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ALLIANZ RESEARCH

IMPACT UNDERWRITING: SUSTAINABLE INSURANCE AS AN OPPORTUNITY FOR SOCIETY AND BUSINESS

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EXECUTIVE SUMMARY



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'Impact underwriting' can accelerate the global economy's sustainable transformation. Due to its role as risk manager, risk carrier and major investor, the insurance industry is in a unique position to promote economic, social and environmental sustainability. But the way forward involves looking beyond focusing on already 'sustainable' activities. Changing for the better requires the implementation of more 'impact' activities that shift non-sustainable behavior and processes in a more sustainable direction. An impact-oriented alignment of just a fraction of the insurance industry's capital flows would be a substantial catalyst for achieving the global sustainability goals.

Impact underwriting can offer a 'double dividend', generating revenues in a growing market besides realizing positive externalities for society. In this context, we identify 9 fields of sustainable action for the insurance sector:

1. **Climate change & weather extremes:** Global tropical cyclone storm intensity, for instance, is expected to increase by 5% and rain intensity by 15%. The risk associated with such disasters are increasingly covered via alternative risk transfers and impact underwriting needs to close existing insurance gaps.
2. **Renewable energy investments:** Global renewable energy capacities will more than triple by 2050. Accordingly, the demand for insuring renewable energy installations against physical, development or operational risks will rise. Risk consulting and risk service solutions support establishing new technologies or developing new territories and provide further opportunities for sustainable insurance solutions.
3. **Alternative mobility:** In 2024 a tipping point will be reached when battery electric vehicles (EV) become cheaper than internal combustion engines (ICE) for passenger vehicles. EVs will dominate new car sales before 2040. Impact underwriting can support this transition by offering insurance solutions to the areas of mobility sharing as well as autonomous driving, and can seize new opportunities in the sector coupling of vehicle batteries with the energy infrastructure.
4. **Real estate:** Non-financial barriers are a major obstacle against the demand of energy efficiency measures. Insurance can play an important role as mediator, service provider, and risk bearer and thus accelerate the implementation of efficiency gains.
5. **Sustainable lifestyle:** Improvements in the energy efficiency of appliances have come short of expectations due to rebound effects resulting from an increase in the usage of the appliances and a larger number of appliances per person. Impact insurance can counteract this trend by offering lower premiums for eco-friendly appliances, cars and buildings. Sustainable insurance claim regulation can allow for upgrades to eco-labelled appliances and machinery and, due to a life-cycle analysis of the emissions associated to a product, appliances might rather be repaired instead of replaced.
6. **The future of work:** Home office usage could double in the foreseeable future and impact underwriting can support the transition towards 'new work' and the sharing economy by reducing implementation barriers resulting from risk averseness, especially coupled with the underlying digitization.
7. **Digitization & sector coupling:** The realization of the energy transition or the sharing economy depends on the progress in digitization. Blockchain is a central enabling technology and its market size is expected to more than double within the next five years. Sector coupling leads to networked electric car batteries functioning as energy system storage, smart appliances' energy demand being regulated according to energy supply and 'prosumers' sharing their self-generated electricity in communities. Impact underwriting can lower the associated risks and thus promote progress towards sustainability .
8. **Emerging customers and regions:** Half of global population is still not connected to the internet. With increasing access to mobile phones, the insurance industry will be able to provide impact insurance solutions to new population groups that are particularly challenged. For instance, in the area of agricultural insurance, insurers could provide micro-insurance and further communicate weather alerts for livestock or crops, to support the decision-making of farmers.
9. **Ecosystem:** Intensifying rainfall and heat waves result in crop yields becoming more erratic, emphasizing the need for insurance and the role of impact underwriting.



'IMPACT UNDERWRITING' CAN ACCELERATE THE GLOBAL ECONOMY'S SUSTAINABLE TRANSFORMATION

In its role as risk manager, risk carrier and investor, the global insurance industry is in a unique position to promote economic, social and environmental sustainability. The vast capital flows and long-term horizon associated with its investment and underwriting businesses can help drive our society's transition from narrowly focusing on short-run profits and job prospects to building a green, fair and inclusive economy. But the way forward involves looking beyond 'sustainable' actions and processes, which aim to preserve a preferred state, and focusing more on 'impact', namely actions and processes that shift non-sustainable behavior and processes in a more sustainable direction. An impact-oriented alignment of just a fraction of the insurance industry's capital flows would be a substantial catalyst for achieving the global sustainability goals¹.

As Environmental, Social and Governance (ESG) methodologies and frameworks develop and start to be incorporated in risk evaluation, an increasing number of high exposures and extensive vulnerabilities have been identified in the insurance sector itself, which has the challenging position of being concerned with ESG from three different positions:

1. ESG in own operations

Sustainable and inclusive operations beyond traditional Corporate Social Responsibility (CSR) approaches.

Philanthropic support of environment, low-income and high-risk customers and regions.

2. ESG in asset management

ESG factors in investments and asset management (responsible investment).

Engagement, active ownership, good corporate citizenship (sustainable investment).

3. ESG in insurance underwriting

ESG factors in underwriting (responsible underwriting).

Sustainable and inclusive insurance products (sustainable underwriting).

In asset management, 'impact' investment could be defined as achieving environmental or social benefits beyond the nexus of the investor's shareholder benefits. Similarly, 'impact underwriting' is about more than just having sustainable insurance solutions in the portfolio; rather, it is about actively shaping and contributing to society². The ESG factors to be considered by the insurer include its attitude and behavior (1) on environmental issues such as resource depletion, climate change, waste and pollution, (2) regarding social aspects, workers and local communities, including health and safety issues and (3) referring to corporate policies and governance, including tax strategies, corruption, structure and remuneration.

As seen in Figure 1, the shift from responsible to sustainable underwriting is hardly a choice: To stay competitive in the market, insurance companies must not only adapt to current and future regulations, but also satisfy investors' increasing demand for sustainable products. Part of the increasing demand results from companies changing their reporting practices to better reflect their commitment to ESG factors, aiming at measuring their resilience against long-term, financially relevant risks³. These involve different product lines of insurance, including employers' liability, directors and officers, product liability and public liability. Related to these risks, the increasing demand for the mitigation of factors that can cause significant reputational harm is an undeniable and observable trend. Information travels quickly due to social media and negative publicity related to ESG, including impacts on brand recognition and reputation, pose an increasing threat to companies. The once non-financial and intangible perception of ESG is increasingly evolving into a financial and tangible factor for the decisions of customers, suppliers, employees, regulators, analysts and other stakeholders. All this presents several ESG market opportunities, which we explore in the next section⁴.

