Ausbau neuer Technologien zur Bekämpfung des Klimawandels
Beiträge der Versicherungsbranche

22.10.2019
Michael Schrempp
Global Head of Green Tech Solutions
Green Tech Solutions within Munich Re
… the world’s largest reinsurer’s financial strength for a greener world

Munich Re (Group)

- World’s largest reinsurer by premium volume
- Founded in 1880
- Total Assets > EUR 260 billion
- Approx. 43,000 employees

Rating

<table>
<thead>
<tr>
<th>Agency</th>
<th>Rating</th>
<th>Outlook</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M Best</td>
<td>A+ (Superior)</td>
<td>stable</td>
</tr>
<tr>
<td>Fitch</td>
<td>AA (Very Strong)</td>
<td>stable</td>
</tr>
<tr>
<td>Moody’s</td>
<td>Aa3 (Excellent)</td>
<td>stable</td>
</tr>
<tr>
<td>S&amp;P</td>
<td>AA- (Very Strong)</td>
<td>stable</td>
</tr>
</tbody>
</table>
Global Risk Landscape 2019
NatCat und Klimarisiken unter den Top 5

Source: World Economic Forum “Global Risk Landscape 2019”

31 October, 2019
First reference to climate change and global warming of Munich Re in 1973

Schadenverläufe nicht gerechnet werden kann, sind Trenduntersuchungen erforderlich. Sie beziehen sich auf thermodynamische Vorgänge, wie z. B. steigende Temperatur der Erdatmosphäre (dadurch Rückzug von Gletschern und Polkappen, Flächenverringerung von Seen und Anstieg der Meerestemperatur); Änderungen in der Luftfeuchtigkeit; Verunreinigung der Erdatmosphäre, z. B. Zunahme des CO₂-Gehaltes der Luft, die eine Änderung der Sonnenenergieabsorption bewirkt. Auf diesen Problembereich wollen wir noch etwas näher eingehen, zumal seine denkbaren Auswirkungen auf den langfristigen Risikotrend unseres Wissens bisher kaum untersucht wurden.
Natural Catastrophes and climate change
45 years of expertise at Munich Re

1973
MR's first global warming alert

1974
Foundation of Geo Risks Research department

1978
First edition of “World Map of Natural Hazards”

1989
First (physical) Globe of Natural Hazards

1990
Analyses of NatCat events in “Schadenspiegel”

1994
First edition of “Topics GEO”

2000
First CD-ROM “World map of Natural Hazards”

2005
Founding of “Munich Climate Insurance Initiative” (MCII)

2007
Climate change defined as strategic topic → Founding Corporate Climate Centre

2009
Founding of “Desertec Industrial Initiative” (Dii)

2011
NATHAN Risk Suite

2014
Contribution to IPCC 5th Assessment Report

2017
NatCatSERVICE online Analysis Tool

2019/2020
Climate Risk Mapper

Quelle: Munich Re
How does climate change affect natural catastrophe risk?

INCREASING EXTREME WEATHER EVENTS

- Increase of emissions
- Warming Air and Sea
  - Increased moisture content in the air
- Sea level raising

IMPORTANT FOR INSURER

- More severe events
- More frequent events

Such as windstorms, thunderstorms, hailstorms, heavy rains or droughts
### Natural catastrophes worldwide: review 2017 and 2018

#### 2017: Costliest year for insurance industry ever (tropical cyclones!)

- **Losses from natural catastrophes**
  - 2017: US$350bn
  - Costliest hurricane season on record: US$220bn

- **Less than half of the losses insured**
  - 2017: US$140bn
  - Floods in South Asia: a humanitarian disaster (~2,700)

#### 2018: Losses driven by tropical cyclones, wildfires and drought events

- **Losses from natural catastrophes in 2018**
  - 2018: US$160bn
  - Costliest event: Wildfire in California (Camp Fire): US$16.5bn (insured losses US$12.5bn)

- **Half of the losses insured**
  - 2018: US$80bn
  - A humanitarian tragedy: Earthquakes and tsunamis hit Indonesia (~3,100 people killed)

**Source:** Munich Re, NatCatSERVICE, January 2019
Climate change: What is it about?
Increase of global mean temperature @ approx. 1°C since 1880

Source: Munich Re, based on data from National Centers for Environmental Information/NOAA (01/2018)
Natural catastrophe losses

Inflation adjusted via country-specific consumer price index and consideration of exchange rate fluctuations between local currency and US$.

