elasticity is a ***measurement*** of ***responsiveness.*** The word "measure" means that elasticity results are reported as numbers, or *elasticity coefficients.* The word "responsiveness" means that there is a stimulus-reaction involved. Some change or stimulus (1% increase in price) causes people to react by changing their behavior (forgo buying a new house), and elasticity measures the extent to which people react. If the price-elasticity of demand coefficient is greater than 1, the demand is then elastic. When the demand is elastic,

a small change in price has a relative big change in quantity consumed. Figure 2 shows an elastic demand curve.

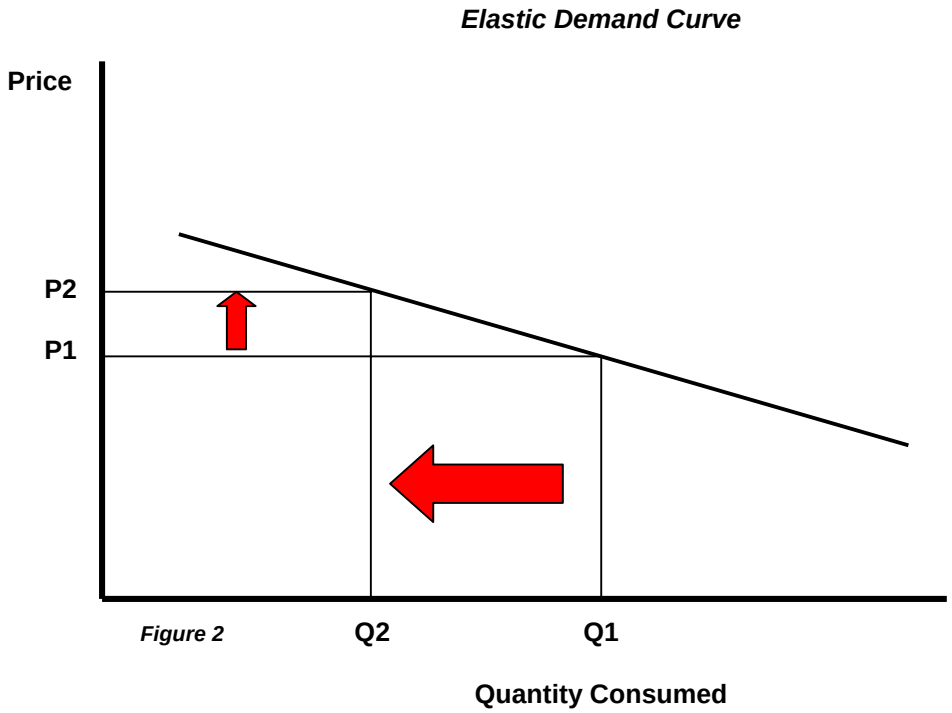

Figure 2

The price at P1 was increased to P2. The corresponding shift of quantity consumed from Q1 to Q2 represents a significant reduction in quantity consumed when compared to the price increase. When price-elasticity of demand is considered in the context of volume of new homes sold, an elastic demand, *or an elasticity coefficient greater than 1,* means that an increase in the sales price will significantly impact the developer's ability to sell the home, condominium, or townhouse. The greater the elasticity coefficient is above 1, the greater the impact. When the price-elasticity of demand coefficient is greater than 1, as the price increases, the associated decrease in quantity consumed ends in a decrease in revenue (Brickley, 1997).

When the elasticity coefficient is *less than 1,* demand is considered to be *inelastic.* When the demand is inelastic, a change in price will have a small impact on the quantity sold. (Figure 3)