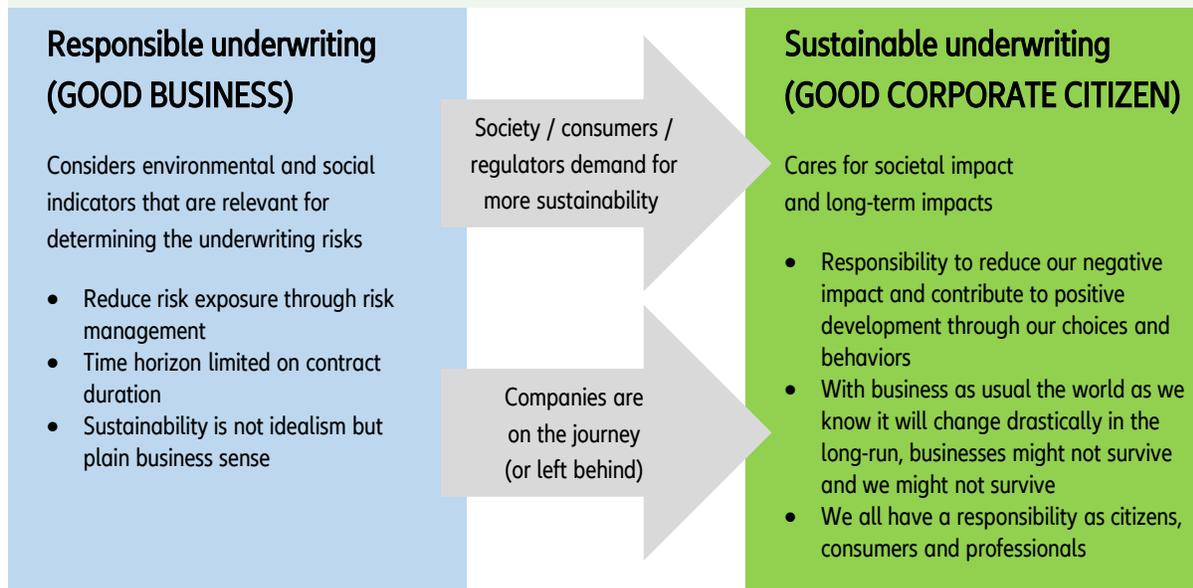
¹ Sustainability goals are manifold with the Sustainable Development Goals (SDGs) and the European Green Deal being two of the most prominent ones.

² As mentioned above, the difference between sustainable and impact should be emphasized. While 'sustainable' refers to the desired state, 'impact' refers to activities that support progressing towards this state.

³ These are driven by customer demands as well as by regulatory frameworks and requirements derived from processes like the Task Force on Climate-related Financial Disclosures (TCFD) and the EU Taxonomy.

⁴ PSI and Allianz launched the first guide to managing sustainability risks in insurance underwriting (UN Environment's Principles for Sustainable Insurance Initiative, 2019). It aids the ESG due diligence process for clients and transactions, provides guidance on integrating ESG risk considerations and rises awareness of ESG opportunities.

Figure 1: Impact underwriting – the evolution from ‘responsible’ to ‘sustainable’ underwriting



Source: Allianz Research



THE 'DOUBLE DIVIDEND': BUSINESS OPPORTUNITIES IN IMPACT UNDERWRITING

As sustainable insurance solution markets offer particularly high growth potentials, engagement in impact underwriting offers a 'double dividend'⁵, generating revenues in a growing market as well as realizing positive externalities for society. Table 1 lays out criteria and definitions for sustainability in the context of impact underwriting in insurance. The scope of the definitions covers environmental and social

criteria and spans from mitigation over adaptations to resilience. In this paper, the criteria for sustainable insurance products are applied to the three ESG risk components of:

- Physical risk: e.g. tangible losses from natural catastrophes, disruption of supply chains or rising morbidity and mortality

- Transition risk: e.g. disruptions of business models by changing demand preferences, technologies or regulation
- Liability risk: e.g. claims of third parties who have suffered loss and damage from an ESG hazard.

Based on the above, we segment the business opportunities ahead in nine fields of sustainable action.

Table 1: Criteria for sustainable insurance solutions

Focus on...	Environmental criteria	Social criteria
... reducing the risk of possible future occurrence of hazard event ⁶ (mitigation)	Support the development of a technology/market focusing on the environment and/or climate change (e.g. renewable energy, environmental goods and services, green infrastructure) and further activities in the mitigation of climate change (e.g. encouraging or rewarding environmentally responsible behavior that improves energy efficiency or avoids pollution).	Raises awareness through various activities (e.g. cause-related marketing or support schemes) to prevent and mitigate social challenges in relation to socially disadvantaged groups.
... reducing the inventory of elements that may be affected by hazard event ⁷ (adaptation)	Reduce the client's exposure to financial (risk reduction) and/or regulatory risks (e.g. CO2 regulations, environmental pollution liability). Protection from environmental risks and adaptation to climate change impacts through managing clients' risks (e.g. weather risks) and/or fostering risk awareness and/or providing incentives for reducing risk exposure.	Fosters socially responsible behavior by offering specifically tailored solutions for socially disadvantaged groups (for e.g. reducing the risk of underserved groups by providing otherwise unavailable access to financial services). A discount on such policies would partly apply.
... reducing the impact to exposed elements when they suffer hazard event ⁸ (resilience)	Conservation of at least one of the following: natural resources, biodiversity, environment. Activities and structural changes that reduce the impact of extreme events or accelerate the recovery from those.	Enable and/or support those that tackle social challenges and issues faced by socially disadvantaged groups ⁹ . These include products that 'help the helper' (for e.g. travel insurance for charity workers, insurance solutions tailored for social value-adding products/services that would otherwise not be insured).

Note: This table is an extension and adaptation of the criteria in Allianz (2018)

Source: Allianz Research

⁵ A term originally relating to the work of Tullock (1967) who extended the idea of taxing externalities according to Pigou (1920).

⁶ In Cardona et al. (2012) this would refer to hazards and is closely related to the concept of mitigation: "Hazard refers to the possible, future occurrence of natural or human-induced physical events that may have adverse effects on vulnerable and exposed elements. Although, at times, hazard has been ascribed the same meaning as risk, currently it is widely accepted that it is a component of risk and not risk itself."

⁷ In Cardona et al. (2012) this would refer to exposure and is closely related to the concept of adaptation: "Exposure refers to the inventory of elements in an area in which hazard events may occur. Hence, if population and economic resources were not located in (exposed to) potentially dangerous settings, no problem of disaster risk would exist. While the literature and common usage often mistakenly conflate exposure and vulnerability, they are distinct. Exposure is a necessary, but not sufficient, determinant of risk. It is possible to be exposed but not vulnerable. However, to be vulnerable to an extreme event, it is necessary to also be exposed."

