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INSURANCE FOR A BETTER WORLD

Accelerating the energy transition and industrial decarbonization through cross sectoral collaboration

The powerful role of insurance

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The Geneva Association

Seminar Hosted by Andlinger Center for Energy + the Environment, jointly with, Center for Policy Research on Energy and Environment
Princeton University
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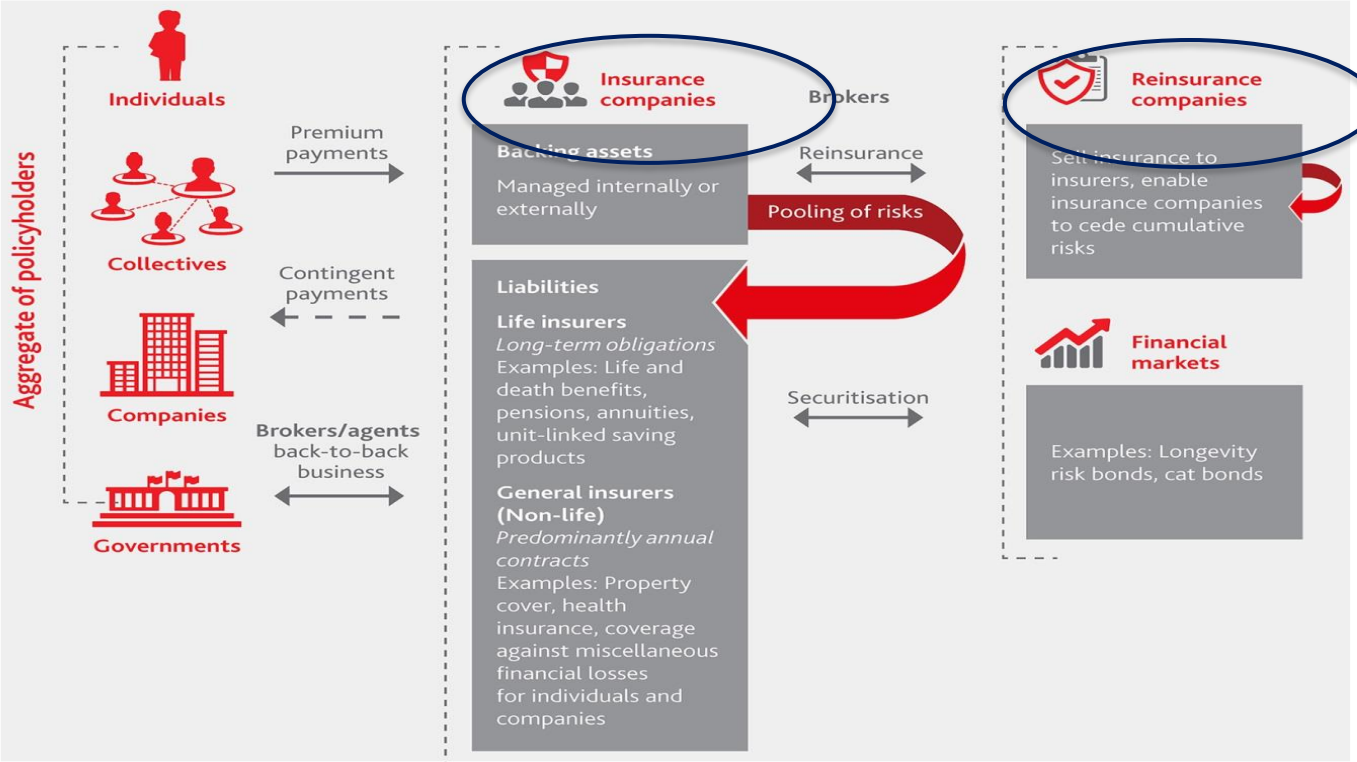
Topics

- A few words about insurance
- Part I: Interface of insurance and extreme weather risk
- Part II: Expediting deployment of climate tech for industrial decarbonization
- What is next?

How does the insurance industry work?



Deeply Regulated

Expertise

- Risk Management experts
- Underwriting/Risk Transfer experts
- Investors

Types of insurance

- Commercial vs. retail
- P&C vs. Life
- Private vs. public

Core Business Model (P&C)

- Transferring risks
- Annual contracts
- Enabler and catalyst for innovation and development

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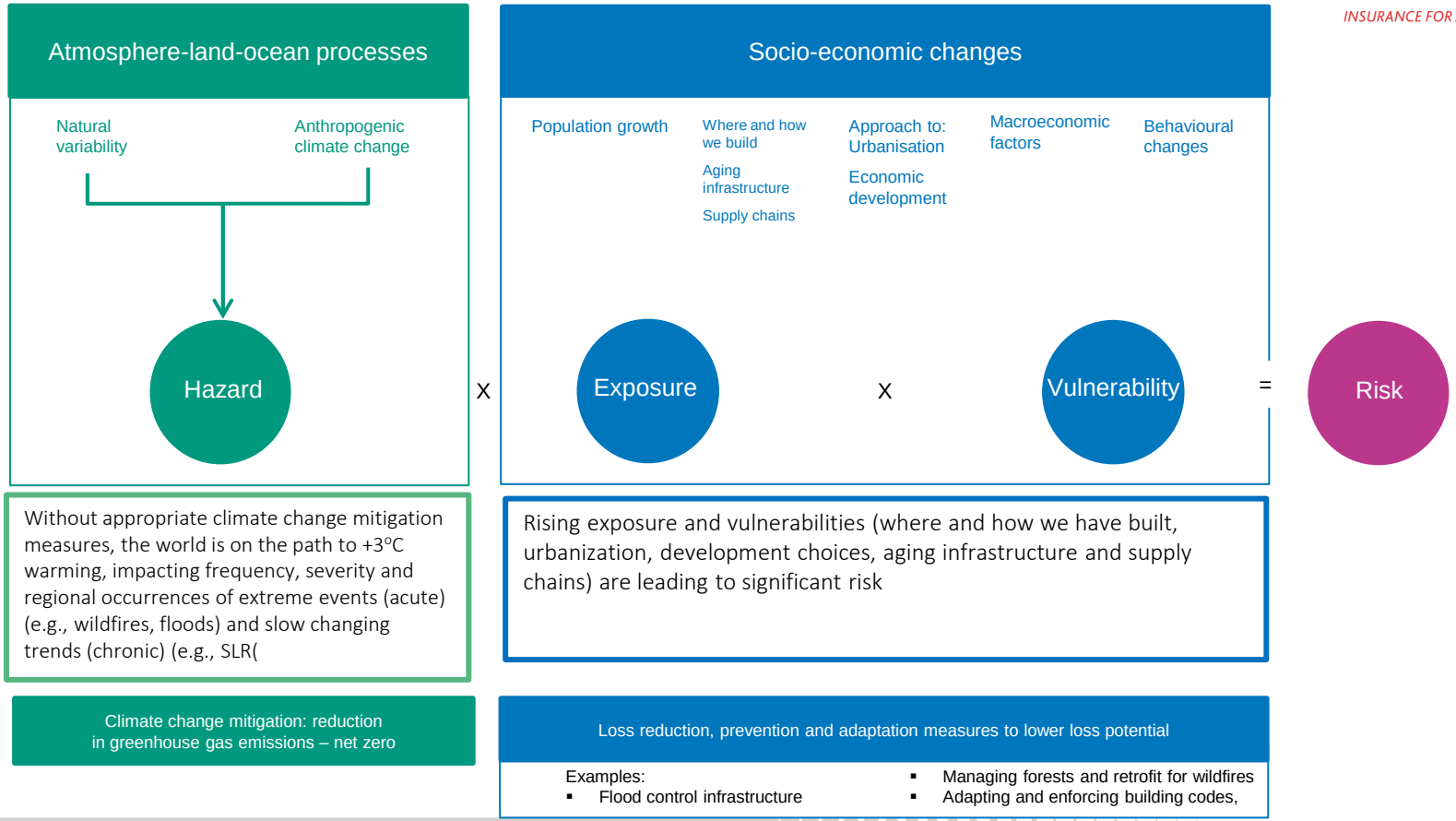
Part I: Interface of insurance and extreme weather risk

How to keep insurance available and affordable in the market?

On going research

Drivers of financial risks associated with weather extremes



Source: Swiss Re Institute, modified by Geneva Association

Global insured losses from weather-related extremes have more than quintupled over the past three decades

from less than USD 20 billion p.a. to more than USD 100 billion p.a.

