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## **State and Local Policy Instruments for the Promotion of Catastrophe Mitigation**

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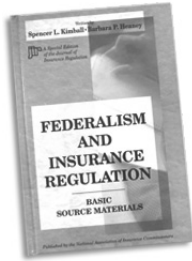
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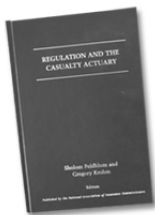
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# State and Local Policy Instruments for the Promotion of Catastrophe Mitigation

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Kathleen McCullough \*

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## Abstract

The mitigation investment decisions of property owners are subject to multiple factors other than just the cost-benefit expectations. Uncertainty regarding cost savings, the financial capacity (and uncertainty) of the decision maker, insurance costs, and responsiveness of those costs to mitigation efforts are just some of the factors contributing to choices made regarding whether and to what extent to mitigate against disaster. Given the variety of factors that contribute to the mitigation decision, the authors assert a broad framework for public policy aimed at promoting mitigation aims first for accountable and empowered property owners, specific mitigation measures most likely to provide greatest value, an engaged and collaborative private sector, and smart messaging.

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## Introduction

Natural disasters continue to be an area of concern for public policymakers. In 2013 alone, natural disasters caused the death of more than 21,610 individuals worldwide and resulted in damages of \$118.6 billion. During the past decade, the U.S. has remained one of the top five countries most frequently hit by natural disasters (Guha-Sapir, Hoiyos and Below, 2015). Pre-loss property protection, or mitigation, efforts made by property owners are critical to reduction of the underlying risk.

Despite the public good that risk protection provides,<sup>1</sup> it still is difficult to effectively incentivize many property owners to invest in property improvements that increase the protection against damage from natural disasters. Indeed, a 2013 joint study by researchers at Florida State University and the Insurance Research Council (IRC) found although the majority of respondents to a survey of primary homeowners in 12 U.S. localities viewed their homes as not “optimally fortified” against wind or wildfire, the majority also planned to spend no money in the near future on mitigating action, despite the fact that 10 of the surveyed localities are in zones considered high risk for losses from these perils (Florida Catastrophic Storm Risk Management Center, 2013). There exists prior research that examines—both theoretically and empirically—the property owner’s mitigation decision. See, for example, Kunreuther and Kleffner (1992); Kunreuther, (1996, 2006); Kleffner and Kelly (2001); Kelly and Kleffner (2003); Ge et al. (2011); and Carson, McCullough and Pooser (2013).

Most prior research efforts in this area primarily focus on the relationship between the insurance contract, insurance decisions, and self-insurance and self-protection. Intuitively, risk-based insurance rating seems a prerequisite for optimal mitigation decisions by insureds, and the literature on the subject supports this intuitive assertion. Empirical and theoretical efforts point to the non-optimal solutions reached when insurance rates are subsidized. These findings hold in—and indeed in multiple studies are solely based on—lines of insurance and

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1. Studies regarding the social and economic effects of mitigation have consistently found that mitigation can result in both public and private good. Fonstion and Holtman (1994) found that newer homes, arguably built to lower standards in the years leading up to 1992, suffered heavier damage from Hurricane Andrew than their older, arguably sturdier, counterparts. Risk Management Solution (2008) also found homes built prior to Hurricane Andrew suffered proportionally more damage in the 2004 and 2005 storm seasons than did the newer homes built in compliance with the most up-to-date (effected after Hurricane Andrew) building codes. Mitigation increases the value of the home, decreases expected losses and decreases the burden placed on the public in the event of a catastrophic event (Kleindorfer and Kunreuther, 1999). Christoplos, Liljelund and Mitchell (2001) found that mitigation not only reduces direct losses (i.e., saves lives, reduces injuries and lowers property losses), but also measurably increases the public good through alleviation of the indirect poverty effect of catastrophes. Regarding the private good of property value enhancement, Simmons, Kruse and Smith (2002), Gatzlaff, McCullough, Meddders and Nyce (2015) and others observed increased home resale prices for homes that made a mitigation investment in a Gulf Coast city.



geographic areas heavily exposed to catastrophe potential. Unfortunately, even where insurance is optimally priced, we continue to see weak structures—existing and newly built. To the extent appropriate building codes are present and enforced, we can expect the building stock eventually will meet a minimum standard of protection against the elements of nature. Furthermore, adaptation to the dangers of the elements via redirected economic development policies may in the future reduce the risk of loss substantively. But it is in this gap wherein lie weak existing structures, limited standards of construction enforcement and increasing development in areas most prone to natural disaster that we make a case for the value of public and private policy programs for property mitigation affordability.

Regulations, building codes, product and installation standards, and land use controls may be (and often all are) used to enforce public standards for safety. Given the huge building inventory that remains unprotected or under-protected, it is clear financial incentives beyond these largely coercive measures are important to consider. Prior research efforts to explain mitigation behavior provide a wealth of information regarding what motivates (or fails to motivate) property owners to protect their properties on a pre-loss basis. Several important categories of explanatory variables considered in the literature indicate significant relationships to mitigation behavior. Property location and characteristics, decision-maker dispositions, beliefs about consequences for and beyond the household (or business), social influences, insurance pricing, and direct policy measures all have been found to correlate with mitigation decisions or practices.<sup>2</sup>

The prior literature enumerates reasons why progress in realizing the risk-reducing potential has been so limited, particularly for individuals and households. Much of this literature centers on optimal insurance contracting. Although insurance premium reductions are offered by several insurance programs and companies and in some places are mandated,<sup>3</sup> links between the insurance cost savings and the cost of mitigation have not been adequately established in the prior research. The actual value of premium reduction programs is difficult to measure on a direct cost-benefit basis. Nevertheless, we do have indirect evidence that while premium reductions, credits and discounts can effect change, they have not substantially improved the existing building stock.<sup>4</sup>

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2. A plethora of literature in the social sciences and engineering has investigated these factors. Ho et al (2008), Ge et al (2011), Carson et al (2013) and Medders et al (2015) together provide a comprehensive literature review of the many variables that are found in relation to mitigation property improvements.

3. Multiple states, such as Alabama, California, Florida, Louisiana, Maryland, Mississippi, New York, South Carolina and Texas, require companies to offer premiums discounts for relevant hazard mitigation measures.

4. The insurance price reduction must be sufficient for the hazard mitigation effect to be perceived as cost-effective over a time period considered reasonable and beneficial to the property owner. The empirical literature indicates limited effectiveness of such incentive programs, and includes Ge et al (2011), Carson et al (2013), Medders et al (2015), Gatzlaff et al (2017) enumerate such programs and outcomes.

