Swiss Re Institute

Swiss Re SONAR

New emerging risk insights

June 2020

Swiss Re SONAR informs and inspires conversations about emerging risks, so the insurance industry can continue to build resilience also in turbulent times.

Contents

Overview

Emerging risk themes by potential impact and timeframe

0–3 years

Computing at the edge – cybersecurity overstretched?

Tipping the scale? – Intergenerational imbalances on the rise

Global pharmaceutical supplies – breaks in the chain?

Standards – into the unknown

Burning question – risky lithium-ion batteries

Deepfakes – the creeping devaluation of truth?

Grey accountability – product liability in the era of smart everything

The sorcerer's apprentice – DIY synthetic bio hazards

> 3 years

Locking it up – carbon removal and insurance **(Special feature)**

Vaping and e-cigarettes – a new wave of addicts? **(Special feature)**

Green buildings – will they pass the test of time?

Out of sight, out of mind – mental health issues among the young

Hydrogen fuel cells – propelling the future?

Teeny weeny high-tech – smart dust

Trend spotlights by potential impact

Moving to a low carbon future **(Special feature)**

A sea change in app usage?

The fragility of healthcare systems

Sustainable supply chain management just as crucial in financial services

Most affected business areas

for **Property** for **Life & Health** for **Casualty**

for **Operations** – incl. regulatory changes for **Financial markets** – incl. insurer's assets

Potential impact

High Medium Low

Foreword

In our very first SONAR publication back in 2013, we profiled "Emerging infectious diseases", highlighting the potential for fast and wide spread of disease due to increased human mobility and trade in food. Two years later, we covered the theme of "Rising pandemic risk", saying that "a global pandemic would affect supply chains and might ultimately also impact financial markets." We went back to the theme again, in 2017. In "Bugs on the march – underestimated infectious diseases," we said "the question isn't whether another deadly infectious disease will appear, but when and how well society is prepared to cope with it." Impact potential: high.

Welcome to Swiss Re's 2020 SONAR report, published as the world grapples with the high impact of pandemic in real time. The COVID-19 crisis is ongoing, and raises many uncertainties. As our SONAR reports to date testify, the warning signs were there. Was the threat of pandemic underestimated, even so? Probably yes, and no. The reach and depth of impact – on economies, financial markets and societies – from the containment measures imposed to halt spread of the virus, were probably underestimated. However, the re/insurance industry has long had pandemic threat on its radar screen.

Nevertheless, the pandemic has triggered many short-term impacts, not all fully anticipated, and some could have longer-term effects. Just one example: with online connectivity, working from home has long been an option for many office-based employees. In the times of COVID-19 lockdown, it has become the norm. And it's very possible that teleconferencing, for instance, will remain standard practice even after lockdown is lifted. Web-based meetings help firms save large travel and office space expenses, and reduce their carbon footprint, but might also come with other as of yet unforeseen risks.

At the beginning of the year, the political agenda and discussion in media was dominated by climate change. Attention then shifted to COVID-19. Nevertheless, adaptation to climate risks and the transition to a low-carbon economy with related opportunities and risks for the insurance industry remain crucial. In the wake of COVID-19 the public and private sectors must focus on both global health and climate change.

The past months have shown the utmost importance of forward-looking risk management. Risk awareness is ever more important as a prerequisite. SONAR contributes to that risk awareness and inspires dialogue. Maintaining global dialogue on evolving exposures and trends will help us best prepare for the future risk landscape.

We look forward to engaging with you to discuss your thoughts and insights.

Patrick Raaflaub
Group Chief Risk Officer

Introduction

Today's risk landscape is complex and ever in a state of flux. Rapid changes give rise to "emerging risks" – morphing or newly developing risks that are difficult to quantify and can have a major impact on the insurance industry. Swiss Re's annual SONAR report, published since 2013, provides a forward-looking perspective. We aim to foster dialogue with all stakeholders to help insurers understand and manage emerging risks more effectively. Some emerging risks presented in this SONAR report may never materialise while others form the basis for future risk pools. Some of the trends depicted may lose importance while others may shape our business environment.

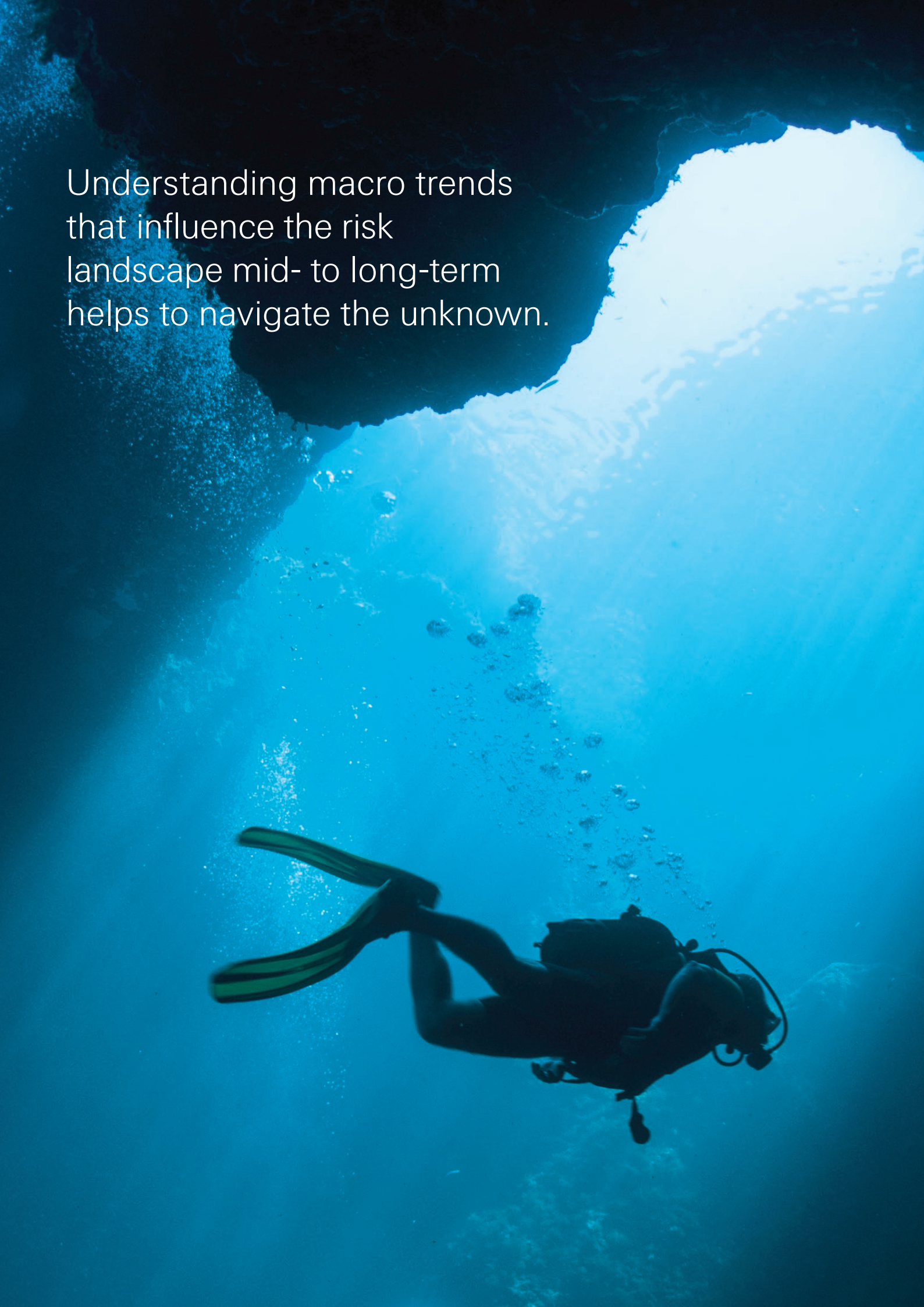
This year's SONAR features 14 new emerging risk themes and four emerging trend spotlights. The emerging risk themes are potential new or changing risks, with both downside risks as well as upside potential for the insurance industry. The trend spotlights highlight contextual developments we deem relevant for insurers, but do not necessarily reflect a specific risk. Several chapters of this year's report cover emerging risks resulting from the COVID-19 crisis. Another focus is the transition to a low-carbon economy: a special trend spotlight sets the scene for several related risk themes, including carbon removal. The report also features a special risk theme on vaping and e-cigarettes.

To assess and underwrite exposures, the insurance industry traditionally uses historical data for identified and insurable risks. However, historical data alone are not sufficient to prepare for the future risk landscape. Here, the insurance industry needs to demonstrate foresight, which is where SONAR comes in. With this report, Swiss Re identifies emerging risks by gathering input and feedback from underwriters, client managers, risk experts and others across the company, and also from external experts and research institutions. The emerging risk themes outlined in the SONAR report are based on early signals collected over the course of a year. They do not reflect the entire emerging risk landscape of the insurance industry nor that of Swiss Re. They have been categorised according to their estimated impact and potential timeframe to materialise, and with respect to the line of business where we think the biggest exposure will lie (see page 2). We only report a risk previously flagged in SONAR if we see new aspects emerge.

We begin the SONAR report with an overview of the macro trends relevant to re/insurance markets and the world at large, as seen by Swiss Re. These trends and their grouping into societal, political, technological & natural and competitive & business themes serve as a backdrop and ordering structure for our emerging risk insights and trend spotlights. In the appendix, we provide an overview of emerging risks with highest impact from past reports (2016–2020). The appendix also explains all terms & definitions used in the report.

Per lines of business, the top emerging risk themes identified in this year's edition are:

for **Property:**	Locking it up – carbon removal and insurance
for **Casualty:**	Burning question – risky lithium-ion batteries
for **Life & Health:**	Global pharmaceutical supplies – breaks in the chain?
for **Financial Markets:**	Tipping the scale? – intergenerational imbalances on the rise
for **Operations:**	Standards – into the unknown


Understanding macro trends
that influence the risk
landscape mid- to long-term
helps to navigate the unknown.

Macro trends

Screening of interdependent macro trends

To navigate the dynamics of the re/insurance landscape, Swiss Re has identified 23 macro trends that reflect mid- to long-term factors which we believe have high potential to shape the industry over the next five to ten years. Some focus on (downside) risk, others highlight opportunities, and some are neutral.

The current COVID-19 health and economic crisis has turned our world upside down. Some of these developments are challenging long-term trend outlooks. In certain aspects, the trends are accelerating paradigm shifts and transitions. In others, expectations and rules taken for granted have suddenly become obsolete. In this SONAR report, we look at the existing macro trends, which have not changed from last year, through this new lens.

The trends fall into interlinked "environment" categories, namely societal, political, competitive and business, as well as technological and natural environments. In addition, we highlight overarching topics that feature strong interdependencies between certain macro trends while also reflecting today's reality, and which we expect will shape the future of our industry.

Societal environment

- Growing middle class in HGM
- Longevity & radical medical innovation
- Connected & collaborative society
- Mass migration & urbanisation
- The future of work & talent gaps
- Rising social inequality & unrest

Political environment

- Public sector moving risk to private sector
- Protectionism & fragmented regulation
- Increasing nationalism
- Instability of geopolitical & economic systems
- Low yield environment & risk of inflation

Technological and natural environment

- Climate change & resource scarcity
- Structural change of energy production, distribution & consumption
- Massive expansion of digital & cyber risk
- Data as an asset
- Technology application as efficiency play
- Disruptive digital technologies
- Autonomous transportation & robotics

Competitive and business environment

- Re/insurance value chain disaggregation
- Rise of collateralised reinsurance
- Strategic partnerships with non-insurance companies & institutions
- Regional champions going global
- Increasing digital customer interaction

Societal environment

Time will tell what impact COVID-19 has on society. Will it accentuate the tendencies that we have seen in the past, such as a rise in social unrest and protests around the globe, bringing large numbers of people onto the streets or will it spur increased international collaboration?

The economic crisis in the aftermath of COVID-19 will affect markets and social groups differently. It already appears that the millennial generation (age 20–40) will be particularly affected by relative income loss and deprived of wealth building capability (see page 23, "Tipping the scale? Intergenerational imbalances on the rise").

Overall, the world has become more equal in terms of wealth and income distribution over the last decades, with developing countries claiming a progressively larger share of global wealth.[1] However, inequality within advanced economies has barely changed, and has even worsened in many OECD countries in recent years. By offering affordable and innovative products (including through public-private partnerships), insurance companies can improve resilience for vulnerable populations and help tackle inequalities that could give rise to further social unrest.

Even if it takes many months to find a cure or a vaccine for COVID-19, the rapid speed in medical innovations of recent years has been remarkable.[2] Improved vaccines and public health programmes impact our life expectancy. World Bank data indicates a global life expectancy of nearly 73 years in 2017, up by 10% since the start of the millennium.[3] However, despite their economic development, relatively poorer countries still exhibit lower life expectancies, which is correlated with lower healthcare expenditure.[4] Furthermore, increased longevity also brings inherent challenges. Globally, the number of people older than 60 years is expected to double from 2017 to reach nearly 2.1 billion by 2050.[5] Ultimately this leads to an aging population, putting more pressure on healthcare and pension systems.

The trend of growing middle class in high-growth markets remains strong, in spite of the COVID-19 crisis setback. In Asia and Africa, middle classes are expected to grow in the next 10 years. At the same time, the share of the middle class in North America and Europe might stagnate. As such, we expect the already-happening shift of growth towards the east to continue (see page 12, "The pivot east continues").

1 Credit Suisse Research Institute, Global wealth report 2019, p.14.
2 For an emerging risk and opportunity perspective on healthcare developments, see Medical Advances: Risks and opportunities for the (re) insurance industry, CRO Forum Emerging Risk Initiative – Position Paper, December 2019. https://www.thecroforum.org/wp-content/uploads/2019/12/CROF-ERI-2019-Medical-Advances.pdf
3 https://data.worldbank.org/indicator/sp.dyn.le00.in
4 Ray, D., Linden, M. Health expenditure, longevity, and child mortality: dynamic panel data approach with global data. Int J Health Econ Manag. 20, 99–119 (2020). https://doi.org/10.1007/s10754-019-09272-z
5 UN World population ageing 2017 highlights, p. 1, https://www.un.org/en/development/desa/population/publications/pdf/ageing/WPA2017_Highlights.pdf

Political environment

COVID-19 will accentuate some of the political trends already observed in the past few years. Globally, governments are supporting their domestic economy with stimulus packages. These can ease the crisis for some in the short term, but they will prolong the public debt crisis and increase related risks in the long term (see page 13, "Downturn and recovery"). Even before the COVID-19 crisis, according to the Institute of International Finance, the ratio of global debt to GDP had hit an all-time high of over 322% in the third quarter of 2019, with total debt reaching close to USD 253 trillion. Developments such as increasing income disparity and demographic shifts within countries put additional strain on public finances. Also, the low-yield environment will most likely continue. A few weeks into the COVID-19 crisis, the entire Treasury yield curve fell below 1%, the first time in history.

COVID-19 will most likely underline nationalistic tendencies, including toward protectionist local regulation. In combination with the polarisation of societies, the rise of disruptive technologies and subsequent need for new regulations (eg, data privacy), the global regulatory landscape has become increasingly fragmented. There is also an anticipated shift from US dominated regulations to more influence from the East, mainly China (see page 24, "Standards – into the unknown").

Anti-globalisation sentiment was nourished by slow economic recovery after the global financial crisis of 2008-09, and by fears of job losses to automation and migration. The COVID-19 outbreak has boosted protectionism even further, with globalisation and open borders easily blamed for the spread of viral disease. In the longer term, however, the pandemic's social and economic implications may renew enthusiasm for international collaboration, as already showing in the medical field.

The current crisis has confirmed governmental authority in many states, but also profiled anti-governmental attitudes and protests. The squeeze on public finances between tax revenue losses and increased demands for spending will likely affirm the macro trend of risk being moved from the public to the private sector, but political debate and readjustments are to be expected for the years to come. Public-private partnerships will play an important role in these discussions.

Technological and natural environment

Recent natural catastrophes, including severe hurricanes, typhoons, widespread drought and wildfires, demonstrate the forceful financial impact climate-related risks can have on the insurance industry. Higher value concentration in exposed regions such as coastal areas increase the impact potential of a natural disaster. The effects of climate change and global warming are evident: warmer average temperatures, rising sea levels, melting ice caps, longer and more frequent heatwaves, erratic rainfall patterns and more weather extremes. The global lockdown due to fighting COVID-19 may have eased environmental pollution for a brief moment, but it will not put a halt to global warming.

