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

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

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

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- 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

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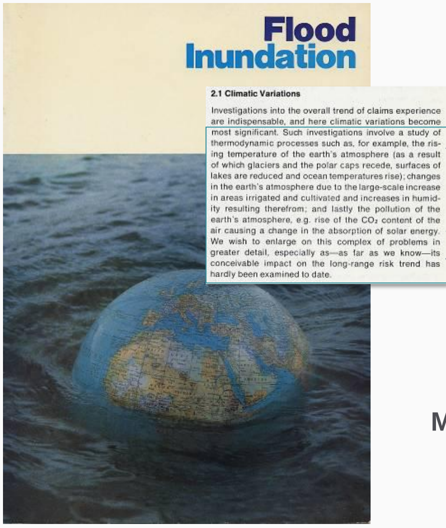

2.1 Climatic Variations

Investigations into the overall trend of claims experience are indispensable, and here climatic variations become most significant. Such investigations involve a study of thermodynamic processes such as, for example, the rising temperature of the earth's atmosphere (as a result of which glaciers and the polar caps recede, surfaces of lakes are reduced and ocean temperatures rise); changes in the earth's atmosphere due to the large-scale increase in areas irrigated and cultivated and increases in humidity resulting therefrom; and lastly the pollution of the earth's atmosphere, e.g. rise of the CO_2 content of the air causing a change in the absorption of solar energy. We wish to enlarge on this complex of problems in greater detail, especially as—as far as we know—its conceivable impact on the long-range risk trend has hardly been examined to date.

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Munich Re Publication, August 1973

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Changing Hazards of Weather Related Natural Catastrophes

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


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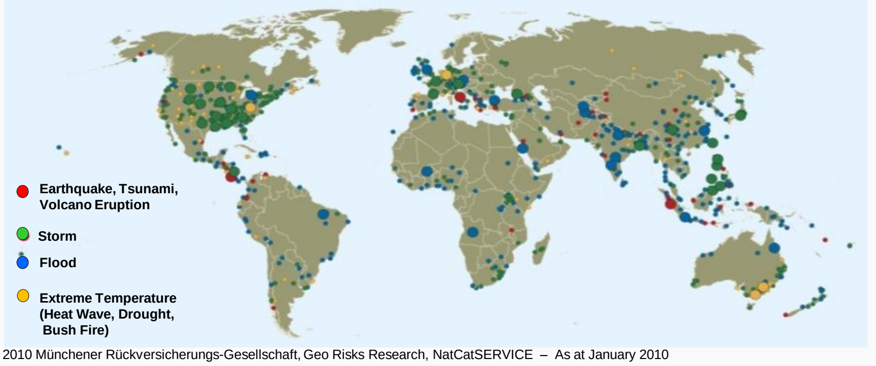
The world's most comprehensive database on natural catastrophes

- 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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Global weather catastrophes 1980 – 2009

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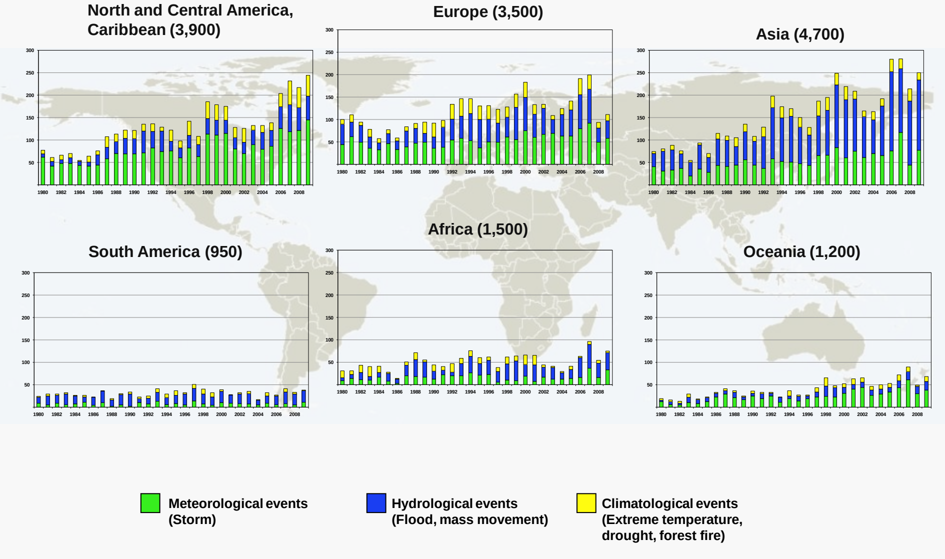
Number of weather related events per continent