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Michael Schrempp – Green Tech Solutions – FVEE Berlin

31 October, 2019
Natural catastrophe losses
Germany (1980–2018)

Inflation adjusted via country-specific consumer price index and consideration of exchange rate fluctuations between local currency and US$.
### Reasons for increase of natural catastrophe losses

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbesserter Lebensstandard</td>
<td>Mittelklasse wächst weltweit rapide an</td>
</tr>
<tr>
<td>Besiedlung und Industrialisierung stark gefährdeter Räume</td>
<td>Besonders Küstengebiete, Gebiete an Flüssen</td>
</tr>
<tr>
<td>Zunahme von Komplexität und Interdependenz</td>
<td>Zunehmende Komplexität von Produktionsstrukturen (inkl. logistischer Ketten), großtechnischer Anlagen etc.</td>
</tr>
<tr>
<td>Klimawandel</td>
<td>Intensivierung und Häufung von Wetterereignissen in bestimmten Regionen</td>
</tr>
</tbody>
</table>

Grundsätzlich KEIN PROBLEM für Versicherer (Prämien wachsen proportional mit dem Risiko)

PROBLEM für Versicherer, falls Risikomodelle nicht an Änderungen angepasst werden
## Climate change: Impact on risk management decisions

Physical impacts of global warming until the end of this century

### Warming by 2100

<table>
<thead>
<tr>
<th>Physical impacts</th>
<th>&lt;2 °C</th>
<th>1.5 °C</th>
<th>2 °C</th>
<th>3 °C</th>
<th>5 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea-Level Rise (cm)</td>
<td>0.3-0.6 m</td>
<td>0.4-0.8 m</td>
<td>0.4-0.9 m</td>
<td>0.5-1.7 m</td>
<td></td>
</tr>
<tr>
<td>Coastal assets to defend ($tn)</td>
<td>$10.2tn</td>
<td>$11.7tn</td>
<td>$14.6tn</td>
<td>$27.5tn</td>
<td></td>
</tr>
<tr>
<td>Chance of ice-free Arctic summer</td>
<td>1 in 30</td>
<td>1 in 6</td>
<td>4 in 6 (63%)</td>
<td>6 in 6 (100%)</td>
<td></td>
</tr>
<tr>
<td>Tropical cyclones:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fewer (#cat 1-5)</td>
<td>-1%</td>
<td>-6%</td>
<td>-16%</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Stronger (#cat 4-5)</td>
<td>+24%*</td>
<td>+16%</td>
<td>+28%</td>
<td>+55%</td>
<td></td>
</tr>
<tr>
<td>Wetter (total rain)</td>
<td>+6%</td>
<td>+12%</td>
<td>+18%</td>
<td>+35%</td>
<td></td>
</tr>
<tr>
<td>Frequency of extreme rainfall</td>
<td>+17%</td>
<td>+36%</td>
<td>+70%</td>
<td>+150%</td>
<td></td>
</tr>
<tr>
<td>Increase in wildfire extent</td>
<td>x1.4</td>
<td>x1.6</td>
<td>x2.0</td>
<td>x2.6</td>
<td></td>
</tr>
<tr>
<td>People facing extreme heatwaves</td>
<td>x22</td>
<td>x27</td>
<td>x80</td>
<td>x300</td>
<td></td>
</tr>
<tr>
<td>Land area hospitable to malaria</td>
<td>+12%</td>
<td>+18%</td>
<td>+29%</td>
<td>+46%</td>
<td></td>
</tr>
</tbody>
</table>

Source: CRO-Forum “The Heat is on” (2019)
Climate change: Impact on risk management decisions (2)

Economic impacts of global warming until the end of this century

<table>
<thead>
<tr>
<th>Economic impacts</th>
<th>&lt;2 °C</th>
<th>3 °C</th>
<th>5 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global GDP impact (2018: $80tn)</td>
<td>-10%</td>
<td>-23%</td>
<td>-45%</td>
</tr>
<tr>
<td>Stranded assets</td>
<td>Transition: fossil fuel assets (supply, power, transport, industry)</td>
<td>Mixed: some fossil fuel assets mothballed, some physical stranding</td>
<td>Physical: uninhabitable zones, agriculture, water-intensive industry, lost tourism etc</td>
</tr>
<tr>
<td>Food supply</td>
<td>Changing diets, some yield loss in tropics</td>
<td>24% yield loss</td>
<td>60% yield loss, 60% demand increase</td>
</tr>
<tr>
<td>Insurance opportunities</td>
<td>New low-carbon assets and infrastructure investment (e.g. CCS)</td>
<td>Increasing demand to manage growing risks</td>
<td>Minimal: recession, tensions, high and unpredictable risks</td>
</tr>
</tbody>
</table>

