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The insurance and risk management industries: new players in the delivery of energy-efficient and renewable energy products and services

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Abstract

The insurance and risk management industries are typically considered to have little interest in energy issues, other than those associated with large energy supply systems. The historical involvement of these industries in the development and deployment of familiar loss-prevention technologies such as automobile air bags, fire prevention/suppression systems, and anti-theft devices, evidences a tradition of mediating and facilitating the use of technology to improve safety and otherwise reduce the likelihood of losses. Through an examination of the connection between risk management and energy technology, we have identified nearly 80 examples of energy-efficient and renewable energy technologies that offer loss-prevention benefits (such as improved fire safety). This article presents the business case for insurer involvement in the sustainable energy sector and documents early case studies of insurer efforts along these lines. We have mapped these opportunities onto the appropriate market segments (life, health, property, liability, business interruption, etc.). We review steps taken by 53 forward-looking insurers and reinsurers, 5 brokers, 7 insurance organizations, and 13 non-insurance organizations. We group the approaches into the categories of: information, education, and demonstration; financial incentives; specialized policies and insurance products; direct investment; customer services and inspections; codes, standards, and policies; research and development; in-house energy management; and an emerging concept informally known as “carbon insurance”. While most companies have made only a modest effort to position themselves in the “green” marketplace, a few have comprehensive environmental programs that include energy efficiency and renewable energy activities.

Keywords: Insurance; Risk management; Energy efficiency; Renewable energy; Sustainability; Climate change

1. Introduction

It is not often that a significant new actor enters the energy efficiency or renewable energy marketplaces. We are now witnessing such an occurrence in the case of the insurance and risk management industries. Given that the insurance sector alone is larger than the energy sector—and that they reach virtually every homeowner and business in developed countries, and an increasingly large number in the developing world—the prospect for their involvement in the development and promotion of sustainable energy technologies stands as an immense opportunity for accelerating related energy policy objectives and market transformation.

The fledgling interest in energy efficiency and renewable energy by the insurance and risk management industries is driven by three factors. The first factor is that a range of relevant loss-prevention benefits are coming to light (Mills and Rosenfeld, 1994; Mills, 1996, 1997; Mills et al., 1998; Pye and McKane, 2000; Deering and Thornton, 1998; Vine et al., 1998). As a result, these measures take on the appeal of more familiar risk management technologies such as automobile seat belts or air bags, smoke alarms, or preventive medicine. The second factor is that insurers (particularly life insurers) are major players in real estate markets as commercial building owners and landlords. As interest in facility energy management grows, insurers stand to benefit directly by becoming engaged in it. Lastly, increased

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competitive pressures continually motivate insurance and risk-management companies to develop new products and services (e.g. energy efficiency) that differentiate firms from their competitors and offer new ways to touch customers.

According to the first factor mentioned above, our inventory of energy-efficiency and renewable energy technologies revealed 78 specific examples that offered risk-management benefits, examples of which are shown in Table 1 (Vine et al., 1998). We identified eight specific relevant ‘‘physical perils’’, and 15 corresponding types of insurance coverage (Table 2). Specific examples include the fire-safety benefits of high-efficiency torchiere light fixtures (Fig. 1), the freeze-damage benefits from thermal management in the design of building roofs (Fig. 2), the occupational safety benefits of high-performance laboratory fume hoods that reduce likelihood of hazardous pollutant spills (Fig. 3), and the roadway safety benefits of photovoltaic-powered light-emitting diode (LED) roadway lighting (Fig. 4).

The preceding examples pertain largely to physical damages and occupational safety. In addition, a study highlighted the particular importance of ‘‘business interruption’’ insurance, and the increasing vulnerability of insurers to this type of loss in the face of a worsening electricity grid reliability situation in many regions (Eto et al., 2001; Mills, 2001a). Various energy efficiency and renewable strategies have particular value in the event of power outages. An often-cited example is the ability of the Harmony Resort on the island of St. John, which weathered hurricanes Marilyn, Bertha, Georges, and Lenny with no loss of (solar) power or (solar) hot water while other facilities on the islands were disrupted for weeks or months, losing tourism income in the process (Deering and Thornton, 2000).

Understanding the great diversity of the insurance and risk management industries is essential to developing relevant scenarios for their involvement in the sustainable energy marketplace. Primary insurance itself is divided into two main branches (property/casualty

Table 1
Energy-efficiency measures with insurance loss-prevention benefits

Efficient refrigeration. Loss of power can cause significant insured business interruptions and damage to property (Eto et al., 2001). High-efficiency food and pharmaceutical storage systems will maintain critical temperatures longer in the absence of power, and will be easier (less power demand) to operate on backup generators.

Energy-efficient windows. During a fire, heat-stressed windows can shatter as a result of differential expansion near the frames, and the increased supply of air flowing through a broken window accelerates the spread of fire and toxic fumes. Efficient windows reduce the likelihood that fire will cause breakage (Kluver, 1994). Efficient multiple-pane windows or windows with retrofit films can reduce energy losses by half or more and are also more resistant to breakage by thieves or windstorms. They also block damaging UV radiation, and enhance occupant comfort (Mills and Rosenfeld, 1994). Tests conducted by Lund University's Institute of Fire Technology for the Swedish company Pilkington Glass AB identified superior performance of windows with low-emissivity (energy-efficient) coatings. Double-glazed units with one low-e coating took three- to four-times longer to break than did ordinary double-glazed units. In addition, these low-e double units performed as well or better than double units with one laminated glass layer (Anderberg, 1985).

Insulated water pipes. Frozen water pipes have been identified as an important cause of losses in Europe and North America. Cold winters correlate to significant reductions in the profitability of pipe insurance providers. The US insurance industry paid $4.5 billion in claims during a 10-year period for freezing pipes in 17 southeastern states. Pipe insulation (or insulation of cold spaces where pipes run) is a simple retrofit that saves energy and reduces the likelihood of freeze damage.

Duct sealing. Eliminating heating system duct leaks can help avoid dangerous pressure imbalances in a building, which can lead to fires or health and life risks from carbon monoxide back-drafting of combustion appliances. Suction-like home depressurization can also accelerate the entry of cancer-causing radon gas from surrounding soils. The hot air released by leaky ducts located in attics also precipitates ice dam formation (Fig. 2).

Urban heat island mitigation. Lowering urban air temperatures by increasing the solar reflectance of roofs and roads and planting urban trees has been shown to reduce air-conditioning costs by up to 50%. Light-colored materials for walls and roofs can be designed to offer the added benefit of increased fire resistance. Reducing urban air-shed temperatures also slows the formation of smog, which in turn reduces health insurance claims. Lighter roof coloration has also shown to reduce the likelihood of heat deaths during urban heat waves (Mills, 2002).

Fuel-switching from electric to gas cooking. Cooking is the number-one cause of house fires in Canada. In the Alberta Fire Commissioners analysis of cooking-related fires in Canada, cooking oil was found to be responsible for 65–75% of kitchen fires, depending on house type. These fires were four times more common in homes with electric stoves (238 per 100,000 houses) than for gas stoves (58 per 100,000 houses) (Vine et al., 1998). The same ratio has been observed in the UK. Gas cooking is approximately twice as energy efficient as electric cooking.

