Expert Views

The relevance of climate change for life and health insurance

Part 1 – The Risk Manager's View

SCOR
The Art & Science of Risk

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In this first part of a series of publications, Dr. Irene Merk, SCOR's Emerging Risks Ambassador, will take the reader on a tour of the various concrete impacts that climate change as an overarching trend can have on life and health insurance risks and the related biometric developments. The second part of the series, by Dr. Sonal Bagul, SCOR's Head of Underwriting & Claims Asia, will cover the medical aspects, explaining the link between these climate change impacts and human health and wellbeing in more detail.

The Anthropocene

We are living in the Anthropocene, a time period during which human behavior is dramatically changing the atmosphere, biosphere and socioeconomic landscape. Climate change, loss of biodiversity, plastic pollution, the spread of endocrine disruptors, obesity, antimicrobial resistance, poverty and social inequality, as well as many other emerging risks and trends caused by human action, are shaping our environment, sometimes with disastrous consequences.

The speed, size and scope of the modifications that humans are making to nature – and that in turn are impacting us – are unprecedented. We have always seen man-made developments leading to changes in health, with both positive and negative impacts, but the magnitude of climate change and its many irreversible aspects are unprecedented. Most importantly, it is happening faster than the ecosystem can adapt, leading to disruption and higher volatility.

This means that projections of future morbidity and mortality are becoming more challenging, and we are more likely to need protection and resilience against shock events and trends. It is, therefore, imperative that companies with long-term business interests, such as life insurers, work toward an understanding of climate change and its direct and indirect impacts on that business. This may include potential upsides, such as opportunities for diversification or support of mitigation actions.

Climate change: a global trend with specific impacts

From a risk management perspective, climate change is best described as an overarching trend that in turn leads to specific risks or impacts. As such, climate change can be understood as more of an umbrella term. Its impacts, sometimes also referred to as drivers or perils, are wide ranging and vary across different regions of the world. They also vary in terms of their relevance to life insurance.

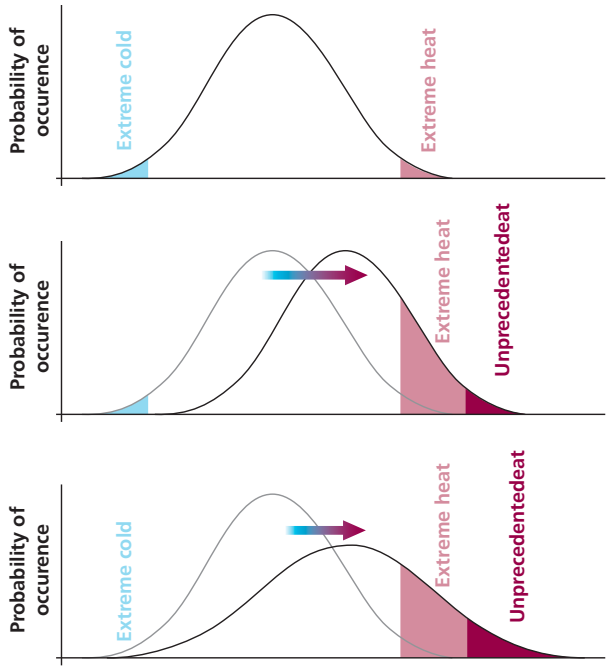
The following paragraphs will present the main climate change-driven risks and their link to life liabilities, in order to give the reader an overview that can serve as a basis for selecting those risks that are most relevant to their business.

Impact: extreme heat

While climate change is driving up average temperatures globally, it is more complicated than a uniform rise in temperatures, and there are many aspects to consider.

As Figure 1 shows, shifting the mean temperature (the first moment of the distribution) – even just by the famous "less than 2 degrees Celsius" – increases the probability of extreme heat dramatically, but also increases the number of days with unprecedented heat. The upside of this scenario could be fewer cases of cold-related deaths. However, if the variability of temperature (the second moment of the distribution) increases as well, which is very likely, then there are fewer gains in extreme cold, but the unprecedented heat increases in relevance.

