Climate adaptation good practice and lessons learned from Germany and the EU Commission

Nationally Determined Contributions (NDC) Implementation in China

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Nationally Determined Contributions (NDC) Implementation

Climate adaptation good practice and lessons learned from Germany and the European Union

Prepared for
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Dr. Gerhard Rappold
September 2020

Table of Contents

Abbreviations

APA	Adaptation Action Plan
AR4	Assessment Report 4 of the UNFCCC
BMEL	Federal Ministry of Food and Agriculture
BMFSFJ	Federal Ministry for Family Affairs, Senior Citizens, Women and Youth
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMZ	Federal Ministry for Economic Cooperation and Development
CLLD	Community Lead Local Development
DAS	German Adaptation Strategy
DCC	Department of Climate Change
DWD	German Meteorological Service
ECCP	European Climate Change Programme
ETC/CCA	European Topic Centre on Climate Change Impacts, Vulnerability and Adaptation
EU	European Union
FYP	Five Year Plan
GIZ	German Corporation for International Cooperation GmbH
IKI	International Climate Initiative
IMA-Anpassung	Interministerial Working Group on Adaptation to Climate Change
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KLiVO	German Climate Preparedness Portal
KomPass	Competence Centre Climate Impacts and Adaptation
MEE	Ministry of Ecology and Environment
MoHURD	Ministry of Housing and Urban Development
NDC	National Determined Contribution
NDRC	National Development and Reform Commission
NRW	North Rhine-Westphalia
RCP	Representative Concentration Pathway
StA AFK	Standing Committee for the Adaptation to Climate Change Impacts
UBA	German Environment Agency
UNFCCC	United Nations Framework Convention on Climate Change
WFD	Water Framework Directive
WG	Working Group

List of Figures

List of Tables

Abstract

This report condenses and reviews the development of climate change adaptation strategies in Germany and at the European Commission (EC).

In the 2000s, the German Environment Agency (UBA), a subordinate of the Federal Ministry of Environment, Nature Conservation and Nuclear Safety (BMU), initiated the political process. Following the release of the German Adaptation Strategy (DAS) in 2007, the BMU took over political responsibility. Two working groups were subsequently established:

- The 'Interministerial Working Group on Adaptation to Climate Change' (IMA-Anpassung) to coordinate policies and activities between the federal ministries;
- The Standing Committee for the Adaptation to Climate Change Impacts (StA-AFK) to coordinate policies and activities between federal and state institutions.

The DAS reflects the federal structure of the government, which follows the principle of subsidiarity. The federal government follows a framing-guidance authority, which grants individual states implementation authority. As a result, the federal authority only represents its own federal point of view, restricted to providing the federal states with guidance. By now, almost every state in Germany has an independent adaptation strategy.

By 2015, the monitoring and indicator system was mature enough to monitor adaptation in Germany. The system consists of 56 impact indicators to monitor the impact of climate change on the strategy's action fields and 46 response indicators to measure responses to changes.

The two working groups, along with over 400 technical experts, worked tirelessly to achieve the system's maturity. They have faced many constraints, including the following:

- Explicit climate-related cause and effect relations do not differentiate between climate change and climate variability;
- Difficulty of monitoring a political strategy at an early, immature stage of adaptation science with scientifically sound indicators;
- The need for indicators that rely on existing data and information with national coverage that do not overlap with existing monitoring systems;
- Stability of the indicator system over a long period of time while ensuring expandability to new scientific findings – a contradiction;
- Serving as a means to communicate climate-induced changes to a wider audience.

An indicator update report should be published every four to five years. While a clear climate signal is obvious, the first and second monitoring reports are more of a baseline and proof of concept. The next report is expected to deliver clearer insights.

Chapter 8.1 explains the technical outline for indicator development. The political-scientific interface requires robust documentation for each indicator, as well as for failed developments – in order to avoid repetitive attempts. Each indicator thus comes with its own factsheet and datasheet. Sectoral indicator background sheets explain the development process as well as the unsuccessful developments.

In 2013, after initiating discourse that included a Green Paper (2007) and White Paper (2009), the EC published its Adaptation Strategy. The EU is a supranational merger of sovereign Member States. Until an EU law is passed, the EC fulfils a supporting function. The EC promotes finance adaptation actions undertaken by the Member States, including the development of adaptation strategies. The EC also supports better decision-making through research (Horizon 2020) and the climate-ADAPT information portal.

In December 2019, the European Green Deal was launched to achieve the goal of making Europe the first 'climate neutral' continent by 2050. This includes a new adaptation strategy and EU climate law. The blueprint, published in May 2020, provides a glimpse into what is to come. The EU policies will more systematically align with the United Nations Sustainable Development Goals (SDGs) and the Paris Agreement. They will also better reflect the outcome of the Sendai Framework for Disaster Risk Management (Build Back Better). The policies will balance European priorities with a globalised and interdependent world.

The concepts of vulnerability and risk are central for tackling adaptation to climate change. From the UNFCC Assessment Report 4 (AR4, 2007) to the UNFCC Assessment Report 5 (AR5, 2014), scientific work on vulnerability and risk advanced considerably, reflecting a fundamental change in approach. The AR4 focused solely on vulnerability, excluding hazard risks and deviating from climate change incidents. The AR5, however, shifted to a comprehensive risk approach. This created a dilemma in Germany and beyond. The German Adaptation Strategy was released in 2008 and the European strategy followed in 2013. The comparison of different countries' and Germany's adaptation strategies before and after the release of AR5 thus proved to be inconsistent.

1 Introduction

In January 2009, the Federal Republic of Germany and the People's Republic of China signed the 'Memorandum of Understanding on Cooperation in Combatting Climate Change,' initiating the bilateral 'Sino-German Working Group on Climate Change' ('the WG') dialogue. In the context of this dialogue, Germany supports relevant programs and projects through the International Climate Initiative (IKI) of the German Environment Ministry (BMU) in cooperation with the Chinese Ministry of Ecology and Environment (MEE).

