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NATURAL PERILS INSURANCE AND COMPENSATION ARRANGEMENTS IN SIX COUNTRIES

Eli Sandberg, Andreas Økland and
Inger Lise Tyholt





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Natural perils insurance and compensation arrangements in six countries

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Preface

The aim of this report is to present an overview of the formal allocation of responsibility for climate change adaptation strategies in Norway, Sweden, Finland, Germany, France and Canada. We describe the natural perils compensation and insurance schemes in operation in these countries, and assess the degree to which they provide incentives for the implementation of preventive measures rather than for the restoration of buildings and infrastructure following a natural perils event. Our study has included a document analysis, combined with a series of semi-structured and in-depth interviews.

This report is published by the Norwegian research centre *Klima 2050*, which addresses “*risk reduction through climate adaptation of buildings and infrastructure*”. *Klima 2050* is a Centre for Research-based Innovation (SFI), financed by the Research Council of Norway and its consortium partners. It facilitates long-term research in close collaboration with the private and public sectors, as well as other research partners. The aim of the centre is to strengthen Norway's innovative capacity and competitiveness in the field of climate change adaptation. The composition of the consortium is key to our ability to reduce the societal risks associated with climate change.

The Centre also aims to consolidate the innovation capacity of the private sector by means of a focus on long-term research. One of its objectives is to facilitate close cooperation between companies performing research and development, and prominent research groups. Emphasis is placed on the development of moisture-resilient buildings, stormwater management, blue-green solutions, measures for preventing water-triggered landslides, socio-economic incentives, and decision-making processes. The centre addresses both extreme weather events and the gradual processes of climate change.

SINTEF is the host institution for the *Klima 2050* SFI, which is administered jointly with the Norwegian University of Science and Technology (NTNU). Other research partners include the BI Norwegian Business School, the Norwegian Geotechnical Institute (NGI) and the Norwegian Meteorological Institute (MET Norway).

The centre's private sector partners represent important segments of the Norwegian building industry, including consultants, entrepreneurs, construction materials manufacturers and technology suppliers. These include *Skanska Norway*, *Multiconsult AS*, *Mestergruppen Arkitekter AS*, *Norgeshus AS*, *Leca AS*, *Skjæveland Gruppen*, *Isola AS* and *Powel AS*. The consortium also includes public sector builders and property developers including *Statsbygg* (the Norwegian Government Estates Agency), *Statens vegvesen* (the Norwegian Public Roads Administration), *Jernbanedirektoratet* (the Norwegian Railways Directorate) and *Avinor AS* (the Norwegian state-owned airports operator). Other key participants are Trondheim municipality, the Norwegian Water Resources and Energy Directorate (NVE), and Finance Norway.

Quality assurance has been carried out by Thor Bjørkvoll.

We would like to thank both the interviewees and quality assurors who have contributed to this project. Our collaboration has been interesting and enlightening.

Trondheim, 17th June 2020

Berit Time
Centre Director, *Klima 2050*
SINTEF

Definition of terms

Climate change adaptation strategies/measures. Strategies or measures developed on the one hand to prevent or mitigate damage, and on the other to exploit the opportunities provided by climate change phenomena. The adoption of adaptation measures assumes a knowledge and understanding of the consequences resulting from the fact that the climate is changing.¹

Natural perils insurance. Insurance payouts made by a private sector insurance company for losses resulting from natural phenomena.

Natural perils compensation. Compensation for losses resulting from natural phenomena provided by the state.

Self insurance. A non-third party insurance arrangement by which a person or business bears the risk itself rather than take out insurance through an insurance company or the state.

Climate change adaptation loan. A discount interest loan provided to fund the climate change adaptation of buildings.

¹ <https://www.miljodirektoratet.no/myndigheter/klimaarbeid/klimatilpasning/>

Executive summary

This study has made an assessment of the allocation of responsibility for the climate change adaptation of buildings and infrastructure among key agencies in Norway, Sweden, Finland, Germany, France and Canada. The report presents the various natural perils insurance and compensation schemes prevailing in these countries with the aim of revealing the extent to which emphasis is placed on incentives to implement preventive measures in preference to building restoration. The report is based on a combination of document studies and in-depth interviews with representatives either from the public authorities or from insurance or financial institutions in the countries in question.

Local municipalities have overall responsibility for the implementation and supervision of climate change adaptation strategies in all the countries examined in this study. Executive authority and the nature of the subordinate state agencies vary from country to country, but the frameworks for the allocation of responsibility exhibit a number of similarities. The allocation of responsibility is to a large extent well-defined and often under statutory regulation. Germany and Canada are particularly distinctive among the countries examined in this study, primarily because the allocation of responsibility for adaptation strategies reflects the fact that they are federal states.

Compared with the work to reduce greenhouse gas emissions, climate change adaptation represents a relatively new area of focus. The EU has evolved into a driving force for climate change adaptation activities in Europe, and in 2013 launched its own adaptation strategy. The strategy focuses on consolidating the foundation for decision-making related to adaptation measures, and on supporting the coordination and funding of actions taken at national level. It delegates responsibility for national strategy development to each member state, and subsidises initiatives for the development of national expertise, which in turn form the basis for the identification of appropriate measures.

In general terms, compensation for the impact of natural perils on property consists of three components;

- Insurance
- Self-assurance (by which the property owner must be prepared to cover the costs of any losses himself)
- State-funded compensation provided by governments, a ministry or a regional public authority

The ways in which these various schemes are triggered depend on both the causes of damage and the nature of the property that incurs damage. The extent to which any given scheme places emphasis either on the cause or the nature of the property varies from country to country. The distinctions between the schemes may be unclear, for instance, in terms of the role of the state as both a formal and informal underwriter for the insurance companies. In Finland, there has to date been no need to establish a state-funded safety net in the form of regional, national or EU funding.

In Norway and France, natural perils insurance and compensation schemes are in part incorporated into the public sector. Insurance premiums are not risk-based, entailing a certain element of public solidarity associated with the schemes. In France, the state-funded compensation scheme is structured as a fund, twelve percent of which is provided by the insurance premiums. This percentage has increased over time, and also finances climate change adaptation measures such as monitoring, mapping, municipal planning, research and the dissemination of information, as well as expropriation and evacuation measures. In Norway, a 0.065 part of fire insurance premiums is allocated to provide compensation for

losses caused by natural phenomena, and is used primarily to cover the restoration of damaged buildings to their original standard.

In Sweden, Finland, Germany and Canada, natural perils insurance and compensation is provided mainly via private sector insurance schemes. In Sweden, Finland and Canada, building insurance is nevertheless referred to as semi-voluntary, because the banks will only grant loans for property to those who have also taken out property insurance. If a property owner has no need to take out a loan, he is not obliged to insure the property. The extent of coverage in these countries is thus approximately just as high as that in Norway and France.

A private sector scheme is able to provide incentives to implement preventive measures by means of excess payments and risk-based premiums. At the same time, the existence of a parallel, state-funded, safety net may act to weaken any incentive to take action to prevent damage caused by natural phenomena. Another factor that may weaken incentives to implement preventive measures is that it is currently common practice among insurance companies to cover property restoration costs above and beyond their original standard following damage caused by natural phenomena. Some insurance companies offer guidelines on climate change adaptation in their policies, and the party taking out the insurance may incur a payout reduction if the guidelines are not adhered to. Even if certain incentives exist either within or outside the schemes, these are considered to be too passive in relation to the expected impacts of climate change.

It is the prerogative of individual insurance companies to offer supplementary cover. However, as a rule, private sector infrastructure is not insured. In Norway, a state-funded scheme provides compensation for losses resulting from natural phenomena to private sector infrastructure such as roads, quaysides and harbour walls. Large private sector companies can take out exclusive insurance policies to cover their infrastructure. This has been the case for a number of bridges in Sweden, the express train infrastructure connecting Stockholm Arlanda airport, and rail infrastructure in Norway. State institutions act as self-insurers in all the countries examined in this study.

The natural perils insurance and compensation schemes that operate in the various countries are different, and all of them have recently been amended or are in the process of revision. However, it is not possible to identify an overall trend in this process. Finland moved away from a private-public scheme to an entirely private sector arrangement in 2014. However, Canada is currently in the progress of developing public sector schemes in response to the refusal by the private sector to offer adequate flood insurance. The Norwegian system has been the subject of review but, to date, no decisions have been taken regarding modification. The solidarity principle infuses both the Norwegian and French systems with high levels of credibility.

Other areas in which the incentive to adopt adaptation measures can complement incentives set out in current insurance and compensation schemes include statutory building regulations and climate change adaptation loans. By requiring higher levels of climate change adaptation, statutory building regulations may contribute towards boosting incentives for property owners to implement preventive measures. Many countries are in the process of revising their statutory building codes to incorporate requirements for adaptation measures. However, our findings indicate that to date, the specificity of these requirements is very limited. The market for green bonds is expanding rapidly and, in the future, climate change adaptation loans may act to provide incentives in the same way as green loans do to promote energy-efficient buildings. For example, in the right context, the level of an insurance premium could be fixed based on the implementation of measures that also triggers a climate change adaptation loan and certification of the adapted buildings. However, such a scenario will also require developments in the field of adaptation performance indicators.

A natural extension of this study will be the development of alternative structures for natural perils insurance and compensation schemes that not only retain the solidarity principle, but which also offer further incentives to building owners to implement preventive measures.

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1 Introduction

This study has made an assessment of the allocation of responsibility for the climate change adaptation of buildings and infrastructure among key agencies in Norway, Sweden, Finland, Germany, France and Canada. The report presents the various natural perils insurance and compensation schemes prevailing in these countries with the aim of revealing the extent to which emphasis is placed on incentives to implement preventive measures in preference to building restoration.

Chapter 1 provides an outline of the background to the study, highlights its significance, and makes reference to other relevant research projects carried out by SINTEF and the *Klima 2050* Centre. Chapter 2 describes the method that has been employed to carry out this study, and Chapters 3 to 8 present the findings obtained from an examination of each of the countries included in the project. Each presentation starts with a brief introduction to the risk situation in the country in question, followed by an assessment of the allocation of executive responsibility for climate change adaptation strategies. This is accompanied by an account of the natural perils insurance and compensation schemes currently in operation in the country. The presentation is concluded with a description of the incentives to implement preventive measures that are built into the schemes in the respective countries.

Chapter 9 compares and contrasts the findings described in the foregoing chapters, and goes on to examine in detail the EU framework for adaptation to climate change. This chapter also includes a discussion of our findings, and sets out some proposals for the extension of our work in the form of new studies.

Chapter 10 presents the conclusions from the study.

1.1 Background to the study

The mitigation of future climate change by emissions reductions currently receives considerably more attention in the climate change debate than issues surrounding the adaptation of the built environment. The reduction in greenhouse gas emissions has been the subject of a number of political processes initiated under the auspices of the UN under its Framework Convention on Climate Change², including the COP3 conference in Kyoto and the COP 21 in Paris, leading in their turn to the Kyoto Protocol³ and the Paris Agreement⁴. Future emissions of greenhouse gases will determine the extent of climate change and thus also the need for the adaptation of buildings and infrastructure. However, ongoing changes in climate have already resulted in a need for such adaptations, regardless of future levels of greenhouse gas emissions.

The EU has acted as a driving force in the work to limit emissions and prepare its member states for the impacts of climate change. Ongoing climate change processes express themselves differently in the various member states. However, some universal and common trends exist, and these constitute the basis for the EU's climate change adaptation strategy⁵. These trends are observed in the form of higher average temperatures and the increasing frequencies of phenomena such as droughts, river flooding and torrential rainstorms, as well as sea level rise.

²

https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveing.pdf

³ <https://lovdata.no/dokument/TRAKTAT/traktat/1997-12-11-3>

⁴ http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf

⁵ https://ec.europa.eu/clima/policies/adaptation/what_en

Higher temperatures and the increasing likelihood of heatwaves and droughts impose demands on a built environment that has to provide both screening and shade, and facilitate the efficient use of water resources. In connection with periods of drought, it is important to monitor both erosion and groundwater levels. Many European cities are built on clayey soils that shrink when they dry out, leading to subsidence damage to buildings and infrastructure.

River flooding is currently the most common form of natural peril recorded in the EU, and both the intensity and frequency of flooding are expected to increase in the future. The development of cross-border flood prevention strategies has been the focus of much effort by the EU since long before the issue became an integrated component of its climate change adaptation strategy. It is also anticipated that torrential downpours and events combining storm winds and high rainfall will increase in frequency in the future. Torrential rain is of particular relevance to urban built environments and infrastructure.

In 2002, the value of European property and infrastructure located closer than 500 metres from the sea was estimated by the EuroSION study, carried out in 2004, to be between EUR 500 and 1000 billion[1]. Today, subsequent inflation and higher building densities mean that this value is probably much higher. Sea level rise may have major direct consequences for building and infrastructure, but it also affects the built environment indirectly due to salt water intrusion into groundwater, combined with an increased risk of coastal inundation.

Since the impacts of climate change will be different in different EU member states, the EU's strategy for climate change adaptation is organised such that the identification and supervision of appropriate measures are administered individually by the country in question, with the EU providing a centralised resource to support knowledge generation and coordinating activities. This model is reflected in the strategies of the respective countries, resulting in the delegation of responsibility for adaptation measures primarily to local public authorities.

In Norway, it is expected that climate change will lead to higher average temperatures and a more humid climate. Torrential rain events and storm surges are also expected to increase in frequency. Water damage is expensive to repair. Figure 1 shows that in Norway during the period 2008-2019, there has been an increase in the number of reported insurance cases involving water damage⁶. Flooding and associated landslides can have major impacts on the local communities where they occur.

⁶ <https://www.finansnorge.no/statistikk/skedeforsikring/natur--og-vaer-skader/v2-vannskader---bygninginnbo/>

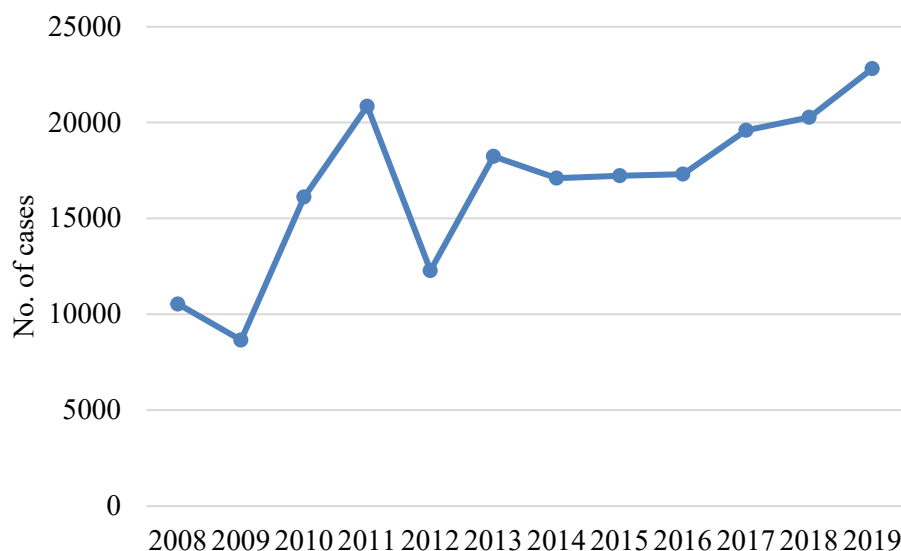


Figure 1. Number of reported insurance cases in Norway involving external water intrusion in the period 2008-2019

Relevance of this study

This study examines the allocation of responsibility for the administration of climate change adaptation strategies in six countries with broadly comparable climatic regimes. In view of the increasing pressure being exerted on current Norwegian strategies, the administrative arrangements in other countries are interesting from a Norwegian perspective. To date, almost no studies have been carried out that have investigated the allocation of responsibility for adaptation strategies at this level of detail. Furthermore, the studies that do exist often focus on individual countries and single damage-causing phenomena, commonly with an emphasis on flooding and other forms of water-related damage.

Struthers (2019), as part of a case study of extreme drought conditions in Chile, found that the political structure within a country may have considerable influence on how it approaches, and succeeds with, the implementation of its adaptation strategies [2]. Dale et al. (2019) emphasise that effective coordination, both across and within administrative hierarchies, may be crucial to the achievement of shared objectives [3]. Financial and political incentives, such as insurance and compensation schemes and subsidies, are developed with the aim of adapting individual decisions to agreed collective objectives⁷.

In the following, we will describe the various natural perils insurance and compensation schemes in operation in the aforementioned six countries. Insurance schemes can provide both incentives and disincentives to the adoption of climate change adaptation measures. Craig (2019) points out that a public-private insurance scheme may provide perverse incentives, such as for higher levels of population settlement in coastal areas [4]. This will depend on the ways in which the schemes are designed. In a comparative study of flood insurance schemes in the EU, Hudson et al. (2019) recommended the adoption of private-public natural perils insurance and compensation schemes for flooding, but incorporating risk-based insurance premiums. The authors highlighted the fact that current schemes based on the solidarity principle provide little incentive for those taking out insurance to implement preventive measures [5].

⁷ <https://climate-adapt.eea.europa.eu/metadata/adaptation-options/economic-incentives-for-behavioural-change>

Wilby and Keenan (2012) distinguish between factors that enable the adoption of climate change adaptation measures and associated incentives. Among incentives, the authors highlight insurance and legislation such as statutory building regulations. Enabling factors include monitoring, flood warning systems, data exchange and contingency planning for natural disasters [6]. The enabling factors are described in the assessment of the allocation of responsibility for climate change adaptation measures in the different countries. In order to incorporate incentives, we describe how the ways in which the schemes in operation in the various countries may incentivise the prior implementation of preventive measures rather than building restoration following a natural disaster. In using the term “preventive measures”, we are referring to the prior construction of more resilient buildings, whereas by “restoration”, we mean the subsequent renovation of damaged buildings to a standard equivalent to that which existed prior to the event.

Incentives to implement preventive measures include reductions in insurance payouts if certain adaptation measures are not put in place. We also refer to carrots rather than sticks, such as reduced insurance premiums or favourable loan terms for the construction of pre-adapted buildings (so-called climate change adaptation loans), as well as subsidies to support the implementation of adaptation measures. Furthermore, we will be taking a close look at building regulations and examining the extent to which these take climate change into account.

Many previous studies have argued that the prior implementation of adaptation measures is socioeconomically more beneficial than subsequent restoration. Hinkel et al. (2010), in an EU study addressing adaptation strategies in the face of sea level rise, also include this among their conclusions. A Norwegian study that investigated the increased risk of water inundation damage in the towns of Tromsø and Stavanger also concluded that pre-adaptation was socioeconomically beneficial [7]. Socioeconomic analyses are intended to help us identify the optimal levels of adaptation measures. Furthermore, such analyses can also assist us in identifying the most effective adaptation and mitigation measures, as well as when and how such measures should be implemented. In a recently completed study carried out by Baills et al. (2020) to evaluate adaptation measures in coastal areas, the authors pointed out that there exist many initiatives that will be economically beneficial provided they are implemented without unnecessary delay [8]. However, the literature also shows us that too little is actually being done. Hudson et al. (2019) highlight current implementation inadequacies and go on to propose structural modifications to natural perils insurance schemes as a means of boosting the incentives to implement preventive measures [4].

The identification of the drivers behind, and the barriers obstructing, the adoption of climate change adaptation measures is a key theme throughout the literature. In another EU study, addressing local adaptation measures, the authors refer to factors such as a lack of financial and personnel resources, low political prioritisation, and uncertainty among the principal barriers [9]. Many studies point out that levels of expertise within the local authorities are too low, that too few resources are allocated for the implementation of adaptation measures at local level, and that coordination between the various responsible administrative agencies is inadequate [2, 10, 11].

1.2 Studies previously carried out by SINTEF

There is no shortage of published guidelines for the pre-adaptation of buildings and infrastructure to climate change. More than 80 such sets of guidelines have been reviewed by the *Klima 2050* Centre, which has concluded, among other things, that when the volume of information available is perceived as overwhelming, this in itself becomes a barrier to the implementation of climate change adaptation measures. In this study, we both recommend

the development of more practical sets of guidelines and strongly request, among other things, guidelines to promote coordination between the various administrative agencies [12].

In the report *Klimatilpasning av bygninger og infrastruktur – samfunnsmessige barrierer og drivere* (The pre-adaptation of buildings and infrastructure to climate change – socioeconomic barriers and drivers), the authors pointed out that current insurance and compensation schemes in operation in Norway fail to provide sufficient incentives for the incorporation of pre-adaptive and preventive measures, and instead incentivise restoration ahead of prevention. They propose that the municipality highlighted in the study be delegated even greater levels of responsibility for implementing adaptation measures and that there may be a need for subsidies to help fund preventive measures [13].

The insurance companies are in possession of useful claims data that may be useful for planning purposes, among others. The *Klima 2050* centre has revealed a willingness among the insurance companies to share these data with various public planning agencies via a digital portal, which can also be used by researchers [14]. As an extension of these findings, a journal article has been published addressing how such data, when it is made available, may be used to provide better explanations and predictions of flooding events [15]. The findings from the work addressing insurance data are assembled in a chapter in a book on climate services. Among other things, these findings reveal that access to claims data will greatly assist local municipalities in their decision-making in the field of climate change adaptation. However, more work will be required on these data before they can be used to support decision-making or be applied in analyses and predictive extrapolations. The *Kunnskapsbank* (Knowledge Bank) system, which is being set up to structure these data, is working to ensure that the reporting of claims cases is logged in a standardised format [16].

2 Method

Our methodology for this study of the allocation of responsibility for climate change adaptation measures and natural perils insurance and compensation schemes in operation in the various countries is based on a document review combined with in-depth interviews with informants resident in the countries in question. The countries examined are Norway, Sweden, Finland, Germany, France and Canada that, while experiencing for the most part similar climatic regimes, nevertheless operate with contrasting insurance and compensation schemes. Our primary focus is directed at the incentives provided to implement preventive measures following a natural disaster. However, we will also assess the roles played by the various public agencies both before and after such events occur.

We have also directed focus on the allocation of responsibility for adaptation strategies and incentives to implement preventive measures at national level. Individual municipalities may operate with their own adaptation measures, and each insurance company and bank with their respective policies and loans, which may contain provisions providing incentives to implement preventive measures that are not included here. Our interviews with umbrella organisations for the insurance companies and financial institutions in the various countries have enabled us to capture some examples of these, although we have not made an assessment of their full scope.

A number of natural perils are directly influenced by ongoing climate change phenomena. These include the risks of flooding and landslides, as well as increased levels of precipitation. However, not all natural perils are directly influenced by changes in climate. An example of such perils that are incorporated in building regulations in many European countries are earthquakes. Natural perils that are not influenced by climate change will not be addressed in the remainder of this report. This study is also limited to the effects of climate-related natural perils on buildings and infrastructure. Forest wildfires and damage to crops, aquaculture facilities and other livestock-related activities are thus excluded.