The current study focuses on possibilities for improvement in realizing the loss-saving potential, and we turn to the role of non-insurance-based policy instruments in moving property owners closer to an optimal level of property protection. This represents an area of the literature that has been considered theoretically, but in large part neglected empirically, mostly due to lack of statistical data. Governments have a range of instruments at their disposal for exerting influence, and lessons can be learned from the experience in implementing these different measures. Non-insurance policy measures have more direct potential to create immediate and easily measurable cost savings (via grants, loans, tax deductions-credits, etc.) than do insurance policy measures (chiefly, premium reduction programs). The current study contributes to the literature on using policy instruments as mitigation strategy by providing: 1) arguments and a framework for policy strategies; and 2) three case studies for consideration. The paper ends with some thoughts on how existing policies can be made more effective.

## **I. Arguments and Framework for Effective Policy Strategy**

The literature is sparse regarding how to optimally incentivize individuals, businesses and communities to mitigate. Assuming proper insurance incentives already in place, property owners can be encouraged to make protective property improvements via financial assistance, financial offsets (often tax incentives) or both. Although the empirical literature on such mitigation programs is extremely limited, there does exist theoretical conversation on the topic, the bulk of which treats the policy instrument as a subsidy. Kelly and Kleffner (2003) and others assert that if governments were to subsidize mitigation, people would spend more on mitigation.<sup>5</sup> Kleindorfer and Kunreuther (1999) submit that often, poorly constructed homes are owned by impoverished individuals or families who cannot afford mitigation or rebuilding costs. The government is likely to provide relief for these people after a large loss at an expense to the public, so it may be particularly desirable to subsidize the direct cost of mitigation for them. Incentives from the private sector, as well as the public sector, are worthwhile for consideration. For instance, financial institutions (banks) support mitigation if the mitigation decreases the probability of mortgage default due to property loss (Kunreuther, 2006).

Critics of policy subsidies claim the existence of most policy instruments used to incentivize socially-appealing individual behaviors (especially in the areas of energy efficiency and climate mitigation) has not been justified on the basis of

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5. Notably, they also assert the mitigation efforts may serve as a substitute for insurance, at least partially, so the importance of proper insurance pricing is paramount to the achievement of the end goal of mitigation policy strategies: to reduce the underlying risk.

market inefficiencies (Jaffe and Stavins, 1994). They argue that there is no energy efficiency gap (i.e., there is no difference between the actual level of investment in improvements and the higher level that would be cost-beneficial from the consumer's and society's point of view). Critics emphasize that in a competitive and efficient market, suppliers produce what consumers want and are willing to pay for. Because there is limited evidence that consumers are willing to pay for closing a mitigation gap, detractors assert that the gap must not exist (Sutherland, 1996). Critics also note that the existence of market failure is not a sufficient justification for government involvement. Feasible, low-cost policies must be available that can eliminate or compensate for these failures. Some analysts argue that policies to date have not been low cost. In addition, they argue that policies have not been adequately evaluated by measuring consumer surplus (i.e., the difference between how much a consumer is willing to pay for a commodity such as property protection or energy efficiency and the amount that the consumer actually pays when a policy is implemented) (Braithwait and Caves, 1994).

In some cases, the critics may be absolutely correct. Does it make economic sense to subsidize property protection improvements for new private construction erected directly in harm's way, say along the Eastern coastline or along fault lines in California? Indeed, if a property owner can afford the property purchase and the construction, should not the same property owner afford to absorb the risk of disaster loss privately, if allowed to build in the first place? Also, although not all public policy interventions may be justified, the major need lies within the existing building stock where much of the lack of justification comes from policies that may be ill-informed or ill-motivated.<sup>6</sup>

### *How Best to Approach: Building a Framework*

Leading contemporary thought leaders contend approaches to social welfare be based on the concept that any redistribution of resources generated by economic growth be used to fund social programs that are “productivist and investment-oriented and that enhance economic participation and make a positive contribution to development” (Midgley, 1999). Consistent with these ideas, we propose a generalized framework for policy instruments to effectively promote voluntary mitigation by property owners. Financial incentives such as grants, tax credits, rebates, low-interest loans and innovative financing address the barrier of first costs. Other financial incentives may be used to somewhat offset property improvement costs less directly or reduce uncertainty regarding savings. Ongoing income tax deductions and property tax exemptions for specific, desired property improvements can serve as powerful incentives, particularly for property owners in high tax brackets. For instance, a 1995 study by Hassett and Metcalf found a

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6. The state of Florida's legislative response to the large-scale losses suffered in the 2004 and 2005 storm seasons, as well as to the insurance market challenges that ensued, has been studied heavily. Medders, Nyce and Karl (2014) provide a lengthy discussion of the market interventions and their undesirable outcomes, as well as sources of information for further study.

10 percentage point change in the tax price for energy investment would lead to a 24% increase in the probability of making an investment.

The various tax codes to which property owners (and income earners) are subject include a great number of special provisions that provide tax advantages intended to achieve non-tax goals considered desirable by policy makers. Arguably, the tax incentive is generally inferior to the direct subsidy as a means to achieving social goals, largely because their incentives may be less equitable as they benefit persons in the highest tax brackets most. On the other hand, grants provided to low-income, or low property value, households and businesses are inequitable as well (albeit in a more socially acceptable way than tax incentives) as their benefits inherently go disproportionately to those in low wealth categories. For these reasons, we submit a framework for consideration that is multi-tiered in its approach, as will be illustrated below.

Given the potential for obstacles to mitigation, as well as relevant research findings, not all mitigation incentives are the same. In addition to first and foremost making mitigation affordable, policy instruments that do the following may be most successful in effecting widespread actual mitigation improvements.

#### **Make strong and relevant building codes a foundation**

Building standards work to achieve effective mitigation. For instance, Fronstin and Holtman (2002) found that older homes in South Florida (built prior to Florida's real estate development boom in the 1960s) suffered proportionally less damage than newer homes (largely built post 1960). Residential building codes in Miami-Dade County, FL, were subsequently strengthened in 1993–1994. Risk Management Solutions (2009) demonstrated that lower losses were suffered in 2004 and 2005 by structures built in compliance with the most up-to-date (post 2002), strengthened building codes. But requirements to build to a code serve more than just a “coercive” purpose. They also signal information to homeowners regarding what building materials and processes make their homes adequately fortified for safe living in the locality where their homes are built. It is critical to the achievement of widespread, effective mitigation that building codes be adequate and enforced to withstand a significant event. Despite their value to effect loss savings, building codes in most states remain insufficient to withstand disaster that can reasonably be expected (Insurance Institute for Business and Home Safety, 2015).

