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Environmental Energy Technologies Division

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DISCLAIMER

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Synopsis

Energy-efficiency improvements offer the insurance industry two areas of opportunity: reducing ordinary claims and avoiding greenhouse-gas emissions that could precipitate natural disaster losses resulting from global climate change. We present three vehicles for taking advantage of this opportunity, including research and development, in-house energy management, and provision of key information to insurance customers and risk managers. The complementary role for renewable energy systems is also introduced.

Abstract

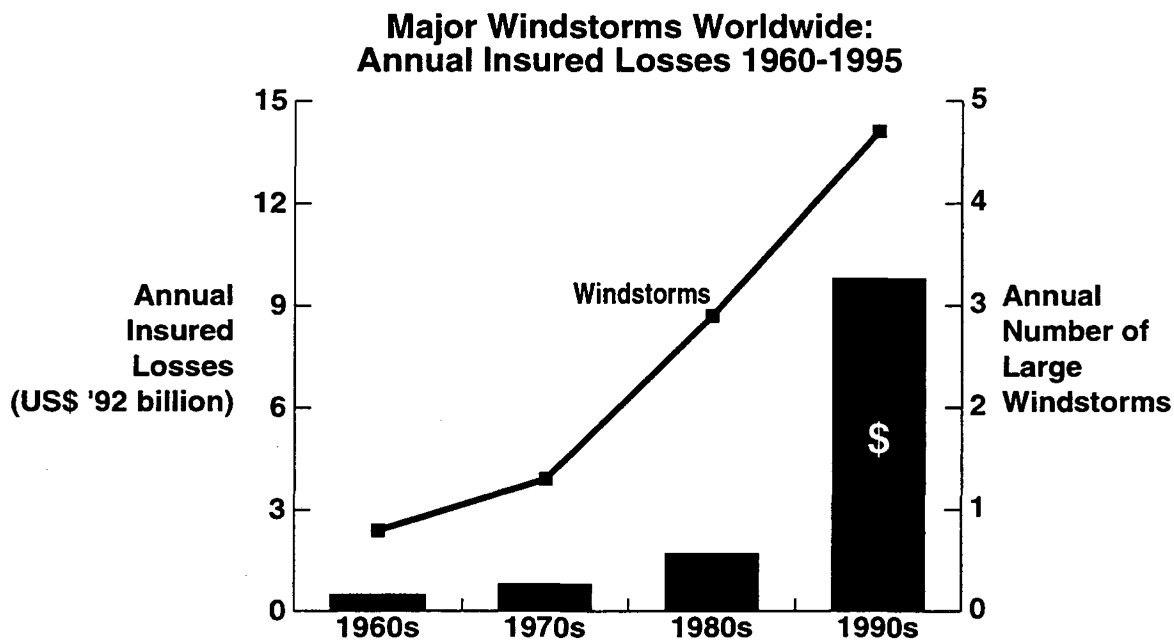
This report argues that the insurance industry should support efforts to identify, improve and implement "no-regrets" energy options that would both reduce near-term business risks caused by insured losses while making a considerable contribution to long-term reductions in greenhouse-gas emissions that also threaten their bottom line. The short-term risk-reducing benefits would have distinct value to insurance companies and their customers irrespective of the timing or extent of future damages related to global climate change.

Our central recommendation is that the international insurance industry initiate a systematic activity to (a) identify technologies that contribute both to traditional loss-prevention and to reducing greenhouse-gas emissions, (b) promote the dissemination of information and the utilization of such technologies in the cases where they have proven to contribute to loss prevention and are commercially available, (c) "lead by example" by implementing in-house energy management programs in their own building stock, and (d) support research, development, and commercialization where promising technologies are not yet available in the marketplace. Once the loss-prevention benefits are sufficiently demonstrated, insurers can promote the use of the corresponding technologies and strategies by introducing risk-adjusted insurance premium schemes.

†This report expands on a version presented at the ECEEE Summer Study, Prague, June 1997

1. Introduction

Natural disasters today represent 85% of large insured catastrophe losses globally, or $12.4 billion in 1995 (Swiss Re 1996). Average annual catastrophe losses have increased considerably in recent years. For example, average annual insured losses from windstorms increased by twenty-fold between the 1960s and 1990s (**Figure 1-1**). Between 1966 and 1987 there were no disasters with insured losses of more than one billion 1990 U.S. dollars, whereas between 1987 and 1992 fifteen have been reported (Leggett 1993, 1994). According to the Reinsurance Association of America, nearly 50% of the insured losses from natural catastrophes during the past 40 years have been incurred since 1990 (Nutter 1994).



YEAR	Storms ($B)	Losses (No.)
scale	right	left
1960s	0.5	0.8
1970s	0.8	1.3
1980s	1.7	2.9
1990s	9.8	4.7

Figure 1-1. *Annual number of large windstorms worldwide and related insured losses. Increasing insurance coverage and concentration of property and populations in areas at risk are major drivers of the increase in windstorm insured losses. Total inflation-corrected losses (insured plus uninsured) have increased 10-fold (from $2 billion/year to $20 billion/year), vs. the 20-fold increase in insured losses shown in the figure (IPCC 1995a). Population growth in at-risk areas (e.g. 40% in the U.S.) does not in and of itself explain the trend. The specific role of climate-change has not been isolated Data for 1990s through 1995.*

The increase in insured losses due to natural disasters is for the most part a result of demographic trends such as the increase of populations in disaster-prone areas and of a growing insurance penetration especially in those regions. However, the world's two-trillion-dollar insurance industry is also concerned about the possibility of a linkage between climate change and the frequency and intensity of catastrophic windstorm, wildfire, hailstorm, mudslide, flooding and drought events (Doornkamp 1990; Kaufmann 1990; Munich Reinsurance Company 1990 and 1994; Swiss Re 1994; Intergovernmental Panel on Climate Change 1995a), since it could considerably accelerate the future increase in insured losses. Insurance companies are also at risk from climate-change impacts on human health (IPCC 1995a,b; Watson 1996).

Since energy consumption is the largest contributor to global greenhouse-gas emissions, promoting energy efficiency and renewable energy is a promising response strategy for the insurance industry (Mills 1996; Mills 1997). In this article we focus on measures in buildings that have the potential of reducing insurance losses involving property, health, health/life, or liability. Research aimed at better integrating energy efficiency with traditional loss-prevention procedures could lead to measures that simultaneously offer insurance benefits and contribute to reducing energy costs. In the buildings sector, efficiency measures of interest may reduce losses from: fire, ice, wind, and water damage; temperature extremes; business interruption; health risks; and equipment performance problems. We then discuss three specific implementation strategies, illustrated with early instances of their application: (1) supporting research, development, and commercialization, (2) spreading information to insurance customers, and (3) "leading by example" in managing insurance industry-owned buildings more efficiently.