Our examination of reference materials has included reviews of a number of reports, scientific publications, legislative Acts and statutory regulations, as well as other relevant documents. We refer to the reference list at the end of this report. The scope of our reviews has covered the allocation of responsibility for the implementation of climate change adaptation measures, insurance and compensation schemes, and the incentives put in place for the implementation of preventive measures in the various countries examined.

Moreover, we have conducted in-depth interviews with key individuals who are very familiar with the insurance and compensation schemes in operation in the countries in question. Dialogue took place in the form of semi-structured interviews, based on an interview guide that accompanies this report (Appendix A). Our informants comprise individuals from the public authorities and insurance and/or financial institutions in the relevant countries (see Appendix B). The interview guide was prepared with the aim of providing questions intended to cover the relevant fields within the scope of this study.

3 Norway

3.1 Risk situation

The climate is undergoing change. In the report "*Klima i Norge i 2100*" (Climate in Norway, 2100) a total of 37 research scientists from a number of research institutes concluded that in Norway, in addition to sea level rise, levels of precipitation will increase, and torrential rain and rain-induced flooding events will continue to become more frequent and more intense. Even if the extrapolations for storm frequency remain highly uncertain, the country must also expect more intense storms as a consequence of temperature increases. Figure 2 shows the observed and anticipated precipitation volumes in Norway for a medium emissions scenario, with median and 10 and 90 percentile values, and measured in percentage deviation for the period 1971 to 2000.

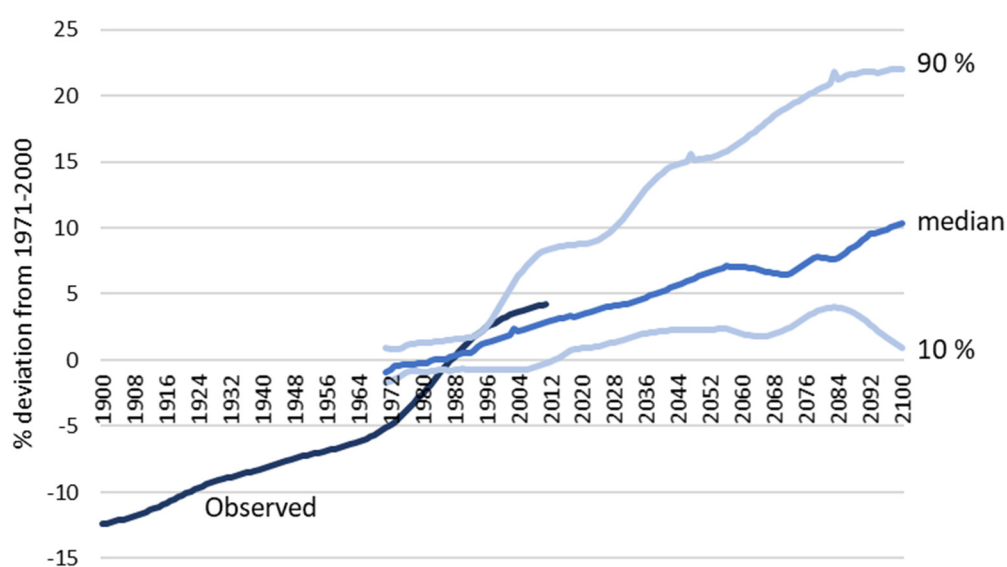


Figure 2. Observations and prognoses for precipitation in Norway in a medium emissions scenario, measured in percentage deviation for the period 1971-2000

The probabilities of occurrence of a 200-year flooding event in Western Norway, Eastern Norway, Mid-Norway and Nordland county are also expected to increase. The figure shows the anticipated probability of a 200-year flooding event for the period 2071-2100 under a medium emissions scenario. In the period 2031-2060, Norway can also expect a general increase in the probability of major flooding events, with an up to 30 percent increase in certain locations in Western Norway and Nordland county. Results published by the Norwegian Centre for Climate Services also show that these probabilities are very sensitive to changes in greenhouse gas emissions. In a high emissions scenario, the probabilities of major flooding events over large parts of the country will increase significantly [17].

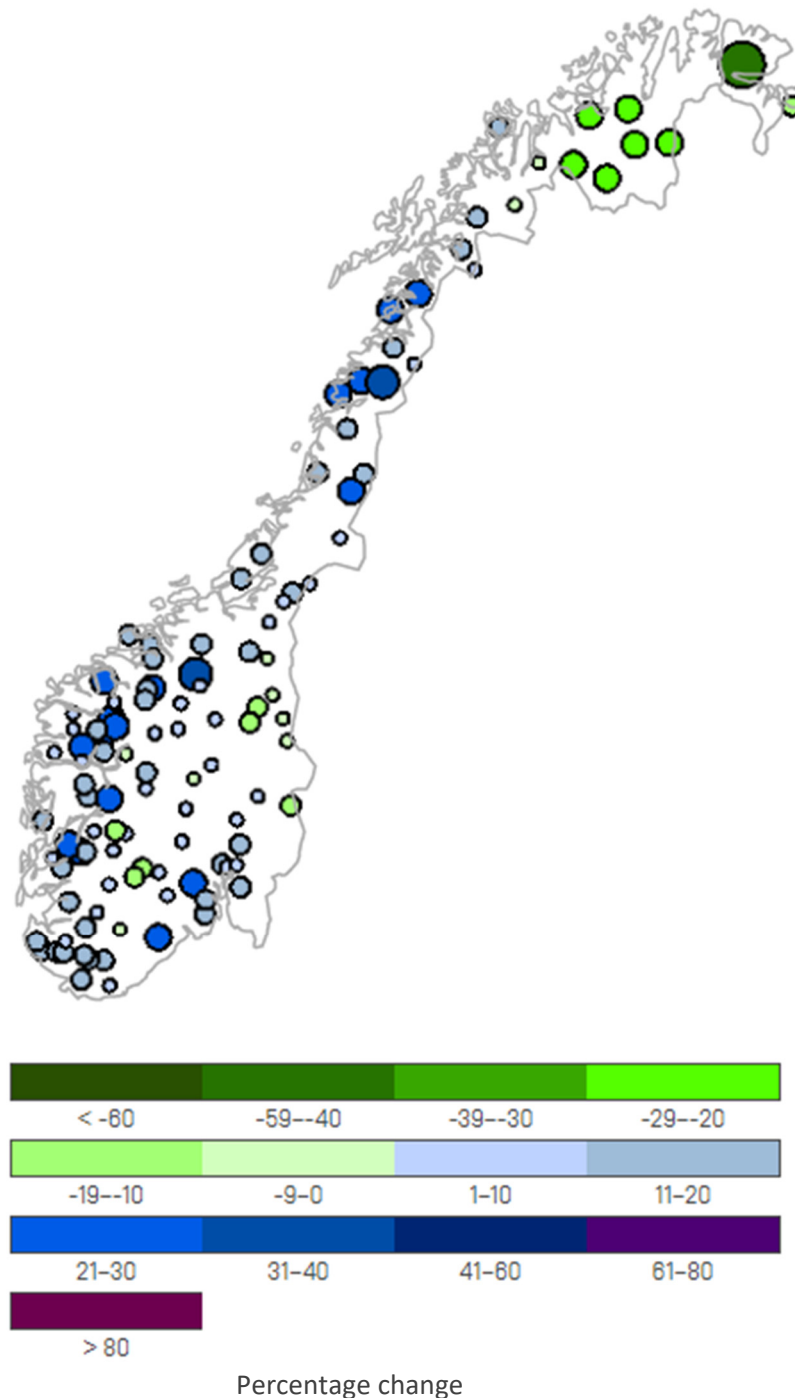


Figure 3. Probability of occurrence of a 200-year flood in the period 2071-2100 in a medium emissions scenario.

During the decade 2008-2018, water damage is recorded as the most common source of insurance claims for buildings, and the second most common behind all comprehensive claims for cars. Water damage is also the second highest source in terms of total payouts made by the insurance companies, where the highest is due to fire damage. In 2016 however, total compensation payouts for water damage to private individuals exceeded those for fire damage. Norway has seen an increase in water damage claims in recent years, and the amount of compensation paid out in 2018 was close to a billion Norwegian kroner. In the period 2008 to 2018, water damage claims represented about 30 percent of the total compensation paid out for private homes and holiday cabins, and 24 percent for business premises. About one third of claims resulted from weather-related causes such as frost, water

inundation from outside the properties, blockages, and backwash from sewage systems. Water inundation from outside the properties was the most common source of these claims. Densely built-up areas prove to be the most vulnerable to water damage.⁸

3.2 Responsibility for climate change adaptation strategies in Norway

We have made an assessment of the allocation of responsibility for climate change adaptation strategies at national level in Norway. This has entailed a review of the ministries that exercise executive authority over the various compensation schemes following an event, and of the tasks carried out by the various directorates and other public sector agencies in terms of adaptation measures, both before and following an event.

In Norway, the municipalities are allocated responsibility for implementing adaptation strategies and related measures. This responsibility is set out in the Norwegian Municipal Planning Act (*plan og bygningsloven*)⁹, the Natural Perils Act (*naturskadeloven*)¹⁰ and the Civil Protection Act (*sivilbeskyttelsesloven*)¹¹. Section 3-1 of the Municipal Planning Act makes it mandatory for municipalities to adapt their infrastructure to anticipated climate change, and to put measures in place to prevent damage. Sections 11-8 and 12-7 stipulate requirements related to safeguarding and monitoring. Section 28-1 imposes a duty on municipalities to refuse building applications in high-risk areas. The Natural Perils Act sets out detailed provisions in terms of what a municipality may permit in terms of building or other forms of property utilisation. For example, Section 23 grants the municipalities the right to expropriate land to provide alternative property sites in high-risk areas. According to Section 14 of the Civil Protection Act, the municipalities have a duty to employ risk and vulnerability analysis tools to make risk assessments of climate change-related events to which they may be vulnerable. Moreover, Section 15 of the Act states that the municipality shall prepare contingency plans on the basis of these analyses.

In Norway, throughout history, people have adapted themselves to changeable weather conditions. However, contemporary climate change processes appear to require additional measures. Figure 4 illustrates the chronological development of climate change adaptation strategies in Norway. It shows the dates of publication of key studies and reports related to adaptation, the introduction of legislative Acts and statutory regulations, as well the extreme weather events that the country has experienced.

⁸ <https://www.finansnorge.no/statistikk/skadeforsikring/>

⁹ <https://lovdata.no/dokument/NL/lov/2008-06-27-71>

¹⁰ <https://lovdata.no/dokument/NL/lov/1994-03-25-7>

¹¹ <https://lovdata.no/dokument/NL/lov/2010-06-25-45>

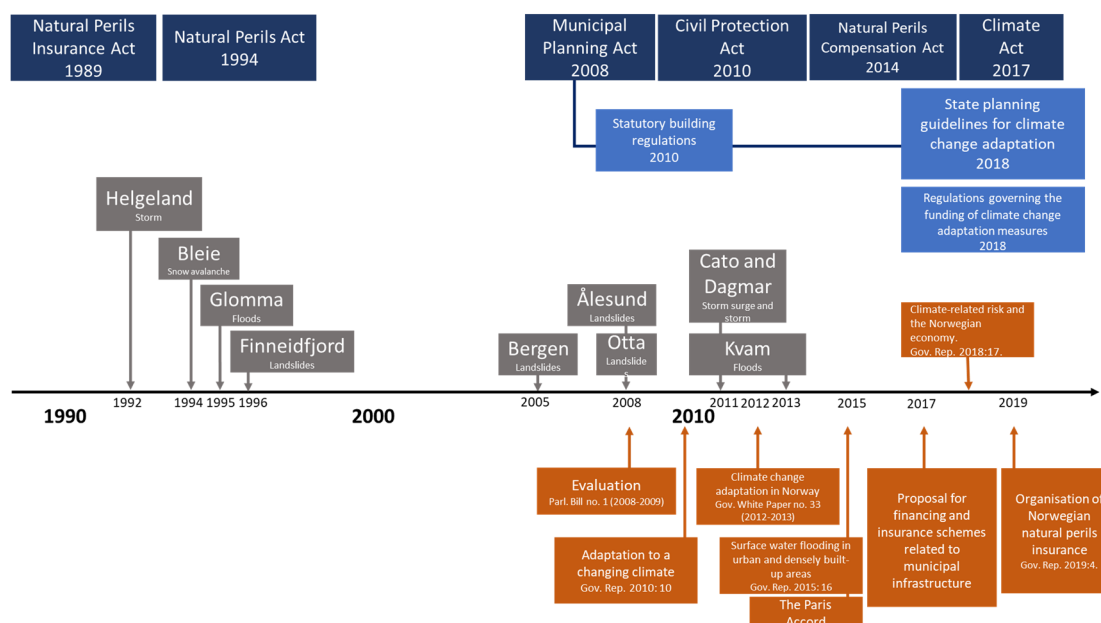


Figure 4. The chronological development of climate change adaptation strategies in Norway (1990-2019)

The authorities began their adaptation-related work in 2008 with the launch of an information gathering exercise on climate change. The municipalities were involved in this work.¹² The exercise resulted in the publication in 2010 of a public report outlining the consequences of climate change.¹³ In 2013, a report was published on the status of climate change adaptation in Norway. It recommended that a committee should be set up to look into surface water flooding in particular.¹⁴ The committee's report was published in 2015.¹⁵ In 2018, a public report was published setting out the various climate-related risk factors and their significance for the Norwegian economy.¹⁶ 2018 also saw the publication of adaptation guidelines for use in planning, directed at the municipalities, county councils and the national authorities. These guidelines were subsequently incorporated into the statutory provisions accompanying the Municipal Planning Act.¹⁷ Reporting to the Intergovernmental Panel on Climate Change (IPCC) entails the continuous assessment of risk factors and adaptation needs. As part of the Paris Agreement, all countries are committed to preparing a climate change adaptation plan and to provide assistance on adaptation issues to the poorest countries.¹⁸ However, climate change adaptation was only referred to in Norway's state budget in 2020 under the items research and foreign aid.¹⁹

The grey-shaded boxes in figure 4 represent serious natural disasters that occurred in Norway in the period between 1990 and the present day. Lives were lost in the hurricane in Helgeland, during the Glomma river floods, and following landslides in Finneidfjord, Bergen

¹² Parl. Bill no.1 (2008-2009). Norwegian state budget 2009.

¹³ Norwegian Government Report (NOU) 2010: 10. *Tilpassing til eit klima i endring* (Adaptation to a changing climate).

¹⁴ White Paper no. 33 (2012-2013). *Klimatilpassning i Norge* (Climate change adaptation in Norway).

¹⁵ Norwegian Government Report (NOU) 2015: 16. *Overvann i byer og tettsteder – som problem og ressurs* (Surface water flooding in urban and densely built-up areas – a problem and a resource).

¹⁶ Norwegian Government Report (NOU) 2018:4. *Klimarisiko og norsk økonomi* (Climate-related risk and the Norwegian economy).

¹⁷ <https://lovdata.no/dokument/SF/forskrift/2018-09-28-1469>

¹⁸ <https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf>

¹⁹ Parl. Bill no. 1 S (2019-2020). *Statsbudsjettet 2020* (Norwegian state budget 2020).

and Ålesund.²⁰ In 2019, as a guideline for use in socioeconomic analyses, a human life was valued at NOK 34.65 million.²¹ The dark and pale blue boxes in the figure represent legislative Acts and statutory regulations related to climate change, respectively. The orange boxes represent public reports, political decisions, and studies that address climate change adaptation from the year (2008) in which the topic landed on the political agenda and up to the present day.

Figure 5 shows how responsibility for climate change adaptation strategies and measures in Norway is currently structured.

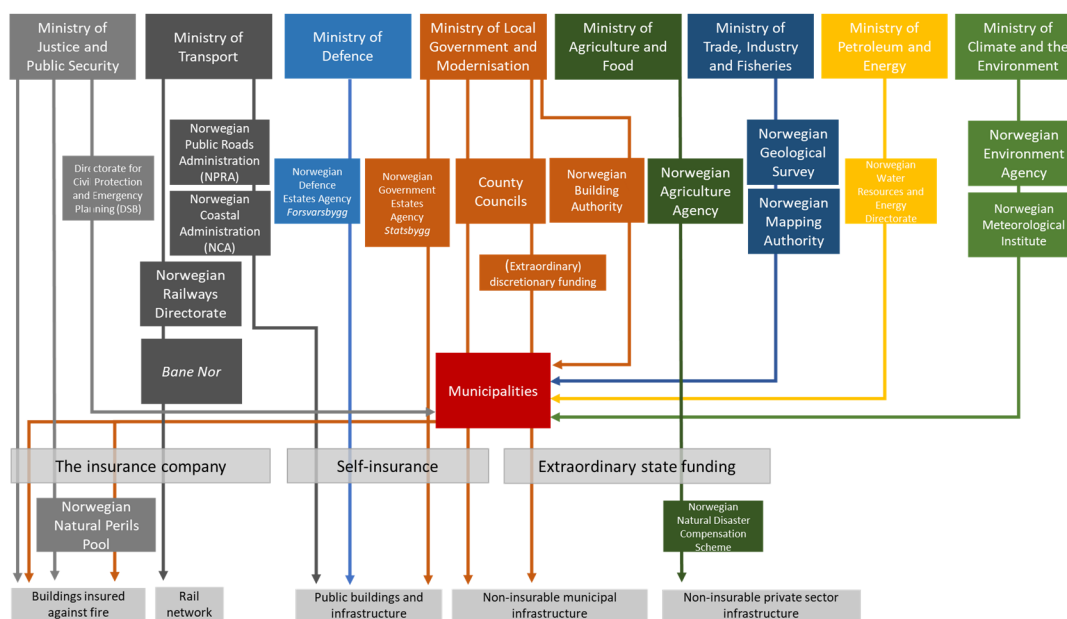


Figure 5. Allocation of responsibility for climate change adaptation strategies and measures in Norway.

Executive authority is placed at the top of the figure. Directorates and other government agencies that operate under the executive ministries are assigned the same colour as the ministry to which they belong. The placement of some agencies and directorates under each other simply indicates that at this level they operate under the same ministry, but are not subordinate to each other. Ministries work together on climate change adaptation, and there is also collaboration between the relevant directorates and other agencies. However, in the figure, emphasis is placed on the role of the municipalities. The lower half of the figure illustrates the types of compensation paid out following a natural disaster. This includes both the schemes currently in operation, and the losses for which compensation is provided by the various schemes. Self insurance is relevant in situations where municipal infrastructure cannot be covered by the insurance companies, and for private sector infrastructure that is subject to losses due to causes other than natural perils events. Information-related activities, such as monitoring, research, mapping and data sharing, are carried out both before and following natural disasters.

The Norwegian Directorate for Civil Protection and Emergency Planning (DSB) has overall administrative responsibility for the Civil Protection Act and civil defence, and is also responsible for monitoring the national risk situation. The DSB also assumes coordinating responsibility for all government agencies that work with climate change adaptation. This

²⁰ <https://www.aftenposten.no/norge/i/G1n69/dette-er-de-noen-av-de-stoerste-naturulykkene-i-norge>

²¹ <https://dfo.no/fagomrader/utredning/samfunnsokonomisk-analyse/verdien-av-et-statistisk-liv-vsl>

requires collaboration across the various sectors of public life, particular in connection with information sharing.

The Norwegian Environment Agency acts as an expert centre on climate change adaptation issues, and administers a support scheme to which both municipalities and county councils may apply in order to boost their in-house expertise on climate change and its impacts.²²

The Norwegian Water Resources and Energy Directorate (NVE) carries out administrative tasks linked to the management of flooding and landslide risk. This entails mapping and surveying tasks, as well as the provision of land use planning guidelines to the municipalities. The Directorate also assists the municipalities with safeguarding measures during the review, planning and implementation phases.

The Norwegian Mapping Authority carries out monitoring, mapping and analyses, and provides publicly accessible information on matters such as sea levels and tides, risk factors and potential impacts. It issues guidelines to the municipalities on matters such as safeguarding against sea level rise and the incorporation of higher frequencies of storm surges into the planning process.

The Norwegian Meteorological Institute prepares weather forecasts, monitors the climate, and carries out independent research on climate-related issues. Hazard alerts are sent to the Ministry of Justice and Public Security, the NVE, the media, the Joint Rescue Coordination Centres, affected County Governors and relevant municipal agencies, the police in risk-vulnerable locations and other agencies responsible for road and rail networks and electricity supplies.

The Norwegian Geological Survey (NGU) carries out monitoring, mapping and research, and shares data on the status of geological factors in Norway. The survey's monitoring of groundwater and unconsolidated sediments is a key task in terms of its contribution to climate change adaptation. The NVE has overall authority in the field of landslides, but the NGU acts as a key partner in this field for both the NVE and the municipalities.

The Norwegian Building Authority (DiBK) draws up requirements for the construction of buildings and has administrative responsibility for the current TEK 17 statutory building regulations.

In Norway, the areas of responsibility in relation to preparedness for events caused by climate change are clearly defined. However, we observe that following an event, legislation often becomes open to interpretation on matters concerning, for example, its direct cause and whether or not the event occurred suddenly and unexpectedly. We have an example involving an application for natural perils compensation for damage to a harbour wall caused by a storm surge. The application was rejected because it could not be established that there had been a storm surge at that location at the time when the damage occurred, and that it was due to the direct action of high energy waves. Lack of maintenance was also highlighted as a cause of the damage.²³

In Norway, the municipalities take out insurance in the same way as private individuals and businesses, and damage to municipal buildings, business premises, homes and holiday cabins that are insured for fire can be covered by a scheme called the Norwegian Natural Perils

²² *Forskrift om tilskudd til klimatilpasning*. 25 June 2018.

<https://lovdata.no/dokument/SF/forskrift/2018-06-25-1169> (Statutory regulations governing the funding of climate change adaptation measures)

²³ *Gulating lagmannsrett* (Court of Appeal). Judgement LG-2018-23731.

Pool²⁴, which is described in more detail in Chapter 3.3.1. In cases of damage to municipal infrastructure that cannot be insured, the municipalities must cover the costs themselves. If these costs exceed municipal budget allocations, they can apply to the County Governors for discretionary funds. If large amounts are involved that exceed designated regional discretionary funding, municipalities may be granted extraordinary discretionary funds by the Ministry of Local Government and Modernisation. The discretionary funding schemes are described in more detail in Chapter 3.3.3. In cases of damage to privately-owned infrastructure by natural phenomena, a public support scheme called *Statens naturskadeordning* (the Norwegian Natural Disaster Compensation Scheme) is available by which a claim can be covered by state funds.²⁵ This scheme is described in more detail in Chapter 3.3.2. If damage to infrastructure cannot be categorised as resulting from natural phenomena, the infrastructure owner must provide coverage.