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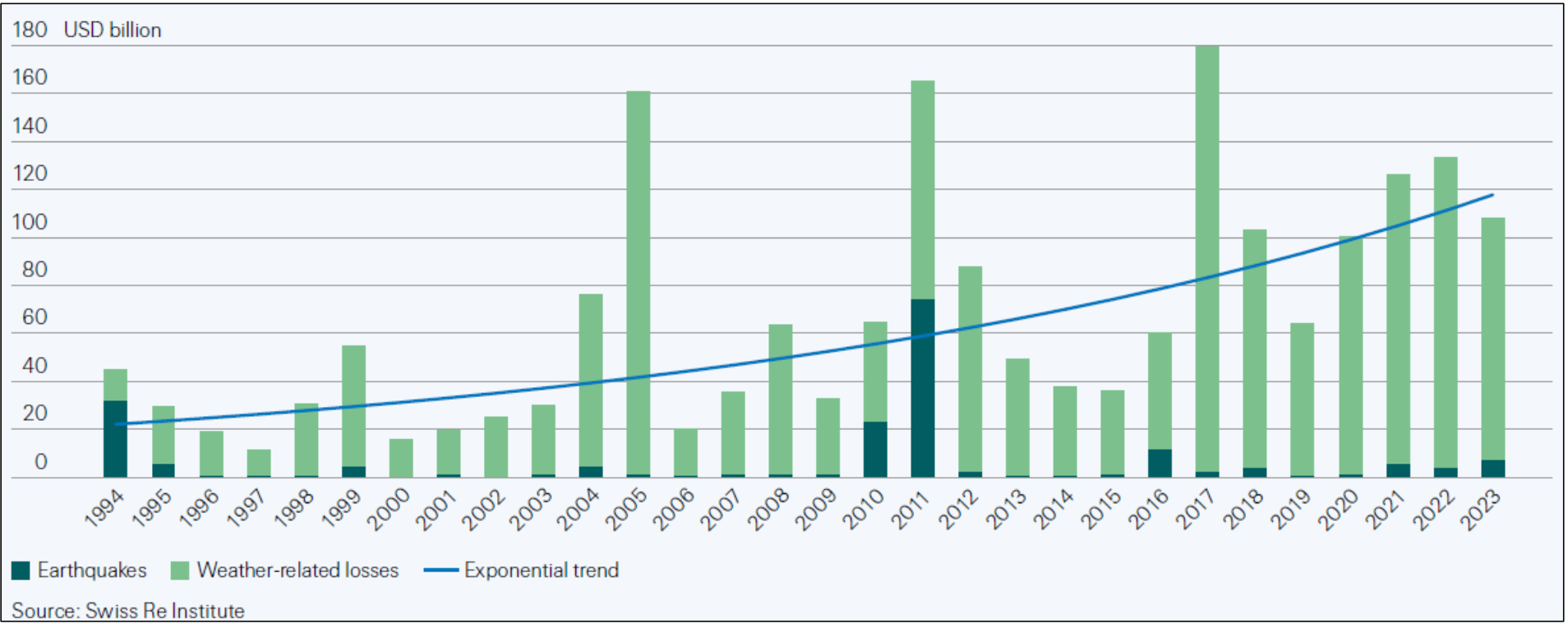

Economic losses from extreme weather events are roughly three times of insured losses and the gap is growing!

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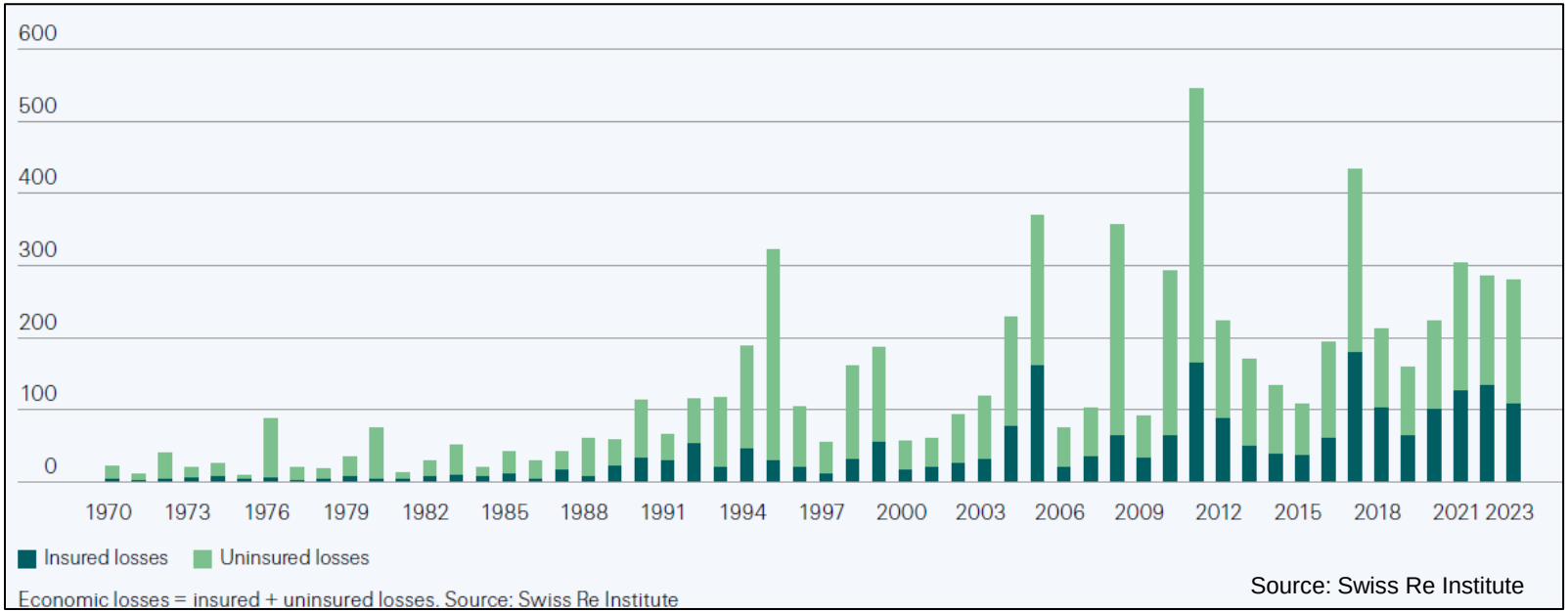

Limited up-take of insurance is linked to (1) lack of risk awareness, (2)underestimation of potential impacts, (3) reliance on post-disaster government hand-outs and (4) lack of culture of risk management (manage crisis than prevent).

Insurance losses linked to non-peak are perils on the rise

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Floods

- Heavy rainfall, pluvial flood
- Fluvial flood

Climate change trend:
Increased frequency of heavy precipitation

Wildfires

- Large uncontrolled fire
- Often starting in rural areas, spreading to urban and industrial areas

Climate change trend:
Increased risk of temperature extremes

Severe convective storms

- Tornadoes
- Hail
- Severe wind gusts

Climate change trend:
In Europe, increased conditions facilitating formation of thunderstorms

Further perils

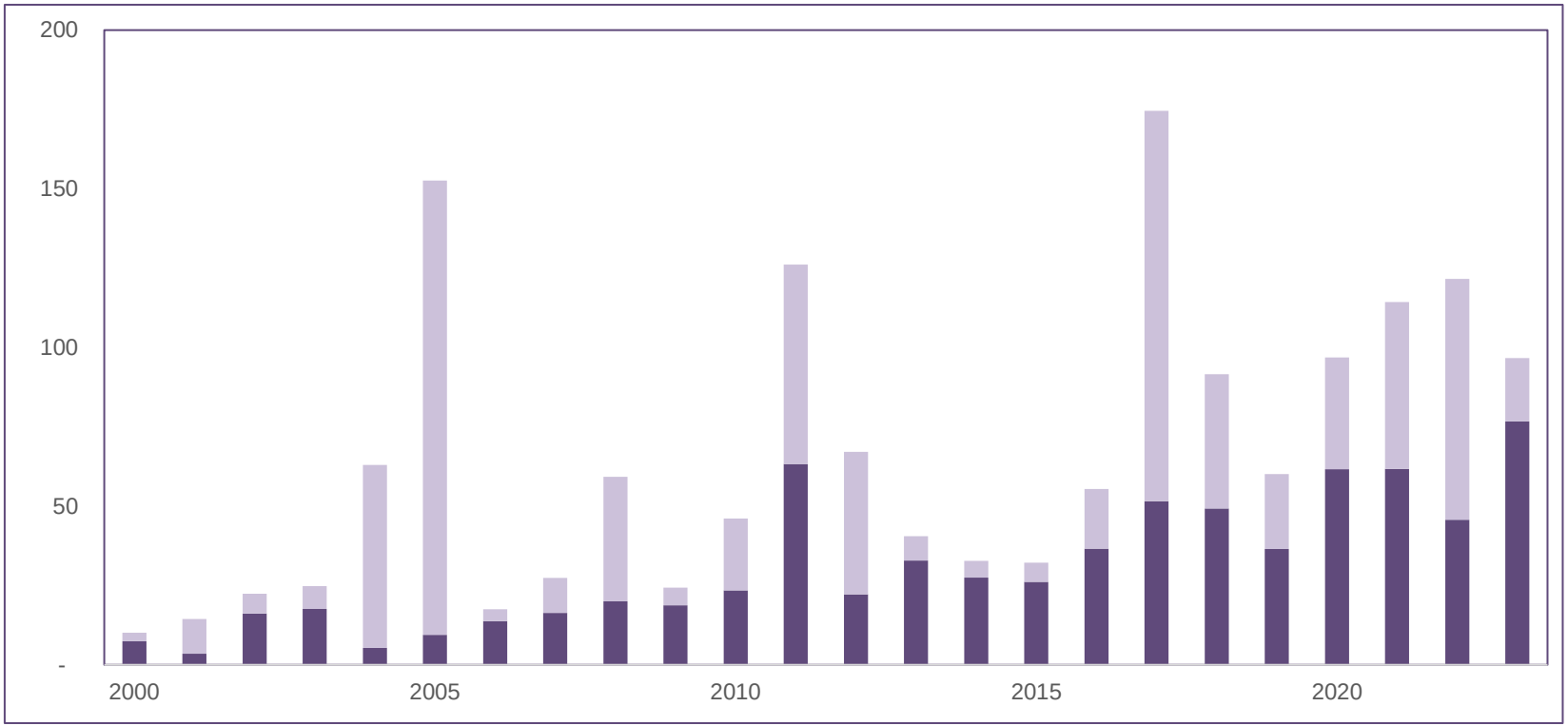
- Droughts
- Heatwaves
- Landslides
- Snow pressure
- …