Building commissioning. Improper performance of heating and cooling systems is an important cause of litigation, business interruption, and contractor call-backs in buildings. An emerging practice called building commissioning aims to: increase quality control during the design, construction, and start-up phases; conduct formal functional testing and inspection of energy-using equipment to ensure that intended performance (and energy savings of 5–30%) are achieved; and provide for operator training. DPIC, the second largest US professional liability insurer for architects and engineers, has cited building commissioning as a significant loss-prevention strategy for claims related to heating and air conditioning systems in buildings. DPIC gives liability premium discounts for firms practicing commissioning.

Table 2
Physical perils and insurance coverage addressed by energy-efficiency and renewable energy technologies and strategies (Vine et al., 1998)

	Number of measures offering benefit[a]
Physical perils	
Extreme temperature episodes	16
Fire & wind damage	38
Home or workplace indoor air quality hazards	38
Home or workplace safety hazards	21
Ice & water damage	17
Outdoor pollution or other environmental hazard	17[b]
Power failures	35
Theft and burglary	6
Insurance coverage—commercial lines	
Boiler & machinery	15
Builder's risk	4
Business interruption	21
Commercial property insurance	36
Completed operations liability	14
Comprehensive general liability	45
Contractors liability	14
Environmental liability	12
Health/life insurance	39
Product liability	5
Professional liability	19
Service interruption	21
Workers' compensation	35
Insurance coverage—personal lines	
Health/life insurance	35
Homeowners insurance	26

[a] The numbers in this column refer to unique technologies and cover all technologies in Table 4 of Vine et al. (1998).
[b] The environmental benefits of improving the outdoor air quality and reducing greenhouse gases are cross-cutting and thus are not included in this table.

and life/health). Within the property/casualty branch are many specialized types of insurance, such as property damage, mechanical equipment breakdown, professional liability, builders risk, and business interruption. Energy strategies must be carefully mapped to the relevant insurance lines, as various types of insurers have very different technical and market priorities.

While the primary focus of this article is on insurers and risk managers, related industries can also play important roles. Beyond primary insurance is the market of reinsurance (insurance-type contracts through which the primary, front-line insurers 'reinsure' themselves against extraordinary losses), as well as allied groups such as brokerages, agents, risk managers, self-insurers, and trade organizations.

In addition to firms formally active in the insurance and risk management arenas, are other potential industry partners in new initiatives for promoting new energy technologies on the basis of loss prevention. These include energy utilities, product manufacturers, non-governmental organizations, consumer-interest organizations, and government.

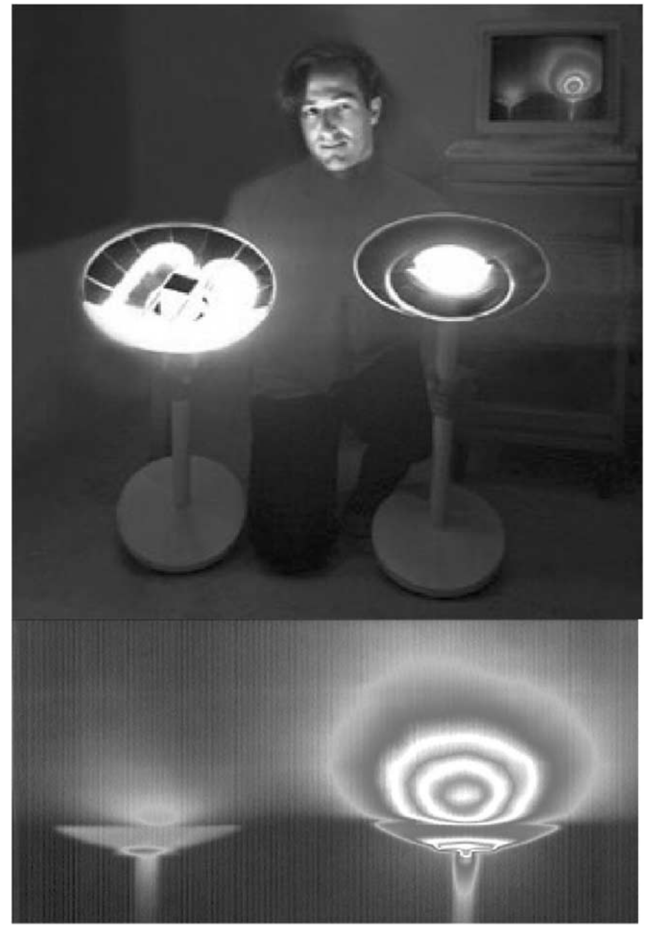

Fig. 1. Efficient replacements for halogen floor lamps. The so-called "halogen torchiere" (right) has become the fastest selling light fixture in the US. The fixture's ultra-hot bulb (operating at approximately 1000°F (500 C)) has been the cause of hundreds of documented fires, plus associated loss of life and injuries. Compact fluorescent replacements for these bulbs (left) have shown to eliminate the fire hazard while reducing energy operating costs by 80% and maintaining light output and quality. The lower panel shows the comparative heat output of the two systems, using a thermograph.

2. Case studies

We reviewed proactive steps taken by 53 forward-looking insurers and reinsurers, 5 brokers, and 7 insurance organizations, and 13 non-insurance organizations in the energy-efficiency and renewable energy arenas. These case studies demonstrate the largely untapped value of energy efficiency and renewable energy to the insurance and risk management communities. We group the approaches into the categories of: information, education, and demonstration; financial incentives; specialized policies and insurance products;

