100% RENEWABLES – WHY DO WE HAVE TO ACHIEVE THIS GOAL, CONTRIBUTIONS OF THE INSURANCE INDUSTRY TO GET THERE?

Prof. Dr. Peter Hoenig, Head of Geo Risks Research/Corporate Climate Centre

4th Taking ESG into Account Conference, Frankfurt, 15 September, 2010

Munich Re

- Insurer for primary insurances
- Founded 1880
- The largest reinsurance company
- Annual premium income of RI ca. € 25 bn
- Leading role in covering risks of natural hazards
Munich Re the First Alerter to Global Warming

Changing Hazards of Weather Related Natural Catastrophes

- More intense weather events
- More frequent weather extremes
- Loss potentials have reached new dimensions
Munich Re NatCatSERVICE

The world's most comprehensive database on natural catastrophes

- From 1980 until today all loss events
- For USA and selected countries in Europe all loss events since 1970
- Retrospectively all Great Natural Catastrophes since 1950
- In addition all major historical events starting from 79 AD (eruption of Vesuvio)
- Currently more than 28,000 events documented

850 natural catastrophes in 2009

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NatCatSERVICE

Global weather catastrophes 1980 – 2009

Number of weather related events per continent

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Reasons for globally increasing losses caused by natural disasters

- Rise in population
- Better standard of living
- Increasing insurance density
- Settlement in extremely exposed regions
- Increased vulnerability of modern societies and technologies to natural hazards
- Change in environmental conditions - Climate Change

NatCatSERVICE
Global natural catastrophes 1980 – 2009
Trend of events (catastrophe class 1-6)
Climate Change and Extreme Weather Events (IPCC, 2007)

<table>
<thead>
<tr>
<th>Phenomenon and direction of trend</th>
<th>Likelihood that trend occurred in late 20th century (typically post 1960)</th>
<th>Likelihood of a human contribution to observed trend</th>
<th>Likelihood of future trends based on projections for 21st century using SRES scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warmer and fewer cold days and nights over most land areas</td>
<td>very likely</td>
<td>Likely</td>
<td>Virtually certain</td>
</tr>
<tr>
<td>Warmer and more frequent hot days and nights over most land areas</td>
<td>very likely</td>
<td>Likely</td>
<td>Virtually certain</td>
</tr>
<tr>
<td>Warm spells/heat waves. Frequency increases over most land areas</td>
<td>Likely</td>
<td>More likely than not</td>
<td>Very likely</td>
</tr>
<tr>
<td>Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas</td>
<td>Likely</td>
<td>More likely than not</td>
<td>Very likely</td>
</tr>
<tr>
<td>Areas affected by droughts increases</td>
<td>Likely in many regions since 1970s</td>
<td>More likely than not</td>
<td>Likely</td>
</tr>
<tr>
<td>Intense tropical cyclone activity increases</td>
<td>Likely in some regions since 1970</td>
<td>More likely than not</td>
<td>Likely</td>
</tr>
<tr>
<td>Increased incidence of extreme high sea level (excludes tsunami)</td>
<td>Likely</td>
<td>More likely than not</td>
<td>Likely</td>
</tr>
</tbody>
</table>

very likely > 90%  likely >66%  more likely than not > 50%

Global Warming is Real! Continental Temperature Changes

Quelle: IPCC FoAR, 2007

Black lines: decadal averages of observations
Blue band: 5-95% range 19 simulations from 5 climate models using only natural forcings
Red band: 5-95% range for 58 simulations from 14 climate models using natural and anthropogenic forcings
**CO₂ concentration in the atmosphere**

of the past 650,000 years from Antarctic ice core data

![Graph showing CO₂ concentration over time](image)


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**Observed changes in sea surface temperature in tropical ocean basins with TC activity**

![Graph showing sea surface temperature changes](image)

Sea surface temperatures of six ocean basins with TC activity

Five-year running means (data: 1968 - 2009)

![Graph showing sea surface temperature changes](image)

Sources: Munich RE, November 2009.