In the context of pursuing ecological civilization, aligned with the policies and measures in its 13th Five Year Plan (FYP), China submitted a 'Nationally Determined Contribution' (NDC) to the United Nations, with the ratification of the PA in September 2016. The Chinese government has made climate change adaptation a priority issue in its NDC:

> *'China will continue to proactively adapt to climate change by enhancing mechanisms and capacities to effectively defend against climate change risks in key areas such as agriculture, forestry and water resources, as well as in cities, coastal and ecologically vulnerable areas and to progressively strengthen early warning and emergency response systems and disaster prevention and reduction mechanisms.'*

In recent years, China has actively been working on this strategic policy issue. In November 2013, the National Development and Reform Commission (NDRC) released the 'National Strategy for Climate Adaptation.' In 2017, the NDRC included infrastructure, agriculture, water, coastal area, forests, public health, tourism and other industries. The Ministry of Housing and Urban Development (MoHURD) started work on climate adaptation projects in 28 pilot cities. The Sino-German Cooperation on NDC implementation will support the implementation of the above actions and further enhance China's actions on climate change in the development of China's 14th FYP and subsequent NDC. During the 9th Sino-German Working Group Meeting on Climate Change, the Department of Climate Change (DCC) of the Ministry of Ecology and Environment (MEE) – transferred from the NDRC to the MEE in 2018 – indicated that it would like to strengthen cooperation with the German government on climate change adaptation. Further specific demands and requests by the Chinese partners were identified at a joint brainstorming workshop in November 2019.

This report is a collection of good practices and lessons learned. Its purpose is to share and contribute valuable knowledge on adaptation for the project proposal.

2 Adaptation to climate change in Germany and at the EU Commission

2.1 Climate adaption in Germany

In 1992, the Intergovernmental Panel on Climate Change (IPCC) first mentioned **adaptation to climate change** (IPCC, 1992). In 2005, Germany addressed adaptation in the Federal Government's Climate Protection Programme, developing a nationwide adaptation strategy (BMU, 2005). However, responsibility for implementing the strategy remained unclear. Eventually, the Water Department of the German Environment Agency (UBA – *Umweltbundesamt*) took control and sparked the political process. In 2006, the establishment of the Competence Centre Climate Impacts and Adaptation (KomPass – *Kompetenzzentrum Klimafolgen und Anpassung*) moved the process forward.

In 2007, the UBA's superordinate ministry, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU – *Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit*), finally took the lead with the support of an informal interdepartmental working group. In December 2008, the German Federal Government and Federal Council (*Bundesrat)* endorsed and published the German Adaptation Strategy (DAS – *Deutsche Anpassungsstrategie*), representing the German government's stance on adaptation (Bundesregierung, 2008).

The government then formalised the informal working group under the title Interministerial Working Group on Climate Change (IMAA – *Interministerielle Arbeitsgruppe Anpassungsstrategie*), representing nearly all federal ministries. Its purpose is the cross-sectoral alignment and further development of the DAS. The DAS, which the federal government wrote from its own perspective, allocates the main planning responsibilities to the federal states. In this light, the DAS is a baseline document for establishing coordinated climate adaptation plans.

In 2009, to connect the federal and state levels, the Conference of Environmental Ministers created the Standing Committee for the Adaptation to Climate Change Impacts (StA AFK – *Ständiger Ausschuss zu Anpassung an die Folgen des Klimwandels*). This body informs the federal and state governments and aligns their adaptation activities.

The aim of the DAS is twofold. First, it aims to reduce the vulnerability of Germany society, economy and environment. And second, it aims to maintain or increase Germany's capacity to adapt. It thus focuses on the following objectives:

- Risk assessment
- Development of decision criteria
- Implementation of adaptation measures
- Awareness raising

The federal states, Federal Government and informed civil society groups follow a participatory approach in their decision-making. The development of adaptation criteria is thus a process of social, public and institutional learning. Platforms like KomPass, the German Climate Preparedness Portal (KLiVO) and the National Climate Initiative (NCI) collect and organise knowledge, experiences and best practices. Through applied science, experts develop practical solutions that they document and make accessible. They perform risk assessment, set goals

for themselves and implement the determined measures. Through awareness raising, the government improves mainstream understanding of climate change and its impacts, thus triggering behavioural change and increasing individual responsibility.

The DAS is scientifically based on an analysis of the climate ensemble of regional climate models, which is based on the three emission scenarios. In establishing the action fields, the DAS considered long onset as well as short onset phenomena, differentiating potential adaptation options into the following action fields:

Table 1 Action Fields of the German Adaptation Strategy (DAS)

• Human Health	• Construction industry
• Soils	• Biological diversity
• Agriculture	• Forestry
• Fishery	• Energy sector
• Finance and insurance sector	• Traffice and transport infrastructure
• Industry and commerce	• Tourism
• Water balance, water management, coastal and marine protection	

In addition, the DAS analysed two cross-sectoral topics in significantly more detail: 1) Spatial, regional and urban development planning; and 2) Civil protection and disaster control. Most federal states use these action fields in their state adaptation strategies and plans, refining and shifting priorities according to their local needs. The DAS is thus a baseline document made official at a later stage of its development.

In August 2011, the Federal Government released the Adaptation Action Plan of the German Adaptation Strategy (APA I – *Aktionsplan Anpassung der Deutschen Anpassungsstrategie*) as a follow-up to the DAS (Bundesregierung, 2008). This report is an advancement of the DAS, defining how the adaptation process should look and how to achieve the DAS goals. APA I laid the building blocks for adaptation to climate change in Germany, establishing that the sector departments would finance all the DAS activities, which thus do not require their own budget line. The most important elements of the APA I are the overlapping **DAS principles** and **DAS pillars** which are listed in Annex a.

The operational section of the APA I lists 150 activities, organised along the pillars above and structured by the action fields, leading institutions or partners, project period, status, source of finance and budget.

2.1.1.1 The Indicators for the German Adaptation Strategy

By the close of 2010, the team of experts released the first version of the indicator system, although it was not yet officially adopted (Schönthaler et al., 2011). The team designed a list of 126 indicators, 75 of which could be viewed as ‘qualified’ for validation. The team divided the indicators into ‘impact indicators’, describing the climate change-induced conversion, and ‘response indicators’, describing the ‘system reaction’ to that change. They covered all 15 action fields of the DAS.

Table 2: Tentative indicators. Source: (Schönthaler et al., 2011)

Action Fields and Cross-sectorial Fields	**Indicators**			
	Impact	Response	Total	For further elaboration
Human Health	9	4	13	11
Building sector	3	4	7	6
Water balance, water management, coastal and marine protection	9	4	14	13
Soil	2	4	6	5
Agriculture	8	11	19	13
Woodland and forestry	7	7	14	14
Fishery Marine Fishery Freshwater fishing	4	3	7	5
Energy sector (conversion, transport and supply)	4	4	8	8
Financial services industry	2	3	5	3
Transport, transport infrastructure	4	4	8	7
Trade and industry	2	3	5	3
Tourism industry	5	1	6	5
Spatial regional and physical development planning		9	9	7
Civil protection	2	3	5	3
Sum	**62**	**64**	**126**	**103**

The initial set-up phase resulted in the establishment of the Vulnerability Network (*Netzwerk Vulnerabilität*) in 2011. The BMU and UBA initiated this network to fulfil the APA I (2011) requirement of working across sectoral departments and delivering a progress report by the end of 2015. The IMAA mandated that the network also participate in preparing the report.