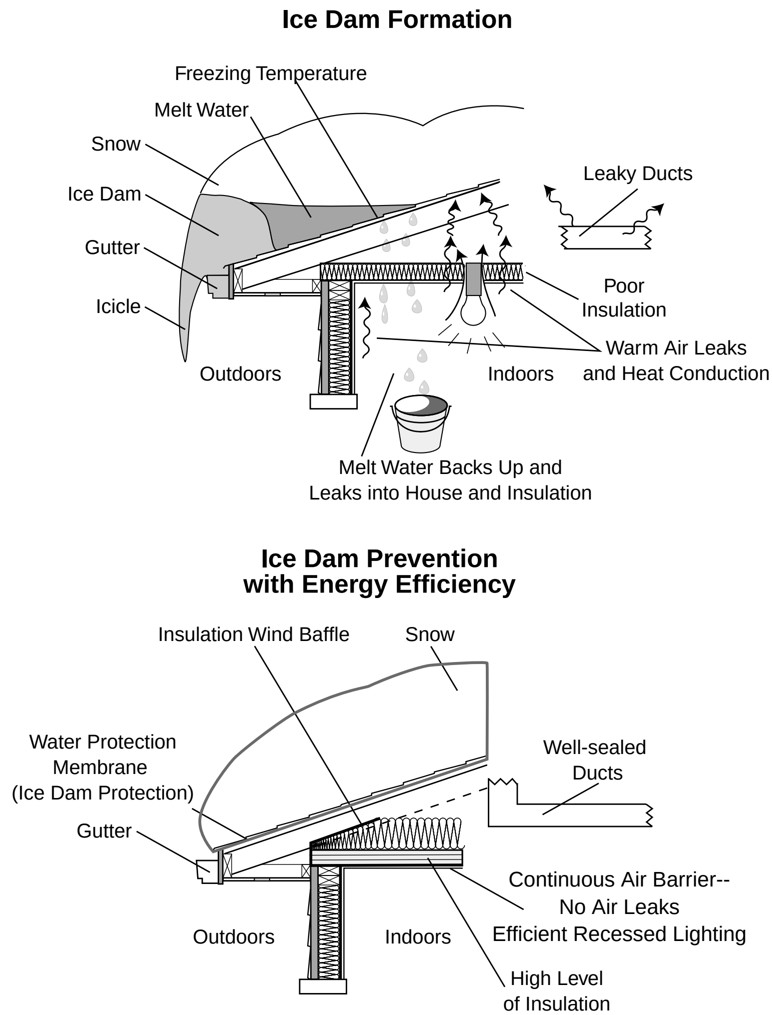

Fig. 2. Reduced heat losses through roofs. Repeated melting and re-freezing of snow can form icicles and ice dams on roof eaves. Melting water tends to pond on the rooftop, behind the ice dam, often causing insured damage to the roof and the building interior. Water runoff or falling ice from rooftops can also present safety hazards. Ice dam formation is accelerated by preventable exfiltration of warm air, insufficient insulation levels, recessed light fixtures with inefficient lamps that generate waste heat, or leaky heating ducts in otherwise cool attics. Electric heating elements often installed along rooflines are intended to provide a drainage channel for the water, but they are unreliable and create substantial added energy costs.

direct investment; customer services and inspections; codes, standards, and policies; research and development; in-house energy management; and an emerging concept informally known as "carbon insurance" (Table 3). While most companies have made only a modest effort to position themselves in the "green" marketplace, a few have comprehensive environmental programs that include energy efficiency and renewable energy activities (e.g., Storebrand, 1998; Swiss Re, 1998).

2.1. Information, education, and demonstration

Insurers' well-established channels of communication with most property and business owners present a unique opportunity to disseminate information about risk management.

The USAA Insurance Company, for example, published a detailed and extensive guide to energy conservation for homeowners, providing basic information on energy saving measures, a simple home energy audit procedure, and a tool for computing cost-effectiveness (USAA, 1992). A more general USAA publication on home remodeling also includes energy savings advice (USAA, 1996).[1]

FM Global Insurance Company has aggressively promoted the risk-prevention benefits of compact fluorescent torchiere light fixtures, which replace high-temperature halogen versions known to be associated with hundreds of structural fires across the United States (Avery et al., 1998). The activity involved a

[1] See also http://www.usaaedfoundation.org/ef_home_building_techniques.asp.

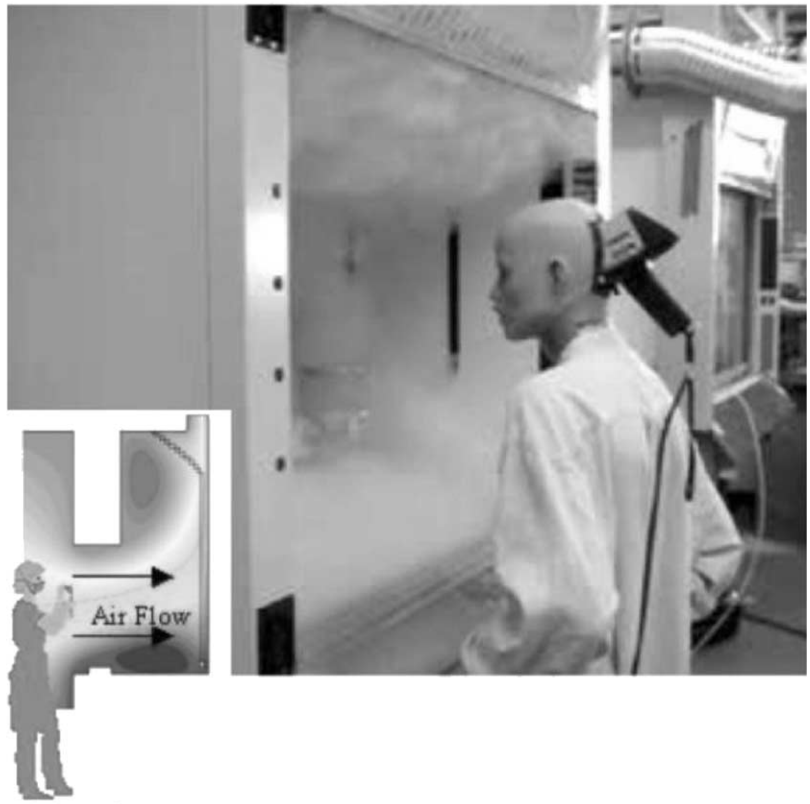

Fig. 3. High-performance laboratory fume hoods. In a conventional laboratory fume hood, air is drawn past the worker and exhausted through the top of the hood. Workers and experimental apparatus can interfere with airflows and thereby cause dangerous eddies and vortices (red and blue circular areas in the inset) with potential for fume spillage and hazards to workers. The Berkeley Hood (shown in photo) instead utilizes a curtain of air introduced from above and below the hood opening in front of the worker, with up to 70% reductions in airflow (and corresponding energy savings) and improved worker safety as a result (Bell et al., 2001).

technology demonstration in student housing at Northeastern University, a follow-up training workshop for university risk managers in the region, and several publications distributed to their customers nationally. In a prime example of cross marketing between government and insurance activities, FM Global included prominent mention of the ENERGY STAR labeling program for efficient (and fire-safe) torchiere fixtures, operated by the US Environmental Protection Agency and the US Department of Energy.

In a few instances, energy utilities have collaborated with insurers. Boston Edison participated in the torchiere project, and the Pacific Gas and Electric Company has created an umbrella under which efficiency-related collaborations with insurers can take place.[2]

Insurers and insurance associations have also participated in a number of workshops and other venues for energy education. A workshop co-organized by the National Renewable Energy Laboratory and the National Association for Independent Insurers (NAII) focused on the disaster preparedness and recovery characteristics of grid-independent photovoltaic power systems (Kats, 1998).

The United Nations Environment Program hosts an international Insurance Industry Initiative for the Environment, which has approximately 80 member companies from 25 countries. Information on energy efficiency and renewable energy has on occasion been circulated among the participants.

2.2. Financial incentives

Today's highly competitive, "soft" and "commoditized" insurance market makes it difficult for insurers to grant premium reductions as an incentive for customers that implement risk management programs. There are, however, some notable exceptions.

In the earliest instance of an insurer financial incentive we are aware of, the Hanover Insurance Company (c.1980), Worcester, MA) gave a 10% credit on

[2] See http://www.pge.com/customer_services/business/energy/insur_alliance.html.

