Risk Assessment:
Climate Change, Insurance, and Utilities

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Our atmosphere is as thin — in proportion to the Earth’s diameter — as a film of condensation on a small steel ball.
Variability is a fact of life; but the dice are loaded.
Managing Risks for Utilities
(costs of impacts and adaptation)
Why Utilities, Insurance, and Climate Change?

• Electric and water utilities are insured (or self-insured, reinsured)

• Both sectors are weather- and climate-sensitive, and have to cope with shareholder, customer, regulator perceptions of the climate problem

• Both can be instrumental in climate solutions

• Both can work *together* on risk-management and new business opportunities
Roadmap

• State of the Science
  – fingerprints & forecasts
  – focusing on aspects most relevant to energy and water utilities

• Implications for Insurers & Utilities

• Managing Risks & Capturing Opportunities
State of the Science: Fingerprints
The Scientific Consensus
http://www.ipcc.ch

Intergovernmental Panel on Climate Change
TAR - 1300 Authors; 1100 Reviewers
Unanimously adopted by 100+ nations (including U.S.)
“Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.”

The Primary Human Influence is Fossil Fuels Combustion

(Second is Deforestation)

World Carbon Dioxide Concentrations

Highest CO₂ levels in 420,000 years (per Vostok Ice Cores)

World Energy Consumption

Today

Gas
Oil
Coal
Nuclear
Hydro +
Biomass
Global mean temperatures are rising faster

Warmest 10 years: 1997-2006

Attribution

- Observed changes are consistent with:
  - ✔️ expected responses to human activity
  - ✖️ inconsistent with alternative explanations

Human Activity is Main Driver of Observed Temperature Changes

Warming shows a significant human contribution over the past 50 years in all regions

September 2006 Temperature Anomalies
(with respect to a 1961-1990 base period)
National Climatic Data Center/NESDIS/NOAA
Regions of observed disproportionate changes in heavy (95\textsuperscript{th} %-ile) and very heavy (99\textsuperscript{th} %-ile) precipitation

Fingerprints.... Floods

Major floods per decade, 1950-2000

There’s a consistent 50-year upward trend in every region except Oceania.
Fingerprints.... Drought

Change in Palmer Drought Severity Index (PDSI) for 1900 to 2002

The trend has been sharply upward everywhere.
Fingerprints.... Storms

- Climate change is affecting storm tracks, winds and temperature patterns

- Human-induced forcing has likely contributed

Fingerprints: Loss of Ice & Snow Cover (Summer -7.4% per decade)

- Loss of land ice --> sea-level rise
- “Darkens” Earth’s surface
- “Freshens” oceans

Since 1979, more than 20% of the Polar Ice Cap has melted away.

ARCTIC SEA ICE BOUNDARY IN 1979

PHOTO: NASA ©2003 NRDC
Harvard Expedition to North Pole
... free water ....

Source: James McCarthy, Harvard
Larsen-B Ice Sheet
Jan 31
2002

Larsen B
Ice Shelf
March 5

1255 square miles
[24x San Francisco]

650 feet thick [4.3 Lake Tahoe's]

720 billion tons

Subsequent 8x increase in outflow glacier speed
Fingerprints ... Glaciers & frozen ground are receding

Area of seasonally frozen ground in the northern hemisphere has decreased by 7% from 1901 to 2002

Fingerprints ... Glacial Earthquakes

Quakes 4.6 or greater on Richter scale
Correlation of Disease Clusters with the 1997-1998 El Nino Weather Extremes

El Nino expected to become more frequent under climate change

Source: Epstein, Harvard Medical School, Science
Overwhelming Correlations
Synthesis of Scientific Literature on
Observed Changes 1970-2004

- 577 studies reviewed
- 765 observed physical changes (94% consistent with warming)
- 28,671 observed biological changes (90% consistent with warming)

State of the Science: Forecast
IPCC (2007) Projections of Future Changes in Climate

Best estimate for low scenario (B1) is 1.8°C (likely range is 1.1°C to 2.9°C), and for high scenario (A1FI) is 4.0°C (likely range is 2.4°C to 6.4°C).

IPCC Change in Runoff: 2041-2060  
(Average of 12 models -- Western US results are among the more robust)

Proportion of land area in extreme drought predicted to increase from 1-3% to 30% by 2090s. Drought duration expected to increase six-fold.

Change in Recurrence of 100-year Droughts

Figure 3.6. Change in the recurrence of 100-year droughts, based on comparisons between climate and water use in 1961 to 1990 and simulations for the 2020s and 2070s (based on the ECHAM4 and HadCM3 GCMs, the IS92a emissions scenario and a business-as-usual water-use scenario). Values calculated with the model WaterGAP 2.1 (Lehner et al., 2005b).