⁸ In Cardona et al. (2012) this would refer to vulnerability and is closely related to the concept of resilience (though resilience is often alternatively interpreted as the combination of mitigation and adaptation): "Vulnerability refers to the propensity of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events. Vulnerability is related to predisposition, susceptibilities, fragilities, weaknesses, deficiencies, or lack of capacities that favor adverse effects on the exposed elements."

Table 2: ESG insurance solution opportunities

ESG-insurance solution opportunities		Insurance opportunities for...			Main SDG engagement
Field of sustainable action	Risks and solutions	... physical risks	... transition risks	... liability risks	
Climate change & weather extremes	Physical Impact on value chains/trade	●			   
	Public private partnerships and alternative risk transfer (cat bonds, catastrophe pools) for tipping point events and systemic risks events	●	●		
	Business interruptions	●	●		
	Inevitable policy response (regulation response to crisis or crisis prevention)		●		
	Market impacts (demand & supply) on value chain and trade risks		●		
	Hedging, export guarantees and other guarantees			●	
Renewable energy investments	Demand for insuring renewable energy installations against physical risks	●			   
	Long-term performance guarantees	●			
	Development risks (e.g. wind approval risk after won auction, geothermal drill failure risk, ...); operational risks (e.g. wind operation risk like noise pollution or geothermal operation risks like earthquakes or ground water pollution, ...); decommissioning risks	●		●	
	Marine insurance	●		●	
	Technical advisory solutions; service solutions for risk assessment, quality assurance / certification of renewable energy plants	●	●	●	
Alternative mobility	Sector coupling of vehicle batteries in energy infrastructure		●	●	   
	Mobility sharing	●	●	●	
	Small electric vehicles	●	●		
	Autonomous driving and ride sharing (logistic & passenger)	●	●		
Real estate	Delay risks			●	   
	Improper implementation risk (e.g. mold)		●	●	
	Further renovation & refurbishment of real estate risks			●	
	Further retrofitting of industry risks		●	●	
Sustainable lifestyle	Smart & interconnected energy efficient home		●		   
	Lower premiums for hybrid or electric cars, eco-efficient buildings, certified appliances/machinery, companies with environmental management systems		●		
	Repair instead of replacement, use of environmentally-friendly and/or recycled materials,		●		
	Upgrade to eco-labelled appliances/machinery, rebuilding to green standards		●		
Corporate citizenship	Smart & interconnected energy efficient buildings			●	   
	ESG scoring services		●	●	
	ESG consulting services	●	●	●	
	Sharing/gig economy and "New Work" insurance	●	●	●	
Digitization & sector coupling	Digitization: autonomous processes, block chain & DLT		●		   
	Exposure to cascading and ripple effects in case of physical damages	●			
	Exposure to cascading and ripple effects in case of non-physical ICT infrastructure damages		●	●	
	High impact threats (e.g. cyber and terrorist attacks)			●	
	Electrification		●		
	Data protection & cyber-ethics		●	●	
Emerging customers and regions	Microinsurance and index based insurance (e.g. for poor farmers and extended issues like food security)	●			   
	Provision of inclusive and accessible insurance products to: low-income customer and customer with disabilities, elderly customers and minorities (accessibility with respect to language, cultural norms, religious requirements, disabilities, ...)		●		
	Insurance products for high-risk groups		●		
Ecosystem	Natural Habitat insurance: Forest, Coral Reef	●			   
	Crop insurance	●			
	Agriculture insurance (e.g. for livestock, crops, fishery, forestry, ...)	●			

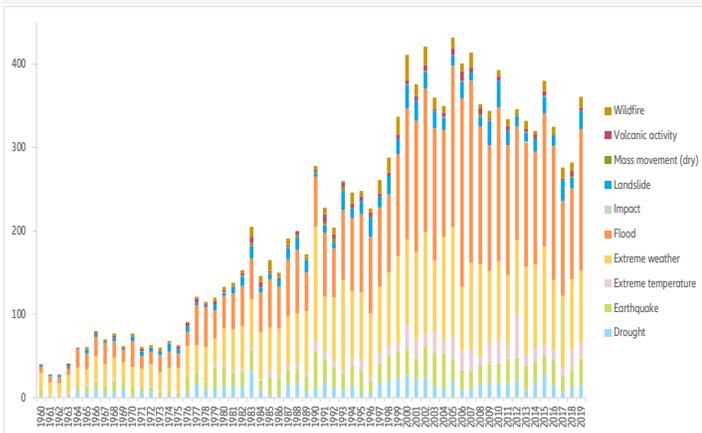
Climate change and weather extremes

As environmental indicators measuring anthropogenic impact continue their long-term post-industrial rise, physical risks such as the tangible disaster losses from natural catastrophes are mounting. Figure 2 shows that the frequency of natural disasters has been increasing in recent years, and researchers predict more severe meteorological and hydrological events to come (Knutson et al. 2010). Recent evidence from a meta-study by Knutson et al. (2020), shows that global tropical cyclone storm intensity, for instance, is expected to increase by 5% and rain intensity by 15%.

The physical impact of these natural disasters on value chains and trade relations presents a huge opportunity for insurance to generate positive impacts: Both economic and insured losses resulting from weather-related catastrophes show an upward trend. Moreover, areas with high industrial activity are often concentrated in coastal areas, and along rivers and river deltas, putting them particularly at risk of extreme weather events. And many regions that have not experienced incidents in the past are likely to be unprepared for extreme events to come in the future. Consequently, the demand for new insurance products

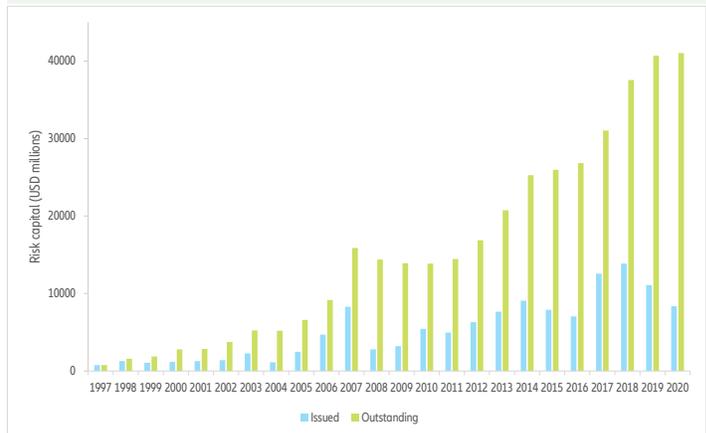
for extreme weather events induced by climate change will continue to grow. In financial markets, investors have already started seizing opportunities to invest in catastrophe risk via alternative risk transfers. Figure 3 shows the increased participation in the insurance-linked securities market, especially for catastrophe bonds¹⁰, designed to hedge sponsors against losses caused by natural disasters. Going forward, it makes sense to hedge against market impacts due to natural catastrophes. Insurers could offer export or other guarantees to cushion the physical impact of extreme events or to mitigate business interruption risk.