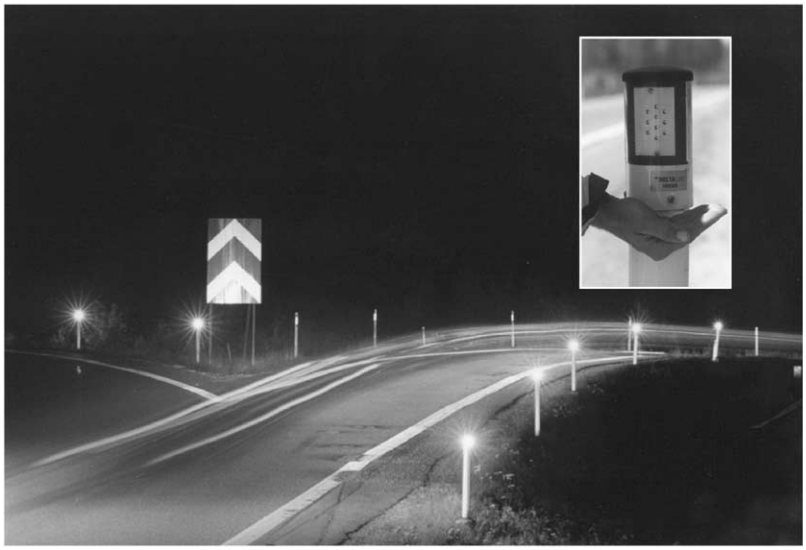

Fig. 4. Light-emitting diode lighting (LEDs). Emerging applications for LEDs promise significant energy savings. They are already widely used in red and green roadway signal lighting and Exit signs. Transportation officials cite safety benefits due to improved visibility and reliability (far longer service life and lower maintenance costs than traditional lamps) (Said, 2001; Prey, 2001). Moreover, they can be economically powered by photovoltaics with backup batteries, to ensure availability during periods of power outages. White LEDs are also beginning to be used for way-lighting, promising significantly reduced energy use and improved safety (Borg, 2001). The photo shows tests underway on Swedish roadway (Orreberget) known for high accident rates. Each pole requires only 3 W of power, which corresponds to lighting energy demand reduction of up to 90% compared to standard lighting systems. In preliminary evaluations drivers have reacted positively. Tests currently underway or planned in Sweden cover 17 miles or roadway, and approximately 800 poles. The inset shows an individual pole head using 10 LEDs (current systems require only 4 LEDs).

homeowner property insurance premiums in six states to solar, underground, and energy-efficient homes, with the justification that the heating systems had fewer running hours, resulting in a reduced fire hazard (Gordes, 2000).

Insurers can also promote strategic education programs for their customers—coupled with financial incentives—be they building owners or building professionals (Mills and Knoepfel, 1997). Some insurers in Massachusetts have offered 10% discounts to people who take a free 6 h course in weatherization, home repair and other subjects.

A fuel cell vendor (Sure Power) has bundled a high-reliability fuel cell system with business interruption insurance underwritten by American International Group (AIG), one of the world's largest insurers. The system was installed on a data center of the First National Bank of Omaha, Nebraska—the country's largest independent bank and seventh largest credit card processor.

Another notable example, pertaining to professional liability insurance for building professionals, is a one-time credit of 10% offered to architects and engineers who receive training in building commissioning. The credit applies to the Professional Liability policies for architects and engineers, and reflects research done by the insurance company (DPIC, an affiliate of the Orion Group) into the role that building commissioning can play in pre-empting physical problems—often related to HVAC systems—that are known to lead to insurance claims (Brady, 1998; Brady and Dasher, 1998).

A variety of financial incentives have also been provided for strategies that improve energy efficiency and reduce risk in the transport sector. The most widely noted of which is "Pay-at-the-Pump" insurance, in which insurance is included in the price of gasoline, thereby rewarding fuel economy and/or reduced driving (McCracken, 1998). This approach has had a mixed reception within the insurance industry, however (AIA, 1995; GAO, 1991; Beattie, 2002). European insurers have awarded credits on personal automobile policies for customers verifying their use of public transportation systems. In Germany, premiums are up to 50% lower for smaller cars driven shorter distances (Zwirner, 2000). Rheinland Versicherungen offers premiums that are proportional to miles driven (Berz and Loster, 2000). The American Insurance Association has also generally supported mass transportation as a means for improving energy efficiency and highway safety (AIA, 1999). In perhaps the most innovative effort to date, through a pilot program offered in Texas by the Progressive Auto Insurance company, drivers are being charged based on actual mileage driven, time of day, and geographic location. With support from the US Department of Transportation's Federal Highway Administration, the Insurance Institute for Highway Safety, and Environmental Defense, Progressive is using global positioning

Table 3
Insurance-related activities involving energy efficiency and renewable energy

Organization	Country	Information, Education, & Demonstration	Financial Incentives	Specialized Policies & Products	Direct Investment	Customer Services & Inspections	Codes, Standards, & Policies	Research & Development	In-House Energy Management	Carbon Insurance
INSURANCE & REINSURANCE COMPANIES										
American International Group (AIG)	US		•	•						
American Modern Insurance Group	US	•								
Aon Risk Services	US			•						•
Bankers Insurance Group	US								•	
Blue Cross & Blue Shield Mutual of Ohio	US								•	
Boiler Inspection & Insurance Company	CA			•						
CGNU (formerly General Accident)	UK								•	
Chubb	US			•		•		•		
Connecticut Mutual Life Insurance Home Office	US								•	
Continental Insurance	US								•	
Delta Lloyd Verzekeringsgroup NV	NL								•	
Developers Professional Insurance Company (DPIC)	US		•							
Employers Re	US			•						
First Treasury	CA			•						
FM Global (formerly Arkwright Mutual)	US	•							•	
Gerling	UK				•					•
Grange Mutual	US									
Guy Carpenter and Company	US								•	
Hanover	US		•							
Harleysville Mutual Insurance Company	US								•	
Hartford Steam Boiler (HSB/IPT & Canadian Subsidiary)	US			•		•			•	
Independent Insurance	UK								•	
ITT Hartford Group, Incorporated	US								•	
Johnson & Higgins	US								•	
Lloyds of London (NatureSave Insurance)	UK	•			•	•				
Milwaukee Insurance	US								•	
Minnesota Mutual Life Insurance Company	US								•	
Munich Re	D	•								
Nationwide Mutual Insurance Company, Inc.	US								•	
New York Life Insurance & Annuity Corp.	US								•	
North American Capacity Insurance Co. (owned by Swiss Re)	US			•						
Pennsylvania Blue Shield	US								•	
Phoenix Home Life Mutual Insurance Co.	US								•	
Progressive Auto Insurance	US		•					•		
Provident Life & Accident Insurance Co.	US								•	
Prudential Assurance	UK								•	
Prudential Insurance Company of America, Inc.	US								•	
Reinland Versicherungen	D		•							
Royal Maccabees Life Insurance Company	US								•	
Safeco	US			•						
St. Paul Fire and Marine Insurance	US								•	
Sorema Re	CA			•						
State Compensation Insurance Fund	US								•	
State Farm	US							•		
State Farm Mutual Automobile Ins Co	US								•	
Storebrand	N				•	•				•
Swiss Re	CH				•				•	•
Trygg-Hansa	S				•					•
USAA	US	•							•	
USF&G was (merged w/by St.Paul's Co.)	US				•				•	
Victoria/Ergo	D				•					•
Westbend Mutual	US							•		
Zurich American Insurance Group / Steadfast	US			•						
INSURANCE BROKERS & AGENTS										
AON	US			•						
Clair Odell Group	US			•		•				
Morris & Mackenzie	CA			•						
NRG Savings Assurance	US			•						
Willis Corroon/Willis Canada	US/CA			•		•				
INSURANCE ORGANIZATIONS										
Advocates for Highway and Auto Safety	US	•					•			
American Insurance Association (AIA)	US	•								
Institute for Business and Home Safety (IBHS)	US	•					•	•		
Institute for Catastrophic Loss Reduction	CA	•					•			
Insurance Institute for Highway Safety (IIHS)	US	•					•			
National Association of Independent Insurers	US	•								
United Nations Environment Programme Insurance Initiative	Int'l	•								
OTHERS										
Boston Edison Company	US	•								
Building Air Quality Alliance (BAQA)	US					•				
Building Code Assistance Project (BCAP)	US									
Environmental Defense	US									
Federal Highway Administration (FHA)	US									
International Energy Agency	Multi-	•					•		•	
Iowa Department of Natural Resources	US									
Pacific Gas & Electric Company	US						•			
Roofing Industry Committee on Wind Issues (RICOWI),	US						•	•		
U.S. Department of Energy, Denver Support Office	US	•						•		
U.S. Department of Transportation	US						•			
U.S. Environmental Protection Agency	US	•							•	
Waterhealth International	US							•		