FIGURE 1: TEMPERATURE DISTRIBUTIONS UNDER DIFFERENT ASSUMPTIONS



Extreme heat in combination with high humidity is predicted to lead to parts of the world becoming uninhabitable to humans, because our bodies will no longer be able to thermoregulate by sweating. Another aspect is that night-time temperatures do not drop as much as they used to, which puts additional stress on humans and other animals. A third aspect is that milder winters disrupt natural defense cycles, e.g. against certain insect pests.

All of these developments have consequences for human health. While some are direct, like heat-strokes, higher overall temperatures also aggravate some existing conditions and can lead to more cardiovascular and pulmonary events, including related deaths. Our second paper will dive into the details of these mechanisms.

Mitigation factors such as the adaptation of building and construction norms, the availability of cool and green spaces, working conditions, and migration, will influence the individual and local extent of the impact.

Impact: severe weather

Several natural catastrophes such as windstorms, floods and droughts are known to be exacerbated by climate change. Aside from the physical damage they inflict, their increasing frequency and severity will also lead to direct loss of life and have long-term detrimental impacts on human wellbeing.

Depending on the local economic and political situation, droughts can lead to famine and social unrest. Floods and storms can cause displacement of population groups, leading to increasing social pressure. Economic development can be stunted by these events, leaving fewer resources for education, health systems and fighting climate change.

However, the impacts also depend on some factors that are under human control, such as building standards and city planning, water management, and political stability.

Impact: air pollution

Erupting volcanoes, earthquakes, wildfires, dust storms and meteorites are natural phenomena that can cause climate change and air pollution. Anthropogenic activities are also responsible for air pollution and climate change, between which there is a complicated relationship. For example, particulate emissions can drop on polar regions, darkening the snow and ice and leading to less sun reflection, which contributes to global warming. Warmer sub-arctic regions encourage plant growth, which darkens the Earth's surface and leads to more global warming.

Wildfires can cause temporary large increases in outdoor airborne particles, and substantial increases in gaseous air pollutants such as carbon monoxide, nitrogen dioxide, formaldehyde, and acetaldehyde. Large wildfires can increase air pollution over thousands of square kilometers. Increased temperatures and heat waves are expected to lead to increasingly frequent wildfires, which will increase air pollution even further.

Air quality has a very high spatial heterogeneity and seasonal variability and is linked to economic developments and political trends among other factors. This makes estimating its outcomes regarding the biometric data of sub-populations very challenging, despite the well-known physiological mechanisms of how air pollution is causing harm to humans, which we will cover in our next paper.

Impact: infectious diseases

Climate change and shifts in ecological conditions, such as changes in temperature, precipitation patterns and extreme weather events, can promote the spread of pathogens, parasites, and diseases. These include high-profile mosquito-transmitted diseases such as malaria, Zika and dengue fever. Many of them spread better under higher temperatures, and benefit from milder winters that no longer decimate them.

Many theories exist regarding the links between climate change and pandemics, infectious diseases in their extreme form. They generally shed a light on the interconnectedness of driving factors, and how indirect effects can be fundamental in explaining outcomes. Understanding the 1998 outbreak of Nipah Virus in Malaysia with 265 infected and 105 fatalities is an example illustrating this principle.

> *"It is probable that initial transmission of NiV from bats to pigs occurred [...] through contamination of pig swill by bat excretions, as a result of migration of these forest fruitbats to cultivated orchards and pig-farms, driven by fruiting failure of forest trees during the El Nino-related drought and anthropogenic fires in Indonesia.[1]"*

The specific extent to which climate change affects vector-borne diseases is vector-, host- and disease-dependent. However, the spread of infectious diseases also depends on other factors: sociodemographic influences, drug resistance and nutrition, as well as environmental influences such as deforestation, agricultural development, water projects, urbanization, global development and land-use change. As a specific example, the decimation of larger animals by humans opens ecological niches for smaller animals with a shorter lifespan, which have a higher metabolism and higher load of pathogens.

The relevance of infectious diseases for life insurance is dependent on how effective societies are at coping with or countering the facilitating factors. Industrialized countries can provide public health infrastructure and programs to monitor, manage, and prevent the spread of many diseases. The burden of climate-sensitive diseases is much higher in poorer countries less capable of preventing and treating illnesses, from where they then can spread to other parts of the globe.