In general, the larger public sector organisations are self-insurers and have to bear the costs resulting from damage caused by natural phenomena themselves. This applies to organisations such as *Forsvarsbygg* (the Norwegian Defence Estates Agency), *Statsbygg* (the Norwegian Government Estates Agency) and *Statens Vegvesen* (the Norwegian Public Roads Administration). After the rail company *Bane Nor* was split off from the Norwegian Rail Authority (NSB) and became a public limited company, it has taken out full insurance on its infrastructure. This insurance covers rail network infrastructure such as tracks, signalling and communications equipment and electrical contact cables. Assets such as station buildings, waiting rooms and office premises are insured for fire damage and incorporated as part of the Natural Perils Pool. Climate change adaptation is one of the three most important areas of focus in the transport sector. However, parts of the Norwegian road and rail networks are not designed to withstand anticipated increases in precipitation volumes, and the current Norwegian National Transport Plan emphasises the need to increase efforts to reduce the vulnerability of infrastructure to the impacts of climate change. This entails initiatives such as continuous and large-scale mapping projects and the inclusion of natural perils risk assessment as part of the planning process.²⁶

3.2.1 Status of climate change adaptation in Norway

The Government White Paper no. 33 (2012-2013) *Klimatilpasning i Norge* (Climate change adaptation in Norway) represents the current policy document for climate change adaptation strategies in Norway.²⁷ Many municipalities and public sector agencies operate with their own adaptation strategies, including the Norwegian Environment Agency²⁸ and the NVE²⁹. In Section 6 of the Norwegian Climate Act (*klimaloven*)³⁰ it states that the Norwegian Parliament shall receive annual updates on the status of climate change adaptation strategies in operation across the country.

Since the municipalities have overall responsibility for the implementation of adaptation measures, a number of studies have been carried out to examine how they exercise their role. The regional research centre *Vestlandsforskning* has made an assessment of the status of adaptation activities carried out in small and medium-sized Norwegian municipalities. It concludes that the need remains to boost levels of expertise within the municipalities and goes on to recommend that funding to promote climate change adaptation should be increased. This will probably require increased levels of funding from the national budget [18]. The Cicero Centre for Climate Research has carried out surveys by sending out

²⁴ <https://www.naturskade.no/>

²⁵ <https://www.landbruksdirektoratet.no/naturskadeordningen/>

²⁶ White Paper no. 33 (2016-2017). *Nasjonal transportplan* (Norwegian National Transport Plan) 2018-2029.

²⁷ <https://www.regjeringen.no/no/dokumenter/meld-st-33-20122013/id725930/>

²⁸ <https://www.miljodirektoratet.no/globalassets/publikasjoner/M1018/M1018.pdf>

²⁹ http://publikasjoner.nve.no/rapport/2015/rapport2015_80.pdf

³⁰ <https://lovdata.no/dokument/NL/lov/2017-06-16-60>

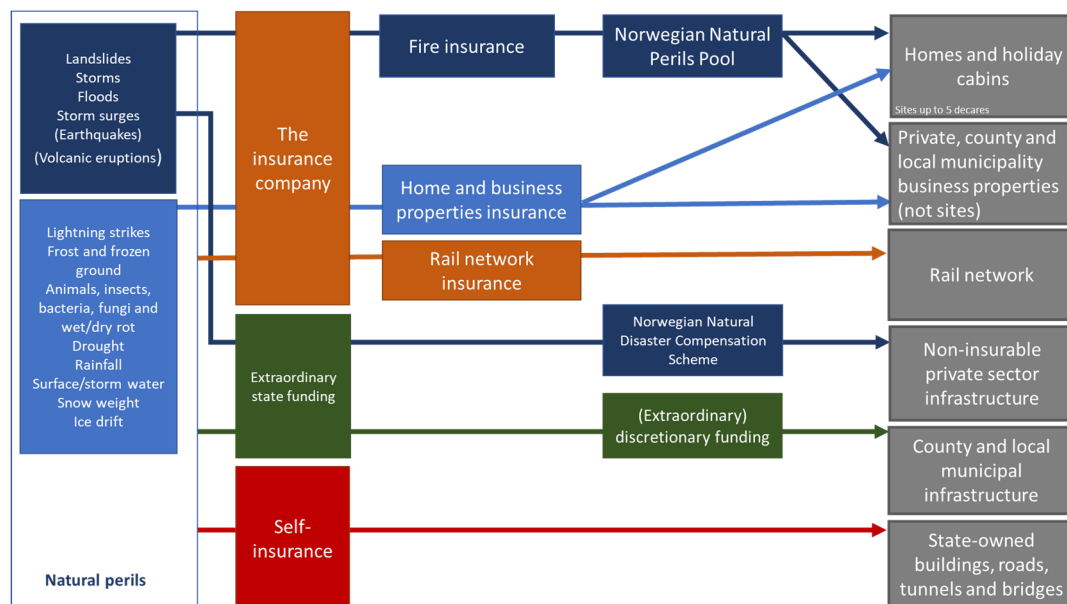
questionnaires to a number of municipalities in order to find out how well equipped they are to respond to climate-related natural perils. Results showed that most of the respondent municipalities have started on some sort of work to address adaptation strategies and measures, although the majority are still in the planning and assessment phase. The largest municipalities are more advanced in this work than the smaller authorities, which is a direct result of lack of resources and expertise in the smaller municipalities [19]. Moreover, both *Vestlandsforskning* and the Cicero centre have found that the implementation of measures has for the most part been triggered in response to local climate-related events.

3.3 Natural perils compensation schemes in Norway

As well as providing an assessment of the allocation of responsibility for adaptation strategies and measures, this study also describes the various natural perils compensation schemes that operate in response to climate-related natural perils events.

In Norway, such schemes fall into three categories, depending on whether the asset for which compensation is claimed has prior fire insurance. Assets that are insured for fire are covered pursuant to the Norwegian Natural Perils Insurance Act (*lov om naturskadeforsikring*)³¹, as described in Chapter 3.3.1. Assets in private ownership that cannot be insured are covered pursuant to the Norwegian Natural Perils Compensation Act (*lov om erstatning for naturskader*)³², as described in Chapter 3.3.2. Furthermore, a certain portion of each County Governor’s government-funded budget is set aside to provide discretionary compensation in response to unforecasted events such as climate-related natural perils that impact on municipal infrastructure. In the event that the compensation required following a given event exceeds this discretionary funding, the Ministry of Local Government and Modernisation can step in and grant extraordinary discretionary compensation. Discretionary funds are discussed in Chapter 3.3.3.

Figure 6 shows the types of weather conditions that trigger the various forms of compensation scheme payouts, and the assets covered by the various schemes once an event has occurred.



³¹ <https://lovdata.no/dokument/NL/lov/1989-06-16-70>

³² <https://lovdata.no/dokument/NL/lov/2014-08-15-59>

Figure 6. Natural perils compensation schemes in Norway structured in relation to assets and causes of loss

Losses resulting from natural perils are defined under Section 1 of the Natural Perils Insurance Act as those that are the direct result of unforecasted weather conditions such as storms, floods, landslides/avalanches, storm surges, earthquakes and volcanic eruptions. Other losses that may be described as resulting from climate-related causes such as lightning strikes, frost, frozen ground, bacteria, fungi, dry and/or wet rot, surface water, weight of snow and ice drift, must be covered either by home or commercial premises insurance or by a supplementary insurance policy. In order for a natural phenomenon to be defined as a storm, the wind velocity must attain a minimum value of 20.8 m/s. For flooding, either the river must overspill its banks or streams must be formed, and in the case of storm surges, water levels must attain levels equivalent to the five-year repeat interval. A landslide or avalanche entails that soil, clay or snow are instantaneously triggered into motion.³³ Norway has one active volcano above sea level on the island of Jan Mayen, which erupted most recently in 1985. There is a meteorological station and an airstrip on the island, but no losses have been reported for these installations. Although earthquakes do occur in Norway, these are generally not strong enough to cause damage that can be directly attributed to earth movements. For this reason, only very few of the insurance claims citing earthquake damage have been granted compensation. Case law indicates that an earthquake must achieve a minimum of 3.7 on the Richter scale in order to be regarded as a natural peril for compensation purposes.

3.3.1 The Norwegian Natural Perils Insurance Scheme (Natural Perils Pool)

A party taking out fire insurance is automatically insured against losses resulting from natural perils. The Norwegian Natural Perils Pool provides coverage against losses resulting from storms, floods, landslides and avalanches, storm surges, earthquakes and volcanic eruptions for all parties that have taken out fire insurance. A 0.065 part of fire premiums is set aside by insurance companies as capital used to cover future natural perils claims. This is a reduction from the previous rate of 0.07, which applied from 2012 until the end of 2019. The party taking out insurance applies to his insurance company if he wishes to submit a claim for losses resulting from natural perils related to assets that are insured against fire. Since the premium is the same for all parties taking out insurance, the Natural Perils Pool ensures a balanced allocation of risk for all policyholders and insurance companies, regardless of their location.

During the period between 1980 and 2018, most losses related to natural perils have resulted from storms (76 percent) and floods (15 percent). Storm-related losses are most common in coastal areas, while those resulting from flooding are more common inland. However, flood-related losses frequently cost more than storm-related losses to the extent that in years characterised by high levels of flooding, payouts for flood-related losses will dominate the total payout figures. Figures 7 and 8 illustrate trends in the number of claims and payout amounts, sorted according to the causes of losses, as recorded by the Natural Perils Pool in the period 1980 to 2018.³⁴

³³ <https://www.naturskade.no/naturskader-og-erstatning/skadeorsaker/>

³⁴ <https://www.finans Norge.no/statistikk/skadeforsikring/nokkeltall/naturskade/>

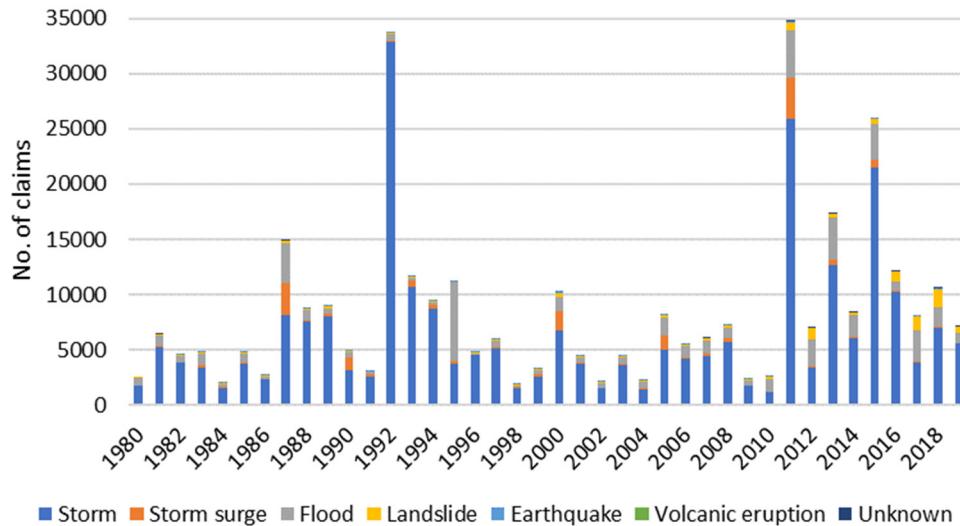


Figure 7. Number of reported natural perils claims in the Norwegian insurance sector in the period 1980 to 2018.

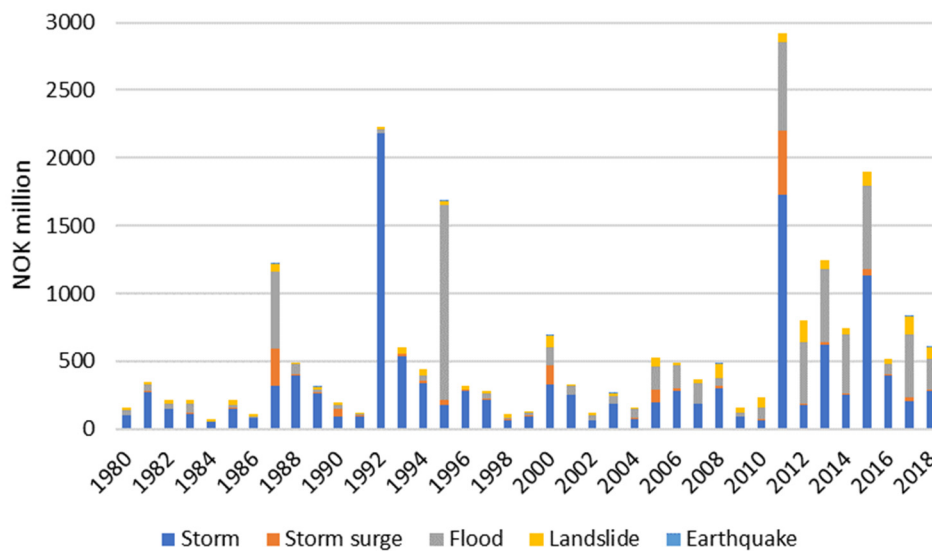


Figure 8. Total payouts made by the Norwegian Natural Perils Pool in the period 1980 to 2018.

The Natural Perils Pool acts as a balancing mechanism between the insurance companies. All those that provide household and contents insurance also incorporate natural perils coverage in their policies. The companies are charged for natural perils claims on the basis of their prevailing market share, and not on the number of claims they actually receive from their customers. If, in a given year, the total premiums paid in are higher than payouts, the companies will enter the surpluses as ear-marked funds in their balance sheets. In situations where payouts exceed premium revenues, the companies will cover their deficits on the basis of their respective market shares. Companies that have been members of the scheme over a prolonged period have accumulated ear-marked funds in their balance sheets and will extract monies from this source. More recent members, who have not accumulated such funds in their balance sheets, will cover any deficits in the usual way. Aspects of the Natural Perils Pool were evaluated in a Norwegian government report published in 2019 (NOU 2019:4). The report discusses the current financing situation and sets out a proposal for a new

financing model. However, no action has been taken regarding the new proposal in terms of amendments to legislation or regulations.³⁵

3.3.2 The Norwegian Natural Disaster Compensation Scheme

The Norwegian Natural Disaster Compensation Scheme is intended to provide coverage for losses involving private roads, bridges, sports facilities, quaysides, harbour walls and other infrastructure that cannot be insured against fire and for which the basis for indemnification exceeds NOK 20,000. Compensation is only provided if losses are the direct result of storms, storm surges, floods, landslides or avalanches, earthquakes or volcanic eruptions. State-, county council- and municipally-owned infrastructure is not covered by this scheme.

The Norwegian Agriculture Agency, which is delegated responsibility for the scheme, normally processes between 1200 and 1500 natural perils-related claims in the course of a year. Flood damage constitutes by far the most common source of claims. In 2018, claims related to damage to roads accounted for about fifty percent of payouts. In 2018, flooding accounted for 90 percent of claims applications, and years characterised by flooding always generate the highest number of cases and the highest levels of compensation payouts. In 2018, 567 cases were recorded, amounting to payouts totalling NOK 83 million.

3.3.3 Discretionary compensation

In Norway, County Governors are directed to set aside at least five percent of their primary budget for unforeseen and extraordinary expenditures, including compensation payments in response to natural perils claims. These funds are termed discretionary. The Ministry shall also set aside a portion of its discretionary funds for municipalities that have to cover losses caused by natural perils in situations where compensation costs exceed their budgets. If a natural peril event occurs, the municipality first submits an application for discretionary funds to the County Governor's office. These funds may be used for crisis management, clear-up operations or the restoration of municipal infrastructure. It is stipulated in the guidelines for the award of discretionary funds that priority shall be assigned to critical infrastructure such as roads, water supply and sewage systems.

In order to qualify for an award of extraordinary discretionary funds, the costs must exceed NOK 250 per inhabitant. For amounts between NOK 250 and NOK 500 per inhabitant, extraordinary discretionary funds are paid out to cover half of the amount that exceeds NOK 250. If the amount exceeds NOK 500 per inhabitant, the Ministry covers the entire amount that exceeds NOK 250. The municipalities are thus obliged to bear a share of the costs. Municipalities may only apply for compensation to cover losses involving their infrastructure that is not previously insured. They are also required to document the extent of the losses incurred.³⁶

This scheme, involving the award of state-funded discretionary compensation, was evaluated in 2017, and a proposal was put forward to replace it with a new insurance-based scheme to cover losses involving municipal infrastructure. The intention behind the insurance-based scheme was that it should operate using the same structure as the Natural Perils Pool. However, the committee charged with implementing the results of the evaluation are proposing a framework designed to provide the municipalities with incentives to implement preventive measures. By releasing funds from the discretionary compensation pot, the

³⁵ NOU 2019:4. *Organisering av norsk naturskadeforsikring – Om Norsk Naturskadepool* (Organisation of Norwegian natural perils insurance – About the Norwegian Natural Perils Pool)

³⁶ The Norwegian Government. *Retningslinjer for skjønnstildelingen 2020* (Guidelines for the granting of discretionary compensation 2020). https://www.regjeringen.no/contentassets/893e7a447a4d45178108c3beef62de0c/2020_retningslinjer-skjonnstildeling.pdf

current proposal is to ear-mark these funds to finance risk-mitigating measures, both prior to and following natural perils events, while compensation for damage to infrastructure can be obtained via an insurance policy. In order to provide incentives to implement preventive measures, the committee is proposing the introduction of an excess or insurance premium, the amount of which will depend on the efforts made by the municipalities to implement preventive measures [20].

3.4 Incentives to implement preventive measures

This study describes the incentives incorporated in compensation schemes to promote the implementation of preventive measures, and also refers to other existing incentive schemes.

3.4.1 Natural disaster compensation, natural perils insurance and discretionary funds

Pursuant to Section 5 of the Norwegian Natural Perils Compensation Act, a compensation amount shall be paid equivalent to the cost of restoring the damaged asset to the condition it was in immediately before the damage was incurred. The Act says nothing about restoring the asset to a higher standard. However, Section 6 of the Act stipulates that lack of maintenance may result in a reduction in the compensation payout. Section 1, subsection 7, of the Act states that weak construction and lack of maintenance and supervision, or situations in which the party claiming compensation could have prevented or reduced the extent of the damage, may result in a reduction in the compensation payout.

Section 7 states that it is possible to apply for funds to cover additional measures implemented to mitigate the risk of future damage due to natural phenomena. Section 8 goes on to stipulate that it is possible to apply for funds to cover the costs of implementing preventive and loss mitigation measures.

From 1 January 2018, Section 1 of the Natural Perils Insurance Act was amended and now stipulates that it is possible for the victims of natural perils to obtain not only compensation for lost buildings and contents, but also a replacement site for rebuilding. Flooding events that impacted the village of Kvam in Gudbrandsdalen in 2011 and 2013 had a major influence on these amendments to the legislation. Following the 2011 floods, permission was granted to rebuild on a site that was affected by the flood waters. A family built a new house in the same site, but this was flooded again in 2013. The insurance company summonsed the municipality on the grounds that it should have rejected the application for the building permit.³⁷ If the municipality decides that building in a given area is no longer justified following a natural perils event, parties that have been impacted and who do not have permission to rebuild or restore the original building are entitled to receive compensation for the loss of their site. The current value of the site will be the value it had prior to the occurrence of the natural perils event. Only a few examples exist of cases in which people have exercised this entitlement. In general, only very few loss cases resulting from natural phenomena are processed through the courts. This is because the majority of such cases are resolved by the Norwegian Natural Disaster Appeals Board. As of March 2020, a total of 1165 cases were considered by the board.³⁸

As an alternative to providing compensation for the loss of a site, insurance companies may cover the costs of safeguarding a site, as well as for inspections and maintenance of the safeguarding measures. However, this only applies if the insured party signs an agreement to this effect, and on condition that the municipality grants permission for rebuilding on the site in question.

³⁷ Eidsivating Appeal Court. Judgement: LE-2018-10723

³⁸ Lovdata Pro

The excess for damages under the Natural Perils Pool scheme is NOK 8,000. In cases of compensation under the Natural Disaster Compensation Scheme, the excess is 30 percent for the first NOK 100,000, and 15 percent for the remainder.

Beyond this, natural perils insurance is provided for restoration of a building to the condition it was in prior to the accident, without any provision of further incentives to implement preventive measures. The scheme was criticised because the flat, non-risk-based, insurance premium provided no incentive to implement preventive measures. However, the committee responsible for evaluating the scheme in 2017 had no mandate to consider this issue³⁹, and focused only on its organisation and the financing model. In the guidelines for the award of discretionary compensation, it states that extraordinary discretionary funds can be granted for the restoration of municipal infrastructure to its original standard, but that compensation can also be awarded to improve the standard if more recent building regulations or similar dictate that the condition of the infrastructure must be improved. In situations where a municipality intends to build or undertake a major restoration project, it is obliged to adhere to prevailing statutory building regulations. So, if a house originally built in the 1950s is being restored, the required standard following restoration will not be equivalent to the standards of the 1950s.

3.4.2 Statutory building regulations in Norway

The current statutory building regulations in Norway are known as TEK17. Chapter 7 of the regulations refers to climate change under the title “safeguards against natural stressors”. Climate-related factors are also referred to in Chapter 10 under “construction safety”, and in Chapter 13, which contains a number of subsections (13-9 to 13-12) that address the threat of moisture, which is closely related to climatic conditions.

The natural stressors discussed in Chapter 7 include floods, landslides and avalanches, and storm surges. In the introduction to Chapter 7, it states that:

“The impact of climate change will be significant for the built environment both in terms of the siting of buildings and the stressors they have to withstand. The Municipal Planning Act and its appurtenant statutory regulations must help to ensure that new buildings and structures are adapted to a changing climate.”

Climate change may lead to the more frequent occurrence of events such as floods, landslides and avalanches, and such events will become more extreme. New knowledge regarding potential hazards and the impacts of climate change may lead us to recognise that some areas that were previously considered safe to build on no longer meet the requirements set out in the Municipal Planning Act and statutory building regulations.”

Even the regulations themselves are formulated in very general terms, and the municipalities thus find themselves exercising major responsibility when it comes to processing building applications. For example, clause 7-1 (1) of the regulations states that: “Buildings and structures shall be sited, designed and constructed in such a way that ensures satisfactory levels of protection against damage or significant detriment in the face of natural stressors”. No explanation is provided of the term “satisfactory” in this context. The building regulations, and the legislation on which these are founded, are functionally-based. This places the onus on the developer to demonstrate that the building in question is adequately equipped to meet its designed functionality, and on the municipality to approve, or reject, the project on the basis of submitted documentation.

³⁹ <https://www.bt.no/btmeninger/kronikk/i/bXVoB/verdas-beste-sovepute>
https://www.vestforsk.no/sites/default/files/migrate_files/vf-rapport-4-2015-forebygging-av-naturskade-endelig.pdf

In a previous version of the regulations (TEK10, Section 13-14), wording was included referring to the need for continuous adaptation to climate change in order to prevent moisture-related damage resulting from climate change phenomena: “*Climate change demands continuous adaptation to climatic factors in order to avoid future moisture-related damage to buildings, structures and other facilities. Significant changes in climate such as increases in annual rainfall and the frequent occurrence of localised torrential rainfall events demand a more targeted focus on critical details related to moisture protection*”. However, this wording was removed in the TEK17 regulations due to a lack of tools necessary to assess compliance with the requirement.

