

Swiss Re



# Prolonged Power Blackout

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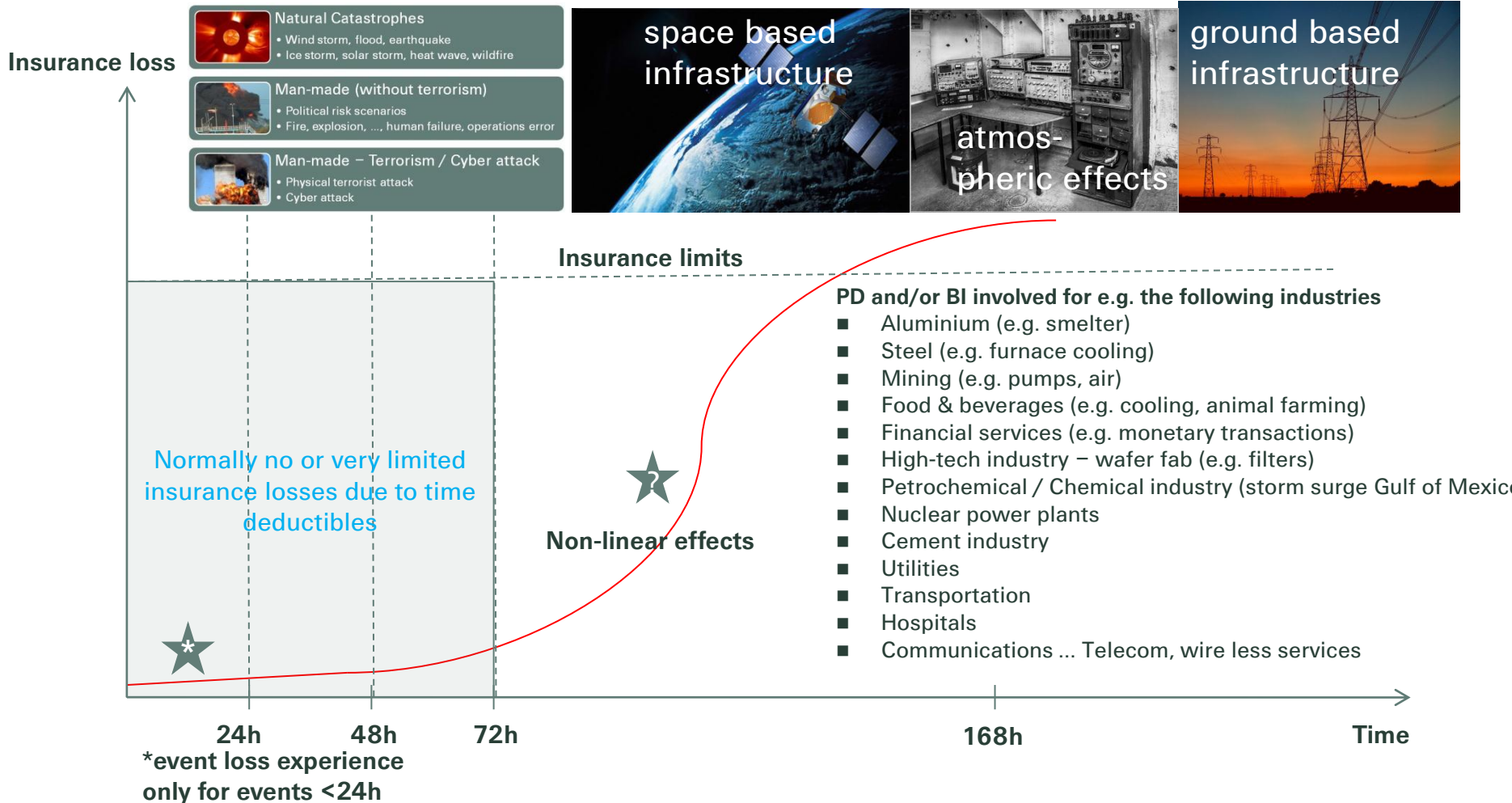


## Prolonged Power Blackout Executive Summary - Scenario


- Increased dependency makes today's society much more vulnerable to power supply interruptions (e.g. services, production, communication)
- The energy infrastructure is exposed to a variety of potential causes of interruptions (e.g. nat cat, solar storm, cyber attacks, human errors)
- A severe solar storm may damage transformers and lead to a
  - large scale power interruption,
  - affecting large areas, and
  - lasting from several days to months
- Cyber attacks on critical infrastructure may also result in a - more regional - prolonged power blackout
- Main lines of business: Property Business Interruption and CBI
- Event goes beyond the scope of insurance and requires collaboration across governments, businesses and society as a whole