#### **Make risk-based insurance pricing a foundation**

Risk-based pricing is a necessary, although possibly insufficient, condition for appropriate loss mitigation incentives (Erlach and Becker, 1972; Dionne and Eeckhoudt, 1985; Kleffner and Kelly, 2001; Kelly and Kleffner, 2003; Medders, 2011; and others). Allow (even require) insurers to set the risk (and mitigation)-based insurance premium appropriately for the specific property location, construction, maintenance and other risk factors. Regardless of policy instrument or strategy to promote mitigation efforts, without proper insurance pricing, the incentives are distorted and can result in unintended consequences. The challenge

is more difficult than it may appear on the surface, however, as political pressures to keep insurance affordable, especially after disasters, results in many states restricting the ability of insurers to charge risk-based rates (Florida Catastrophic Storm Risk Management Center, 2011; Medders et al, 2014).

### **Keep the property owner's "skin in the game"**

Ensure that owners of properties still have significant financial stake in the event of catastrophe. If a property owner has the perception that insurance settlements and/or disaster assistance after a loss void the need for financial preparation, mitigation policies may suffer (Kaplow, 1991; Kunreuther and Kleffner, 1992; Kelly and Kleffner, 2003; Medders, 2011; and others). High insurance policy deductibles in cases of catastrophic events can help curtail the problem if used appropriately, but also can result in distorted incentives for policymakers who must decide whether a particular event meets the criteria for catastrophe declaration.<sup>7</sup> Mitigation strategies can keep the property owner's financial stake in losses by not fully subsidizing the mitigation measures being incentivized.

### **Ensure the improvements promoted are best fit for risk reduction**

Not all property protection improvements are the same. Incentivize only those improvements proven to: 1) effectively reduce losses greater than the cost of the improvement; and 2) solve the greatest and most pertinent vulnerability challenge(s) for each community region targeted within reason. For instance, roof systems may be effectively improved in several ways to better protect against windstorms; a specific improvement in roof geometry (e.g., from gable to hip shape) may be highly desirable but infeasible (Florida Catastrophic Storm Risk Management Center, 2010).

### **Target property owners with incentives of "best fit"**

Use policy intuition, learning from past experiments, to determine which property owner groups of interest are likely to respond most positively to which incentive strategies. Build the strategies accordingly. Property owners are likely to voluntarily select into the most financially appealing program if multiple financial incentives are offered, so be cautious if you have specific social goals in mind (e.g., serving the low-income population with highest priority). It makes economic sense to target high-wealth individuals with indirect tax incentives, medium-

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7. The Federal Emergency Management Agency (FEMA) is currently considering implementation of a new rule that would make states' receipt of federal public assistance on a post-disaster basis contingent on a deductible. It pertains to funds for repair and replacement of public buildings and infrastructure. The deductible amount would be likely based on both a state risk index and fiscal capacity. The proposed first-year deductibles range from \$million (Alaska, North Dakota, Vermont, Wyoming) to \$52.53 million (California). The rule, as now proposed, would allow states to "buy down" the deductible by meeting mitigation standards via acceptable direct mitigation efforts and/or building codes. Details are available via the Office of the Federal Register, which published the proposed rule on Jan. 12, 2017.

wealth individuals with innovative financing instruments, and low-wealth individuals and minorities with the most highly subsidized mitigation programs.

### **Include the broader economic private sector in the solution**

Policymakers often look to the insurance market first for solutions to the social and private costs of catastrophe risk (Kleffner and Kelly, 2001; Kelly and Kleffner, 2003; Medders, et al, 2014). We assert policy strategies that invite local financial institutions and other economic stakeholders to participate in subsidizing mitigation costs to customers enhance the success of the strategies by enhancing community-level “buy in” to the programs. For instance, the inclusion of the banking-lending sector in strategies by offering mitigation loans with better-than-market terms directly “invites” the banks into solving the problem of how to make the communities they serve more sustainable. Negotiating with property improvement vendors can reduce the costs of mitigation for property owners through volume discounts or incentivizing multiple improvements simultaneously (e.g., upgrading all openings or an entire system of improvements rather than merely one improvement).

### **Educate property owners**

Property owners must recognize the risk, the cost of insurance, mitigation options (and costs) and the details of the incentive program before they can possibly be expected to desire participation. The real estate, emergency management, regional development and other stakeholders are needed to help educate the public. Effective public education addresses not only the facts (e.g., costs and benefits) but also misconceptions and misperceptions of the facts (e.g., perceived costs and benefits). And to the extent attempts to educate may be expected to fall on “deaf ears,” close-minded thinking or fixations, the way in which the message is conveyed takes on special importance (Baisley and Medders, 2017).

### **Apply peer pressure**

This element is closely related to education since peer pressure is simply strategic education by way of local example or comparison. Provide feedback on mitigation participation by neighborhood. Stress the collateral effects damage on one property can have to surrounding and nearby properties. Studies have found some evidence of the efficacy of this neighbor effect (Ge et al, 2011, and Carson et al, 2013).

It is important to note the funding mechanism plays a role in how (and how well) social and economic goals may be achieved. The framework suggested here could easily include a recommendation for private funding, at least to the extent practicable. We stop short of including a suggested source of funding only because states and local governments are inherently limited in their choice sets. Federal funding, particularly the amounts available through the Federal Emergency Disaster Agency (FEMA), is available on a competitive basis to state agencies and local communities meeting eligibility requirements. State funding also may be

available from various sources of revenue—taxes, utility fees, licenses and professional fees, and payments to state-based entities that can be made transferable. Regional and local sources of public funding tend to be extremely limited and temporary, and as such cannot be depended upon for running long-term programs. Private sources of funding—through lenders and/ or investors—is an attractive source of capital as not only does it shift the costs and financial risks of public strategies to the private sector, but by doing so, it also expands the interest in program success directly to the private sector.

### *The Benefits of the Framework*

We assert that policy instruments built thoughtfully with the framework above in mind meet social requirements, as well as have the best likelihood of reaching economic goals policymakers are charged with achieving. A caveat: We espouse strategies that *subsidize* or *finance*, rather than *provide* property mitigation against disasters. The importance of the property owner retaining some sense of private cost (however small) and thus ownership in the property improvements to be made cannot be overstated. Multiple stakeholders can benefit in numerous ways from a successful strategy, several of which are discussed briefly here.