Inelastic Demand Curve

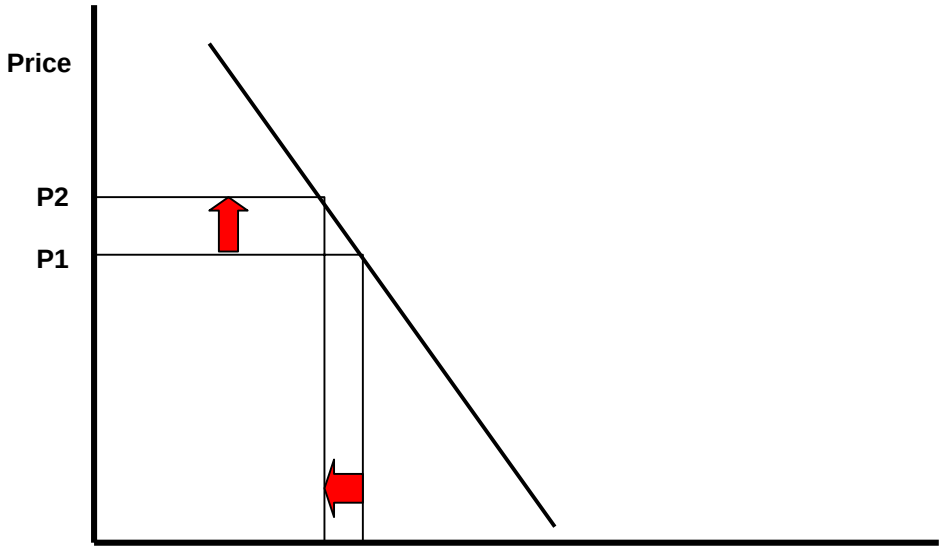

Figure 3

The price at P1 was increased to P2. The corresponding shift of quantity consumed from Q1 to Q2 represents an insignificant reduction in quantity consumed when compared to the price increase. While there is a reduction in the quantity of products consumed when the elasticity of demand coefficient is less than 1, *or inelastic,* the responsiveness of the consumer's preference is insignificantly affected by the increase in price. If the elasticity of demand coefficient is less than one, or inelastic, the increase in price brings in more revenue then that lost by the insignificant reduction in quantity consumed (Brickley, 1997).

Now comes the question what is the price-elasticity of demand for new housing or the percentage change in new home, condominium, and townhouse sales divided by the percentage change in new home prices? Computing price-elasticity is far beyond the scope of this paper. We have, however, researched current writings on elasticity and the housing market in an effort to determine if this demand is *elastic or inelastic.*

In a recent paper, DiPasquale and Weaton (Housing Market, 1992), the price-elasticity of demand was computed numerous times using a series of different adjustment models. The adjustments factored into the equation included the cost of the land, which often is not computed in other studies, and the expected age of ownership. The price-elasticity of demand coefficient for all equations with and without adjustment factors fell between -0.09 to -0.19 or a very *inelastic coefficient* (Housing Market, 1992). While the law of supply and demand dictates that an increase in price will result in a reduction in quantity consumed, an inelastic demand coefficient suggests that the revenues generated by the increase in price offset the lost volume of sales. An elasticity of -0.09 means that for every 1% increase in price, the quantity demanded will decrease by 0.09%. Given the small (5.6%) movement in the homeownership rate over the past three decades, in contrast to the 110% swing in real prices, a very inelastic demand coefficient is reasonable to expect (Housing Market, 1992).

The DiPasquale study produced a lower price-elasticity of demand coefficient than other studies. Quigley's study also produced inelastic coefficients ranging between -0.5 to -0.7 (Quigley, 1979). The difference is that the DiPasquale study

included variables that addressed housing as both a consumption and an investment good while the Quigley study only used consumption good variables.

The price-elasticity of demand being less than 1, as reported in these studies clearly demonstrate that the installation cost of the fire sprinkler system, which relate to a 1% cost increase, will have a negligible impact, if even measurable, on sale of the new home, condominium, or townhouse.

What this all means is that the consumer comes to the table with a set amount of money available to purchase a new home, condominium, or townhouse. The consumer is restricted by the amount of money they bring to the table, not the value of the housing. Again, very few people, and certainly I am not one of them, can afford a 6,000 square foot single-family home, condominium, or townhouse. There are fire sprinklers in $12,500 homes, $25,000 homes, and $250,000 homes. The fire sprinkler system, as the major life safety system from the ravages of fire, should be viewed as essential to the safety and welfare of the occupant just as much as Ground Fault Circuit Interpreters, fire resistant material, earthquake bracing and the many other construction code requirements that are in place to protect the occupant. Surely, the builders are not arguing that those who live in affordable housing should not be given proven fire safety protection?

As indicated earlier, price changes also influence the supply of housing. The elasticity of supply is the percentage change in quantity supplied divided by the percentage change in price. The supply side of the housing equation is a more complex issue with developers particularly with respect to short and long run implications. In the short run, an increase in demand is countered by an increase in

price while supply remains pretty much constant as the time to build a new single-family home could take longer than the period of the increased demand. Thus the developer is speculating what the demand will be months later when the house is completed. With increasing material and labor costs, the homebuilder is always looking for innovative ways to construct the new home at the least cost because of the *uncertainty* of the market once the home is available for sale.

In most studies on housing construction, the production or supply side of new housing units is determined by the price of the house (Follain, 1992). The average price of the new stock increases as this stock grows, because useable land becomes scarcer. High price levels will generate an increased flow of units only until the current stock catches up with the long run supply schedule (Housing Market, 1992). This can be illustrated in a supply and demand graph as in Figure 4.