3.4.3 Other incentive schemes

So-called “green loans” are currently being offered by several Norwegian banks. A green loan offers discounts on interest rates relative to traditional loan terms and conditions, provided that certain criteria are met. However, this currently applies only to energy-efficient buildings. An exception is provided by *Kommunalbanken* (the Municipal Sector Bank), which also offers green loans to fund climate change adaptation measures linked to the building and rebuilding of municipal and county authority buildings.⁴⁰ Green loans can be granted to fund adaptation measures such as green roofs, rain beds and moisture proofing. Applications for such loans must provide information about what the measures protect against, and descriptions of how they work. In order to qualify for a green loan, the applicant must be certified in the class “very good” or better (“excellent” or “outstanding”) according to the BREEAM environmental building standard. Building in vulnerable areas will not be approved, so project applications must also include the results of a risk and vulnerability analysis.

The BREEAM manual is used as a basis for the environmental certification of buildings. In order for a building to obtain a high certification, it must meet certain requirements related to climate change adaptation, such as the use of moisture-proofed materials. However, the main emphasis of the BREEAM system is on a building’s climate footprint. The preparation of a new version of the Norwegian BREEAM manual (BREEAM NOR) is currently ongoing, and it is expected to be in use from the end of 2021.⁴¹

A support scheme exists for climate change adaptation in Norway, but it is targeted only at the municipalities, and for purposes such as expertise development in the field of climate-related risk and its impacts, and not to fund adaptation measures.

⁴⁰ https://www.kbn.com/globalassets/dokumenter/gronne-land/gront-landprogram_kriteriesett.pdf

⁴¹ <https://byggalliansen.no/wp-content/uploads/2019/04/Notat-Paris-Proof-bygg.pdf>

4 Sweden

4.1 Risk situation

During the last ten years, the most common natural perils to have impacted on Sweden are related to storms. This applies not only to high winds, but also to snowstorms. Natural perils events involving water are also frequent occurrences, including those resulting from heavy rains, snowmelts and high water levels in lakes and river catchments. Other natural perils resulting from phenomena such as landslides, rock avalanches and snow pressure are less common. Since 2011, the Swedish insurance sector organisation *Svensk Försäkring*, also known as Insurance Sweden, has been gathering statistics on claims resulting from water inundation, and since 2015 from other natural perils events such as landslides, rock and snow avalanches, earthquakes, volcanic eruptions, snow pressure and hailstorms. In 2018, insurance payouts in the wake of damage caused by storms amounted to approximately SEK 170 million. Also, in 2018, insurance companies paid out SEK 590 million in compensation for natural perils claims made by homes and businesses. Currently, compensation for fire and water leakage from pipes accounts for the majority of payouts.

According to our informant at Insurance Sweden, there have been three major natural disasters in Sweden this century – the hurricane Gudrun, that struck in 2005, the forest wildfire in Västmanland in 2014, and the more widespread forest fires of 2018. Hurricane Gudrun cost the insurance companies SEK 3.8 billion in compensation payouts. During the wildfires of 2018, Sweden received help to extinguish the blazes from other European countries, including Poland, facilitated by an EU agreement.

4.2 Responsibility for climate change adaptation strategies in Sweden

Figure 9 illustrates the hierarchy of responsibility for climate change adaptation strategies in Sweden.

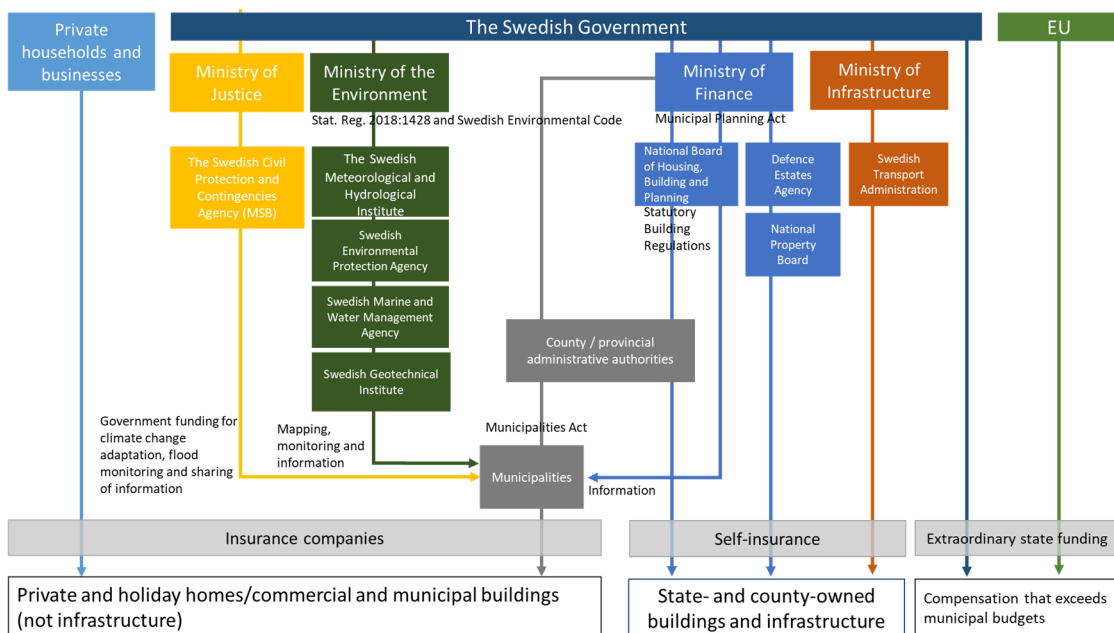


Figure 9. Responsibility for climate change adaptation strategies in Sweden

In Sweden, although the Ministry of Justice is the executive authority for civil protection, the municipalities have overall responsibility for implementing climate change adaptation strategies and measures. The Civil Protection and Contingencies Authority (MSB) is an administrative public agency organised under the Ministry of Justice, and is delegated a general responsibility for public safety. The MSB is responsible for crisis contingency planning, civil defence and accident preparedness. To date, the contingency situations for which the MSB has had responsibility have largely been linked to natural disasters overseas, and not in Sweden. Our informant at Insurance Sweden states that, since the forest wildfires of 2018, the role of the MSB in terms of crisis contingency has been the subject of some debate. This is because the MSB had been delegated no specific tasks, leaving the municipal rescue and emergency services to deal with the disaster alone. However, the municipal services, which are heavily reliant on recruiting volunteers, are simply not equipped to deal with natural perils events on this scale. This situation has been the object of much criticism, and it has been pointed out that the terms and conditions set out for working in the emergency rescue services are inadequate. The MSB is also delegated responsibility for the disbursement of funds to the municipalities to support the implementation of preventive measures, and approximately SEK 100 million are available annually for this purpose. However, our informant points out that this amount is too small to enable the municipalities to achieve very much in terms of adaptation measures.

In Sweden, the Ministry of the Environment is the executive authority for environmental surveying, monitoring and information dissemination. Administrative agencies subordinate to the Ministry of the Environment include the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish Environmental Protection Agency, the Marine and Water Resources Agency (HaV) and the Swedish Geotechnical Institute (SGI). The role of the SMHI includes the production of forecasts for weather, water resources and water availability. The Environmental Protection Agency acts in the role of a national environmental bureau, being responsible for issues related to climate and air quality, soil, biological diversity, polluted areas, waste cycles and refuse management, as well as environmental monitoring and research activities. Climate change adaptation issues also constitute an integral part of the role exercised by the Swedish environmental bureau as administrator of properties owned by the Swedish state. This means that it is responsible for the safeguarding of buildings and other facilities against the impacts of climate change. HaV is the agency with responsibilities in the fields of conservation, restoration, and the sustainable exploitation of lakes, streams and the marine environment. Sweden operates with a set of statutory regulations that govern work carried out by the authorities in the field of climate change adaptation⁴², and a legislative Environmental Code⁴³.

The Swedish Ministry of Infrastructure is responsible for issues related to transport infrastructure, digitalisation, the postal services and energy. The Swedish Transport Administration is a public agency organised under the Ministry of Infrastructure with responsibility for the overall long-term planning of infrastructure linked to the road and rail networks, maritime transport and aviation, as well as for the planning, construction, operation and maintenance of the public sector road and rail networks. The Swedish National Board of Housing, Building and Planning is organised under the Ministry of Finance and is the government agency responsible for civil planning, urban development, buildings and homes. It is the equivalent of the Norwegian Building Authority. The National Property Board of Sweden (SFV), which is equivalent to the Norwegian Government Estates Agency (*Statsbygg*), and the Swedish Defence Estates Agency (equivalent to the Norwegian *Forsvarsbygg*), are also organised under the Ministry of Finance.

⁴² *Förordning (2018:1428) om myndigheters klimatanpassningsarbete* (Statutory regulation governing the public authorities' work to address adaptation to climate change)

⁴³ Miljöbalk (1998:808) (The Swedish Environmental Code).

The National Board of Housing, Building and Planning is responsible for coordinating climate change adaptation strategies as they apply to the built environment. Its role is to support the municipalities in implementing adaptation measures, and to identify areas where there is a need for knowledge and expertise. In 2018, the Board published a report addressing whether there was a need to update Sweden's statutory building regulations. The report points out that climate change will impact on issues such as ventilation, thermal comfort, moisture, water treatment and sewage, energy consumption, as well as the physical stressors on built structures such as weight of snow, wind strengths and torrential rain. However, since the existing regulations are already function-based, the report concluded that, for the most part, they did not require amendment in the light of climate change. An opportunity has nevertheless been created to employ climate change extrapolations to identify the stressors that built structures will have to withstand, and these stressors will be looked into.⁴⁴

The provincial administrative authorities of Sweden, known as “*län*”, are the equivalent of the Norwegian counties (*fylker*). Both these and the municipalities, or local authorities, are organised under the Ministry of Finance. In June 2018, in the wake of the prevailing national adaptation strategy, the Swedish government delegated the Regional Authority⁴⁵ for Planning, Building and Housing the role of coordinator for adaptation strategies in the field of physical planning. According to the Swedish Municipal Planning Act⁴⁶, the municipalities have responsibility for ensuring that building takes place in areas that are safe, and that buildings are adequately resilient. However, according to the Act, the municipalities have no responsibility for existing buildings. This responsibility devolves to their respective owners. The administrative provincial authorities are responsible for coordinating the information that is provided to the municipalities, and also have the opportunity to express their views on both high-level and detailed plans concerning building construction. However, the municipalities are not obliged to adhere to the advice issued by the provincial authorities. It is thus possible that some municipalities build in areas that the provincial authorities have advised against. The insurance company *Länsförsäkringar* has stated that it is not willing to insure recently built homes on sites that the provincial authorities have recommended should not be built on.

The municipalities have the freedom to interpret the provisions of the Municipal Planning Act, and it is clear that different municipalities interpret these differently. Many municipalities have opted to build close to the sea, and both industrial and business premises are built in ports, despite the risk of sea level rise.⁴⁷ It is said that a house that is built today should be designed to last for at least 100 years. However, it is not uncommon for the municipalities to operate with a planning perspective of only between 30 and 40 years.

4.2.1 Status of climate change adaptation in Sweden

The municipalities are delegated a high degree of autonomy. In situations where municipalities share river catchments, we observe examples of both effective and ineffective collaboration. There is a great deal of variation in the levels of expertise in the field of climate change adaptation among the municipalities. During the last four years, *Svensk Försäkring* has published a report looking into the strategic work carried out by the municipalities in terms of adaptation strategies and measures. Seventy-one percent of Sweden's 290 municipalities responded to a questionnaire. The results showed that the

⁴⁴ The Swedish National Board of Housing, Building and Planning (2018). *Analys av reglerna om enkelt avhjälpta hinder* (Analysis of the regulations governing easily remedied hindrances). <https://www.boverket.se/sv/om-boverket/publicerat-av-boverket/publikationer/2018/analys-av-reglerna-om-enkelt-avhjalpta-hinder/>

⁴⁵ *Länsstyrelsen* is the regional agency representing the government in a given province.

⁴⁶ *Markanvändnings- och bygglag 5.2.1999/132* (the Swedish Municipal Planning Act)

⁴⁷ <https://www.expressen.se/kvallsposten/har-dranks-den-skanska-orten-kan-forsvinna-fran-kartan/>

smaller municipalities do not involve themselves in any form of adaptation-related work, largely due to a combined lack of expertise and resources. However, some local authorities have developed municipal adaptation action plans.⁴⁸

In 2018, Sweden passed a national climate change adaptation strategy, in line with the prevailing EU strategy.⁴⁹ Regional plans were already in place because the regions had been delegated responsibility for adaptation strategies since 2013. The work to prepare a national action plan is underway, and current assessments are highlighting the challenges the country faces in putting plans into action at municipal level where the real responsibility for land use planning lies. According to our informant at *Svensk Försäkring*, there is some effective collaboration among the state authorities, although this is restricted largely to general and executive levels.

⁴⁸ *Klimatanpassning 2019 - Så långt har Sveriges kommuner kommit* (Climate change adaptation 2019. Progress made by the Swedish municipalities).

⁴⁹

https://www.regeringen.se/494483/contentassets/8c1f4fe980ec4fcb8448251acde6bd08/171816300_w_ebb.pdf

4.3 Natural perils compensation schemes in Sweden

Figure 10 shows the compensation schemes that are practised in Sweden, and the causes of losses for which compensation is provided by the various schemes.

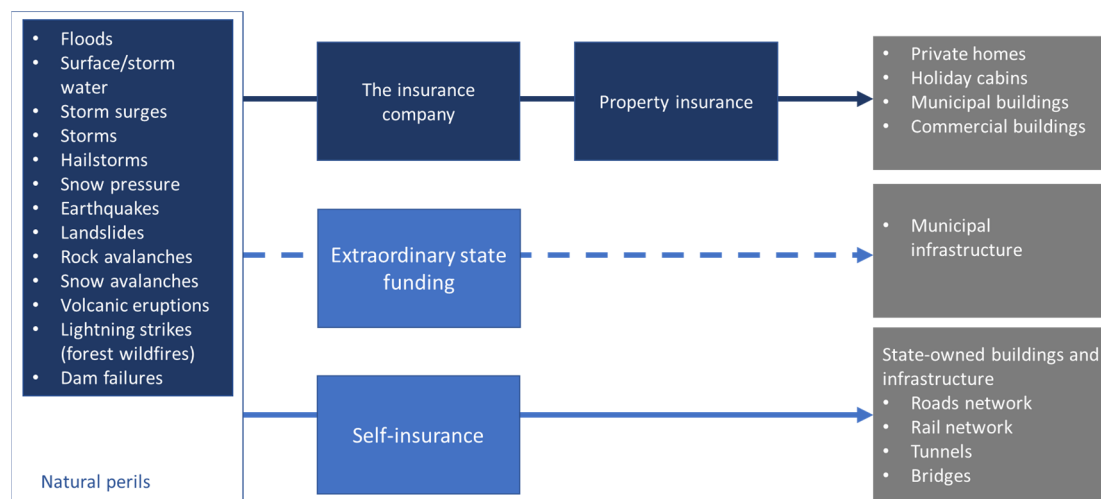


Figure 10. Natural perils compensation schemes in Sweden

In Sweden, natural perils include floods, storms, hailstorms, snow pressure, earthquakes, land- and rockslides, snow avalanches, volcanic eruptions, lightning strikes and hydropower dam failures. There are no state-funded compensation schemes, so all insurance has to be taken out using the private sector insurance companies. The companies offer a comprehensive selection of home insurance options, and it is possible to insure private homes, holiday cabins, business premises and municipal buildings. It is not possible to insure infrastructure, for the simple reason that there is no demand. However, the *Øresund* bridge, the *Höglusten* bridge, as well as the Stockholm airport express railway (*Arlandabanen*) and its trains, which are owned by private sector companies, are insured. The state acts as self-insurer for its buildings and infrastructure, and coverage extends to all types of natural peril.

However, a higher level of risk is linked to water-related losses, which is reflected in higher excess outlays for self-insurers. This applies regardless of whether losses due to water damage are the result of natural phenomena or the defective plumbing of a washing machine. Otherwise, insurance policy terms and conditions are identical. No compensation is offered for damage to unserviced sites, or for property located outside a house on the same plot, such as boathouses, jetties and flagpoles. The house itself and its contents are covered by the insurance. Sweden operates with a legislative Act relating to Insurance Policies⁵⁰, and this ultimately determines the scope of compensation. The Act stipulates that no compensation can be offered for more than the value of the house prior to the accident, and no provision will be made to help pay for improvements.

It is not mandatory to take out house insurance in Sweden. However, 97 percent of Swedish households are in fact insured. Among those who own their own home, 99.9 percent take out insurance, simply because the banks will only grant mortgages on insured properties.

The insurance companies are not obliged to charge flat premiums, so these will vary. Standard home insurance policies provide coverage for fire, burglary, water damage due to tap failures and leaking pipes, and natural perils. The total costs of claims determine the premiums charged, and an area's postcode is commonly used as a measure of historical

⁵⁰ *Försäkringsavtalslag (2005:104)*. The Swedish Act relating to Insurance Policies.

claims costs. If the number of fires in a given area declines, and the number of water inundations increases, the calculations balance out resulting in no increase in premiums.

4.3.1 The state safety net

In Sweden, municipalities may obtain natural perils compensation if the costs of restoring affected buildings and infrastructure exceed the municipal budget. This compensation is granted via the national budget, or by government approval of extraordinary funds. Sweden is also able to apply for EU funds to finance restoration work, as was the case in 2005, after the country was struck by hurricane Gudrun.⁵¹

4.4 Incentives to implement preventive measures

Since insurance premiums depend on postcode-related total and historical claims payouts for a given insurance object, there is no incentive for the insured party specifically to implement any preventive measures against damage that may be caused by climate-related phenomena. Currently, private persons are under no obligation to put preventive measures in place. In order to boost incentives to implement preventive measures, the insurance companies employ their own inspectors whose job it is to encourage and advise those taking out insurance on how to avoid incurring the same damage should a new accident occur. Costs associated with improvements must be borne by the home-owners themselves. Businesses, on the other hand, are required to have certain measures in place in order to obtain insurance.

A statutory provision stipulates that if a property is located in a hazardous location, or if there is a risk to life and health, the municipalities have a right to expropriate the property.⁵² In Sweden, it is possible to redeem a property that has been at risk of damage from a landslide. The property is redeemed at its market value, although this only occurs very rarely. The MSB operates with legislation that governs the activities of the emergency rescue services. In common with the Municipal Planning Act, this legislation recognises only risks to life and health, and does not recognise financial risk in the event that a building is damaged or destroyed.⁵³

⁵¹ https://ec.europa.eu/regional_policy/sources/thesubs/doc/interventions_since_2002.pdf

⁵² *Expropriationslag (1972:719)* (the Swedish Expropriation Act).

⁵³ *Lag (2003:778) om skydd mot olyckor* (the Swedish Accident Protection Act).

5 Finland

5.1 Background

Finland exhibits relatively little vulnerability to natural perils, with the exception of the regular spring floods, for which communities are well prepared. With the exception of some holiday cabins, people do not normally inhabit areas that are vulnerable to flooding. With the exception of research funding, Finland has experienced little need for EU funds to finance the restoration of buildings and infrastructure following natural perils events. Nor has the country experienced events on a scale that have generated a need for extraordinary funding from its national budget. However, Finland is expecting increases in the frequency of extreme weather events, sea level rise and higher levels of rainfall, and the issue of climate change adaptation policy is rising up the political agenda. An issue that has been the subject of heated debate is the inadequate condition of the country's road network. It is not possible to insure infrastructure in Finland, and our informant, who is a former research scientist at the Finnish meteorological institute, tells us that the country's roads are poorly equipped to withstand increased weather stressors in the future.

Helsinki experienced its biggest marine flooding event ever in 2005. Following this event, the city implemented a series of adaptation measures, including the elevation of ground levels in preparation for development projects along the coast. Helsinki municipality has also prepared a set of guidelines on how to mitigate flood risk.⁵⁴

5.2 Responsibility for climate change adaptation strategies in Finland

The allocation of responsibility for climate change adaptation strategies in Finland is illustrated in Figure 11.

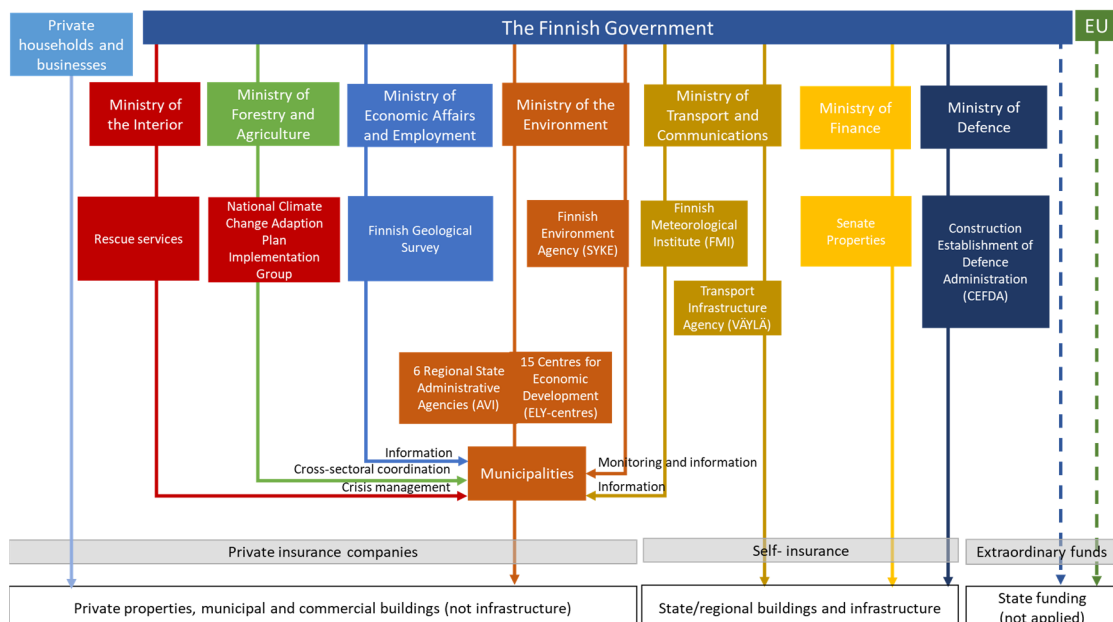


Figure 11. Allocation of responsibility for climate change adaptation strategies in Finland.

⁵⁴ City of Helsinki (2013). The City of Helsinki Instruction on Prevention and Control of Floods - Protection of residents and property in flood hazard areas in Helsinki. https://www.hel.fi/static/helsinki/julkaisut/Tulvaohje_eng_17062013.pdf

In Finland, the Ministry of Forestry and Agriculture assumes the role of executive coordinator in the field of climate change adaptation strategy, while the Ministry of the Interior assumes overall responsibility for emergency preparedness. These two ministries hold overall responsibility in the fields of natural disasters and climate change adaptation strategies. However, in the specific case of buildings and infrastructure, the delegation of responsibility is complex and somewhat more diffuse. No particular ministry has responsibility in this field, unlike the situation in Sweden where the Ministry of Infrastructure assumes specific responsibility for infrastructure.