Impact: water and food security

Low water quality is a major source of global mortality and morbidity. According to the WHO, 1.8 billion people use drinking-water sources contaminated with feces. Flooding and heavy rainfall (which change their patterns due to climate change) sometimes cause overflows from sewage treatment plants into fresh water sources or agricultural plots, which may contaminate drinking water or food. In addition, this can also increase the number and prevalence of waterborne parasites found in drinking water. While some regions are expected to see an increase in rainfall driven by climate change, it could lead to water shortages in other (mostly already arid or semi-arid) regions due to droughts.

Agriculture is at the mercy of extreme events and unpredictable weather. The increase in the frequency and severity of droughts, floods and severe weather is likely to drive yields down. The elevated CO2 levels and higher temperatures have an impact on the development of some species of weeds, insects and other pests, which could decrease the average crop yields. Global yields could decline by up to 30% by 2050, while in some regions, warmer temperatures may increase crop yields. Climate

change is also likely to lead to a poleward shift of the highly productive agricultural areas. As a result, tropical developing regions will be hit hardest by climate change. This could induce forced migrations of populations and geopolitical issues.

Food safety is also likely to be affected by climate change. The increase in humidity and temperature favors the bacterial and fungal contamination of food, such as with salmonella or mycotoxin produced by molds. Anthropogenic activity also leads to risks for food safety due to contamination by pesticide residues and other pollutants in the food chain. For example, the toxic methylmercury load of fish increases by 3-5% for each 1°C rise in water temperature.

More than any of the other climate change-driven perils discussed so far, water and food security are subject to political and economic conditions. They have contributing factors beyond climate change that are, in principle, amenable to improvement but burdened by the complexity of actors and scope.

Indirect impacts

Besides the obvious and direct impacts of climate change as discussed above, it is key to also consider the potential indirect impacts.

The prime example is mental health, which was cited for the first time in the 2022 IPCC report. There are many aspects to this, including stress resulting from having been exposed to extreme weather events, anxiety for the future of the Earth, and despair about the destruction of nature. There is also a relationship between increased temperatures and suicide numbers. According to the literature[2], for every one person affected physically during a disaster, 40 people are affected psychologically.

Climate change will also lead to displacements and the migration of populations, due to effects such as water scarcity, desertification, and the geopolitical conflicts that often surround resources. Among the many other problems it creates, population displacement undermines the provision of medical care and vaccination programs, hinders the effective fight against many infectious diseases and can lead to sociopolitical unrest. As an example, some analysts quoted the rise in food prices as the cause of the Arab Spring movement.

The global population in low-elevation coastal zones is expected to strongly increase over the next decades, and many of the world's megacities are located in coastal zones. Currently, there are more than 150 cities with more than one million inhabitants in coastal areas, and the already "built in" sea-level rise of 0.5 m by 2100 is threatening the future of these populations (and indeed of some small island nations altogether). Actions such as defending against inundations and re-building after flooding and soil subsidence take resources away from economic development elsewhere, such as in education and public health.

Attributing parts of these indirect impacts to climate change is a highly challenging task.

The relevance of climate change for life insurance

Given the multitude of direct and indirect impacts from climate change, how can an insurance undertaking select those that are relevant for its business? The following observations may help.

1. The relevance depends on the type of insurance product. This is especially evident for the frequently cited example of vector-borne infectious diseases (such as malaria, Zika, chikungunya, dengue fever) that are expected to occur more frequently and over a wider geographic range due to climate change. They are generally non-fatal, which means that even a very strong increase will not affect mortality covers. This peril is only relevant in conjunction with disability or medical covers.
2. The relevance depends on the region of the world. For instance, air quality is poorer in Asia than in Europe. Extreme floods, droughts

and hurricanes, as well as food and water shortages, are unevenly distributed. This means the geographical area of an insurer's activities plays a major role. It also explains why it is very helpful in communications to always combine specific climate change-caused perils with a region or market, by talking for instance about "air pollution Australia," "heat wave UK," or "vector-borne diseases U.S." Life insurance is far from spread evenly across the world; it is highly concentrated in developed countries, which are less exposed to most of the perils discussed.