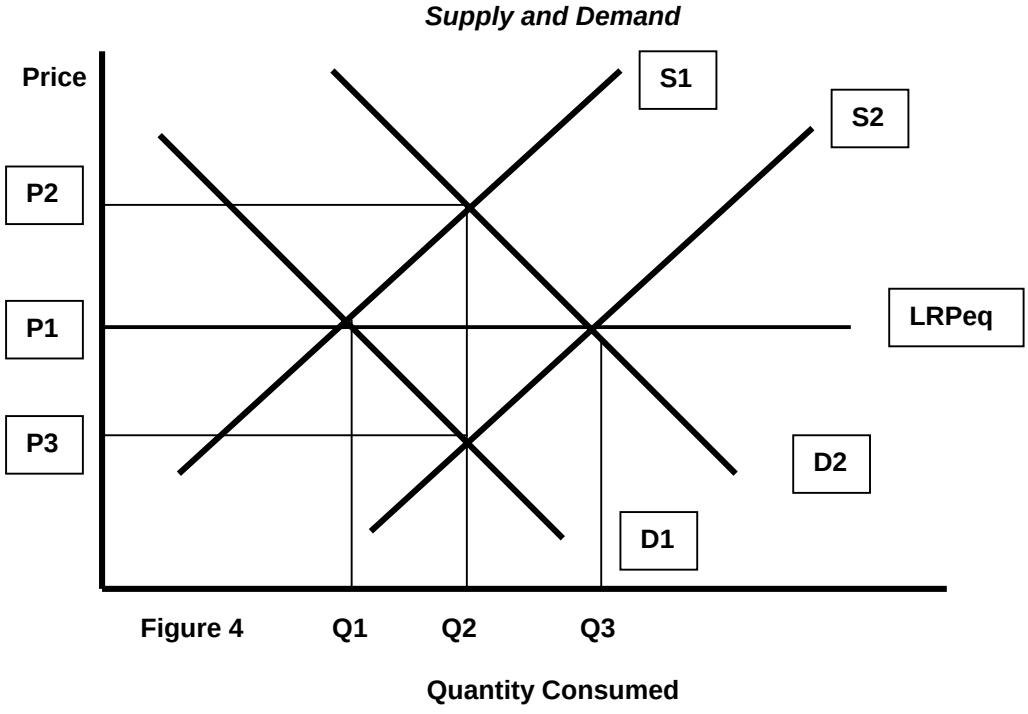

Figure 4

Assuming that some market shock such as increased income or tax incentives causes the demand to shift from D1 to D2. Due to an inelastic supply in the short run (it takes time for construction to react to the demand shift), the price of housing increases from P1 to P2 in response to the increased demand, which also causes the change quantity consumed from Q1 to Q2. Homebuilders, seeing that the long run equilibrium price (LRPeq) is below the current market price, increase production to take advantage of the increased price. As new housing stock enters the market, the supply cure shifts from S1 to S2 at which time the market is again at its long run equilibrium prices. As the prices lower towards equilibrium, consumption increases to Q3. Thus, new construction results from a price that exceeds the long run replacement cost of housing. It therefore can be argued that a 1% increase in price could be beneficial to the developer (Brickley, 1997)

If the housing stock is being produced at the D2-S2 level of long run price equilibrium as shown in Figure 4 and the demand shifts to D1 because of new tax law changes or decreases in disposable income or other negative demand drivers, the homebuilder has few options to survive. The homebuilder has the option of maintaining the higher price level in hopes of finding one with excess disposable income or lowers the price towards P3. Because many actions external to the construction process may cause a negative shift in demand, it is good business practice for the homebuilder to take every action possible to keep construction cost down. ***We suggest that it is the uncertainty of the future housing market that is the foundation of the developer's resistance to adding fire sprinklers, not the fear that a simple 1% added cost will chase away potential buyers. This***

uncertainty in no sense of the imagination justifies opposing life safety systems.

While the impact of a price change is the most substantive issue addressed herein, we will also discuss other factors impacting demand.

B. Demographic Changes and Population Shifts. Demographic changes account for shifts, and sometimes shocks, in the supply and demand for housing. In the short run, population increases may be managed with a relatively fixed housing inventory, but only with a corresponding increase in prices as envisioned from a demand curve shift. In the long run, demographic changes or population increases, especially under conditions of rising real income, is one of, if not the most significant factor in determining the level of new construction, or the supply side of the economic picture (Smith, 1969).

A 1% increase in the cost of constructing the house, even with the assumption that the homebuilder passes this cost on to the consumer in a price increase, will have little to no bearing with respect to the *population factor* underlying the demand for housing. Some states may be experiencing some small areas or regions of negative demographic change. Florida is a rapid growth state with some counties listed in the top ten fastest growth regions of the country. Rapid population growth areas are faced with a fixed market in the short run because of the length of time it takes homebuilders to respond with new housing stock to meet this increase in demand is often considered the long run. The homebuilder's dilemma is to identify the correct volume of new construction to meet population increase created demands. Of concern is making a distinction between demand for new housing

supplies based on population increases or shocks caused by other factors such as tax or income changes (Alm, 1994). If a homebuilder overbuilds because of shock induced demand, a market can become over built, which means a greater supply than needed during aftershock - larger supply means lower prices.

Demographic changes also impact demand for housing. Demographic movement of older age groups has some impact on the ability of the homebuyer to meet mortgage rates. Population increases causes an increase in demand for housing or a shift of the demand curve as shown in Figure 4. With this shift in demand comes an increase in price in the short run. A 1% increase in price to install the fire sprinkler system would be part of, or easily absorbed in, the price increase resulting from changes in population.