2. Climate Change Awareness and Initiatives by the Insurance Industry

During 1993, a series of headlines in major newspapers described a growing concern within the insurance industry. "Storm Loss New Blow to Insurers" proclaimed *The New York Times*; "Global Warming Makes Insurers Sweat" suggested *London's Financial Times*; "As Insurance Costs from Hurricanes Soar, Higher rates Loom" warned *The Wall Street Journal*. The headlines reflected a strong increase in insured losses from extreme weather events and a series of catastrophic events, including the most damaging storm in the history of the insurance industry, Hurricane Andrew, which led to insured losses on the order of $US 17 billion followed by rapidly increasing homeowner premiums and even the withdrawal of some insurers from region (Nelson 1996; Gordes n/d).

Insurers began to publicly voice their concerns about the threat of climate change. Franklin Nutter, President of the Reinsurance Association of America, summed up the industry's concern this way: "The insurance business is first in line to be affected by climate change; it could bankrupt the industry." Swiss Re published a report in 1994 stating that "the phenomenon of climatic change is not some vague threat in the distant future but forms part of a process which has already been going on for millions of years [...] Human intervention in the natural climatic system could accelerate global climatic change to such an extent that society might no longer be able to adapt quickly enough to this development."

While the scientific debates attract considerable attention in the popular media, many insurers take the position that any non-zero chance of climate change is an imperative for some level of action. Eugene Lecomte, President Emeritus of the US-based Institute for Business and Home Safety, IBHS (formerly the Insurance Institute for Property Loss Reduction (IIPLR)), stated that "the scientific uncertainty surrounding climate change...does not relieve [insurers] of their responsibility to continue to protect people and their possessions" (Lecomte 1997).

By the mid-1990s the first insurers started to appear at the international climate negotiations. At the Berlin Climate Summit of April 1995, Munich Re, Swiss Re, Storebrand, Lloyd's of London, and the British Bankers Association sent participants or observers for talks with governments. A seminar for insurers, bankers and financial analysts took place on the eve of the Berlin Summit and led to the first book specifically on this subject (Leggett 1996). The Lloyd's of London delegation produced a report which advocated a stronger involvement by the industry in the intergovernmental negotiation process and concluded: "it is thus probable that the insurance industry is going to have to take some initiatives by itself, or along with the banking industry."

Some insurers have been considerably more reticent and have avoided making any statements. "It's not a good practice to raise people's fears unless you have solid science; otherwise people don't believe you the next time," was the message by Charles L. Kline, president of Centre Cat, a Bermuda based reinsurer. Others have taken a more proactive and precautionary approach.

One of the most prominent expressions of commitment to a precautionary policy in dealing with environmental and climate change risks is the Statement of Environmental Commitment by the Insurance Industry launched at the United Nations in Geneva in November 1995. By the end of 1997, the Statement had been signed by 71 insurance companies from 25 countries (UNEP 1995). These companies represent all major regions of the world: *Africa* (South Africa, Tanzania), *Asia* (Hong Kong, Indonesia, Japan, Singapore, South Korea, Thailand), *Australia and Oceania* (Australia, New Zealand), *Europe* (Austria, Denmark, France, Germany, Italy, Norway, Portugal, Russia, Spain, Sweden, Switzerland, United Kingdom), *North America* (Canada, United States), and *South America* (Argentina)

Indeed, to the insurance industry, the absence of certainty is not synonymous with the absence of risk (Durand 1996). The industry is quite familiar with acting to reduce risks even before full information about them is available; this is the heart of the philosophy of insurance loss-prevention.

The publication of the Second Assessment Report (SAR) of the Intergovernmental Panel on Climate Change (IPCC) in June 1996 was a turning point in the debate on climate change, stating that "the balance of evidence suggests a discernible human influence on global climate." The major sources of risks related to climatic change are described in detail in the report. Human activities, including the burning of fossil fuels, land use change, and agriculture are increasing the atmospheric concentration of greenhouse gases, which tend to warm the atmosphere. The SAR also included a chapter authored by members of the insurance and finance industries (IPCC 1995a).

Human activities, according to the SAR, are projected to alter regional and global climate and climate-related parameters such as temperature, precipitation, soil moisture and sea levels. Additionally, some human communities have become more vulnerable to hazards such as storms, floods and droughts as a result of increasing population density in sensitive areas. Inadequate planning and construction also contribute to higher vulnerability in certain areas. The conclusions of the SAR have led to more active participation of insurance companies in the public debate on climate change. At the second Conference of the Parties of the Climate Convention in Geneva on 9 July 1996, for example, the companies of the UNEP Insurance Industry Initiative presented a position paper which states:

> "The cost of [extreme weather events] could escalate dramatically as a consequence of the increased greenhouse effect due to human activities. The resultant climate change may alter the frequency and/or severity of extreme weather events and/or their regional distribution. The exact influence is not yet known, due to the limitations of today's understanding of the climate system. It is clear, though, that even small shifts of regional climate zones and/or storm patterns carry the potential of increased property damage, exacerbated by inadequate planning and construction in certain areas. [...] The property insurance industry is the financial sector most likely to be directly affected by climate change.[...] Changes in human health (e.g. spreading of diseases) may affect the life assurance and pension industries. Returns on long-term investments and capital projects may be affected by mitigation measures that alter the economics of whole industries."

The position paper also reiterates the group's commitment to take constructive steps to address the problem, calls for substantial reductions in emissions, and stresses that action should not be delayed in the name of attaining full understanding of all mechanisms involved in climate change **(Figure 2-1)**.

Figure 2-1 Excerpts from United Nations Insurance Industry Initiative Statements (UNEP 1995; UNEP 1996).

"We are committed to work together to address key issues such as pollution reduction, the efficient use of resources, and climate change."

"We are convinced that ... it is not possible to quantify anticipated economic and social impacts of climate change fully before taking action. Research is needed to reduce uncertainty but cannot eliminate it entirely."

"We are convinced that ... the most efficient precautionary measure is substantial reduction of greenhouse gas emissions with respect to a "business-as-usual" scenario fo greenhouse gas emissions."

"We insist that ... negotiations for the Framework Convention on Climate Change must achieve early, substantial reductions in greenhouse gas emissions ... the position of the insurance and reinsurance sector [must] be represented when discussing or negotiating possible solutions."

The process of insurance-industry involvement in the climate-change issue is complicated in light of the multifaceted nature of the industry. Potential climate changes will effect different insurance sub-sectors—property, life, health, etc.—quite differently. Moreover, from a public policy standpoint, only a portion of the total societal costs of natural disasters are covered by insurers. As a striking illustration of this, the 30 largest natural disasters between 1970 and 1995 in terms of insured losses involved a combined cost of more than US$80 billion and the loss of 10,000 lives, while the 30 largest in terms of loss of life involved 1.1 million lives and "only" US$6 billion in losses (Swiss Re 1996). In the case of windstorm losses (see Fig 1-1), only about half of the total economic cost of natural disasters globally is insured.