Table 4
Selected insurance companies offering Energy savings insurance

Insurance companies
AIG (US)
Hartford Steam Boiler (US) and affiliate Boiler Inspection & Insurance (Canada). Both firms now owned by AIG
CGU (UK, Canadian Subsidiary)
Chubb (US)
Employers Re (US)
Lloyds of London (UK)
New Hampshire Insurance Co. (US subsidiary of AIG)
North America capacity Insurance Co. (US, owned by Swiss Re)
Safeco Insurance Company of America (US)—surety bond
Sorema Re (Canada—Now owned by Scor Reinsurance; reinsures BI&IQ̃ policies)
US Fidelity and Guarantee Co. (US)—surety bonds
Zurich American/Steadfast Insurance Co. (US)
Agents/Brokers
Aon Risk Services (US)—broker
Morris & Mackenzie (Canada, broker)
NRG Savings Assurance (US—sole agent representing NACICo)
Willis Canada (Broker—US headquarters)

technology to track customer's actual driving habits and adjusting monthly insurance bills accordingly. Preliminary evidence indicates that the participants in the program are driving less. The US Environmental Protection Agency (EPA) will work cooperatively with the other partners to study the reduction in auto emissions, if any, from participating in the innovative insurance plan.[3]

2.3. Specialized policies and insurance products

Another strategy available to insurers is to design new types of insurance policies and products that promote risk-reducing sustainable energy technologies and strategies. Central to the success of such policies are robust measurement and verification procedures and methods to model and quantify the uncertainties. Insurers have begun to interface with the US Department of Energy's International Performance Measurement and Verification Protocol (IPMVP) (Kats et al., 1999).

As an example, we have identified 12 past and present providers of specialized insurance policies for third-party energy service companies that implement energy efficiency technologies (Table 4). The policies protect the installer or building owner against under-achievement of contracted energy savings targets, and thus help reduce business risks for the emerging energy service industry. These insurers thus have an incentive to promote quality assurance and post-retrofit savings monitoring and verification. We have identified a $1 billion/year market potential for Energy Savings Insurance in the US (Mills, 2001b).

The weak link in this emerging market is the lack of actuarially sound methods of quantifying the uncertainties and targeting measurement efforts. Reduced uncertainty would translate to lower ESI premiums, and lower costs of financing. Associating projected financial returns with risks would also motivate financial decision makers to take energy efficiency more seriously as an investment avenue. The current crises in corporate accounting practices and within the ESCO industry lends additional primacy to this issue.

A company within the Lloyds of London syndicate has launched a new "Naturesave" commercial property policy, emphasizing that sustainable development and responsible risk management can go hand in hand. Insureds receive specialized surveys (known as Environmental Performance Reviews). The company offers a household property policy, and directs 10% of premiums to environmental projects.

Other innovative examples involve new products or services to help address indoor air quality problems, an issue integrally related to energy performance. Indoor air quality is a significant emerging issue within the insurance industry (McGowan, 1996; Diamond, 1999; Ceniceros, 2001), as evidenced by a flurry of insurance press coverage including cover stories in two of the industry's leading trade journals (Goch, 2001a; Deering, 2001). The issue is affecting residential and commercial customers alike. While most such claims are settled out of court, six past US examples that we have identified resulted in payouts totaling $100 million (Chen and Vine, 1998, 1999; Goch, 2001a).

Mold-related problems are the leading concern at present, with construction defect suits and litigation among the fastest growing areas of tort litigation in the US—with nearly $130 million in paid claims anticipated for Texas alone in 2001 (Deering, 2001). The co-chair of a National Association of Independent Insurers (NAII) task force on the issue said that mold could be the next

[3] See http://www.epa.gov/projectxl/progressive/index.htm.

"asbestos" in terms of litigation and insurance losses; as many as 10,000 cases may already be in litigation across the US (Deering, 2001). In the UK over the past 10 years, tenant groups have brought lawsuits against large municipal landlords for property damage and health effects caused by inefficient, damp dwellings. This has stimulated a significant amount of energy efficiency retrofit work.

Following are three prominent examples of proactive responses to indoor air quality concerns by insurers:

- The Building Air Quality Alliance (BAQA) developed a "due diligence IAQ screen" to help building managers reduce their potential liability by completing a checklist to ensure that a building has good indoor air quality practices. BAQA has developed an IAQ risk assessment protocol and an IAQ insurance policy for building owners with the Clair Odell Group, an insurance brokerage firm, and an insurance provider.
- Environmental Resource Process Management (Atlanta) and an unnamed insurance underwriter are working together to develop a way of assessing IAQ risks in buildings, and to offer a form of liability coverage that would pay for correcting the IAQ problem.
- Willis Corroon, a major insurance broker, is also developing a new type of IAQ policy for property owners, managers, and developers. The product will bundle insurance with audits and guidelines on design, construction, and maintenance practices that minimize the risk of IAQ problems. Coverage will include payments for the correction of problems and loss of use.

2.4. Direct investment

Insurers are among the more significant players in world financial markets, and these involvements often touch on the energy sector. As an illustration, insurers were responsible for about 15% of all contributions to US money and capital markets in 1996 (American Council of Life Insurance, 1997).

A few insurers have demonstrated an interest in venture capital investment in sustainable energy technologies (Deering and Thornton, 2000). Swiss Re, for example, invested in a US-based solar photovoltaic company that is developing new manufacturing techniques (Business Wire, 2000). Gerling—a UK-based insurer—has founded the Gerling Sustainable Development Project (GSDP), through which they have established the $100M Sustainability Investment Partners (SIP) to provide venture capital, carbon offset financial products (e.g. under the Clean Development Mechanism or Emissions Trading schemes), and carbon-target insurance. Norway's Storebrand, Swiss Re, and Victoria/Ergo of Germany have partnered with Gerling on the SIP initiative (Kohler, 1999).

The Storebrand Principle Global Fund (formerly known as the Storebrand-Scudder Environmental Value) is an early example of environmental investing, to which insurance companies (Swiss Re, Gerling, Trygg-Hansa) and other investors had already contributed $133 million as of 1999. Energy efficiency is one of the criteria used to evaluate securities as they are considered for inclusion in this fund.