C. Income. Income is another underlying factor impacting demand for housing. What we are seeking is a measurement of the sensitivity of demand for new housing to changes in disposable income, which happens to be a definition of income elasticity of demand. All else being equal, an increase in income increases the demand for housing (Follain, 1992). The sudden increase in income cause a shock resulting in a demand curve shift as shown in Figure 4 (Alm, 1994).

Simple logic suggests that a 1% increase in price will have no bearing on the sensitivity of a buyer who comes to the new home with an increased handful of disposable income. The increased income is the force that is causing the potential homebuyer to seek a new home. Now the homebuyer must distinguish between the many unique and comfort features offered in the housing stock. We suggest that the homebuyer will view the smoke detector as a necessity and, given factual

information, will also view the fire sprinkler system as a necessity. Builders are attempting to portray the fire sprinkler systems as anything other than a necessity, thereby causing the homebuyer to judge if the increased income should be disposed on a fire sprinkler system. But, is the potential buyer given the same option of installing other life safety items such as roofing tie downs and earthquake bracing? No, government has established construction standards that must be met for the sole purpose of protecting the homebuyer. The Orange County Fire Authority (OCFA) has established a 6,000 square foot threshold for residential occupancy fire protection. In essence, OCFA is telling the public if they have a structure greater than 6,000 square feet, there is a great chance that first responding fire services will be faced with a fire greater than their suppression capabilities; that additional fire suppression forces must respond to help control the fire; and, the time it will take for the additional responding units to arrive is such that any occupant still in the structure will not survive. With the potential of an 82% reduction in fire deaths, the fire sprinkler system should be viewed as a necessity.

D. Cost and availability of credit. This is the substantive issue with which the Orange County Builders need to focus their concerns for it is the mortgage rate that dictates the house I buy, not the 1% cost increase coming from installing fire sprinklers. Credit variables have a strong influence upon the demand for housing since this demand for most families is quite sensitive to down payments and monthly payment requirements (Smith, 1969). These payments depend upon the nominal purchase price, the mortgage interest rate, the loan to value ratio, and the amortization term of the mortgage. Smith suggests in his study that the main

influence of these credit variables come to bear when the potential homebuyer makes the economic distinction between renting and buying housing, not in distinguishing between housing features (Smith, 1969). He suggests that although more stringent credit terms could reduce the demand for housing, this demand is not absolutely eliminated as much of this is demand being shifted to rental housing (Smith, 1969). Smith continues with the observation that more stringent credit terms will reduce the overall quality of housing services demanded.

Often the homebuyer seeks property that is beyond their capabilities to afford. Instead of seeking a home that is within budget, the dream home financially out of reach or slightly out of reach is sought, this is the American way. When the homebuyer attempts to make the dream house affordable, the necessity of various comfort features within the home is questioned. Often with eliminating or reducing many of the comfort features within the home, the property is still not within budget. Typically there are a number of special features that impact the cost of a new house much greater than the 1% cost increase of a fire sprinkler system. We suggest that many homebuilders view the fire sprinkler system as a special feature that could be deleted when the potential homebuyer attempts to make non-affordable housing affordable. The mindset of the homebuyer and the homebuilder must change to categorize the fire sprinkler system to be as much a necessity as a ground fault circuit interpreter and a smoke detector.

E. The cost of rental housing. The demand for owner-occupied housing depends on the annual cost of its only substitute, rental housing. Demand for rental housing is a function of income and the rental price. When market shocks occur

such as tax credits or income increases, the rental market suffers as renters seek to purchase their own home. The rental market is quick to raise or lower its rent to offset and changes in tax benefits partially to retain its base of renters (Alm, 1994).

One study argues that the elasticity of demand with respect to price for new housing and for rent is practically identical - no significant statistical distinction (Housing Market, 1992). This suggests that a 1% increase in the price of the new home will have very little impact on deciding whether to buy or rent housing. Many new rental properties, at least those three-stories and above built in Florida, are protected with fire sprinkler systems.

F. Consumer preferences. Some of the studies on supply and demand of housing address consumer preferences as location and site. One study suggests that there exists very different housing markets in coastal verses non-coastal locations and that supply and demand elasticity is different between regions (Abraham, 1996). This study also argues that a distinction must be made between metropolitan and urban housing markets to eliminate any potential data bias. This study suggests that consumer preference helps drive prices high in coastal and MSA's housing creating bubbles or periods of unsupportable high prices - bubbles which occasionally burst causing a rapid decline in prices (Abraham, 1996). A 1% increase in the price of a new home, condominium or townhouse from adding a fire sprinkler system would hardly be the focus of concern as many other factors come into play when considering consumer preferences.

Consumer preference is often a factor when determining comfort features of the new home. We must argue that, given factual information on residential fires,

and obtaining a clear picture of fires rapid spread through a home, that the consumer preference will be in strongly in favor of fire sprinkler systems.