Climate change trend:
Increased risk of temperature extremes

Source: Munich Re, NatCatSERVICE

Rising trend in global insured losses for non-peak perils

Annual insured losses in $bn



Source: Munich Re, NatCatSERVICE; inflation-adjusted

We are underestimating the risks: Indirect and compounding impacts of extreme weather events

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- Business interruption and related economic losses caused by:
  - Damages and destruction of critical infrastructure
  - Supply chain interruptions
  - Rippling effects of business interruption

- Compounding impacts – Interactions of physical climate risk and transition risks –
  - Summer 2022 in Europe (extreme heat),
  - Renewables (Hail)

Insurability of solar projects against extreme weather risk (e.g. Hail)

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Stages of project development, financing and execution

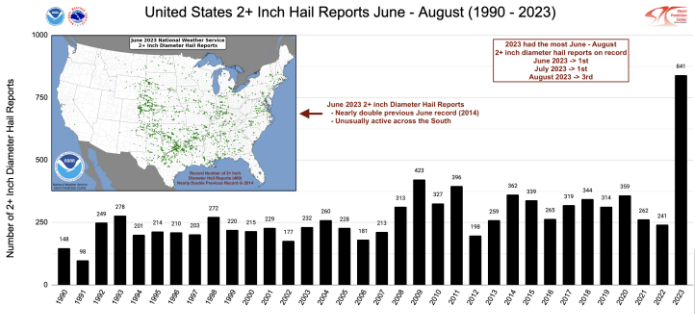
Phase 1: Conceptualisation studies	Phase 2: Feasibility studies	Phase 3: Pre-engineering design	Phase 4: Engineering design	Phase 5: Execution	Phase 6: Operation
Site selection approved	Basis of design approved	Technology selection approved	Final investment decision	Procurement and construction	

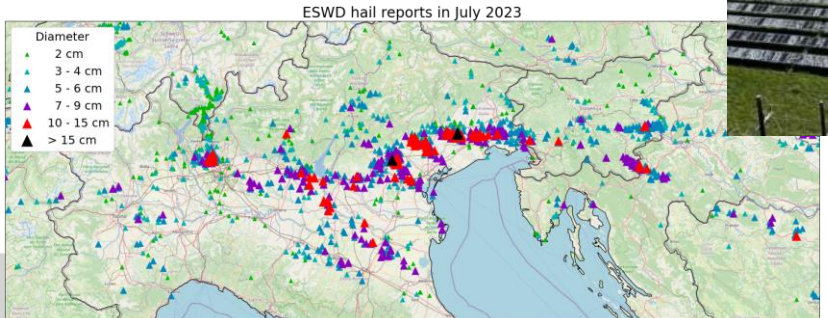
Project development milestones

Traditional touch point of re/insurers

Reconsidering touchpoints of re/insurers and project developers for early engagement

Source: Geneva Association





The narrative around insurance protection against extreme weather events is evolving and being refocused on key issues (1/2)

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Problem: With rising risks of extreme weather events and slow changing trends, and in the absence of appropriate risk mitigation measures, in some regions, insurers are limiting or cease offering new policies for some perils, some in response to regulatory pressures to cap insurance premiums. Reinsurers are also leaving some markets.

- This is leading to significant concerns among homeowners, businesses, government, investors and regulators now and for the future.

The narrative around insurance protection against extreme weather events is evolving and being refocused on key issues (2/2)

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- **A year ago:** "insurers leaving the market and leaving homeowners stranded"
- **Over the last six months:**
  - Risks have not been adequately reflected in home prices and insurance premiums.
  - How the risk is being created? Who is impacted? Who has the mandate to manage it?
  - Importance of investing in risk reduction and risk preventions has come into focus
  - Insurance regulators are being mandated by state governments bring focus to the need to reduce and prevent risks as opposed to capping insurance prices
  - Increasingly, regulators are concerned about how banks are assessing extreme event risks for offering mortgage? How are they managing risks in their infrastructure and real estate lending portfolios?
  - Not a systemic risk: 2% of USD 50 Tri hosing market is at risk
- **Now:** Government, regulators, legislators are starting to realize the need for
  - "All-of-Society" approach to managing risks to attract insurers back in the market. Availability of insurance?

Significant amount of research in underway supported by the insurance indutry

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- **Modeling of physical climate risk**
  - From Natural Catastrophe models to forward looking stochastic modelling of risks (GA reports)
- **Various approaches to reduce and prevent risk at home and community level**
  - Institute for Business and Home Insurance
  - Intact Center for Climate Adaptation
  - Flood risk management (Ga reports)
- Importance of preserving and managing nature-based systems to enhance resilience and reduce impacts of extreme weather events (GA report)
- **Insurance product innovation**
  - Public-private insurance solutions that industry cannot underwrite alone (pools) (GA reports)
  - Products and incentivize risk reduction or risk prevention or incentivize conservation of nature (GA reports)
  - To offer insurance in the absence of loss and damage data (Parametric insurance)

My current research focus: Demonstrating the need for and benefits of a paradigm shift in the way society manages physical climate risks

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- **Need for risk-based and system-based "all-of-society" approach to managing physical climate risk** taking into consideration assets' whole life-cycle

- **Need for a holistic approach to risk management:**
  - Clarity on risk governance: public policy, regulatory frameworks, landscape of stakeholders with different mandates and incentives
  - Ability of key stakeholders to identify and assess risks
  - Communicating risks to enhance risk awareness and empower risk-based decision making
  - Measures to reducing existing risks (e.g. retrofits, flood barriers, nature-based solutions, real-time maintenance) and preventing new risks (e.g. zoning, upgrading building codes)
  - Transferring residual risks through insurance markets
  - Risk financing – managing government's budget
  - Building forward more resiliently

With focus on housing, industrial and infrastructure systems (with focus on energy)

- **Implications for re/insurers:** enhanced risk analytics for better decision-making over medium to long-term**,** product and service innovation, opportunities for cross-sectoral partnerships, etc.

- **Implications for regulatory bodies:** how can they support/promote risk management to keep insurance available and affordable in their respective markets? Can risk management be integrated to reduce cost of capital to incentivize investments in resilient assets?

- **Implications for public policy**

Part II: Expediting deployment of climate tech for industrial decarbonization

Phase I: Recently completed and being operationalized

Phase II: Will be launched in 2025

Expediting climate tech deployment industrial decarbonisation

Critical importance of cross-sectoral collaboration and role of insurance

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A Multi-stakeholder Collaboration:

- **Insurance:** Allianz, AIG, AXA XL, AXIS Capital, Intact Financial, Liberty Mutual, Manulife, Munich Re, SCOR, Swiss Re, Tokio Marine, New Energy Risk, Energetic Capital, KhW Analytics
- **Government:** US Department of Energy
- **Financing:** Breakthrough Energy (120 Climate venture in growth stage)
- **Banking:** HSBC, Citi
- **Engineering**: Worley
- +150 leading experts from the climate tech ecosystem

Report 1

Climate tech for industrial decarbonisation: What role for insurers?

Report 2

Bringing Climate Tech to Market: The powerful role of insurance

Challenge: How to expedite decarbonisation of seven essential economic sectors ?