The insurance industry holds a keen interest in and responsibility to uphold awareness of climate risks and is an effective partner for climate-risk adaptation and the transition to a low-carbon economy. A larger part of global energy consumption is still sourced from fossil fuels. Ongoing commitment to the Paris Climate Agreement from government and industry, alongside further technological advancement will be necessary to modernise energy economies and prevent further global warming (see page 28 “Moving to a low carbon future” and page 34, “Locking it up – carbon removal”).

Due to the rapid spread of internet-enabled devices and universal connectivity (see page 12, “Digital innovation”), questions around the product liability arise (see page 42, “Grey accountability – product liability in the era of smart everything”). Overall, risks in the digital world have increased. The shift from human intervention to software-enabled processes drives efficiency and convenience but also comes with new vulnerabilities.

According to cyber-security company Malwarebytes, the number of ransomware incidents fell slightly in 2019, but they were more sophisticated and damaging.[6] With respect to the insurance opportunity, cyber continues to be largely a prevention market. Yet demand for insurance protection continues to rise rapidly (see page 40 “Computing at the edge – cyber-security overstreched”). To gain the required risk knowledge and ability to provide a full-services offering, insurers are partnering with cyber security companies.

Another form of digital attack are so-called deepfakes, digital content fabricated from underlying authentic source material with the help of artificial intelligence (see page 41, “Deepfakes – the creeping devaluation of truth”).

[6] 2020 State of Malware Report, Malwarebytes Labs, Feb. 2020, p 11f.

Competitive and business environment

Persistent low yields and the current regulatory environment have impacted the entire insurance industry, most importantly life insurers and to a lesser extent reinsurers. If the COVID-19-induced recession leads to a sustained credit crisis involving downgrades and spread widening, pressure on primary insurers' solvency ratios will increase. This could generate new demand for capital-relief transactions from reinsurers.

The competitive environment is changing quickly, also due to technology. The use of large data pool – from wearables, smart homes, telematics devices or social media – by insurers has so far remained limited. Increasingly, insurers are partnering with non-insurance companies and institutions. Most partnerships focus on improving access to the end customer, increasing access to data or improving efficiency. There are examples of insurers partnering with social media sites to distribute and manage policies, and internet retailers providing point of sale insurance covers (see page 12, "Digital Innovation").

The extent to which insurers interact digitally with their policyholders and distribute their products is still modest (see page 46, "A sea change in app usage?"). As the purchase of insurance moves online, being part of high touchpoint digital ecosystems will become increasingly important for long-term growth.[7] A Swiss Re COVID-19 Consumer Survey in Asia-Pacific (APAC) shows that online processing of insurance policies from start to finish is a main consideration for the majority of consumers when selecting an insurer, and most strongly so in China (77%).[8]

Large insurers invest significant resources to stay at the forefront, both to enhance their existing value chain and in search of disruptive business models. One way to pursue innovation is through external ventures. Start-ups using technological innovation to improve insurance, so called InsurTechs, are in high demand.

[7] Also see Digital ecosystems: extending the boundaries of value creation in insurance, Swiss Re Institute, 2019, https://www.swissre.com/institute/research/topics-and-risk-dialogues/digital-and-technology/Digital-ecosystems.html

[8] https://www.swissre.com/risk-knowledge/building-societal-resilience/COVID-19/market-announcement-covid19-consumer-survey.html

The pivot east continues

The middle class in the east is growing rapidly. Together the world's two most populous countries, China and India, are forecast to represent over 43.3% of the global middle class by 2030.[9] The shift in global insurance market growth to Asia also remains ongoing. China consolidated its position as the second largest insurance market in the world in 2018.[10]

The growth of the Asian middle class will foster consumption and inherently increase protection needs. Insurance spending in China has increased in both life and non-life, and most emerging markets demonstrate large insurance catch-up potential. The COVID-19 pandemic is unlikely to change anything here. A Swiss Re COVID-19 Consumer Survey conducted in major APAC markets in April found that while more than a quarter of the 2500 respondents were worried about their financial future, demand for risk protection continues. Consumers seemed ready cut other expenses more first, with 78% willing to sacrifice eating out, 57% to give up gym membership, and just 14% willing to sacrifice insurance premiums.[11]

The growth in Asia's high growth markets has led to the emergence of several large re/insurers. Their market capitalisation is remarkable, as is the broad retail customer base and millions of internet users in the region. The re/insurers' strong capital base allows them to invest significant amounts in tech-driven innovation. And even with the high online penetration, the re/insurers also still have millions of sales people.

Leading companies in the region will continue to benefit from the ongoing strength of their domestic markets, particularly in life & health insurance. In this sector, penetration remains low across Asia and as the middle-class cohort increases in size, so too will premium growth. The leading re/inusrance players are at the forefront of the industries adoption of new technology and consumer engagement.

Digital innovation

Digitalisation and related technologies have fundamentally altered how we interact and manage our lives. They continue to change individual consumer behaviour, transform organisational operations and cultures – including those of companies in the insurance industry – and they enable new offerings and process optimisation in all sectors of business and industry.[12] They can even change processes at the politics level as shown, for example, by the influence of social media on political discourse.

The universal connectivity is mind boggling and the sheer amount of data calls for effective computation and network capabilities (see page 40, "Computing at the edge"). Over 4 billion people are connected online, 90% via mobile devices. That is only a fraction of the digital world, which also includes interconnected networks, sensors, tools, software, robots and other physical devices. According to a report from the World Economic Forum, a modern offshore drilling platform features around 80 000 sensors, which are forecast to generate approximately 15 petabytes of data volume during the lifetime of the platform.[13] Sensors are getting ever smaller and more ubiquitous. "Smart dust" applications are close to market. These pollen-grain sized, wireless communicating devices are used to measure light, vibration, temperature, noise or any other physical force, allowing for monitoring in areas never even thought of before (see page 43, "Teeny weeny high-tech – smart dust").

9 K. Hamel and B. Tong, "Look East instead of West for the future global middle class," oecd-development-matters.org, 7. May 2019, https://oecd-development-matters.org/2019/05/07/look-east-instead-of-west-for-the-future-global-middle-class/

10 sigma 3/2019: World insurance: the great pivot east continues, Swiss Re, p. 8f.

11 https://www.swissre.com/risk-knowledge/building-societal-resilience/covid-19/market-announcement-covid19-consumer-survey.html

12 For a more detailed recent analysis of insurance opportunity from digital innovations see sigma 1/2020: Data-driven insurance: ready for the next frontier? Swiss Re.

13 Digital Transformation Initiative: Oil and Gas Industry, WEF White Paper 2017, p. 9.

The increasing number of internet-connected devices has led to exponential growth in the volume of digital data generated. If accessible and with adequate analytics capabilities, insurance companies can benefit from this vast amount of data. They can mirror sensor-equipped physical assets or processes, for example an industrial setting, virtually. Such "digital twins" enable better monitoring and modelling of risks and can thus help to optimise risk management, loss prevention and pricing.

Insurance companies can also use these data to better understand customer needs and preferences. Insights gained from data allow insurers to provide consumers with more flexible and personalised products and services, and to make offerings efficient and affordable. New tools to analyse the data and extract useful insights are proliferating and will change the way insurers interact with consumers.

First-movers in more data-driven business models can gain a lead in experience and customer base. However, first-mover advantage can also bear risks. Innovative research and development requires large investments with uncertain returns, and betting on a wrong horse can entail large losses. First-movers relying on data-driven business models also carry the burden of testing customers' willingness to share data. Furthermore, they need to carefully evaluate regulatory limitations and anticipate potential reputational risks.

Downturn and recovery

The shutdown of public life in many countries due to COVID-19 has led to significantly lower economic activity. The fear of a strong downturn and related uncertainties is visible in the increased financial market volatility, and the roller-coaster ride in oil prices. The current crisis differs from a typical economic downturn as the services sector, which is usually more stable, has been hit harder than manufacturing. This means the post-COVID-19 recovery will be slower that usual as a rebound in demand for services will likely lag the release of pent up demand for manufactured goods. There could also well be shifts in the geopolitical arena: some economies are better prepared than others for the economic shock that the COVID-19 crisis has unleashed and will be more resilient to the fallout.[14]

In many countries, governments have provided emergency loans and even helicopter money to shore up the economy. This raises the question of how quickly state support will pull back once crisis times are over. The role of central banks is also unclear: will they monetise the huge public debt load and bring back inflation? Globalisation has been a driver of low inflation over the last 20 years, but a trend of rising nationalism and the emergence of new, more local supply chains could make goods more expensive.

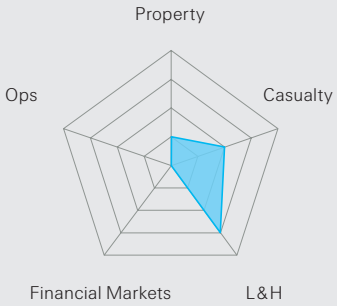
Even if inflation is a looming threat for the future, we believe the low interest rate environment will persist for a while yet, and central banks are likely to cap yield increases to accommodate the massive fiscal stimulus. In the overall economy, debt outside financial institutions has become more worrisome, and with corporate debt levels at all-time highs. In addition, severe liquidity issues have emerged in both the corporate and government bond markets. Liquidity problems in funding markets can further amplify the depth of a recession.

The spread and mortality rate of COVID-19 is introducing new complexities for insurers in claims, underwriting, policy terms and more. The long-run will also bring opportunities, however. For instance in personal lines, rising consumer risk awareness will lead to increased desire for the protection that insurance can provide.

[14] Economic and financial risk insights, Swiss Re Institute, 9. April 2020, https://www.swissre.com/institute/research/sigma-research/Economic-Outlook/watch-out-for-paradigm-shifts.html

14 Emerging risk themes and 4 Trend spotlights

Impact	Medium
Most affected business areas	L&H, Casualty
Time frame (years)	0–3



Potential impacts

- Drug shortages can lead to increased healthcare costs, triggered by longer treatment times. Where patients do not follow a treatment due to drug shortages, an increase in morbidity and mortality may result.
- Medical malpractice or professional indemnity claims against hospitals, doctors and pharmacies could result from mistreatment or mis-prescription of alternative drugs.
- Product liability/product recall events might be triggered if alternative drugs are manufactured under less stringent standards.
- Pressures to increase production could lead to drugs of sub-standard quality reaching the market, in turn resulting in product recall events and product liability losses.
- Depending on circumstance, non-damage business interruption and/or contingent business interruption could be triggered through supply chain disruptions.

Global pharmaceutical supplies – breaks in the chain?

The global supply chain for many drugs has been under pressure, even before the outbreak of the COVID-19 pandemic. Further disruptions to the chain could lead to heightened risk of product liability, product recall and medical malpractice claims, notably in the US and Europe. The US Food and Drug Administration estimates that a very large percentage of the active ingredients in everyday pharmaceutical products, particularly in generic drugs for chronic diseases like high cholesterol and high blood pressure, are manufactured in China and India. Healthcare systems in Europe have similar dependency on foreign suppliers.

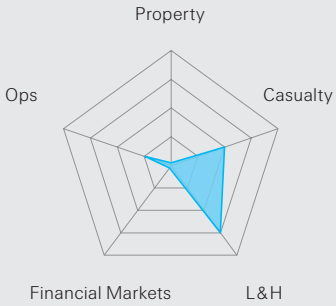
The offshoring of drug production to emerging markets is one part of the risk story. The other is that foreign producers have themselves become increasingly concentrated to achieve economies of scale. In some cases, there are only a few production plants for a specific active ingredient of a generic drug, which can trigger other complications like inclusion of off-specification ingredients. For example, in the US drugs were removed from the market this year because an active pharmaceutical ingredient (API) sourced from Asia did not meet specifications.[15] Another example was a shortage of the antibiotic Piperacillin/Tazobactam in 2017, which is on the "World Health Organization's list of Essential Medicines".[16] The shortage was triggered by an explosion at a plant in China, one of the few producers of the drug.[17] Another example was contamination of APIs at a plant in India, which triggered a larger recall of generic drugs, and in turn supply shortages for patients/consumers in the US.[18] Besides product liability and product recall claims, these examples also contributed to a shortage of the drug because the API could not be easily sourced elsewhere, nor replaced.

The key driver of the move to offshore drugs production has been the ambition to slow the increase of healthcare costs in the developed world. Even incidents like the shortage of Piperacillin/Tazobactam, which demonstrate inherent weaknesses in the global sourcing system, did not change the trend. If anything, the risks have amplified with a growing dearth of supplies of treatments for pain, epilepsy, depression and diabetes. The gravity of the situation has only fully come to light due to the COVID-19 pandemic, in particular after India's decision to ban the export of certain medicines, which has raised another hurdle to the fluid movement of drugs and medical supplies across the world.

A shortage of drugs can lead to quality of treatment falling below standard, in turn leading to increased insurance claims. Doctors and pharmacists may have to offer a patient alternative medication, which may have different concentrations and mix proportions of active ingredients. If such discrepancies go unnoticed, patient mistreatment can occur. Patients might also switch to other drugs without informing their doctor, also increasing the risk of negative health outcomes. Where no alternatives are available, delayed treatment, or none at all, is another risk. All such scenarios can drive healthcare costs and associated insurance claims higher. In addition, mistreatment or wrong prescriptions can lead to medical malpractice and professional indemnity claims against hospitals, doctors and pharmacies.

15 https://www.fda.gov/drugs/drug-safety-and-availability/fda-updates-and-press-announcements-ndma-zantac-ranitidine
16 21st WHO Model List of Essential Medicines (2019), p 14/
17 "Explosion at Chinese antibiotics factory leaves a shortage of lifesaving antibiotics" Bactiguard, 19. May, 2017 https://www.bactiguard.se/en/news-press/news/explosion-at-chinese-antibiotics-factory-leaves-a-shortage-of-lifesaving-antibiotics
18 https://www.fda.gov/drugs/drug-safety-and-availability/fda-updates-and-press-announcements-angiotensin-ii-receptor-blocker-arb-recalls-valsartan-losartan

Impact	Medium
Most affected business areas	L&H, Casualty
Time frame (years)	>3



Potential impacts

- The high nicotine content of e-cigarette devices creates addicts, especially among adolescents who may later switch to standard tobacco products.
- There have been reports of serious lung disease – partly related to misuse of devices – that have required hospitalization and, in a few cases, caused death. This can affect product liability, and also life and health covers.
- The long-term effects of e-cigarette and vaping devices are still unknown. Many chemicals present in consumption are considered a cancer risk, so this field has to be watched closely to avoid surprises on liability and life & health covers.
- Possible explosion of devices poses an additional liability exposure.
- Regulation on e-cigarette consumption and marketing may have also implications on insurance.

Vaping and e-cigarettes – a new wave of addicts?

Some e-cigarette devices pack a big punch, containing as much nicotine in one cartridge as a whole a pack of cigarettes. Such large doses add to the number of e-cigarette addicts, who are also exposed to the risks associated with the devices. The growing use of e-cigarettes could see rising claims in Life and Health in particular.