#### **Participating individual property owners**

Current and potential property owners inarguably benefit from appropriate mitigation expenditures. We know from prior research that affordability of mitigation measures is a substantial barrier to mitigation for many homeowners. Peacock (2003), International Hurricane Research Center (2004), Kunreuther and Kleffner (1992), Kunreuther (2006), Medders (2011), and Medders, Bass and McCullough (2017) provide illustrations—theoretical empirical—of the affordability (and perceived affordability) challenges. Financial incentives that make these expenditures more affordable by reducing, offsetting or delaying costs, but that also keep the value of the subsidy at a maximum less than the total cost of the improvement, provide immediate assistance to the property owner, as well as a continued sense of interest in and responsibility for the effectiveness of the mitigation measure employed.

#### **Government**

Various levels of government, regardless of whether directly involved with a specific program, benefit from policies that incentivize individuals to pay their costs of mitigation against disasters. Privately-funded expenditures reduce the social (general tax) burden on both a pre- and post-disaster basis. Individual mitigation efforts that result in lower windstorm damages create less pressure on public assistance programs after a disaster. During disaster planning, governments whose citizens engage voluntarily in home hardening can allocate greater funds to the “common” costs of disaster mitigation and recovery, such as critical infrastructure.

Furthermore, these strategies, when details of design, implementation and promotion are accomplished at the local level, reduce the pressure on already-overburdened state and federal program funds. Municipalities and county governments participating in the design and implementation of local mitigation programs that encourage citizens to invest in windstorm mitigation would not have to compete for scarce general revenue in the state budget. They also enjoy more specific benefits from their participation. For instance, the choice of products, installers and installation techniques that receive favorable treatment can be controlled at the local level. Given the regional differences in the types of damages that are likely to be most severe, a homeowner in one locality (e.g., Miami, FL; Dauphin Island, AL) can be expected to financially benefit from a particular category of mitigation (e.g., hurricane shutters) to a greater degree than a homeowner in a different locality (e.g., Tallahassee, FL; Montgomery, AL).

### **Insurers, reinsurers, bankers and investors**

As risk takers and as businesses with a product/service to market, players in the financial sector stand to benefit from the adoption of mitigation programs. Property insurers, especially those doing business in windstorm-prone areas, have long encouraged the mitigation of buildings against windstorms. In fact, billions of insurance and reinsurance industry dollars have gone into the research and development of “best practice” home hardening designs, materials and techniques. Programs that improve the affordability of home hardening can reduce actual loss damages from windstorms, and thus reduce the cost of providing homeowners insurance.

Protecting homes against natural disasters decreases the risk of leveraging oneself financially to purchase a home. Thus, banks and other finance companies holding mortgages and home equity loans face a reduced risk of default. To the extent that insurers, banks, mortgage companies and other investors participate directly in providing the source of capital for these programs, they benefit from an increased demand for their capital and the resulting interest gains.

### **Construction and disaster protection industries**

The encouragement of property mitigation efforts inherently creates increased demand for the products and services of companies working in the manufacturing, construction and disaster protection industries. Increased demand likely leads to increased jobs for those in these and related industries.

### **Nonparticipating property owners and tenants**

Property owners and renters not participating directly in a mitigation financing program still are likely to benefit from such a program in multiple ways. First, a hardened property is not only less susceptible to direct damage from disasters, but also is less likely to produce damage to neighboring buildings (such as collateral damage resulting from windborne debris). Thus, the neighbors benefit via reduced collateral risk to their own properties and belongings. Second, whether simply a matter of education by observation or a sense of peer pressure, there is



evidence that individuals are more likely to engage in mitigation if their neighbors do. Research indicates that individuals react positively to efforts made by their neighbors (Peacock, 2003; Kunreuther et al, 2009, Carson et al, 2013).

## II. Three Speculative Case Studies

The mosaic of current strategies intended to reduce the vulnerability of the building stock to disaster is complex and dynamic, ranging from local, state and regional initiatives to a portfolio of federal policies and programs. Numerous policy innovations could be added to this mix, and many are being tried in natural “laboratories” across the U.S. and around the world. Governments at the state (and to a lesser extent, local) level in the U.S. have adopted an array of policies to promote catastrophe mitigation and other types of socially desirable outcomes by individual and commercial property owners. However, because of different regulatory environments, resource limitations, political interests and other factors, considerable variation exists among the states in their mitigation programs. In this section, we focus on three current state-level policies—California earthquake, Colorado wildfire and Florida windstorm—using markedly different approaches to reduce physical catastrophe risk.

### *Why These Perils and These States?*

The perils selected for evaluation here—earthquake, wildfire and high wind from tropical storms—each have a history of disastrous consequences in the U.S. and specifically within the states selected for this study. Other perils could be studied as well, but are more difficult to link directly to state-level policy directives or to property improvements (as opposed to life safety measures). Flood as a peril has a strong and long-lived mitigation program via the National Flood Insurance Program (NFIP) and the Federal Emergency Management Agency (FEMA). The flood hazard mitigation programs across the nation are directly linked to this federal policy and are part of a larger insurance program that has historically been filled with subsidies and since 2005, financial deficits, with outcomes difficult, if not impossible, to extract, from the broader federal policy. Tornado and other non-tropical storm high wind is another peril of interest but is not directly considered here, mostly because of the limited nature of state policies aimed at property improvement rather than life safety measures.

The states included in this study have been selected for three reasons: 1) pervasive scope of threat; 2) existence of mitigation policy to address the threat; and 3) sufficient program implementation history from which to draw pragmatic lessons. California, Colorado and Florida all face substantial catastrophe exposure, and each of these states has responded to at least one catastrophe threat to a degree that provides lessons for other jurisdictions. These three states have been at the

forefront of catastrophe mitigation and to a lesser extent, risk-based insurance pricing as well (Multi-hazard Mitigation Council, 2015).

Most of the state of California is susceptible to earthquake. A recent report provides information on the latest estimated likelihoods of an earthquake magnitude 6.7 or larger occurring in areas of the state during the next 30 years (Wang, 2016). Although probabilities vary widely by area, any single earthquake of significant magnitude could affect the entire state economically. California has over many years incorporated earthquake mitigation measures into its building codes statewide, as well as into its policy for voluntary property improvements in areas most at risk (Muir-Wood, 2016).