Table 3 List of the Vulnerability Network members – translated. Source: (adelphi et al., 2015)

- Federal Office of Civil Protection and Disaster Assistance
- Federal Agency for Nature Conservation
- Federal Maritime and Hydrographic Agency
- Federal Office of Economic Affairs and Export Control
- Federal Institute for Geosciences and Natural Resources
- Federal Institute of Hydrology
- Federal Highway Research Institute
- Federal Agency for Technical Relief
- Federal Office for Building and Regional Planning
- Deutsche Gesellschaft für Internationale Zusammenarbeit
- German Meteorological Service
- The Thünen Institute
- Kreditanstalt für Wiederaufbau (German Development Bank)
- Project Management Agency of the German Aerospace Center
- Robert Koch Institute
- Federal Environmental Agency

The Vulnerability Network combines the technical and methodological expertise of different sectors. A scientific consortium supports cooperation between the associated agencies. It is responsible for developing the methods, conducting the vulnerability analysis in cooperation with the network, and facilitating regular exchange. The consortium prepares the basis for decisions and next analytical steps, which are then agreed upon in a joint meeting. Over the course of three years, the network and consortium met eight times. State agencies supported the work by providing data, results and technical expertise and were involved through the StA AFK. The network delivers its results to the IMAA.

2.1.1.2 Monitoring and indicator development

During this period, the working groups, committees and other institutions began operationalising the political process on adaptation. They based political steering on the IMAA and pursued two working lines – 'vulnerability' and 'adaptation monitoring and indicators'. The large number of public service stakeholders and complexity and novelty of the topic posed a major challenge. A pre-condition for both working lines, particularly for DAS monitoring and indicator development, was to not overlap with existing federal and state monitoring systems.

The requirements for the DAS monitoring and indicator system were as follows:

- Indicators should have a clear cause-effect relationship to climate change
- Indicators should be closely linked to the DAS
- All 15 action fields should be represented
- Indicators should be scientifically sound over a longer period of time
- Initial input data should already exist and be available for all German regions and states
- The indicator system should be designed so as to further develop alongside the ongoing research on adaptation

This proved to be quite a challenging set of requirements. The DAS is a political document, not a scientifically-validated paper. In 2008, both adaptation science and the political discourse was still young, which together with administrative alignment across federal sector departments, resulted in a heterogeneous document. Nevertheless, its goal was to serve as a foundation for the indicator system, which was to be scientifically justified.

The DAS indicator system and consecutive monitoring report were developed in six phases:

1) Narrowing down the adaptation themes
2) Prioritizing the (sub-) themes to be covered
3) Drafting indicator ideas and specifying the indicators
4) Political agreement of the DAS indicators
5) Preparing the monitoring report
6) Political agreement of the monitoring report[1]

Six years later, under the leadership of the IMAA and StA AFK, and with the contribution of 450 individuals from federal and state government agencies, federations, associations, academia and business corporations, the team of experts finalised the indicator and monitoring systems. The systems consisted of the following elements:

- List of 102 agreed-upon DAS indicators organised by action fields

[1] (Schönthaler et al., 2015a)

- Indicator factsheets to explain the climate change cause-effect relationship and keys for interpretation
- Indicator data sheets (spreadsheets) with explanations to compute the indicators and related graphics
- Background papers for the development of indicators related to action fields and cross-sectional themes
- Indicator-based monitoring report
- Bibliography
- Handbook with descriptions of processes and procedures for reporting consolidation
- Contact file for each contributing expert

The 102 indicators are divided into 55 impact indicators that describe the impact of climate change, 42 response indicators that document adaptation responses and five cross-sectoral indicators that represent the overarching activities of the Federal Government (Ministerium für Landwirtschaft und Umwelt des Landes Sachsen-Anhalt, 2015).

The selection of indicators is based on a valid or plausible linkage to climate change. This does not mean that the indicators measure climate change directly, since other influences may impact individual indicators. The indicators thus do not describe climate change quantitatively.[2]

From 2015 onwards, the work initiated in 2011 finally produced written results. The team of experts published these results in short succession (see: Figure 1). The most relevant reports from 2015 are the DAS Monitoring Report 2015 and APA II.

The DAS Monitoring Report 2015 extensively covers each indicator, organised by action area. It can be considered the baseline report that spearheaded the development of the indicators. The second monitoring report was published by the close of 2019 and includes a direct comparison between itself and its predecessor report.

The more interesting of the two is APA II. While the first report focused on the adaptation process itself, the second report opened up to include interlinkages with other German and international policy processes, such as the EU Adaptation Strategy, the 'Protection of Critical Infrastructure', the 'German Commodity Strategy' and others. APA II also reviewed the implementation of other measures, including 43 finalised projects, 78% of which are running.

What was new in APA II was the consolidation of the 15 action fields into six 'clusters'. An analysis of the 300+ impact relations between the 15 action areas revealed action fields that are strongly related or have similar impact, such as coastal protection and fishery. (See Annex B)

Clusters with similar spatial extents or impacts that are covered by different departments are now interlinked, such as spatial planning and civil protection.

Recommended literature for institutional learning on adaptation are

1) the 'Manual for the consolidation of indicator-based reporting on the implementation of the German Adaptation Strategy to Climate Change (DAS)'; (Schönthaler et al., 2015b)

[2] The technical issues about the indicator monitoring system will be discussed in chapter 3.1.

2) the ‘Methodology for the evaluation of the German adaptation strategy’; and
3) the ‘Guidelines for climate impact and vulnerability assessments’.

Documents one and two describe the organisation and workflows used to set up the adaptation monitoring system. Their target audience is new public servants that get involved at varying points of the process. Only the second is available in English. As the title explains, the third is a guidebook for vulnerability analysis. It refers to but is not dependent on the German adaptation process, comparable with the GIZ Vulnerability Source Book, only more recent.