The remainder of this article presents specific and proactive strategies that can be employed by insurance companies wishing to address the climate change issue in ways that also support the day-to-day financial success of their core business.

3. Energy Efficiency as a No-Regrets Insurance Loss-Prevention Strategy

Energy-efficient technologies in many cases offer benefits beyond energy savings (Mills and Rosenfeld 1994). Energy-efficient windows, for example, considerably reduce noise in buildings and improve thermal comfort. Many energy-efficient technologies carry the potential of reducing or preventing insured losses caused by:

- fire
- ice, water, and wind
- theft
- health risks ("bodily injury")
- business-interruption
- professional liability claims

Table 3-1 shows some of the potential beneficial links between energy efficiency and reduced insured losses (Mills 1996). Some of these links are strong and have been demonstrated in practice, others are weaker and still need to be explored. A few examples are highlighted in **Figure 3-1.** Our central point is that the short-term loss-prevention benefits of these energy-efficiency measures would have distinct value to insurers and their customers irrespective of the timing or extent of additional losses related to global climate changes potentially avoided through the reduced use of energy and its associated greenhouse-gas emissions. Hence our use of the term "no-regrets."

Table 3-1. Potential for energy-efficient and renewable energy technologies to prevent insured losses.

	Named Perils & Events							Insured Risks Mitigated		
Loss-Prevention Measure	**Fire & Wind Damage**	**Ice & Water Damage**	**Extreme Temperature Episodes**	**Theft**	**Power Failures**	**Health & Safety (Lighting)**	**Health & Safety (Indoor Air Quality)**	**Ins. Type**	**Ins. Cov.**	**Ins. Line**
Air Jacket for spray booths							√	Liab	WC H	CL
Building commissioning	√	√	√			√	√	PD Liab	WC CGL BR CO CLC BM E&O H	CL
Central heating controls							√	Liab	H	CL
Compact fluorescent lamps						√		Liab	WC PI H	CL PL
Daylighting					√	√		PD	BI H	CL
Demand-controlled ventilation	√				√		√	PD Liab	WC H	CL
Economizer cooling							√	Liab	WC E&O BI	CL
Efficient appliances	√				√		√	PD Liab	HO PL CGL	CL PL
Efficient commercial food refrigeration					√			PD	RI BI	CL
Efficient duct systems	√	√					√	PD Liab	WC E&O HO H	CL PL
Efficient outdoor lighting				√		√		PD Liab	CGL PI	CL PL
Efficient wall and roof framing	√	√	√					PD	HO E&O	CL PL
Efficient windows	√	√		√	√			PD Liab	HO E&O H	CL PL
Electrochromic glazings				√				PD	PD	CL
Electronic lighting ballasts	√					√		PD	CGL WC	CL
Energy management & control systems				√	√		√	PD Liab	CGL BM BI H	
Energy audits & diagnostics						√	√	PD Liab	BM BI CGL H E&O	CL
Extra interior gypsum board	√							PD	HO	PL
Fuel switching from electric to gas cooking	√			√				PD	HO BI CGL	CL PL
Heat-recovery ventilation		√					√	PD Liab	CGL HO H	CL PL

Loss-Prevention Measure	Named Perils & Events							Insured Risks Mitigated		
	Fire & Wind Damage	Ice & Water Damage	Extreme Temperature Episodes	Theft	Power Failures	Health & Safety (Lighting)	Health & Safety (Indoor Air Quality)	Ins. Type	Ins. Cov.	Ins. Line
Insulated water pipes		√	√					PD Liab	HO CGL BI	CL PL
LED exit signs					√	√		Liab	WC CGL PLC E&O	CL
Light guides/Light pipes	√				√	√		PD	BI	CL
Light-colored roofs	√		√		√		√	PD	HO H	CL PL
Measurement & Verification Protocols	√	√				√	√	PD Liab	BI BM E&O	CL
Natural ventilation					√		√	Liab	WC H	CL
Passive solar home construction	√	√	√		√		√	PD	H HO	PL
Radiant barriers	√							PD	HO	PL
Radiant hydronic cooling					√		√	Liab	WC	CL
Radon-resistant housing							√	Liab	CO CLC H	PL
Reduce indoor pollution sources							√	Liab	WC E&O H	CL
Reduced mercury in lighting						√		Liab	WC PLC H	CL
Roof/attic insulation		√	√					PD	HO H	PL
Sealed-combustion appliances	√						√	PD Liab	PD PI E&O HO H	CL PL
Thermal energy storage	√							PD	PD	CL
Torchiere light fixture with compact fluorescent lamp	√							PD Liab	HO PI PLC H	CL PL

Key:

Insurance Type

Liab - Third Party Liability

PD - Property Damage

Insurance Line

PL - Personal Lines

CL - Commercial Lines

Insurance Coverage

Personal Lines

PI - Personal Injury

PLI - Personal Lines Insurance

HO - Homeowners Insurance Policy

H - Health/Life Insurance

Insurance Coverage

Commercial Lines Coverage

BI - Business Interruption

BM - Boiler & Machinery

BR - Builder's Risk

CGL - Comprehensive General Liability

CLC - Contractors Liability Coverage

CO - Completed Operations

E&O - Errors and Ommisions

PLC - Products Liability

RI - Refrigeration Insurance

WC - Workers' Compensation

Figure 3-1. Examples of energy-efficiency measures that also contribute to insurance loss prevention.

- ***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 rapidly accelerates the spread of fire and toxic fumes. Efficient windows may reduce the likelihood that fire will cause breakage (Berdahl 1995a). Efficient dual-pane windows or windows with retrofit films are also more resistant to breakage by thieves or windstorms (Howard 1989). In hot climates, selective window coatings also considerably reduce glass temperatures, thereby enhancing worker comfort (thermal discomfort is one cause of professional liability claims in new buildings).

- ***Insulated water pipes.*** Frozen water pipes have been identified as an important cause of losses in Austria, France, Germany, Switzerland, and the U.K. (see Fig. 3-2); cold winters correlate to significant reductions in the profitability of pipe insurance (Swiss Re 1992). According to the Disaster Recovery Business Alliance, the U.S. insurance industry paid $4.5 billion in claims during a 10-year period for freezing pipes in 17 southeastern states. Pipe insulation is a simple energy retrofit that saves energy and reduces the likelihood of freeze damage (IIPLR 1996a).