Wildfire is a threat to many regions and localities in the U.S. What makes Colorado particularly interesting for this study are both its exposure and its response. The state of Colorado holds the second largest number of properties and total exposed value categorized as “Very High” risk for wildfire among all U.S. states, with 50,000 properties so designated at approximately \$14 billion estimated value (Botts et al, 2015). As such, it is surpassed only by California—a much larger state—which is at lower risk proportionate to its property numbers and population (Botts, 2015). Colorado has responded to the wildfire risk with concerted efforts to promote property mitigation since the early 1990s.<sup>8</sup> It is the first state to implement direct financial incentives on a statewide basis to promote wildfire mitigation.

Florida is the state with the most vulnerability to the wind peril from tropical storms and hurricanes, given the combined loss frequency and severity it faces from such events. Florida’s modeled probable maximum loss is greater than that of all states combined from Texas to Maine. Four of the 10 costliest hurricane catastrophes in U.S. history made landfall in Florida (Hartwig, 2016). All of Florida is exposed to hurricane events and, not surprisingly, has the highest probable maximum loss (PML) estimates of any state, with \$54 billion aggregate gross PML for a 100-year return period, estimated in 2016 (State of Florida Financial Services Commission, 2016). Florida led the nation in the adoption of building codes to reflect acknowledgement of the importance of wind mitigation to risk reduction (Fronstin and Holtman, 1994; RMS, 2009; Florida Catastrophic Storm Risk Management Center, 2010). The state was the first to embark on windstorm mitigation affordability programs, having two such programs currently in place and one additional widespread program now ended.

Since most policy instruments summarized here are going concerns with limited data accessibility, we cannot fully evaluate the performance of the measure as evidence of their effectiveness in achieving social and economic goals. Instead, we use what we know from prior research, anecdotal evidence from past programs and the design of the programs highlighted to speculate as to their efficacy according to the framework asserted above.

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8. Colorado Springs passed its first wildfire-related ordinance in 1993, focusing on roofing materials and defensible buffer space.

*California Earthquake – Codes and Insurance***Building codes**

California Residential Building Codes have required new homes be constructed to an “earthquake standard” consistent with the International Building Codes since 1979 (Marshall, 2017). Older dwellings, depending on year of construction and building codes existing in the state in that year, are typically more vulnerable to damage from earthquake shaking (in extreme cases causing the house to slide off its foundation).

**Risk-based insurance**

The state of California years ago made the decision not to require property owners to carry earthquake insurance. This public policy choice can have either or both of two possible effects: 1) events result in true private costs held by the homeowner, which serve as financial incentive to mitigate; or 2) events result in outcries for disaster relief, which are then met with federal and state aid dollars on a post event basis, thus effectively making what would otherwise be private costs social costs instead. Research suggests the policy has had both results at various times (Marshall, 2017). For those residential property owners who do choose to carry earthquake insurance, pricing does adjust for mitigation measures—indirectly or directly—depending on when the dwelling was built. Dwellings built post 1979 are assumed to be “retrofitted,” and thus the base price reflects the reduced risk via consideration of year built. Homeowners of older dwellings can earn earthquake insurance premium discounts ranging up to a 20% reduction in premium.<sup>9</sup>

*California Earthquake – Direction Mitigation Incentives*

Today, throughout California, and most particularly Northern California, local governments have created financial incentives to encourage owners to voluntarily retrofit existing buildings to improve how well they will withstand earthquakes. At the state level, after battling about and ultimately letting die an earthquake tax credit bill introduced during the 2015 California legislative session, a grant program for a limited number of homeowners is being offered instead.

**State of California retrofit grants<sup>10</sup>**

One thousand (1,000) grants in amounts of up to \$3,000 have been made available by the state to fund voluntary improvements to wood frame structures by bolting them to their foundations using metal rods and plywood. According to the Insurance Institute for Business and Home Safety (IBHS), the cost of earthquake

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9. The maximum 20% discount applies to structures insured by the California Earthquake Authority that are “maximally” mitigated and were constructed prior to 1940 (Marshall, 2017).

10. For more details about this grant program, see Lin (2015).

damage to unbolted homes can be as high as \$400,000, while the cost of retrofit is typically \$2,000 to \$10,000, averaging \$5,000.

#### **Berkeley Transfer Tax Seismic Retrofit Refund Program<sup>11</sup>**

This program allows for up to one-third of the city of Berkeley property transfer tax to be refunded for voluntary eligible seismic upgrades to residential property. The program purportedly has resulted in Berkeley enjoying three times as many retrofitted buildings as adjacent cities.

#### **Other local government loan and grant strategies<sup>12</sup>**

Strategies undertaken by local California governments are numerous, and several are mentioned here without attempting an exhaustive list. Fremont, San Leandro, San Mateo, Santa Clara and Vacaville offer low-interest or special assessment district loans, at interest rates as low as 3% with terms as long as 25 years, for seismic improvements, redevelopment and/or engineering analysis. Localities providing small grants to assist with earthquake retrofits and/or assessments include: Brentwood, Colma, Dixon, Emeryville, Morgan Hill, Napa, Pinole, San Mateo, Sonoma, St. Helena, Windsor, San Francisco and Vallejo.

Clearly, California public policy efforts to promote earthquake mitigation for existing construction lie heavily at the local level. Localities choosing to do so may fund and administer strategies that make best sense for their communities and homeowners given the particular needs of the area, and must generally also find local ways to fund the programs. The necessity to find funding often results in creativity and innovation. Berkeley, in fact, was a pioneer in the advent of the well-known Property Assessed Clean Energy (PACE) programs, promoting energy efficiency improvements to homes and business properties (Medders, 2011).

#### *Colorado Wildfire – Codes and Insurance*

Colorado faces increased risk to wildfire losses due to economic (and real) development, disease that affects hundreds of thousands of forest acres and drought. Until recently, the state appeared to view wildfires and wildfire losses as inevitable. Today, a paradigm shift appears to be taking place within state and local governments to shift the responsibility to property owners.

Almost all Colorado jurisdictions considered by the IBHS to be either “High” or “Very High” risk for wildfire have adopted the 2015 International Fire Code as

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11. A property transfer tax of 1.5 % is imposed on all transfers by deeds, instruments, writings or any other document by which any lands, tenements or other interests in real property are sold, located in the city of Berkeley, which are, or is granted, assigned, transferred or otherwise conveyed to or vested in a purchaser, or purchasers thereof, or any other person or persons, by his/her or their direction. See Berkeley Municipal Code for details of the Berkeley Transfer Tax and Seismic Retrofit Refund.

12. Several local California strategies are highlighted by the Northern California Chapter of the Earthquake Engineering Research Institute, [www.eerinc.org](http://www.eerinc.org).

the minimum standard for new construction. Additionally, 65% of all code jurisdictions (including counties, fire protection districts and municipalities) have adopted this standard (International Code Council, 2017).