Reasons for globally increasing losses caused by natural disasters

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- 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

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Global natural catastrophes 1980 – 2009

Trend of events (catastrophe class 1-6)

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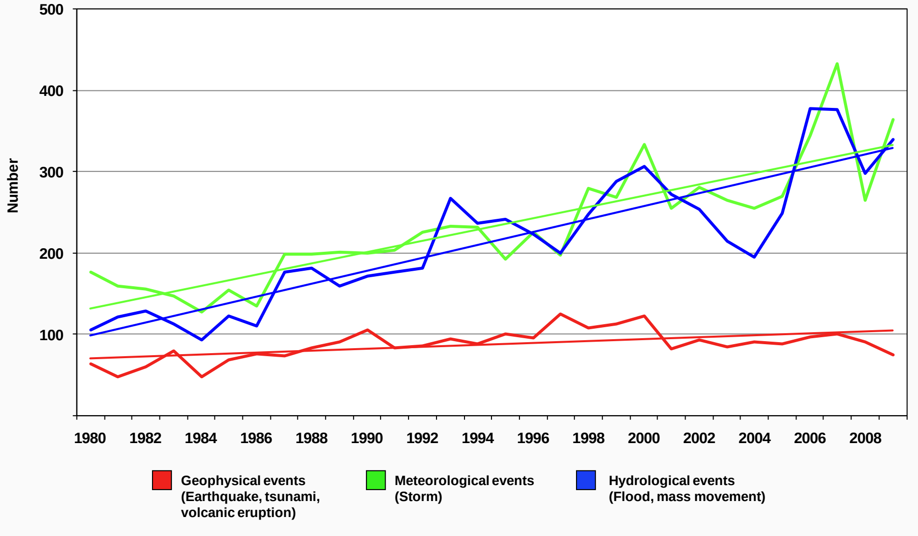

Climate Change and Extreme Weather Events (IPCC, 2007)

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Phenomenon[a] and direction of trend	Likelihood that trend occurred in late 20th century (typically post 1960)	Likelihood of a human contribution to observed trend[b]	Likelihood of future trends based on projections for 21st century using SRES scenarios
Warmer and fewer cold days and nights over most land areas	*Very likely*[c]	*Likely*[d]	*Virtually certain*[d]
Warmer and more frequent hot days and nights over most land areas	*Very likely*[e]	*Likely (nights)*[d]	*Virtually certain*[d]
Warm spells/heat waves. Frequency increases over most land areas	*Likely*	*More likely than not*[f]	*Very likely*
Heavy precipitation events. Frequency (or proportion of total rainfall from heavy falls) increases over most areas	*Likely*	*More likely than not*[f]	*Very likely*
Area affected by droughts increases	*Likely* in many regions since 1970s	*More likely than not*	*Likely*
Intense tropical cyclone activity increases	*Likely* in some regions since 1970	*More likely than not*[f]	*Likely*
Increased incidence of extreme high sea level (excludes tsunamis)[g]	*Likely*	*More likely than not*[f,h]	*Likely*[i]

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

Global Warming is Real!
Continental Temperature Changes

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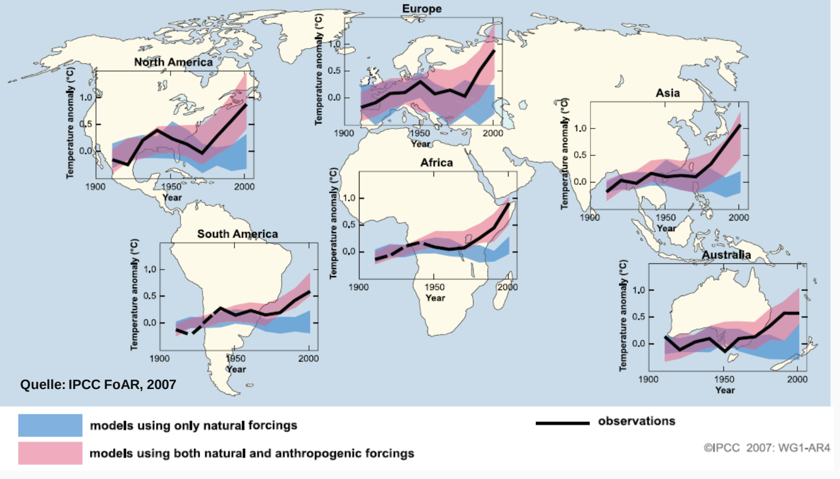