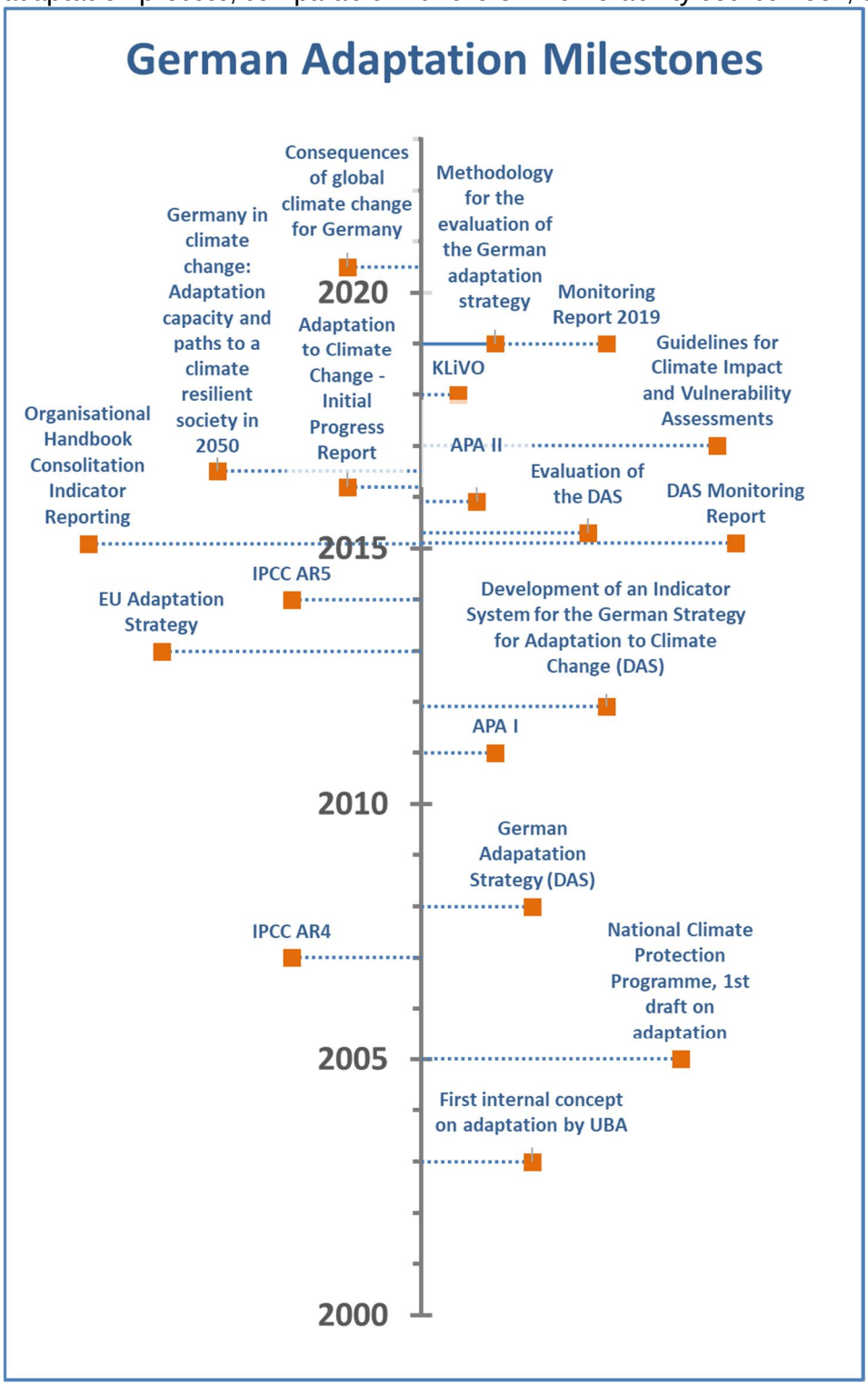

Figure 1: Timeline of adaptation (federal level) in Germany 2003 – 2020. By the author

2.2 Climate Adaptation in the EU

In December 2019, Ms. Ursula von der Leyen, Head of the European Union (EU) Commission, presented the 'European Green Deal' (The European Green Deal, 2019) – a concept to achieve a CO^2-neutral EU, making Europe the first climate neutral continent. The time plan of the Green Deal indicates a new Adaptation Strategy in 2020/2021. In May 2020, the EU released the blueprint for the new Adaptation Strategy. The strategy will be discussed at the end of this chapter.

Before we dive deeper into the EU's adaptation activities, we will quickly review the institutional set-up of the European Union. The EU is a political and economic union of 27 sovereign member states. It is not a sovereign federal state. What differentiates the EU from a sovereign state is the following: Member States are sovereign bodies that agree to a supranational merger. The EU, as well as its member states, directly elect representative bodies. The member states are integrated into the EU multi-state polity through the principle of subsidiarity (Golub, 1996) quoted by (Gemmer et al., 2011).

The EU is comprised of the following political bodies:

- The Council of the European Union: representing member state governments;
- The European Council: the body of heads of states and governments;
- The European Parliament: elected by and representing European citizens;
- The European Commission: the European executive, although with limited power in comparison to a national executive.

The EU Commission is in essence the executive body of the EU. It ensures the correct implementation of European legal acts such as directives, regulations and decisions, and implements the EU budget and agreed-upon funding programmes. Technical implementation is done by the sovereign member states. The EU finances investments according to agreed programmes. It builds capacity and accelerates innovation and exchange. The Member States are however responsible for legal and physical (infrastructure) realisation.

In contrast, China is a unitary sovereign state structured into 34 provinces. China's National People's Congress has comparable functional similarity to the European Parliament or the national parliaments of the member states. In contrast to the EU's principle of subsidiarity, decision-making in China is more centralised. It has stronger systems to insure the accountability of provincial and local agencies upwards to the central government agencies (Dryer, 2009).

Despite the differences, both polities face the common challenge of how to promote adaptation to climate change in the context of multi-level governance and diverse conditions.(Gemmer et al., 2011). This is a significant impetus for exchange and mutual learning.

Publishing the first Adaptation Strategy of 2013 and preparing for the second was a long process (European Commission, 2013). It began in 2000 with the European Climate Change Programme (ECCP). The ECCP's intention was to implement the commitments made by the EU under the Kyoto Protocol. It was signed by all member states in 2002. The ECCP was updated in 2005. This was the first official programmatic mentioning of 'adaptation to climate change' in the EU context.

Two years after the ECCP 2, a series of documents were published in the EU, beginning with the **EU Green Paper**[3] in 2007 (European Commission, 2007). It examined climate change impacts on EU member states, including the 'external dimension' – the indirect effects of EU foreign policy and economic interests on non-EU member states.

The paper indicated the most vulnerable areas and economic sectors in Europe. It stated that 'early adaptation' is significantly more cost effective than bearing costs or residual damage, which would force EU member states into reactive, unplanned adaptation. The report clarifies the distribution of work and obligations between the EU, national, regional and local levels. The EU becomes responsible when climate impacts do not follow administrative boundaries and when the public sector has a decisive role, such as with land use/spatial planning, building codes and disaster management strategies. The EU is also responsible for sectors with strong pan-European integration such as agriculture, fisheries, energy networks and water.

The EU contributes by sourcing applied research for adaptation and by integrating adaptation into regional and community development programmes and funds.