Colorado now ranks second in the nation for homeowners insurance catastrophe claims, primarily due to widespread hailstorms and some of the nation's most destructive wildfires (Multihazard Mitigation Council, 2015). In the highest-risk regions of the state, many insurers now require their insureds to meet wildfire mitigation standards to remain insured. In most areas of significant wildfire risk, premium credits typically are available for approved mitigation measures taken (Colorado Division of Insurance, 2016).

### *Colorado Wildfire – Direct Mitigation Incentives*

Two policy strategies of note are leading state efforts to reduce individual risks of property owners to fire loss. One is a statewide federal income tax deduction strategy, and the other is a local financial incentive strategy—both targeting primarily smaller (and easily effected) expenditures to “create and maintain a defensible space around structures” (Colorado Department of Revenue, 2013).

#### **Wildfire mitigation measures subtraction<sup>13</sup>**

This tax strategy provides eligible property owners—in the form of individuals, estates or trusts—a deduction from federal taxable income certain costs incurred while performing wildfire mitigation measures on their property. The maximum deduction is \$2,500 or the owner's federal taxable income, whichever is less. The deduction is available for tax years 2009–2024. The number of participants to date is unknown but estimated at approximately 20,000.

#### **Boulder Wildfire Partners program<sup>14</sup>**

This is a voluntary program, established in 2013, offering financial incentives to defray the upfront costs of basic wildfire mitigation. The localized strategy offers up to \$300 in rebates along with expert assessment and advice regarding the property's wildfire risk and value of improvements in reducing the risk. The program is funded through Boulder County and a Wildfire Risk Reduction Grant from the Colorado Department of Natural Resources (\$250,000 of which was specially earmarked for mitigation rebates). Although precise participation is unknown, the allocated annual funding for 2014, 2015 and 2016 was all spent. During 2016 and 2017, other high fire risk Colorado jurisdictions have begun similar programs.

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13. See the Colorado Department of Revenue (2013) for more details on mitigation measures and tax deductions.

14. See Wildfire Partners (2011, 2016) for additional information.

### *Florida Windstorm Codes and Insurance*

The state of Florida continues to be one of the leading examples of building code safety. The Miami-Dade area of South Florida upgraded its residential building codes for wind in 1993, following Hurricane Andrew. The rest of the state followed, and by 2005, building codes had been strengthened for hurricane wind on a statewide basis. The IBHS rated Florida first and second among Atlantic and coastal states for building code effectiveness in its 2012 and 2015 Rating the States reports, respectively. Since publication of the 2015 Rating the States report, Florida has adopted and is enforcing the 2012 edition of the IRC (IBHS, 2015).

Florida requires insurance companies to offer windstorm improvement insurance discounts, promulgated by the Office of Insurance Regulation (OIR), for individual property features demonstrated to reduce windstorm losses. These discounts apply only to the windstorm (including non-hurricane wind) portion of policies and can be high enough to virtually erase the windstorm premium. Full mitigation credits have been required for more than a decade. During the 2007–2012 period, however, state legislation and how it was implemented by the OIR combined to result in disproportionately high credits for many insurance policies for existing property features, thus providing little or no incentive for further risk reduction (Medders et al, 2014). Since 2012, insurers have been allowed to correct the mitigation credits to more accurately reflect the reduction in risk (Medders and Nicholson, 2017).

### *Florida Windstorm – Direct Mitigation Incentives*

Florida policymakers have struggled with how to manage the state’s inherent exposure to hurricanes and tropical storms. The state enjoyed a hurricane-free decade from hurricane season 2006 through 2015. Two hurricanes affected the state in late 2016—Hermine and Matthew—yet did not result in widespread catastrophic losses (Medders and Nicholson, 2017). Based on what Florida has learned from its own experiences as well as that of other states, the state’s most recently enacted policy instruments to reduce the underlying risk rely largely on three funding sources: FEMA grants, transfers from state-based insurance entities earmarked for mitigation and investments by the private sector.

### **Florida PACE legislation<sup>15</sup>**

The Florida Legislature in 2010 was the first state to enact a statute to authorize special financial districts for the purposes of financing disaster mitigation. Other states, including California and Colorado, had earlier enacted legislation to make such strategies possible for energy efficiency improvements, deemed PACE legislation, with high participation rates by property owners—

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<sup>15</sup> See Medders (2011) for program details. The Florida Catastrophic Storm Risk Management Center was awarded a grant from the Florida Division of Emergency Management’s Residential Construction Mitigation Program (RCMP).

residential and commercial—eligible for the energy improvement programs. The Florida legislation makes it possible for local communities to establish special financing districts wherein property owners can voluntarily participate in loans to finance energy and/ or windstorm improvements on a long-term basis and to be paid back through property tax assessments. The Florida programs primarily serve the commercial property market as some federal agencies have not supported the property lien necessary to reduce the risk of default on residential loans.

### **Florida Division of Emergency Management (DEM) retrofit programs<sup>16</sup>**

The Florida DEM presently operates at least three retrofit grant strategies to help prepare existing homes to better withstand hurricanes and other windstorms.: 1) mobile home tie-downs; 2) single-family residence retrofits for low-income homeowners; and 3) the Veterans Direct Grant for military veteran homeowners residing in the state with grant funding for up to \$15,000 per grant to help defray retrofit costs. The mobile home tie-down program has funded more than 30,000 tie-downs to date and the single-family residence retrofit programs approximately 1,000 partially-funded retrofits (usually at 75% subsidy level). The Veterans Direct Grant is new (began in late 2014), but by 2015, it had at least 25 applicants.

Particularly interesting about the Florida programs are their sources of funding. The PACE funding ultimately comes from private individuals and entities willing to invest in mortgage-like securities (special-purpose bonds). The Florida DEM retrofit programs are funded largely through a virtually automatic annual transfer of \$10 million from the state’s pseudo-reinsurance entity, the Florida Hurricane Catastrophe Fund.<sup>17</sup>

### *The Policy Strategies in Light of an Optimal Framework*

The three states highlighted here take differing approaches as a means to encourage voluntary mitigation by property owners against disaster losses. Here we address the extent to which the programs meet the elements of an optimal policy framework, as described in this study. Table I summarizes the discussion.

### **Affordability**

All three states attempt to effect affordability of property improvements to protect against natural disasters. The multiple programs in each state, with the exception of the Wildfire Partners program at only \$300 per rebate-grant, do substantially improve affordability for homeowners, although to varying degrees.