- ***Reduced heat losses through roofs.*** Ice dams are rooftop ice build-ups that result from repeated melting and refreezing of snow. Melting water collects behind the ice dams, damaging the roof. A single large blizzard in the U.S. in early 1996 was estimated to have resulted in 10,000 to 15,000 such water damage claims, with an average cost of $2,000 per home (Levick 1996). Ice dams form because of preventable heat leaks caused by air leakage, insufficient insulation levels, or leaky heating ducts (Fisette 1996; IIPLR 1997). Adding to the energy liability of roof-ice buildups are the widely used electric heating elements often installed along rooflines, intended to melt the ice.

- ***Aerosol duct sealing.*** Eliminating heating system duct leaks can help avoid dangerous pressure imbalances in a home (Modera et al. 1996), which can lead to fire risks caused by flame roll-out or health and life risks from carbon monoxide backdrafting from gas appliances and accelerated radon entry from surrounding soils. The hot air released by leaky ducts located in attics is also a precursor to ice dam formation. (See preceding bullet.)

- ***Urban heat island mitigation.*** Lowering urban air temperatures by increasing the reflectances of roofs and roads and planting urban trees has been shown to reduce air-conditioning costs by up to 50% (Rosenfeld et al. 1995). Light-colored materials for walls and roofs can be designed to offer the added benefit of increased fire resistance (Berdahl 1995b). Reducing urban airshed temperatures also reduces smog, which in turn reduces health insurance claims.

- ***Weatherization of multifamily buildings.*** Analysis of top-floor apartments typical of Chicago has shown that lightening hundreds of roofs, insulating attics, and utilizing natural ventilation would have greatly reduced the likelihood of hundreds of heat deaths during the U.S. heatwave of 1995, while achieving considerable energy savings (Huang 1996).

- ***Torchiere halogen light fixture efficiency measures.*** According to the Consumer Products Safety Commission, halogen torchiere uplighter fixtures are one of the primary causes of lighting-related fires in homes (Calwell 1996; Arkwright 1997). Compact fluorescent lamp replacements have been shown to yield 80% energy savings while eliminating the fire hazard (Siminovitch and Page 1996). College student dormitories are good candidates for insurance industry intervention; and many are already moving to ban halogen torchieres and incentivize energy-efficient alternatives.

- ***Promotion of residential building code compliance.*** Safety-related performance targets set by codes are often not met in the field, an issue of concern to the insurance industry. Recent surveys of homes in the Western U.S. ostensibly built to meet the mandatory energy code showed a 50% noncompliance rate (Wang 1996; Vine 1996). Improved education of builders and code-enforcement officials can help ensure that building performance objectives are attained.

- ***Gas vs. electric cooking.*** Cooking has been found to be the number-one cause of house fires in the U.S., Canada, and the UK (Wijayasinghe and Makey 1997). In an 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). The same ratio was found in a study conducted in the UK (Whittington and Wilson 1980).

- ***Building commissioning.*** An important cause of litigation, business interruption, and contractor call-backs in buildings is improper performance of heating and cooling systems. A reemerging practice called 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) are achieved; and provide for operator training.

A systematic analysis of energy-efficient technologies from an insurance loss prevention perspective is needed. Together, the energy efficiency community and the loss prevention community should work on identifying and improving such "no-regrets" options.

Energy efficiency cannot be discussed properly without considering indoor environmental quality (IEQ). Improperly applied efficiency measures can compromise IEQ, while properly applied ones can improve it, thereby amplifying the insurance-related benefits.

There are at least five linkages between human health, productivity, and the indoor environment: infectious diseases, respiratory diseases (allergies/asthma), acute sick building health symptoms, poor worker performance, and electronic equipment failures. Insured health care, lost-productivity, and professional liability costs resulting from indoor air quality problems are substantial (McGowan 1996; Fisk and Rosenfeld 1996). The largest SBS claim we have identified involved a $29.9 million settlement against Reliance Insurance Company for occupant respiratory-illness problems experienced at the Polk County courthouse in the U.S. The Commonwealth of Massachusetts' Registry of Motor Vehicles Building was the site of another major case. There is a valuable body of research in a number of areas with implications for decreasing this class of insurance costs: causes of Sick Building Syndrome (SBS), reducing indoor pollutant sources, identifying "high-radon" areas and designing radon-resistant homes, and minimizing the use of air recirculation (Mills 1996; Failla n/d). Energy efficiency, of course, also reduces the emissions of potentially hazardous substances e.g. from powerplants into the outdoor air, and other associated public-health-related insurance risks (Romm and Ervin 1996).

The insurance industry has yet to formally and systematically quantify the types of losses considered here, but a review of the energy and insurance literature has uncovered a cross-section of examples from several countries of losses that are partly associated with energy-using equipment **(Figures 3-2 and 3-3)**. Some notable U.S. examples of property losses from structural fires that might be mitigated partially through energy efficiency include 157,000 fires, 735 deaths, and $2.5 billion in insured losses stemming from heating or electrical equipment in buildings. Some relevant U.S. examples for health and life insurance include 13,000 radon-related lung-cancer deaths annually, 1,500 carbon monoxide deaths (and 12,000 carbon monoxide-related poisonings), and 800 deaths from urban heat catastrophes. Table 3-1 suggests various energy-efficiency measures that could mitigate such losses.

3.1. Anticipating and Mitigating Undesirable Efficiency/Loss Interactions

In the past, the sporadic debate between the "insurance" and "energy-efficiency" communities has often been limited to single applications (lacking a systematic approach) characterized by misunderstandings. For example, the insurance industry was very concerned at an early stage that insulation materials for residential buildings would increase fire risk. It took many years for those concerns and related misunderstandings to be resolved. Halven (1983) cautioned against the use of insulation, asserting that it is a volatile fuel for fire, but went on to note that it is in fact the improper *application* of insulation (i.e. too close to combustion appliances) that is the core problem. Thus, the issue shifts to one of poor construction practices and code enforcement, rather than energy-efficiency *per se*. In another example, some insurance groups believe that tight buildings are more vulnerable to pressure build-up and explosion during intense windstorms, while others are not (IIPLR 1996b). In any event, these potentialities must be identified, analyzed, and mitigated. In the future, enhanced dialogue, joint research and implementation projects between the energy efficiency and the insurance communities are sorely needed.