In 2009, the related **White Paper** titled 'Adapting to climate change: Towards a European framework for action'[4] was published. It sets out a framework to reduce the EU's vulnerability to climate change and was built on the consultation triggered by the Green Book in 2007. The White Paper's key message is to overcome 'autonomous adaptation' to avoid maladaptation. This calls for a substantial EU Adaptation Strategy to provide orientation for the EU and its States. The Adaptation Strategy was to be developed by 2013. The EU Commission member actively took on its role to support, integrate and coordinate adaptation approaches.

The four pillars of the Green Book where modified as follows:

1. Building the knowledge base;
2. Integration into key EU policy areas;
3. Employing a combination of policy instruments (market-based instruments, guidelines, public-private partnerships) to ensure effective delivery of adaptation;
4. Stepping up international cooperation on adaptation.

A major deliverable of the White Paper was the Climate-Adapt platform (https://climate-adapt.eea.europa.eu).

[3] Green Papers are documents published by the European Commission to stimulate discussion on given topics at European level. They invite the relevant parties (bodies or individuals) to participate in a consultation process and debate on the basis of the proposals they put forward. Green Papers may give rise to legislative developments that are then outlined in White Papers. (from: EUR-Lex Glossary of summaries, https://eur-lex.europa.eu/summary/glossary/green_paper.html, access 25.08.2020)

[4] European Commission White Papers are documents containing proposals for European Union (EU) action in a specific area. In some cases, they follow on from a Green Paper published to launch a consultation process at EU level. The purpose of a White Paper is to launch a debate with the public, stakeholders, the European Parliament and the Council in order to arrive at a political consensus. (from: EUR-Lex Glossary of summaries, https://eur-lex.europa.eu/summary/glossary/white_paper.html, access 25.08.2020)

2.2.1 The first EU Strategy on adaptation to climate change

The Green and White Papers resulted in the Adaptation Strategy, which aims to 'contribute to a more resilient Europe.' To meet this aim, the strategy defines three objectives, which it seeks to deliver on and implement through eight actions (see Table 4).

Table 4: EU Adaptation Strategy, Objectives and Actions

Objectives	Actions
Promoting action by member states	1. Encourage all member states to adopt comprehensive adaptation strategies
	2. Provide LIFE funding to support capacity building and step up adaptation action in Europe
	3. Introduce adaptation in the Covenant of Mayors framework
Better-informed decision-making	4. Bridge the knowledge gap
	5. Further develop Climate-ADAPT as the 'one - stop shop' for adaptation information in Europe
Climate-proofing EU action: Promoting adaptation in key vulnerable sectors	6. Facilitate the climate-proofing of the Common Agricultural Policy, the Cohesion Policy and the Common Fisheries Policy
	7. Ensuring more resilient infrastructure
	8. Promote insurance and other financial products for resilient investment and business decisions

The Adaptation Strategy was published in 2013. It reflects the institutional set-up of the European Union, where member states are sovereign and the EU's role is to engage and support them. As mentioned above, legally-binding directives require supranational approval. This means that the EU provides opportunities to members states through financial support (Action 2: LIFE Programme) and knowledge sharing (Action 5: Climate ADAPT Platform). Furthermore, the EU supports 'good and responsible governance' by pushing public-welfare topics like climate-proofing to reduce risk for our societies. Another type governance support is the support of the 'Covenant of Mayors' initiative[5] as an example of knowledge for local adaptation strategies and awareness raising, which is voluntarily committed to implementing EU climate and energy objectives to extend its activities on adaptation to climate change. Another example is the Horizon 2020 Project "RESIN[6]" created the Climate Risk Typology and Adaptation Options Library (see factsheet). It addresses urban adaptation strategies by developing standardised methodologies and decision-support tools.

The shift from 'laying out the adaptation map,' learning and technical justifications in the Green and White Papers to more coherent political action for the wellbeing of European (and other) citizens is visible in the Adaptation Strategy. The European Adaptation Strategy sets out a framework and mechanisms to significantly enhance the EU's preparedness for the current and future impacts of climate change. The responsibility to act, however, remains with the member states.

[5] The covenant of Mayors for Climate & Energy is an initiative by thousands of local governments voluntarily committed to implementing EU climate and energy objectives. Further information https://www.eumayors.eu/

[6] RESIN: Climate Resilient Cities and Infrastructures. It is an interdisciplinary, practice-based research project investigating climate resilience in European cities. Implemented 2013 – 2016)