In the renewable energy project finance market, US life insurance companies were the number-one lender for independent power projects during the 1980s (Selman, 1999).

2.5. Customer services and inspections

The risk-management benefits of sustainable energy strategies suggest possibilities for entirely new profit centers within insurance firms, or their subsidiaries.

Chubb Insurance Company has avoided claims thanks to the use of infrared cameras in detecting electrical and other risks. Some of the risks identified also correlate with energy inefficiencies, e.g., refrigerant leakage, water damage to roofs, eroded insulation in steel-making furnaces, and ruptured underground district heating lines. Munich Re has recommended the use of IR cameras as a loss-prevention tool, citing the prompt detection of broken hot water pipes as an example of how to minimize water damage losses and save energy. IR sensing technology is also widely used in identifying heat losses in building envelopes.

Hartford Steam Boiler has been a leader in mechanical equipment inspections, as evidenced by its eye-opening IR analysis of electrical and other fire hazards in 200 New York City buildings, and more recently through a subsidiary that provides energy management services along with a broader constellation of facilities management assistance. Infrared inspections might also prove useful in other areas, such as identifying heat losses (and associated energy waste) in roofs that invite costly ice dam formation or poorly insulated pipes exposed to freeze damage.

Norway's Storebrand has conducted customer-focused activities in which they provide building inspections (commercial and residential) and provide advice on improving indoor air quality and energy efficiency.

2.6. Codes, standards, and policies

Insurers have long been involved in the development and support of building standards integral to the disaster-resilience of the properties they insure. To the extent that energy-efficient technologies can offer risk management benefits (e.g., reduction of ice damming risks or elimination of pilot lights), insurers could expand their involvement to include the energy dimension of building and appliance codes and standards.

While the insurance industry's Institute for Business and Home Safety (IBHS) and the Canadian Institute for Catastrophic Loss Reduction (ICLR)—both insurance-based organizations—have endorsed the improved enforcement of building energy codes (Lecomte et al., 1998), there are as yet few if any examples of individual insurer involvement in the energy code arena. The endorsement by IBHS and ICLR was made in a report published in the aftermath of the great North American ice storm of 1998 in which energy-related service disruptions resulted in considerable insurance costs (Lecomte et al., 1998). The authors encouraged the systemic promotion of energy-efficient and renewable technologies as an element of a new insurance paradigm based on "sustainable development" and the prevention of losses following disasters.

Opportunities also exist in the transport sector. An active state and federal lobbyist for highway safety is the Advocates for Highway and Auto Safety (1999). *Advocates'* members include most major auto insurance, health insurance, and public health and safety organizations. An interesting policy position of *Advocates* relevant to energy use is that they support federal controls on speed limits and increased funding for public transport. *Advocates* supports public transport to reduce air pollution and accidents due to road congestion (Advocates 1999). In Congressional testimony, the assistant general counsel for the American Insurance Association (AIA) and spokesperson for *Advocates*, David Snyder, made a special point of the importance of reducing highway speed limits and improving public transport to combat perhaps the leading cause of accidents, aggressive driving. Snyder cited reports that over half of all accidents are due to aggressive driving such as speeding, tailgating, red light running, passing on the shoulder, unnecessary flashing of headlights, etc. Snyder attributed aggressive driving to higher speed limits and increased congestion. AIA also advocated reduced speed limits as a means of reducing energy use and enhancing highway safety in a policy paper on climate change (AIA, 1999). In early 2002, the Insurance Institute for Highway Safety became the first insurance organization to support the stalled Corporate Average Fuel Economy (CAFE) standards, citing new techniques to improve fuel economy without compromising safety through reduced vehicle weight (Beattie, 2002).

2.7. Research and development

We have previously discussed the role that insurers can play in energy R&D (Mills and Knoepfel, 1997). Insurance-related technical organizations such as the Factory Mutual Research Corporation and Underwriters Laboratory evidence insurers' historic role in technology assessment and R&D. However, with a few modest exceptions, the resources of these organizations have yet to be focused squarely on the opportunities for innovation in the intersection of energy and risk management.

One example of such a partnership is a Cooperative Research and Development Agreement (CRADA) between various elements of the US insurance and roofing industries and the US Department of Energy's Oak Ridge National Laboratory. The private partner is the Roofing Industry Committee on Wind Issues (RICOWI), which includes all major roofing trade associations in North America and various insurance partners (the Institute for Business and Home Safety, State Farm, and Chubb) (Vine et al., 1998). One aim of this cost-shared project is to analyze mechanisms of roof failure during severe windstorms and to identify specific ways in which energy-efficiency detailing can also enhance roof structural integrity in the face of such storms.

IBHS, focusing on natural disaster preparedness and recovery, partnered with the US Department of Energy in developing and deploying an extremely low-energy ultraviolet water disinfection system. The design is based on UV Waterworks, which utilizes small ultraviolet lamps to disinfect the water (Gadgil and Shown, 1995). The device will be manufactured by WaterHealth International, and can be operated with solar photovoltaic cells when grid-based power is unavailable. IBHS has also explored topics such as frozen water pipes and rooftop ice damming, for which, as previously noted, some risk management solutions also yield energy savings.

2.8. In-house energy management

The insurance industry (especially the life insurance segment) is one of the world's most significant owners of real estate. Our survey of ten largest insurance companies globally identified assets in real estate (buildings, land, movables) amounting to $US 105 billion (Mills and Knoepfel, 1997). The exact figure for the floor area of these buildings is not known, but we estimate it at about one billion square feet (10^8 square meters), corresponding to an annual energy expenditure of $US1.6 billion. Many insurers operate in-house energy management programs, with varying degrees of effort.

Given the importance of computer-related tasks in insurance operations, the potentially beneficial impact of energy-efficient technologies on worker productivity can be of particular importance. In a carefully controlled research study, West Bend Mutual Insurance Company reported a 7% increase in productivity (numbers of files processed pertaining to applications, endorsements, renewals, and quotes) following the

Fig. 5. Using Photovoltaics for Disaster Recovery. One example of using PV systems in disaster recovery operations involves Direct Global Power's Reconstructive Solar Technology and Relief Taskforce (RESTART), which deploys solar-powered sources for use in disaster-stricken areas. The system shown in the photo was leased for demonstration purposes by American Modern Insurance Group to process claims in disaster areas without power (Gordes, 2000).

implementation of a variety of energy- and non-energy related worker environment improvement measures (Kroner et al., 1992). Energy savings were 38% and were statistically associated with one-third of the total productivity gain.

One particular concern for insurers is the ability to process claims following natural disasters. One company—American Modern Insurance Group—is testing a mobile office system (Fig. 5) powered with photovoltaic panels in order to process post-disaster claims in areas without power (Gordes, 2000).

As large real estate owners, insurers also tend to purchase enormous volumes of energy-using equipment. Several European insurance companies (Delta Lloyd Verzekeringsgroup NV, CGNU, Independent Assurance, and Prudential Assurance) are collaborating with the International Energy Agency to harness the purchasing power of large building owners to create new markets for energy-efficient photocopiers.