# Blackouts: non-linear effects





 applied assumptions

# Assumption grid to build scenarios

## Impact on GDP

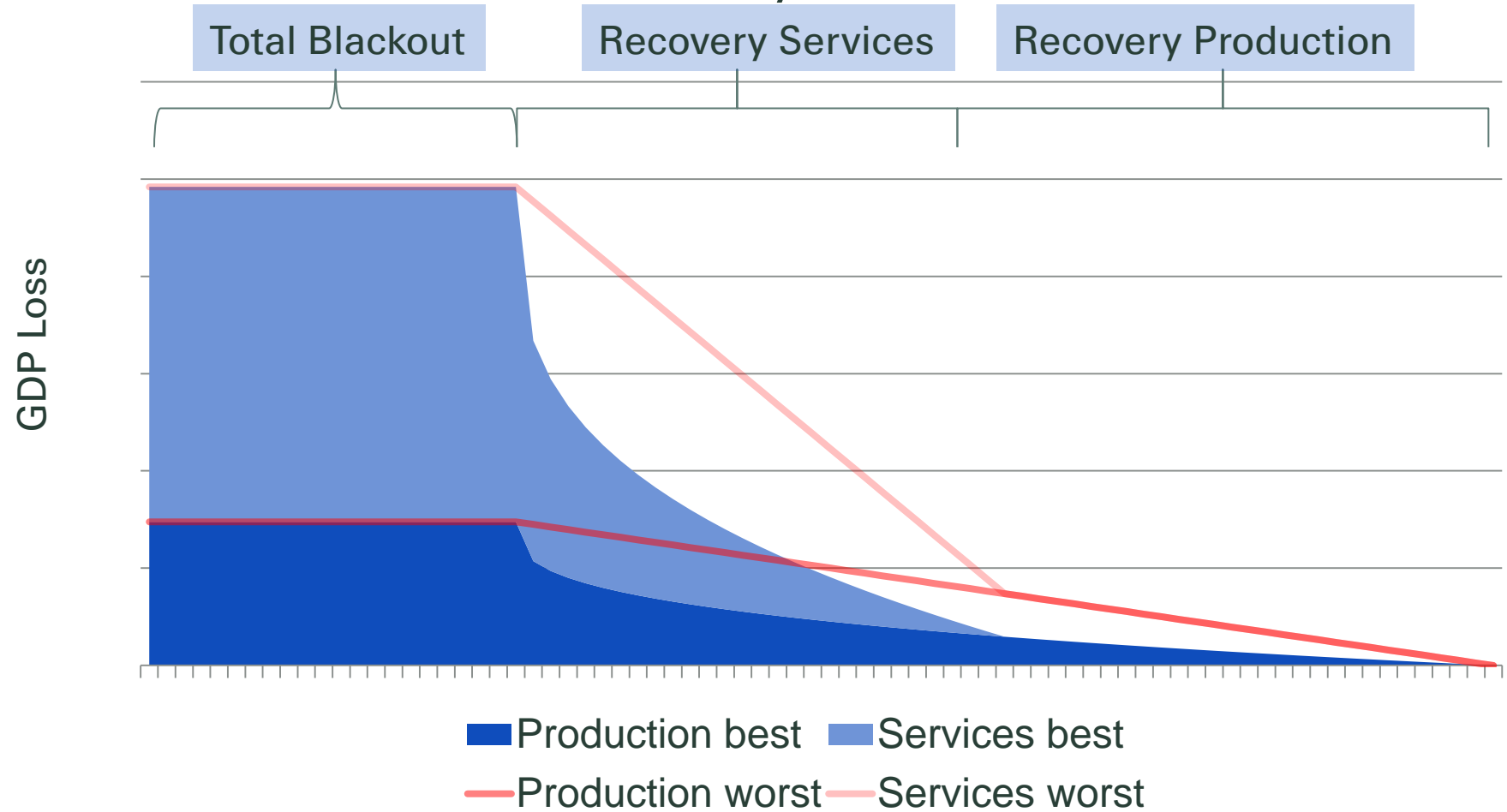
Transformer % affected	GDP affected	Total Blackout days	Recovery days Services	Recovery days Production	Accumulation of regions
1%	1%	<1	<1	<1	No
3%	3%	2	7	7	Local
<b>10%</b>	5%	7	14	14	<b>Europe</b>
20%	<b>10%</b>	14	<b>28</b>	28	US/CDN/Europe
35%	50%	<b>21</b>	56	<b>56</b>	US/CDN/Europe/Japan
50%	100%	112	112	112	Germany
		365	365	365	US/CDN
		730		730	UK