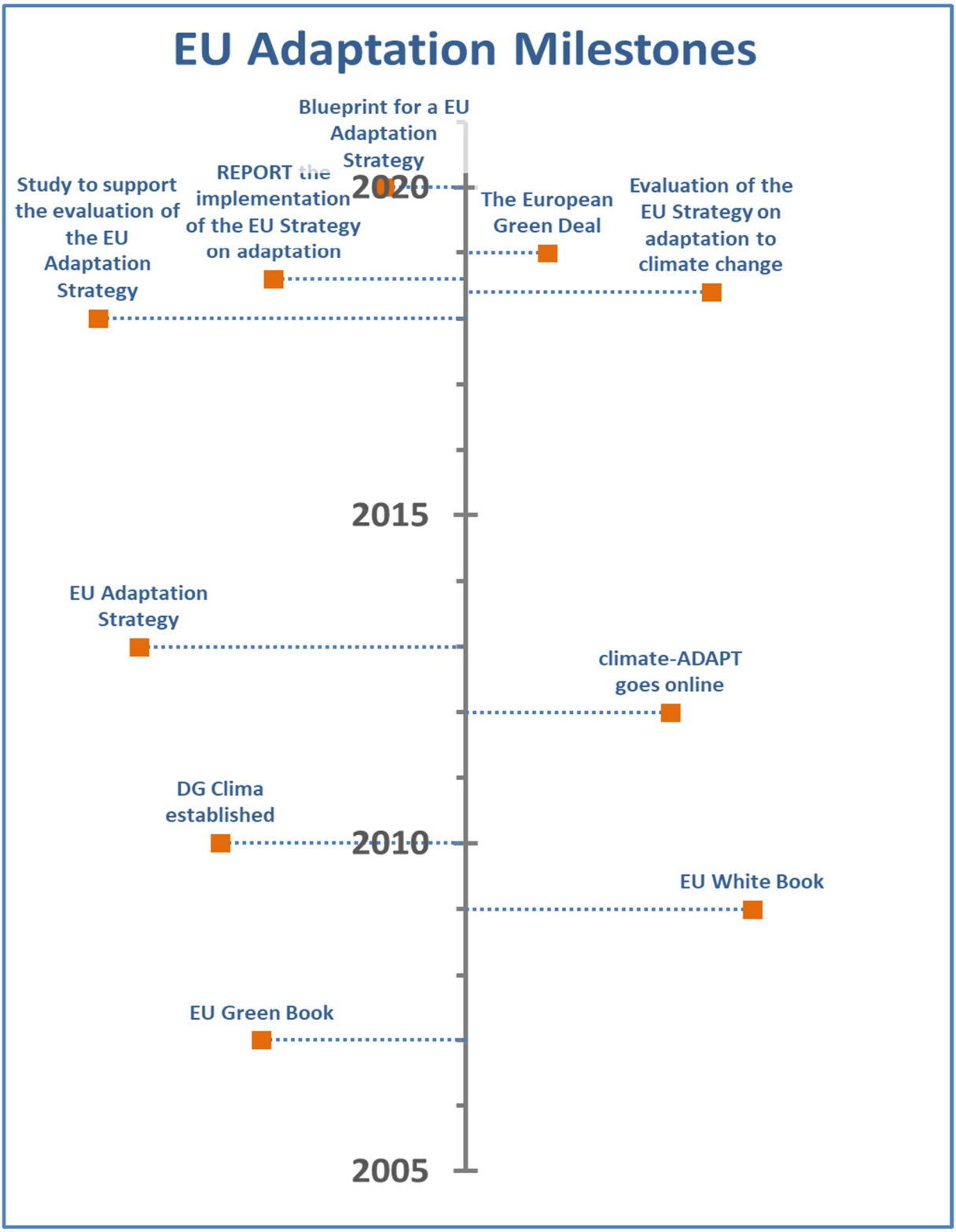

Figure 2 EU Adaptation Milestones. By the author

2.2.2 The revision of the EU Adaptation Strategy in the light of the 'European Green Deal'

On December 11, 2019, Ms. Ursula von der Leyen, Head of the EU Commission, proposed the European Green Deal, which aims to make Europe the first 'climate neutral' continent. The goal is to get net emissions to zero by 2050. It consists of many regulations in the finance market and the energy, mobility, trade, industry, agriculture and forestry sectors. The budget is 100 billion EUR. The European Green Deal is one of the EU Commission's six priorities for the 2019-2024 period.

The 2019-2024 EU priorities, particularly the Green Deal, are pushing EU policy to be more in line with the SDGs and Paris Agreement. In May 2020, the Commission published its blueprint for a more ambitious Adaptation Strategy. According to the document, the 'ultimate goal of climate action is to protect people, planet and prosperity against the impacts of climate change.' This is a far broader goal than the previous one of increased resilience. It explicitly integrates mitigation, adaptation and the global perspective. It sets the goal to ensuring the welfare of EU citizens, the natural environment, cultural heritage and economic assets. Consequently, the new strategy also tackles new priorities pushed by the New Green Deal like Biodiversity, Farm to Fork, Forestry, the Climate Pact, the Sustainable Build Environment and Renovation Wave.

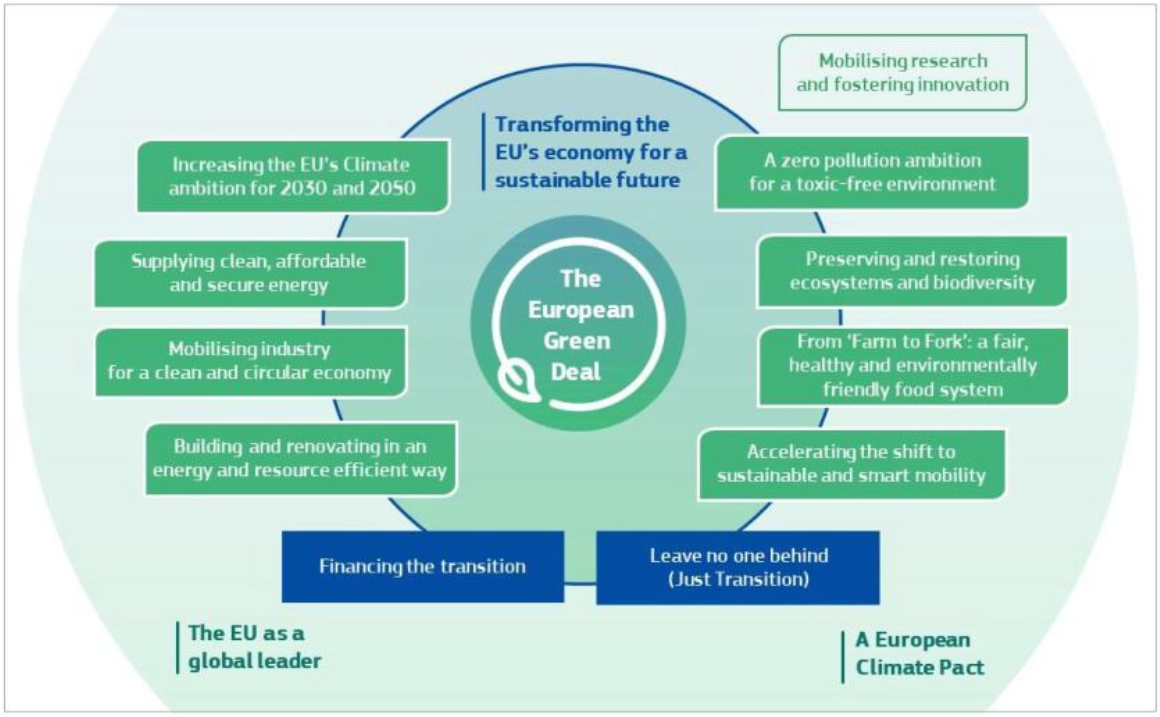

Figure 3: The European Green Deal. Source: European Commission (2020)

The blueprint warns that that the current global contributions to the Paris Agreement only limit the temperature increase to 3°C – not below 2°C. For the EU, a 3°C temperature increase would result in a minimum annual loss of 170 Billion EUR per year or 1.36% reduction of GDP. It points out that even with the monitoring of adaptation measures and activities, 'it is not possible to determine with any certainty whether decisive progress in increased resilience at the EU level has been achieved by 2020.' This is a critical issue and a matter for further research.

In comparison to previous reports, this blueprint is aligned with the UN global goals, referring explicitly to other UN guidelines, such as the Sendai Framework for Disaster Risk Reduction. The blueprint is action-oriented. It systematically reviews the work that 'is done' and addresses 'what more needs to be done.' While the pillars of the 2013 Adaptation Strategy were considered, the structure was changed to a general value-oriented setting, as follows: "People – Planet – Prosperity" and the following action-oriented topics:

1. More and better data
2. Deeper knowledge and faster deployment of solutions
3. Closing the climate protection gap
4. Preventing damage to infrastructure and beyond
5. Adapting forests and other ecosystems for an adapting society
6. Oceans
7. Reinforced global action for climate resilience

The blueprint uses the same instruments as in the first adaptation strategy. It receives its funding through established and new funding programs, as well as research and knowledge management, although it is by far more ambitious. As part of the New Green Deal the EU Commission issued a proposal for an EU Climate LAW[7], to achieve a climate neutral Europe by 2050 in a socially-fair and cost-efficient manner. The adaptation strategy shall support this and shall strengthening the efforts on climate-proofing, resilience building, prevention and preparedness. The objective is that any stakeholder can integrate climate change into her/his risk management practices.