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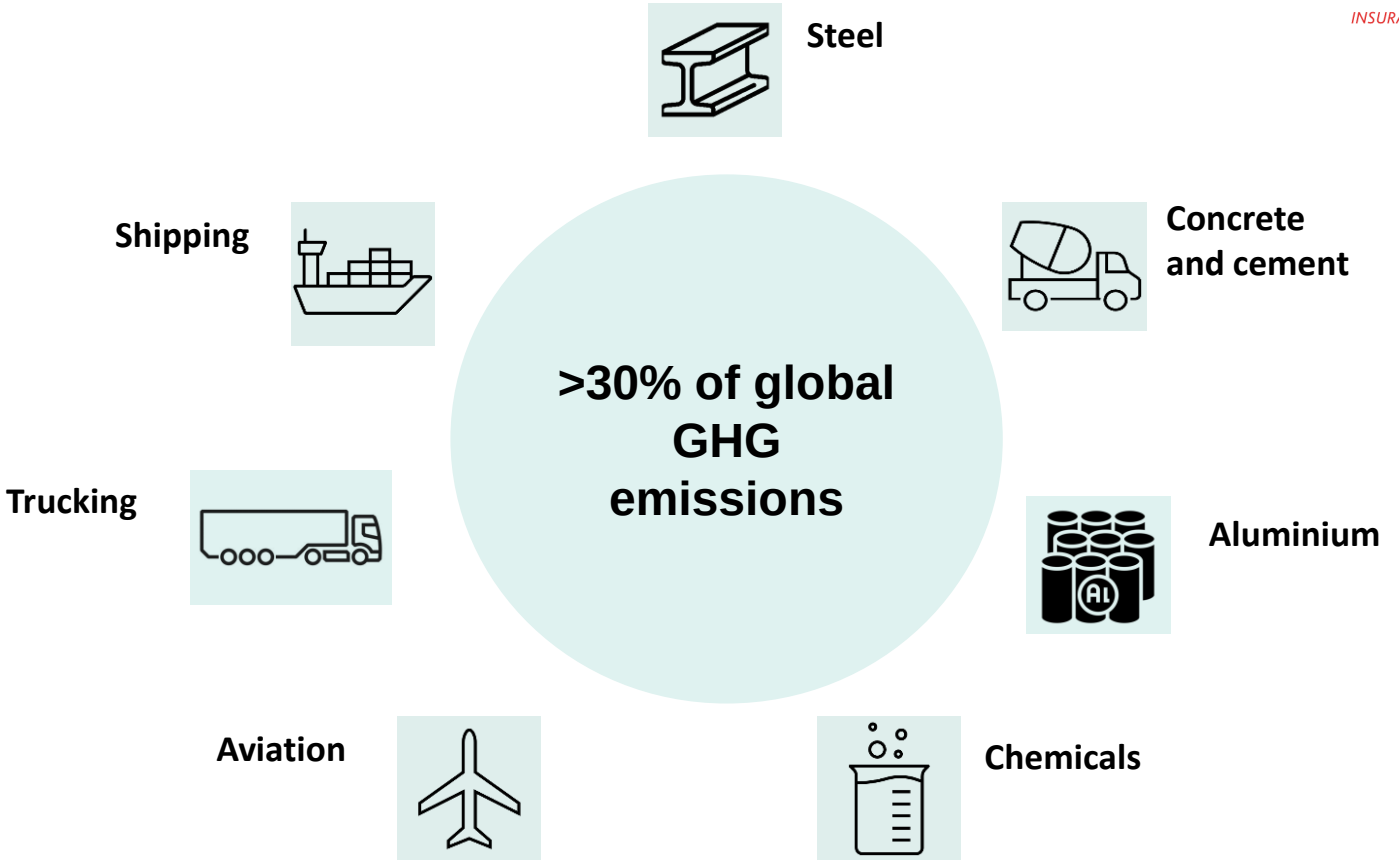

Why is the timing right?

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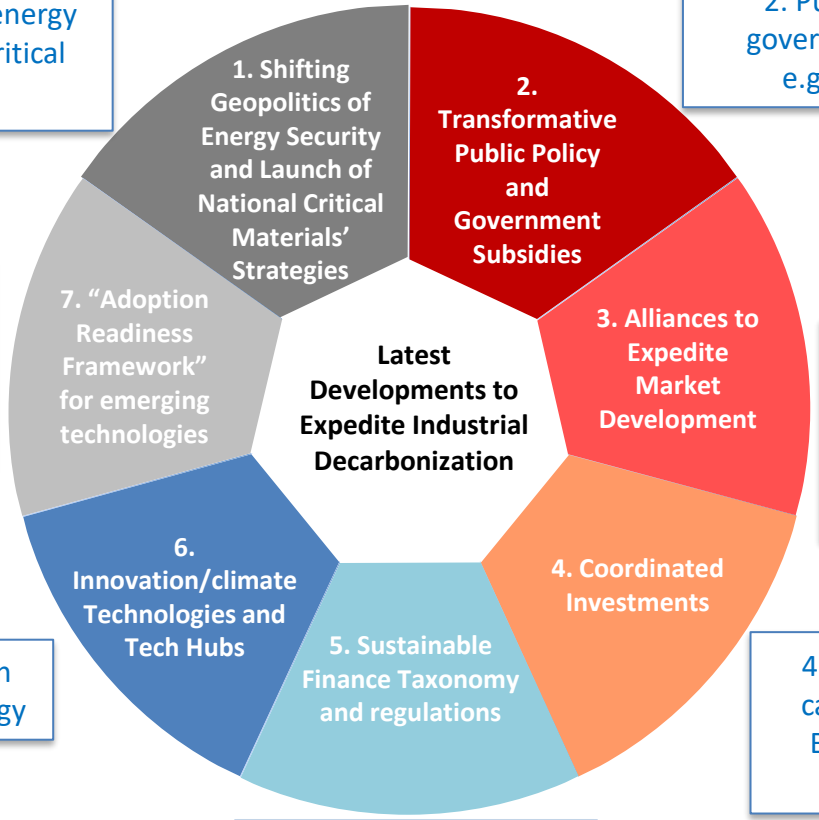
1. Shift in geopolitics of energy security with focus on critical materials

2. Public policy and government subsidies e.g. US, EU, etc.)



7. Paradigm shift in approach to climate tech commercialization and market readiness

3. First Mover coalitions, regional and multi-lateral alliances

6. Innovation and technology

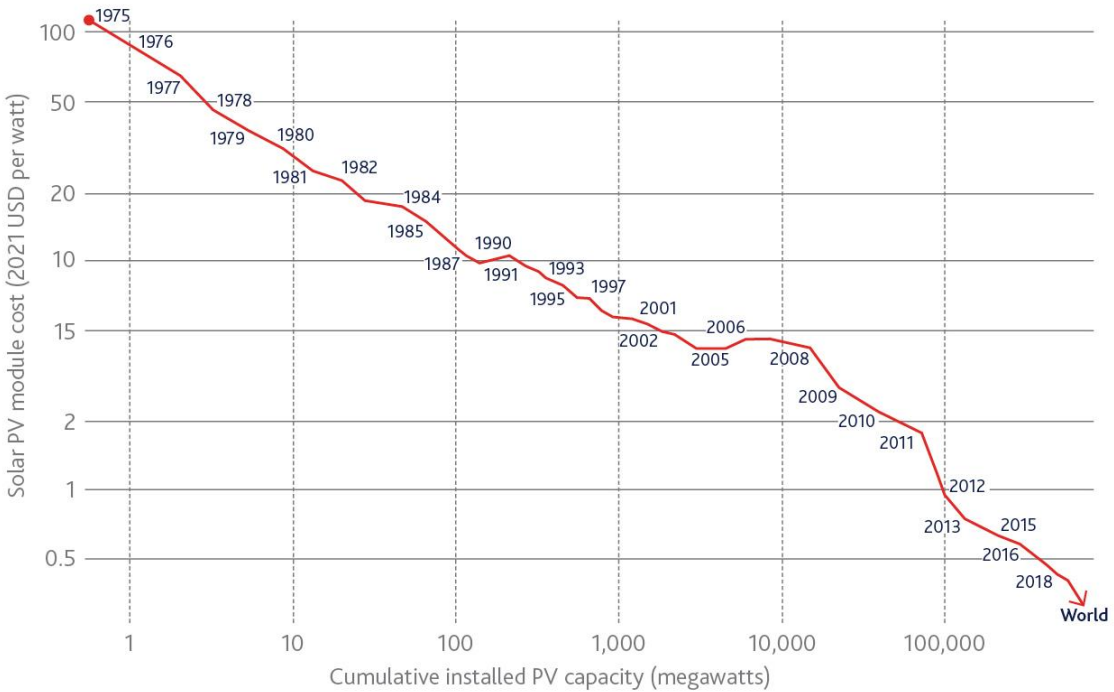
4. Coordinated capital such as Breakthrough Energy

5. Sustainable finance & regulatory reporting

It took four decades for solar to become cost competitive with their fossil fuel counterparts. Yet solar has not realised its full deployment potential!

We don't have time!

Solar PV module prices vs. cumulative installed capacity



1975 → 2021
World

1975
115.28 USD per watt; 0.54 megawatts

2021
0.27 USD per watt; 848,404.56 megawatts

Source: Our World in Data

What are the challenges with expediting development and commercial deployment of climate technologies?