G. The Glitter Factor. We shared the *elasticity of demand* literature that clearly indicates that a 1% increase in construction costs will not chase away potential new homebuyers. We suggested that the amount of monthly income that the potential homebuyer can use for housing is the decisive factor. And directed correlated to the amount of money brought to the table is the current home loan interest rates. A potential homebuyer may be able to afford a $100,000 house at today's interest rate. Should the interest rate increase and the amount of money available for monthly payments remains constant, the sales price of the affordable home will reduce for this potential homebuyer. And conversely, should the interest rate decrease, the homebuyer can now afford a more expensive home with their monthly payment. If the potential homebuyer comes to the sale with sufficient money to buy a $100,000 new home at the higher spending limit based upon current interest rates, then all they can afford is a $100,000 home. The substantive issue is that fire sprinkler systems can be installed in the $20,000 new home, the $200,000 new home or any value of home. What the homebuilder wants is a home that will attract the potential homebuyer to choose its new home over the competing new homebuilder and the existing home seller. To make the new home "more sellable," the homebuilder wants to add as much "glitter" to distinguish its home from the competition.

Most new homebuilders have failed to realize that a residential fire sprinkler systems is in fact a the wanted "glitter" that will distinguish its home from the

competition. As reported herein earlier, the National Institute of Science and Technology reports that there will be an 82% reduction in fire deaths in our nation should fire sprinkler systems be placed in residential occupancies. The flaw with this statistic is the remaining 18% of fire deaths not reduced are in fact those occurring outside of the residential setting. Thus, the new homebuilder could easily report that the residential fire sprinkler system installed in its new home will provide almost certain life safety, a very sellable or “glitter” item particularly those homebuyers with young children. While we will not argue that hot tubs, upgraded countertops in kitchens and bathrooms, unique architectural designs, and many other creative features add glitter to the home and make it more sellable. But the want of adding more glitter should not lead to eliminating proven life safety residential fire sprinkler systems. The simple solution is that the residential fire sprinkler system should be considered and promoted as not only an essential life safety system, but also the glitter that they are by the homebuilder. Millions of fire service leaders in the United States recognize the life safety benefits of residential fire sprinklers, the same recognition by the homebuilder is past due.

IV. THE INSURANCE ISSUE.

There are insurance savings for fire sprinklered properties over those not sprinklered. The insurance savings can be substantial. There are hundreds of individual considerations that are visited when analyzing property insurance rating for a specific property. Insurance grading of the fire protection system within a property is not automatic. In fact, over 60% of those who have fire sprinkler systems who read this paper the first time are not be receiving insurance credit for fire sprinkler systems.

Many fully sprinklered properties remain on the insurance roles as a non-sprinklered property simply because somebody did not request that the property be graded. There are various procedures that must be followed before a property is graded with many insurance carriers requesting field inspection fees to recover its costs. The Insurance Services Organization (ISO), Commercial Risk Services surveys property and formulates a list for its member insurance companies to use in determining rates.

A. THE BASE RATE

While base rates differ little between insurance companies, particularly if they all subscribe to a single grading service, there are enough peculiarities in the overall insurance picture for a property that would warrant insurance shopping should your rates become excessive. We will discuss modifications later in this paper but first, the base rate. Commercial Risk Services reported insurance base rate range for a hotel constructed similar to our example hotel as follows:

Hotel Occupancies Insurance Base Rate Per $100 Insured

	Non-Sprinklered	Sprinklered
Building	.257 - .285	.088 - .097
Contents	.512 - .569	.303 - .334

Please understand that these figures reflect non-combustible materials used in construction and a reasonably effective fire suppression force with a reasonable response time to this property location. Multi-story wood frame constructed properties located miles from a responding fire department may have a base rate above these average parameters.

Using the minimum rate for each category, the insurance picture for an $11.25 high rise hotel would be:

Insurance	Non-Sprinklered	Sprinklered
Building	$28,912.50	$ 9,900.00
Contents	$10,240.00	$ 6,060.00
Total	$39,152.50	$15,960.00
Annual Insurance Savings		**$23,192.50**

A new constructed or retrofitted hotel, assuming that it is fully protected with an automatic fire sprinkler system will have saved $23,192.50 per year over the rate that would have been charged had the building been non-sprinklered. Again, new and retrofitted existing properties will not receive this insurance savings unless a fire sprinkler grading request has been made to the insurance company.