Finland's equivalent of the Norwegian *Statsbygg* (*Sennatti*) has, among its various roles, responsibility for public buildings and infrastructure, while the equivalent in Finland of the Norwegian *Forsvarsbygg* (CEFDA) is responsible for buildings and infrastructure belonging to the armed forces. The Finnish Transport Infrastructure Agency (*Väylä*) is responsible for transport infrastructure and, as in Norway, the various sectors are self-insurers.

The provincial administrative agencies, equivalent to the Norwegian county administrations (*fylkeskommuner*) exercise no formal role in relation to climate change adaptation strategy, but are involved in land use planning in their respective municipalities, and may grant funding for this purpose. The municipalities, on the other hand, have a great deal of responsibility for adaptation strategies. For example, it is they that issue building and development permits. The Finnish municipalities can determine whether or not they will insure their buildings, and which buildings shall be insured. Large municipalities, such as Helsinki, are for the most part self-insurers.

5.2.1 Status of climate change adaptation in Finland

In 2012, prior to the issue of recommendations by the EU, Finland had launched its national climate change adaptation strategy.⁵⁵ This strategy was subsequently reviewed in 2019. The review demonstrates that a national adaptation strategy has been in place since 2005 and has been subject to revision every ten years. The current strategy was approved in 2014. For the most part, action plans within the adaptation strategy are linked to economic segments, and it is the water action plan that is regarded as the most prominent.

In principle, Finland has established agencies with responsibilities for coordination and collaboration as part of this strategy, which also includes specific and detailed adaptation objectives. However, the committee responsible for the review has pointed out a lack of coordination and collaboration both within and between the various agencies at state, regional and local levels. There is also uncertainty regarding how the various objectives should be achieved. The fact that the allocation of responsibility at equivalent levels is unclear is primarily the result of the fact that the concept of climate adaptation is relatively new in Finland – a country that up to now has focused its efforts largely on the reduction of greenhouse gas emissions, at the expense of attention paid to climate change adaptation. The person recently appointed to head the coordination of the implementation of the adaptation strategy also acted as chair of the review committee. Our informant in Finland tells us that it is expected that national efforts in the field of climate change adaptation will receive a boost in the future.⁵⁶

⁵⁵ http://mmm.fi/documents/1410837/1721050/MMMjulkaisu2005_1a.pdf/63f5d78d-8492-4621-b019-fe38d7aeb709

⁵⁶ https://mmm.fi/en/article/-/asset_publisher/vuoden-2018-timanttiteko-palkinto-kansallisen-ilmastomuutokseen-sopeutumissuunnitelman-toimeenpanolle

5.3 Natural perils compensation schemes in Finland

Figure 12 shows the various compensation schemes in operation in Finland, and the causes of losses for which compensation is provided by the various schemes.

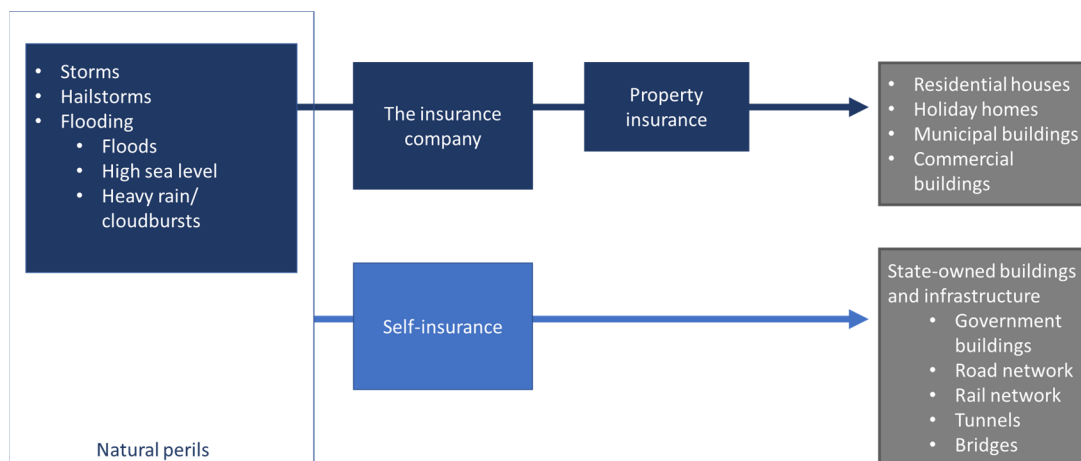


Figure 12. Natural perils compensation schemes in Finland.

Prior to 2014, Finland operated with a flood insurance programme that was financed by the state. Currently, however, only private sector insurance companies offer compensation to municipalities, private individuals and Finnish businesses, on condition that they have taken out some form of property insurance. In Finland, it is possible to obtain coverage only against losses due to storms, floods and hail, although phenomena such as episodes of torrential rain and sea level rise are included under the definition of flooding. The definitions of what provides grounds for compensation are set out in the various policies issued by individual insurance companies. However, no guidelines have been prepared in the case of flooding. Flooding of rivers and lakes shall correspond to a predefined 50-year interval and, in the case of sea level rise, wind velocities must attain 15 m/s or be linked to another exceptional cause. In the case of torrential rainfall events, a threshold is stipulated at 30 millimetres per hour, or 75 millimetres in a 24-hour period. As a general rule, an event must also be regarded as sudden and unforecasted. Prior to payout, the Finnish Environment Agency (SYKE) and the meteorological institute both provide assistance to the insurance companies following natural perils events in order to ensure that the event in question complies with the provisions set out in the relevant insurance policies.

Only buildings with contents may be insured, although a part of a property site located close to a building is often included in the coverage. It is not possible to insure infrastructure such as private and municipal bridges and roads. However, our informant from the sector organisation Finance Finland tells us that it is possible to enter into special agreements with the insurance companies. State-owned buildings and infrastructure must be covered by the executive public authority. Municipal infrastructure is covered by self-insurance mechanisms, while it is possible to take out insurance for municipal buildings in Finland.

As an EU member state, Finland is able to apply to the EU for funds if the country is subjected to a natural perils event for which the municipalities are unable to provide compensation. There is no state-funded compensation scheme in Finland, but the state will grant funds if the costs of restoration following a natural perils event exceed the budgets of the affected municipalities.

5.4 Incentives to implement preventive measures

Parties taking out insurance in Finland are not obliged to take out property insurance. However, coverage across the country is high. Those taking out insurance receive compensation to finance the restoration of buildings back to a standard equivalent to that which existed prior to the storm, flood or hailstorm, provided that they have met the requirements set out in prevailing building regulations.⁵⁷

Even though direct incentives to implement preventive measures are not provided in insurance policies, our informant from Finance Finland reported that a trend has been established in the wording of policies by which precautionary guidelines are included on how to mitigate the risks linked to natural perils. Parties taking out insurance may risk reduced payouts if they do not comply with these guidelines. Section 103 of the Finnish Municipal Planning Act requires that measures are put in place to manage surface water.⁵⁸

⁵⁷ https://www.ym.fi/en-US/Land_use_and_building/Legislation_and_instructions/The_National_Building_Code_of_Finland

6 Germany

6.1 Risk situation

In recent years, the most common natural perils situations in Germany have been the result of extreme rainfall events. Events in Münster in 2014, and in Simbach and Braunsbach in 2016, are examples of situations involving extensive devastation caused by storms that included high volumes of torrential rain.

A study carried out by the Global Precipitation Climatology Centre⁵⁹ at Germany's meteorological institute⁶⁰ highlights the types of weather events that historically have had the most destructive impacts. The study presents an analysis of precipitation events for the period 2001 to 2018, and highlights three major findings. The first of these is that the greatest damage is not caused by extended periods of precipitation (continuous rainfall with a duration of more than nine hours), but rather by shorter periods of torrential rain restricted to localised areas. The second finding is that these events can occur across the entire country, regardless of topographical conditions. The third is that a particularly large number of these events are recorded during otherwise dry periods, such as the drought of 2018. This is due to the fact that dry ground absorbs water much less easily than ground that is already partially saturated. This increases the danger of water remaining on the surface and the risk of local flooding events in response to high volumes of rain over short periods in combination with drought.⁶¹

6.2 Responsibility for climate change adaptation strategies in Germany

Figure 13 shows the allocation of responsibility for climate change adaptation strategies in Germany. Germany is administered as a federal republic, and as such the country is divided into federal states, districts and municipalities⁶². Germany's administrative structure also includes districts that are responsible for regional planning.

⁵⁹ Global Precipitation Climatology Centre (GPCC).

⁶⁰ *Deutscher Wetterdienst (DWD)*. (The German Meteorological Institute).

⁶¹ <https://www.en.gdv.de/en/issues/our-news/the-earth-is-melting--how-insurers-are-responding-53946>

⁶² *Bundesländer, Kreis, Gemeinden* (Federal states, districts and municipalities).

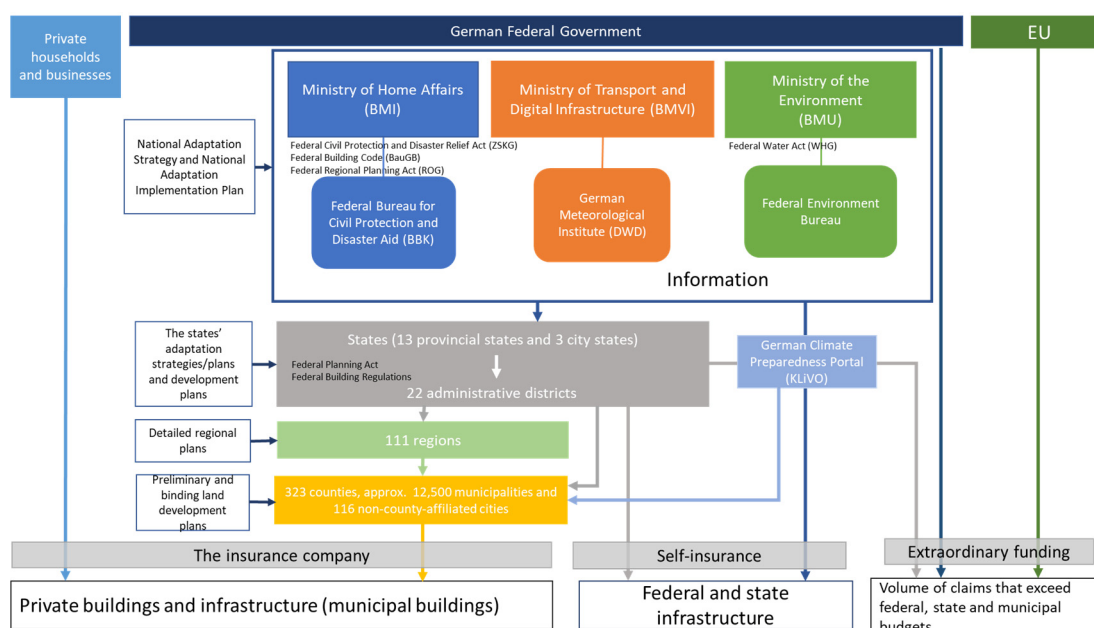


Figure 13. Allocation of responsibility for climate change adaptation strategies in Germany.

At national level, the German federal government assumes responsibility for obtaining scientific information about climate change adaptation, and for providing financial support [21]. The municipalities have local responsibility for the implementation of adaptation measures, but the administration of climate-related policy is not a mandatory municipal responsibility. As a result, there are differences between practices among the federal states, and from municipality to municipality. There is also some variation in the organisation of work related to adaptation strategies among the municipalities. Some have dedicated climate policy units or coordination groups, while others operate without a formal organisational structure.

The German Ministry of the Environment⁶³ plays a key role in terms of climate change adaptation strategies. It has been responsible for the development of the German national adaptation strategy in collaboration with the federal states since 2008. The strategy sets out the overall framework and a set of guidelines for climate change adaptation policy at national level.⁶⁴ As part of the national climate change adaptation action plan, published in 2011 and which is complementary to the strategy, responsibility for the preparation of adaptation targets and appurtenant guidelines was delegated to the federal states.⁶⁵ In the revised version of the national adaptation implementation plan, published in 2015, there is a presentation of both ongoing and future actions that are being taken to address climate change.⁶⁶

The German Meteorological Institute is organised under the Ministry of Transport and Digital Infrastructure⁶⁷. The institute measures and monitors climate phenomena. It generates

⁶³ *Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit, BMU (Federal Ministry for Environment, Nature Conservation and Nuclear Security).*

⁶⁴ *Deutsche Anpassungsstrategie an den Klimawandel, DAS.*

https://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/das_gesamt_en_bf.pdf

⁶⁵ *Aktionsplan I Anpassung der DAS an den Klimawandel, APA.*

⁶⁶ *Aktionsplan II Anpassung der Deutschen Anpassungsstrategie an den Klimawandel.*

https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimawandel_das_fortschrittsbericht_bf.pdf

⁶⁷ *Bundesministerium für Verkehr und digitale Infrastruktur (BMVI).*

climatic data and climate change prognoses, and analyses the current and potential impacts of climate change.

The Climate Services Agency⁶⁸ is organised under the German Meteorological Institute and comprises a selection of relevant bureaux that supply material in support of long-term climate-related information and services. The agency was established in the autumn of 2015 and is made up of the Federal Environment Bureau⁶⁹, the Federal Institute for Water Infrastructure⁷⁰, Germany's Federal Maritime and Hydrographic Bureau⁷¹, the Federal Hydrology Institute⁷², the Institute for Geological Sciences and Natural Resources⁷³, the Federal Highways Research Institute⁷⁴ and The Julius Kühn Institute⁷⁵.

In the same year, the organisation *KlimAdapt* was established, organised under the German Environment Agency. *KlimAdapt* is an administrative body that runs *KomPass*, an expert centre for climate change impacts and adaptation. It offers guidance and services directly linked to climate change adaptation strategies. It is intended to offer a range of adaptation services for organisations at all levels, including the federal states and municipalities, associations, companies and others. The objective of *KlimaAdapt* is to put all organisations in a position to implement adaptation measures within their respective fields of responsibility by providing easily accessible climate-related data, information and consultancy services. For the most part, *KlimaAdapt*'s services are offered via the German Climate Preparedness Portal (KLiVO)⁷⁶.

The Federal Bureau for Civil Protection and Disaster Aid⁷⁷ is responsible for implementing federal tasks in the fields of civil protection, planning and the preparation of measures needed to obtain emergency supplies and carry out contingency planning in the event of specific natural perils (coordination and crisis management), as well as planning in connection with the safeguarding of critical infrastructure. The Bureau is organised under the German Ministry of Home Affairs⁷⁸.

6.2.1 Status of climate change adaptation in Germany

Germany has been included in assessments carried out by the EU in 2005 and 2018 as part of work linked to its climate change adaptation strategy. The assessments are based, among other things, on a review of the various member states' adaptation planning. The results are presented in a scorecard summarising their adaptation preparedness⁷⁹. Germany scores high on the vast majority of adaptation indicators. A national adaptation strategy (DAS) was approved in 2008, and an appurtenant action plan in 2011. The plan was evaluated and revised in 2015, and then again in 2018. In terms of potential for improvement, the evaluations highlighted elements such as vertical coordination mechanisms between the federal government and the states.

⁶⁸ *Deutscher Klimadienst (DKD)*.

⁶⁹ *Umweltbundesamt (UBA)*.

⁷⁰ *Bundesanstalt für Wasserbau (BAW)*.

⁷¹ *Bundesamt für Seeschifffahrt und Hydrographie (BSH)*.

⁷² *Bundesanstalt für Gewässerkunde (BfG)*.

⁷³ *Bundesanstalt für Geowissenschaften und Rohstoffe (BGR)*.

⁷⁴ *Bundesanstalt für Straßenwesen (BASt)*.

⁷⁵ *Bundesforschungsinstitut für Kulturpflanzen (JKI)*.

⁷⁶ https://www.klivportal.de/EN/KliVo/klivo_node_eng.html

⁷⁷ *Bundesamt für Bevölkerungsschutz und Katastrophenhilfe (BBK)*.

⁷⁸ *Bundesministerium des Innern, für Bau und Heimat (BMI)*.

⁷⁹ https://ec.europa.eu/clima/sites/clima/files/adaptation/what/docs/country_fiche_de_en.pdf

At national level, particular focus is directed on climate change adaptation in the German Federal Building Code⁸⁰ and the Federal Regional Planning Act⁸¹. The latter stipulates that consideration should be given to specific requirements related to safeguarding strategies in response to climate change by means of measures that mitigate climate change while at the same time promoting adaptation.

The Federal Water Act⁸² serves to integrate the EU Floods Directive, the Marine Strategy Framework Directive and the provisions set out in the Industrial Emissions Directive, as they apply to water resources legislation in Germany.

6.3 Natural perils compensation schemes in Germany

Prior to 1991, natural perils events in Germany were dominated by storms, hail and ice, and it was possible to take out insurance against these in the private insurance market. However, there was no guarantee that the state would provide compensation for losses resulting from other natural phenomena. Payouts and other support from the federal or state governments was sourced from *ad hoc* compensation funds. In June 1991, the Federal Audit Board approved a scheme which offered broader coverage for extreme weather events. The scheme had to be accessed on a voluntary basis via the private insurance market, and it rapidly became incorporated into every household and/or private property and contents insurance policy. It also became standard in policies covering industrial and commercial properties.⁸³

Since 1991, the so-called Natural Catastrophe, or Nat-Cat, has become a standard form of natural perils insurance for houses and other buildings. Such policies cover losses resulting from storms and hailstorms. Standard Nat-Cat clauses are typically included in standard home insurance policies. Coverage against extreme weather events such as floods, earthquakes, torrential rain events, snow avalanches, landslips and landslides is voluntary and can be taken out in the form of supplementary policies. However, it is currently not possible to obtain insurance against sea inundation caused by storms. These supplementary policies are risk-based, and if the insured party implements preventive measures to reduce risk, his premiums will be reduced. In order to categorise flood risk, a zonal system called ZÜRS has been established, within which four flood zones have been defined.

A combined house insurance policy currently provides coverage for the building, including annexes and contents, as well as interior and exterior piping and other technical installations, including fencing, paths, elevated cables, greenhouses and trees.

The government and the 16 federal states act as self-insurers, such that state infrastructure, such as roads, bridges and suchlike, is not insured. According to our informant from the sector organisation the German Insurance Association, it is possible to insure infrastructure in the private market, although in general, there is no demand for such insurance.

Municipalities are able to take out their own insurance, and will normally seek coverage for important and vulnerable buildings such as schools and the town hall. If the municipalities suffer non-insured losses, they will normally apply for financial assistance from the federal government.

In the event of major natural disasters, the federal government and state administrations will grant funds if necessary. If the devastation is so great that Germany is unable to bear the

⁸⁰ The German Federal Building Code (BauGB). <http://www.gesetze-im-internet.de/bbaug/index.html>

⁸¹ The Federal Regional Planning Act (ROG). <https://germanlawarchive.iuscomp.org/?p=647>

⁸² Federal Water Act (WHG). <https://germanlawarchive.iuscomp.org/?p=326>

⁸³

https://www.consoseguros.es/web/documents/10184/48069/CCS_Natural_Catastrophes_Insurance_Cover.pdf/d7cf67cc-9591-476b-87d9-728e6a57ca60

costs itself, it can apply for financial support from the EU's solidarity fund⁸⁴, and indeed, Germany has received EU support following flooding events in 2002, 2013 and 2016, and following a storm in 2007.⁸⁵

Figure 14 shows the various compensation schemes in operation in Germany, and the causes of losses for which compensation is provided by the various schemes.

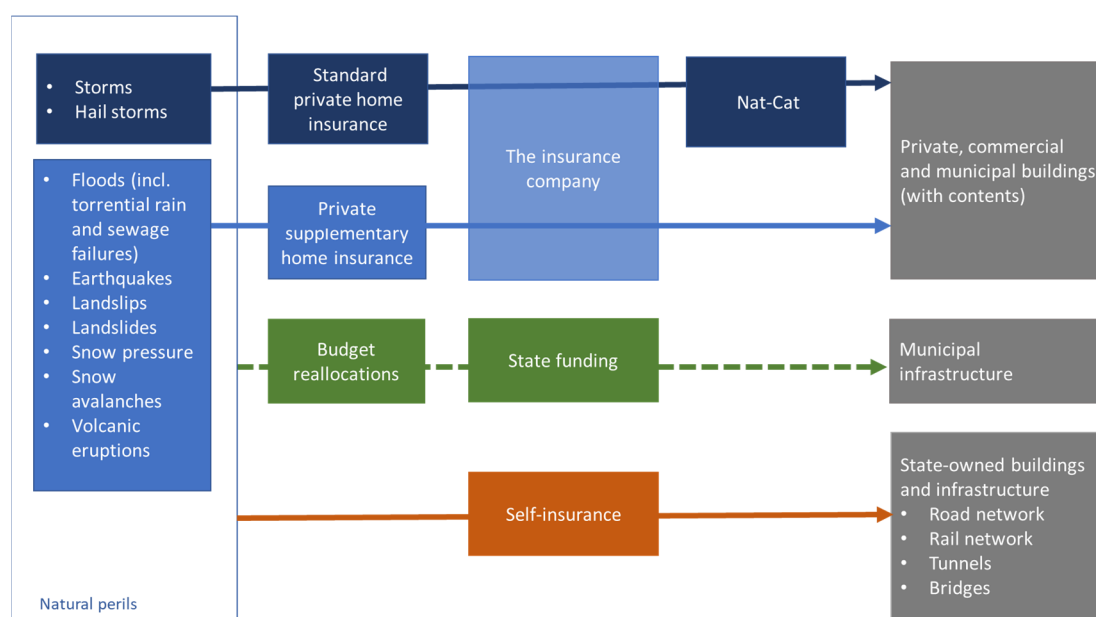


Figure 14. Natural perils compensation schemes in operation in Germany, once losses have been incurred.

6.4 Incentives to implement preventive measures

It is mandatory, where possible and at reasonable expense, for German home-owners to take appropriate precautions to prevent flooding.⁸⁶ Private home insurance policies provide coverage for the restoration of homes to a standard that is better than that prior to the accident. The system is known as flexible compensation insurance. For example, if a house built in 1960 is destroyed by fire following a lightning strike, the policy will cover expenses linked to heat insulation and solar panels, even if the old house did not have these installed. The only requirement is that such installations are defined as mandatory in prevailing statutory building regulations. In order to pay for this, the insured party's premium is increased year after year in line with an index issued by DESTATIS, the German national statistics bureau. Many insurance policies include supplementary clauses addressing the added costs of restoring homes to improved standards.