3. The relevance depends on the age profile of the insureds. The WHO's fact sheet on climate change and health from 2014 predicts[3]: "Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, mainly from malnutrition, malaria, diarrhoea, and heat stress" and specifies "38,000 due to heat exposure in elderly people, 48,000 due to diarrhoea, 60,000 due to malaria, and 95,000 due to childhood undernutrition." Deaths from diarrhoea and malaria predominantly affect younger children as well, meaning that the majority of climate change victims will be the very young and the very old. Generally speaking, these groups tend to have less insurance cover.
4. The relevance depends on the health and socioeconomic status of the insureds. When considering the biometric consequences of climate change for life insurance, it is important to understand that the general population expectation is not representative of the insured population. People who can afford life insurance have better socioeconomic status and health than average (including as a consequence of selection through medical underwriting), and a lower proportion of manual and outdoor work. This was starkly evidenced in lower Covid-19 mortality in the insured population. There are exceptions, though. Wealth can protect against malnutrition, but not as easily against poor air quality.
5. The relevance of indirect impacts will be difficult to gauge and to detect among the volatility of biometric observations, and needs to be followed by monitoring early signals. Mental health, for instance, is a very relevant concern for all parts of the population as it is linked to the immune system and also to accidents and suicides.

In summary, the relevance of climate change-driven risks for insurance liabilities will depend on the individual profile of the insurer, and can only be assessed on a case-by-case basis. Suitable tools are sensitivities and scenarios adapted to the duration and nature of the portfolio.

Building adverse scenarios: the example of U.S. heat

Overall, there are currently no generally agreed upon and applied standard scenarios for life insurance liabilities under climate change. This is also true for the time horizon over which the impacts are discussed, or what should be considered short-, medium- and long-term in the context of life insurance.

Most of the papers published on this topic, e.g. by the International Actuarial Association, by local actuarial bodies, or by consultants and supervisors, have kept to explaining the general mechanisms of interaction between climate change and health, without quantifying any life insurance biometric scenarios*. The same holds true for external reporting by major life insurers, as evidenced by scanning their TCFD reports**.

At SCOR, we have therefore built our own scenario, focusing on the impacts of extreme heat in the U.S. This scenario was identified according to the approach explained above and in close discussion with internal actuarial, medical and risk management experts from across SCOR. It reflects SCOR's significant engagement in the U.S. life insurance market and the fact that, among the various climate change-driven perils, extreme heat is one of the most relevant for the insured population in the U.S.

Extreme heat can cause strain on the body and can lead to potentially deadly illnesses, such as heat exhaustion and heat stroke. Additionally, heat stress can contribute to death from cardiovascular diseases, such as heart attacks and strokes. As mentioned by the US Environmental Protection Agency, heat exposure is the "leading weather-related killer in the United States, even though most heat-related deaths are preventable through outreach and intervention."[4] Examination of extreme events has revealed challenges in capturing the full extent of heat-related deaths. For example, studies of the 1995 heat wave event in Chicago suggest that there may have been hundreds more deaths than were actually reported as "heat-related" on death certificates.

For these reasons, we decided against using the current baseline of around 600-1,300 officially recorded heat-related deaths in the U.S. per year as a starting point for the scenario. Instead, we looked to modify the general mortality with a suitable factor that would reflect indirect causations as well. Beyond aggravating cardiovascular and pulmonary diseases, there is for instance also a clear relationship between increased temperatures and suicide numbers.

Searching in the medical literature yielded estimates on the relative increase in daily mortality during heat waves as a function of temperature increase for various regions of the U.S.[5]. Building on the IPCC scenario "RCP 8.5***", which is a very adverse future development, we projected the number of additional hot days per U.S. region until 2060. Before applying the additional heat-related mortality burden to the projected U.S. population, we modified the impact to allow for adaptation of the population over time. This was driven by the insight that heat is a relative concept, and that already hotter regions of the U.S. are currently observed to be more resilient to heat waves compared to temperate regions. Heat-

* One exception so far is the 2020 voluntary climate stress test by the French insurance supervisor, which was limited to France in its biometric assumptions.

** Task Force on Climate-related Financial Disclosures – see www.fsb-tcfd.org

*** RCP stands for "representative concentration pathway". In-depth descriptions of RCP climate scenarios can be found in the Intergovernmental Panel on Climate Change Fifth Assessment Report.

related mortality risk is higher in the Northeast and Midwest than in the South, yet the South has the highest number of heat days. It is to be expected that over time and with increased incidences of extreme heat and heat waves, there will be various adaptation measures such as adapting outdoor behavior, installing more air conditioning, and making cities and homes more resilient. Humans can also biophysically adapt, and have the option to migrate to other, less impacted parts of the country.