Source: CRO-Forum “The Heat is on” (2019)
Politische Ziele zur Dämpfung des Klimawandels

50% Wahrscheinlichkeit einer Temperaturerhöhung auf über 2°C

Paris Agreement (2015): 165 UN-Vertragsstaaten einigen sich auf 2°C

- 2°C Limit: begrenzung des Anstiegs der globalen Mitteltemperatur auf 2°C, wenn möglich auf 1.5°C
- Klimaversicherung: Klimawandelbedingte Schäden und Verluste werden als dritte Säule anerkannt, neben Adaption und Mitigatio

Komplette Dekarbonisierung bis 2050 in vier Phasen

Nötige Schritte zur Erreichung des 2° Limits

1. Basistechnologien
   Entwicklung EE, Ausbau EE, Entwicklung Effizienztechnologien

2. Systemintegration
   Digitalisierung, Speicher Entwicklung, Verbindung Verkehrs-, Industrie- und Wärmesektor

3. Synthetische Kraftstoffe
   Großskalige Elektrolyse, Wasserstoff, Methanol

4. Finale Dekarbonisierung
   Ersatz aller fossilen Brennstoffe, CO2-freie Technologien

Quelle: Munich Re, basierend auf acatech Daten
Munich Re’s climate change strategy with focus on the following fields of activity

<table>
<thead>
<tr>
<th>Risk assessment &amp; measurement</th>
<th>Risk transfer solutions</th>
<th>Asset management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detecting and assessing climate change impacts on frequency and intensity of natural hazards</td>
<td>Understanding climate related financial disclosure requirements and providing tools to measure physical &amp; transitional risk</td>
<td>Providing risk transfer solutions for new technologies and PPP solutions for markets particularly affected by adverse effects of climate change</td>
</tr>
<tr>
<td>Providing risk transfer solutions for new technologies and PPP solutions for markets particularly affected by adverse effects of climate change</td>
<td>Supporting the expansion of renewable energies and infrastructure projects with our sustainable investment strategy</td>
<td></td>
</tr>
</tbody>
</table>

**CARBON NEUTRALITY OF MUNICH RE**

**NEW COAL GUIDELINES**
Withdrawal from insurance of new coal power plants and coal mines; no investment in coal intensive shares and bonds

**TCFD (TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES)**
Participation in UNEP PSI Working Group on TCFD elaborating industry standards for disclosures

Source: Munich Re
Munich RE has build up a diversified Renewable Energy Investment Portfolio (approx. 1.6 bn EUR/1.15 GW)

<table>
<thead>
<tr>
<th>Countries</th>
<th>Technology</th>
<th>Equity/Debt Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK 21%</td>
<td>Wind 57%</td>
<td>Equity 29%</td>
</tr>
<tr>
<td>France 15%</td>
<td>Solar 6%</td>
<td>Debt 71%</td>
</tr>
<tr>
<td>Sweden 6%</td>
<td>Hydro 32%</td>
<td></td>
</tr>
<tr>
<td>Norway 9%</td>
<td>Geothermal 6%</td>
<td></td>
</tr>
<tr>
<td>Germany 11%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain 10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy 16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada 10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USA 10%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Munich RE invests substantially in Renewable Energy Projects using internal expertise to assess the projects adequately.
Stromerzeugung aus Sonnen- und Windenergie in den Wüsten Nordafrikas und des Nahen Ostens

Die Idee der Desertec Foundation

„Die Wüsten der Erde empfangen in 6 Stunden mehr Energie von der Sonne, als die Menschheit in einem Jahr verbraucht“

Gründung der Dii GmbH (2009)…

… und noch immer aktiv: https://dii-desertenergy.org
Risiken erneuerbarer Energien

Technologisches-/Regulatorisches Risiko

- Marktperspektive:
  Viele Technologien bisher nur mit kurzer kommerzieller Erfahrung; Garantie-/Performance-Risiken für Hersteller.
- Investorenperspektive:
  Neue Risiken = Investitionshemmnis

Rolle der Versicherungswirtschaft bei der Implementierung neuer Technologien

Ermöglichung/Beschleunigung der Kommerzialisierung neuer Technologien

- Schaffung von Investitionssicherheit – Beispiele:
  - Kommerzielle Satelliten
  - Leistungsgarantien für Solarkraftwerke, Windenergie oder Batteriespeicher