Black lines: decadal averages of observations
Blue band: 5-95% range 19 simulations from 5 climate models using only natural forcings
Red band: 5-95% range for 58 simulations from 14 climate models using natural and anthropogenic forcings

CO_2 concentration in the atmosphere

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

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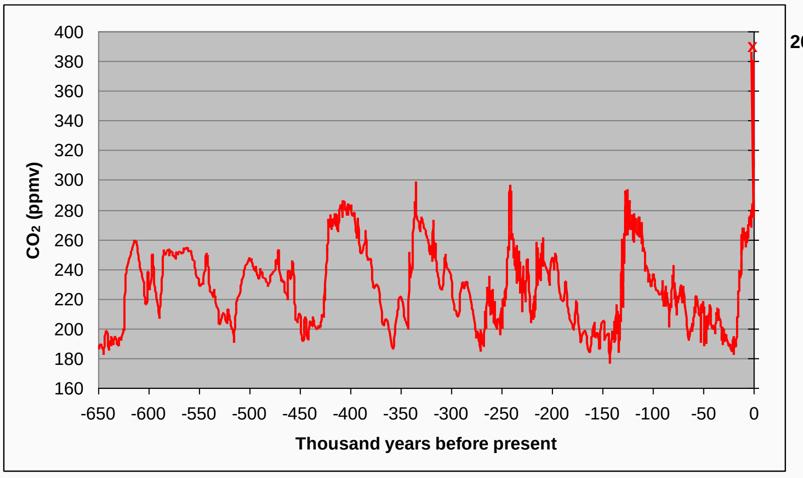

Sources: Siegenthaler et al., Science (2005). Etheridge et al., J. Geophys. Res. (1996). Petit et al., Nature (1999). Fischer et al., Science (1999). Indermühle et al., Geophys. Res. Lett. (2000). Monnin et al., Earth Planet. Sci. Lett. (2004). Monnin et al., Science (2001).

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

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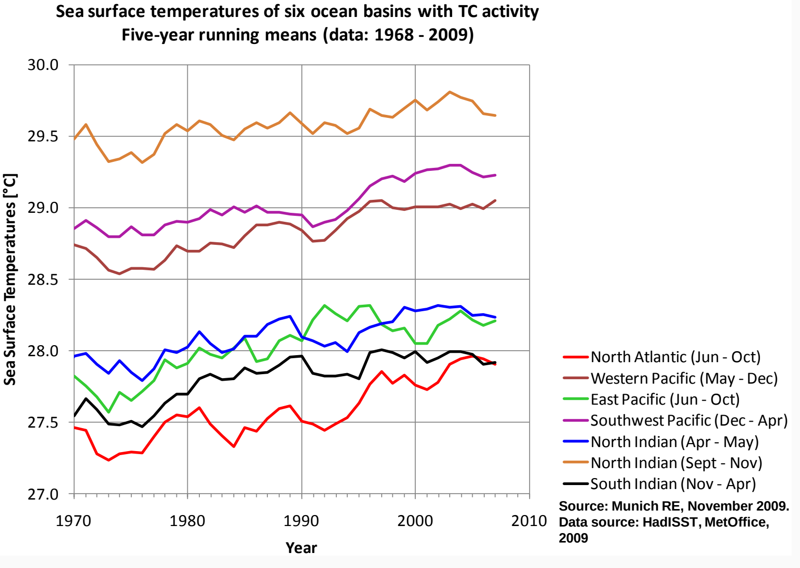

Source: Munich RE, November 2009. Data source: HadISST, MetOffice, 2009

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

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Sea level rise projections for three IPCC emission scenarios.