B. THE MODIFICATIONS

After the base rate is determined, the insurance carrier modifies the base rates to determine that which will be the final rate. The modification may be a credit or a debit added to the base rate. It is the modification of the base rate that really distinguishes one insurance company from others. Please understand that an insurance company has discretion to grant or not grant modifications. One type of modification is known as "Company Deviation." While Company Deviation is intended to provide proper credit for fire safe communities, this modification factor is often used by the insurance company to remain competitive. Company Deviation is normally no more than ten percent. A "Package Discount" is one type of modification that is easily understood. A Package Discount may be granted if the insurance company is writing most or all of the other lines of coverage. A moderate average package discount would be approximately

twenty percent. Another variable available at the insurance company's discretion is based upon the total premium generated on the risk and is known as a "Size Credit." This is usually no more than fifteen percent. And, additionally, most insurance companies have what is referred to as an "Individual Risk Premium Modification Plan (IRPM)." This underwriting tool permits the insurance company underwriter to debit or credit the premium based on the individual risk characteristics not contemplated in other modifications. Modification rates for IRPM are established and permitted by the State Insurance Commissioner. During a IRPM evaluation, management, employees, the physical condition and maintenance of the property, and other features are analyzed and credit or debit established. For example, an insurance underwriter may visit a property and ask to discuss property safety with management. If management says that they are too busy to discuss safety, the underwriter can debit the property up to 15%. On the other hand, if management shows a keen interest on life and property safety, the modification can be a 15% credit. The IRPM is often used to adjust the insurance premium to reflect past history of the property. The typical range of IRPM credit to debit allowed is as follows:

Management	*Employees*	*Location*	*Safety*	*Building*	*Protection*
15 to 15	11 to 11	10 to 10	10 to 10	7 to 7	2 to 2

In viewing how these modifications may impact the hotel used as an example, we have computed the following modifications assuming the best case scenario for each modification:

	Non-Sprinklered	Sprinklered
THE HOTEL	0.257	0.088
Less 10% Company Deviation	0.231	0.079
Less 20% Package Discount	0.185	0.063
Less 15% Size Credit	0.157	0.054
Less 10% IRPM	Not Allowed	0.049

While these figures reflect the ideal insurance scenario, real application of modifications sometimes result in debits greater than credits. IRPM is often related to the underwriter's vision of liability potential for the property. An indication of such is the fact that insurance underwriters will not give a positive IRPM on non-sprinklered properties.

Having described some of the insurance industry polices, let me share some real world examples. Restaurants in Monterey's city owned prestigious Fisherman's Wharf are required to carry insurance. Restaurant insurance rates, based upon high payouts for fire losses, are high. Restaurants not protected with fire sprinklers pay a base rate of $1.54 per $100 insured before modifications discussed above are applied. This means a $500,000 restaurant would pay $7,700 annual for fire insurance. A restaurant protected by a fire sprinkler system is faced with a base rate of $0.27 per $100. The $500,000 restaurant, again before modifications are applied, would be charged $1,350 annually for fire insurance. This would mean a $6,350 annual savings for sprinklered over the non-sprinklered restaurant. Assuming the building and contents cost $100 per square foot to construct, (low estimate) the restaurant size would be approximately

5,000 square feet. And further assuming the installation cost of the fire sprinkler system is $2.00 per square foot, the installation cost of the fire sprinkler system would be $10,000. The insurance saving would pay for the installation of the fire sprinkler system in under 2-years. Please understand that we qualified this savings as figures before modifications are applied. If the restaurateur has all its insurance coverage with the same insurer, this plus other modifications can easily reduce the initial non-sprinkler rate by half. But correspondingly, the same modifications would have a similar reduction should it be applied to a fire sprinkler protected building. Thus the recovery of the cost for installing the fire sprinkler system would be longer but there will always be recovery as there the insurance rate for fire sprinkler protected property is always lower than non-sprinkler protected property.

Of course, the larger the building, the greater the insurance savings. Also at issue is the type of risk involved. Hotels and restaurants have higher insurance rates than does residential occupancies. I can say however, that I am experiencing a 10% reduction in my homeowner's policy as a result of my single-family home fire sprinkler system from my insurance carrier, State Farm Insurance. This is an additional 10% to the 10% already received for dead bolts and smoke detection. I computed my payback, or the recovery of the costs of retrofitting a fire sprinkler system in my 3,800 square foot home from insurance savings as 14.5 years.

C. Water Damage Myth.

Left unchecked, fire causes complete and far-reaching destruction of property. In the restaurant example we used, the insurance company charges a base rate of $1.54 per $100 insured for non-sprinkler protected property verses $0.27 per $100

insured for sprinkler protected property, a significant difference. In all cases, in all occupancies, commercial or residential, base rates for non-sprinkler protected property is always higher than fire sprinkler protected property. Insurance companies realize that replacing a water soaked carpet is a hundred fold less expensive than repairing structural fire damage. Fire sprinklers keeps the fire in check and fire damage is kept at a minimum, particularly structural fire damage. The $0.27 base rate for fire sprinkler protected restaurants is the insurance company's assessment of its risk of paying to repair fire and water damage in a fire sprinkler protected property. Typically, $0.04 - $0.08 of the $0.27 base rate is in place specifically to address repair of water damage.