Figure 2: Global reported natural disasters by type¹¹ (1960 to 2019)



Sources: Allianz Research, EMDAT (2020)

Figure 3: Catastrophe bond, ILS risk capital issued / outstanding p.a.¹²



Note: Reproduced with permission of Artemis (www.artemis.bm)
Sources: Allianz Research, Artemis (2020)

Renewable energy investments

To limit the extent of global warming to 1.5°C, global capital flows need to finance the energy transition, moving towards carbon-neutral infrastructure projects and technologies (see e.g. Schmidt, 2014). Renewable energy generation and capacity have been rising over the past decade, with a record-high increase in installed capacity expected in 2020, outpacing net installations for fossil fuel and nuclear power combined (REN21, 2020).

According to the U.S. Energy Information Administration (2019), renewable production capacities have to more than triple by 2050. With the International Renewable Energy Agency (IRENA) projecting major shifts in energy carriers by 2050 (Figure 4), there's significant scope for sustainable insurance solutions.

Demand is expected to rise for insuring renewable energy installations against physical or development risks.

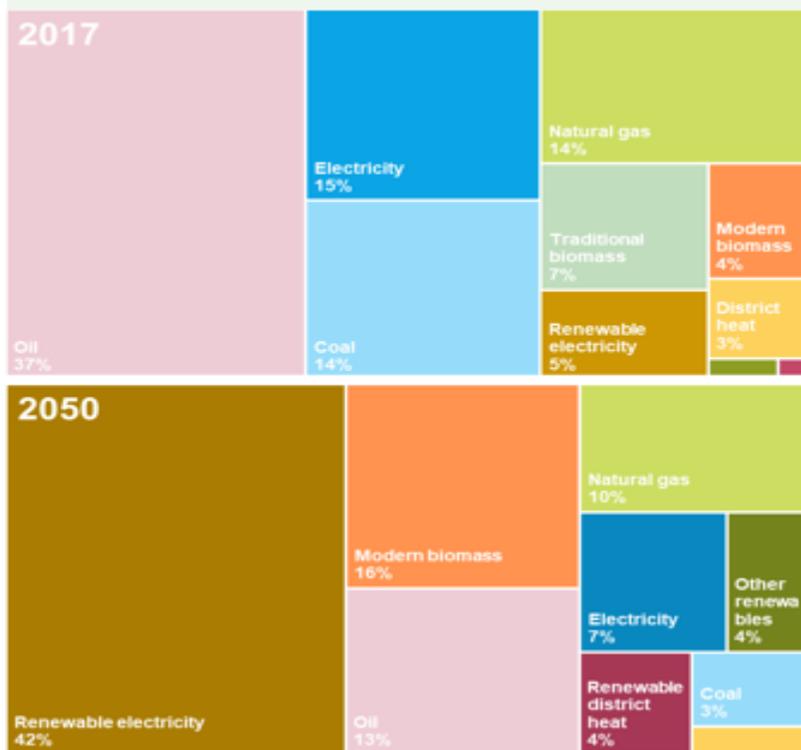
Furthermore, operational risks like earthquakes (e.g. caused by geothermal energy production) or groundwater pollution widen the field of sustainable action. Additionally, the risk of decommissioning or any long-term performance guarantees for energy infrastructure and especially the demand for risk consulting and risk service solutions in establishing new technologies or developing new territories, provide opportunities for the insurance sector.

¹⁰ Nearly half of the insurance-linked securities market are catastrophe bonds.

¹¹ The change over time can be influenced by the increased coverage of reporting over time. The incompleteness of historical data can lead to significant underreporting in the past. The increase over time is, therefore, not directly reflective of the actual trend in disaster events, especially in the distant past.

¹² Data includes some private catastrophe bond transactions as well as any life, mortality or longevity insurance-linked security deals tracked.

Figure 4: Renewable electricity – the world’s largest energy carrier by 2017 / 2050



Note: Breakdown of total final energy consumption by energy carrier in 2017 and 2050¹³
 Sources: Allianz Research, International Renewable Energy Agency (2020)

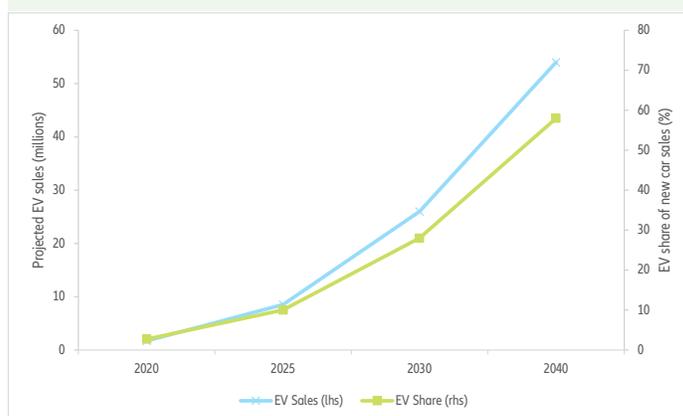
Alternative mobility

The future of mobility is electrified, autonomous, shared and connected, and this will create economic opportunities for impact insurance activities. Electric vehicles, for instance, are already seeing vital progress, with dramatic falls in the cost of renewable power and recent gains in the rate of energy productivity (Energy Transitions Commission, 2017). With battery prices coming down, a

tipping point will be reached soon when battery electric vehicles (EV) become cheaper than internal combustion engines (ICE) for passenger vehicles. Even though forecasts differ, the common trend points approximately towards 2024 (Energy Transitions Commission, 2020; BloombergNEF, 2019). The predominance of electric passenger cars on the street will still take decades

after this price switch, but the share of EVs in new car sales is expected to surpass 50% shortly before 2040 (Figure 5). To stay competitive in this future mobility market, insurance companies will need to adapt their insurance solutions to the areas of mobility-sharing as well as autonomous driving, but can also seize new opportunities as well, such as in the sector coupling of vehicle batteries with energy infrastructure.

Figure 5: Projected development in electric vehicle sales



Sources: Allianz Research, Bloomberg NEF (2020)

¹³ The values for 2050 refer to the Transforming Energy Scenario which describes an ambitious yet realistic energy transformation pathway based largely on renewable energy sources and steadily improved energy efficiency. This would set the energy system on the path needed to keep the rise in global temperatures to well <2°C and towards 1.5°C during this century (International Renewable Energy Agency, 2020).

Real estate

Regulators are increasingly focusing their attention on the pressing issue of improving the energy-efficiency of buildings, setting greener building standards in order to achieve their efficiency ambitions. As a result, construction material demand and installations will change in response to performance requirements, which will be relevant for manufacturers, investment partners and other industry professionals. A surge in demand for the technologies required for high-performance buildings is looming ahead, in particular mechanical equipment such as heat pumps and heat recovery ventilators (Vancouver Economic Commission, 2018).