While some legitimate problems no doubt exist, care should be taken to separate these from poorly reasoned or sensationalized concerns. For example, the popular media has fomented public misconceptions about the con-

Figure 3-2. Examples of insured property losses that may be reduced by proper application of energy-efficiency and indoor environmental quality technologies and practices. [notes on page 23]

PROPERTY/CASUALTY LOSSES

Losses from ice damage to roofs (ice dams)

- US: $20 to $30 million from one storm in 1995 (total damages, including ice dams).[1]

Losses from frozen water pipes

- US (1985-1995): $450 million/year.[2]
- CH (1988): US$29 million/year (36 million Sfr.)—residential only.[3]
- D (1989): US$84 million/year (141 Million DM)—residential only.[3]

Fires caused by heating equipment

- CH (1995): US$14 million (17.8 million sFr).[4]
- US (1993): 72,000 structural fires (15% of total), 385 fire-related deaths (10% of total), 2,142 injuries (9% of total), $551 million fire-related losses (11% of total).[5] Residential buildings carry about 80% of the insured losses, and nearly all of the fires, deaths, and injuries.
- CA (1994): 5,331 structural fires (8% of total), 17 fire-related deaths (4.5% of total), 219 injuries (6.2% of total), $72 million fire-related losses [$97 million C$] fire-related losses (8.4% of total).[6]

Structural fires caused by electrical equipment and appliances

- US (1993): 85,000 structural fires (18% of total), 360 fire-related deaths (9% of total), 3,500 injuries (16% of total), $1.2 billion fire-related losses (25% of total).[7] Residential buildings carry about two-thirds of the insured losses, and a considerably higher share of number of fires, deaths, and injuries.
- US (1995): 2,800 fires and 25 fire-related deaths from light fixtures.[8] 200 fires from torchieres.
- CA: At least 10 fires from torchiere light fixtures;[9]
- UK (1995): $28 million (£ 46.6 million) from electrical equipment (of which 32% caused by electric lighting).[10]
- CH (1995): $57 million (71,1 million sFr) (of which 34% caused by cables/installation, 31% caused by appliances, 24% caused by incorrect use of appliances, 11% others).[11]
- CA (1994): 8,387 structural fires (13% of total), 17 fire-related deaths (5% of total), 394 injuries (11% of total), US$125 million ($168 million $C) fire-related losses (15% of total).[12] [Includes electrical distribution equipment such as wiring; does not include cooking equipment.] In Canada, cooking fires were found to be four times more common in homes with electric stoves (238 per 100,000 houses) than for gas stoves (58 per 100,000 houses). The same ratio was found in a study conducted in the UK (Whittington and Wilson 1980).

Premature failure of electronic equipment caused by poor indoor air quality

- US: 20% of circuit board failures—$200 million per year in U.S. telephone switching offices.[13]
- D (West Germany) (1984): US$80 million computer premiums; US$240 million telecommunications and low-voltage equipment premiums.[14]
- CH (1984): US$10 million computer premiums.[15]

Figure 3-3. Examples of insured health and life losses that may be reduced by proper application of energy-efficiency and indoor environmental quality technologies and practices. [notes on page 23]

HEALTH & LIFE LOSSES

Deaths from extreme temperature episodes

- US (1995): 700 summer heat deaths in Chicago.[16] Swiss Re cites 805 total deaths nationally.[17]
- US (1995): More than 46 deaths caused by cold waves.[18]

Deaths or illness from carbon monoxide poisoning in homes[19]

- US Each year, about 1,500 deaths result from CO poisonings. Of these about 1,000 are from CO emissions caused by malfunctioning, incorrectly installed, or misused combustion appliances such as furnaces and gas ranges, by the improper indoor use of outdoor appliances like barbecues, and by operating automobiles or generators in garages. Centers for Disease Control in Atlanta suggests that the lifetime risk of unintentional fatal CO poisoning indoors is about one in 3,000. Malfunctioning indoor combustion appliances are the primary cause of CO posionings.

- US (1993): CO poisonings: More than 12,000 non-fatal carbon monoxide poisonings were reported to the American Association of Poison Control Centers in 1993, but the Association believes this represents only a fraction of the actual number of events; often, nonfatal poisonings are often misdiagnosed as flu or other afflictions.

Deaths or illness from radon gas in homes

- US: 4 million homes (6% of the entire housing stock) above US Environmental Protection Agency safe levels; estimated 6,000 to 18,000 lung cancer deaths annually. Associated medical and life insurance costs not quantified.
- N: 200 deaths annually.[20]

Workers compensation losses caused by "sick building syndrome" or bad indoor air quality

- US: studies report that from 5 to 40% of workers report problems, cost estimated at $50 billion annually.[21] Largest U.S. insurance sick building syndrome claim to-date is $29.9 million.

Health insurance costs of asthma (partially related to poor indoor air quality)

- US: $13 billion annually.[22]
- D: About 8 million German citizens suffer from asthma. Among children the asthma rate is 12 to 15 %, and it is the most common chronic childhood illness. Since the end of World War II the number of children to suffer from asthma has increased tenfold. About 6,000 children die each year of asthma in Germany.[23]

nection between energy-efficiency and indoor air quality problems. The scientific record shows that while misapplications of efficient technologies can indeed contribute to indoor air quality (IAQ) problems, this is not a necessary consequence of energy efficiency. In fact, energy-efficiency strategies can also be synonymous with improved IAQ.

4. Potential Constructive Roles for the Insurance Industry

As suggested by the examples provided above, the insurance industry could encourage customers to employ technologies and practices that reduce the likelihood of insured health, property, and liability losses. This gives the industry a rare opportunity to help customers save money on energy bills and at the same time reduce the likelihood of insured losses. The technical measures we have identified are generally profitable to the consumer, i.e. the energy cash-flow savings amortize the capital investment in the course of a few months to a few years.

Many other stakeholders (public and private) are already active in promoting energy efficiency. These include federal and local government energy and environmental agencies, energy utilities, energy-service companies, consumer-interest organizations, and a range of professional societies. The insurance industry would be a welcome newcomer, especially insofar that it would bring a unique perspective focusing on the loss-prevention benefits. In the following sections we discuss three specific implementation strategies applicable to the insurance industry: supporting research and development, providing information to insurance consumers, and leading by example in managing buildings owned by insurance companies more efficiently.

4.1. Participating in the Research, Development, and Commercialization of New Energy-Efficiency Technologies and Services

Little research has been done to identify and promote the market penetration of loss-preventing, energy-efficiency technologies. The insurance industry could participate in strategic research and development (R&D) and pre-commercial activities necessary to move new loss-reducing technologies into the marketplace. The founding of the Underwriters Laboratory early in this century stands as a precedent for such an enterprise. Insurers support research in other areas, such as medical technology or automobile-safety technology.

Most of the strategies discussed in this article were supported by government-sponsored R&D programs now falling victim to widespread budget cutting in many countries. The U.S. Department of Energy's R&D budget for energy-efficient building technologies fell from $368 million in 1995 to $217 million in 1996—a 41% reduction. Difficult economic times have also led to reduced R&D within the traditional private sector firms (e.g. building component manufacturers). Further compounding the problem, the current trend toward utility deregulation has also led many utilities to reduce their R&D activities. The insurance industry could serve a vital function by stepping into this growing R&D void, independently or in cost-sharing partnerships with existing R&D programs. Insurance industry support of strategic energy-related R&D has been endorsed by the Reinsurance Association of America (Nutter 1996).