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<sup>16</sup> Operational details of Florida hurricane mitigation programs can be found at the Florida Division of Emergency Management ([www.floridadisaster.org](http://www.floridadisaster.org)) and the “Hurricane Loss Mitigation Program Review” presentation by the Florida DEM to the State Board of Administration, Oct. 14, 2014.

<sup>17</sup> It should be acknowledged that the programs have been aided by FEMA grants as well.

**Building codes**

Each of the three states generally has strong building codes, although Colorado may benefit from a statewide code for fire safety. As previously stated, California's post-1979 construction and Florida's post-2005 construction are thought by experts to meet reasonable safety standards against earthquake and windstorm, respectively.

**Risk-based insurance pricing**

All three states allow risk-based insurance rating to a degree. The California Earthquake Authority (CEA) uses an actuarial basis for its ratings, as do private earthquake insurers. In Colorado, most homeowners, even in high wildfire risk areas, can get private homeowners insurance. Insurers are allowed to price properties according to the risk. Florida private market residential insurers must get their rates approved but can generally get risk-based rates. Citizens Property Insurance Corporation (Citizens), the state's residual market insurer, is still incrementally moving toward actuarially sound rates. Homeowners covered by Citizens (largely in Southeast Florida) may not yet be paying for their insurance in an amount proportionate to their risk.

**Property owner financial stake**

The California, Colorado and Florida mitigation programs all leave participating property owners with significant "skin in the game," meaning the property owner still has adequate financial incentive to maintain the mitigation measures taken, as well as further protect the property from loss.

**Targeted improvements**

For the most part, experts agree that California's largest remaining risk lies with unreinforced frame buildings (Muir-Wood, 2016; Marshall, 2017), and the mitigation policies studied here do address those properties. Colorado's federal tax deduction program is aimed at property improvements known to be effective against wildfire loss (Quarles et al, 2014). Its localized grant program is effective in the sense that it targets mitigation efforts that are relevant but largely neglected by many homeowners—tree removal, removing dried leaves from gutters and installation of fire-resistant vegetation—yet lacks effectiveness in that these are small measures in the event of a major fire. Florida's windstorm mitigation programs help property owners afford property improvements that make good sense given their specific wind zone and construction design. Unfortunately, the state's insurance credit program and its list of features for which discounts are available drives the choices of mitigation measures outlined in the non-insurance mitigation strategies even though it has been shown that individual property improvements (e.g., roof-to-wall attachment) are disproportionately less effective than suites of improvements (e.g., roofing system).



**Targeted incentives**

Most of the programs studied do provide incentives for property owners who are on the financial margin of being able to afford proper mitigation measures and thus may “tip” the decision in favor of mitigation. In Florida, the funding amounts can be large enough to incentivize homeowners who otherwise could not afford the expenditures. The possible exception is the Colorado-Boulder Wildfire Partners (WP) program. At only \$300 each, the rebates-grants offered through WP may result in high participation rates, but we submit results in mitigation measures that make little difference in the event of a wildfire disaster and would have likely been done regardless of the rebate-grant availability.

**Economic sector involvement**

One major shortcoming of nearly all mitigation programs, including the ones evaluated here, is the lack of participation by the broader private sector (broader than insurance, that is). In some states, especially if immediately following a disaster, insurers may be required to participate in the costs of mitigation, namely through premium credits, and sometimes disproportionately so (Medders et al, 2014). The argument is the insurer can expect to benefit later via reduced losses in the event of a disaster. Do not other sectors benefit from reduced disaster losses as well (e.g., fewer foreclosures and abandoned properties post-disaster, which must be dealt with by banks), and thus using the same argument have reason to participate in the upfront costs of incentivizing property improvements? In the case of the Florida PACE programs, investors were found but have been dissuaded by lack of federal government enthusiasm for the programs.

**Education and peer pressure**

While each state—California, Colorado and Florida—is known to be a leader in risk and resiliency education (Multihazard Mitigation Council, 2015), none optimally educates its public. To be fair, it is not an easy challenge. Optimal education regarding risk and mitigation includes—to the extent practicable—information about: 1) how well the property fared in past loss events; 2) what the present (and future estimated) level of risk (and possible loss) is; 3) the costs and expected benefits of available options for protecting against the risks; and 4) how well protected the neighborhood/community is (e.g., participation rates in property improvement programs), at a minimum. While these points may seem straightforward, in practice often they are not. Take Florida for instance. Two strategies aimed at property owner education—a home rating system and a community high-flood marker program—were never fully implemented. The real estate community expressed concern that these policies would serve more to scare away home buyers than to educate them (Florida Catastrophic Storm Risk Management Center, 2010).

The discussion above is not an exhaustive treatment of the programs under consideration or their advantages and disadvantages. What it does attempt to accomplish is a survey evaluation of multiple resiliency strategies for multiple locales and perils that could be used to illustrate: 1) there exists no mitigation

strategy currently in use that works optimally to incentivize the improvement of existing structures; and 2) achievement of optimal mitigation strategies depends not only on plan design but also integration with at least the building code and insurance systems present within a state. The mitigation-insurance relationship is a complicated one and warrants further discussion.

### *The Complexities of the Mitigation-Insurance Relationship*

Much historical evidence is available regarding the actual relationship between the availability/pricing of insurance and personal investments in risk-reducing activities. The results are mixed because while insurance transfers risk of financial loss from the individual to the insurance company, it inherently creates an incentive for insurance companies to develop a pricing scheme that rewards policyholders who mitigate. In other words, higher premiums for greater risk exposure should translate to incentives for property owners to mitigate their risk if adequate and appropriate insurance premium incentives (i.e., mitigation credits or discounts) are present.

Although the perils and strategies differ, what these states have in common is the attempt to use policy instruments to promote mitigation under non-optimal insurance conditions. As stated previously, California property owners are not required to purchase earthquake insurance. The portion who do is estimated to be quite low at under 10%. Such low insurance penetration can have mixed effects. It does leave the property owner exposed and, thus, intuitively having the incentive to mitigate. But as also discussed earlier, expectations of disaster relief can have a counter effect on incentives to mitigate.