Some fire sprinkler naysayers argue that accidental discharge of water is an issue of concern of the insurance company. Again a small percentage of the base rate for fire sprinkler property is in place to repair water damage. Should there be a history of accidental discharge, then the insurance company would charge higher rates than they currently do. Factory Mutual, a nationally recognized testing laboratory reports the chance of an accidental discharge from a sprinkler is of odds that rival winning the California State Lottery. There are reported instances of water discharge as a result of an intentional act. Again, the base rate factors in expected water damage caused by intentional acts. In some cases, where conditions exist where fire sprinkler system tampering is a greater risk, the insurance company may increase the base rate through the modification process.

There have been renegade insurance carriers in the past that failed to make a rate distinction between fire sprinkler protected and non-protected property. For the most part, insurance companies make such a rate distinction. All major insurance

companies who write property insurance offer a rate reduction for fire sprinkler protected property. Because of a significant reduction in expected fire losses afforded by fire sprinkler systems, an insurance company must provide a rate reduction for fire sprinkler protected property to remain competitive in the insurance market. The simple solution should an insurance carrier not make a rate distinction for fire sprinkler protected property is to deal with an insurance carrier who does.

And some states have experienced confusion created by independent insurance agents who may not be fully cognizant of the rates available for fire sprinkler protected properties available from the insurance companies they represent. Any insurance agent who represents that fire sprinkler systems will increase the cost of insurance does so in conflict with the major insurance carriers. The simple solution here is to obtain information directly from the insurance company. By doing so, the independent insurance agent will become enlightened as to how insurance companies recognize the benefits of fire sprinkler systems.

V. GOVERNMENT'S ROLE IN FIRE SAFETY.

We have proven that the price-elasticity of demand is inelastic and, therefore, the impact of a 1% price increase of a new home will have a negligible effect on the sale of the property. If so, why do we have challenges to fire sprinkler ordinances for new housing? There is a valid concern that increased cost of construction during periods of declining demand may prove costly to the homebuilder. We suggest that it is the fear of higher construction costs during declining periods of demand that is the basis of the homebuilder's resistance to install fire sprinklers. Forward looking forecasting models can provide data that will bring some comfort that the market will

be stable when the construction of the home is completed, but not with certainty. Government needs to revisit its community fire protection role and mission.

It is not known to what extent the Orange County Fire Authority and other Orange County governmental entities have addressed things that can help the developer comply with a fire sprinkler ordinance or at least make its compliance more viable. Accordingly, I have added this section for the purposes of initiating thought. It is expected that some, if not all of these issues have already been addressed.

A recent meeting of a city commission in Northeast Florida included discussion on the repeal of a fire sprinkler ordinance. My presentation before the commission focused on infrastructure exceptions and alternatives and other incentives in an effort to encourage city leadership to buy into a cooperative *fire safe community* plan. I explained that developer incentives to install fire sprinklers can be generated by allowing the water supply to be tapped on the users side of the water meter instead of a costly water main tap, that a much less expensive cross-connection protection valve could be specified and that hydrant spacing could be extended - all code allowed actions. During testimony of others, an attorney representing the developer leaned over and whispered that they had asked for these code allowed exceptions but were denied and that if they were allowed the exceptions they would not have challenged to fire sprinkler ordinance. The city commission finally visited these infrastructure issues and kept the fire sprinkler ordinance intact.

The city water department wanted a distinctive tap of the water main for each fire sprinkler system even though the code will allow tapping on the user's side of the water meter when the water supply is adequate at that point to operate the fire

sprinkler system. Its rationale - shutting off water for non-payment of the water bill would also shut down the fire sprinkler system thereby creating liability concerns for the city. When asked how many times each month does the water department turnoff water for non-payment - nobody knew. I suspect that a person who has enough insight to install a fire sprinkler system in a house will also have enough insight to pay the water bill.

You can kill a roach with a fly swatter or you can use a double-barrel shotgun. The cross-connection protection demanded by this city was equivalent to that double-barrel shotgun. While we agree that a cross-connection protection is important to prevent the back siphoning of contaminated water into the drinking water supply, demanding a $5,000 valve is overstating the needs when a $600 valve meets cross-connection code requirements.

Each hydrant costs $3,500 to install. Many code officials allow farther distances between hydrants because fire sprinklers significantly reduce the volume of water that is needed for firefighting - farther distances means less hydrants or less cost - but not this city. Had this city recognized these code allowed exceptions, the installation of a fire sprinkler system would be economically viable for the developer. But even more perplexing, had this city recognized code allowed exceptions and alternatives, governmental infrastructure and operational cost would also be reduced.