An early example of such a partnership is a Cooperative Research and Development Agreement (CRADA) between various elements of the U.S. insurance and roofing industries and the U.S. Department of Energy's Oak Ridge National Laboratory. The private partner is the Roofing Industry Committee on Wind Issues, which includes all major roofing trade associations in North America and various insurance partners (the Institute for Business and Home Safety, K2 Technologies, Risk Management Solutions, and Allstate). The aim of this costshared 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.

Examples of other promising R&D frontiers include development of energy-efficient and fire-resistant windows, paints, and light fixtures, and development of improved indoor air quality monitoring devices, and methods to reduce airborne disease transmission (e.g., colds, flu) in office buildings. While not technology development *per se*, there is a need for improved research on many fundamental building science issues such as ice dam formation and mitigation, and the causes of Sick Building Syndrome. Other research opportunities include definitive studies on the connections between indoor environmental factors (air quality, lighting, thermal comfort) and worker productivity and health (Kroner et al. 1992).

Past experience in the energy sector could offer a model for insurance industry R&D. The Electric Power Research Institute (EPRI) and the Gas Research Institute (GRI) spend $1 billion a year on technology and market research for energy utilities (less than 0.5% of revenues). They provide a common knowledge base for large and small energy companies and serve as an interface among the numerous energy utility companies, regulatory bodies, and providers of energy technologies. In the U.S., the insurance industry's Institute for Business and Home Safety is one venue where such research could take place. IBHS's mission is to reduce deaths, injuries, and loss of property resulting from natural disasters.

In closing this discussion on technology R&D, it is important to add that basic *market* research must be carried out on the particular types of losses potentially addressed with energy-efficient technologies. There is currently a remarkable lack of basic data on specific loss categories of interest (e.g. fires caused by halogen light fixtures), with only generally relevant data such as that presented in Figures 3-2 and 3-3. We hope that in the future, new categories of insurance loss statistics are collected so that it may be easier to quantify the potential loss reductions from the types of measures described here. The IBHS Insurance Paid Loss Data Base, currently under development, may prove to be a useful repository of such information.

In tandem with R&D, insurers can become involved in precommercialization activities and financing for new technologies, e.g. through venture capital investments. There are various precedents in the general area of environment and energy. In one example, American Reinsurance (Am-Re) company created a Technology Transfer Department that initially specialized in offering clients emerging technological solutions for environmental risk mitigation (Goodman n/d). Through their Strategic Ventures group, the focus is currently on providing venture capital for start-up companies working to commercialize these new technologies. Their flagship project is with Molten Metals Technology (MMT), a firm that developed a method of recycling industrial wastes. One Am-Re insurance customer who generates such waste is now anticipating the profitable reuse of their wastes, and may even receive insurance premium rebates for doing so. An excellent prospect in the area of energy efficiency involves supporting the commercialization and deployment of new fire-safe "torchiere" uplighter fixtures that utilize compact fluorescent lamps or other high-efficiency lamps. The current fixtures use halogen lamps have been associated with numerous fires and fire-related deaths, and about 40 million are in use in the United States today (Ramstad 1997; Calwell and Mills 1997).

4.2. Providing Consumer Information Risk Managment Services, & Support for Building Code Enforcement

There are a host of ways in which insurance companies can help educate the public about energy efficiency. Where loss-prevention benefits are uncertain, the focus can be restricted to the direct cost savings or other known benefits. Potential forms of such assistance include the provision of energy-efficiency information, offering specialty audits and risk-management assistance, supporting building code compliance and quality assurance, and promoting product labeling.

4.2.1. Provide Energy-Efficiency Information & Education

Given their extensive contact with the public, insurance companies are in an excellent position to provide energy-efficiency information as a customer service. (This has been done extensively by energy utilities, e.g. through information provided with bills.) As an example, the USAA insurance company published a detailed 17-page handbook on energy efficiency for homeowners (The USAA Foundation 1992).

Safety-related product labeling—a very targeted form of consumer information—has existed in most industrialized countries for some time, and can be championed by insurance interests as exemplified by the Underwriters Laboratory labeling program. Various energy agencies around the world operate programs for energy-performance labeling of buildings and energy-using devices within them (e.g. Home Energy Rating Systems in the United States). IBHS is now planning to introduce a comprehensive whole-building label to help consumers know when they have a particularly safe home. Where loss-prevention synergisms are sufficiently well known, energy-related features could be added to the list of criteria for receiving the label. An example of component-specific labeling would be to incorporate the fire-safety aspects of windows into the existing National Fenestration Rating Council labels for window efficiency.

Insurers can also promote strategic education programs for their customers, be they building owners or building professionals. Some insurers in Massachusetts are offering 10% discounts to people who take a free six-hour course in weatherization, home repair and other subjects (Steitner 1996). Premium discounts are also being discussed for architects and engineers who become trained in energy-efficient/loss-preventing procedures.

4.2.2 Offer Specialty Audits or Risk Management Assistance

Insurers have an established tradition of providing on-site inspections and risk management advice or services. This approach, however, has rarely been done with a focus on energy-efficient loss-prevention technologies. One U.S. insurer—Arkwright Mutual—has recently chose to address the risk of fires caused by halogen torchiere light fixtures in student dorms. Arkwright, in collaboration with Lawrence Berkeley National Laboratory, Boston Edison electric company, and Emes (a lighting manufacturer), has audited student dorms and installed highly efficient and fire-safe compact fluorescent torchiere fixtures in place of halogen ones at two universities. Pilot projects will be used in a broad education program, designed to reach a large number of universities.

The second-largest U.S. professional liability insurer of architects and engineers, DPIC, has taken a keen interest in promoting "building commissioning"—a quality-assurance process focusing on energy-using systems—as a loss-prevention strategy and cites heating, ventilating, and air conditioning cases as the largest source and cost of claims for the company (see Figure 3-1 for a definition of commissioning). Insurers and legal experts have cited commissioning as a way to decrease the likelihood of professional liability lawsuits pertaining to indoor air quality problems and other results of malfunctioning equipment (Brady 1995; Tyler 1995). Other non-energy benefits that may correlate with reduced insurance claims include improved occupant comfort, avoidance of extreme premature equipment failures, and reduced contractor call-backs or change orders. A DPIC study of 44 closed cases between 1989 and 1992 identified a payout of nearly $26 million for HVAC-related claims, and concluded that in some cases the claims "would have not existed or been significantly less costly if commissioning had been provided" (Thomsen 1997). Since energy utilities are also interested in promoting commissioning, opportunities exist for innovative cost-sharing partnerships between insurers and utilities in designing and implementing commissioning programs.