In Germany, the stipulation of building regulations is devolved to the individual federal states. The various regulations are structured in accordance with a set of guidelines developed at national level, which ensures some level of consistency in building regulation.

⁸⁴ OECD report, Disaster Risk

⁸⁵ https://ec.europa.eu/regional_policy/sources/the_funds/doc/interventions_since_2002.pdf

⁸⁶ Act relating to the organisation of water balance. Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG) § 5 Allgemeine Sorgfaltspflichten, https://www.gesetze-im-internet.de/whg_2009/_5.html

The regulations are more detailed in areas such as energy consumption than climate change adaptation, but the government is currently working on a revision of the national guidelines that will place greater emphasis on adaptation in future versions. The current regulations include requirements linked to predefined stressors such as temperature, wind and precipitation that new buildings must be built to withstand. Thus, our informant understands that it will be relatively easy to update the regulations to focus on stressors that are specifically linked to anticipated future climatic conditions, rather than the current emphasis on historical data.

7 France

7.1 Risk situation

Climate change is expressed somewhat differently in France than in Norway. The French Meteorological Institute Météo France⁸⁷ reports that in general, the climate is becoming progressively dryer and warmer, with more frequent and intense heatwaves and increasing risks of forest wildfires in the summer months. In winter, average rainfall is increasing across large parts of the country. These changes will most probably result in an increase in damage to buildings as a direct result of floods and fires, as well indirect damage caused by changes in groundwater levels.

The various regions of France currently exhibit major differences in climatic conditions. The northern and western areas of the country exhibit a temperate, maritime climate with up to 2,000 millimetres of rainfall a year, and very little variation in temperature. Eastern regions exhibit a more continental climate with greater temperature variation and less rainfall (700 mm annually). The south of the country exhibits a Mediterranean climate, with very little rainfall in summer, and mild, wetter winters.⁸⁸ Current climate change processes are modifying the boundaries between these historical climatic zones. The most marked change is taking place at the northern boundary of the Mediterranean zone. This is moving northwards, causing increasingly large parts of the country to experience climatic conditions that are more like continental Spain.

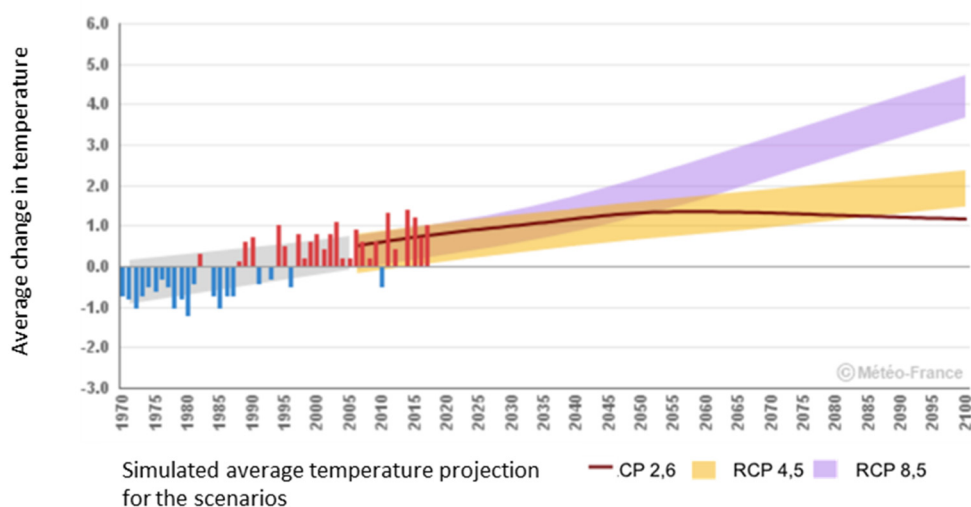


Figure 15. Trends in average temperatures in France, compared with the reference period 1976-2005.

7.2 Responsibility for climate change adaptation strategies in France

The Ministry for the Ecological and Inclusive Transition of France (*Ministère de la Transition écologique et solidaire*) has overall responsibility for climate change adaptation policy in France. The Ministry, established in 2019, operates with a wide range of responsibilities, including areas that are normally administered by other dedicated ministries. These areas include transport, road and rail infrastructure, energy, the environment, water,

⁸⁷ <http://www.meteofrance.fr/climat-passe-et-futur/climathd>

⁸⁸ https://snl.no/Klima_i_Frankrike (Climate in France).

air, aviation, as well as responsibility for natural perils risk prevention and technological risk. The Ministry is also responsible for drafting France's statutory building regulations. The establishment of this Ministry is the expression of a clear political ambition to make sustainable development an integral part of French government focus.

However, responsibility is further delegated and centred around predefined areas of focus such as flooding and natural disasters. The influence of EU strategies and joint European obligations can be detected at all levels of the decision-making hierarchy. This includes planning at national and regional levels (there are 13 regions excluding the overseas territories⁸⁹), as well as at the district level of the 101 *departements*, and the municipalities, numbering about 36,000.

In 2001, the organisation ONERC (National Observatory on the Effects of Global Warming⁹⁰) was established with the aim of disseminating knowledge and information about the risks associated with climate change, and to draft a series of measures designed to mitigate the resultant damage. The observatory prepared a national climate change adaptation strategy in 2006, which was later revised in 2017. This strategy is key to the work currently in progress to make climate change issues an integral part of policymaking. ONERC produces its own climate change indicators and publishes these on its website. These data also include levels of population exposure to climate-related events.

ONERC is monitored by the National Council for Ecological Transition (CNTE⁹¹), which every three years carries out an assessment of ONERC's adaptation strategy and the status of the measures it implements. A number of organisations and fora have been established to assist in gathering data on the need for measures in connection climate change adaptation planning. The work to implement preventive measures and risk mitigation in connection with natural perils is supported by the National Natural Perils Observatory (ONRN)⁹² and CEREMA⁹³ (Centre for Studies and Expertise on Risk, Environment, Mobility and Development).

Figure 16 shows the link between strategy documents issued by the EU (illustrated by the Floods Directive) and their influence at national, regional, district (*department*) and municipal levels in France.

Areas of focus are presented in documents such as the *Plan National d'Adaptation au Changement Climatique* (National Climate Change Adaptation Plan) and include topics such as infrastructure and the transport system, urban development and the built environment, natural perils and insurance, and the funding of relevant measures.

France's climate change adaptation strategy was passed in 2006, and a national action plan approved in 2011. The action plan has since been revised in 2018. Climate change adaptation is incorporated in a number of political and administrative planning processes both at regional and local level. These include land use planning, so-called "climate-air-energy" planning, and flood risk management strategies. An assessment by the EU of France's activities in relation to climate change adaptation highlighted in particular the quality of coordination between the various administrative levels as the principal challenge to France achieving an effective adaptation strategy.

⁸⁹ Guadeloupe, Martinique, French Guyana, Réunion and Mayotte.

⁹⁰ *Observatoire national sur les effets du réchauffement climatique.*

⁹¹ *Le conseil national de la transition écologique.*

⁹² *Observatoire National des Risques Naturels.*

⁹³ *Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement.*

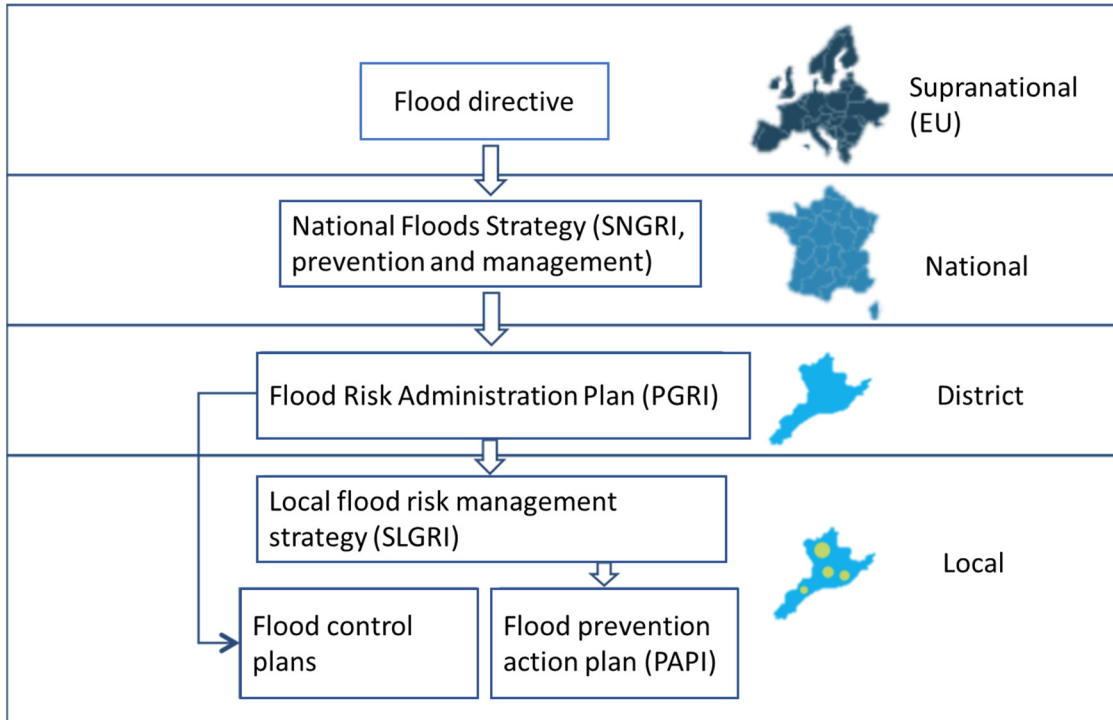


Figure 16. The link between the EU Floods Directive and its influence on the geographical administrative hierarchy in terms of flood prevention planning and management in France.

7.3 Natural perils compensation schemes in France

The occurrence of several major flooding events laid the foundation for the establishment in 1982 of a joint French natural perils compensation scheme. The system, known as “CATNAT” (an abbreviation of *catastrophes naturelles*, or “*cat.nat*”, has since undergone a number of revisions. The scheme is based on the solidarity principle and is financed by a surcharge imposed on all French property, vehicle and business insurance policies. Currently, the surcharge is 12% of the insurance premium, with the exception of vehicles, for which the rate is 6%. The state acts as a last resort reinsurer for the scheme, and offers reinsurance via a fund known as the CCR (*Caisse Centrale de Réassurance*).

Figure 17 illustrates the natural perils compensation schemes available in France, and the causes of losses for which compensation is provided by the various schemes. All private property insurance includes some form of natural perils insurance. Municipalities insure their own buildings in the private insurance market and, for the most part, state agencies make use of self-insurance mechanisms.

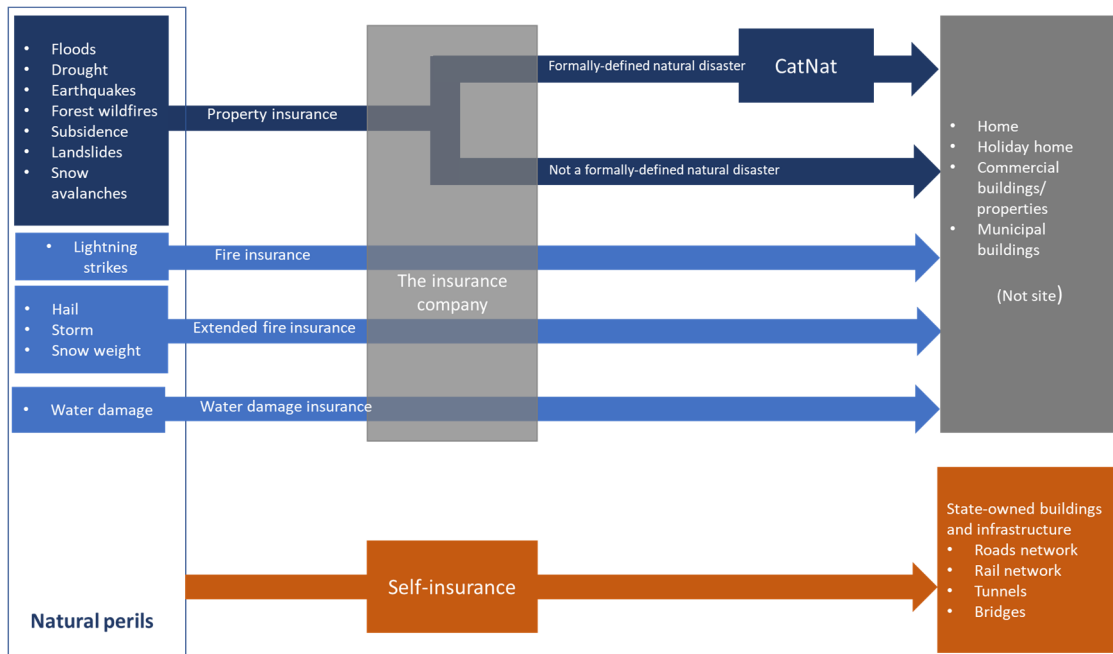


Figure 17. Natural perils compensation in France

When the scheme was introduced, reference was made to the French constitution in which it states that “*the nation declares that all French citizens are equal and united in solidarity in the event of losses resulting from natural disasters*”.⁹⁴ The establishment of the scheme coincided with changes in the guidelines for public land use planning and the introduction of associated risk strategies (*Plan d’exposition aux Risques Naturels Prévisibles* or *PER*).

The CATNAT scheme entails that in the event of a natural disaster, all insurance holders shall refer only to their own insurance company. The mayor, or mayors, in the affected municipalities then draft an application to have the event declared as a natural disaster as defined in the provisions of the CATNAT scheme. This is then sent to the Prefect (the equivalent of a Norwegian County Governor) who then forwards the information to an inter-ministerial commission that determines whether or not the event can in fact be declared a natural disaster. The process of establishing an event as a natural disaster is time-consuming, and settlement following a CATNAT event may take several years.

Natural phenomena that are not recognised as natural disasters for reasons such as that they are too local in extent, must rely on compensation payouts from the standard insurance schemes. Figure 18 illustrates the administrative process that follows natural disasters in France.

The CATNAT system has undergone repeated reforms since its establishment in 1982, and the surcharge has been increased from its original 2.5% of the premium to the current 12% as a result of the increase in submitted cases. The scheme is popular among the population and appears to be politically robust, even though on many occasions the state has had to supply capital in connection with major natural disasters. Today, 99% of private properties in France are insured against natural disasters under this scheme.

⁹⁴“*La Nation proclame la solidarité et l’égalité de tous les Français devant les charges qui résultent des calamités nationales*”

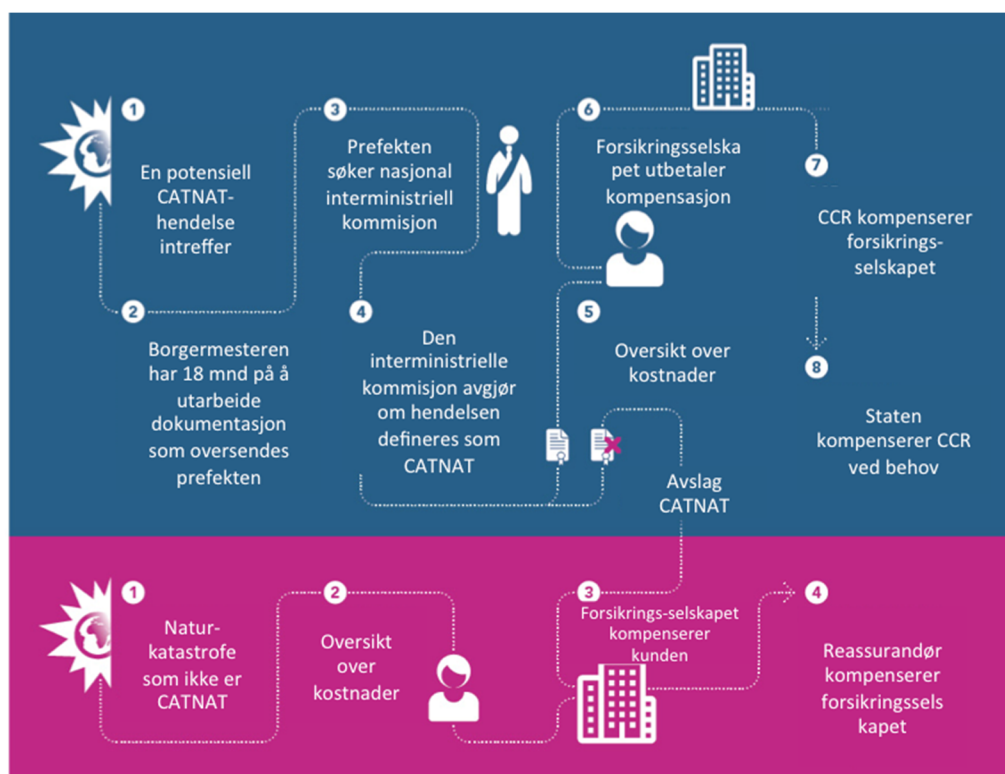


Figure 18. Administration of the French CATNAT natural perils compensation scheme

7.4 Incentives to implement preventive measures

Twelve percent of the CATNAT surcharge feeds into the FPRNM fund (*Fonds de Prévention des Risques Naturels Majeurs*), which is also known as the Barnier Fund. The fund finances the implementation of preventive measures against natural disasters in risk-vulnerable areas, the expropriation of particularly vulnerable properties, and various assessments and studies addressing a variety of natural perils-related risk factors. It also finances evacuation operations in the event of natural disasters.

One of the municipal measures that the Barnier Fund finances in full is the drafting of local plans for the prevention of natural disasters – the so-called *Plan de Prévention des Risques Naturels*, or *PPRN*). The implementation of measures set out in these plans is financed locally with support of up to 50% from the fund. The municipalities determine their risk-vulnerable areas and appurtenant preventive strategies on a voluntary basis. However, an Act was passed in 2001 stipulating that areas that have been subject to three or more CATNAT events since 1995 may have the surcharge on their insurance premiums increased to 24% after 3 events, 36% after 4 events, etc.

French building regulations are founded on legislation that is assembled under the so-called CCH Code (*code de la construction et de l'habitation*), and are set out in a series of collated technical documents (*DTUs*). These documents are not easily available to the public, and access is so costly as to be prohibitive for private individuals and small or medium-sized businesses despite the fact that they have been drafted by the French standards organisation AFNOR.

Buildings are highlighted as being key to France's strategy to limit greenhouse gas emissions. The regulation and supervision of legislation governing new-build construction

are the responsibility of the Ministry for the Ecological and Inclusive Transition of France. For this reason, energy efficiency has become a key component of prevailing building regulations. At the same time, risk mitigation and natural perils prevention in response to climate change have also received greater levels of attention.

The impacts of more frequent and more intense droughts will have major consequences for the built environment in France. Large areas of the country are founded on clayey soils that are poorly compactible when saturated, but which display a tendency to shrink under drought conditions. It has been calculated that the 2003 drought resulted in damage to buildings in more than 8,000 municipalities, amounting to losses in excess of EUR 1 billion. In order to prevent future damage as a result of drought-related subsidence, the *DTUs* have set out requirements related to the depth of foundations (to prevent subsidence) and for an anti-friction layer to be installed between buildings (to mitigate subsidence-related damage).

A separate and more easily accessible standard has been prepared for the prevention of flood-related damage to existing buildings. This standard sets out a selection of strategies and an Excel worksheet illustrating a decision tree for determining the most effective preventive measures.

8 Canada

8.1 Risk situation

Canada is the world's second largest country in terms of area, and is characterised by major diversity in terms of climate and topography. The country encompasses prairies and forests, mountain ranges and plains, rivers and streams, and weather conditions ranging from bitter cold to scorching heat. Canada faces major challenges in relation to natural disasters and risks associated with climate change. The most common natural disaster is flooding, often caused by rapid snow melting, the breach of ice dams, or following torrential rains that may occur throughout the year. Other natural perils include snow avalanches, earthquakes, tornadoes, landslides, hurricanes, severe storms, storm surges and forest wildfires.

Floods result in the greatest damage to properties. All regions of the country, including villages and cities, are vulnerable to flooding at almost any time of the year and, in the past, floods have impacted on hundreds of thousands of Canadian citizens. The worst floods in recent history occurred in central and southern Alberta in June 2013 and along the Manitoba Red River in May 1997. The total costs resulting from losses following the Manitoba Red River floods was estimated to be CAD 499 million. Thousands of volunteers and military personnel worked together for more than a month to combat the spring flood waters and to evacuate more than 25,000 people from many tens of affected communities.⁹⁵

8.2 Responsibility for climate change adaptation strategies in Canada

Canada is a federation made up of ten provinces and three territories. The provinces have their own devolved governments, in contrast to the territories that are under the direct administration of the federal government. The provinces and territories are further subdivided into 3,573 municipalities.

Jurisdiction in Canada is delegated to a series of federal, provincial/territorial and municipal agencies. Figure 19 shows the allocation of responsibility for climate change adaptation strategies in Canada.

⁹⁵ <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/ntrl-hzrds/fld-en.aspx>

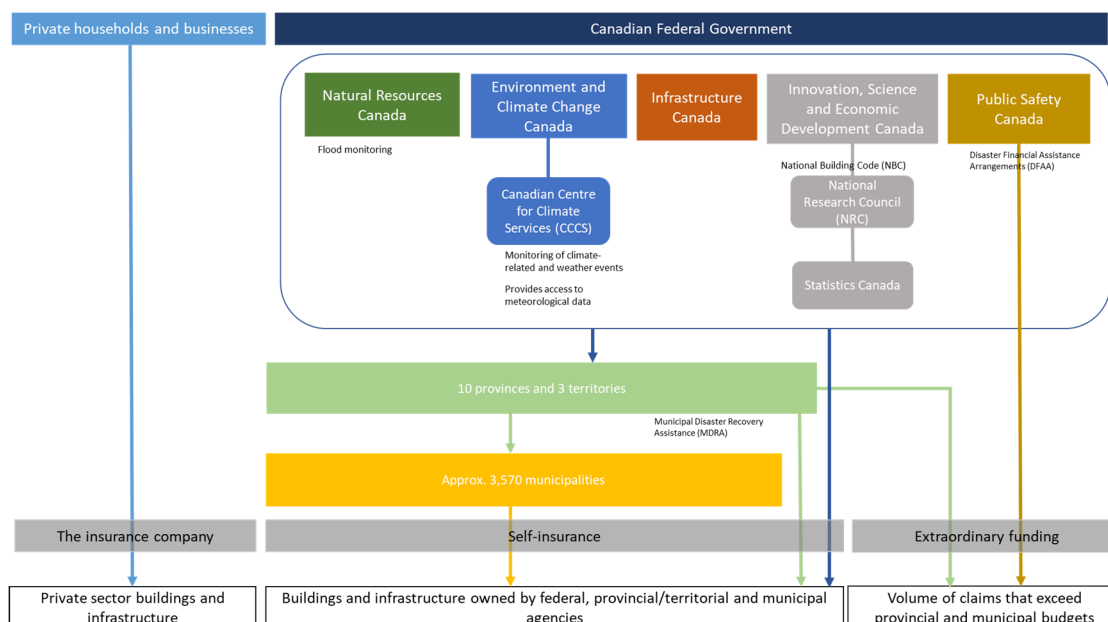


Figure 19. Allocation of responsibility for climate change adaptation strategies in Canada

Constitutionally, Canada is a complex country, and in spite of the fact that the issue of climate change adaptation has been the subject of a great deal of attention in recent years, there exists no clear allocation of responsibility for policy in this field. Canada’s first climate change mitigation strategy was drafted in the wake of the Paris Accord, which the country ratified in 2016. This strategy, commonly known as the Pan-Canadian Framework (PCF), is made up of four key sections addressing carbon pricing, emissions reductions, green technology and employment growth, and climate change adaptation.⁹⁶ The PCF was drafted as part of a collaboration between federal and provincial/territorial authorities and included a list of priorities linked to a nationwide focus on climate change adaptation. However, according to our informant, a Vice-President at the Insurance Bureau of Canada, the allocation of responsibility in this field remains poorly defined. The strategy is widely regarded rather as a working set of guidelines than a legislative text.