## Severe solar storm Economic loss calculation

- "Carrington"-type event; return period of 150-500 years
- Geomagnetic Induced Current will damage 10% of transformers in a specific region (e.g. USA/Canada, Scandinavia/UK, or Japan)
- Total blackout: 3 weeks
- Regional impact: 10% of GDP affected
- No accumulation among regions due to area and grid independency, except Europe
- Recovery of GDP
  - Services within 4 weeks
  - Production within 8 weeks
- Split GDP in Services/Production: 70%/30%

# Economic loss calculation Total blackout incl. recovery



# Severe solar storm ("Carrington"-type event) Economic/Swiss Re loss Best - worst case estimates



Regions	Economic Loss		Swiss Re Total		Reinsurance		CorSo	
	Best	Worst	Best	Worst	Best	Worst	Best	Worst
US&Canada	128'808	163'866						
Scandinavia & UK	28'903	37'210						
Germany, France, Italy, Switzerland, Austria	73'934	95'185						
<i>Accumulation Europe</i>	102'837	132'395						
Japan	41'746	53'745						
Australia	7'617	9'806						

Figures in mUSD



## Regional impact – Minor Event

- "Hydro-Quebec + findings from Auckland"-type event
- Geomagnetic Induced Current will damage 3% of transformers in a small region
- Total blackout: 2 days for the region plus 8 weeks for a smaller area (1%)
- Regional impact: 3% (2 days) respectively 1% (4/8 weeks) of GDP affected
- Europe mainly Country impact, but accumulation due to grid connectivity possible
- Recovery of GDP
  - Services within 4 weeks
  - Production within 8 weeks
- Swiss Re impact estimates based on the major event factors





## Regional impact – Frequency Event

Minor Event

Regions	Economic Loss	Total Swiss Re	Swiss Re R/I	Swiss Re CorSo
Scandinavia & UK	192			
Germany, France, Italy, Switzerland, Austria	492			

Figures in mUSD



## Validity check with historical events

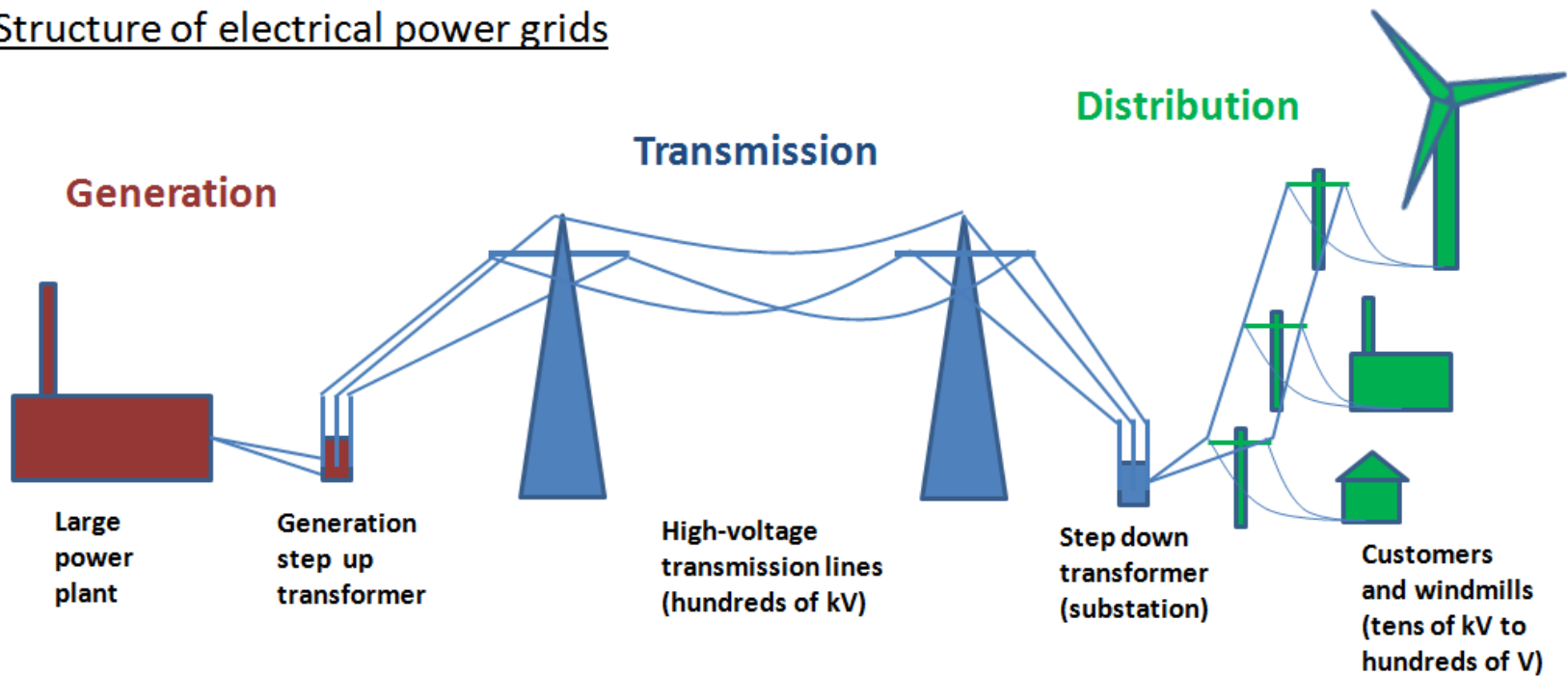
Event	Cause	Duration	People	Economic loss
Hydro Quebec 1989	Solar storm	9 hours	6m	CAD 10m
USA/CDN 2003	Various	4 days	50m	USD 4bn-8bn
Italy/Swiss 2003	Natural event	1.5 hours up to 2 days	56m	unknown