- **Speed** and **scale** of climate tech commercialization
- Massive **financing gap**
- Categorizing Technologies:
  - Category 1**:** Technologies that are commercialized but have not reached full market potential (e.g. solar and wind)
  - **Category 2: Technologies that are still in pre-commercialisation stages** (e.g. green hydrogen, carbon management, industrial geothermal, SAF, LDES, etc)

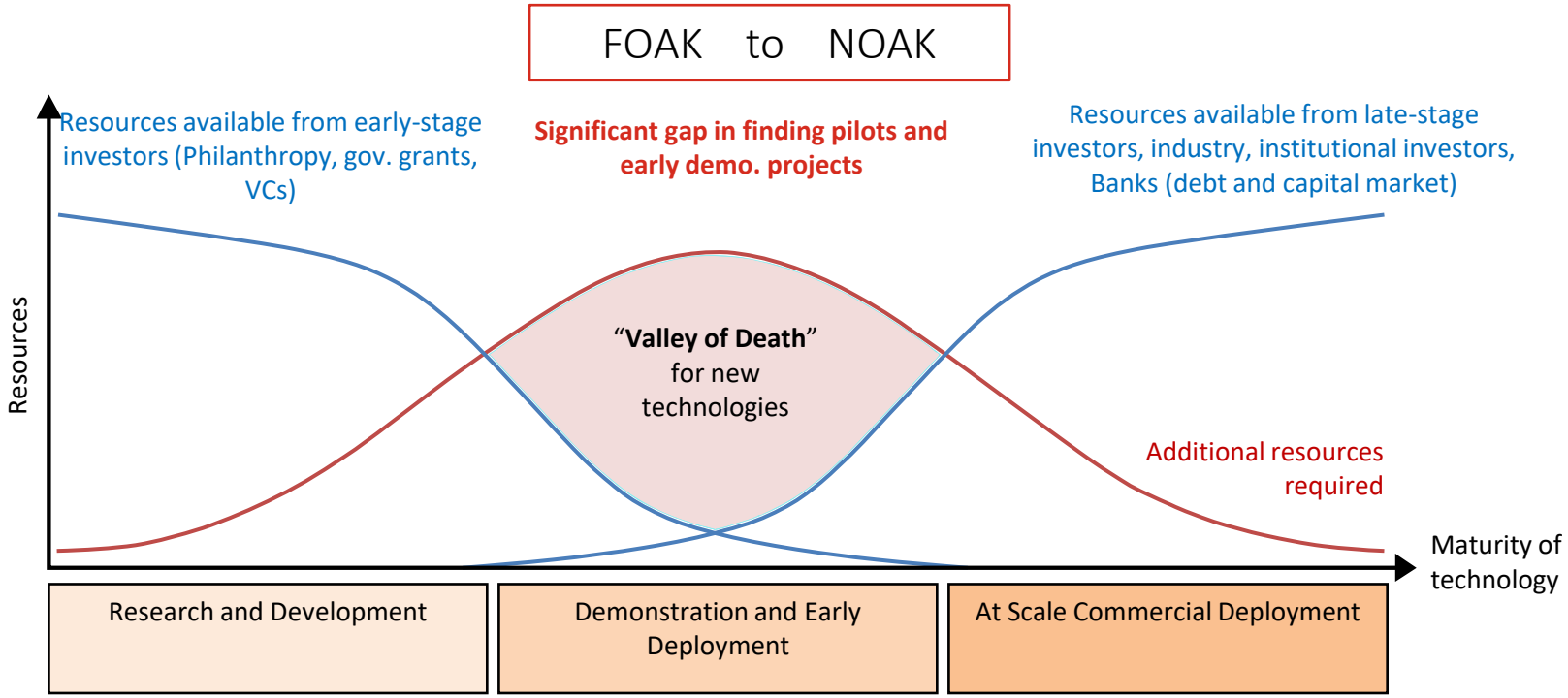
  These technologies are **capital intensive (valley of death)**, **highly complex**, with **untested risks**, challenges with **scaling and market readiness**, **scarcity of data** for assessing insurability conditions

  - Category 3: Technologies that are in R&D phase but if commercialised, they will be transformative (e.g. fusion)
- **80%** of new technologies are being **scaled by entrepreneurial firms**

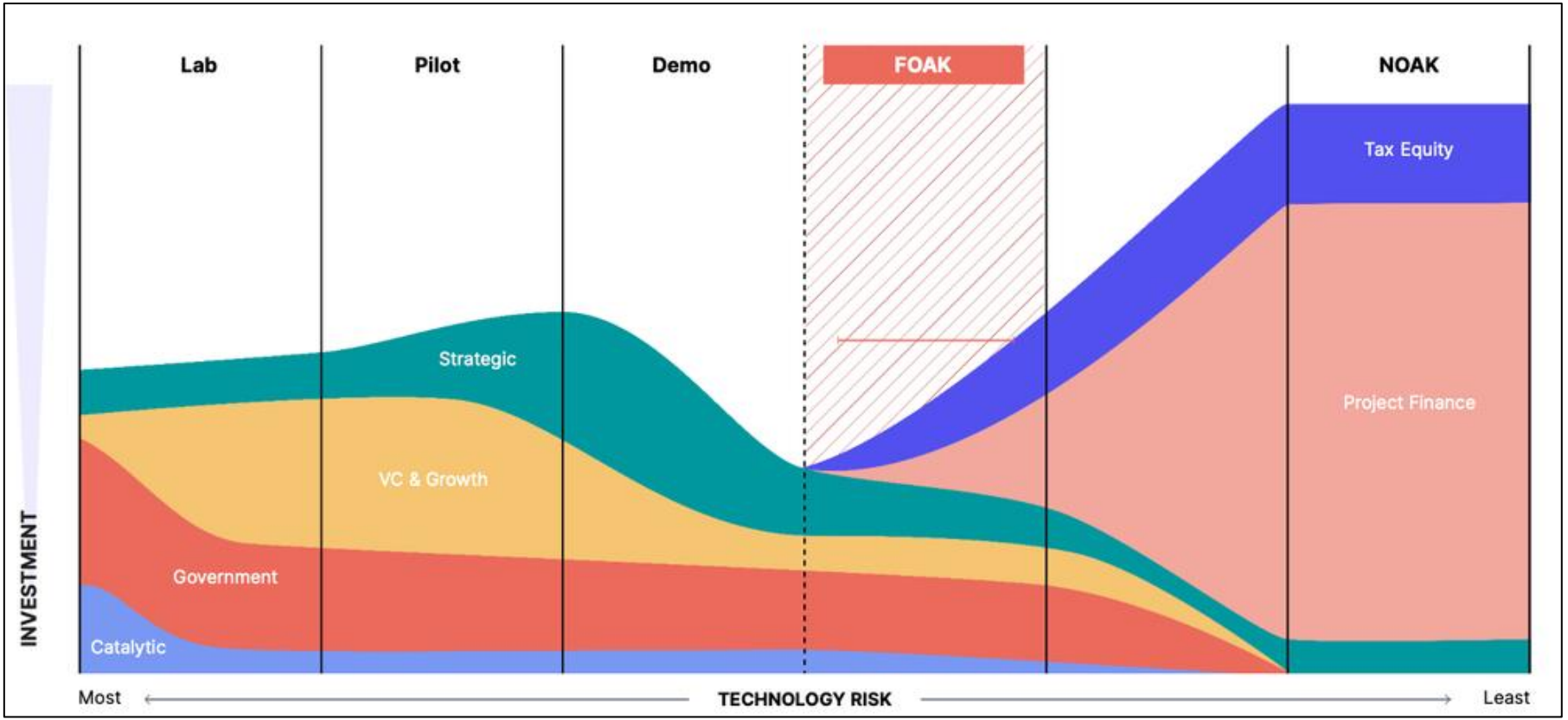
Unlocking capital and expediting market readiness requires cross-sectoral collaboration to innovate risk management and financing solutions.

Traditional Climate Tech Commercialization

Valley of death



Pilot and Early demonstration stages: Blended Capital Stack From FOAK to NOAK



Source: CTVC 2024

Traditional Climate Tech Commercialization

Technology Readiness Level

Technology stages	Technology Readiness Level (TRL)	
At-scale Commercial Deployment	9	Wide-scale commercial deployment
	8	Early commercial deployment
Demonstration and Early Deployment	7	Complete system demonstration in an operational environment
	6	Early field demonstration and system refinements completed
	5	Early system validation demonstrated in a laboratory or limited field application
	4	Subsystem or component validation in a laboratory environment to simulate service conditions
Research and Development	3	Proof-of-concept validation
	2	Technology concepts and/or application formulated
	1	Exploratory research transitioning basic science into laboratory applications

Valley of Death

Traditionally, re/insurers are engaged at this stage

Early engagement of insurance companies' risk Engineering Teams from TRL 6 could be mutually beneficial for all stakeholders

Source: The Geneva Association 2024

17+1 risks hinder climate technologies' market readiness delaying commercial deployment

Adoption Readiness Level Framework (US Dept of Energy)

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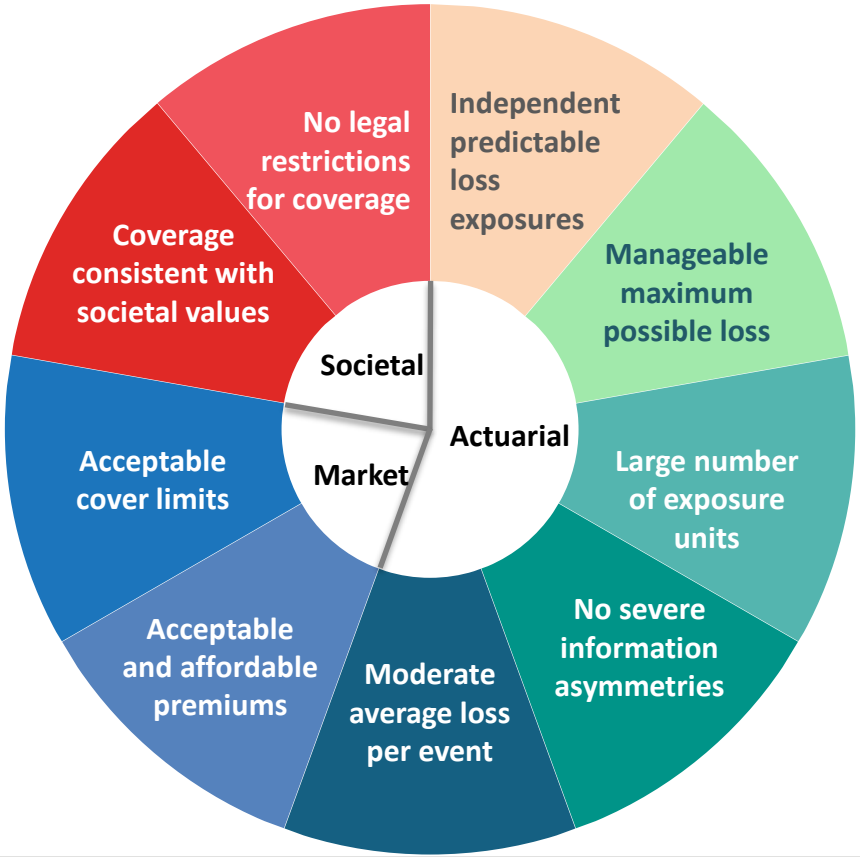
I. Value Proposition	II. Market Acceptance	III. Resource Maturity		IV. License to Operate	
1. Delivered Cost	4. Demand Maturity / Market Openness	7. Capital Flow and	10. Manufacturing & Supply Chain	13. Regulatory Environment	16. Environmental & Safety
2. Functional Performance	5. Market Size	8. Project Development, Integration, Management	11. Materials Sourcing	14. Policy Environment	17. Community Perception
3. Ease of Use / Complexity	6. Downstream Value Chain	9. Infrastructure	12. Workforce	15. Permitting & Siting	
			18. Insurability and availability of affordable insurance		