Various public agencies have been allocated partial responsibility for the adaptation of buildings and infrastructure. At federal government level, overall responsibility is held by the Ministry for Infrastructure⁹⁷, although the Ministry for Environment and Climate Change⁹⁸ and the National Research Council of Canada⁹⁹, which are both organised under the Ministry for Innovation, Science and Economic Development¹⁰⁰, also have supporting roles. Each province has its own public infrastructure agencies, and most municipalities operate with public departments that play key roles in the field of climate change adaptation. The municipalities assume overall responsibility for the implementation of adaptation measures as they apply to buildings and infrastructure.

Canadian statutory building regulations are essentially an assemblage of general guidelines made up of reference materials, and are revised as and when required by the National Research Council. However, individual provinces and municipalities are free to accept or

⁹⁶ <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html>

⁹⁷ Infrastructure Canada

⁹⁸ Environment and Climate Change Canada

⁹⁹ National Research Council of Canada

¹⁰⁰ Innovation, Science and Economic Development Canada

reject the regulations for use. In this respect, the municipalities play a subordinate role to the provinces and, for the most part, implement their activities in line with the regulations.

The Ministry for Infrastructure has overall responsibility for public infrastructure in Canada. In 2018 it introduced the so-called Climate Lens Assessment (CLA)¹⁰¹ for all major infrastructure projects (those costing more than CAD 10 million) that apply for funding from the Canadian government. The CLA encourages state agencies to focus on the potential impacts of climate change and other hazards during the planning of their projects. The CLA is a set of guidelines designed to raise awareness among decision-makers of climate change-related risk linked to the financing, design, construction and operation of major infrastructure projects. The CLA offers guidance with the aim of achieving designs that ensure minimal greenhouse gas emissions and optimum resilience in the face of the impacts of climate change. It is currently mandatory to apply the CLA in many of the projects linked to programmes administered by the Ministry of Infrastructure, such as the Investing in Canada Program (ICIP), the Disaster Mitigation and Adaptation Fund (DMAF) and the Smart Cities Challenge.

In 2018 the Canadian government launched a targeted climate change adaptation fund linked to a national programme with the aim of investing CAD 2 billion in major infrastructure projects. The projects incorporated into the programme are intended to assist local communities with improving their risk management strategies in response to natural perils events. The fund helps to subsidise the projects, but also assumes a certain level of local funding.¹⁰² The level of subsidy varies depending on a number of factors, but particular emphasis is placed on emissions reductions and climate change adaptation of the infrastructure project.

Environment and Climate Change Canada has overall responsibility for coordinating the country's environmental policy. The Canadian Centre for Climate Services (CCCS)¹⁰³ is an agency organised under Environment and Climate Change Canada with responsibility for monitoring climate-related and weather events across the country. The government portal ClimateData.ca¹⁰⁴ provides decision-makers with access to nationwide and local climate-related data, which may help to raise awareness and lay the foundations for the adoption of adaptation strategies.

The federal government gathers data as input to risk modelling in connection with natural perils such as floods and forest wildfires. This is carried out by the agency Natural Resources Canada¹⁰⁵. The national statistics bureau¹⁰⁶, which is organised under the Ministry for Innovation, Science and Economic Development, gathers data related to infrastructure and building capital.

The provinces operate with their own natural resource agencies that are responsible for gathering data and for risk modelling, while the municipalities carry out capital management and normally have supervisory authority for their own properties, such as surface water management systems, infrastructure and buildings.

Since there are a great many agencies involved in the monitoring, gathering and dissemination of information related to climate change adaptation, a coordinating federal-

¹⁰¹ Climate Lens Assessment. <https://www.wsp.com/en-CA/insights/ca-climate-lens>

¹⁰² Disaster Mitigation and Adaptation Fund, DMAF. <https://www.infrastructure.gc.ca/dmaf-faac/index-eng.html>

¹⁰³ Canadian Centre for Climate Services (CCCS)

¹⁰⁴ <https://climatedata.ca/>

¹⁰⁵ Natural Resources Canada

¹⁰⁶ Statistics Canada

provincial body has been set up, known as the Adaptation Plenary¹⁰⁷. In addition to the involvement of the federal and provincial agencies in determining adaptation priorities, private sector stakeholders also exert an influence by participating in a series of working groups.

The Ministry of Public Safety¹⁰⁸ is responsible for coordinating emergency response activities in the event of major incidents such as natural disasters. It is also responsible for a support programme, funded by the federal government, which was established in 1970. The programme was set up to fund preventive measures designed to avert major losses in the wake of serious incidents. In the first instance, payment for the restoration of public infrastructure following a natural disaster is the responsibility of the affected province or municipality. However, depending on the scale of the disaster, the province or municipality in question may be entitled to have some of the costs covered by the federal government. Each province operates with its own financial funding programme, and the nature of these varies from province to province. In situations where there are major costs linked to restoration following a natural disaster, the provinces may lend support to the municipalities from their funding programmes. In general, the major urban municipalities in Canada are self-insurers.¹⁰⁹

8.3 Natural perils compensation schemes in Canada

In Canada, the scheme offering compensation in the wake of natural disasters has not changed since 1960. It is possible to obtain coverage against natural disasters in the private insurance market. Private home insurance policies normally cover natural disasters resulting from storms, ice storms, hail, lightning strikes and forest wildfires. This insurance scheme exhibits no variation regardless of location, or whether the policy is taken out on private, business or public sector properties. Insurance is taken out mainly by private individuals and commercial enterprises.

There is very little insurance cover for public infrastructure in Canada, and the public authorities normally act as self-insurers. The municipalities are heavily reliant on the provinces for compensation if the costs of restoration operations exceed their budgets. The provinces, in turn, are dependent on the federal government to cover costs in the event of large-scale disasters.

It only became possible to obtain coverage against floods in 2016, and flood insurance schemes vary from province to province across the country. In practice, it is virtually impossible to obtain flood insurance in high-risk areas. Premiums are closely related to risk, and in high-risk areas the premiums are so high that many people simply cannot afford to take out insurance. The public authorities regard the lack of flood insurance as a problem, and the current insurance arrangements as lacking in community spirit. A political debate is thus in progress about a potential restructuring of flood insurance schemes.

In Canada, only 22 insurance companies of a total of more than 200, offer flood insurance. Among the reasons for this is that flood risk assessment has only been carried out for a short time, and the models used in the assessment process have only been available since 2015. The insurance companies continue to be sceptical of these models. However, our informant expects that once the models have been improved and are more precise, with an ability to

¹⁰⁷ Adaptation Plenary. <https://www.nrcan.gc.ca/climate-change/impacts-adaptations/adapting-our-changing-climate/10027>

¹⁰⁸ Public Safety Canada

¹⁰⁹ Disaster Financial Assistance Arrangements (DFAA). <https://www.publicsafety.gc.ca/cnt/mrgnc-mngmnt/rcvr-dsstrs/dsstr-fnncl-ssstnc-rrngmnts/index-en.aspx>

forecast flood risk, risk pricing will be more accurate, thus enabling more insurance companies to offer flood insurance.

Our informant goes on to say that even if flood risk assessment is improved, and more insurance companies become willing to offer flood insurance, approximately ten percent of people living in flood risk areas will still not be able to afford coverage in the private insurance market if current premium levels remain the same. However, in his opinion, other forms of natural peril insurance are functioning well. In their attempts to revise their own flood insurance schemes, the public authorities in Canada are looking for inspiration at the public-private flood reinsurance model applied in the UK (Flood Re). The aim here is to ensure that the inhabitants of high-risk areas will also be able to afford insurance against flooding.

The Insurance Bureau of Canada is currently working with the federal government and the provinces to draft a new insurance arrangement similar to the Flood Re model, and private sector insurance companies are also involved in the process.

The scheme will provide coverage for all types of properties, and there will be no restrictions based on size of site. It will also be possible to insure privately-owned roads and bridges, where premiums will be fixed in accordance with risk-based pricing principles. In general, the insurance market is characterised by high levels of competition and a multitude of players.

Canada operates with a semi-voluntary insurance scheme by which the banks require property buyers to take out home insurance in order to obtain a mortgage. Currently, the banks only require that fire and standard insurance policies are taken out. Flood insurance is still not mandatory.

Figure 20 shows the natural perils compensation schemes that are available in Canada and the causes of losses for which compensation is provided by the various schemes.

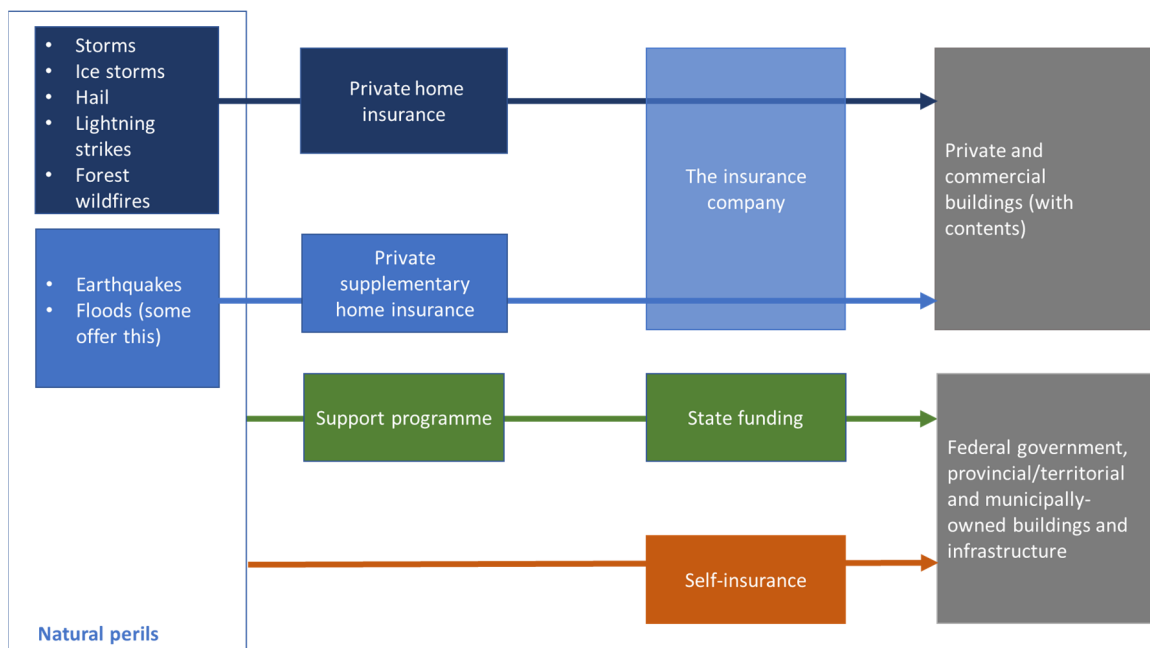


Figure 20. Natural perils compensation schemes in Canada

8.4 Incentives to implement preventive measures

There is a general guideline in operation in Canada stating that following building damage resulting from natural phenomena, restoration work shall be carried out such that the likelihood of subsequent damage is reduced, regardless of the condition of the property/building prior to the event. However, according to our informant, this guideline is not normally adhered to. There are some exceptions, such as following a flooding event that impacted on homes built on a floodplain in Ottawa. In this case, some home-owners were granted permission to rebuild on the floodplain, where a risk of further flooding remained, provided that they raised the foundations. In Quebec, Calgary and Ontario, compensation has recently been awarded to cover the purchase of properties on new sites, thus avoiding the need to rebuild on the floodplain.

Normally, the home-owner has to find the additional costs of rebuilding following an event if this is to take place on the same site, and at the same time make modifications that reduce the risk of new damage. Some insurance companies are considering reducing premiums if home-owners either implement climate change adaptation measures in connection with their restoration work, or make prior preventive modifications. However, only very few companies currently offer this arrangement.

Last year, Quebec launched a new political approach designed to persuade people to move from properties at risk of flooding. The province offered a buy-out programme by which it fixed an upper limit to the level of publicly-funded compensation that would be paid to cover losses related to any given property. The ceiling is fixed at CAD 100,000 and payouts are calculated cumulatively over the lifetime of the property. When the cumulative payout reaches CAD 50,000, the owner will be offered a lump sum from the province to purchase the property. The buy-out has an upper limit of CAD 250,000. This scheme provides owners with an incentive either to move or to implement measures to reduce the risk and extent of damage in the event of a natural disaster. This is the first time that a structured programme of this type has been tested in Canada and it is proving to be controversial.

9 Country comparison – results and discussion

9.1 Introduction

Even if climate change adaptation is a relatively new concept, a number of aspects of adaptation have long histories in the form of preventive measures taken in response to threats of damage and loss presented by natural hazards.

A variety of building traditions in a number of countries and individual regions reflect climate change adaptation in practice. Over many years, factors such as annual temperatures, precipitation volumes and wind conditions have exerted an influence on building construction. By constraining the natural flow systems of streams and rivers, humans have succeeded in expanding the area on which building can take place. At the same time they have had to implement safeguards against the hazards presented by seasonal phenomena such as spring floods and autumnal storms.

Thus, when we talk of climate change adaptation as a new concept, we do so only in a qualified sense. However, there is no doubt about the fundamental difference between our current ideas of climate change adaptation and those of the past – adaptation as discussed in this report addresses *adaptation to a climate that is undergoing change*, where the physical stressors on buildings and infrastructure are changing progressively from what they were in the past.

Climate change is expressed in different ways in the countries examined in this study. In the future, these differences will be reflected in the measures implemented by these countries to adapt to climate change. It is not the aim of this study to evaluate the extent to which each country has succeeded in its implementation of adaptation strategies, but to present the various natural perils compensation and insurance schemes currently in operation.

9.2 Climate change adaptation in the EU

Among a number of supranational agencies, the EU has been the principal force behind the need to address climate change adaptation. The organisation launched its own climate change adaptation strategy in 2013. The strategy places emphasis on consolidating the criteria for decision-making in relation to adaptation measures, general preventive measures for key industries and infrastructure, and the coordination and financing of national action plans. The strategy also incorporates sectors such as agriculture, which are outside the areas of focus of the *Klima 2050* Centre. The strategy is operationalised by means of eight actionable aims¹¹⁰:

- To encourage all member states to adopt their own comprehensive adaptation strategies
- To offer co-funding schemes to support the implementation of adaptation measures
- To introduce adaptation measures as part of the EU Covenant of Mayors Framework
- To bridge knowledge gaps
- To further develop the European Climate Adaptation Platform (Climate-ADAPT) as an information hub (one-stop-shop) for European adaptation strategies
- To facilitate the climate-proofing of key EU-wide policies

¹¹⁰ https://ec.europa.eu/clima/policies/adaptation/what_en

- To promote more resilient and flexible infrastructure
- To promote insurance and other financial products in support of resilient investment decisions

The EU's approach to climate change adaptation permits a significant degree of freedom for individual member states to best identify, prioritise and address their respective key areas of focus. The idea is that national adaptation strategies should be accompanied by action plans that demonstrate how the strategies should be put into operation. Today, twenty-five of the EU's member states have prepared a national climate change adaptation strategy – an increase compared with 2013, when the number was 15. Following an evaluation of the strategy carried out in 2017-2018, it was judged to have been a success.

Finland was one of the few countries that had already approved a national adaptation strategy and action plan even before the EU had begun work with its supranational strategy, and Finland continues to be a pioneer in this field.

The establishment of an EU-wide strategy has clearly had an impact on the development of the adaptation strategies and actions plans adopted in Sweden and France. The responsibility for such strategies and plans in both countries is decentralised and delegated to the municipalities. Following a parliamentary proposition submitted by the Swedish government for a climate change adaptation policy in 2018, the National Board of Housing, Building and Planning (*Boverket*) has assumed responsibility for coordinating adaptation strategies as they apply to buildings and infrastructure, including reviewing the need to amend building regulations in order to make them more responsive to climate change.

Norway, under the influence of the EU and, in particular, its neighbouring countries, finally adopted a climate change adaptation strategy in 2010. An increasing number of municipalities in both Norway and Sweden are currently drafting their own adaptation strategies. There are also examples in Norway of public sector agencies and key adaptation-promoting organisations now operating with their own adaptation strategies.

9.3 Responsibility for climate change adaptation strategies

In all of the countries examined in this study, climate change adaptation policy is regarded primarily as a matter for local concern. It is the municipalities, which are responsible for land use planning, that are delegated responsibility for addressing climate change adaptation in the built environment. State agencies serve to provide resources and support in the gathering of data and relevant know-how.

There is a clear distinction in terms of administrative structures between federal states such as Germany and Canada on the one hand, and unitary states such as Norway, Sweden, Finland and France on the other. In the federal states, administration is centralised at regional level.

In Germany, the municipalities are allocated a general responsibility for the implementation of adaptation strategies at local level, but it is not considered mandatory for the municipalities to develop or exercise their own climate-related policies. Priorities are determined at federal level, where regulations such as building regulation frameworks, are drafted. It is then up to each of the states to develop a set of detailed regulations within the constraints provided by the federally-determined framework.

In Canada, the municipalities have overall responsibility for the implementation of climate change adaptation measures. However, the allocation of other aspects of responsibility does not appear to be very clearly defined. Constitutionally, Canada is a complex country, and it is also characterised by major diversity in terms of climate and topography. Individual federal states are granted a high degree of autonomy, which is expressed to some extent in the way that responsibility for adaptation policy is allocated.

In the other countries examined in this study, the delegation of responsibility for adaptation policies is generally well defined and often enshrined in law. This is illustrated in the figures showing the administrative structures that operate in the respective countries. However, in terms of the specific responsibility for buildings and infrastructure, allocation of responsibility is less clear. Sweden and Canada operate with ministries that are specifically dedicated to infrastructure, whereas in the other countries, responsibility is fragmented among a number of different ministries.

Both from our informants and in the literature [2, 9 and 10], we note a lack of effective coordination of climate change adaptation policies and strategies. In Canada, a federal-provincial forum has been set up to enable the various agencies to optimise the coordination of their adaptation strategies. Private sector organisations also participate in this forum. In Norway, responsibility for coordination is allocated to the Directorate for Civil Protection and Emergency Planning (DSB), and in Finland to the Ministry of Agriculture.

9.4 Natural perils compensation and insurance schemes

The various schemes examined in this study have histories that extend much further back than our current use of the term climate change adaptation. We have seen no shortage of insurance and compensation schemes providing coverage against natural perils such as floods, storms, and landslides, as well as non-climate-related phenomena such as earthquakes and volcanic eruptions. Now that the climate is in a state of change, these schemes are coming under considerable pressure. We thus feel justified in raising questions as to the sustainability of these schemes – both in terms of their financial capacity and their ability to function as safety nets for the communities living in the countries examined in this study. The schemes are in the process of development, whether this be in the form of minor amendments to premium surcharge rates (as in France), adjustments to the funding model (as in Norway) or fundamental alterations to their underlying principles (as in Finland and Canada). Table 1 provides a graphical summary of the principles behind the current insurance and compensation schemes in operation in the countries examined in this study.

Table 1. Principles governing the insurance and compensation schemes examined in this study. Green indicates “yes”, red indicates “no” and yellow indicates “in part”.

	Norway	Sweden	Finland	Germany	France	Canada
Private-public scheme	Green	Red	Red	Red	Green	Red
Semi-voluntary scheme	Green	Green	Green	Red	Green	Yellow
Risk-based insurance premium	Red	Green	Green	Green	Red	Green
Weather type-dependent	Green	Yellow	Green	Green	Green	Green
Covers private infrastructure	Green	Yellow	Red	Red	Yellow	Yellow
Covers public buildings and infrastructure	Red	Red	Red	Red	Yellow	Red

The private-public schemes adhere to the solidarity principle in that they offer flat rate insurance premiums. This is a key feature of the Norwegian scheme. In the report "*Klimatilpasning i Norge*" (Climate Change Adaptation in Norway), the Norwegian natural perils schemes are considered to be of major benefit to society. In France, the current natural perils insurance and compensation model is popular. However, there is pressure among EU countries to adopt private sector insurance schemes, and Finland made the transition from a private-public to a private sector scheme in 2014. Canada is currently looking into the possibility of moving from a private insurance system to a private-public scheme because the flood insurance market in some of its flood risk areas is essentially dysfunctional. Following flooding in Germany in 2002 and 2013, there was a national debate as to whether a mandatory natural perils insurance scheme should be introduced. However, no action was taken. Even if those living in risk-vulnerable areas pay higher premiums than those in low-risk areas, the insurance market currently operating in Germany seems to be functioning effectively. Our informants in Sweden, Finland and Germany are all of the opinion that the natural perils insurance schemes in their respective countries are fit for purpose.

The various insurance and compensation schemes in operation in the countries examined in this study exhibit differences not only in their basic organisation, but also in content. Norway and France, which both operate with private-public schemes, also offer coverage against the greatest number of climate-related natural perils. Table 2 illustrates the natural perils against which coverage is provided in the various countries.