Estimates of Swiss Federal Office of Energy<sup>1</sup>: A blackout may result in an economic loss between CHF 2bn and 4bn per day

<sup>1</sup> electrosuisse  
Bulletin 12s/2011

# Power network

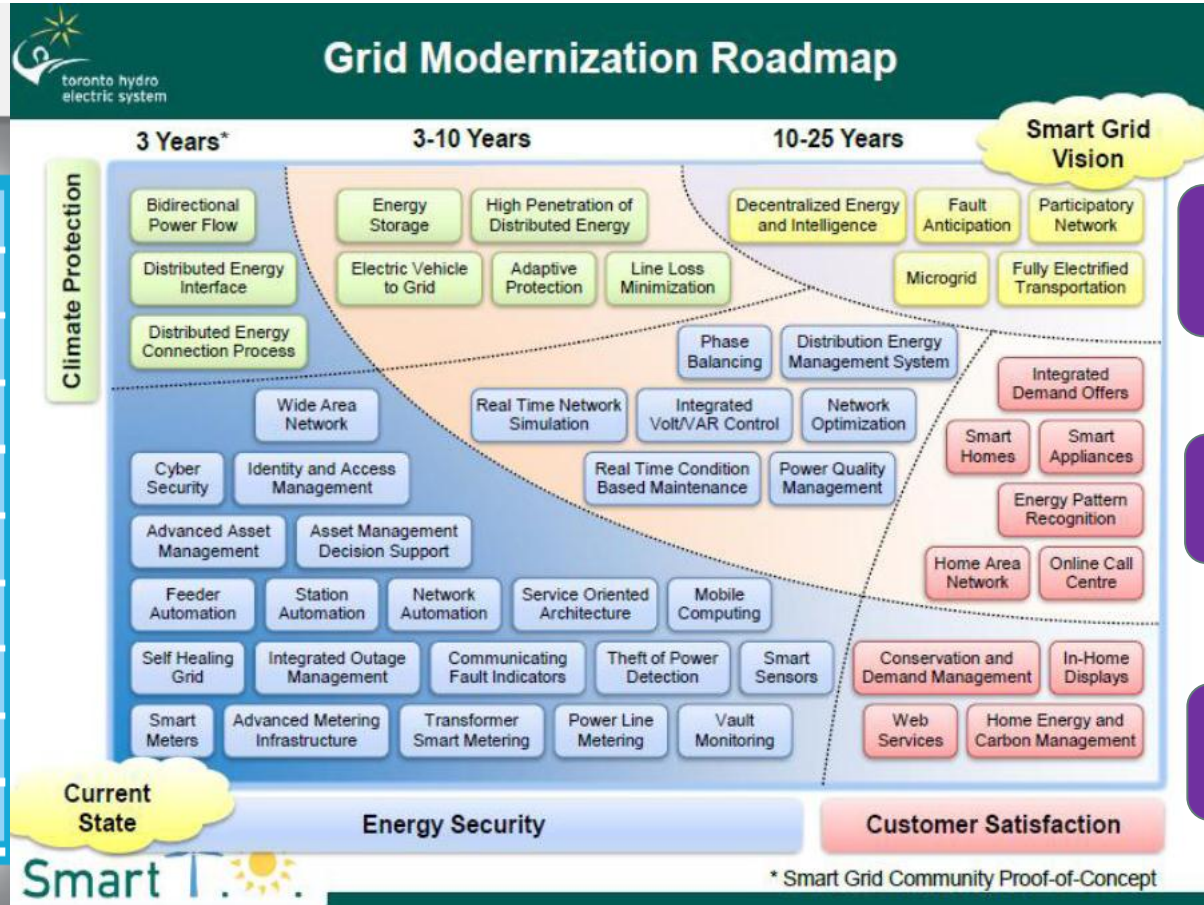
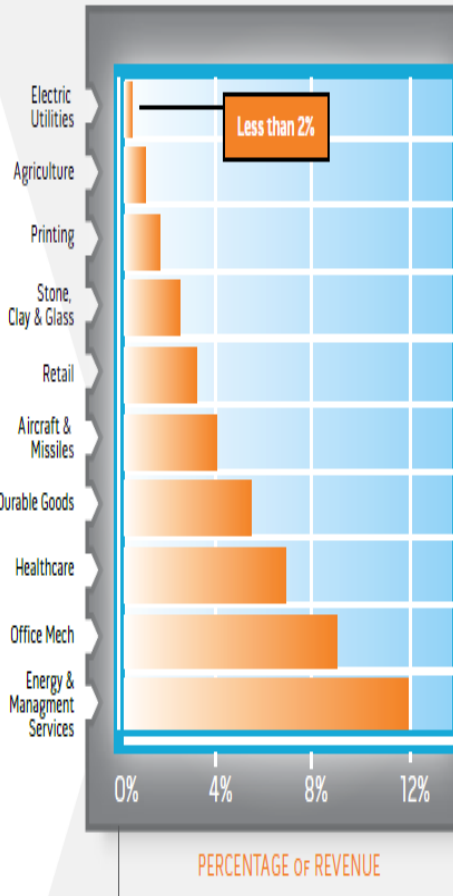
## Structure of electrical power grids