Case studies of the correction of 73 physical deficiencies in 16 real buildings yielded an additional electricity savings of 41% (24%, excluding one large high-saving project) at costs ranging from $0.7/m^2$ to $6/m^2$, with average cost-benefit ratios (commissioning costs vs. energy savings) of approximately 1.0 (Piette et al. 1995; Piette and Nordman 1996).

While commissioning typically applies to new or renovated buildings, routine inspections of existing buildings can also reveal sources of energy waste and insurance risks. The consequences of insufficient maintenance were highlighted by the results of a new study conducted by Hartford Steam Boiler Inspection & Insurance Company, in which inspections of 200 buildings insured by HSB in New York City revealed that 75% of all electrical system failures result from a lack of maintenance (Prince 1997). Electrical system failures cost the company $100 million over the past 10 years.

Another type of comprehensive energy-efficiency strategy, instrumented energy audits, helps identify energy-related problems that can lead to insured losses. One tool used in this work is the infrared (IR) camera, which has long been used to detect electrical problems with motors, transformers, etc. that waste energy and can cause fires. Munich Re has recommended the use of IR cameras as a loss-prevention tool, citing the early detection of broken hot water pipes as an example of how to minimize water damage losses and save energy. IR cameras can also identify inefficient windows and gaps in insulation. Blower doors and pressure manometers are also valuable tools for energy audits, enabling a user to identify potentially dangerous pressure imbalances in a building that could lead to fire or health-related insurance losses or professional liability claims (e.g. due to unacceptable comfort conditions) if not remedied. Auditors can also perform indoor air quality measurements as a risk-management service. In-house building operators can also play a role in implementing integrated loss prevention and energy savings procedures. This is exemplified by the role played by advanced data visualization systems that can detect energy-wasting equipment malfunctions that jeopardize health and safety (Meyers et al 1996).

In Germany, insurance companies are starting to offer environmental and technical risk management services to customers, typically including appraisals of different energy systems and options. Often, separate consultancy companies are created as a spin-off of in-house risk management activities. This is seen as a good way of creating new profit centers that build on existing know-how, as well as supporting loss prevention. Examples of companies that offer such external risk management services are: ARIS, Colonia/Nordstern Insurance Co., Hannover-Sicherheitstechnik Co., Gerling-Konzern Allgemeine Insurance Co., and Allianz Zentrum für Technik.

In the process of making its own buildings more efficient (see Section 4.3), the insurance industry can acquire considerable relevant skill which could be offered to other property owners and managers. It is even possible that special in-house expertise and services could develop into new business lines in energy auditing, retrofit evaluation, installation and management of energy-efficient systems, building commissioning (see below), savings measurement and verification, and ongoing energy-management services. On the other hand, there are also many private specialty firms that could provide these services to insurance companies and/or partner with them in delivering services to third parties.

4.2.3. Support Building Code Compliance and Quality Assurance

Various organizations are working to improve compliance with energy codes. Several studies have found that half of new buildings do not meet mandatory energy standards (Wang 1996; Vine 1996). Insurance companies have a commensurate interest in compliance with safety codes. More than 75% of code enforcement officials failed a competency exam delivered by the IBHS.

There are numerous loss-prevention synergisms between safety and energy code compliance. Examples include the protection of water pipes from freeze damage, minimizing the risk of ice-dams and heat deaths by maintaining the thermal integrity of roofing systems, and protecting occupants from fires or backdrafting from combustion appliances as a result of poorly installed duct systems. The insurance industry could join in efforts to train and provide education and incentives to code officials to improve compliance with both energy and non-energy elements of the codes. IBHS—which represents almost 75% of the US property/casualty insurance sector—has recently endorsed energy code enforcement efforts (Lecomte 1997). IBHS has since trained more than 2,500 inspectors, builders, and contractors.

In an excellent demonstration of insurer promotion of quality assurance, one U.S. company, the Clair Odell Group, is launching an innovative policy to cover indoor air quality claims (IEQ Strategies 1997). The new policies will cover bodily injury claims, property damage, loss of rent, and the cost of mitigation. Eligibility is only available when the building owner/manager is a member of the Building Air Quality Alliance, an organization that has developed a specific protocol for preventing IAQ problems. The BAQA has developed a specific protocol for avoiding IAQ problems in buildings.

There is a new Insurance Services Office (ISO) rating system for communities, which rewards communities that enforce building codes (Steitner 1996). The Building Code Effectiveness Grading program began in May 1996 and is resulting in up to 15% premium reductions by some insurers, and is now being used in ten states. In an unrelated effort, Massachusetts homeowners taking a six-hour course on topics such as weatherization, home repair, and lead-paint hazards can receive 10% premium discounts from some insurers (Steitner 1996).

4.3. Leading by Example: Implementing Energy-Efficiency in Buildings Owned by Insurance Companies

"Market Pull" strategies are one of the most innovative approaches to improving energy efficiency harnessing the purchasing power of large energy users to steer entire markets toward increased use of efficient technologies. The Swedish government's National Board for Industrial and Technical Development (Nutek) has been the world leader in this area, organizing owners of large numbers of buildings (including insurance companies) to set standards for procurement of efficient energy-using products (Holm 1993). A U.S. consortium of government and non-government organizations is also very active in this area, as is the International Energy Agency (IEA). Several European insurance companies are now collaborating with members of an IEA project to use the purchasing power of large building owners to create new markets for energy-efficient copiers.

The insurance industry is one of the world's most important owners of real estate. Our survey of the ten largest insurance companies globally identified assets in real estate (buildings, land, movables) amounting to $US 105 billion. The exact figure for the floor area of these buildings is not known, but we estimate it at about 100 million square meters based on a U.S. average value for MetLife. (For comparison, this exceeds the total US government ownership of buildings for civilian purposes (USDOE 1995)). At U.S. energy prices, this amount of floor area corresponds to an annual energy bill of $1.6 billion. U.S. life insurance companies own $50 billion worth of commercial real estate, 22% of all institutional holdings (Real Estate Research Corporation 1996; Institute of Real Estate Management 1991). The three largest U.S. insurance companies own 42 million square meters of floor space, equivalent to 10% of the U.S. total (i.e. institutional plus non-institutional). The three companies (Equitable, Prudential, and MetLife) rank numbers one, six and seven, respectively, on the 250-company list (Reed 1996).

Given their considerable presence in the real estate marketplace, if insurance companies marshaled their purchasing power by adopting state-of-the-art practices for technology procurement and efficient building operations in the buildings they own, they would make a significant contribution to reducing energy demand. High-visibility demonstration projects based on controlled experiments in insurance buildings could quantify the benefits of energy-efficiency measures and set a model for others.