Quelle: Munich Re
Risk pyramid according to severity

The Warranty Risk of Solar is a fundamental risk

- External Physical Damage Risk (such as natural hazards)
- Warranty Risk of Solar
- Business interruption (BI) due to Political Risks
- BI due to Physical Damage Risk
- BI due to non-physical damage or O&M issues

Highest priority for mitigation at the base of the pyramid

Threat to material assets of the project
Standards in PV Performance Warranty

- Backsheet: Annual deg. of 0.7% for 25 years
- Dual Glass: Annual deg. of 0.5% for 30 years
- ... 0.45% for 35 years ... in 20XX
- Origin: not only technical, but marketing, competition, term of feed-in-tariffs, etc.

→ Financial model highly depends on this assumed annual degradation rate
→ Supplier’s Performance Warranty acts like an insurance: (i) repair, (ii) replace, or (iii) compensate underperformance.
→ However, the Supplier usual does not have the financial of an insurance company
Business enabling examples
Photovoltaic (PV) Sales and Buyers Cover

Description
Long-term performance cover for
- Investors in and manufacturer of photovoltaic modules
- Protecting the performance of solar panels up to 30 years

Risk Transfer Solution
- Chosen projects covered
- In case of insolvency, the cover is transferred
- Realization through covering technology AND credit risk
- Enabled to offer competitive rates

Achievements
- Creation of significant global insurance market
- Stable renewal business
- Munich Re established as Warranty Partner

Value proposition
- Planning stability due to dedicated capacity for Buyers and Project Investors
- Reliable Insurance partner and qualified due diligence

In case of Manufacturer’s insolvency

Munich Re’s PV Warranty Insurance

Project A  Warranty claims
Project B  Warranty claims
Project C  Warranty claims
**Business enabling examples**

**Energy Storage System (ESS) Performance Warranty Cover**

### Description

Long-term performance cover for

- Battery Cells & Packs
- Stationary Energy Storage Systems
- E-Mobility Applications

### Risk Transfer Solution

- Indemnification of excessive warranty claims
- One time premium based on insured year’s revenue
- Non-cancellable for the insurer

### Achievements

- Increased predictability for financial reserving
- Boost of growth-relevant cash reserves for R&D/marketing
- Balance sheet protection

### Value proposition

- Enterprise risk management (ERM) cover for revenues of global annual production
- Long-term security for manufacturer during multi-year liability period

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**CORPORATE COVER** against excessive maintenance costs

- "Qualified" Project A: Cover
- "Qualified" Project B: Cover
- "Rest of Production": No Cover

**PROJECT COVER** against excessive maintenance costs

- "Qualified" Project A: Cover
- "Qualified" Project B: Cover
- "Rest of Production": No Cover

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**Insolvency of the Manufacturer**

- COVER FOR THE MANUFACTURER
- COVER FOR THE PROJECT OWNER IN THE INSOLVENCY CASE
Green Tech Solutions
Growing profitable business while tackling climate change

Established Renewables
- Solar Energy
- Wind Energy
- Hydro

Smart Energy
- Electrical Energy Storage
- E-Mobility
- Energy Efficiency
- LED Asset/Installation Performance
- Air Conditioning/Heating
- Sustainability Improvements

Disruptive Technologies
- Bio Energy/Waste to Energy
- Fuel Cells
- Decontamination
- Water Treatment
- Efficient Resource Extraction
More than USD 1.8 bn exposure in support of over USD 25 bn capital in green technologies

- Internal expertise due to industry experts in-house
- Own test field at research center
- More than 200 PV manufacturing sites audited

Focus on Technology and Performance Risk

Long term performance protection up to 25 years

Additional triggers, e.g., Insolvency of the manufacturer

World-class partnerships with research and certification institutes, e.g., DEKRA, Fraunhofer, TÜV, VDE, …

Over 120 insured projects and manufacturers in 16 countries

18 GW insured
Munich Re GTS’ Value Proposition
Increasing profits and enabling business

- Adding the financial credibility to win customer trust & market share
- Risk assessment assures product quality and investment security
- Overall savings due to better financing terms & lower cost of capital

Innovative risk solutions ...

- Decreased financing cost
- Increased revenue
- Flexible allocation of capital
- Higher attractiveness to investors
- Reserving and freeing-up capital for growth relevant business activities becomes predictable
- ... to grow your business and drive success
- Adding the financial credibility to win customer trust & market share

Increased revenue

Higher attractiveness to investors

Flexible allocation of capital

Decreased financing cost
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