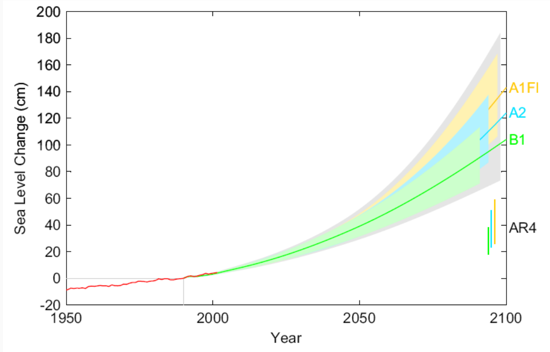

Table 1. Temperature ranges and associated sea-level ranges by the year 2100 for different IPCC emission scenarios

Scenario	Temperature range, °C above 1980–2000	Model average, °C above 1980–2000	Sea-level range, cm above 1990	Model average, cm above 1990
B1	1.4–2.9	2.0	81–131	104
A1T	1.9–3.8	2.6	97–158	124
B2	2.0–3.8	2.7	89–145	114
A1B	2.3–4.3	3.1	97–156	124
A2	2.9–5.3	3.9	98–155	124
A1FI	3.4–6.1	4.6	113–179	143

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

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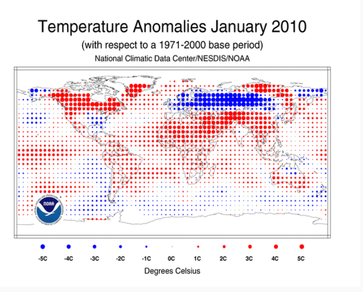
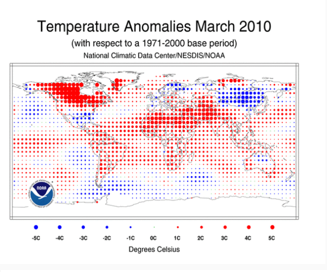
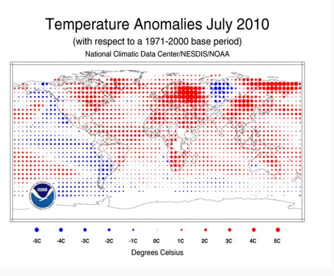




January 2010: 4th warmest
February 2010: 6th warmest
March 2010: 1st warmest
April 2010: 1st warmest
May 2010: 1st warmest
June 2010: 1st warmest
July 2010: 2nd warmest



2010: Global Warming Sets New Records

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- 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

CO_2 – the Most Important Greenhouse Gas

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- CO_2 contributes more than 60% to anthropogenic global warming
- CO_2 on average stays in the atmosphere more than 100 years
- The largest part of CO_2 emissions stems from burning of fossil fuels

=> Key to long term environmentally friendly and sustainable energy supply are renewable energies

Potential for Renewable Energies

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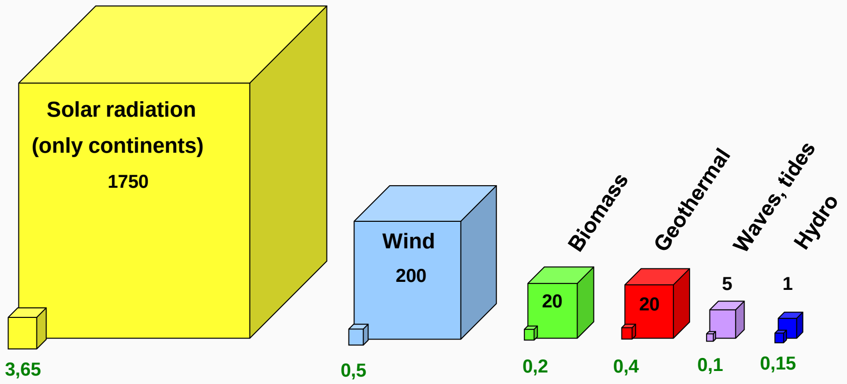
Global primary energy consumption: 491 EJ/a — 1



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)

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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

Figure: Desertec Foundation

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

Motivations for the Dii

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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

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07/13/09	▪ Joint signature for a memorandum of understanding by 12 companies and the DESERTEC Foundation for the formation of the Dii GmbH
10/30/09	▪ Legal foundation of the planning company ▪ Appointment of Paul van Son as CEO ▪ Definition of Dii's governance structure
03/10/10	▪ Appointment of Prof. Klaus Töpfer as special envoy
10/31/12	▪ Development of an implementable roadmap to „green energy generation" in the deserts of North Africa and the Middle East
2020	▪ 20GW installed capacity (according to political goal of MSP)
2050	▪ 100GW installed capacity (referring to the 15% aim of the Dii concept)

Dii GmbH – Current Shareholders and Associated Partners

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Dii Shareholder (as at June 2010)