Lastly, US insurers are beginning to look at the benefits of participating in the government's voluntary energy savings programs, such as Rebuild America and ENERGY STAR. Thanks to energy management efforts at its headquarters, the Hartford Steam Boiler Inspection and Insurance Company is the first insurer to receive the ENERGY STAR building label (Fig. 6).[4] Twenty-two other insurers have participated in the ENERGY STAR Buildings or Green Lights Programs. Given the scale of insurer real estate ownership, the industry has an unparalleled opportunity to display leadership by example in the field of energy management.

[4] See http://www.epa.gov/buildings/label/html/190.html.

2.9. Carbon insurance

Several insurance companies have recognized or otherwise explored the potential for new products related to the performance of energy efficient and renewable energy projects implemented under the so-called Joint Implementation (JI), Clean Development Mechanism (CDM), and Emissions Trading systems, all of which are methods of implementing carbon-emission reductions under the Kyoto Protocol to the UN Framework Convention on Climate Change (Zwirner, 2000; Swiss Re, 2000).

Storebrand—Norway's largest insurer—has proposed an innovative concept for insuring carbon emissions contracts (Willums and Solsbery, 1999). The essence of the concept is for insurers to themselves develop carbon-saving projects and bank the resulting emissions for use in paying claims resulting from under-performance of specific projects or contracts developed by its customers.

One US firm, AON (the world's largest insurance broker) launched AON Carbon—subsequently renamed AON Environmental Solutions—to provide insurance associated with carbon-market risks (AON, 2000; Aldred, 2000).

Insurers note that perceived risks and absence of risk-management strategies increases the cost of capital for greenhouse-gas-reduction projects.

3. Barriers to insurer involvement in sustainable energy

While the preceding case studies show that there is a remarkable level of activity among insurers, there remain various barriers to significantly expanding the level of participation by insurers and risk managers.

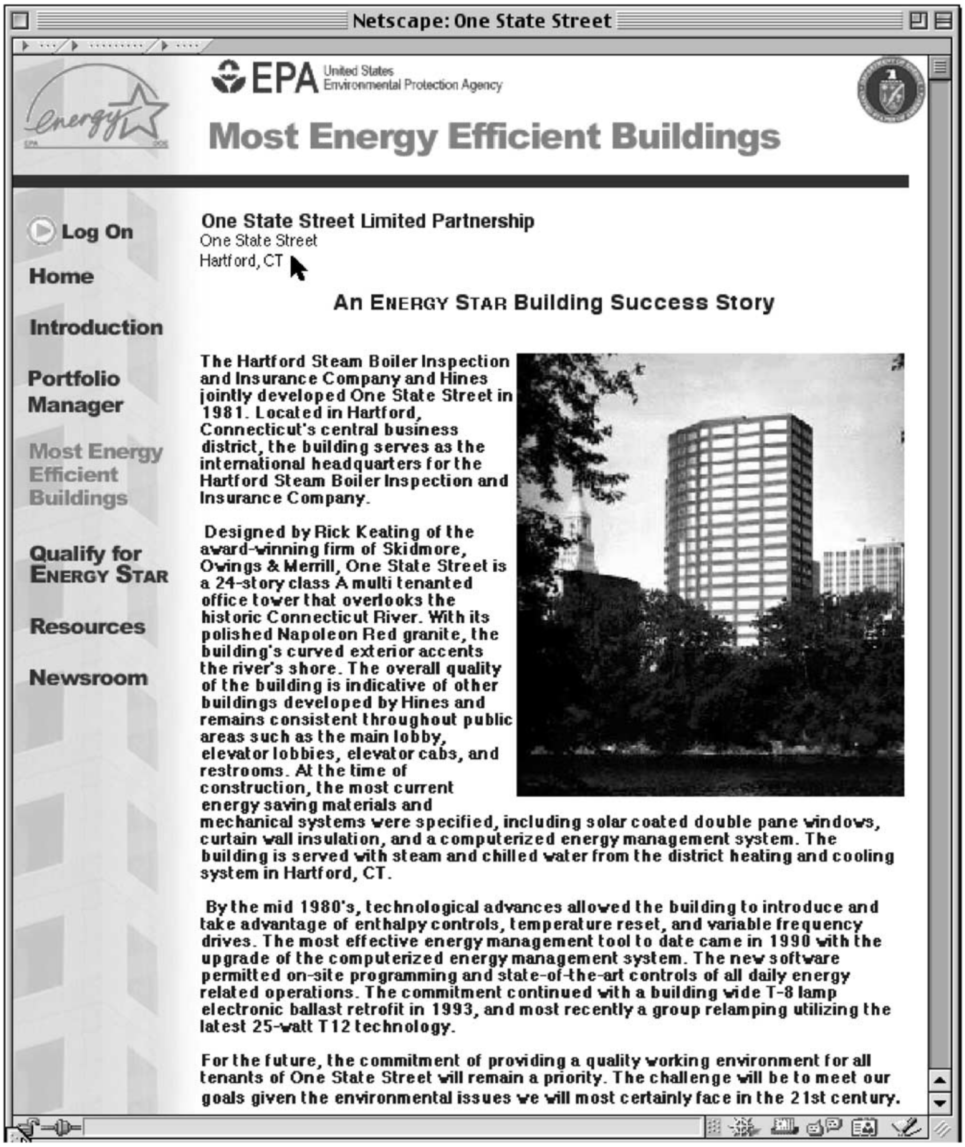

Fig. 6. Insurers Apply ENERGY STAR Label to their own Buildings. Headquarters of Hartford Steam Boiler Inspection and Insurance Company was among the first recipients of the ENERGY STAR commercial buildings label.

These barriers are summarized in Table 5 and described in more detail below.

3.1. Technical issues

While there is a growing literature and documentation of the risk management benefits of energy-efficient and renewable energy technologies, there remains a need for more specific quantitative information. In some cases, actuarial-quality statistical analyses may be required; in other cases, engineering-type documentation of the benefits may suffice. This need was corroborated by a group of insurers interviewed by the Iowa Department of Natural Resources (IDNR, 2000).

Surprisingly, insurers are rarely involved in technology R&D. Although there are some notable exceptions, most insurance research is focused on the financial and market issues.