Source: IPCC 4th Assessment (2007), Ch 3
The Consensus

- **Human-induced climate change is here:** we’ve been studying this for over a century

- The climate consensus, is about as good as it ever gets in science.
  - It’s about like that for:
    - Human evolution
    - Health consequences of tobacco smoke

- One can quibble with specific points, but not with the systematic observed pattern of evidence

- Uncertainties are explicit; and are shrinking

- No alternate theory has been advanced
Open Questions

• Not the existence of human-induced climate change, or lack thereof, but rather:
  – How much?
  – How fast?
  – Smooth versus abrupt change
  – Feedbacks
    • Positive
    • Negative
  – Geography of impacts; downscaling
  – Gaps in models (especially cryosphere)
  – Attribution of Impacts
  – Society’s ability to adapt
  – Costs of mitigation and adaptation
  – Policy pathways
Donuts Exist Despite the Holes

Source: Krispy Creme
Risks for Insurers & Utilities
$3.8 Trillion
World Insurance Market

- World’s biggest industry
- Important to all other business segments
- Major player in financial markets
- Enormous political influence

Source: Swiss Re, Sigma
Climate Change: Intersection with insurance

Insurers are:
- integrators
- risk managers
- vulnerable
- selective
- potentially part of solution
Anticipated Losses

Property
- Property damage
- Mold/moisture
- Forest products
- Agricultural losses
- Fisheries
- Business interruption
- Roadway

Life/Health
- Injury
- Infectious diseases
- Heat stress
- Respiratory
- Pollutant releases
- Food poisoning
- Mental health
- Nutrition/water

Liability
- Products
- Negligence
- Nuisance
- Fiduciary
- Tort / BI
- Environmental
- Roadway liability insurance
“We'd be out of our minds if we wrote weather insurance on the opinion global warming would have no effect at all.”

- Warren Buffett
2006 annual Shareholder meeting
Uncertainty: Physical ➔ Financial

Non-climate factors play a role, but…

- Trends consistent with observed change
- Why are non-weather losses growing more slowly?
- Would have been even worse without prevention efforts

Changes in Averages vs. Extremes

Source: IPCC 3rd Assessment (2001)
Extremes Shift *More Than Avg’s.*

Rare Extremes Cause Most of the Damages & Insured Losses

The European heat wave of Summer 2003

Event was “six-sigmas” outside of norm. 16°F above average in France and Germany was a 1-in-10,000 event to 1-in-46,000 event

Shareholder Resolutions Link Business Atmosphere to Climate Change Liability

2000-2006 Data: ISS 2007
2007 Data (as of 02.06.07): Ceres 2007
D&O Heats Up
Climate change—a rapidly emerging insurance risk—has reached the world’s boardrooms.

A.M. Best’s Exclusive Rankings:
Reinsurers, Reinsurance Brokers—2006
Leading U.S. Property/Casualty Writers by Line—2006
Global Warming Puts The Heat On Directors & Officers

See Page 12

Top Stories of the Week

Bush Opposition Leaves TRIA Extension In Doubt
The White House threw cold water on legislation providing a long-term extension of the Terrorism Risk Insurance Act, while small insurers voiced concern over mandatory coverage for all types of attacks. Page 6

State Regulator Cleared For Private NAIC Sessions
In the first ruling of its kind, North Dakota's attorney general has upheld the legality of the nation's insurance regulators barring the public from certain meetings of their national association. Page 8

Katrina Battle Heats Up
The legal battle between a major insurer and a high-profile plaintiff attorney over Katrina claims expanded on three new fronts. Page 10

‘Woman Of The Year’ Offers Career Advice
AFTW’s 2007 “Insurance Woman of the Year,” H. Elizabeth Mitchell, president of Platinum Underwriters Re, shares some of the secrets of her success for those trying to make it in the industry. Page 10
U.N. climate report stirs liability fears

Scientific testimony may fuel lawsuits on global warming

By ROBERTO CENCERRAS

The publication of a U.N. report last week linking human activity to global warming could encourage liability suits against companies, but it also reduces the chances of more claims. New York and New Jersey insurers, for instance, would already cite the evidence as a reason to raise rates.

The report, which links the burning of fossil fuels to warming, increases the likelihood that commercial policyholders and their liability insurers will have to pay more damages against asbestos and other lawsuits. The report could also force companies to invest in new areas that could become politically charged, such as renewable energy or nuclear power.

Marsh reaps $3.9B with Putnam deal

Insurance firm sale will sharpen focus, boosts war chest

By SALLY ROBERTS

New York—Marsh & McLennan Inc.'s sale of Putnam Investments, its investment arm, to Great-West Lifeco of Canada is a catalyst for the insurance industry. The deal, announced last week, will make the insurance giant a larger player in the emerging global market of asset management.