Sea Level Rise Projections
(after Vermeers & Rahmstorf, PNAS 0907765106, 2009)

Sea level rise projections for three IPCC emission scenarios.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Temperature range, °C above 1980-2000</th>
<th>Model average, °C above 1980-2000</th>
<th>Sea level range, cm above 1999</th>
<th>Model average, cm above 1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1.4-2.9</td>
<td>2.0</td>
<td>81-131</td>
<td>104</td>
</tr>
<tr>
<td>A1T</td>
<td>1.9-3.8</td>
<td>2.6</td>
<td>97-158</td>
<td>124</td>
</tr>
<tr>
<td>B2</td>
<td>2.0-3.8</td>
<td>2.7</td>
<td>89-145</td>
<td>114</td>
</tr>
<tr>
<td>A1B</td>
<td>2.3-4.3</td>
<td>3.1</td>
<td>97-156</td>
<td>124</td>
</tr>
<tr>
<td>A2</td>
<td>2.9-5.3</td>
<td>3.9</td>
<td>98-155</td>
<td>124</td>
</tr>
<tr>
<td>A1R</td>
<td>3.4-6.1</td>
<td>4.6</td>
<td>113-179</td>
<td>143</td>
</tr>
</tbody>
</table>

2010: Global Warming Sets New Records
First seven months in 2010 warmest since 1880!

January 2010: 4th warmest
February 2010: 6th warmest
March 2010: 1st warmest
April 2010: 1st warmest
May 2010: 1st warmest
June 2010: 1st warmest
July 2010: 2nd warmest
2010: Global Warming Sets New Records

- New temperature record for Moscow on 29 July with 37.8°C, in other places in Russia more than 40°C.
- Highest ever measured air temperature in Asia: May 2010, Pakistan, 53.5°C
- Pakistan Flood in July and August 2010 the worst ever documented
- 1st half year 2010 with second highest number of weather related natural catastrophes since 1980
- Arctic sea ice cover at record low until end of June 2010
- August 2010 the wettest ever recorded in Germany

CO₂ – the Most Important Greenhouse Gas

- CO₂ contributes more than 60% to anthropogenic global warming
- CO₂ on average stays in the atmosphere more than 100 years
- The largest part of CO₂ emissions stems from burning of fossil fuels

=> Key to long term environmentally friendly and sustainable energy supply are renewable energies
Global primary energy consumption: 491 EJ/a

Physical energy potential: ca. 2,000
Technical potential (existing technologies): ca. 5

Source: Dr. Joachim Nitsch, DLR, Stuttgart

A Big Step to a Solution: Munich Re has initiated the foundation of the Desertec Industrial Initiative (Dii GmbH)

Origin and Vision

- Developed by the Club of Rome’s TREC Initiative
- Vision: Providing EUMENA with sustainable renewable energy from the desert in North Africa

Within 6 hours, deserts receive more energy from the sun than humankind consumes within a year.
Motivations for the Dii

Basic assumptions and facts

- Sources of renewable energy are abundant.
- The concept aims to make use in particular of solar energy from the deserts, the biggest energy resource available on earth and also other renewable energy sources.
- 90% of the world's population are living less than 3.000 km from deserts and thus could be easily supplied via efficient modern HVDC lines with clean power.
- The concept offers an integrated solution for a variety of mankind's key future problems: Climate change, lack of energy, lack of drinking water, further economic development for MENA*.

*Middle East and North Africa
Source: www.desertec.org

The founding of the Dii GmbH

Milestones

- Joint signature for a memorandum of understanding by 12 companies and the DESERTEC Foundation for the formation of the Dii GmbH
- Legal foundation of the planning company
- Appointment of Paul van Son as CEO
- Definition of Dii’s governance structure
- Appointment of Prof. Klaus Töpfer as special envoy
- Development of an implementable roadmap to „green energy generation“ in the deserts of North Africa and the Middle East
- 20GW installed capacity (according to political goal of MSP)
- 100GW installed capacity (referring to the 15% aim of the Dii concept)
### Dii GmbH – Current Shareholders and Associated Partners

#### Dii Shareholder
(as at June 2010)

- ABB
- ABENGOA SOLAR
- c’ITAL
- Deutsche Bank
- e.on
- HSH NORDBANK
- DESERTEC
- FLAGSOL
- Munich RE
- m+W zander
- NAREV!
- SAINT-GOBAIN SOLAR
- SCHOTT SOLAR
- SIEMENS
- RED ELECTRA (EDISON)
- VORWEG GEHEN

#### Dii Associated Partners
(as at July 2010)

- 3M
- Audi
- AUDI Finance
- BILSTEIN
- BERGER
- COMMERZBANK
- Concentrix
- Commerz
- CENTERG
- EVONIK
- FIVE BANK
- FLABEG
- IBM
- Halgen Händelmann Group
- KREFF
- LAHMER towering
- Morgan Stanley
- NUR ENERGIE
- OHL
- OMV
- 52 SCHÖLLER
- TEMRA ENERGIBank