By 2018, the number of e-cigarette users globally had risen to 41 million.[19] The number of tobacco smokers was much larger at 1 billion, but on a decreasing trend.[20] There has been a significant rise in the number of adolescents using e-cigarette devices in last five years. Between 2011 and 2018, e-cigarette use among US high school students increased from 1.5% to 20.8%, coinciding with the market introduction of devices targeting young adults.[21] Regulators have been looking into the marketing practices of the e-cigarette industry. Product design, such as flavours (eg, crème brulee) to attract young adults are also being scrutinised. However, regulation varies across jurisdictions. For example, in the US there is no limit in Federal Drug Administration (FDA) regulation for nicotine, meaning that high-addiction products are readily available.[22] In the EU, there is a limit, and efforts by tobacco companies to push the EU limit higher have not succeeded so far.[23]

E-cigarettes pose other risks beyond the dangers of the contents inhaled. For instance, on rare occasion some devices have exploded.[24] Explosions that happen close to the face can lead to facial disfigurement, and consequent claims for plastic surgery treatments and for emotional distress. Another risk is the misuse of the devices. At the time of writing, in the US there have been 2 758 cases of lung injury associated with street-bought cannabis liquid consumed through e-cigarettes.[25]

19 L. Jones, "Vaping: How popular are e-cigarettes?", BBC News, 15. Sept. 2019.
20 WHO global report on trends in prevalence of tobacco smoking 2000-2025, 2. ed., WHO, 2018
21 K.A. Cullen et al., "Notes from the Field: Use of Electronic Cigarettes and Any Tobacco Product Among Middle and High School Students - United States, 2011-2018." MMWR. Morbidity and mortality weekly report vol. 67,no45 2018. D. T. Levy et al., "The Prevalence and Characteristics of E-Cigarette Users in the U.S." International journal of environmental research and public health vol. 14, no10 2017.
22 https://www.fda.gov/tobacco-products/products-guidance-regulations/rules-regulations-and-guidance
23 Directive 2014/40/EU of the European Pariament and of the Council, 3 April 2014, https://ec.europa.eu/health/sites/health/files/tobacco/docs/dir_201440_en.pdf
24 L. Ives, "How likely is your e-cigarette to explode?", BBC News, 18. May. 2018.
25 https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html

Vaping is getting riskier

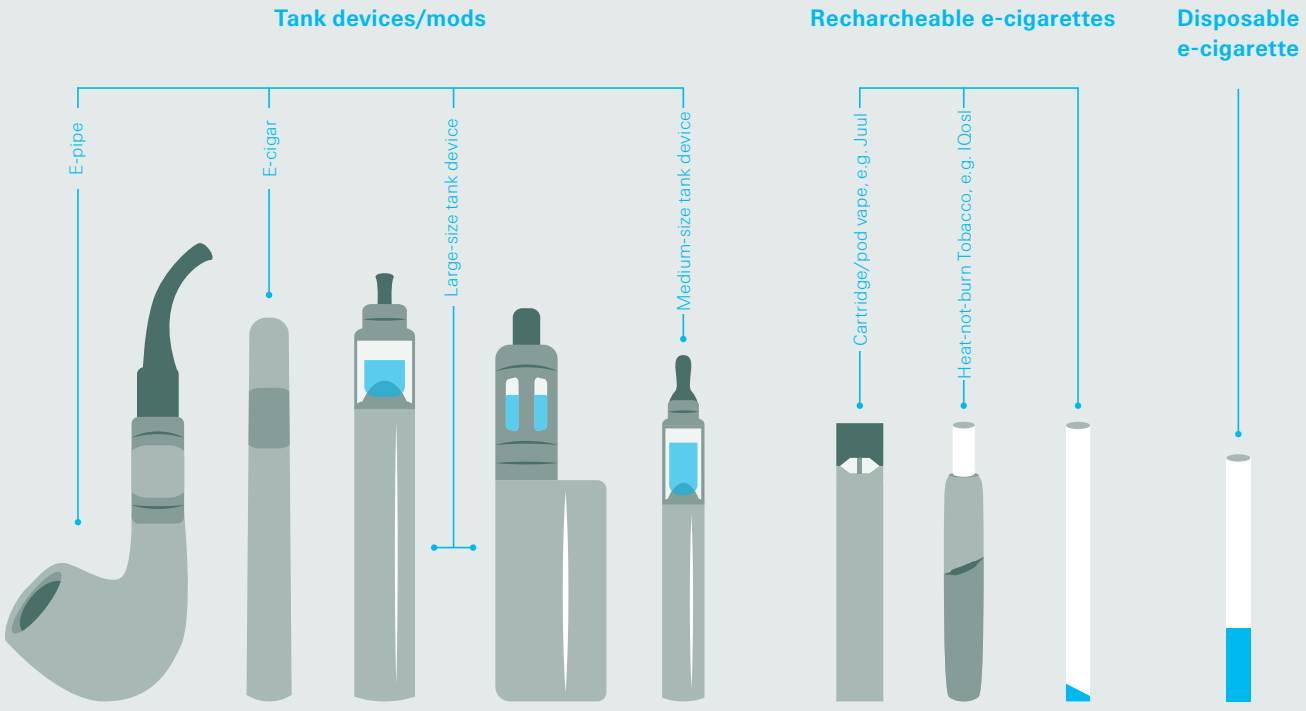
There has been a sustained boom in vaping since the advent of first e-cigarettes almost 20 years ago. A vape device is an electronic kit that converts a substance into an aerosol that can be inhaled (vaped) by the user. In theory, it is supposed to be less harmful than tobacco smoke, which contains a variety of harmful combusted particles linked to heart and respiratory disease, and cancer. The combustion happens at high temperatures and results in the release of high levels of toxic chemicals. With vaping, the active substances are selected and the process of vapourisation occurs at much lower temperature, avoiding combustion. Vaping devices often contain a battery or power source, a heater or atomiser coil, and a liquid reservoir or heating chamber.

The range of vaping devices has developed rapidly, with ever new shapes and sizes, mechanisms and uses. The range of materials/ ingredients consumed is also increasing. They include tobacco, nicotine liquids, other flavoured liquids as well as THC (from cannabis) and cannabinoid (CBD) oils plus additives. The diversified consumption patterns result in various risk profiles and regulations.

Some of the ingredients used (like nicotine) are highly addictive, and some (vitamin E acetate) can be harmful. That said, data regarding the long-term health risks from many of the chemicals vaped is lacking. This applies to commercially available vaping products, and even more to black-market offerings. Taken together, these elements make the insurance risks landscape very complex and difficult to read.

SONAR first highlighted e-cigarettes back in 2014. We examined claims that e-cigarettes are a less harmful alternative to tobacco because they would allow users to cut down on or even quit nicotine.[26] Since then, there has been mounting evidence of dual use of regular cigarettes and vapes, as well as of vaping serving as an entry-point to regular smoking, particularly amongthe young. In recent years, Swiss Re has published two Life & Health Trend Spotlights on e-cigarettes highlighting this and other vaping-related risks.[27]

Vaping device overview

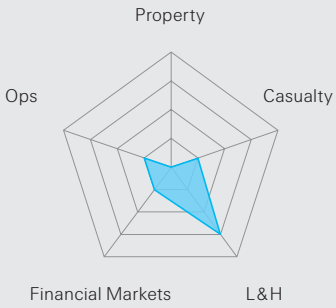


Source: Swiss Re

[26] "E-cigarettes,", Swiss Re SONAR. New emerging risk insights, July 2014, p. 13.

[27] "Lifting the e-cigarette smokescreen", (Swiss Re Life & Health Trend Spotlight), https://www.swissre.com/reinsurance/life-and-health/solutions/life-guide/lifting-the-e-cigarette-smoke-screen.html, "E-cigarette complications and consequences" (Swiss Re Insitute Life & Health Trend Spotlight, Oct. 2019.) https://www.swissre.com/reinsurance/life-and-health/solutions/life-guide/ecigarette-complications-and-consequences.html

Impact	Medium
Most affected business areas	L&H
Time frame (years)	0 – 3



Potential impacts

- If insurers overlook possible mental health issues among the young, healthcare payments of the insured later on in life may be higher (more so if the individual is underwritten prior to clinical diagnosis). In such cases, propensity to claim would increase due to reoccurring episodes of mental illness, in addition to a potential increase in claims duration. Return-to-work periods for mental disorders are case-specific and can vary largely.
- Neglecting mental health among the young could lead to an increase in physical diseases such as obesity, diabetes or cardio-vascular problems in later life, leading also to higher associated healthcare expenditures and insurance claims.
- If mental health issues are not addressed in time, there could be an increase in disability cases and, in severe situations, claims related to early mortality.

Out of sight, out of mind – mental health issues among the young

The growth in the number of people diagnosed with mental health issues has driven global healthcare costs and disability claims higher, and should serve as a wake-up call for life and health insurers. The term "mental health" covers a broad range of conditions, from neurological ailments like dementia to psychological disorders like depression. In 2010, the global cost of direct treatments for mental health conditions (including eg, Alzheimers) for all age groups was USD 800 billion, with an additional USD 1.7 trillion in indirect costs in the form of lower economic output and social security payouts.[28] With the steep rise in case numbers, today, ten years later, the costs will likely be much higher.

A notable development has been declining mental health among teenagers and young adults, with one in six people aged 10–19 affected.[29] In the US, the suicide rate among 15- to 24-year olds in 2017 reached its highest level in recent history.[30] This is likely just the tip of the iceberg. Stigma around mental health means many sufferers are not open about their condition, and do not seek help. The stigma can be more prevalent in different cultures, and the number of people across the world living with mental health issues is very likely to be much higher than known.

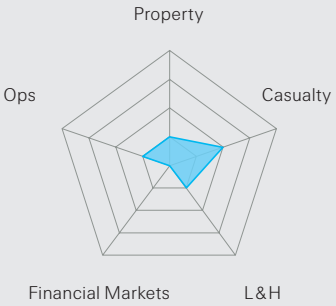
Poor mental health among the young does not stem only from the changes that happen during puberty. It can come from a desire for greater autonomy, pressure to conform with peers, from exploration of sexual identity and challenges from social gender norms. A common but also highly debated theme is the role of (social) media. Today's all-pervasive media presence can increase the disparity between adolescents' actual reality and their perceptions or aspirations for the future. These pressures can contribute to adverse mental health outcomes.

As children and young adults tend not to buy insurance, health insurers have likely not given due consideration to this risk pool. Specific health programmes or apps to identify those at risk from mental illness are currently not on the industry's radar screen. They should be: research shows that healthy children grow into healthy adults, who can enjoy life and contribute to society unhindered. Left untreated, children showing even early signs of mental health issues could grow into adults with more debilitating conditions later on in life. Further, often mental illness does not exist in silo. It can have many co-morbidities such as obesity, cardiovascular diseases, back pain or diabetes, all with origin in childhood. Preventing mental illness is an important topic for insurers because doing so can help reduce health costs, including disability claims, and also cases of early mortality.

Mental illness can afflict more people than usual, and be a more prominent theme in public discourse, in times of pandemic like this year's COVID-19 crisis. A study in Japan in 2009 during the swine influenza pandemic reported "overwhelming fear" among the public in times of considerable economic and social disruption. In Hong Kong, around 19% of respondents to a survey reported panic, low mood or mental disturbance at the height of the pandemic. The proportion fell to 3% ten months later when the pandemic was over. Here too, prevention can be a cure. In times of self-isolation, maintaining social connections through video calls and social apps is a primary way to cope. Where possible, people should stay active, exercise and leave home for short periods. Psychological first aid to help excessive anxiety and panic is available, and can include different forms of relaxation therapy, mindfulness techniques, and cognitive behaviour therapy, all now readily available online.

[28] Trautmann, J. Rehm and H.-U. Wittchen, "The economic costs of mental disorders", Embo Rep, vol 17, no9 2016 p. 1245f.
[29] "Adolescent mental health", World Health Organization, 23 October 2019. https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health .
[30] O. Miron et a., "Suicide Rates Among Adolescents and Young Adults in the United States, 2000-2017", JAMA, vol 321, no23 2019; "Mental health issues increased significantly in young adults over last decade" ScienceDaily, 15 March 2019, https://www.sciencedaily.com/releases/2019/03/190315110908.html

Impact	Low
Most affected business areas	Casualty
Time frame (years)	0 – 3



Potential impacts

- The proliferation of synthetic biology capabilities increases the risk of amateur or professional lab spills, of synthesized or modified organisms into the environment. This could trigger liability lines and impact Life & Health. DIY-synthetic biology also poses a range of ethical and regulatory questions.
- Potentially, antimicrobial resistances could be triggered from DIY synthetic biology, inviting liability claims (eg, from hospitals or farming companies).
- Environmental liability covers could be affected from release of modified bacteria and other microbials that impact ecosystems and biodiversity.
- The enabling of amateur synthetic biology – garage biology, bio-hacking etc. – with DIY kits may incite criminal and terrorist activity. Bioterrorism with intentional manufacture and release of hazardous organisms could come with increased loss potential.
- The mis-use of lab equipment and knowledge marketed by universities or other deep-pocket organisations could lead to major liability claims.

The sorcerer's apprentice – DIY synthetic bio hazards

The proliferation of rudimentary bio-technology do-it-yourself (DIY) kits increase the likelihood of the manufacture and release of new biological threats in the form of synthesised micro-organisms, deliberately or accidentally.[31] The spread of synthesised adversarial micro-organisms could affect L&H and liability covers.

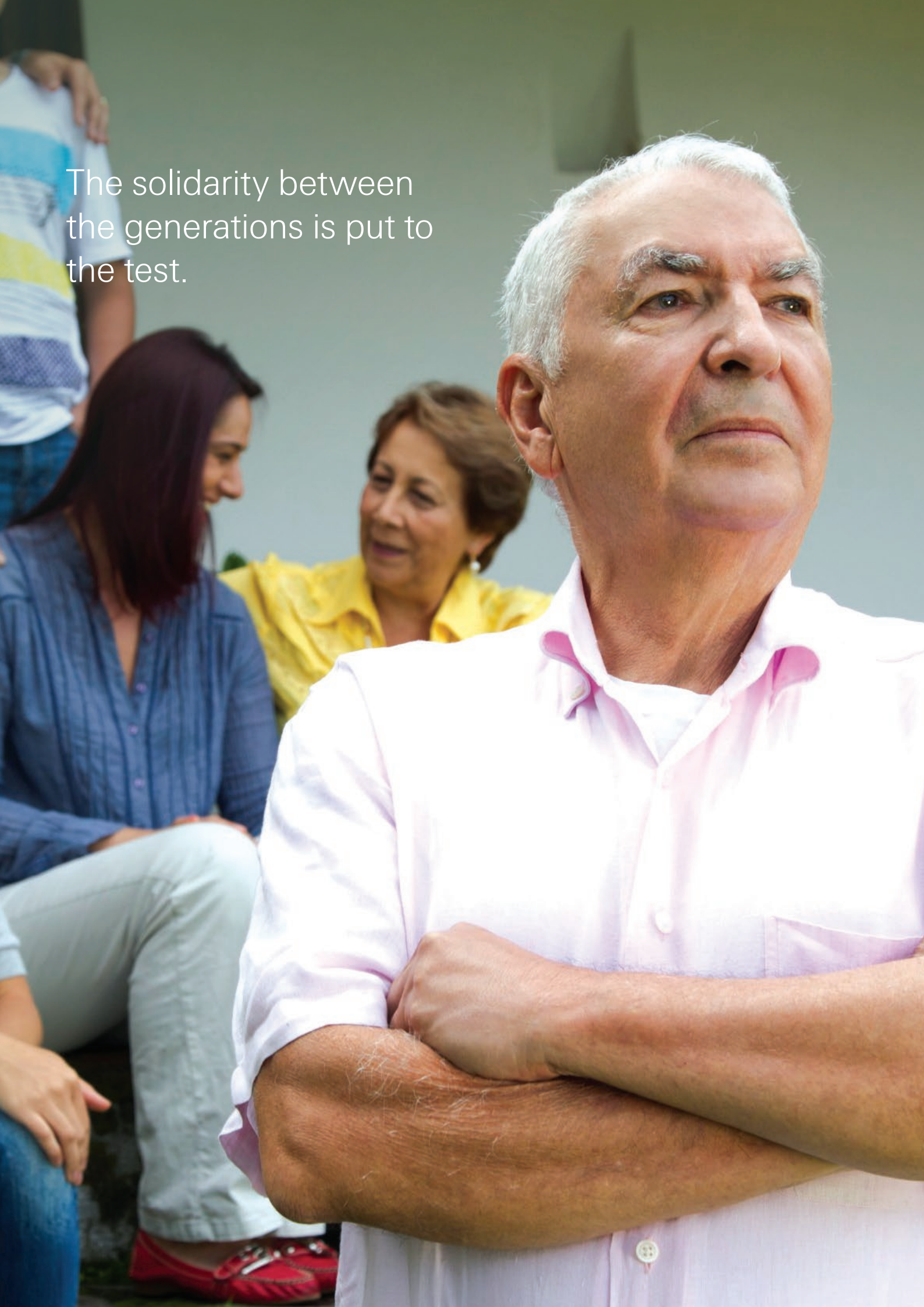
Synthetic biology technology – the engineering of new biological parts and organisms – is becoming more powerful, cheaper and more readily available.[32] In the context of professional R&D, measures are in place to prevent leakage and proliferation of synthesised micro-organisms beyond the laboratory. However, tools to experiment with synthetic biology have become accessible to ordinary citizens too, who may not always strictly follow lab protocol.