Table 2. Natural perils against which coverage is provided in insurance and compensation schemes in operation in the countries examined in this study

	Norway	Sweden	Finland	Germany	France	Canada
Landslides	Green	Yellow	Red	Yellow	Green	Red
Storms	Green	Yellow	Green	Green	Yellow	Green
Floods	Green	Yellow	Green	Yellow	Green	Yellow
Storm surges	Green	Red	Red	Red	Yellow	Red
Earthquakes	Green	Yellow	Red	Yellow	Green	Yellow
Volcanic eruptions	Green	Yellow	Red	Yellow	Green	Red
Lightning strikes	Red	Yellow	Red	Red	Yellow	Green
Frost and frozen ground	Red	Red	Red	Red	Red	Red
Animals, insects, fungi and wet/dry rot	Red	Red	Red	Red	Red	Red
Drought	Red	Red	Red	Red	Green	Red
Rainfall	Red	Yellow	Yellow	Yellow	Red	Red
Surface water	Red	Yellow	Green	Red	Green	Red
Snow weight	Red	Yellow	Red	Yellow	Yellow	Red
Ice drift	Red	Yellow	Red	Red	Red	Red
Hail	Red	Yellow	Green	Green	Red	Green
Forest wildfires	Red	Yellow	Red	Red	Green	Green
Subsidence	Red	Red	Red	Red	Green	Red

With the exception of Sweden, the various insurance and/or compensation schemes in all the countries examined in this study provide detailed specifications of the weather types that trigger payouts. In the case of purely private sector schemes, this will vary from company to company. A given set of weather types/other causes will be specified in a standard home or business premises insurance policy, but it will be necessary to take out supplementary

coverage against other climate-related phenomena. The policy will also stipulate criteria regarding the intensity of the weather phenomenon at the time the damage was incurred, which have to be met in order to trigger a payout. This will vary from country to country, but not between the insurance companies. In Norway, standard insurance and supplementary policies cover a wide range of climate-related phenomena. Table 2 provides a list of the phenomena that are included under the definition of a natural peril. In Norway, these phenomena are specifically stated in the various policies. The green colour code in the table indicates the phenomena against which coverage is provided in the natural perils insurance and/or compensation schemes in operation in the countries examined in this study. The yellow colour code indicates that coverage is provided against the phenomena in question, but with exceptions.

9.5 Incentives to implement preventive measures

The issue of whether emphasis should be placed on incentives to implement preventive measures, as opposed to payouts to fund restoration, is high on the agendas in both Canada and Norway. There may be less economic incentive for private individuals or businesses to implement preventive adaptation measures on their properties than to do nothing. However, such measures have to be considered for socioeconomic reasons. A number of research reports [12 and 17], as well as literature articles [4 and 8], conclude by demanding support schemes and increases in municipal funding for the implementation of preventive climate adaptation measures.

Risk-based insurance premiums and excess payments provide some incentive to implement preventive measures. However, these incentives can be counteracted by state-funded safety nets or the promise of EU funding. This applies equally to private individuals and businesses as it does to the municipalities. However, in Norway, the solidarity principle remains resilient, and discussions are in progress to find out how it will be possible to boost incentives to implement preventive adaptation measures while still maintaining a spirit of solidarity.

In Finland, more and more insurance companies are providing their clients with guidance on the implementation of adaptation measures in their policies, with the threat of reduced payouts if these measures are not implemented. In Germany, an arrangement is in place designed to ensure that any restoration work following an event must improve on the original standard of the property. German insurance premiums continue to rise as a direct result of this arrangement. In Canada, insurance companies offer lower premiums to home-owners who can show that they have implemented preventive climate change adaptation measures on their properties. An alternative to the current Canadian private-public scheme has been proposed by which the state-funded safety net is removed in cases related to compensation in the wake of climate-related events. This will require a smoothly functioning private sector insurance market across the entire country. In France, a portion of the insurance premium is set aside to fund the implementation of preventive measures.

One form of incentive scheme – the climate change adaptation, or “green”, loan, is yet to be tested extensively. In Norway, the Municipal Sector Bank offers municipalities discount interest rates on loans used to finance the implementation of preventive adaptation measures on municipal buildings. In order to be granted a green loan, the project must meet a set of pre-determined criteria. In Norway, green loans may be granted to private individuals and businesses to finance energy-efficient buildings.

Subsidies are granted primarily to fund climate change adaptation measures carried out in developing countries¹¹¹. Enova is a Norwegian government enterprise responsible for promoting eco-friendly energy generation and consumption. It grants funding to support investment in the installation of climate-friendly systems in buildings. Currently, however, this funding is directed exclusively at systems designed to reduce greenhouse gas emissions. Norway also provides a funding mechanism to support skills and expertise development in the municipalities, and Canada operates with a “climate change adaptation” fund.

All the countries examined in this study have statutory regulations in place that correspond to Norwegian building regulations, and these are generally subject to revision at intervals of a few years. Our sources in Sweden and Germany have informed us that work is in progress to amend their regulations to take greater account of climate change-related risk.

In Canada, the Climate Lens Assessment mechanism represents an innovative political initiative designed to encourage public sector organisations to improve their assessments of the impacts of climate change and other hazards in connection with their building projects.

Today, major incentives are created in the wake of damaging events. The flooding in Kvam in Norway was in itself sufficient to trigger a change in legislation towards the introduction of incentives to implement preventive measures. Flooding in Helsinki led to a number of climate change adaptation measures, including the elevation of ground levels in coastal areas. The natural perils insurance scheme in Germany was made subject to review following two major flooding events.

9.6 Discussion

Despite the fact that humans have adapted themselves to climate change throughout the ages, it appears that other trends and concerns are currently assigned higher priority than the adaptation to climate change of our built environment. For example, there is a trend for developers to opt for flat roofs because they are more efficient in terms of surface area, even though pitched roofs ensure more effective water run-off and far less likelihood of water damage. Other aspects where aesthetic considerations are given precedence over practical concerns include roof beam extensions and the placement of windows.

Swedish municipalities normally base their land use and development planning on lifetime perspectives of between 30 and 40 years, even though the lifetime of well-maintained buildings may be considerably longer than this. There is a great deal of variation in building lifetimes. Some of us live in houses that are many hundreds of years old, while houses built during the 1970s are constantly being demolished. This is partly the result of building materials and construction methods, but also of changes in our functional needs. A positive change has been the increased use of more resilient building materials.

The imposition of restrictions on where a building can be located may reduce the need to implement climate change adaptation measures on the building itself. Thus the need to adapt buildings to climate change will be less in municipalities that opt to build in locations that are at low risk of damage resulting from climate-related phenomena. At the same time, it is not an easy task to predict the probability of natural disasters resulting from a changing climate more than 40 years into the future.

The Scandinavian countries exert a mutual influence on one another in terms of the development of their building regulations. In Sweden, a review is in progress to look into

¹¹¹ <https://www.adaptation-fund.org/about/partners-supporters/>

ways in which adaptation measures can be incorporated into the building regulations, and it is likely that similar reviews will be carried out in Norway and Finland. However, statutory regulations will only apply to new buildings and those requiring rehabilitation. This means that the impact of incorporating higher levels of adaptation requirements will only be gradual unless the process is combined with measures to boost the number of rehabilitation projects.

The adaptation of the built environment to climate change is a difficult and multifaceted issue. The first issue concerns uncertainty linked to the relationship between risk and potential consequences, which may constrain proactive thinking. Not knowing exactly how climate change will express itself in the long term, added to the fact that damage to buildings will be caused by climate change-related events, introduces uncertainty into our judgements on what levels of resilience we want to achieve in the face of future natural perils. The second issue is related to our political and financial will to make short-term investments in the present in order to make savings in the long-term. A third problem is the issue of an individual's wishes and rights to live exactly where he or she pleases, even if a progressively changing climate means that the home in question is located in a high-risk area or, in the case of essential infrastructure, incurs high costs to society in connection with maintenance and restoration in the event of damage.

The need to make long-term projections, combined with the anticipated costs associated with events such as floods, landslides, torrential rain and storm surges, makes it difficult to calculate the costs that will be incurred in the future if adaptation measures are not implemented now. Our limited ability to measure or calculate the effects of potential measures also explains why we experience delays in the introduction of more incentive schemes such as green loans, the certification of adapted buildings, and subsidies, either in the form of risk equalisation mechanisms for those taking out insurance or the direct financing of adaptation measures. In a wider context, the concept of climate change adaptation continues to evolve, as is supported by the existence of ongoing revisions of natural perils insurance and compensation schemes being carried out in the countries examined in this study. The research literature emphasises the value of indicators that can be used to measure a municipality's ability to implement adaptations to climate change [18 and 19].

A lack of knowledge and data about probabilities and costs constitute a barrier to the identification of the natural perils that are likely to occur and the preventive measures needed to safeguard against them. More data can contribute towards better decision-making and enable us to quantify the effects of adaptation measures, for example by allowing us to make comparisons with restoration projects or situations in which no measures are implemented. In Canada, flood risk modelling is currently in the development phase, and this may explain the lack of a flood insurance market in high-risk areas. Canada has also established a data resource service that can be utilised to inform decision-making. In Norway, the *Kunnskapsbank* (Knowledge Bank) system will be able to perform a similar role, once the insurance data are acquired and in place. However, it will be difficult to calculate the impacts because adaptations to a changing climate are being, and have been, carried out for centuries. For example, when it comes to insuring infrastructure, the distinction between insured loss and wear and tear will remain a grey area.

A relevant explanation for the lack of development in the field of climate change adaptation is that the term is relatively new when compared with the concept of greenhouse gas emissions reduction. While ideas on emissions reduction arrived on the political agenda in Norway in the wake of the Brundtland Report in 1987, concepts involving the climate change adaptation of buildings and infrastructure were not introduced before 2008. This may explain the poor levels of coordination and lack of knowledge. Another explanation for the lack of coordination is that the executive authority with responsibility for buildings and

infrastructure is dispersed across a large number of ministries. Sweden and Canada operate with their own ministries dedicated specifically to infrastructure. Lack of knowledge may also provide an explanation for the prioritisation of erroneous measures and for the fact that too little is being done to reduce the risk of damage to buildings and infrastructure resulting from climate-related phenomena.

Natural perils compensation and/or insurance schemes can be used to generate incentives for the implementation of preventive measures, but the way in which such schemes are structured will play a significant role. Pure natural perils insurance schemes related to climate change phenomena will release the pressures on public funds, and may provide stronger incentives for the implementation of preventive measures than are provided by current public sector arrangements. The model applied in Germany provides the insurance companies with incentives to demand that their clients put preventive measures in place. This allows them to avoid the costs associated with measures that are “above and beyond restoration”. The German scheme also provides for a restored building environment that meets the most recent requirements and which is more resilient in the face of future climate change. However, it remains uncertain as to whether it provides clients with the right incentives to implement preventive measures. The fact that the scheme entails that a building should not only be restored following damage, but that the restored condition shall be better than the original, may lead to contradictory incentives [3]. In Sweden, insurance premiums are stipulated on the basis of a combination of different risk factors. According to Hudson et al. (2019), a scheme of this type will reduce any incentive to implement preventive measures unless a reduction in premiums is introduced in situations where it can be shown that measures have been taken to reduce the risk of damage due to natural perils [4].

The incorporation of incentives in insurance policies also assumes that insurance can be offered, and that it will be in demand at the stipulated premiums [10]. The existence of an insurance market will ultimately depend on the level of risk [4]. In Finland and Sweden, the risk of natural disasters is relatively low, and there is no demand to insure infrastructure. In Sweden, it is possible to take out insurance against many types of climate-related natural perils. Germany operates with risk-based insurance premiums. However, people have been willing to pay these premiums, even in high-risk areas. Our informants in Sweden, Finland and Germany characterise their respective countries’ insurance schemes as fit for purpose. However, in Canada there are examples of areas where the levels of risk are too high to permit the existence of an insurance market. The presence of high risk may result in a restructuring involving the introduction of a private-public scheme that, ideally, may also provide incentives for the implementation of preventive measures. Hudson et al. (2019), recommend a private-public scheme formulated in such a way that it incorporates risk-based insurance premiums [4].

9.7 Future studies

This study has drawn comparisons from six countries between the mechanisms of allocation of responsibility for climate change adaptation, and natural perils compensation schemes, with a particular emphasis on incentives to implement preventive measures. We have limited our focus to the impacts of natural perils on buildings and infrastructure. Adaptation to anthropocentric climate change is a relatively new issue on the political agenda and is an exciting topic that offers opportunities for further study.

This study, as well as other studies and reports, has revealed that overall, the levels of incentives incorporated in current compensation schemes to implement preventive measures in these countries are low. The achievement of an effective design of natural perils insurance and compensation schemes incorporating incentives to implement preventive measures

should be the subject of future research. The drafting of other incentive schemes, such as green loans, will be subject of further investigation by the *Klima 2050* research centre.

We should also be developing indicators to measure the performance of climate change adaptation strategies. Meaningful indicators that tell us something about the extent and quality of adaptation strategies will have value in the sense that they can help to document adaptation work taking place at municipal level, and of the work to develop incentive schemes in the form of municipal subsidies, green loans, funding for the incorporation of adaptation measures into buildings, and certification schemes. Such indicators can then be used to sort those taking out insurance and loans, and subsequently to adapt insurance premiums and interest rates.

However, measurement of the impact of the various adaptation strategies remains a much more challenging task, in particular because of the inherent uncertainty linked to climate change processes and their consequences. However, we continue to observe the development of risk assessment and management tools, and increasingly large volumes of data are becoming available, giving us the opportunity to carry out quantitative analyses of the impacts of climate change-related risk and to perform comparative assessments of the effectiveness of the various adaptation strategies.

This study has focused on the impacts of climate-related natural perils on buildings and infrastructure. Damage caused by such events to assets other than buildings and infrastructure is also becoming increasingly more relevant. In Norway, some debate has taken place on the establishment of a “Climate Change Fund” in the wake of record high temperatures and subsequent drought and wildfires during the summer of 2018. Ultimately, the issue was handled with the issue of a package of crisis measures. The Norwegian aquaculture sector requested the introduction of a scheme to compensate for stock losses resulting from algal blooms that effectively suffocated large numbers of farmed salmon in the spring of 2019. The drafting of financing models designed to subsidise such schemes is becoming increasingly relevant.

It will also be very interesting to assess the methods available for an examination of how climate change-related risk is managed as part of the planning activities carried out by municipalities and self-insurers. A survey carried out among the insurance companies will be able to provide a better indication of the scope of incentives to implement adaptation measures currently incorporated in insurance policies. Such incentives may include reductions in premiums if insured parties are willing to put preventive measures in place. Surveys may also be useful in revealing the extent of the granting of green loans and other loans for climate change adaptation measures by the banks. In any event, such surveys will provide a snapshot of the current situation. These are markets that we believe will be undergoing significant changes in the years ahead.

The reinsurance market will also be impacted by climate change. A scenario study designed to analyse the impact on the reinsurance market under a number of climate change scenarios will be both relevant and future-oriented.

10 Conclusions

This study has carried out an assessment of the mechanisms of allocation of responsibility for climate change adaptation in the six countries Norway, Sweden, Finland, Germany, France and Canada. We have also compared the natural perils insurance and compensation schemes currently operating in the various countries, and the incentives to implement preventive measures that exist both within and outside the existing schemes.

The climate change adaptation of buildings is regarded in all the countries examined as a matter of local responsibility, in contrast to the issue of greenhouse gas emissions reductions, which is a subject of key national and international concern. The municipalities are allocated overall responsibility for dealing with climate change adaptation issues. The EU has acted as a driving force behind the linkage of local adaptation strategies to national policy making in this field within its member states. In principle, the allocation of responsibility, coordination and collaborative activities within the six countries are well-defined, and all of them operate with some form of climate change adaptation strategy. However, climate change adaptation is a relatively novel issue, and this study has recorded a consequent lack of expertise and coordination.

In general, the drafting of legislation and guidelines for functional specifications is vague and open to interpretation. Germany has specified the stressors that new buildings must be constructed to withstand, and these can be modified relatively easily in response to anticipated future climatic patterns. The definitions of stressors currently defined in German legislation are nevertheless based on historical meteorological data. In general, the allocation of responsibility for specific existing buildings and infrastructure is poorly defined and coordinated.

Natural perils insurance and compensation schemes vary widely among the countries examined in this study. Norway and France operate with private-public schemes in which the public sector is allocated a key role. These schemes are based on the solidarity principle, under which no relation exists between insurance premiums and natural perils risk. The trend within the EU is moving towards the privatisation of the natural perils insurance market, and Finland has recently transitioned from its previous private-public scheme to an exclusively private sector arrangement. Private sector schemes enable the insurance companies to link premiums to the probability of occurrence of any given natural peril event, and in this way provide their clients with incentives to implement preventive measures. In Canada, consideration is being given to moving in the opposite direction – from a private sector scheme to a private-public arrangement. This is the direct result of the charging of excessive premiums in certain flood-vulnerable areas, which has effectively made flood insurance unavailable.

This study has demonstrated that the various schemes are in a state of constant flux in response to ongoing climate change processes. Increases in the frequency of extreme weather events, combined with a generally warmer and wetter climate, are imposing great stresses on the viability of current schemes. Water, mainly in the form of floods, has been the traditional driver of developments in the field of natural perils insurance and compensation schemes. Major floods result in high levels of costs, both in terms of direct losses to building owners and to society as a whole. Experience obtained from flooding events in both Helsinki and in Gudbrandsdalen in Norway serves to highlight the challenges involved when responsibility is allocated to local municipalities, whose strategies tend to be largely reactive. It is only after an area has been subjected to a natural perils event that measures are implemented or legislation enacted, as in the case of the Kvam floods in Norway. Here, following repeated flooding events, the law was changed to ensure that inhabitants could also be compensated for losses linked to the value of their damaged property site, and to rebuild their homes on land less at risk of flooding.

It is likely that increased costs associated with other types of climate change-related natural perils will influence changes to compensation schemes. France and Germany have recorded increases in compensation payouts for damage resulting from phenomena such as drought-induced subsidence. Such payouts are expected to increase in frequency as a result of climate change. However, this is not expected to be a relevant issue in Norway, where water damage resulting from floods, heavy and torrential rain, as well as landslides, is anticipated to increase most in response to climate change.

The *ex ante* measurement of the future impacts of climate change remains a challenging task. We also face major challenges in attempting to assess the impact of incentives, and of any modifications made to natural perils insurance and compensation schemes. In Norway, socioeconomic considerations and experience from other countries are useful during the drafting of natural perils insurance and compensation schemes. Local conditions must be viewed in the context of national strategies and guidelines, and national expert centres must act in support of locally-based agencies in order to preserve the solidarity principle. They must also contribute towards the establishment of adequate incentives to ensure that measures designed to prevent climate change-related damage to buildings and infrastructure are put in place.

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Appendix A. Interview guide

Natural disaster compensation and insurance schemes

Interview guide

We are interested in mapping the structure of the schemes for natural disaster compensation and insurance. We would like the interview to have a semi-structured format, but below you can find a preliminary interview guide.

First, we want to get an overview of the agencies, directorates and ministries responsible for climate change adaptation in general. Later we want to dig deeper into the schemes for natural disaster insurance and compensation. Lastly, we want to go into details in the structure for natural disaster compensation regarding incentives for adaptation in form of improvements or recovery.

Preventive measures ex ante (before incident/disaster) like monitoring, mapping, investments and ex post (after incidents) measures are equally relevant for the general mapping. It is further of great interest to identify and/or separate schemes for 1) private households, 2) businesses, and 3) public buildings and infrastructure. Public: municipality, province/county, and governmental level.

Climate adaptation – a general overview

Which agencies, ministries and directorates are responsible for climate change adaptation for buildings and infrastructure? (This means that you can exclude damage to crops, forests, livestock, furniture, vehicles, etc.)

How is climate adaptation before and after a natural damage funded?

What role does the EU have for climate adaptation before and after an eventual natural accident in Finland?

Which agencies are responsible for monitoring, gathering information, making information accessible, etc.?

What are the Regional State Administrative Agencies' responsibilities when it comes to climate adaptation?

Can you mention central legislation or guidelines that are followed by the responsible agencies, ministries or directorates?

To what extent do the jurisdictional framework conditions open for individual interpretation?

Is the division of responsibilities clear and defined?

How is the coordination between the different responsible agencies, ministries, directorates and regional and local governments?

Natural disaster insurance and compensation

Do the schemes separate between damages caused by different weather types, or on different types of buildings and infrastructure, for different geographical areas, etc.?

To what extent is private insurance companies involved in the schemes, or how are the schemes financed?

Do private households and businesses as well as municipalities use the same insurance companies?

Is it possible to insure municipal and private infrastructure?

Are you obliged to sign property insurance?

Are the insurance companies obliged to charge a flat premium? (Reference to the provision)

Does the property insurance cover all types of damage (caused by different weather types)?

What types of property are covered? (Boundary on plot size? Private roads and bridges, etc.)

What are your opinions on whether the schemes are clear and whether the areas of responsibility are clearly defined?

Are there any discussions going on the design of these schemes and what are the main topics?

Are the schemes, in your opinion, efficient?

Can we expect a restructuring of the schemes ahead?

Has there been any restructuring in the past, and how was the scheme designed previously?

What is the financing scheme for reinsurance?

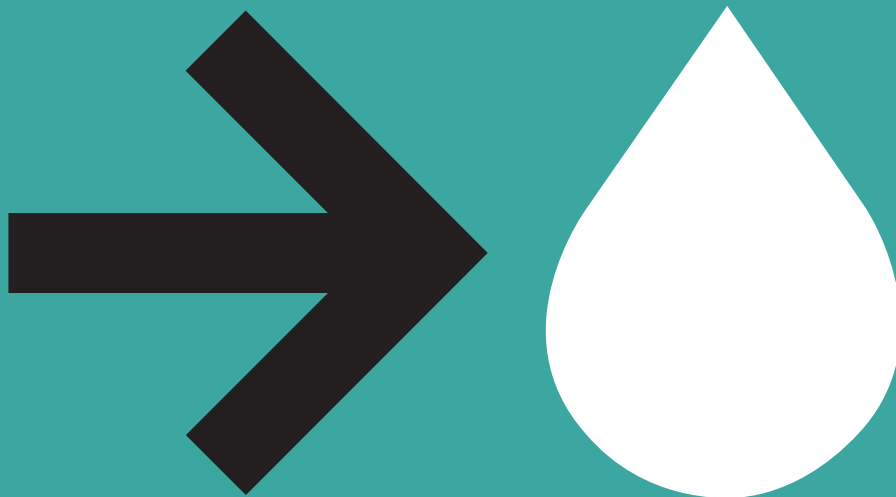
Incentives for adaptation

Does the scheme for natural disaster compensation provide incentives to only restore (to as it was before the accident) or improve the performance of the buildings and/or infrastructure with the purpose to reduce the risk for natural damage caused by climate change? Here we are interested in specific formulations of the scheme, jurisdictions, etc.

In case of expropriation, how is the property compensated?

Appendix B. List of informants

Name	Role	Place of work	Country
Mia Ebeltoft	Deputy Director	<i>Finans Norge</i> (Norwegian Financial Services Association)	Norway
Synnøve B. Folkvord	Deputy Research Director	Norwegian Natural Perils Pool	Norway
Steffan Moberg	Lawyer	<i>Svensk Försäkring</i> (Insurance Sweden)	Sweden
Karoliina Phili-Sihvola	Senior Auditor (formerly research scientist)	National Audit Office of Finland (formerly a research scientist at the Finnish Meteorological Institute)	Finland
Petri Mero	Head of Loss Prevention	Finance Finland	Finland
Oliver Hauner	Head of Property and Engineering Insurance, Loss Prevention, Statistics	German Insurance Association	Germany
Roland Nussbaum	Managing Director	<i>Mission Risques Naturels</i>	France
Craig Stewart	Vice-President, Federal Affairs	Insurance Bureau of Canada	Canada



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