### Dii GmbH objectives

**Overview of the main modules**

| Regulatory / legislative environment | Analyse and develop a technical, economic, political and regulatory framework for feasible investments into renewable energy and interconnected grids |
| Roll-out Plan / financing | Develop a detailed roll-out plan until 2020 |
| Roll-out Plan / financing | Develop a long-term roll-out plan for the period up to 2050, providing investment and financing guidance |
| Additional studies | Originate some early reference projects to prove the feasibility of the concept |
| Additional studies | Conduct in-depth studies on specific subjects |
Result from pre-studies by the German Centre for Aerospace

**Generation: Advantages for CSP plants**

- Concentrating Solar-Thermal-Power-Plants (CSP):
  - Focusing of solar power with the aid of mirrors
  - Transformation of radiation into heat, which can be stored easily
  - Power generation by steam turbines
  - Turbines can supplementary be run by biomass or gas
  - ▶ Base load capability

Reflects current status, however Dii remains open to new technologies!

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**Transmission: Advantages for and high-voltage direct current grids**

- High-voltage direct current (HVDC):
  - Losses add up to a maximum of 3% every 1,000 km of transmission
  - Existing experience with HVDC grids up to 3 – 5 GW capacity (Siemens, ABB)
  - The DLR has estimated that the costs of producing and transporting solar-thermal power between 2020-2030 will be lower than that of the conventional power production technologies in Europe due to constantly rising fuel prices and environmental costs

Reflects current status, however Dii remains open to new technologies!
Long-distance electricity transmission
HVDC transmission lines in China and Europe

- Technology available: overhead transmission lines, submarine cables, underground cables
- China: Xiangjiaba–Shanghai, one of the world's longest transmission links with a capacity of 6,400 MW over a distance of 2,000 km (under construction)
- Europe: longest submarine cable and longest transmission link from Norway to the Netherlands (580 km, 700 MW)

Source: ABB, Siemens

Munich Re’s goals as the initiator of the Dii GmbH
www.dii-eumena.com

<table>
<thead>
<tr>
<th>Mid term</th>
<th>Long term</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSURANCE SOLUTIONS FOR RENEWABLE ENERGIES</td>
<td>CLIMATE PROTECTION</td>
</tr>
<tr>
<td>Leading role in developing new risk transfer solutions for renewable energies / new technologies</td>
<td>Support of CO₂ mitigation projects</td>
</tr>
<tr>
<td>INVESTMENT</td>
<td>BUSINESS OPPORTUNITIES</td>
</tr>
<tr>
<td>New (direct) investment options</td>
<td>Leading provider of renewable energy insurance</td>
</tr>
</tbody>
</table>
Characteristics of Renewable Energies

- High circadian, diurnal, seasonal and interannual fluctuations
- New technologies with little operational experience
- Construction in adverse environments (off shore, deserts)
- High start investments necessary

-> Insurance products will play a key role for the quick switch to renewables and thus for climate change mitigation and a long term sustainable energy supply. Without appropriate insurance investors would shun to go into these new technologies.
### Security for Investors into Renewable Energies

#### Protecting the entire life cycle of renewable energy projects

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Solution</th>
</tr>
</thead>
</table>
| - Increased demand for renewable energy and related investments  
- New technological challenges create new risks  
- Risks and threats change as projects move through different phases of their life cycle  
- Developing renewable energy technology creates new technical problems which often lead to increased losses. | - Construction Phase: Erection – All Risk, Transit/Marine, 3rd Party Liability, Advance Loss of Profits/Delay in Start-Up  
- Operational Phase: All Risks – Traditional P&C Covers, including Machinery Breakdown, Loss of Profits, Delivery Guarantee, Premature Aging of Solar Cells  
- Strengthen security and reliability for investors by offering complete life cycle protection |

### Conclusions

- Climate change is real and one of the largest risks humankind has to cope with in this century
- In order to avoid unmanageable conditions we have to reduce CO₂-emissions significantly
- Key to climate protection are renewable energies and increased energy efficiency
- 100% renewable energies is feasible in the next decades
- New technological solutions can be supported by insurance covers, which transfer the largest risks for investors and thus incentivize investments
- Munich Re is ready to support new energy technologies by custom made insurance solutions and direct investments
THANK YOU VERY MUCH FOR YOUR INTEREST
Prof. Dr. Peter Hoeppe, Munich Re