For example, synthetic biology kits are the new chemistry sets for children. The kits provide basic laboratory equipment and functionality, and enable the DIY manufacture of fluorescent proteins, among other.[33] And in the US, mail-order kits allow individuals to edit the genome of e-coli bacteria found in their kitchen.[34] A fully-fledged genetic engineering home lab kit with microfuge and PCR machine (polymerase chain reaction) can cost just USD 2 000. People can even order frogs for home delivery, to treat with gene therapy to increase their growth.[35] DIY labs can also be used to engineer synthetic opiates or other drugs.[36]

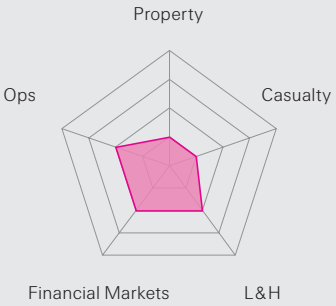
DIY synthetic biology is often promoted under the guise of citizen science and as part of the public outreach of university laboratories.[37] But it's also touted as self-organised "bio-hacking" with political or artistic undertones. Grassroot synthetic biologists may consciously evade professional expert oversight and ignore safety requirements.[38] Amateurs seeking a new hobby also contribute to a growing market for home lab experiments, without biosafety supervision. Incorrect use of home kits can lead to self-harm, and also affect third parties.

Knowingly or unknowingly, amateurs may not always follow correct procedures. For instance, the easiest way to dispose of waste generated from a DIY kit at home is through the kitchen or bathroom sink. This and other inappropriate disposal actions can open the door to a whole range of biohazard releases into the environment and community.

31 WEF "Going Viral. The Transformation of Biological Risks", Global Risks 2019 Report, World Economic Forum, 2019: Going Viral. The Transformation of Biological Risks, p. 45.
32 The multidisciplinary field of synthetic biology is not narrowly defined but covers a broad range of biotechnological methods including genetic engineering and CRISPR-Cas9 gene editing. https://en.wikipedia.org/wiki/Synthetic_biology
33 L. Brownell, "BioBits: new bilogy kits for a new generation of kids", Wyss Institute, 1 August 2018, https://wyss.harvard.edu/news/biobits-new-biology-kits-for-a-new-generation-of-kids/ .
34 https://www.amazon.com/DIY-Bacterial-Genome-Engineering-CRISPR/dp/B071ZXW1TW; A. Sneed, "Mail order CRISPR kits allow absolutely anyone to hack DNA," Scientific American, 2. Nov. 2017, https://www.scientificamerican.com/article/mail-order-crispr-kits-allow-absolutely-anyone-to-hack-dna/
35 https://www.the-odin.com/genetic-engineering-home-lab-kit/; https://www.the-odin.com/frog-ge-kit/
36 Oye, T. Bubela and J. Lawson, "Regulate 'home-brew' opiates, Nature, vol 521, no521 2015, p 281-283.
37 Citizen science is scientific research undertaken by amateurs, under guidance or in collaboration with scientific institutions. See "citizen science – an opportunity for insurance?" Swiss Re SONAR. New emerging risk insights 2017, p 23.
38 A new lease of life. Understanding the risks of synthetic biology, Lloyd's Emerging Risk Report, 2018, p 34.


The solidarity between
the generations is put to
the test.

Impact	High
Most affected business areas	Financial Markets, Operations
Time frame (years)	0 – 3



Potential impacts

- A growing life insurance protection gap: the ageing population and "starved" millennials will likely mean more requirement to insure longer lives, at the same time as there being reduced demand for insurance.
- Insurance companies will need to find ways of distributing insurance at significantly lower prices while also ensuring adequate pricing of risks to be able to pay for future claims.
- The impact of low growth and low interest rates could lead to lower premium income, lower guaranteed returns (especially in the life business), assets moving towards higher returns, and changes in offered products.
- Millennials' frustration and distrust in governmental authority could foster social unrest, with possible property damage and other insurance impacts.
- A growing debt trap may encourage more risky investment behaviours, increasing financial market risk, including for institutional investors like insurers and pension funds.

Tipping the scale? – Intergenerational imbalances on the rise

The lockdown measures imposed to contain the COVID-19 outbreak will likely lead to a short, sharp recession. The shock has also, however, accentuated longer-term structural problems in many markets. In particular, the negative economic consequences will impact younger generations for years to come: millions of working age people face a slump in incomes and even unemployment. And this will increase pressures on intergenerational social contracts.

Millennials born between 1980 and 2000 were still kids, teenagers or young adults at the time of the global financial crisis in 2008–09. Post crisis, many had to suffer austerity and unemployment. This generation built up debt from spending on education, a supposed investment in their future careers. Instead, many have experienced precarious professional development, moving from one temporary job to another. Not able to afford independent living, they have also tended to stay at home with parents for longer. The risk of becoming a "lost generation"[39] remains, with still high rates of youth unemployment in many markets.[40]

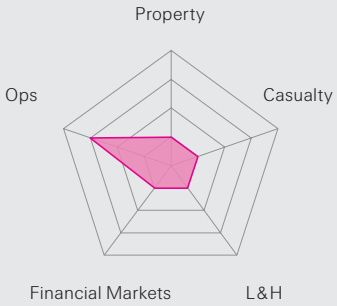
Millennials are now at the beginning or in the midst of their professional lives. They may have children or plans to buy (or build) a house. They are the textbook example of a large insurance market. However, that market is set to shrink significantly in the near term. The COVID-19 outbreak and economic downturn means household budgets are under pressure.[41] It remains to be seen how this affects insurance spending (see page 12 "The pivot East").

The COVID-19 crisis is also bringing issues around intergenerational solidarity and justice to the fore. With more baby boomers reaching retirement age, in many countries the size of elderly population requiring support - emotional, physical and financial – is growing. Data from the OECD shows that there will be a surge in the ratio of older people (65+) per working age person (20–64) by 2060 in all members of this club of mostly rich countries.[42]

Some mature markets, particularly in Europe, face the prospect of "Japanification", a long-running period of economic inertia. Over the last 30 years, as Japan's population has aged, the economy has been characterised by low growth, low inflation, and low interest rates.[43] Such a scenario could have significant ramifications in democracies where pensions are effectively claims on the future earnings of younger generations. Changing this system would require reform against the interests of the aging majority. On the other hand, a political stranglehold of elder voters could nurture frustration and anti-democratic sentiment among the younger generations facing ever-growing financial burdens in times when they are unable to sustain wealth accumulation. A frustration that could build and explode.

39 See "Generation Lost?" Global Risks 2014, World Economic Forum, 2014, p 33-38.
40 From latest available figures (2019) the international Labor Organisation (ILO) reported 13.6% youth unemployment rate globally, with considerable regional variation, from under 9% in North America up to over 30% in Northern Africa.
41 ILO experts see young workers, and particular young women, as most affected by Covid-19 fallouts. They are more affected by lay-offs and automation than older cohorts. The young also more often work in the informal economy and in temporary employment, often on low pay and without social protection. S. Puerto and K. Kim, "Young workers will be hit hard by COVID-19's economic fallout", iloblog.org 15. April 2020. https://iloblog.org/2020/04/15/young-workers-will-be-hit-hard-by-covid-19s-economic-fallout/
42 D. Rouzet, D., et al. (2019), "Fiscal challenges and inclusive growth in ageing societies", OECD Economic Policy Papers, No. 27, OECD Publishing, Paris 2019, https://doi.org/10.1787/c553d8d2-en p. 10 Figure 2.
43 See sigma No 6/2019, Swiss Re, p. 32-40.

Impact	Medium
Most affected business areas	Operations
Time frame (years)	0 – 3



Potential impacts:

- Challenges to standardisation mean challenges to business: harmonised of standards are essential for any transaction, for risk assessment and risk pooling, and in any reporting function.
- Diversity of competing (or lack of common) standards increases operational costs for insurers doing business on an international scale.
- Fragmentation of standards hinders scalability of solutions and access to markets across countries with different governance systems.
- Divergence in digital technology regulation and governance generates more cyber risk potential.
- Sustainability has become a key priority in all industries, including insurance. Lack of agreed standards on sustainability ratings and reporting increases uncertainty, and the risk and reporting burden that companies face. This can drive up operation costs and reputational risk.

Standards – into the unknown

Standards – established norms – have been a fundamental driver of globalisation. For example, technical standards are core to any industrial process. They unify the handling or design of products and services, and allow exchangeability of parts and tasks across production entities and countries. Harmonised standards in regulation similarly facilitate cross-industry and cross-border transactions, including in re/insurance. Lack and potential erosion of agreed standards increase operational costs and make risk management more complex, thus impeding business. For insurers, fragmentation in standards and regulation means less scalable market conduct given variance in governance requirements, and increased uncertainty and downside risk.

Since the Cold War, globalisation has to a large extent been led by western powers, in particular the US. However, in the current geopolitical climate, the spirit of global cooperation is under strain. For example, in spite of an impasse in the US-China trade war with the signing of the Phase 1 agreement in January 2020, fundamental differences between the two remain and tensions will be ongoing for a while. There are also signs of cracks in global pacts, such as G7 or G20. These strains bring the concept and further progression of globalisation into question. If standards and regulations are pushed to further unilateral aims, markets will become more divided, and national borders and regional (as opposed to global) unions more important.

A very important case is the internet, which hosts a large share of all business operations in the world today. It also integrates and broadens markets, risk pools and analytics capacities. However, in recent years the internet has become more divided, fragmented and regionalised, and may become even more so in the near future. The global technology sector is being affected by the "great decoupling" between the US and China over leadership and standard-setting in areas like semi-conductors, cloud computing and 5G, affecting supply chain resilience and investment flows.[44] Competing technology regulations and governance are damaging the economic potential of next generation technologies and also raise cybersecurity risks.[45]

Another case reflecting power structures in the world of standards is China's Belt and Road (B&R) Initiative, a collection of infrastructure projects launched by President Xi Jinping in 2013. In the past, financing for large infrastructure projects in many countries has often come from multilateral bodies like the IMF or World Bank, with "strings attached": the funding institutions have stipulated adherence to pre-defined governance criteria. With B&R, China is establishing its own set of (parallel) standards for infrastructure projects, and also for the terms of international cooperation and trade.

An important area for progress in global cooperation will be standardisation in the realm of sustainability metrics and reporting.[46] Environmental, social and governance (ESG) parameters and their measurement criteria are only beginning to become standardised. Most progress has been made in Europe, and Asia is also engaged with defining common language and understanding. This process of harmonisation is crucial for standardisation of asset classes and companies' return on investment, their reputation and long-term strategy. Crucially, it will also facilitate the transition to a sustainable, low-carbon economy.

44 I. Bremmer and Cliff C. Kupchan, Top Risks 2020 (coronavirus edition), Eurasia Group, March 2020, p. 7.
45 Also see "Wild Wide Web. Consequences of Digital Fragmentation", Global Risks 2020, World Economic Forum 2020, p 60ff.
46 Toward Common Metrics and Consistent Reporting of Sustainable Value Creation. White paper, consultation draft, World Economic Forum, January 2020.]

Emerging trend spotlight

The fragility of public healthcare

On 11 March 2020, the World Health Organization (WHO) declared a global pandemic from COVID-19. One quarter later, the pandemic rages on. Public health and healthcare systems – from prevention to treatment – are at the centre of attention. Particularly through Life and Health business, insurers are both partner to and dependent on effective health systems. Insights into the vulnerabilities of healthcare systems and ways to improve their resilience are of vital interest to all stakeholders.

Preparedness to cope with the pandemic appears to have been insufficient in most places locally, nationally and internationally. However, some public health systems responded faster to the COVID-19 outbreak than others. It is too soon to make a conclusive judgement about best practices, but where different experience do offer learnings, these need to be taken up and implemented as quickly as possible. Being better prepared can save lives and help reduce economic losses.

Some "positives" from the COVID-19 experience that most experts would agree on:[47]

Testing: South Korea, Iceland and other countries which adopted broad testing early on were able to keep a lid on the virus spread, even without shutting down public life entirely.[48] Testing also requires follow-up measures – voluntary or forced – to have any impact, particularly quarantine in the case of positive test results. Testing should be free of charge to incentivise people to come forward.
Tracking/contact tracing: Early action on inspecting travellers entering a country, and also limiting travel to and from affected areas within a country, is important. Tracking down virus carriers/contacts early helps stop a pandemic in its first steps.
Financial protection: People who cannot afford to stay away from work or see a doctor risk further spreading of infection. In this regard, a large sub-set of economically under-protected people significantly affects also insured populations.
Adaptability of medical capacity and processes: To effectively deploy preventive and therapeutic measures, capacity needs to be readily available and adaptable. Lack of hand sanitisers, medical masks and intensive care beds with respirators have all proved fatal in the COVID-19 pandemic.
Adherence, communication and public trust: Early-on education as to the importance of regular hand sanitizing and social distancing has proved effective. If not enforced, it appears that discipline was largely dependent on experience (eg, memory of recent comparable disease outbreak such as SARS.
Collaboration: From very local to global coordination, cooperation has been confirmed as an important factor in managing the COVID-19 outbreak. Challenges from virus spread, supply chain and capacity issues can be overcome by mutual aid and exchange. Action in silos is mostly prone to failure.

The above points all touch upon a larger theme of resilience. The COVID-19 experience may raise the profile of resilience over pure cost-saving considerations. The insurance industry can help improve immediate pandemic response mechanisms and public health resilience in the long term by providing risk expertise and financial risk transfer solutions. Insurers can also engage in prevention to avoid losses – for example by supporting testing approaches through covering their individual costs. Collaborative approaches may foster public-private partnerships, such as a "pandemic pool", a pre-agreed risk-sharing arrangement between the public sector and the re/insurance industry to cover losses from a global pandemic. A public-private pandemic pool would not only give customers clarity about what is and isn't covered, but also provide protection at an affordable price which insurers would otherwise not be able to offer.

47 Most of the points currently discussed and highlighted below have already been listed in the WHO checklist for inluenza pandemic preparedness planning from 2005: https://www.who.int/influenza/resources/documents/FluCheck6web.pdf
48 M. Safi, "10 key lessons for the future to be learned from fighting Covid-19", theguardian.com,1. May 2020,

We need to reduce greenhouse gas emissions to reach net-zero by 2050. The re/insurance industry can help accelerate this transition.

Emerging trend spotlight

Moving to a low-carbon future

By keeping global warming to well below 2˚C from pre-industrial levels, the target is to reduce greenhouse gas (GHG) emissions to net-zero by 2050. Achieving this is a daunting prospect but, in our view, both a mission possible and necessary. The cost of meeting the target is estimated to be 1–2% of global GDP.[49] Failure to meet the target would be far more costly over the longer term.

Emission reduction and removal

How to get to net-zero? First, all sectors of the economy need to limit emissions as much as possible (see infographics 1 and 2). Second, remaining emissions need to be removed from the atmosphere through biological or technical means, and be permanently stored (see page 34, "Locking it up – carbon removal and insurance").[50] To achieve net-zero by 2050, climate science says that 10–20 billion tons of carbon emissions will need to be removed from the atmosphere each year.

The transition to a low-carbon future presents many opportunities for insurers but also new climate-related risks. Insurers themselves can commit to net-zero emission strategies, combining GHG reduction and carbon removal. Economy-wide, transition success depends on awareness and management of the potential hurdles, risks and unintended consequences inherent in change projects. The insurance industry can play a pivotal role by providing specialist risk transfer knowledge and capacity to partners in other sectors of the economy, and also as long-term investors in the net-zero journey.

Risks and insurance opportunities in energy production,...

Energy production accounts for about two-thirds of global GHG emissions. Moving from fossil fuels to renewables while also boosting energy efficiency is crucial to achieving net-zero. The transition will take time and comes with new challenges, including increased volatility of power production, transmission and storage. Fluctuating weather patterns affect wind, hydro and solar power generation and, subsequently, put a strain on existing power infrastructure. Innovations in large-scale storage technology and digitalisation will go some way to offset such problems but will also create new interfaces, additional complexities, and risk of prototype failure.