Putnam’s $4 billion will be used to expand its presence in areas such as Canada, Asia, and Latin America. The deal also boosts Marsh & McLennan’s war chest, allowing the firm to invest more in its own businesses.

The sale comes as the insurance industry faces increasing pressure to diversify its revenue streams. With the growth of alternative investments, such as real estate and infrastructure, insurers are looking for new ways to boost their earnings. The Putnam buy will help Marsh & McLennan achieve this goal.
June 3, 2007, 5:13 pm

What Insurers Should Do About Climate Change

Insurers are likely to soon take a leadership role in reducing the risks of climate change as companies become more liable for damage related to it. The authors of a study jointly published by the Stanford Environmental Law Journal and the Stanford Journal of International Law sketch out several ways that companies who disproportionately contribute to global warming could be held responsible for its damage as the science of global warming becomes clearer.

The most common example is owners of property damaged by a warmer world's extreme weather suing companies that disproportionately emitted greenhouse gases. As well as paying out on insurance covering such liability claims, insurers will have to pay for several kinds of damage related to global warming, the authors say. They'll have to pay for car crashes on wet roads and ski resorts that insure themselves against warm winters short on snow.

"The insurance industry, perhaps more than any other institution, has the power to set the stage for enduring and significant contributions to solving the problem of global climate change," say environmental consultant Christina Ross, government scientist Evan Mills and environmental-law expert Sean B. Hecht.
Considerations for Utilities
[insurance, self-insurance, reinsurance]

• Infrastructure repair, redesign, fortification [property]
• Service provision & lost revenues
  – Changes in demand for energy and water
  – Failure to deliver [contingent business interruption]
  – Eroded water quality [product liability]
• Liability
  – As providers of services [general liability]
  – As emitters [various liability]
  – As impacted businesses [directors and officers liability]
• Reputation
  – Part of problem or solution?
  – Preparedness in the eyes of public, customers, shareholders, regulators
• Risk profiles of climate responses
• Insurance availability & affordability
Availability & Affordability

• Exodus of insurers from coasts (and elsewhere)

• Quiet “hollowing out” of insurance

• Customers “going Bare”: 9 utilities (10% of membership) left in OIL Mutual Ins. Co. May 2007
  – Paid $100 million in fees to leave
  – CEO says “It was a stunning blow”

• Rand Report on commercial insurance in FL
  – In 2005: one insured paid $250k for $38m coverage
  – In 2006: paid $940k for $5m coverage, i.e. a ~29-fold bump in the “cost of risk”
Physical Impacts to Watch For

- **Elevated temperatures** - peak demand (water & energy); increased T&D (“I²R”) losses; loss of cooling water; erosion of water quality; increased evaporation
- **Sea level rise** - infrastructure inundation; corrosion; wastewater; salt-water intrusion into drinking water
- **Reduced lake levels** - hydro output; water avail./qual.
- **Storm -- Precipitation, flood, lightning** - infrastructure damage & power outages; siltation of reservoirs; water quality (turbidity, nutrients, pathogens, toxins, algal blooms, bacteria, acidification, fertilizers and pesticides)
- **Drought** - reduced hydro output; water supply-demand; water quality (reduced dilution, increased salinity)
- **Subsidence & permafrost melt** - damaged pipelines, generators; transmission networks; groundwater quality
Climatic Shifts in Hydrograph

Fingerprints

- Percent of precipitation falling as rain (vs snow) increased at 74% of U.S. stations
- April snow equivalent down 15-30% in western North America
- Stream-flow peaking 1-4 weeks earlier (western US mountains)
- Earlier river-ice breakup

Source: Brian H. Hurd
Dept of Agricultural Economics and Agricultural Business, New Mexico State University
Tanzania: Drought >> Blackouts

1990

Mt. Kilimanjaro

2000

Mt. Kilimanjaro
Water Quality: California

Sea-level Rise

San Francisco

Sacramento-San Joaquin Delta

Reduced Sierra Runoff
Rising Salinity

Sea-level Rise

Salt Water Intrusion (California Delta)

Reduced Runoff

Example of salinity-rise episode during drought of 1992 (Science 2007)

http://baydeltaoffice.water.ca.gov/climatechange.cfm
Forecast Decrease in Sierra Nevada Snowmelt

Increasing Temperature

April 1 snow water equivalent (inches)

2050 Change in Reservoir Inflows
April-July
Spring Runoff

-30%  -50%  -12%  -25%  -18%  -32%  -21%  -12%  -0%  -30%  -5%  -30%  -12%  -48%  -50%
Shasta  Oroville  Folsom  New Don Pedro

2 emissions scenarios; 2 models

- GFDL – A2
- PCM – A2
- GFDL – B1
- PCM – B1

California Department of Water Resources
Sea-level Rise = 10 feet = half of Greenland melting

(Source: Harvard University)
Sea-level Rise = 10 feet = half of Greenland melting

(Source: Harvard University)
Power outages were a factor in slowness of draining New Orleans following Hurricane Katrina.