Source: Modifed by Geneva Association with U.S. Department of Energy

How Insurers assess insurability conditions for emerging climate tech?

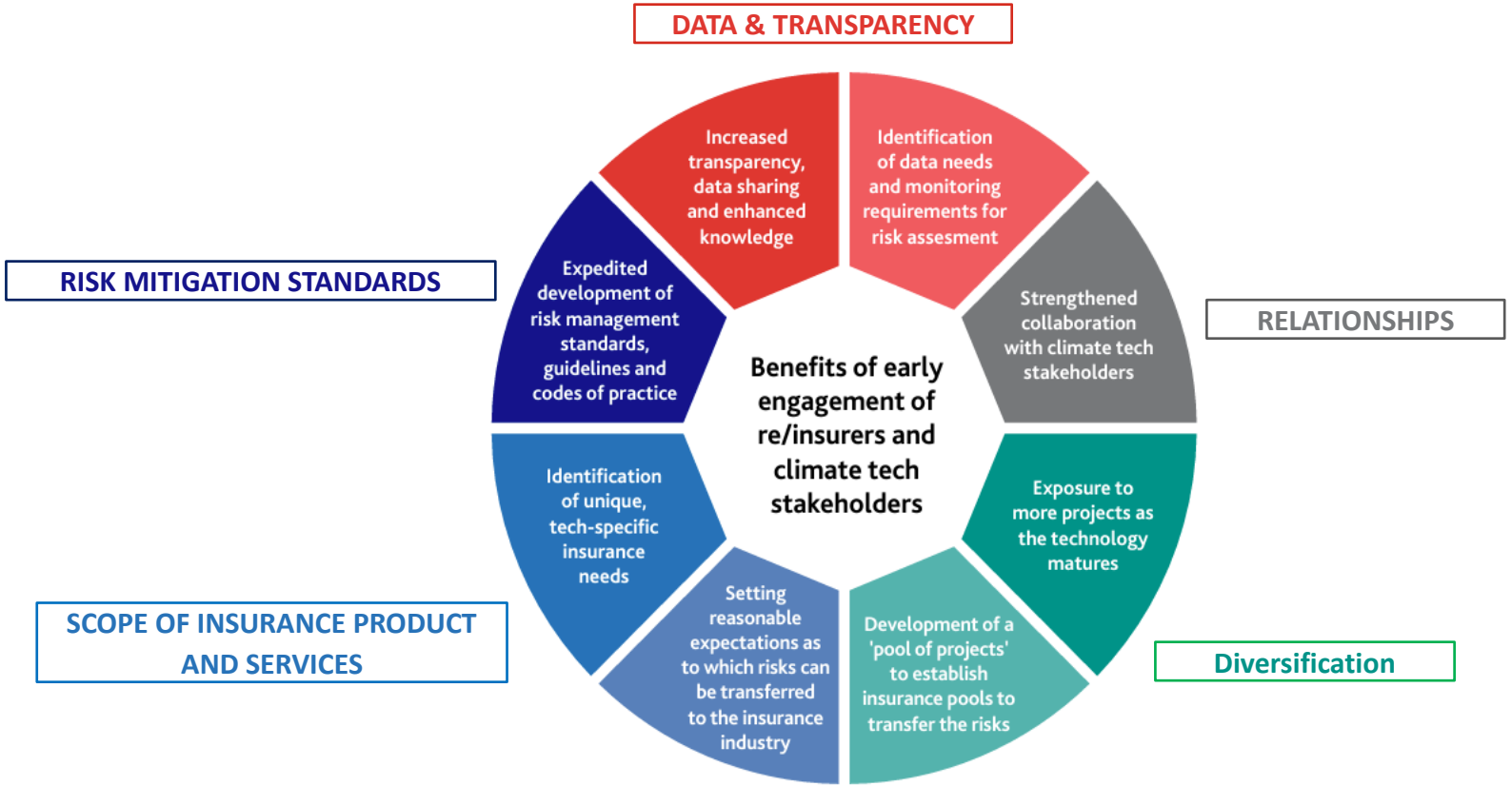
Nine critical criteria that impact insurability of climate technologies



1. **Assessing insurability conditions for new climate technologies is complex and will take time.**
   - Important to get a head start as early as TRL 6.
2. **Examples of critical factors for assessing insurability conditions for new technologies**
   - Independent predictable loss exposure
   - Manageable Maximum Potential Loss
   - Large number of exposure units
   - No major information asymmetry / Transparency
3. **Different stakeholders involved may have different insurability interests** depending on their Financial risks

Source: The Geneva Association 2024

Why is it important to engage insurers' risk engineering teams from pilot and early demonstration (FOAK) across as many projects



Source: The Geneva Association 2024

A novel "Insurability Readiness Framework" (IRF) to help expedite framing and assessing risks from early stage

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- IRF classifies climate tech **risks into 7 categories from insurance lens. For each risk it offers a list of key issues** that need to be considered for assessing insurability conditions

1. Technology risk
2. Project information and organization risk
3. Legal, financial, and compliance risk
4. Location-specific risk of extreme weather events and low changing climatic trends
5. Business interruption and supply chain risk
6. Long-term risk
7. Environmental, social, and governance risk

- **We developed the IRF to:**
  - **Enable informed conversations** between climate tech stakeholders and re/insurers from early stages
  - **Help pinpoint areas that pose the greatest challenges** to insurability
  - Identify **risks that may require different interventions**, such as PPPs or government backstops.

Source: The Geneva Association 2024, See Report 2

Mapping IRF on project development cycle – collecting information for risk assessment

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Example: Technology risk and green hydrogen

Relevant risks from ARL: Functional Performance (#2), Ease of Use/Complexity (#3), Manufacturing and Supply Chain (#10)

Project development phase	Conceptual Study	Feasibility Study	Pre-FEED	FEED	EPC	Operation	Remarks
	FEL-0	FEL-1	FEL-2	FEL-3			
Cost estimate Class	Class 5	Class 4	Class 4	Class 3	Class 2		
This would requires description of issues including:							
1. Basic technology overview and the scale up strategy (is the project more of the same proven size capacity module in series or actual scale up of modules?	P		D	Q			
2. Material Selection		P	F				
3. Development Process, for example:							
– Has any third party certification been carried out on the technology and at project level, considering also the interface risks?		P	D	F			
4. Technology performance, for example:							Some electrolyser suppliers will not be able to provide reliable data for long-term operation/ scale-up etc
– Functional performance of components and sub-components, new or prototype and upscaled technology sections		P	D			Q	
– Performance Metrics		P	D			Q	
– Proof of Reliability and Durability		P	D			Q	
– Proof of Scale and Quantity		P	D			Q	
– Proof of Integration with Existing Systems		P	D			Q	
5. Risk Assessment of Technology and level of technology maturity, for example:							
– Are the complete details of the testing and validation process for onboarding the technology available?			P	F			
– What level of protection and or automatic shutdown features does your project have to prevent damage to equipment			P	F			
6. Due Diligence Activities / Results							
– Have all external commercial operating conditions (such as interface risk, power interruption, grid instability, surcharge event etc. been taken into consideration in the scenario testing?			D	F			Whilst this is a standard process, no operating data is available to support
7. Quality Control			D	F			

Source: Geneva Association and Worley

Importance of expediting development of risk management standards and codes of practice for project replication

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Example: Offshore Code of Practice

Goal: Develop a best practice paper on state-of-the-art risk management practice for construction of offshore wind farms