The shift to renewable energy will need insurance solutions to facilitate innovation, infrastructure and operational needs. For some engineering insurers, the surge in renewable energy capacity has already been a key source of growth. Product innovations such as revenue insurance coverages for no-sunshine, no-wind and drought in the case of hydro energy can complement traditional P&C covers for construction, operation and maintenance. While the opportunities are enormous, insurance market prices need to increasingly reflect this changing risk landscape. Caution is warranted with the accumulation risks from increasing complexity of systems, the number of interfaces, and the exposure to extreme weather events.

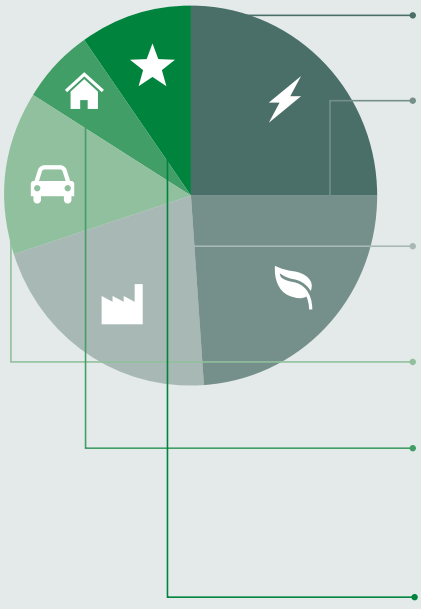
[49] N. Stern, Stern Review on The Economics of Climate Change, Gov. of the UK, 30 October 2006.
[50] J. Mulligan, G. Ellison and K. Levin, Foundational Questions on Carbon Removal in the United States, Working Paper, World Resources Institute, Washington DC, September 2018.

ON Hellisheiði geothermal power plant (ON Power)
Photo by Arni Saeberg

Defining net zero emissions
Net-zero emissions are achieved when any human-caused greenhouse gas (GHG) emissions remaining after emission reductions are balanced out by removing GHGs from the atmosphere. Carbon dioxide (CO2) is the most prominent but not the only form of GHG emission. In 2010, CO2 emissions accounted for around 76% of total GHG emissions resulting from human activities (IPCC, 2014). When referring to net-zero GHG emissions, non-carbon emissions converted to CO2 equivalents are included.

...in construction and manufacturing,...
The building and manufacturing industries are energy intensive. Adding the indirect emissions from upstream generation of electricity and commercial heat, the two sectors account for more than 50% of all energy-related GHG emissions. Thus, a shift to renewables and more energy efficiency are crucial to reduce emissions in these sectors. Mitigation measures are also needed for process-related emissions (eg, from chemical processes). One possibility is to substitute emission-intensive goods or materials like cement with alternatives that require less emission-intensive processes (see page 36 "Green buildings – will they pass the test of time?"). Carbon capture, utilisation or storage (CCUS) processes that capture emissions from point sources and either re-use or store them, are included in many reduction scenarios. However, technologies such as cement substitutes and CCUS are still at prototype stage. When deployed fast at scale, risk accumulation may result from undiscovered shortcomings. Insurers can partner with industry to establish risk assessment standards and procedures, including judging degree of success for new technologies, and contribute risk management know-how. Insurance solutions can then be provided to foster increasing deployment. In the case of solar panels, for instance, there are schemes to compensate insureds for replacements when climate-related risks inflict damage.

Graphic 1: Pie chart on amount and main sources of emissions per sector



25% Electricity and heat production
More than 70% of power generation is still based on fossil fuels.

24% Agriculture, forestry and other land use
Emissions in the forestry sector (12% of global emissions) mainly stem from deforestation and forest degradation. Around 40% of emissions in agriculture (10-12% of global emissions) come from livestock.

21% Industry
The highest-emitting sub-sectors are steel and cement. Some of the associated process emissions are among the most difficult to abate.

15% Transport
72% of global transport emissions come from road vehicles.

6.4% Buildings
Emissions stem from onsite energy generation, and burning fuels for heating and cooking (emissions generated by use of electricity in buildings is covered in sector "Electricity and heat production").

9.6% Others

Source: adapted from Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014

...transport,...
The transport sector accounts for around 15% of global GHG emissions. With the trend of increasing urbanisation, a move to low carbon transport systems is most pressing in cities and for connections to urban centres. Electrification, autonomous driving, ride-sharing schemes and the rise of mobility ecosystems[51] are transforming travel. Yet, still more than 70% of the global emissions from transport come from road vehicles. Currently the main alternatives to combustion engines are electric and hydrogen fuel-cell vehicles but challenges remain, including the availability of charging infrastructure and safety concerns around fire risk (see page 37, "Burning question – risky lithium-ion batteries" and page 38 "Hydrogen fuel cells – propelling the future?").

The insurance industry needs to keep pace with the changes in the mobility market. The developments present enormous opportunities for more flexible and digital insurance solutions, which can also encompass new forms of electric transport like e-bikes and scooters. InsurTechs already provide more flexible solutions, such as insurance models for gig economy workers covering both work and personal use of electric vehicles. An underwriting challenge lies in the uncertainties about the risks involved in modes of mobility, given the still short history of associated data observations.

...and forestry & agriculture.
Climate change impacts forestry and agriculture significantly. At the same time, there is significant potential to reduce emissions in the sectors. Global warming has already increased the frequency and severity of droughts and wild fires, which in turn accelerate the GHG emission rates from soils and forests. The wildfires in New South Wales and Queensland alone spewed more than 300 million tons of carbon dioxide into the atmosphere between August and December 2019, more than half of Australia's total GHG footprint last year.[52] In agriculture, increases in productivity can help reduce emissions per unit of agricultural output and thus generate significant mitigation benefits. Parametric tools tracking, for example, soil moisture can support the required increases in productivity.

On the asset side
The insurance sector also contributes to the net-zero target by providing long-term investments in renewable infrastructure that comply with ESG criteria. As institutional investors, insurers are well positioned to invest in the transition to a low-carbon economy. Our analysis has shown that complying with ESG criteria makes economic sense as the risk-adjusted returns are higher.[53] Moreover, assets are particularly vulnerable to stranding where the level of emissions associated with extracting and processing a resource would exceed the available carbon budget.[54] Failure to switch to low-carbon portfolios bears elevated risk of assets experiencing pre-mature write-down or devaluation (eg, "stranded assets"). The industry can do more. In a survey, sector executives said there is need for more "green" technology investment opportunities and structures that are close to the insurance industry's risk appetite.[55]

51 Mobility ecosystems: striving towards a seamless interface for customers, Digital Ecosystems Series, Swiss Re Institute, May 2019. https://www.swissre.com/dam/jcr:7762f0e7-6ee7-4cf6-b4d0-a3d21d023dc0/ZRH-19-03239_Mobility_Ecosystems_Exptertise_Publication_FINAL_WEB_III.pdf
52 H. Lee, "Bushfires Release Over Half Austrialia's Annual Carbon Emissions", time.com, 23. December 2019.
53 https://www.swissre.com/our-business/managing-our-assets/responsible-investing-in-practice.html
54 The heat is on: Insurability and Resilience in a Changing Climate, position paper, CRO Forum Emerging Risk Initative, 2019, p 33.
55 Climate Change and the Insurance Industry: Taking Action as Risk Managers and Investors, The Geneva Association, 2018, p 22.

Hurdles, trade-offs and unintended effects

While many risks along the envisioned transition can be addressed through classic insurance offerings, others cannot be tackled by insurance alone. These will require collaboration among governments, supranational organisations and society. The transition will face hurdles, some lessening but others growing in stature along the journey. While CO2-intense assets may become stranded, price dynamics for low-carbon assets are also likely to shift significantly in the long run, and sometimes not in ways favourable to any net-zero investment. Some innovative low-carbon or negative emissions business models and technologies are likely to prevail, but others will not break through. It is not always possible to foresee unintended consequences of transition. It will not always be easy to foster and maintain favourable framework conditions, and questions of fairness and justice will also be raised. There will be losers along the way, like workers in the coal or other sectors who will need re-skills to find new employment in a low-carbon economy. The transition will also require changes in traditions, and social and cultural habits. To ease tension and avoid the build-up of political resistance that could slow down, halt or even reverse progress, societies and governments will need to alleviate resulting social hardship and address the interests of all stakeholders. Trade-offs, gains and losses have to be monitored and balanced over different social, geographical and time scales. This includes reconciling different dimensions of sustainability and avoiding potential clashes, for instance between an afforestation project on the one hand, and land rights on the other.

Apart from potentially increased domestic political tensions, there are also likely to be geopolitical shifts. Some nations are better prepared and will gain, while others are unwilling (or unable) to prepare as they will not profit in similar ways. Among the latter are those economies – rich and poor – currently very dependent on fossil resources. Such nations and actors might use the prospect of carbon removal as an excuse to delay and obstruct the transition.

Takeaways

The transition to the low-carbon economy with net-zero and even net-negative emissions requires political, technological and behavioural change. Finding new ways to cope with the required changes calls for innovation and offers new opportunities for business across different sectors, and in all core areas of insurance including risk knowledge and transfer, and investment. Traditional covers already contribute to the required risk-taking. Our industry also needs to be ready to accommodate emerging technologies with no or very limited loss histories. As green technologies mature, the focus may shift from support in risk assessment and know-how, to risk transfer solutions for rapid upscaling.

Insurers need to act now. Evermore, clients, investors and employees demand consideration of ESG criteria. Supporting and adapting to the transition will be necessary to keep businesses future fit. Moreover, as the impacts of global warming become more apparent, the risk landscape may change fundamentally. This can raise insurability and affordability concerns in the long-term, especially in property and speciality lines. Being part of transition is not only an opportunity for insurers, but also a prerequisite for longer-term competitiveness and sustainability.

Graphic 2: How to tackle the transition

Electricity and heat production

- The share of renewables is set to grow. The main sectors will be wind and solar energy, which are among the cheapest sources of power.
- Enabling structures with adequate grids and storage systems need to be built and maintained.

Industrial products and processes

- Material efficiency and recycling can be increased, alternative processes (eg, hydrogen steel making) established, and innovative substitutes (eg, cement-free concrete) introduced.
- Carbon capture, utilisation and storage (CCUS) enables industries to decarbonize and turn a limited amount of hard-to-abate emissions into useful products.

Insurance industry

- Building on its core expertise and tradition, re/insurance can offer:
  - risk transfer solutions
  - investments
  - thought leadership in risk management issues

Buildings

- Technologies are available to construct and retro-fit buildings to be net-zero energy. Target measures include:
  - shifting away from fossil fuels for onsite energy creation, heating and cooking
  - energy efficiency improvements through insulation
  - use of innovative technologies for appliances
  - sustained product performance (eg, higher efficiency and longevity for heat pumps)

Agriculture, forestry and other land use

- Forestry and other land use: the largest potential lies in stopping deforestation and promoting reforestation.
- Agriculture: a shift towards plant-based diets, and reductions in food and agricultural waste would reduce emissions. Lab-grown food could revolutionise the sector.

Transport

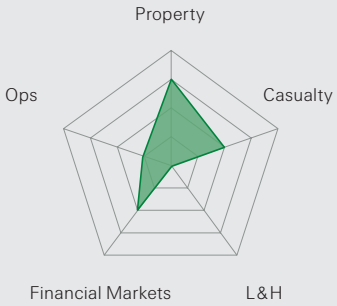
- Emissions can be reduced by:
  - a modal shift to low-carbon transport systems (eg, road to rail, especially in cities)
  - enhancing vehicle efficiencies
  - reducing carbon intensity of fuels (eg, through e-mobility, hydrogen fuel cell vehicles, biofuels in aviation and shipping)
  - more careful consideration of journey behaviours.

Carbon removal

- Carbon dioxide can be taken out of the atmosphere and stored through natural approaches (eg, afforestation) and technological approaches (eg, direct air capture and storage underground).

Source: Swiss Re

Impact	High
Most affected business areas	P&C, Financial Markets
Time frame (years)	> 3



Potential impacts

- Technological and hybrid solutions (eg, DACS and Bio-Energy with Carbon Capture and Storage) will rely on the construction of plants, pipelines and facilities. These will generate demand for traditional engineering and property insurance covers, which would include new types of risks.
- There will also be demand for insurance for related services, such as marine transport.
- Some carbon removal solutions come with significant trade-offs and side-effects. Certain technologies are still in a prototype stage (see page 35). Engaging in solutions – be it through insurance offerings, investments, or buying certificates – which turn out to have negative impacts or are flawed may lead to reputational damage and financial losses.

Locking it up – carbon removal and insurance

Carbon removal is taking carbon dioxide out of the atmosphere and storing it permanently. According to most climate models, decisive carbon removal together with lower greenhouse gas (GHG) emissions are needed to limit global warming to below 2°C from pre-industrial levels. To reach that target, it is forecast that the carbon removal industry will grow to the size of today's oil & gas industry by 2050.[56] However, the industry is still in its infancy and scalability has yet to be proven. The said growth would bring a wealth of opportunities for insurance and investments, but also many challenges. The risks attached to different removal approaches still have to be evaluated. There are also secondary effects as stakeholders could potentially seek to delay emission reduction efforts in light of the promise of large-scale carbon removal.

Carbon removal solutions – also known as Negative Emission Technologies (NETs) and practices – broadly fall into three categories:

- nature-based processes that use natural plants to capture carbon dioxide from the air
- technological processes that use engineering tools
- hybrid approaches, using both natural and technological processes (see page 35)

Companies developing carbon removal solutions are growing in number. Their scale-up plans are impressive, from a few kilo-tonnes today to mega- and giga-tonnes by 2030. The frontrunners are attracting considerable investor interest (in triple-digit USD millions), including the more expensive solutions such as Direct Air Capture and Storage (DACS).

Recently, more and more businesses have expressed willingness to pay for carbon removal services. Buyers favour the cheaper and more readily available nature-based solutions. Tree planting initiatives are popular, and carbon sequestration in soils through changes in agricultural practices is gaining momentum and policy support, particularly in the US. Most other NET are still at low level of technological readiness.

The business case for carbon removal services is built on sales of carbon removal certificates. First market initiatives to facilitate the trade of such certificates took shape in 2019. Buyers want attestation for having captured and stored a certain amount of carbon permanently. However, both natural and technological NETs have storage reversal risks. For example, carbon removal certificates from afforestation are annulled should newly-planted trees burn in a wildfire at a later date. The risk of storage reversal is lower for technological solutions. For instance, geological formations used in some hybrid and technological solutions to store carbon have proven very effective in containing volatile substances such as oil and gas over millions of years. Current best practice is to set aside up to 20% of the carbon removal certificates from soil carbon sequestration or afforestation projects as a buffer, independent of the actual performance of such projects.

Innovative insurance could facilitate continued growth of the carbon removal industry. In general, insurers may increase their understanding of the new carbon removal risk pools by designing pilot offerings for property and engineering covers and investing at small scale, to gradually build up the necessary risk knowledge for profitable business in the future. By 2050, billions of tons of CO2 will need to be stored: the front-runners among insurers will profit from the experience gathered over the next decade.

[56] S. Khagram, Global Climate Restoration for People, Prosperity and Planet, Arizona State University, January 2020.