Yet another governmental entity has an unalterable water supply policy that is hampering a developer's interest to install fire sprinklers in a new single-family development of 104 homes. The water purveyor has plans to install 5/8 inch water meters for the domestic water supply for each home. The friction loss and water flow

of the 5/8 inch meter when compared to available water pressures produces a water volume and pressure below that required to operate the fire sprinkler system. When confronted with this situation, typically a 3/4-inch meter that has greater water flow volume and less friction loss is installed. But this political jurisdiction does not allow the installation of a 3/4 inch water meter - its policy calls for a 1 inch meter as the next step up from the 5/8 inch meter. While the 1 inch meter is more than what is needed, its installation to provide proper water supply and pressure for the fire sprinkler system is an acceptable alternative up to the point of realization that with the 1 inch meter comes a $1,000 impact fee. The impact fee was established under the premise that one who needs a 1 inch meter will be consuming more of the limited resource (water) thereby causing a greater impact on the utilities than one who uses a 5/8 inch meter. But the 1 inch meter is not being installed because of a need for greater consumption - it is being installed to ensure the fire sprinkler system will have adequate water pressure and volume to operate. And, the fire suppression impact on the water purveyor is typically thousands of times greater when fighting fires in non-sprinklered property verses sprinklered property. This water purveyor needs to revisit its impact fees and its prohibition on 3/4 inch water meters.

Government needs to look for innovative ways to promote community fire safety. A community fire safety plan requires the input and support of the fire department, water department, building and zoning departments and city management. Some jurisdictions provide tax incentives for fire sprinkler property, which is justified because fire sprinklers significantly reduce fire suppression needs.

But simply accepting code allowed exceptions for fire sprinklers often would offset installation costs.

VI. CONCLUSIONS.

We must do better in finding solutions to minimize the United States fire problem. A residential fire sprinkler system is the answer. Homebuilders must recognize community needs and encourage the installation of fire sprinkler systems in new housing stock. Over one million families each year could move into fire safe environments. While we recognize the uncertainty of housing markets and the risk homebuilders take when building homes during market demand swings, homebuilders must do the right thing for the community and the homebuyer by revisiting its resistance to residential fire sprinklers.

The most important finding in this study is that there exists a very inelastic demand coefficient for the price of new housing. This means that the expected 1% increase in price for adding a fire sprinkler system will cause an insignificant change in consumption of homes. ***This does not support the homebuilder's contention that the added cost of installing fire sprinklers results in the loss of potential homebuyers.*** It is the mortgage rate that dictates the dollar value of a house, condominium, or townhouse one can afford, not the cost of the fire sprinkler system. Fire sprinkler systems can be found in housing of all values and prices. It is also clear that homebuilders must recognize that residential fire sprinklers are a life saving *necessity* of every new home, condominium, and townhouse and become the catalyst and leader to move the United States towards the path to fire safe communities.

Insurance reductions for fire sprinkler protected property is always lower than that of non-sprinkler protected properties. Insurance agents who say differently do not reflect facts available by contacting the main office of the insurance carriers. All major insurance companies who write property fire insurance offer a reduced rate for fire sprinkler protected property. Water damage is a very minor concern of the insurance company when compared to potential fire losses, particularly structural damages caused by fire.

Government must take a strong and far-reaching role in community fire safety. Government's mission must be such that all division leaders have the opportunity and responsibility to make fire safe communities become reality. Water departments, fire departments, building departments, and city or county management must look outside of their realm, understand the needs of other divisions, and seek ways to make residential fire sprinklers a main point within the fire safe community. Fire sprinklers typically reduce fire suppression costs thereby justifying tax incentives, which have been applied by many communities as a fire sprinkler incentive. Code allowed infrastructure options coupled with tax incentives will more than offset the expense of installing fire sprinkler systems. This will also be the needed incentive to motivate homebuilders to include fire sprinklers in their new buildings with interest instead of continually challenging the need to protect new home buyers from the tragedy of fire. The fire safe community of the future will be lead by a coalition of homebuilders, governmental officials, fire officials, and others interested in community fire safety.

It is time to begin efforts to minimize the U.S. fire death rate. With NIST's estimated 82% reduction in fire deaths by adding fire sprinklers where we sleep, there is no better way that through residential fire sprinklers.

About the author: Buddy Dewar was graduated from Florida Atlantic University with a Bachelors of Science in Economics with concentration in Econometrics – quantitative economic analysis. Buddy Dewar also was graduated from Nova Southeastern University with a Master in Business Administration and is a member of the International Honor Society Sigma Beta Delta in recognition of his academic achievements. He has a distinguished fire service career, which includes working as a firefighter, fire officer, and fire chief, Superintendent of the Florida State Fire College, and Director of Florida's State Fire Marshal's Office. While directing Florida's State Fire Marshal's Office, he successfully lobbied for progressive fire safety laws that can be linked to current reductions in the fire death rate in Florida. Buddy has served on numerous national and state committees and commissions and has often been recognized by his peers by being elected chair of these groups. Buddy is a frequently sought after public speaker known for his entertaining presentations. Buddy currently is serving as Director of the Regional Operations for the National Fire Sprinkler Association. He was the first person to serve a two-year term as President of the Florida State Firefighters' Association. He has received numerous awards for his fire service and his programs have been featured in People Magazine.

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