# Technology changes R&D investment needed Electric Utilities are not investing a lot ....

R&D as a % of Revenue





## Mitigation measures: 2 strategies:

- **Engineering solutions**, increasing robustness of electrical components
  - i.e. DC blocking devices, digital filters, improved relays for deliberate tripping of components, ...
  - retrofitting with new technology
  - replacing old with new (GIC resilient) technology
  
- **Improved operating procedures:**
  - n-1 testing is no longer sufficient, call for a detailed and precise vulnerability assessment of the grid, new design would be very costly
  - shut down procedures and coordinated restarts. Require more accurate space weather forecasts (regional strength and duration ...), dynamic modeling of the grid
  - plan for shifting grid loads and create "buffers" to protect long power lines
  - install back up transformers
  - current restructuring of European grid should result in new standards and new resilient design



## some of the biggest hurdles to overcome

- MYOPIA: Short term cost/benefit thinking in businesses > Top down regulation seems to be required
  - cost of risk mitigation should have an impact on the risk profile and lead to a risk reduction (what are the risk, what is at stake, what are the limits of tolerable business risk for the company?)
- Conflict of interest in case a company generating electricity and functions as a TSO (transmissions system operator)
- 100 yr event is not the day-to-day business of a grid operator ... our prolonged black out scenarios are not easily accepted!
- current vulnerabilities are not yet sufficiently stress tested by historical events
- our power grid is "too big to fail" at least for political reasons ....
- and the financial crisis goes on, government debt is still on the rise and we do not have sufficient money to be invested in our infrastructure ...

# Members of the Insurers' Working Group on Solar Storm Risk



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## Prolonged Power Blackout Executive Summary - Mitigation

- Loss prevention and emergency measures by Governments (CII defined as strategic assets) and Electric Power Industry (e.g. shut down/circuit break) possible and in discussion
- Raising awareness by Insurance Sector (e.g. CRO Forum publication and Task Force, lobbying via Geneva Association)
- Swiss Re internal risk mitigation steps
- Is the risk of a prolonged power black out in a metropolitan area a tolerable risk, considering the fact that corresponding technical mitigation and adaptation measures are available?  
**We think it is not "a bearable residual risk" ( as stated by some grid operators)**





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