2.3 A comparison: The German Climate Preparedness Portal "KLiVO" and European "Climate-ADAPT" Information Portal

2.3.1 The German Climate Preparedness Portal - KLiVO (www.klivoportal.de)

The German KLiVO portal compiles data and information on climate change and adaptation measures in Germany. Available in German and English, it responds to the large amount of information on climate change adaptation by organising and disseminating climate information and verified climate data. The service is free of charge.

The portal structures data and information according to the DAS[8], making access easy for public administration. KliVO develops and frequently updates the climate preparedness measures based on state and federal agencies and municipalities. The German Environment Agency (UBA) and German Weather Service (DWD) accompany the portal by providing networking opportunities for relevant actors.[9]

Aim: KLiVO aims to support relevant actors in taking adequate measures in response to climate change, including identifying climate impacts on a scientific basis, making informed decisions on taking action, planning and conducting measures and evaluating their impact.

[7] https://ec.europa.eu/clima/policies/eu-climate-action/law_en

[8] The shift by the DAS-Monitoring Report from "action fields" to "clusters" is not consistently implemented – may be for a good reason: most state and municipal adaptation plans are organised along action fields.

[9] Umweltbundesamt. (2018, September 25). Vorgestellt: Das Deutsche Klimavorsorgeportal. Retrieved July 29, 2020, from https://www.umweltbundesamt.de/vorgestellt-das-deutsche-klimavorsorgeportal-0

Target groups:

- Federal government
- Federal states
- Municipal level in developing strategies and measures
- Businesses
- Associations
- Civil society
- Citizens[10]

Data and information: KLiVO compiles information and scientific research on adaptation strategies on the national, federal and municipal levels. KLiVO edits these 'Climate Protection Services' (*Klimavorsorgedienste*) into factsheets. In total, the platform makes 127 factsheets available, including maps, climate information, networking opportunities, practical support, studies, qualification and consulting services, laws and norms as well as knowledge portals and webtools.[10] To easily access the information they need, users can filter the factsheets according to the following criteria:

- Aim
- Action field
- Climate variables
- Climate impact
- Region
- Target group
- Federal state
- Category of tool

The factsheets include a short description of the intervention, its target group, its scientific background and relevant climate variables. The factsheet also includes information on the category of the tool, the publisher and date of publication of the information and links to further information (BMU, n.d.). If users have further inquiries, KLiVo provides contact information for the services listed on the factsheets as well as links to relevant networks, such as the German Climate Service (DKD), KlimAdapt Networks and institutions like UBA and DWD.

The portal mainly serves the purpose of bundling information from various relevant sources. Users can submit new programmes or services through a contact sheet with the relevant information. Like the existing services, an independent expert team reviews the submission according to its relation to climate change, applicability in the wider German context, timeliness, scientific validity and accessibility, and then verifies the submission (BMU, n.d.).

[10]Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU). (n.d.). KLiVO Portal - FAQ. Retrieved July 29, 2020, from https://www.klivoportal.de/DE/FAQ/faq_node.html

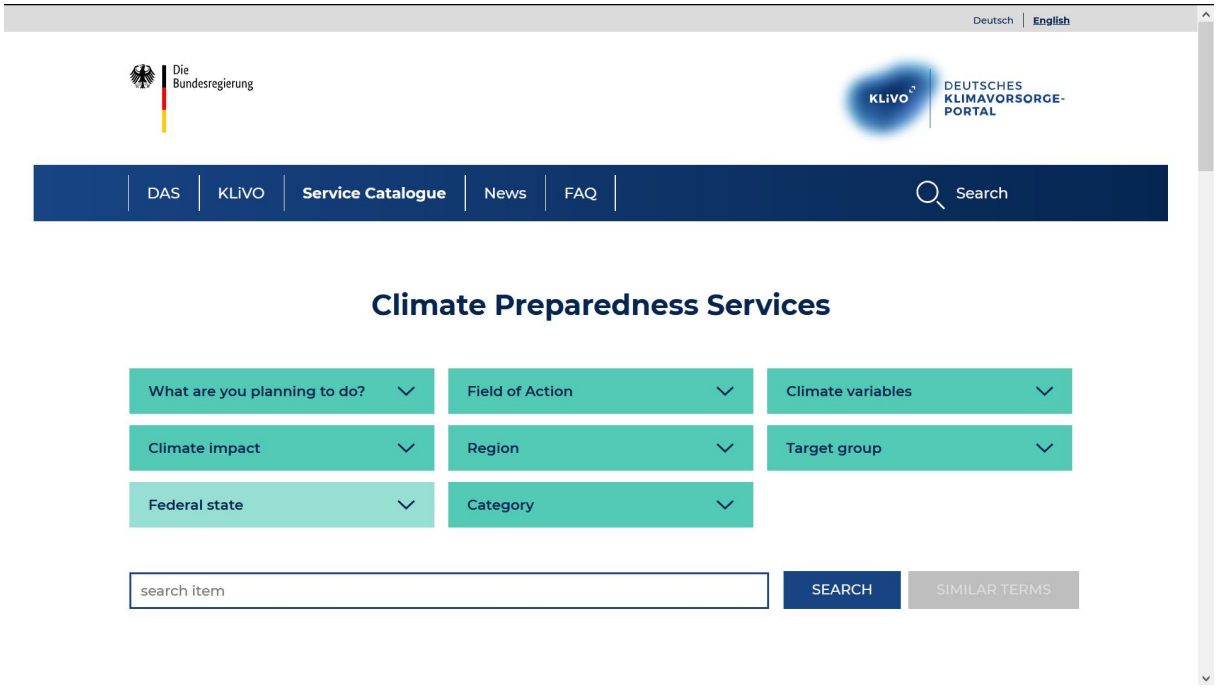

Figure 4 Filters of the climate preparedness services (derived online 28.07.2020 from: klivoportal.de)

2.3.2 The European Commission One Stop Climate Information Portal Climate-ADAPT (https://climate-adapt.eea.europa.eu/)

The European Climate Adaptation Platform (Climate-ADAPT) is a partnership between the European Commission (EC) and the European Environment Agency (EEA). It consists of a database of quality-checked information to support decision-making on the EU, national and regional levels. Launched in 2012, it seeks to overcome the lack of a consistent knowledge base on adaptation policies and tools. It is a 'one-stop shop' for adaptation information in Europe (Umweltbundesamt, 2015).