At this step in the scenario, we projected the expected number of additional deaths in the U.S. population caused by the higher future number of hot days under the adverse RCP 8.5 scenario over a period of four decades, splitting the results by region, age, and gender.

Extreme temperatures increase heat-related illness and mortality risk, especially for vulnerable groups such as older adults, infants and young children, pregnant women, lower socioeconomic classes, and outdoor workers. For example, death rates for age groups 65+ were observed to be around six times that of the general population in the past, and non-Hispanic Blacks[6] were twice as likely to die from heat. We took into account the fact that SCOR's portfolio has a lower-than-average exposure to these parts of the population when applying the future additional heat-related mortality rates to our projected claims. The calibration of this factor will always be company-dependent and subject to expert judgement. Indications can be taken for instance from the different observed mortality between the general and the insured population during the Covid-19 pandemic.

Based on the outcome of this study, SCOR was in a position to estimate its exposure to climate change-driven additional U.S. heat mortality under an adverse scenario and over a time horizon of several decades. This is allowing the management to assess the related exposure and to take suitable actions.

The path ahead: transition risk

The observations in this paper so far have focused on physical risks, which form a significant part of the overall climate change impacts. In addition, however, there are also risks linked to the so-called "transition". At the current point in time, although many developments toward decarbonization are already under way, the exact shape, duration and outcome of the transition is still unclear. In fact, although the term transition is widely used to denote an uncertain and turbulent period until a new perceived stable state with permanently lower emissions is reached, it is not a well-defined concept and will likely only be determined retrospectively.

> *The International Actuarial Association writes[6] that because of "the sensitivity of mortality and morbidity rates to unemployment and mental health, transition risk may have more material impacts on a life insurer's risk profile than physical risks in the short term."*

There is very little published academic research on the potential impact of transitional risk on mortality. Areas likely to be impacted include the following:

- Public spending might be diverted from prevention and healthcare toward efforts to mitigate or adapt to the impacts of climate change.
- Reduction in GDP, unemployment in certain sectors "stranded" via the transition, and economic depression are known to be related to increases in suicides and higher disability claims.
- The costs of the transition are expected to be unequally distributed, with proportionally higher impact on lower incomes, leading to social discontent and potentially to unrest.
- As an upside, potential improvements in individual behavior such as more physical exercise and less consumption of meat and of low-quality foods could have positive outcomes for health and wellbeing.

However, in the long term, the transition is expected to be of secondary importance for life insurance.

Climate change litigation, where companies are sued for not properly responding to the consequences of climate change and failing to steer their undertaking

successfully through the transition period, might also affect life insurers. While this does not impact the biometric side, it could damage the capital basis and going concern of an insurance company if not managed properly.

Changing perspectives: inside-out

The perspective of this analysis so far has been on the consequences that climate change can have on a life undertaking and its future, also called the "outside-in view." This is complemented by looking at the effects that an activity has on aggravating or improving climate change, that is to say an "inside-out view." Together, these are also referred to as "double materiality."

For the life insurance business, the inside-out perspective is clearly a very different exercise when compared to industries such as manufacturing, transport, or construction. By their nature, life insurance products are not directly generating greenhouse gases, and the operations of a reinsurer in particular are comparatively small, but there are various secondary-order aspects that can be considered to get a broader picture.

For products where the insureds can choose among investment options, offering green options is a clear signal. Products that encourage insureds to lead healthier lives can boost individual resilience. Life and health insurance covers contribute to the ability of families and communities to re-build after a negative event. The natural alignment of interest between (re)insurer and insured for life and health products leads to a benefit for the company to be generated from protecting clients from the impacts of climate change, making the inside-out impact overall more of an opportunity than a risk.

Closing remarks

At SCOR, we see it as imperative to partner with our clients to better understand emerging trends and risks, and to develop tailored insurance solutions that help people to remain resilient in this evolving risk landscape. This series aims to contribute to a deeper understanding of the relevance of climate change for life insurance and to facilitate the development of suitable actions.