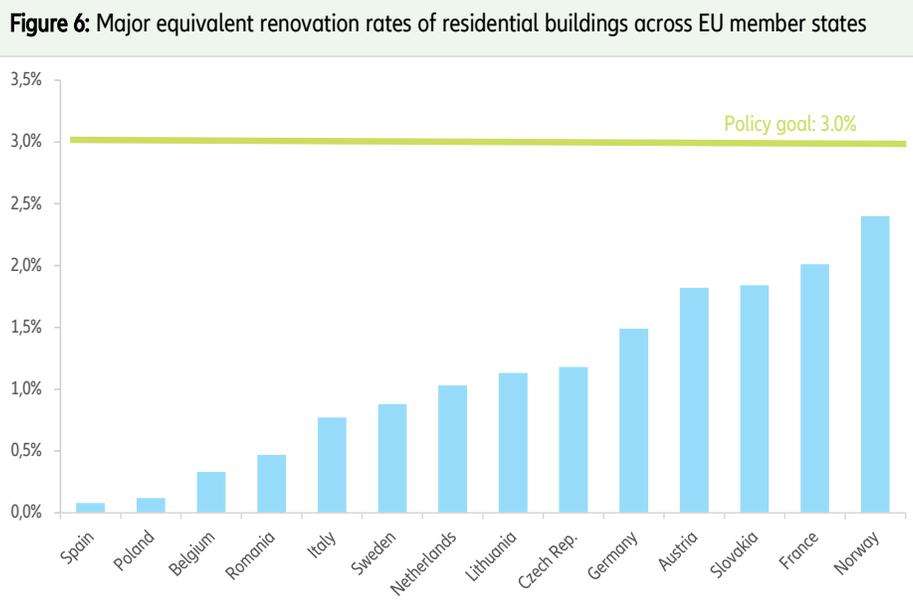
Besides health and social reasons for building green, the growth of the market is also being pulled by client demand and pushed by environmental regulations globally. For instance, European legislation makes nearly Zero-Energy Buildings (nZEBs) a standard by 2020. Buildings accounted for 40% of the EU's energy consumption, 36% of its CO2 emissions and 55% of its electricity

consumption in 2016 (European Parliament, 2016). Given that at least two-thirds of today's buildings will still be standing in 2050, and considering their vast energy consumption, a longer term vision is necessary to align with the challenges ahead (ZEBRA, 2016). Figure 6 shows the major equivalent renovation rates¹⁴ for EU member states. The annual share of the building stock undergoing major renovations is very low: it is below 0.5% in Spain, Poland or Belgium; around 1% in the Netherlands or Lithuania and above 1.5% in others like Germany, France or Austria. Even though the current renovation rate of existing buildings is low, it is estimated that renovation accounts for 57% of all construction activity (European Parliament, 2016). The annual renovation rate of building stock will need to more than double to reach the 3.0% renovation rate necessary to reach the EU's energy efficiency and climate objectives (European Commission, 2019).

In order to make use of the potential environmental, social and economic

benefits of a faster transition, insurance companies should extend their solutions to insure, for instance, delay risks or improper implementation risks¹⁵. Non-financial barriers are a major obstacle for the demand of energy-efficiency measures and include misinformation, distrust and the inability to find qualified workers that are able to implement the measure. Insurance can play an important role as mediator, service provider and risk-bearer and thus distinctly accelerate the implementation of efficiency gains.

Additionally, operating cost savings, short payback periods and asset value increases achieved from investments in new green buildings and green retrofit projects will give further rise to market demand. Consequently, for insurers, a stronger involvement in the business of renovation and refurbishment of real estate or retrofitting of whole industries provides manifold opportunities for impact underwriting activities.



Sources: Allianz Research, ZEBRA (2020)

¹⁴ Because of the lack of an official European definition of major renovations, ZEBRA (2020) developed an indicator to ease comparisons. The consortium assumes that with major renovations, a building's final energy demand for heating can be reduced by 50 to 80%. For more information on the study, including methodology, refer to ZEBRA (2020).

¹⁵ Typical improper implementation risks being mold, leakage, thermal bridges, or problems with the heating system.

Sustainable lifestyle

In EU households, 20% of energy consumption at home is caused by cooking, lighting and other appliances. Unfortunately, improvements in the energy efficiency haven't brought this down, as increased efficiency has led to reduced usage costs that resulted in (1) an increase in usage and (2) a larger number of appliances per person. Consequently, as shown in Figure 7, the absolute value of energy demand has grown even as the individual

energy consumption of each electrical appliance has decreased. In this context, impact underwriting could play an important role by tailoring P&C insurance conditions and claiming regulation towards attaining reduced energy demand. Insurance companies already offer lower premiums for certified and eco-friendly appliances or electric cars and eco-efficient buildings, respectively. Upgrades to eco-labelled appliances and machinery will foster green

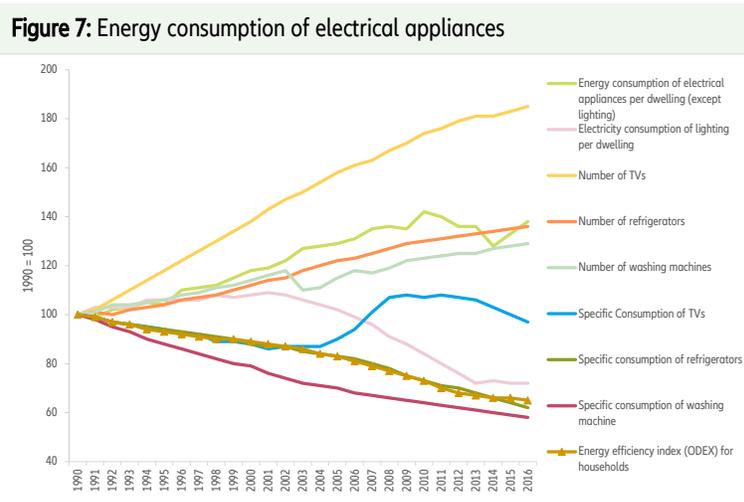
insurance products. In a life-cycle analysis of the emissions associated with a product, this could mean that appliances are repaired instead of replaced. In this respect it is not only important to advance the methods used to determine life-cycle emissions but also to stipulate resource preserving repair options in the product design, which can be further stimulated through promoting beneficial insurance conditions for such products.