Another significant barrier is that energy-efficient technologies can at times work at cross purposes to the goals of risk management (Mills and Knoepfel, 1997; Vine et al., 1998). Although the use of sustainable energy technologies and strategies generally reduces insurance risks—or is risk-neutral—if applied incorrectly energy management can compromise indoor air quality, cause water damage, pose fire hazards, etc. Various entities within the insurance community have made reference to such problems. Even very pro-sustainability European insurers Gerling and Rheinland Versicherungen and have been careful to flag potential downsides (Kohler, 1999; Zwirner, 2000). Perhaps the most widespread instance is the negative association

Table 5
Barriers to increased insurer involvement in energy sustainable energy markets

Technical issues
Lack of quantitative documentation of benefits and uncertainties
Insurer involvement in technology and R&D is limited in many cases
Solated adverse side-effects of improperly applied energy-efficient technologies
Nature of the insurance industry & marketplace
Fragmentation—many types of insurers, each with different needs
Difficult history with environmental issues, exemplified by Superfund litigation
Regulatory hurdles to innovation, rate changes, etc.
Energy/environment community perceptions of insurers
Perception of insurers as a "cash cow" with unbounded financial resources
Poor understanding of how the insurance business works
Assumption that insurers will instinctively promote sustainable energy to battle climate change
Insurer perceptions of energy/environment community
Adversarial history between environmentalists and industry
Perception that sustainable energy is being used as "Trojan horse" by climate change advocates

between indoor air quality problems and energy efficiency in buildings (Frazer, 1998; Diamond, 1999). As a case-in-point, over $100 million has been paid out for water damages caused by externally applied foam insulation retrofits (Deering, 2001), and mold has become a crisis that insurers say may be as great as the one posed by asbestos. More energy-efficient, gas cooking can contribute to indoor air pollution (Jarvis et al., 1996). Downsides have also been noted in the transport sector, e.g., Mooney (1998) raised concerns about safety problems from lightweight, efficient vehicles, although this has been largely dismissed (GAO, 1991; Beattie, 2002). The American Insurance Association, while supportive of certain efficiency options, has also stated that certain measures could present adverse risk characteristics (AIA, 1999). The US insurance industry's premiere trade journal featured a story about the uncertain safety aspects of gas-electric hybrid cars (Goch, 2001b). These problems are generally resolvable, but energy R&D organizations (public as well as private) are driven largely if not exclusively by relatively narrow energy-related objectives and do not necessarily consider risk management issues. It is also prudent for energy-efficiency enthusiasts to be thoughtful about the impacts of their proposals on the insurance sector's business environment. As mentioned above, "Pay-at-the-pump" automobile insurance was promoted heavily in the name of energy savings and combating the uninsured driver problem, but was perceived as a very unattractive business proposition by some in the insurance community (Sommer et al., 1995; AIA, 1995).

3.2. Nature of insurance industry and marketplace

The insurance industry is highly competitive and there are numerous disincentives to assume the risks associated with new products and concepts. Fragmentation among the types of insurers, plus the allied industries of reinsurance, brokerages, agents, and self-insurers can also impede innovation and the diffusion of new business concepts. While many perceive the insurance industry as a monolith, the reality is quite different. In the US alone, there were 3316 property-casualty companies and 1969 life and health companies in operation as of 1996. Added to this are thousands of firms who provide allied services.

Especially in the United States, insurers have had a difficult history with issues pertaining to environment and pollution prevention. Many years of litigation over "Superfund" toxic waste cleanup has translated into billions of dollars in unanticipated costs and headaches for insurers. While the types of energy initiatives outlined in this paper are a far cry from waste cleanup, the association with "environment" can nonetheless dampen insurer enthusiasm.

There are also a variety of regulatory hurdles (Mills, 2002). Insurers must seek approvals for rate changes and investments, including those designed as incentives for energy efficiency or renewables. Diversification into subsidiary industries (such as Energy Services) may also invoke regulatory review. Similarly, in the US, insurer R&D costs cannot ordinarily be placed into the insurance premiums. Meanwhile, the regulatory community is largely unaware of the risk-management benefits of energy-efficient technologies. Insurers interviewed by the Iowa Department of Natural Resources cited difficulties in gaining regulatory approval for premium credits as a key barrier; they also cited concern about being forced by "environmental organizations" to offer credits (IDNR, 2000).

3.3. Energy/environment community perceptions of insurance industry

Another set of barriers are inadvertently created by the energy and environmental community's perception of insurers as a "cash cow" ready to reward efficiency and renewable energy projects with deep premium credits, grants, etc. While the insurance industry has enormous revenues, its ability to allocate monies to new and high-risk ventures outside of the core business is highly limited. Moreover, as mentioned above, the industry has become increasingly competitive, which has translated into premium and profit reductions. The so-called "soft market" conditions of the past two decades—and recent losses from 9/11—have made it particularly difficult to implement new premium credits to promote the use of new technology.

The energy/environmental community also has a poor understanding of the insurance business. This makes it difficult to craft propositions that make real business sense for insurers. Considerable discussion of this is provided by Mills et al. (2001).

There is also a growing perception that insurers will automatically and instinctively promote sustainable energy projects because it will reduce greenhouse gas emissions and thereby lower the risk of weather-related natural disasters. While there are well-documented connections between extreme weather events, global climate change, and insurer vulnerability (Vellinga et al., 2001; Cohen et al., 2001), remaining uncertainties—amplified by exclusive atmospheric science jargon—paralyze most insurers. Moreover, the prospective benefits would manifest well into the future, far ahead of the short financial planning horizon of most insurance interests. In addition, the government sector provides a limited buffer through its flood and crop insurance programs, disaster relief, etc. While the specter of climate change has motivated some far-sighted and proactive insurers to pursue sustainable energy technologies, "Mainstreet" insurers have been slow to assume this perspective (Mills et al., 2001).

3.4. Insurance industry perceptions of energy/environment community

There are also barriers inherent in insurance community perceptions of the energy/environmental community. History has often evidenced an adversarial relationship between non-governmental organizations and insurers, as seen in the cases of Superfund cleanup litigation and asbestos abatement. In the case of energy, it is far more likely that non-governmental organizations would prefer to operate as allies of the insurers, but the historical perception must be recognized and overcome.

Lastly, emphasis on sustainable energy technologies may come to be viewed as a Trojan Horse for politicizing insurers around the climate change issue (Mills et al., 2001). This perception can distract insurers' focus on the direct and meaningful relationship between certain efficiency or renewable energy measures and risk management, such as property protection, or indoor air quality enhancement. One attempt at using climate change to enlist insurers as supporters of energy-efficiency building codes (with no mention of the risk-management dimension of energy efficiency and renewables) revealed considerable puzzlement, disinterest, and distrust on the part of insurers (IDNR, 2000).

4. Conclusions

There is tremendous promise for insurers to become more involved in the energy efficiency and renewable energy marketplaces. Early precedents illustrate the wide array of ways in which insurers have already participated, but barriers also remain.

It is somewhat curious that the European insurance community—which is generally considered to be more advanced in efforts related to global environmental issues—appears to be less active in the practical promotion of energy efficiency and renewable energy. Note that most of the examples in Table 3 are from US-based insurers. The UNEP insurance group—an assembly of the most environmentally aware insurers from around the world—has given only glancing attention to the above-mentioned synergisms offered by energy efficient and renewable energy technologies.

The challenge is to continue to identify and articulate the ways in which energy efficiency and renewable energy can moderate or prevent insurance losses, and to make the business case for how sustainable energy technologies can improve the competitive advantage of insurance and risk management firms. To be successful, sustainable energy technologies must address acute strategic issues faced by these industries. A good example is the rapid growth in indoor air quality claims and construction defects litigation haunting many insurers; many of these claims trace back to bad design and application of energy-related systems. The growing insurance risks associated with electricity reliability are another example, which can be addressed, in part, through efficiency and distributed renewable energy supply solutions.

There is, also, considerable scope for a more diverse set of industry actors (agents, brokers, underwriters, risk managers, trade associations, and executives) to be educated and involved in assessing and implementing the opportunities. While insurance regulators and policy makers have yet to focus on the issues, their participation is very much on the critical path to more broad-based innovation in this area, and their absence from discussions thus far is unfortunate.

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