Unfortunately, the negative consequences of climate change are mostly borne by those who did not play a part in causing it, namely the young and the poor in developing countries. The vulnerability of insured people is predicted to be much lower than for the general population, and in our opinion limited to selected perils such as extreme heat and mental health. The second paper of this series will take a deep dive into the link between climate change impacts and human health and wellbeing.

As a global independent reinsurance company, SCOR contributes to the welfare, resilience and sustainable development of society by bridging the protection gap, increasing insurance reach, helping to protect insureds against the risks they face, pushing back the frontiers of insurability and acting as a responsible investor.

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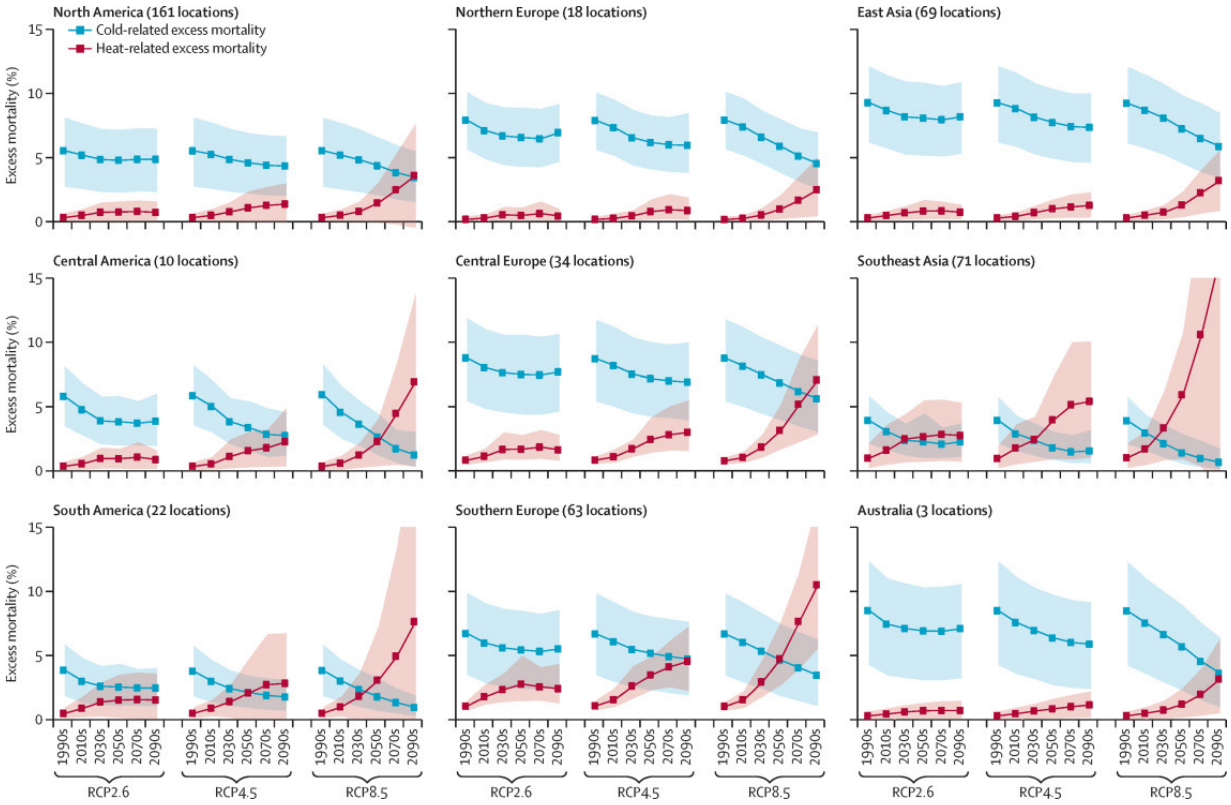
Illustration of the relationship between predicted future temperatures and mortality



The graph shows the excess mortality by decade attributed to heat and cold in nine regions and under three climate change scenarios (RCP2.6, RCP4.5, and RCP8.5). Estimates are reported as GCM-ensemble average decadal fractions. The shaded areas represent 95% empirical CIs. RCP=representative concentration pathway. GCM=general circulation model. (Reproduced from Gasparrini et. al. (2017))

Sources

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