Non-energy benefits can also be of interest here. West Bend Mutual Insurance company reported a 7% increase in productivity (defined as numbers of files processed related to applications, endorsements, renewals, and quotes) following the implementation of a variety of energy- and non-energy-related worker environment improvement measures (Kroner et al. 1992). The energy measures included individually controlled heating and cooling systems in worker offices (responsible for one-third of the total productivity gain), high-frequency lighting ballasts, task lighting, and increased use of daylighting. The implemented energy-efficiency measures also achieved a 38% reduction in energy costs.

Various insurance companies have already embarked on in-house energy management programs. The 71 signatories of the UNEP Statment of Environmental Commitment by the Insurance Industry, mentioned above, have pledged themselves to manage their properties in a more environmental manner. A central barrier to be faced in this process is that the vast majority of real estate owned by insurers is leased to other occupants, rather than being occupied by the insurer. Here arises the proverbial "landlord-tenant" problem, where the owner who must finance most energy-efficiency improvements does not pay the energy bills. In the U.S. life insurance sector, for example, only 11% of all insurer-owned real estate is occupied by the owner companies, which is down from 20% in 1980 (American Council of Life Insurers 1995). Another potential barrier is that insurance-owned buildings are often operated by independent property-management firms, who will not ordinarily pursue energy-efficiency unless explicit guidelines are provided by their clients. In the US, for example, two-thirds of all office buildings are managed by these third parties.

Insurance companies can take advantage of existing voluntary energy-efficiency programs offered by energy utilities or government agencies. The U.S. Environmental Protection Agency's Energy Star Buildings Program (e.g. Green Lights) and the U.S. Department of Energy's Rebuild America Program are two major examples.

4.3.1. Case Study: In-House Energy Management at Swiss Re

Environmental benefits, equally or even more important than economic benefits, were a driving force behind the founding of Swiss Re's own in-house energy management program for its headquarter operations in Zurich, as evidenced by this excerpt from the company's Energy Charter (Swiss Re 1995):

> "The current energy consumption patterns of the world's population may lead to irreversible climate change, and hence also to unforseeable harmful consequences. As a global reinsurance company, Swiss Re has an interest in the development of appropriate energy production and energy use strategies: these must be globally-oriented, ecologically sustainable, and also economically and socially acceptable."

According to the Charter, by the year 2000 both heat and electricity use per square meter are to be reduced by an average of 10% from 1994 levels in existing buildings and by 30% in new buildings. New or renovated buildings owned by the company but leased to others are to comply with Switzerland's SIA recommendation for energy-efficient design. An initial annual funding level of 1 million Sfr (~$US 800,000) has been made available for additional improvements in these buildings.

Energy-conserving principles are to be applied to all major equipment procurement processes at Swiss Re's headquarters. All photocopiers, PCs, and computer monitors—be they leased or purchased—must carry the most recent Swiss "Energy 2000" label demonstrating compliance with strict energy conservation requirements.

The Charter also calls for adding environmental exemality costs to the commercial price of energy when making cost-effectiveness calculations. Incentives are offered to Swiss Re's employees who devise innovative energy-saving suggestions.

4.4. Integrated Applications of No-Regrets Energy Efficiency and Renewable Energy Systems

Renewable energy sources, when properly applied and integrated with insurance risk management requirements aimed at reducing property and liability risks, can offer additional, can offer additional loss-prevention prospects for the insurance industry. The design integration of renewable energy technologies and energy efficient end-use technologies contributes to maximizing the insurance loss-prevention potential while minimizing the overall energy demand and thus the capital requirement for renewable supply equipment. Innovative mechanisms are being developed to facilitate insurance-industry financing of renewable energy projects (Leggett 1997).

Biomass energy presents one promising avenue. According to General Accident Insurance, certain wastes cause insurance claims following unintended contamination of soils and water bodies. In an attempt to address this, demonstration projects are underway in which the waste is being partially processed and used to fertilize certain types of willows. The willows are subsequently processed to produce environmentally friendly energy (i.e. no net carbon-dioxide emissions).

Solar energy can also offer a variety of insurance-related benefits. Solar photovoltaic ("PV") devices reduce business interruption losses by providing emergency power following natural or manmade disasters (Florida Solar Energy Center 1995; Stauffer 1995). PV devices are today powering tornado, flood, and oil-spill warning systems (Judkoff et al. 1997). Solar space- or water-heating systems, not depending on fuel supply, can help to reduce risks related to fuel storage and transport". Renewable heating systems in buildings also minimize the necessary operating time of combustion appliances associated with some building fires.

Centralized but diversified renewable electric supply systems—e.g. multiple wind turbines compared to a single thermal power generator—can increase the overall reliability of power grids, reducing insurance risks related to business interruption. Hydroelectric power plants can help prevent flood damages (assuming they don't create a false sense of security and encourage housing development in highly vulnerable flood plains).

Implementation avenues analogous to those we've presented above for energy-efficient technologies can apply as well in the case of renewables. More work in this area is needed.

5. Conclusions and Recommendations

By supporting selected energy-efficiency and renewable energy options, the insurance industry could reduce near-term business risks while making a considerable contribution to long-term reductions in greenhouse-gas emissions which also threaten their bottom line. This represents an attractive and previously untapped "no-regrets" opportunity for the insurance industry, as the risk-reducing benefits offer distinct value irrespective of the timing or extent of damages related to global climate change.

Surprisingly little has been done to-date along these lines. While the insurance industry has historically been involved in basic research and development, it has yet to closely examine the types of loss-prevention technologies and strategies described here. Basic market data (e.g. loss statistics) are also often lacking.

Our central recommendation is that the international insurance industry initiate a systematic activity to (a) identify technologies that contribute both to traditional loss-prevention and to reducing greenhouse-gas emissions, (b) promote the dissemination of information and the utilization of such technologies in the cases where they have proven to contribute to loss prevention and are commercially available, (c) "lead by example" by implementing in-house energy management programs in their own building stock, and (d) support research, development and commercialization where promising technologies are not yet available in the marketplace, or where it is in the interest of insurers to accelerate market penetration. Once the loss-prevention benefits are sufficiently well demonstrated, insurers can promote the use of the corresponding technologies and strategies by introducing risk-adequate insurance premium schemes.

In this article we have focused on the three specific implementation areas just listed. Additional strategies to be considered include: (1) financing customer efficiency improvements as a new business line, (2) establishing investment portfolios that support key energy-efficiency and renewable energy technologies and services, (3) forming customer-focused partnerships with energy utilities, and (4) exploring the issues and opportunities associated with the application of energy-related/loss-prevention concepts in the special context of developing countries.

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