Corporate citizenship and the future of work

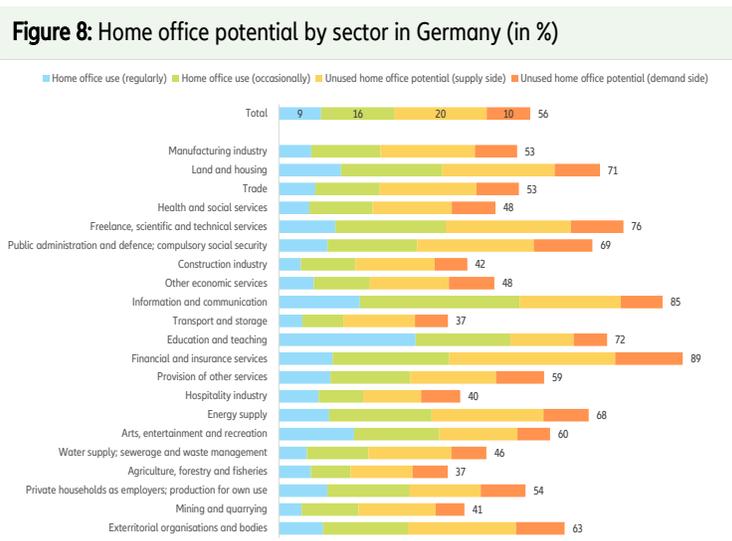
The Covid-19 pandemic has been a trial run of remote work at a grand scale, giving an indication of what the future of work could be like in the context of greater digitization and automation. Mobility to places of work experienced an unprecedented decline and industry experts expect this pattern to persist: Business trips will be replaced

by virtual meetings and office tables by the kitchen table at home. As employers realize that working permanently from home is a feasible option, they could be tempted to give up expensive office space. Figure 8 shows the home-office potential across sectors in Germany, according to an analysis by Alipour, Falck & Schüller (2020).

Impact underwriting can play a role in adapting solutions to this new work environment by reducing implementation barriers resulting from risk averseness, along with supporting the transition to the sharing economy and underlining the importance of creating value in things that otherwise would be dumped.



Sources: Allianz Research, European Environment Agency (2019)



Note: Sectors sorted in descending order of gross value added

Sources: Allianz Research, Alipour, Falck & Schüller (2020)

Digitization and sector coupling

Progress in digitization underpins most of what we have discussed in the previous sections, from the energy transition to the evolution of remote work and is thus an essential requirement for achieving sustainability. However, this progress can be held back by risks related to cyber-induced business interruption.

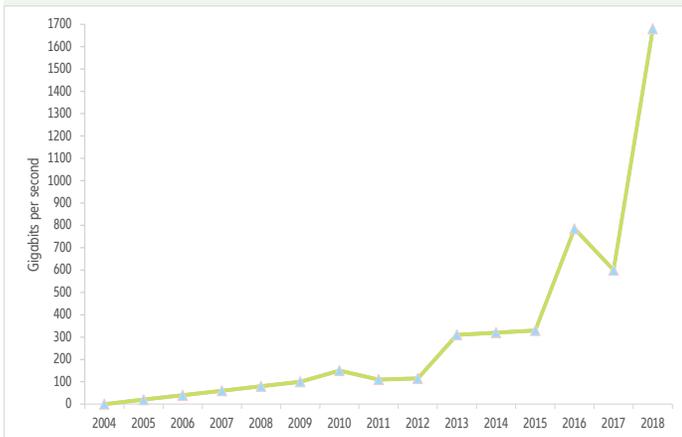
Figure 9 shows that distributed denial of service¹⁶ (DDoS) attacks on non-physical ICT infrastructure have peaked recently, and the trend of significant growth continues year-over-year (Anstee et al, 2016; Coburn et al, 2019). With businesses moving to take advantage of digital efficiencies, the number of connected devices used is growing at around 12% annually (Coburn et al, 2019), and this makes business activities even more vulnerable to cyber-attacks. Impact underwriting could cater to the demand for non-damage business interruption insurance, offering affirmative cyber insurance or entire cyber insurance portfolios, as well as risk consulting and risk services:

Blockchain and distributed ledger technology (DLT) are beginning to rewire our digital infrastructure and challenge our thinking on how data, information, assets and even governance can be reorganized and reimaged. In 2018, PwC's global blockchain survey identified that 84% of the respondents are actively involved¹⁷ with blockchain technology. Moreover, Deep Analysis (2019) forecasts a tremendous market growth for the enterprise blockchain market in the years ahead (Figure 10). Insurance companies are already starting to offer cryptocurrency theft coverage in cyber affirmative policies, which includes the cover of theft of cryptocurrencies in digital wallets caused by malicious outsiders (Barlyn, 2018).

Beyond the risk of cyber-attacks, society will also be exposed to cascading and ripple effects in case of any physical damages to critical ICT infrastructure. Changing catastrophe patterns and increasing terrorist threats result in the re-evaluation of locations that were previously thought to be secure.

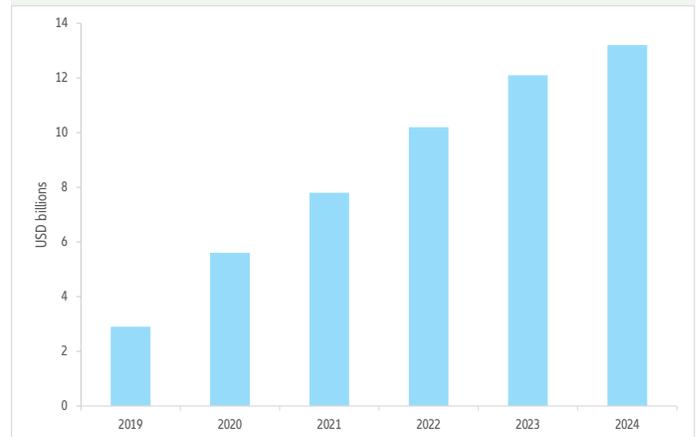
Future attacks that trigger fires, damage to machinery and physical loss to major assets may trigger unanticipated claims to insurers through traditional non-cyber insurance lines (Coburn et al, 2019). Changing patterns of risk make it more challenging to apply actuarial analysis of past years of claims experience to next year's likely cost structure. Crucially, the potential for accumulation risk from a major cyber catastrophe is continually shifting. It will take a concerted effort by many different organizations and agencies, investment in law enforcement, legal reforms and changes in the economics of software production to reduce the loss rates to society from cyber-attacks. Insurance companies will play a major role in this growing and competitive cyber risk market in the future as adoptions will accelerate thanks to advancements in big data analytics solutions. Integration of responsible data handling, data protection issues and cyber-ethics will be part of it.

Figure 9: Peak DDoS attack intensity from 2004 through 2018



Sources: Allianz Research, Coburn et al. (2019)

Figure 10: Enterprise blockchain market growth (2019 – 2024)



Sources: Allianz Research, Deep Analysis (2019)

¹⁶ A distributed denial of service (DDoS) attack is a form of cyber-attack that increases the traffic on a network, overwhelming it and making it inaccessible to legitimate users (Kohout, 2018).