**U.S. economy total cost:**
~$80B/year

**Average cost to utilities**
$49 million/storm; max. $890 million (EEI)

**RMS Scenario:**
$2.7B for NY
Temperature-Related Insurance Loss Experience

Lightning-related claims accelerate with temperature

Each symbol represents a lightning storm event

Adapted from figure in Mills, Evan, 2005, Insurance in a climate of change, *Science* 309, pp. 1040-1044

Source: Hartford Steam Boiler Inspection and Insurance Co.
Permafrost Melt Hazard Potential

Settlement of several meters is possible


Electrical transmission
Pipelines
Bilbino nuclear station
Managing Risks & Capturing Opportunities
From Risk … to Opportunity

The insurance sector has a key role to play in helping to mitigate the effects of climate change … and by developing new products and solutions that can support emerging greenhouse-gas and renewable energy markets.

- Marsh & McLennan

Ceres Report: 25 strategies; ~220 examples; ~120 insurers
Cutting U.S. Emissions in Half with Climate-Stabilization "Wedges"

After Pacala and Socolow (Science)
More Business!

The fundamental strength to deliver customized insurance solutions.
Promoting Loss Prevention

- **Institute for Business and Home Safety’s** “Fortified… for safer living” stds.
  - Wind-resistant rigid foam panel walls and multi-glazed windows
  - Ice-dam resistant
  - Mold resistant
  - Water-resistant insulation

Some insurers are giving premium credits..., why not combine with utility rebates??
Financing Solutions

- **Tokio Marine & Nichido** has reforested 7,500 acres of mangroves in Indonesia, Thailand, Philippines, Myanmar and Vietnam. 5,000 more acres in progress.

Source: http://www.tokiomarine-nichido.co.jp/english/index.html
Crafting Innovative Insurance Products

- **Fireman’s Fund**: first-ever “Green-Buildings Insurance”
  - Premium credits for green features
  - Rebuild green after loss
  - Talking with utilities....

- **Lloyds**: Energy Savings Insurance

- **Munich Re**: geothermal performance insurance

- **Various**: weather derivatives
Providing New Customer Services

- **Insurance Australia Group** offering on-line automobile carbon-offset service for customers

Participating in Carbon Markets

- AIG, Marsh, others offering carbon project risk-management consulting services; insurance

Leading by Example

Carbon Disclosure Project
Insurers’ responses: AIG, Aon, Marsh & McLennan, MBIA, Safeco, St. Paul Travelers, Unum Provident

Swiss Re’s “Gherkin” building (London)
- Energy efficiency
- Daylighting
- Natural ventilation

Source: http://www.cdproject.net/
Sustainable Asset Management

- **Munich Re:** membership in sustainable investment indices; screens its own investments

- **Allianz:** endorsed the Ceres/INCR "Call to Action"

- **Gerling:** Select 21 Fund includes energy and environmental criteria in the selection of securities
Risks Are Also Associated with Responses to Climate Change

- Emissions reductions: supply- and demand-side
  - Green buildings
  - Nuclear power
  - Hydrogen energy
  - Renewable energy
  - Carbon capture & storage
  - Carbon offsets/trading

- Comparative risk assessments needed
Carbon Capture & Storage (CCS)

- Lake Nyos - 1986 (Cameroon): Natural CO$_2$ leak killed 1800 people, 3500 farm animals
Win-Win Solutions:

**Boston Edison**
Fire-causing halogen lamps v CFLs

**PG&E**
Direct-current data centers
Making Lemonade: Energy

Your carbon footprint is: 10,656 lbs. CO₂ per year (estimated*)

Equivalent to burning 549 gallons of gasoline

How do you measure up?
Your footprint: 10,656 lbs.
Average Californian: 22,941 lbs.
Average American: 32,607 lbs.
Average Global Person: 8,750 lbs.

*Information on how these calculations are made can be found on the last page.

Re-Calculate  Continue
Making Lemonade: Water
Insurer-Utility Partnerships?

1. Efficiency

2. Risk assessment & management: customer-facing analysis, services

3. Energy-carbon performance assurance

4. Synergisms between energy/water management and risk management
Thank You

http://insurance.lbl.gov
Thank You

http://insurance.lbl.gov