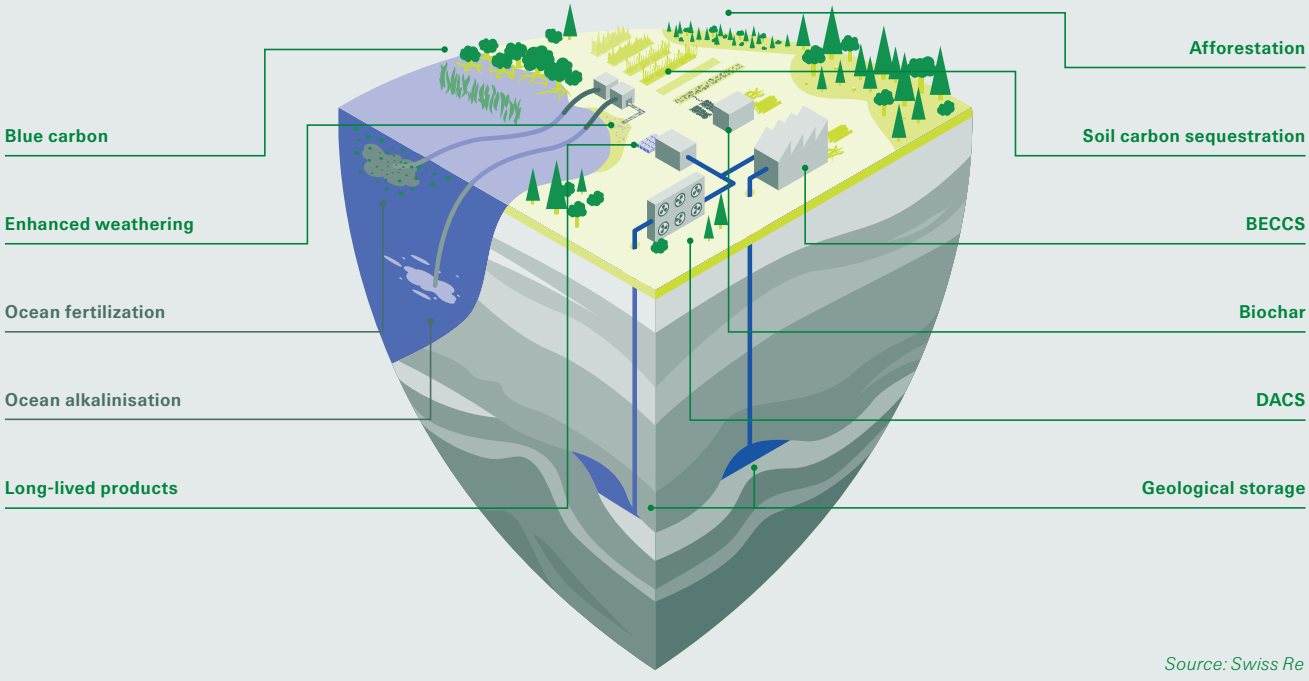
Carbon removal 101

Nature-based solutions capture carbon dioxide through plants that use it to build up their biomass. The storage is in the form of the biomass itself (wood, peat, roots) or converted to humus in the top soil. Examples include **afforestation** on previously woodless land or **soil carbon sequestration** through regenerative agriculture practices. **Blue carbon** refers to fostering the build-up of carbon stock in wetlands such as mangroves or peatlands. Nature-based solutions are relatively well established but not widely deployed. If done right, for instance by avoiding monoculture tree plantations, they come with ecological and social co-benefits beyond drawing down carbon dioxide (CO2) from the atmosphere. These might include biodiversity, flood protection and drought resilience. Nature-based solutions, however, require resources such as land and water that are in direct competition with food and fodder production, and other human activities. Moreover, nature-based solutions do not produce negative emissions instantly: it takes decades to grow a forest or build up peat and humus.

Technological solutions use engineering tools to capture carbon dioxide directly from ambient air, to provide a suitable storage medium, or both. **Direct Air Capture and Storage (DACS)** uses air filter machines and sends the concentrated CO2 to deep geological formations, similar to oil or gas reservoirs. The air captured CO2 can also be converted to stable carbonate minerals or other **long-lived products** such as carbon fibres. Other technical solutions seek to accelerate the natural carbon cycle, either by spreading fine-ground minerals on land (so-called **enhanced weathering**) or by modifying the oceans' chemistry to increase their CO2 uptake rate (**ocean fertilisation** and **ocean alkalinisation** - ideas mostly abandoned given the significant risk of ecological side effects). Technological solutions come with the benefit of low land requirements and permanence of storage. However, they require large amounts of renewable energy and are therefore more capital and operating expenditure intensive than nature-based solutions. Consequently, most technological carbon removal solutions need to be further developed and tested before upscaling is possible.

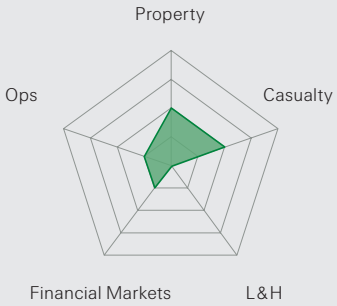
Hybrid solutions use natural plants to capture carbon dioxide from air like in the nature-based solutions, but then deploy engineering tools to exploit the more reliable storage options as in the technological solutions. In **Bioenergy and Carbon Capture and Storage (BECCS),** biomass is burned for power generation and the resulting CO2 is stripped from the flue gas and stored in geologic formations like in the DACS solution. Another prominent hybrid approach is the production of **biochar** from plant biomass. Biochar retains carbon for centuries and if mixed with soil, it improves soil quality by retaining moisture and nutrients.

Graphic 3: Carbon removal solutions



Source: Swiss Re

Impact	Medium
Most affected business areas	Property, Casualty
Time frame (years)	> 3



Potential impacts

- The lack of experience with many new materials in construction poses risks in case of failure over time (long-tail exposure).
- Big serial loss and/or accumulation potential exists because of the economies of scale of widely applied materials and/or standard products.
- The insurance industry may offer Green Building Upgrades Coverage (ie, to cover the expense of upgrading a building to gain/regain green building certification after an insured event).
- Failure to achieve a Green Standards labelling (eg, planning/supervision error, construction failure or product defect) or losing a Green Standards labelling during operation of the building due to product defects may trigger liability claims (eg, due to a reduced property value).
- The clearer the roles and responsibilities, the smaller the effort needed to achieve, maintain and enforce standards.

Green buildings – will they pass the test of time?

Publicly-traded companies in the building materials industry generated around USD 891 billion in global revenues in 2018. The lion's share came from the cement and aggregates segments, glass products and concrete manufacturing. The increased focus on "green" building is now changing the nature of the industry. Current building requirements are being continually amended to minimise the impact of the built environment on the planet, which means cutting emissions and energy usage. However, the lack of long-term experience with new and more sustainable building materials also poses new risks that underwriters need to address, particularly in casualty and professional indemnity.

One growth area is concrete production from recycled materials such as fly ash from power stations. Wood from sustainable forests is another booming area, as are water-efficient plumbing fixtures, self-healing concrete and organically-coated steel. These developments combine the dawn of "smart" buildings. Leading architects and designers are already thinking about zero-emissions buildings, buildings with new geometries using less materials, massively taller structures or buildings that are themselves virtual "cities" — all concepts that will provide fertile ground for innovation in construction materials. As a result, the worldwide market for green construction materials is expected to grow from USD 171 billion in 2015 to more than USD 377 billion by 2022.[57]

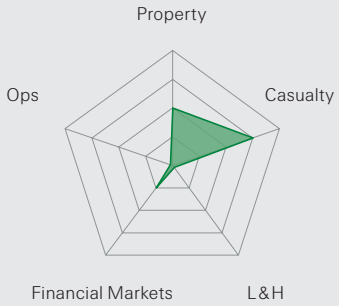
To this end, the construction sector is an ideal testing environment for scientific innovation and a powerful economic driver for the implementation of new technologies, designs and materials. Successful products can be adopted at scale. That said, all this increases the loss potential if innovations don't pass the test of time.

From past experience, areas of concern are underperformance of products, non-compliance with building standards, structural deficiencies, indoor pollution, leakages, moisture and mould and deterioration. All of these lead to either expensive repairs or, in the worst case scenario, a building being demolished. New technologies such as 3D printing, nano- or green building materials where no established norms or standards exist, amplify the exposure. This could be exacerbated by time-pressure on construction sites leading to faulty application of the new materials and technologies.

The wave of green innovation in the building sector has also brought a flood of labels, ratings and certification programmes. These make determining the relevant standards for a particular project challenging. For re/insurers to efficiently support the transition to green construction materials, a robust legal framework with clear responsibilities is essential to achieve, maintain and enforce standards and good practice (see page 24, "Standards – into the unknown")

57 E. Prasad and B. Sinha, "Green Building Materials Market", alliedmarketresearch.com, Dec, 2016. https://www.alliedmarketresearch.com/green-buildings-materials-market

Impact	Medium
Most affected business areas	Property, Casualty
Time frame (years)	0 – 3



Potential impacts

- Fires in LIB production facilities can trigger property damage, business interruption and environmental liability claims.
- Events during LIB production such as fires/explosions that injure workers may trigger claims in employer liability and workers' compensation.
- The transport of LIBs can lead to accumulation risks, impacting marine covers and others.
- Losses caused by burning batteries when in use can result in property and casualty claims. Product defects (eg, in laptops or smart phones), can lead to large-scale recall events resulting in economic losses and reputational issues. This may trigger standard or extended warranty covers.
- Special decontamination measures after an event can cause prolonged downtime of critical infrastructure.
- Environmental and human rights issues in mining and LIB disposal may lead to reputation issues for the companies involved, including insurers.

Burning question – risky lithium-ion batteries

The availability of light-weight, high-performing and cost-efficient batteries to store electricity is vital for mobile devices and also transition to a low-carbon economy. However, state-of-the-art lithium-ion batteries (LIBs) also bring risks, most prominently fire risks. Others are the environmental and human costs of mining raw materials for use in the production of the batteries and questions around their recycling. The risks could trigger claims in casualty and property lines of business.

Since 2010, the price of LIBs has fallen by more than 80%,[58] and they have become the most widely used type of rechargeable batteries. They can be found in mobile devices, portable instruments and (hybrid) electric vehicles. They are also used in stationary battery energy storage systems. However, through mechanical damage, overheating, short circuits, overcharging or production defects, a lithium-ion cell can reach a temperature at which heat increases further very rapidly, with sudden release of the energy stored in the battery. This can result in flammable and toxic gas leaks and fires. Once LIB-cell fires start they can be hard to extinguish as they do not need oxygen from the surrounding air to continue burning. To fight the fire, the batteries then need to be cooled in water, the most effective cooling agent for yet undamaged cells. The contaminated fire-fighting water and toxic gases must be handled properly to avoid damage to health and the environment, meaning that special fire safety and ventilation precautions are necessary.

The fire hazards associated with LIBs span their entire value chain, starting at cell production facilities. LIB cell production involves physical, chemical and thermal treatment of electrochemically active materials, and also handling of electrically charged LIB cells. The fire (property loss) exposure is much higher than for other types of batteries.

The transport of the finished batteries also poses a significant risk when cargo is not properly handled. As recently as January 2020, a wrongly declared cargo of LIBs led to a fire aboard a container vessel.[59] As these vessels are becoming larger and more complex, on board fires can lead to rising accumulation risk. That is why the International Union of Marine Insurers (IUMI) says tackling misdeclaration is an essential part of the action needed to prevent container ship fires.[60] It is also essential for more accurate pricing in marine insurance.

During LIB use, different causes can lead to battery failure and fires. A particular concern for insurers are unexpected product defects that can trigger claims in casualty lines. Causes of LIB product defects may include contamination in the production process and the composition of ingredients. Product defects might not easily detectible at the production site. They might only be recognised once the LIBs fail during use, leading to large-scale product recall events.

At the end of their life, improper collection and recycling of LIBs increases the risk of releasing hazardous substances into the environment. They also present an ongoing fire risk in garbage trucks, and at waste and recycling facilities. For example, it is estimated that 65% of fires in California's waste facilities in 2017 started with LIBs.[61]

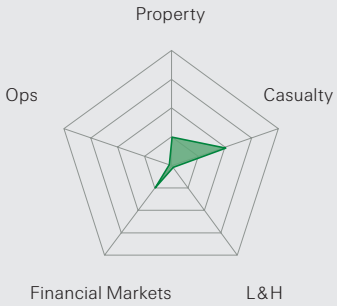
58 "Battery Pack Prices Fall As Market Ramps Up With Market Average At $156/kWh In 2019", BloombergNEF, 3. December 2019, https://about.bnef.com/blog/battery-pack-prices-fall-as-market-ramps-up-with-market-average-at-156-kwh-in-2019/

59 "Fire Aboard Cosco Boxship Caused by Container Load of Batteries", The Martime Ececutive, 8. January 2020, https://www.maritime-executive.com/article/fire-aboard-cosco-boxship-caused-by-container-load-of-batteries

60 "IUMI on the coronavirus and containership fires", Hellenic Shipping News, 17. February 2020, https://www.hellenicshippingnews.com/iumi-on-the-coronavirus-and-containership-fires/

61 "Lithium-ion Batteries are Causing Five-alarm Fires in Garbage Trucks, Waste and Recycling Facilities" Waste 360, 21. May 2018, https://www.waste360.com/safety/lithium-ion-batteries-are-causing-five-alarm-fires-garbage-trucks-waste-and-recycling

Impact	Low
Most affected business areas	Casualty
Time frame (years)	> 3



Potential impacts

- Hydrogen is combustible in combination with oxygen: above a certain ratio the mixture is explosive.
- Leaks from a hydrogen tank may lead to explosions and trigger property claims.
- If fires or explosions of hydrogen tanks are caused by negligent handling or production defects, product liability policies may be triggered.
- Insurance companies will need to assess the pricing and investment risks for a growing hydrogen fuel industry.

Hydrogen fuel cells – propelling the future?

Hydrogen fuel cell technology is developing rapidly, and enables energy storage and emission-free mobility. In its compressed form it has high energy density, which is promising for use as fuel for larger vehicles, and for the transition to a low-carbon economy. Surplus renewable electricity can be used for hydrogen fuel production. All told, however, scaling up the technology for sustainable, wider adoption brings significant risks, potentially triggering property and product liability claims.

Hydrogen-powered cells combine hydrogen and oxygen to produce an electric current, and the only by-product is water. With no moving parts, hydrogen fuel cells are efficient and reliable and, with appropriate storage tank capacity, provide power for long periods of time. The advantages of hydrogen-fuelled vehicles compared with electric vehicles include quicker charging time and longer driving range.

Cars are not the only application. Excess renewable energy may be used to produce hydrogen fuel, which can then be stored underground, for example in salt caverns. This makes the fuel well suited for heating applications, where seasonal storage is important. Hence, countries with little space for wind and solar facilities would still be able to benefit from carbon-free energy. The UK government has recognised that hydrogen fuel could play a main role in meeting net-zero emissions, and a Hydrogen Taskforce has been established to develop a strategy to scale up the industry.[62]

Despite the advantages of hydrogen fuel technology, there are a number of prohibiting factors that have prevented it (so far) from becoming mainstream. Hydrogen production and compression for storage is an energy-intensive process. Moreover, the high costs associated with hydrogen fuel vehicles are a major prohibiting factor compared to electric-battery vehicles.[63] Infrastructure for refuelling with hydrogen is still in its infancy. The tanks needed to store hydrogen also need to be strong enough to withstand the huge pressures involved.

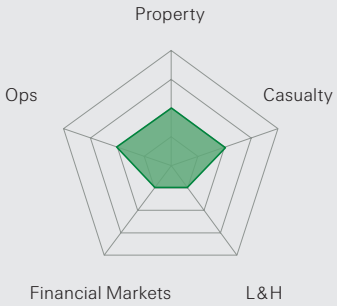
To date, application has mostly been in hydrogen-fuel vehicles. As an example, local fleets of public transport and municipal utility vehicles are already in use. Fuel cell adoption is also growing in the manufacturing sector, and associated infrastructure continues to scale. In all areas, the main danger is the high explosivity of hydrogen when combined with a certain amount of oxygen. This ratio does not come about quickly because hydrogen does dissipate quickly. Even so, no "vehicles powered by any flammable gasses" (including hydrogen) are permitted to use the channel tunnel linking the UK and France.[64] Explosions at a hydrogen storage tank in South Korea and a hydrogen filling station in Norway in 2019 have given rise to more concerns.[65]

All said, the hydrogen fuel sector has the potential to progress the transition to low-carbon economies. To support this development, insurers will need to fully assess the safety risks when underwriting hydrogen-cell powered vehicles and facilities.