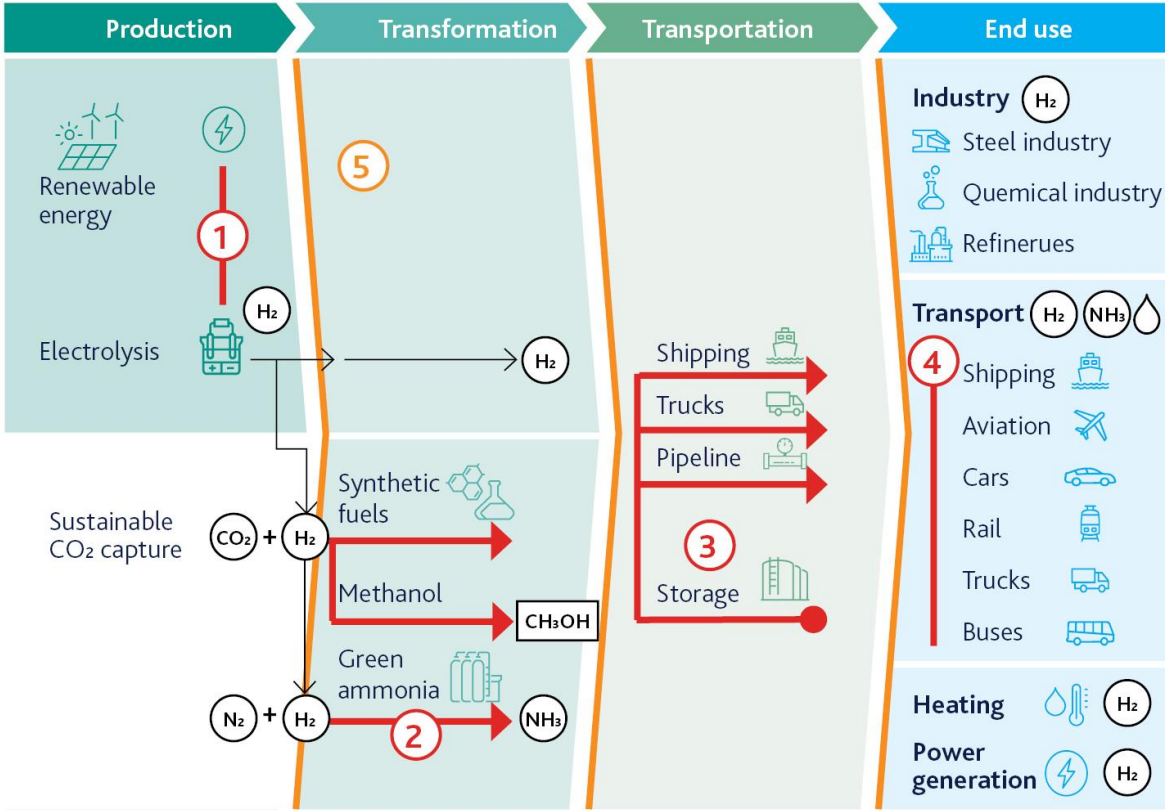
1. Ensure risk transparency to all parties to a project
2. Ensure all parties adhere to same risk philosophy at every process stage
3. Mitigate risk exposures of all parties to a project
4. Keep risks insurable in the long term (pro-active approach)

Parties involved: More than 90 representatives in 10 expert teams were engaged:

- Insurers, reinsurers, insurance brokers
- Manufacturers, operators, developers
- Investors, banks, consultants, certifiers, energy providers
- Shipping companies, technical surveyors, Marine Warranty Surveyors (MWS)

Source: Climate Tech Report 2 P. 25

Applying the IRF to complex green hydrogen projects to frame risks along the value chain and identifying risks that may be most challenging



Source: Modified from IRENA

Need to consider:

1. Risks within each component of the project value chain
2. Risks across the value chain **component**

Most challenging risks from IRF

- Technology risk
- Project information and organization risk
- Long-term risk

Scaling of carbon removal industry is hindered by long-term risks

Risks associated with technological CCUS solutions from 49 to 700 MT p.a.

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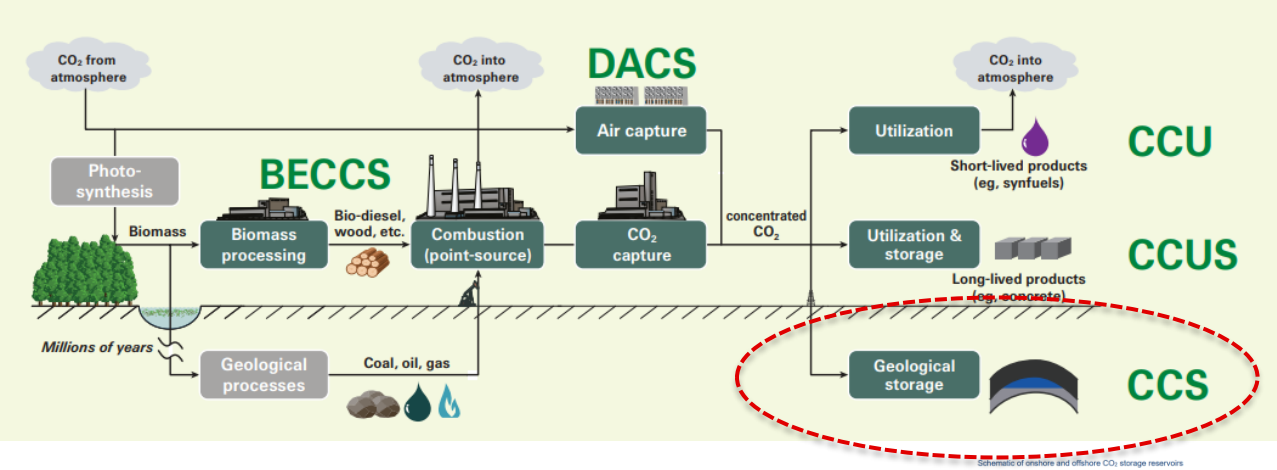

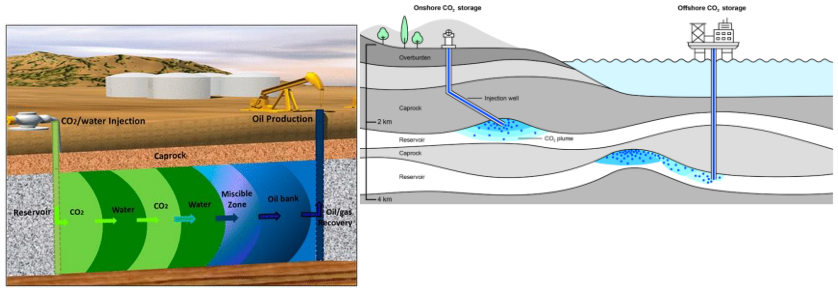

Source: Swiss Re.
https://www.swissre.com/dam/jcr:31e39033-0ca6-418e-a540-d61b8e7d7b31/swiss-re-institute-expertise-publication-insurance-%20rationale-for-carbon-removal-solutions.pdf

- Long-term risk: Elephant in the room: Long term durability of geological and ins situ mineralization storage?
- Other Risks:
  - Technological risks
  - Legal, finance, compliance and litigation risk
  - Insufficient monitoring capabilities or resources
  - loss of carbon certificates, price risk and/or delivery risk.

Source: The Geneva Association 2024

Moving ahead to operationalize IRF and facilitate early engagement

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- Engagement of re/insurance companies in the climate tech projects is being enabled by the US government
  - US Department of Energy (DoE) is convening workshops with key stakeholders including re/insurers to facilitate new partnerships and enable FOAK to NOAK projects for high priority technologies
- Insurability of Carbon Capture, Usage & Storage (CCUS) being pursued by Clean Energy Ministerial (29 ministries of energy) and OGCI (Oil & Gas Climate Initiative - 12 largest companies)
  - Co-hosted a meeting with GA on challenges with scaling CCUS from insurance lens, engaging 8 GA members (8 July)
  - Initiatives are underway to work with re/insurers on insurability of CCUS

What is next ?

- **Market adoption:** How are industrial sectors adopting these emerging technologies, implications for their business models and subsequently commercial insurance needs?
- **Insurance needs to make projects bankable** (bring debt and capital market finanincg) - What are insurance needs for debt and capital market financing of such decarbonization projects – paving the way for banks and institutional investors to finance the industrial projects
- **Insurance markets:** What changes are needed in the insurance markets to best leverage the insurance industry value chain to expedite the development and deployment of commercial scale projects?
- **Environmental risks** and related liabilities associated with the full supply and value chains of emerging technologies

Thank you

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Traditional climate tech commercialization: TRL