¹⁷ Involvement can be research, development, pilot projects or live applications (PwC, 2018).

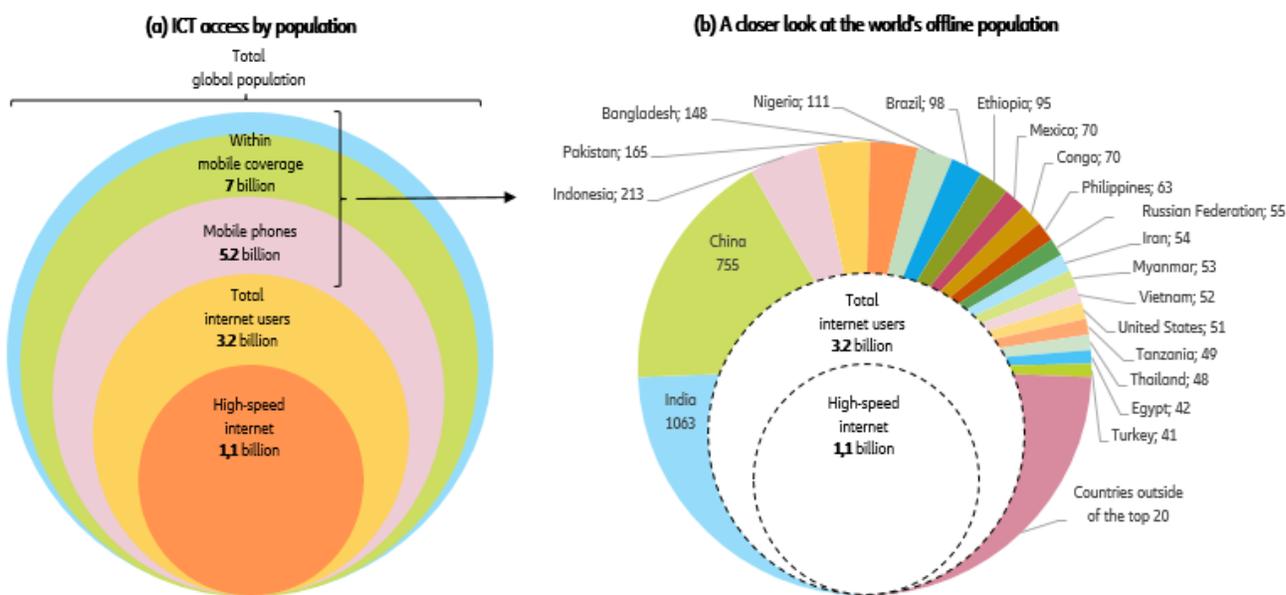
Emerging Customers and regions

With increasing access to mobile phones and the internet in Emerging Markets, the insurance industry will be able to provide insurance solutions to population groups that have been particularly challenged by not being able to insure their risks. The current offline population (see Figure 11) represents future insurance clients who become approachable and addressable. Impact underwriting can provide new insurance products tailored for their specific needs, enhancing for instance the provision of inclusive and accessible insurance products to low-income customers, customers with disabilities, elderly customers and minorities. By offering solutions to customers via connected mobile devices, the in-

surance industry could actively shape their risk behavior. For instance, in the area of agricultural insurance, insurers could include weather alerts for livestock, crops, fishery and forestry to support the decision-making of farmers. For poor farmers, microinsurance or index based insurance¹⁸ is an innovative and increasingly popular approach to insurance provision (International Association of Insurance Supervisors, 2018). Linking agricultural insurance to an index rather than to actual incurred losses is more cost-effective and, if communicated effectively, can foster trust between insurers and the insured.

Mobile banking, which is more and more accessible to the poor, can also make agricultural insurance more affordable and simultaneously increase its availability and quick payouts. Claims processing is likely to be the next area of focus for IoT¹⁹ investment. Finally, this type of insurance allows farmers to invest more confidently and manage losses better, which helps smallholders to improve their productivity and grow their business in a more sustainable way. In this way, improved access to insurance can directly and indirectly enhance livelihoods, reduce poverty and create opportunities for sustainable economic advancement.

Figure 11: Access to mobile phones and the internet (a) by population and (b) by country



Sources: Allianz Research, World Bank (2016)

¹⁸ The insurance product involves contracts where a claim is defined with reference to a predetermined index. Index-based agricultural microinsurance offers payouts connected to publicly observable indexes, such as temperature or rainfall, rather than actual incurred losses.

¹⁹ IoT refers to the 'internet of things', which mainly refers to 'smart' appliances and objects with extended functionalities through internet connection capability.

Ecosystem

Regarding agriculture in particular, the provision of effective insurance is also a way to facilitate a more productive agricultural sector. Intensifying rainfall and heatwaves are making crop yields more erratic, emphasizing the need for insurance and the role of impact underwriting.

Figure 12 illustrates the results from a multi-model simulation study for different underlying climate change scenarios (analyzing various scenarios in various different models). The red areas indicate a significant (more than 5%) decrease and the blue areas a significant increase in the respective crop yield, for the indicated share (>50% or >75%) of the underlying model runs, given a 2.5°C increase in global mean temperature. Still, with rising average temperature it is predicted that also the variance of temperature and precipitation will be impacted, including an increase in the frequency and duration of extreme events. When evaluating the effect of climate change on crop yields it is crucial to account not only for the mean effects of rising temperature but also for crop yield variance.