62 The Role of Hydrogen in Delivering Net Zero, Hydrogen Taskforce, www.hydrogentaskforce.co.uk, 2020.
63 M. Kane, "Battery Electric Vs Hydrogen Fuel Cell: Efficiency Comparison", insideevs.com, 28. March 2020, https://insideevs.com/news/406676/battery-electric-hydrogen-fuel-cell-efficiency-comparison/
64 https://www.eurotunnelfreight.com/uk/safety-and-security/vehicle-restrictions/; F. Nicoll, "Behind the wheel of a hydrogen-powered car", BBC World Service, 5. November 2019, https://www.bbc.com/news/business-50212037
65 H. Jin and J. Chung, "Hydrogen hurdles: a deadly blast hampers South Korea's big fuel cell car bet", Reuters Business News, 25. September 2019, reuters.com; "Norway: Explosion at hydrogen filling station", electrive.com, 11. June 2019 https://www.electrive.com/2019/06/11/norway-explosion-at-fuel-cell-filling-station/


H2
D2
Danger
Explosive Atmosphere

Impact	High
Most affected business areas	Property, Operations
Time frame (years)	0 – 3



Potential impacts:

- Edge computing leads to higher cyber exposures in industry and other sectors. There will also be exposures in professional and consumer solutions involving mobile devices.
- The increased complexity of systems/networks with the addition of edge computing could increase potential cyber risk exposures.
- Decentralisation may also favour lower severity but higher frequency risk.
- Edge computing often takes place at remote environments and under conditions of limited physical security. Cyber incidents can cause machine failure or malfunction, and even business interruption. In connection with autonomous vehicles or health-critical devices, this can lead to injuries or fatalities.
- Liability may be more difficult to assign in case of failure in the edge-computing world.

Computing at the edge – cybersecurity overstretched?

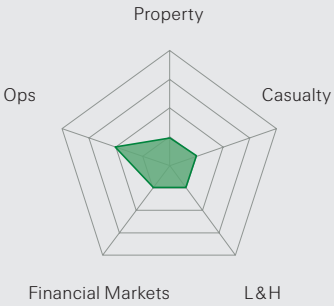
Edge computing can supercharge data exchange, but also lead to more cybersecurity breaches. Fast broadband connections and central cloud servers enable the rapid transfer and process of massive amounts of information on the data highway. However, with Internet of Things (IoT), data needs to be transferred and processed not just more quickly, but instantaneously. Think of autonomous vehicles: any time-lag in signal transmission and processing can prove fatal.

This is where edge computing comes in. To minimise latency in data transactions, computing power is added close to the connected end-devices themselves. In other words, at the periphery or edge of a network. Edge computing does not replace cloud services. It complements them by transferring the processing power from cloud platforms to where the data is created and consumed. Edge computing is playing a pivotal role in innovating and maintaining digital ecosystems across manufacturing, utilities, robotics and all other spheres demanding low-latency, a development in which 5G is likely to play an ever-increasing role.

The addition of more and ever-evolving interconnected devices to a network also, however, increases potential attack surfaces. Poor implementation of edge computing can expose system vulnerabilities, which hackers could target using latest innovations in artificial intelligence to search through codes for entry points and deploy intelligent malware. Decentralised by nature, edge computing is less likely to benefit from a strong security monitoring. Data collected, consumed and intermediately stored at the edge can also be vulnerable to environmental conditions, and these can be harsh, such as in, for instance, the context of a wind turbine or in agriculture. This adds physical challenges to the maintenance of devices as well as data retention and security.[66] By moving security concerns to the periphery, edge computing heightens cyber risk potential from under-service, negligence and blind spots. Any device that remains connected to a network beyond its projected life span and is no longer updated with adequate security patches invites attackers. A scenario of "internet of forgotten things" that are more vulnerable to cybercrime is not a long stretch of the imagination.[67]

[66] iSF 30 Information Security Forum, Threat Horizon 2022: Digital and physical worlds collide, iSF 30 Information Security Forum, Jan. 2020, p 19.
[67] Ibid., p 25ff.

Impact	Medium
Most affected business areas	Operations
Time frame (years)	0 – 3



Potential impacts

- Increasing numbers of individuals may be susceptible to deepfake harassment or defamation. Harm may not be restricted to reputational damage. It could extend to mental health, damage to professional career, and financial loss. Some of these effects may, in turn, trigger insurance claims in personal lines.
- Organisations can be "hacked" and "hijacked" by social engineering attacks through deepfakes. Financial and reputational loss can be significant.
- Insurance operations can be adversely affected by the increasing risk of claims fraud and social engineering attacks. With increased propensity to question everything – and particularly the truth – court evidence will become more contested.
- Procedures to verify customer identity and claims accuracy could become more costly.
- Deepfakes targeted at or picked up by larger audiences may cause social unrest, hate crimes and violence. They can also influence political decisions and distort financial markets.

Deepfakes – the creeping devaluation of truth?

Deepfakes are media formats that use artificial intelligence to fabricate digital content from underlying authentic source material. For example, the technology can hijack and misuse a person's identity by mingling real video-images and/or voice recordings with fabricated content. The synthesised avatar can be made to say or do anything just as convincingly as the target person, thus feigning the appearance of the actual individual. Deepfakes can be streamed in real time: social media platforms enable very effective spread of disinformation.

Deepfakes are taking the phenomenon of "forged authenticity" to new levels.[68] It is nearly impossible for a lay third-person to tell the difference. Deepfakes can be used to discredit people, extort money through social engineering or blackmail, damage corporate reputations and manipulate public opinion. Deepfake events could trigger insurance policies in both the personal and commercial sectors.

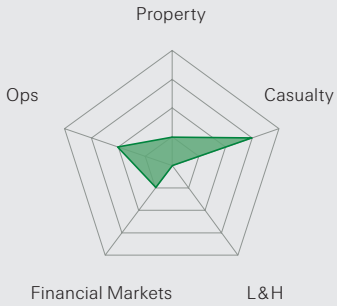
With digital technology becoming more sophisticated, cheaper and more accessible, deepfakes are a booming business. The legal environment cannot keep pace. A race between deepfake innovation and technologies designed to mitigate deepfake risk is more than likely. Whatever happens, trust in empirical fact will suffer.

While deepfakes will normally latch on to a specific person – whether a celebrity, a public figure or unknown individual – their impact can go beyond the original intention and individual target. On a societal level, they can lead to flawed individual and collective decision-making (eg, when instigating hate). The proliferation of fabricated misconceptions can also impact financial markets and – in a worst-case scenario – trigger civil unrest.

For the insurance industry, the consequences include increased loss potential on the insureds' side from social engineering and identity infringement. Insurance operations could also be substantially affected through an increasing risk of claims fraud and social engineering attacks. Moreover, digitalisation of client relationships – regarding customer identity verification and claims handling, for example – may well need additional fraud-prevention measures. The impact will likely also be seen in court. In jurisdictions where video evidence is accepted, litigation could be prolonged and more costly, since any footage is more likely to be contested. Indeed, any media format could be suspected of having been deepfaked. The most detrimental impact of all is that in effect, deepfake diminishes the value of truth itself.

[68] Forged Authenticity: Governing Deepfake risks, Policy brief, International Risk Governance Center IRGC, EPFL, Lausanne 2019.

Impact	Medium
Most affected business areas	Casualty, Operations
Time frame (years)	0 – 3



Potential impacts

- As products become more digitised, and subsequent updates and modifications become also widely accessible and changeable, where responsibility for correct operations actually lies is no longer so clear cut. Assigning liability is more challenging, and traditional insurance covers may need to be revisited as new products emerge.
- Establishment of liability will need to be rethought. Liability may shift from party to party, depending on whether a repair or modify has been made, and by whom.
- This gives rise to more concerns about product liability as a result of unconventional repairs and modifications, as well as professional liability of the agents who undertake the repairs and modifications.

Grey accountability – product liability in the era of smart everything

More and more, products are becoming services that are dependent on a relationship with a provider (eg, software updates). It is more challenging to assign liability in these cases than with a stand-alone physical product. Traditional insurance covers for product liability will need to be revisited and likely re-designed.

In September 2019, when hurricane Dorian approached America's East Coast, an electrical car manufacturer enabled the use of extended battery capacity for some customers without physically accessing the respective cars.[69] The convenience of having components of a product easily purchased and modifiable over the internet also means that these can just as easily and conveniently be taken away, by the companies who provided them in the first place.

Liability issues with software will likely crop up more as the scope of digital transformation continues to expand. Smart intelligence technology has increased the convenience and safety in countless ways (such as advanced driver-assistance systems), but it needs to be continuously maintained. In 2018, the OECD explained that such intelligent and connected devices could "become defective".[70] In addition, the devices may only be safe to use as long as they are constantly connected. There may be occasions where connection is interrupted or where a software or patch update is pending, opening a gap in the security framework.

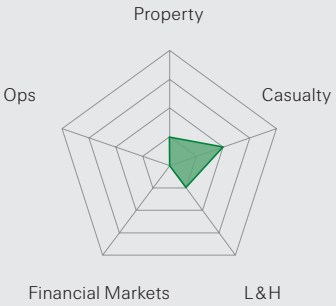
With IoT devices now in widespread use at home and in production, software has become a central component of many products. If software is an integral part of a good, a modification and/or failure on the part of the producer or distributor to deliver updates could potentially make the product unsafe to use. What if the provider of software updates goes out of business or refuses to update older devices, in effect forcing purchase of a new model?

The European Union is planning right-to-repair regulation for consumers, and some states in the US already grant right to repair and modify. The aim of the proposed EU regulations is to ensure that manufacturers allow access to relevant information to their products for professional repair and maintenance personnel. From here, it may be a short step to legislation making the information available to consumers too. This gives rise to concerns about product risk and liability, particularly with respect to manufacturer warranties and insurance. There are also competition concerns: if repair information is widely available, is a manufacturer still liable for a product that has been repaired, but not by them?

For example, there is already a growing "grey market" in products for farm tractor software, the majority of which originate from Ukraine.[71] This unlicensed alternative software and associated diagnostic equipment is prone to malware and illegal botnets, which could impact the health and safety of operators. A further complexity is the many IoT devices that essentially provide services, ranging from controlling the home temperature, music playlists, shopping and keeping the fridge stocked. These trigger liability questions and in worse-case scenarios, also criminal repercussions.

69 "How the world will change as computers spread into everyday objects", The Economist 12. September 2019.
70 Challenges to Consumer Policy in the Digital Age, Background Report G20 International Conference on Consumer Policy, Tokushima, Japan, Sept 2019, OECD, 2019.
71 J. Bloomberg, "John Deere's Digital Transformation Runs Afoul Of Rith-To-Repair Movement", Forbes.com, 30. April 2017.

Impact	Low
Most affected business areas	Casualty
Time frame (years)	> 3



Potential impacts

- Workers' compensation/employers liability claims could result if employees inhale smart dust and suffer ill effects.
- Children/family of workers are potentially second line of exposure, if workers take dust home with them (eg, on their clothes).
- Smart dust leaking out to communities and causing health problems can lead to general liability claims.
- There could also be a risk of defective products, leading to product liability claims
- There could be environmental impairment liability claims if smart dust pollutes water sources or third-party property.
- Data privacy risks could trigger lawsuits.

Teeny weeny high-tech – smart dust

Imagine a world in which crops are no longer monitored by field, but by every single plant.[72] Or where each part of a bridge, down to the last rivet, is monitored for corrosion. And where rather than scan a whole body, every organ of the body is individually scanned at the same time. Powered by large investments, this technology is close to moving from the research lab into the real world.[73] The tiniest of tiny devices – microelectromechanical systems (MEMs) – are set to revolutionise the way we manufacture, gather data and diagnose illness. The many applications could also trigger insurance events across P&C and L&H.

Made of minute slivers of silicon and guided by software, the sometimes pollen-grain sized MEM devices are released like dust into an environment, to measure light, vibration, temperature, noise or any other physical force. Working simultaneously and autonomously, they store and relay data wirelessly back to a server. Dubbed "smart dust," MEMs can have many other applications to those already mentioned, including in next-generation radio frequency identification chips (RFID) for digitising supply chains, interactions with IoT devices, or wireless monitoring of services and people. With the latter, privacy concerns will become a major issue.

Because of its tiny size, smart dust can easily be transferred to another environment it was not intended for. Should it then continue to submit information in the new environment, this could corrupt data sets and lead to wrong treatments in a hospital (medical malpractice claims), or flawed operations in a chemical plant (accident and property damage claims). There are also potential pollution issues. That people can ingest it raises the question of what it does to our bodies. Workers compensation/ employers liability would be an issue here.

If employed agriculturally, smart dust has to be re-applied every year because rain and wind will carry it away. In its new location smart dust can leach out metals or chemicals which could contribute to soil and groundwater pollution, leading to environmental impairment claims. Moreover, since smart dust will also be in the surface water, it could drain into any water body and enter into the food chain. If the dust ends up in humans and damages health, product liability claims could result.

All these issues make underwriting the technology problematic. As smart dust is not expected to hit the market with a big splash, but rather appear slowly over the next decade as more and more of the research initiatives reach market readiness, underwriting risks may remain under the radar.

[72] N. Sharma, B.D. Pant and J. Mathur, "MEMS Devices Used in Agriculture – A Review", Journal of Biosensors & Bioelectronics, vol. 10, no1 2019.
[73] See eg companies listed under keyword smart dust at https://www.ventureradar.com/

Knowing the entire supply chain is key to managing sustainability risks.

Emerging trend spotlight

A sea change in app usage?

Across the globe, more than 90% of the approximately 4 billion people connected online use mobile devices and spend several hours each day in the virtual world.[74] Mobile devices and software applications (apps) are central to what has been a fundamental shift in consumer behaviours. Apps have come to orchestrate our lives, our work, our leisure activities, and our relationships. Apps help us find our way to a place, a product and even a person.

With respect to buying behaviour, a study says that already in 2017, telecoms customers conducted roughly 70% of their purchases either partly or wholly online.[75] This year, the lockdowns mandated by many governments in response to the COVID-19 crisis have triggered an unprecedented upsurge in remote service consumption. For example, a medical services app run by a Chinese insurer has handled 1.72 billion platform visits since the outbreak.[76] Businesses that did not sell online before have also gone virtual in the lockdown, and not just big players: the small flower shop and award-winning restaurant have set up delivery services too.

The containment measures introduced to slow/reduce the spread of COVID-19 have not only changed how much, but also what we consume online. In the first quarter of 2020, consumers worldwide spent over USD 23.4 billion through app stores, a record high.[77] While games continue to account for more than half the spend, other apps have been downloaded more as well. Just one example: compared to the previous quarter, the downloads of health & fitness apps in the first quarter of 2020 increased by 40% on Google Play and by 30% on iOS.

Up to the COVID-19 outbreak, the insurance industry was a laggard in digitalised service offerings. While many people use the internet to research insurance, relatively few purchases are made online.[78] Increased demand for online services may favour the competition from Insurtech start-ups and tech-savvy players entering the markets in case traditional players are not able to gain momentum. In April 2020, Swiss Re commissioned a survey in the APAC region, whose respondents put the ability of an insurer to process policies and claims fully online a top priority (see page 12, "The pivot East).[79]

The COVID-19 crisis is also leading to a revaluation of data privacy versus safety and security gains. Since digital location tracing may assist in containing the spread of the pandemic, many governments are collaborating with telecoms and technology companies to introduce some element of tracing and monitoring. Relaxed data provisions and laws may also reduce the barriers to more data-driven insurance business models. However, this will only benefit the insurance industry if it has the capacity and possibility to gather and use the data in a meaningful and ethical way.

According to the Economist magazine, many of the 10 million people who have gone online for health services during the COVID-19 crisis in China alone will continue to do so in the future.[80] It remains to be seen if and when consumers revert to offline service purchases once the COVID-19 restrictions are lifted. Regulatory adaptation will also bear influence. Whatever happens, however, the upsurge in online living courtesy of the pandemic is likely to leave its mark.[81]

74 "Connected Commerce: Connectivity is Enabling Lifestyle Evolution", Nielsen Global Connect, 19, November 2018

75 Customers' lives are digital – but is your customer care still analogue?, McKinsey, 2017.

76 "Ping An Donates £1.1m of COVID-19 Medical Supplies to the United Kingdom", Bloomberg.com, 3. April 2020.

77 S. Perez, "Consumers spent record $23.4 billion on apps in Q1 2020, thanks to being stuck indoors", Techcrunch.com, 2. April 2020.

78 Sigma 01/2020, Swiss Re Institute, 2020

79 "Swiss Re COVID-19 Consumer Survey: Financial anxiety, demand for insurance products accelerates across APAC", Swissre.com, 29. April 2020, https://www.swissre.com/risk-knowledge/building-societal-resilience/covid-19/market-announcement-covid19-consumer-survey.html

80 "Millions of Chinese, cooped up and anxious, turn to online doctors", The Economist, 5. March 2020.