ABB, ABENGOA SOLAR, cevital, Deutsche Bank, Enel Green Power, e.on, HSH NORDBANK, DESERTEC FOUNDATION, FLAGSOL, Munich RE, m+w zander, NAREVA Holding, SAINT-GOBAIN SOLAR, SCHOTT solar, SIEMENS, RED ELÉCTRICA DE ESPAÑA, VORWEG GEHEN RWE

Dii Associated Partners (as at July 2010)

3M, Audi, BearingPoint Management & Technology Consultants, BILFINGER BERGER, COMMERZBANK, Concentrix solar, CONERGY, EVONIK INDUSTRIES, First Solar, FLABEG, IBM, Italgen Italcementi Group, KAEFER, LAHMEYER INTERNATIONAL, MAURI SOLARE, Morgan Stanley, NUR ENERGIE, OMV, SCHOELLER, ΤΕΡΝΑ ΕΝΕΡΓΕΙΑΚΗ

Dii GmbH objectives

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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 ▪ 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 ▪ Conduct in-depth studies on specific subjects

Result from pre-studies by the German Centre for Aerospace

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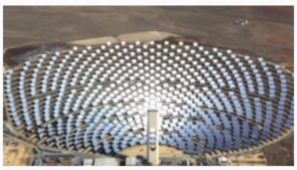
Generation: Advantages for CSP plants



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!

Result from pre-studies by the German Centre for Aerospace

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Transmission: Advantages for and high-voltage direct current grids

Source: Böhm, Siemens AG

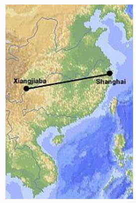
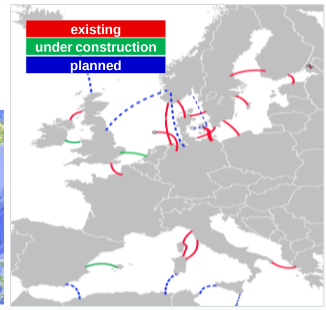
High-voltage direct current (HVDC)

- 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

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Munich Re's goals as the initiator of the Dii GmbH

www.dii-eumena.com

Mid term	INSURANCE SOLUTIONS FOR RENEWABLE ENERGIES	**Leading role in developing new risk transfer solutions for renewable energies / new technologies**
	INVESTMENT	**New (direct) investment options**
Long term	CLIMATE PROTECTION	**Support of CO_2 mitigation projects**
	BUSINESS OPPORTUNITIES	**Leading provider of renewable energy insurance**

Munich Re Publication on „Energy Situation, Problems with Commodities and Insurance“ dated 1978

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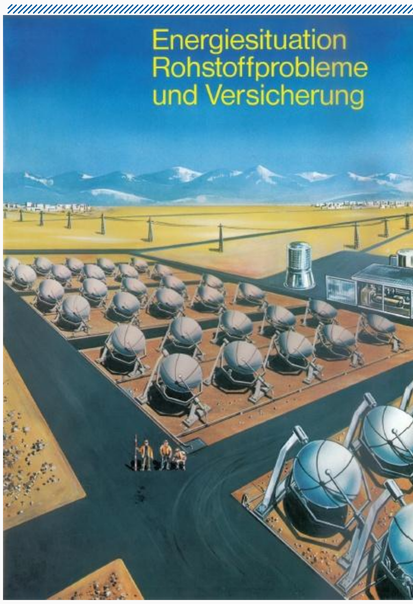

Das Titelbild zeigt eine Sonnen- oder Solarfarm, wie sie für Afrika und die südlichen Gegenden Europas konzipiert wird. Mehrere zusammengeschaltete Parabolspiegel sorgen für Wassererhitzung im Paraboloidbrennpunkt. Der Wasserdampf wird zu einer Dampfturbine geleitet, die einen Stromgenerator antreibt. Vor dem Rücklauf zu den Spiegeln durchläuft das Wasser noch einen Kühlturm (neben dem Generator-Container sichtbar). Die hier gezeigte Anlage, deren kleinste Einheit auf 50 kW ausgelegt ist, wurde vom Luft- und Raumfahrtkonzern Messerschmitt-Bölkow-Blohm entwickelt.

Druck: Carl Gerber Grafische Betriebe GmbH,
Muthmannstraße 4, D-8000 München 45

Characteristics of Renewable Energies

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- 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

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Protecting the entire life cycle of renewable energy projects

Challenge	Solution
▪ 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

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- 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 CO_2-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

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