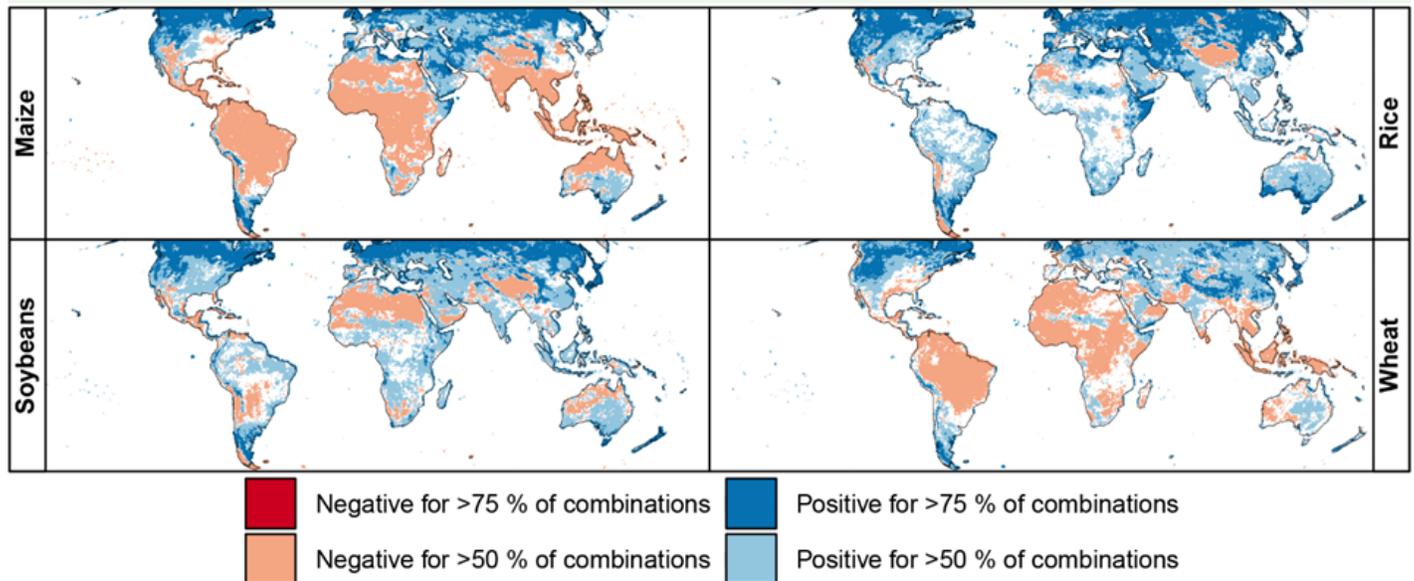
Figure 13 illustrates expected significant (>5%) increases (blue) and decreases (red) in variance, for the indicated share (>50% or >75%) of the simulation runs, given a 2.5°C increase in global mean temperature. While the losses in average yields are particularly affecting developing and emerging countries, increases in yield variability are expected in much of the Northern Hemisphere, particularly in North America, Central Asia, and China.

Besides agricultural and crop insurance, natural landscapes can also be subject to sustainable insurance solutions. Some natural assets, such as coral reefs, can be much more effective in carbon capture than man-made solutions. The world's first insurance policy on a coral reef is now in place in Mexico²¹. By protecting the Mesoamerican coral reef off the coast of Mexico's Yucatan Peninsula, the region's ability to sustain itself economically is being ensured. More specifically, if the reef would die, it would no longer be able to prevent beach erosion, which, in turn, would threaten the region's key source of income, tourism. Nature-based insurance solutions can help to speed up the recovery after a natural disaster and

help reduce the damage to the local and national economies overall, making them more resilient.

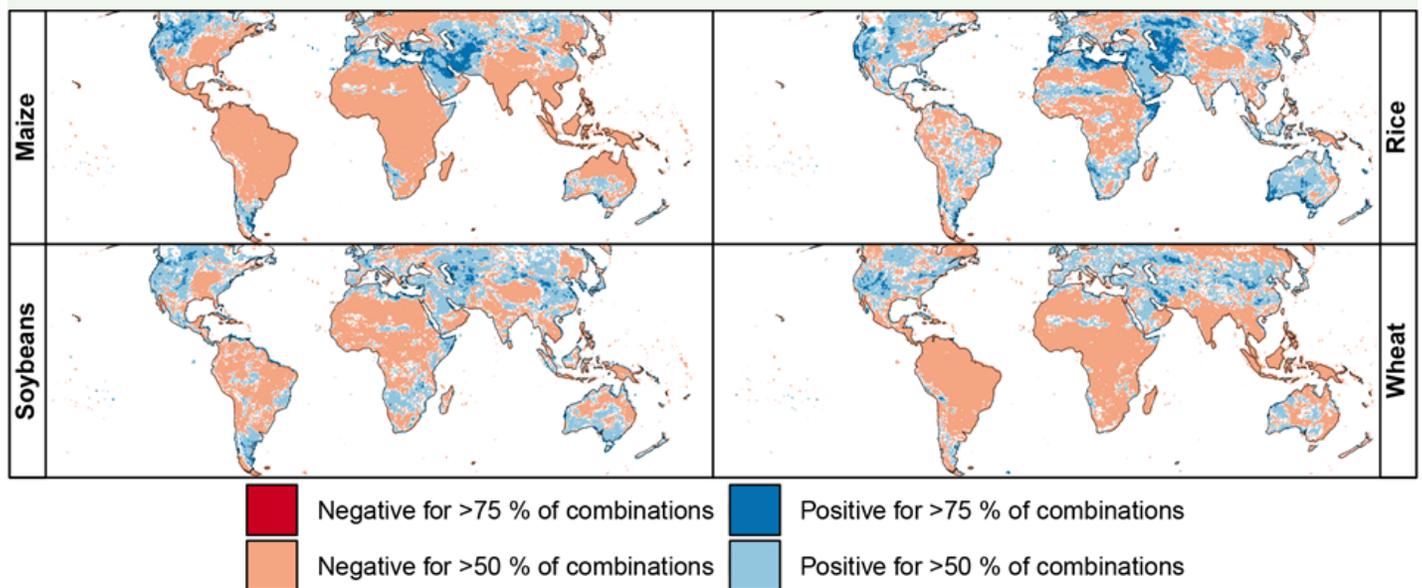
The role of the financial sector, especially the insurance industry, in protecting and restoring natural landscapes could become crucial in the future. The conservation of a valuable natural asset is creating a scalable new market for the insurance industry and could be applied to other regions and ecosystems. Investing in nature is gaining importance in fighting the consequences of global warming. The double dividend claim remains plausible: Public-private collaborations between the insurance industry and local governments allow to measure how much risk, for instance a reef, can reduce. Insuring nature equals ensuring a resilient future as long-term consequences from exploiting the nature are expected to be much more costly. At the same time, local economies benefit economically as tourism will be based on a more sustainable foundation. Investing in nature will not cause economic damage. On the contrary, perhaps, it will be a key driver for many economies to survive and flourish in the future.

²⁰ For a detailed description of the coral reef insurance, please refer to Nature Conservancy (2019).

Figure 12: Changes in crop yields at different levels of global warming

Note: Percentage of crop model simulations indicating an increase (blue) or decrease (red) in yield of >5% at each grid point at 2.5°C increase in GMT (Global mean temperature change) as compared to the historical period for maize, rice, soybeans and wheat under rain-fed conditions. White indicates either a change of <5% or disagreement among the models in the direction of yield change.

Source: Ostberg et al. (2018)

Figure 13: Changes in crop yields variability at different levels of global warming

Note: Percentage of crop model simulations in the 2.5°C warming bin indicating an increase (blue) or decrease (red) in yield variance of >5% compared to the historical period (1980–2010), for maize, rice, soy, and wheat under rain-fed conditions. White indicates either a change of <5% or disagreement among the models in the direction of change.

Source: Ostberg et al. (2018)

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