81 SONAR has featured several trendspotlights related to these topics over the past years: "Financial services and the digital revolution" (2019, p. 40), "The surveillance economy" (2019, p. 27), "Precious information: Market conduct and ethics in the age of big data" (2018, p. 23), "Testing phase: InsurTech in Asia" (2018, p. 39), "Data privacy – balancing personal rights and underwriting needs" (2017, p. 26).

Emerging trend spotlight

Sustainable supply chain management just as crucial for financial services

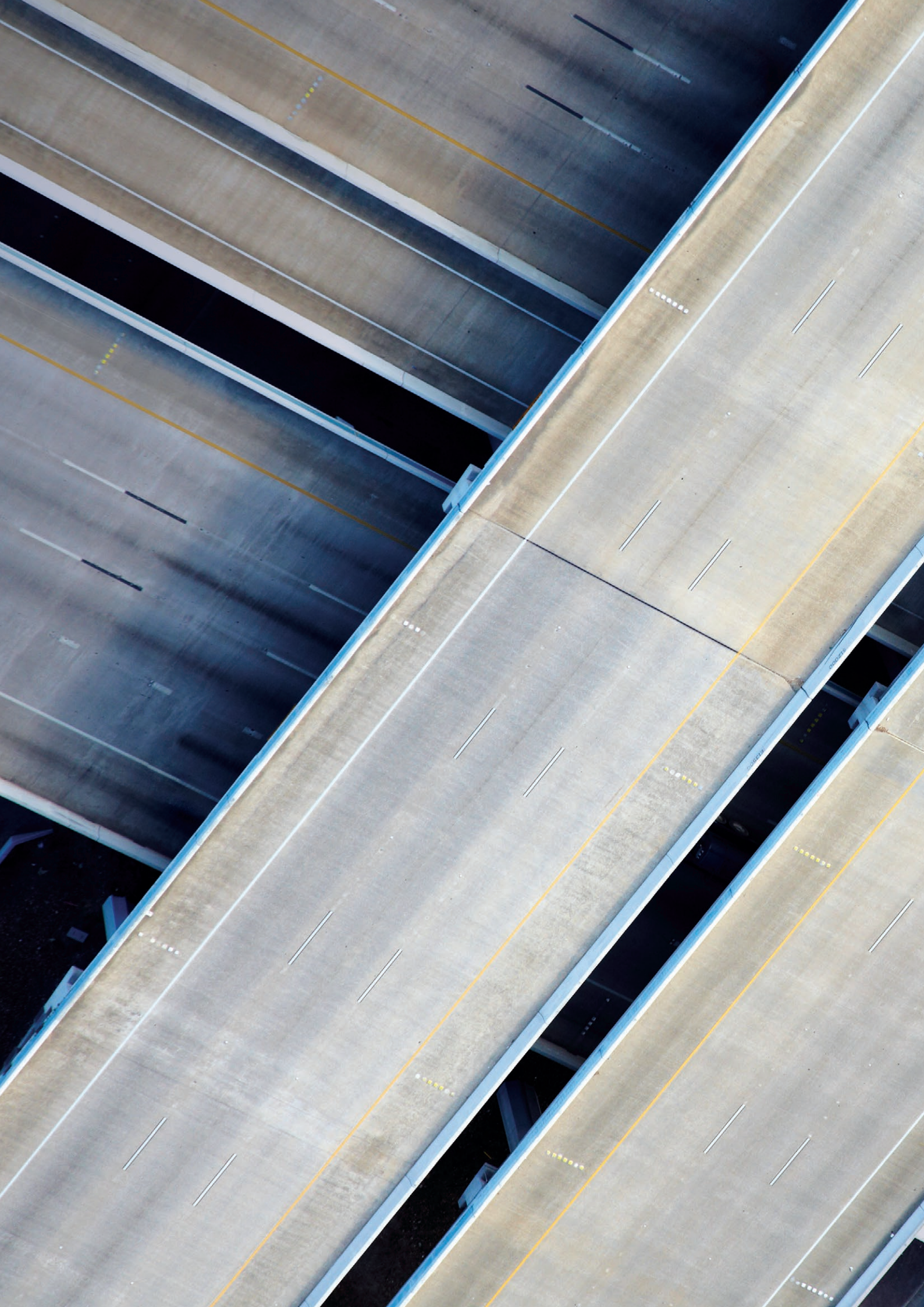
There has been increasing focus on corporate responsibility and to environment, social and governance (ESG) criteria across all industries, including the financial services sector. Investors, rating agencies and regulators have pressured banks and insurers to assume accountability for both their own and their suppliers' behaviours. Outsourcing and emerging market expansion have led to more complex and geographically-dispersed supply chains. From an enterprise management perspective, a company's resilience, longer-term operational stability and ultimately financial performance depend on the sustainability of its supply chain in ever-changing conditions.

Knowing the entire supply chain – not just a direct supplier – is key to managing sustainability risks. Financial services operations typically centre around less "tangible" procurement needs, such as IT, data management and HR services. These services entail engagement of people and to this end, employee contractual and working conditions are significant factors in ESG-compliant supply chain management. Non-discrimination and respect of human rights is crucial along the whole chain. Another area that has come under increasing scrutiny include data privacy rights, protection and the digital responsibility of the financial industry. A weak spot in the supply chain may lie, for instance, in the transfer of personal data between a procurer/originator of data, and the supplier agency processing it.

The direct environmental footprint of financial services firms stems mainly from the energy consumption of IT infrastructure and buildings, waste from redundant hardware, as well as from carbon dioxide (CO2) emissions from transport and travel. With IT and data management increasingly outsourced, the financial sector's direct use of energy is reducing, but consumption is still ongoing at the location of other participants in the value chain. Ideally, a purchasing firm's own sustainability ambitions converge with those of suppliers, clients and other stakeholders.

All told, however, compliance with ESG criteria along the whole chain does not ensure long-term business sustainability. Supply chains also need to be resilient to shocks. What if a single-supplier of a product or service in the chain is unable to deliver due to a pandemic or a cyber-attack? Or if outage of a cloud-based platform for which there is no alternative leads to business disruption and also possible loss of data? Diversity of suppliers in number and geography helps increase the resilience of a supply chain, but reconciliation and active management of the trade-offs between outside requirements, process optimisation and robustness of supply chains will still be critical. Responsible, sustainable supply chain management presents many opportunities for any insurance or banking business, and can also serve as competitive differentiator.


To be prepared for the future risk
landscape it is not enough to build
on past experience.



Appendix A: High impact emerging risk themes 2016 – 2020

As of 2013, Swiss Re has published new emerging risk insights in its SONAR report every year. Listed below are our risk themes from the SONAR reports 2016–2020 with high-impact potential. All these are based on early signals collected in the year leading to report publication. Therefore, they do not reflect the top risks of the entire emerging risk landscape but only of the new risks from a given year. The overview helps reflect on older emerging risks. It also shows that some of the risks reappear since new aspects have emerged or the risk persists with increased urgency.

2016	2017	2018	2019	2020
The great monetary experiment (cont.)	Bugs on the march – underestimated infectious diseases	Asbestos reloaded – USD 100 billion in losses and counting	Limits to tinkering – the fiscal and monetary policy balance at risk	Computing at the edge – cybersecurity overstretched?
Internet fragmentation	Reduced market access – protecting your own backyard	A brave new world? – emerging geopolitical risk	Teaching an old dog new tricks – digital tech meets legacy hardware	Tipping the scale? Intergenerational imbalances on the rise
Emerging market crises 2.0	The perfect storm – cloud risk accumulation	Algorithms are only human too – opaque, biased, misled	Off the leash – 5G mobile networks	Locking it up – carbon removal and insurance (Special Feature)
	The big drying – growing water stress	Coming back to bite us – lurking cyber risks	It's existential – climate change and life & health (Special feature)	
	The return of inflation – the effect on insurance business	A slow poison – the erosion of risk diversification	Don't ask, don't tell – genetic testing and adverse selection	
	Island solutions – regulatory fragmentation			

- Societal environment
- Political environment
- Technological and natural environment
- Competitive and business environment

Summary of top risks (2016 – 2020)

2016

The great monetary experiment (cont.): Quantitative easing continues, resulting in a low to negative interest rate environment. Economic growth and inflation remains tepid in the euro area and Japan, triggering discussions about additional monetary policy stimulus. Negative interest rates will further undermine conventional business models, particularly for life insurers and pension funds.

Internet fragmentation: Cyber crime and espionage have grown strongly, making the internet less safe. Governments urge more effective protection of online assets and consideration of isolating critical IT infrastructure from global networks. Disconnected national/regional nets will become more common. Technology companies risk disruption to their business model and might face liability suits if no longer able to access data stored on cross-border servers.

Emerging market crises 2.0: Amid rising US interest rates, economic growth in China has continued to slow, with knock-on impact on commodity prices leading to net capital outflows from emerging markets. Emerging market turmoil could hurt insurers' balance sheets and may trigger detrimental regulatory consequences.

2017

Bugs on the march - underestimated infectious diseases: The risk factors associated with infectious diseases, even known ones, are changing (eg, climate change, animal husbandry, land use, and poor health in areas connected with the world economy). These factors could facilitate outbreak and proliferation of infectious diseases.

Reduced market access - protecting your own backyard: Free trade, open markets and globalisation are coming under increasing pressure, with governments favouring local markets and national champions. Protectionism is no longer an emerging market phenomenon.

The perfect storm - cloud risk accumulation: More widespread use of cloud and cloud-of-clouds solutions comes with a variety of risks: cyberattack, technical failure, prolonged outage and data inaccessibility. The data volumes involved and service interruption potential pose significant and catastrophic risk to system resilience.

The big drying - growing water stress: Farming, industrial use and household consumption are exacerbating water shortages in a growing number of regions (eg, California, US mid-West, southern Europe, the Mediterranean, South Africa). Severe water shortages also have an adverse impact on food production and can undercut oil and gas production.

The return of inflation - the effect on insurance business: Inflation is picking up in US and UK (not yet Europe and Japan). A sudden increase in inflation can adversely impact insurer profits. The long-term effects of the accommodative monetary policy of recent years remain unclear.

Island solutions - regulatory fragmentation: International regulatory coordination activities among G20 are increasingly stalling, diminishing the chance for international standards and norms, and leaving an uneven playing field. Regulatory island solutions increase coordination and operational costs, and compliance burden.

2018

Asbestos reloaded – USD 100 billion in losses and counting: Millions of metric tons of asbestos are still being processed in many countries. A UN report showed that over 300 million people in Europe and Central Asia are potentially exposed. Latin America and other regions are at risk also.

A brave new world? Emerging geopolitical risk: The global political and economic balance has become multi-polar. Global institutions lack mitigating power in circumstances of conflict. Aggressive propaganda, cyberattacks and other means of "hybrid war" between nation states increase uncertainty.

Algorithms are only human too – opaque, biased, misled: Algorithms are susceptible to discriminatory bias. Black-boxed workings of algorithmic calculations can conceal and perpetuate mistakes. What's lacking is governance around development and application of algorithms.

Coming back to bite us – lurking cyber risks: Flaws and vulnerabilities in hardware (chips) and software may remain undetected for a long time (eg, "sleeper" cyber risk played out in the recent WannaCry-attack). The risk is mis-pricing in cyber-covers, which may in turn impact operations.

A slow poison – the erosion of risk diversification: Re/insurance provides financial protection from risks by deploying capital across borders and lines of business. National protectionism and regulatory fragmentation are jeopardizing the benefits of international diversification.

2019

Limits to tinkering – the fiscal and monetary policy balance at risk: There is a growing consensus that another economic downturn will need a fiscal response. Potential responses include quantitative easing, "helicopter money" or modern monetary theory. The re/insurance industry could benefit if changes to policy bring growth and financial stability. The possible flipside is a rise in uncertainty, causing higher financial market volatility and declines in asset valuations.

Teaching an old dog new tricks – digital tech meets legacy hardware: Technological improvements are ongoing. Hardware in areas of critical infrastructure, including smart electric power grids or pipelines, hospitals or cash points, however, is often outdated. As a consequence, insurers face higher risk accumulation unexpected loss potential in the areas of property damage, bodily injury, business interruption and cyber risk.

Off the leash – 5G mobile networks: 5G will enable wireless connectivity in real time for any device of the IoT, such as autonomous cars or sensor-steered factory. Current concerns regarding potential negative health effects from electromagnetic fields are likely to increase. Hackers can also exploit 5G speed and volume to acquire (or steal) more data faster. Major concerns are possible privacy and security breaches, and espionage.

It's existential – climate change and life & health: The most pronounced risks from climate change affecting human health stem from heatwaves, floods, droughts, fires and vector-borne diseases. Millions of lives and healthcare services could be at risk. Without action, mortality rates and healthcare costs could soar, and this would have significant consequences for the health, workers' compensation and life insurance lines of business.

Don't ask, don't tell – genetic testing and adverse selection: Over the past years, the cost of genetic testing has declined significantly and, with direct-to-consumer testing kits, genetic tests are now available and affordable for individual use. It has been widely adopted by public health systems and individuals. This has significant implications for life insurers, not least in respect to the regulatory constraints involved.

2020

Computing at the edge – cybersecurity overstretched?: With the IoT, data needs to be transferred and processed not just more quickly, but instantaneously. This is where edge computing comes in. To minimise latency in data transactions, computing power is being installed close to the connected end-devices themselves. Edge computing can supercharge data exchange but also lead to more cybersecurity breaches.

Tipping the scale? - Intergenerational imbalances on the rise: The lockdown measures imposed to contain the COVID-19 outbreak will likely lead to a short, sharp recession. This shock accentuates longer-term structural problems. The negative economic consequences will impact younger generations for years to come.

Locking it up – carbon removal and insurance: According to most climate models, decisive carbon removal together with lower greenhouse gas emissions are needed to limit global warming to below 2°C from pre-industrial levels. Carbon removal is taking carbon dioxide out of the atmosphere and storing it permanently. The industry is still in its infancy and scalability has yet to be proven. The risks attached to different removal approaches are yet to be evaluated.

What is SONAR?

SONAR stands for Systematic Observation of Notions Associated with Risk. It is Swiss Re's process for identifying, assessing and managing emerging risks. Experts across the company use a web-based platform to collect early signals of emerging risks. All signals are assessed and prioritised by an emerging risk management team, which closely interacts with topic experts from Swiss Re's business areas. The team serves as a catalyst for risk identification and assessment to define and implement recommendations in collaboration with the business. The findings are regularly shared internally and summarised for external audiences here.

What are emerging risks?

We define emerging risks as newly developing or changing risks that are difficult to quantify and could have a major impact on society and industry.

What are emerging risk themes?

Emerging risk themes illustrate potential new or changing risk developments for the insurance industry. They are mainly derived from SONAR but also draw on other sources. All themes have been assessed and edited by Swiss Re's emerging risk management experts. This report only features new emerging risk themes (ie, topics covered in previous editions are not listed again). You can retrieve prior reports from our webpage: www.swissre.com/sonar

What is meant by overall impact?

The overall impact of an emerging risk is an indicator of the potential financial, reputational and/or regulatory effect on the insurance industry. It is assessed on a scale from high to low:

HIGH	Potentially high financial, reputational and/or regulatory impact or significant stakeholder concern
MEDIUM	Potentially medium financial, reputational and/or regulatory impact or moderate stakeholder concern
LOW	Potentially low financial, reputational and/or regulatory impact, or low stakeholder concern

What is meant by time frame?

We divide themes into those likely to occur in less than three years and those likely to occur over a longer time horizon. This assessment should not be used as an indicator of when action is needed, as some themes likely to occur in the more distant future may, nonetheless, require immediate action to prepare.

What is meant by impact per business area?

Spider graph indicating the potential impact on major insurance business areas on a scale from 0 (= no impact) to 4 (=significant impact).

What are trend spotlights?

Boxes throughout the text provide selective spotlights on emerging trends which could become relevant for the re/insurance industry and its clients. The selection of topics is non-exhaustive, and descriptions are intended as food for thought and discussion starters rather than comprehensive reviews.

What are macro trends?

Swiss Re has identified a set of macro trends assumed to have a high impact on the re/insurance industry within the next five to ten years. The macro trends featured in this report have been selected independently through expert discussions and surveys. They provide context to the emerging risk insights from the SONAR process.

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