In both Colorado and Florida, residential property owners are provided wildfire and hurricane insurance, respectively, as part of the homeowners insurance policy. The vast majority of residential property owners in these states do carry highly valued homeowners insurance policies (i.e., high insurance-to-value ratios). In neither state have insurers been allowed consistently to price the insurance in line with the risk underwritten (Medders, Nyce and Karl, 2014). Such conditions can produce counter effects to mitigation strategies. Studies such as Ehrlich and Becker (1972), Kunreuther and Kleffner (1992) and Carson et al (2013) find that the incentive to voluntarily reduce losses via mitigation is reduced by the presence of full insurance, all else constant, and that the problem of using insurance as a substitute for risk-mitigating behavior is exacerbated when premiums are not risk-based (Kleffner and Kelly, 2001).<sup>18</sup>

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18. Separate from the relationship between property insurance and risk mitigating behavior, evidence also supports the idea that an expectation of disaster relief is likely incorporated into individual mitigation cost-benefit analyses in similar fashion. Kaplow (1991), Kelly and Kleffner (2003), and Kunreuther and Pauly (2006) each asserted that government relief distorts mitigation incentives because individuals no longer bear the full cost of their (in)actions.

**Table 1:  
Program Profiles Within the Framework Recommended**

	<b>California Earthquake</b>	<b>Colorado Wildfire</b>	<b>Florida Windstorm</b>
<b>Significantly improves affordability?</b>	Grants: YES Tax refunds: YES	Tax deduction: YES Grants: NO	PACE: YES Grants: YES
<b>Underscored by strong building codes?</b>	YES	YES in most jurisdictions and NO in others	YES
<b>Underscored by risk-based insurance rating?</b>	YES, to the extent properties are insured	YES in some jurisdictions and NO in others	YES in some jurisdictions and NO in others
<b>Property owner has financial stake?</b>	Grants: YES Tax refunds: YES	Tax deduction: YES Grants: YES	PACE: YES Grants: YES
<b>Targets “best fit” improvements?</b>	Grants: YES Tax refunds: YES	Tax deduction: YES Grants: MAYBE	PACE: MAYBE Grants: MAYBE
<b>Property owners likely incentivized?</b>	Those on the margin of affordability	Those on the margin of affordability	PACE: Those who can afford or are on margin of affordability Grants: Those who could not otherwise afford
<b>Includes participation from economic community?</b>	NO directly, although some vendors may choose to collaborate with local government on pricing	NO directly, although some vendors may choose to collaborate with local government on pricing	PACE: YES, does involve investors willing to take muni-bond risk Grants: NO
<b>Adequately educates?</b>	NO	NO	UNKNOWN
<b>Uses peer pressure?</b>	NO	NO	NO

Rational individuals are reasonably expected to be averse to loss of property and/or risk of injury and increasingly risk averse in light of potential catastrophic loss resulting from a potentially catastrophic peril. Theoretical analyses by Dionne and Eeckhoudt (1985) and Hiebert (1989) imply that increases in risk aversion

result in increased expenditures on mitigation, and Jullien, Salanie and Salanie (1999) found evidence of the same given the effectiveness of the mitigation technique is predictable. Ge et al's (2011) and Carson et al's (2013) empirical findings support these results, while Briys, Schlesinger and Schulenburg (1991) and Kelly and Kleffner (2003) find that when the mitigation measure is imperfect, risk-averse individuals may rationally decrease self-insurance and self-protection. Policymakers generally expect rational property owners to purchase adequate insurance and engage in property fortification in an effort to prevent or reduce losses. Nevertheless, homeowners may not, in fact, behave in the ways we expect or desire, for various rational—as well as irrational—reasons.

The likelihood of increases in future disaster losses, whether from continued development in disaster-prone regions, climate-related changes in risk or both makes an improved understanding of the mitigation-insurance relationship even more important for future disaster policy. If pricing is fully reflective of the risk, take-up rates could conceivably be near zero for demand-elastic homeowners (such as we already see in California earthquake insurance). While that would simplify the mitigation-insurance relationship, resiliency then may require more than the state of the art codes or retrofits available or even understood today. State insurance regulators, as well as policymakers, have an interest in ensuring both the simplicity and the effectiveness of strategies aimed at reduction of the risks that underlie the insurance promise.

### **III. Conclusions and Further Research Needed**

The protection of property from disasters contributes to reducing external dependence and vulnerabilities in the economic domain. In this paper, we discuss factors that influence mitigation decisions and appropriate policy approaches for their direct promotion. Although not all public policies seem justified, we argue specific policies for promoting catastrophe mitigation may be required, and preferably are based on economic instruments and/or the provision of information to consumers.

Mitigation investment decisions often are affected by insurance choices (as well as the insurance choice set) and expectations about disaster relief. Furthermore, we know mitigation decisions are associated with beliefs about consequences for and beyond the household and with receiving mitigation consulting and financial incentives, although the effectiveness of financial measures depends on how they are implemented.

We know from the prior literature that perceptions of risk knowledge are related to mitigating behavior. The emergence of risk perception research is motivated by the significant differences between expert assessments of risk and intuitive judgments of risk (i.e., risk perception) made by lay individuals. Studies of the relation of disaster risk perception to adoption of property protection

measures have surveyed a range of perils, such as nuclear power plants, floods, landslides and earthquake events, as well as looked at disasters generically.

Given the multiple, and at times conflicting, factors that contribute to the mitigation decision, a sensible framework for public policy aimed at promoting mitigation finds ways to leave property owners with a financial stake in the loss outcome and risk-based pricing, both of which yield economic reasons to consider mitigating. Furthermore, the sensible design is well researched on which specific mitigation efforts are most likely to provide greatest value on a net loss cost savings basis, and collaborates with the private sector to maximize these savings and/or minimize the costs required to achieve these savings. Lastly, the successful policy will thoughtfully offer the mitigation message to property owners in relatable ways and with an appreciable sense of the property owner's financial dilemma.

We briefly evaluate three states and their recent public policy approaches to three perils, respectively: 1) California's approach to earthquake risk reduction; 2) Colorado's strategy for wildfire mitigation; and 3) Florida's promotional efforts to harden the building stock against hurricanes and wind risk. These programs are discussed according to the policy framework we have asserted.

Further research is needed to link mitigation program effectiveness differences to specific policy failures. Research also is needed as to how effectiveness may be related to characteristics of the peril(s) of exposure. Additionally, research efforts that provide evidence for superior performance of particular public education and incentive approaches to reach property owners whose properties are non-optimally protected would be informative and important to policymakers, as well as insurers. Finally, innovative approaches to educate the private sector, as well as the public, are needed if true community resiliency is to be actualized.

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# Journal of Insurance Regulation

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Cummins, J. David and Richard A. Derrig, eds., 1989. *Financial Models of Insurance Solvency*, Norwell, Mass.: Kluwer Academic Publishers.

Manders, John M., Therese M. Vaughan and Robert H. Myers, Jr., 1994. “Insurance Regulation in the Public Interest: Where Do We Go from Here?” *Journal of Insurance Regulation*, 12: 285.

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