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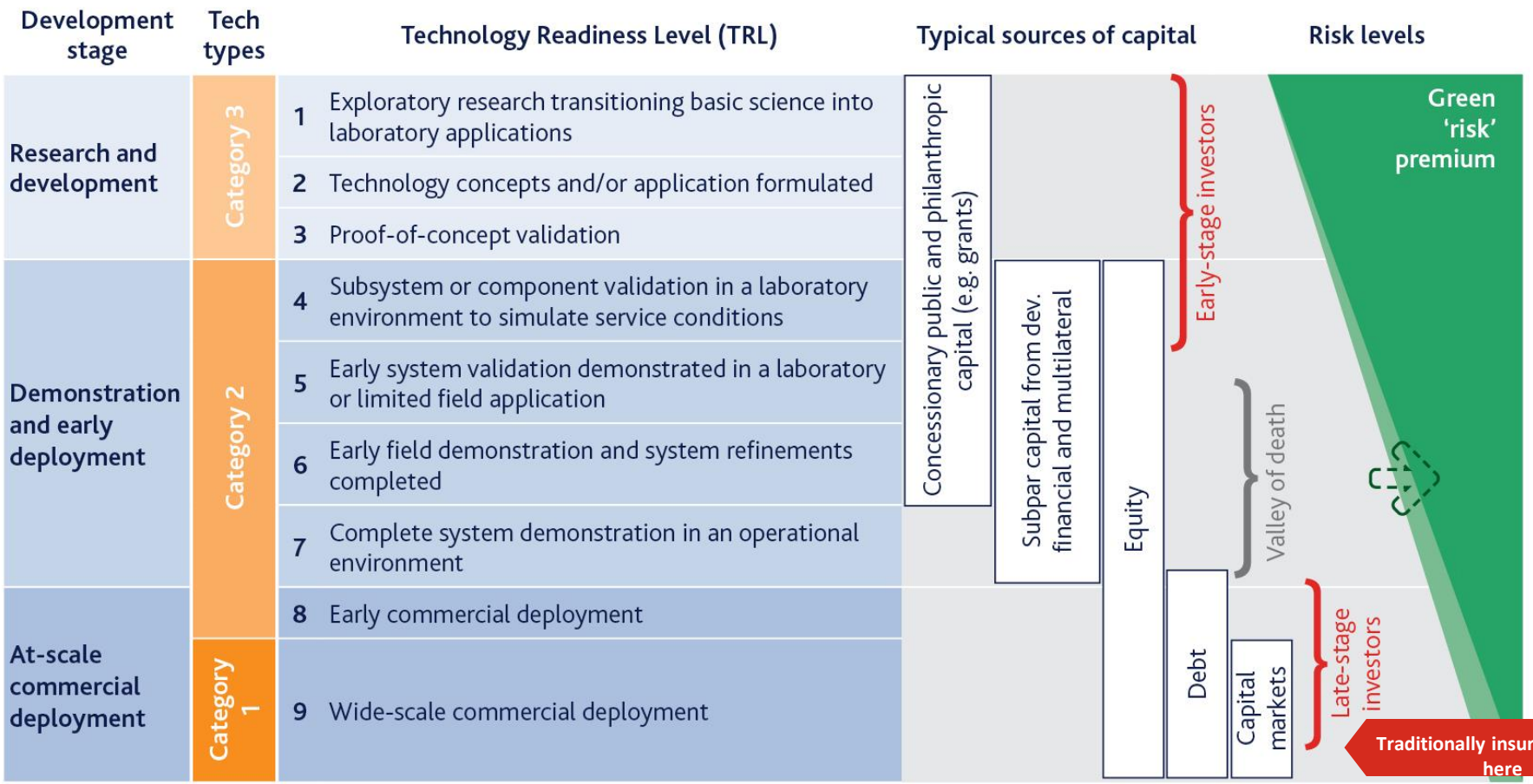
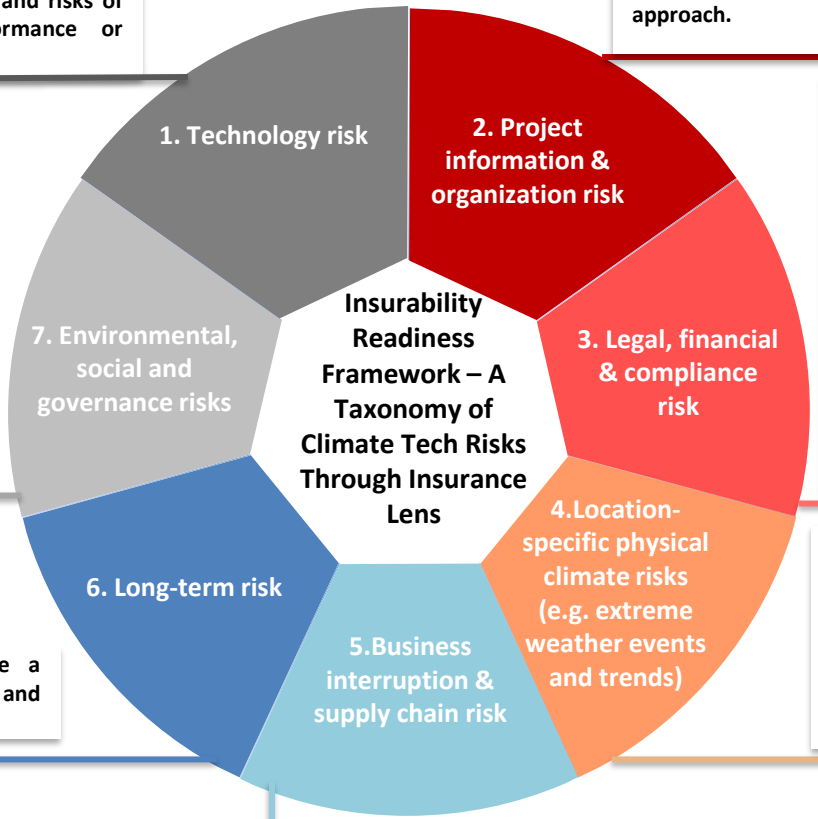




Potential risks for applied technologies, such as key components for upscaled features, prototypical designs, integration of technologies and processes, and risks of technology and equipment underperformance or failure.

Risks associated with the development, organization and management of the project with a system-based approach.

Encompasses any legal or contractual aspect of the project and interactions between stakeholders that could halt the project, such as issues with licenses, contractual obligations and statuary compliance. It also includes any financial aspects, such as solvency or sanction-related topics. Additionally, it covers issues related to inadequate compliance by stakeholders that could halt the project, such as not adhering to antitrust rules, and potentially lead to financial troubles.

Location- or portfolio-location-specific extreme events (Nat Cat, e.g., severe storms, floods, wildfires, extreme heat) that may impact the project over its lifetime. Considers any risk management measures that are being considered to build resilience.

Any aspect that can lead to delays in the project, such as supply chain issues, as well as any aspect that can impact production during operation and impact profitability.

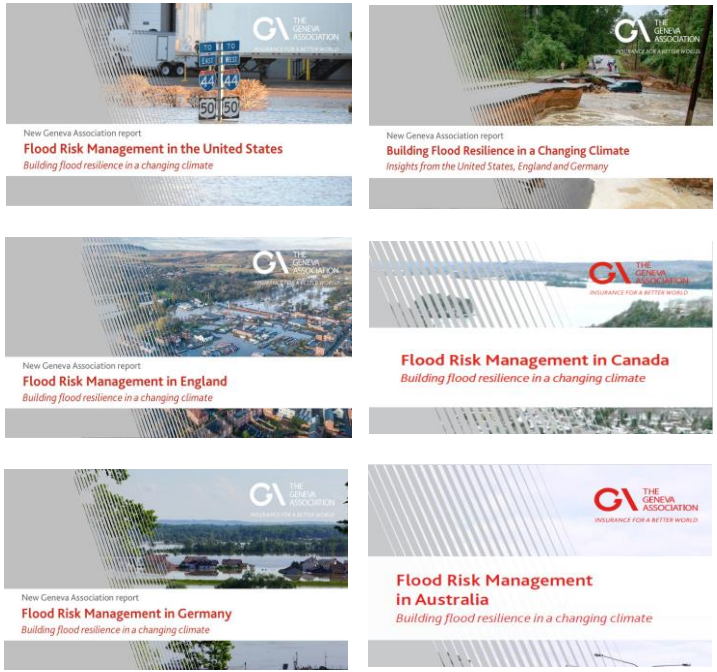
Any long-term issues that could have a significant impact on the profitability and success of the project.

Risks related to factors such as labor practices, human rated rights, board diversity, community engagement, biodiversity and nature-related management, and transparent reporting.

Highlights of CC&E Research and Reports 2018-2024 (1/3)

Managing Physical Climate Risk: Leveraging innovations in Catastrophe risk modelling

2018



Flood risk management: engaged leading experts from GA network, academia, government agencies and insurance associations in each country

2020

Highlights of CC&E Research and Reports 2018-2024 (1/3)

Climate change litigation, in partnership with Clyde & Co and London School of Economics

2021

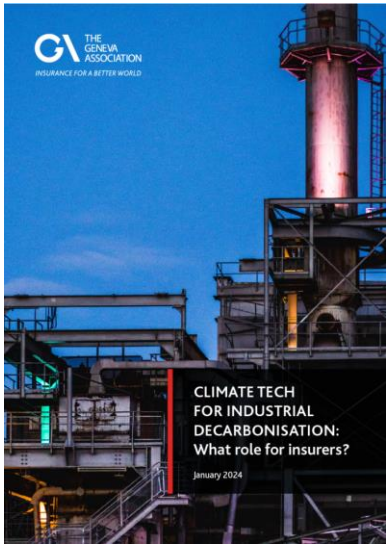
Climate risk assessment: task force representing 28 members and 18 regulatory bodies

2022

Highlights of CC&E Research and Reports 2018-2024 (3/3)

Nature and the insurance industry, in partnership with The Nature Conservancy and Conservation International

Climate change and health & life insurance: contribution to report led by Health & Demography work stream



Climate tech for industrial decarbonization, in partnership with US Dept. of Energy, Breakthrough Energy, Worley

2022 (cont.)

2024