Aim: The portal aims to support Europe in adapting to climate change by providing users with easily-accessible open information and data on:

- Expected climate change in Europe
- Current and future vulnerability of regions and sectors
- EU, national and transnational adaptation strategies and actions
- Adaptation case studies and potential adaptation options
- Tools that support adaptation planning (*Climate-ADAPT*, n.d.-a)

Target group: Decision-makers on the EU, national and regional levels responsible for the development and implementation of climate adaptation measures and strategies.

Data and information: The platform mainly operate as a meta-platform and refers to further (mostly external) sources. The database currently consists of 2,148 quality-checked items, including publications, reports, maps, graphs, datasets and indicators ("European Climate Adaptation Platform Climate-ADAPT," 2012). Descriptive texts accompany the links to external information. The information providers carry out the quality assurance (including peer review procedures) of the information presented. The team at the EEA and the European Topic Cen-

tre on Climate Change Impacts, Vulnerability and Adaptation (ETC/CCA) ensures that the quality of metadata in the database follows agreed-upon rules. The individual pages include disclaimers and provide information on relevant sources.

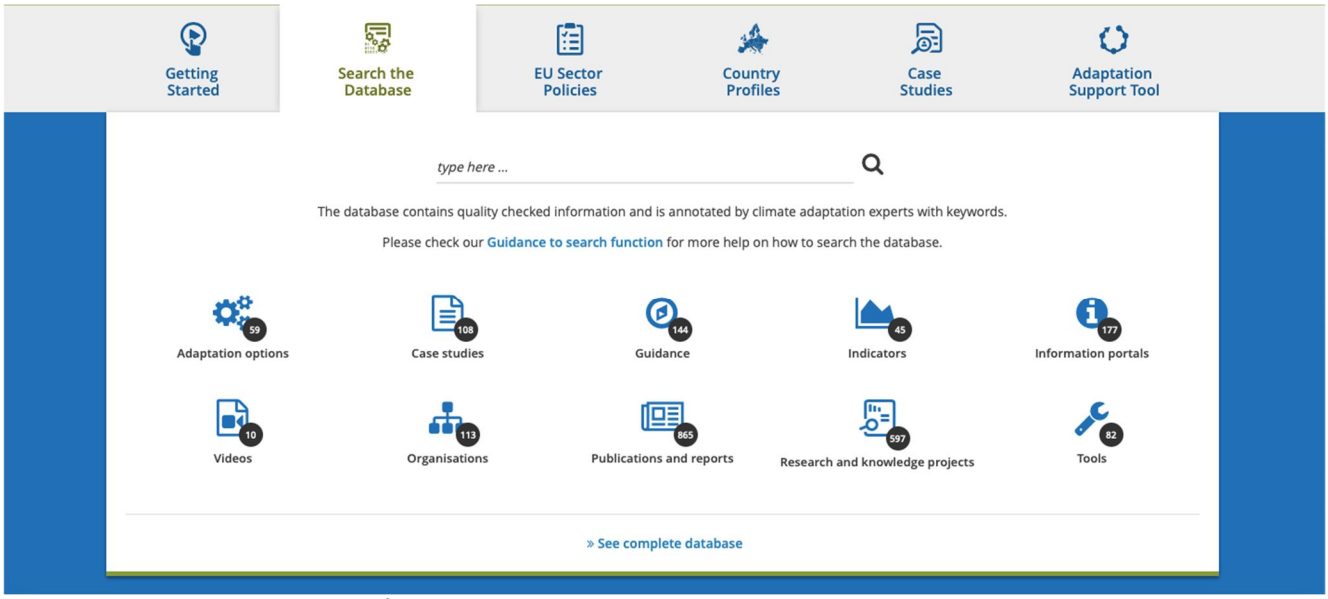

Figure 5 Overview of Climate-ADAPT´s structure database contents (Derived Online 28.07.2020 from: https://climate-adapt.eea.europa.eu)

The portal is organized under the following main entry points:

- EU policy: EU adaptation policy, adaptation in EU policy sectors (agriculture, biodiversity, coastal areas, forestry, water management, marine and fisheries, ecosystem-based approaches, disaster risk reduction, buildings, energy, transport, health, urban), EU regional policy
- Countries, transnational regions, cities
- Knowledge: Topics, data and indicators, research projects, tools, practice
- Networks

The Climate-ADAPT database provides access to all relevant sources of information by using tailored search criteria, allowing for a quick overview by screening the metadata available for each information source. The database structures information into nine different types of data and organises that information into 14 sectors, seven climate impacts, five adaptation elements, different geographic levels and years. Beyond the database, the portal also provides guidance through the Climate-ADAPT Adaptation Support Tool (*Climate-ADAPT*, n.d.-b). This helps users develop their own adaptation approaches that are consistent with the adaptation policy cycle. Webinars and information videos guide new users, supporting them in efficiently navigating the website and using its contents. The videos are adapted to the needs of actors on the local, national, regional and European levels (*Climate-ADAPT*, n.d.-c).

Actors that wish to share their knowledge or tools can submit adaptation activities on the website. The criteria for information provided include language of submission, relevance in the European context and type of contribution. Providers are guided through the submission process, while an independent expert team is responsible for verifying the information.

3 Methodological approaches

3.1 Measuring Adaptation: Indicators and Monitoring

This chapter covers and discusses indicator development from a technical point of view.

As described earlier in the overview of the political process, the design process for the DAS indicator system required a major joint effort. This was due in part to the novelty of the topic, but also included scientific and methodological challenges.

The combination of the requirements from the political domain and scientific methodology, combined with the development over time, could only be addressed well with great effort. The success of the indicator development, despite political and technical ambivalence, can be attributed to the good work and high level of commitment of the Federal Environment Agency and the interministerial and joint national – state level working groups. As a reminder, the main task entailed creating a proper administrative process for a cross-sectoral topic in a federally-organised state, which could also be represented financially.

The following aspects were relevant for the selection of the indicators:

- Each indicator should have an explicit cause-effect relation to climate change. So-called '**impact indicators**' should at least be partly influenced by the impact of climate change. The '**response indicators'** should describe activities that either describe or prevent the adaptation process;

- The data for the indicator compilation should be already available and likely available in the future. The explicit methodological requirements were:
    - Criteria for the **data sources**: independence, data transparency, actuality, punctuality, data availability;
    - Criteria for the **data basis**: time series presentation, completeness, accuracy, coherence;
    - Criteria for the **derivation of indicators**: effort of the indicator derivation, requirements of the method/method quality;
    - Criteria for **relevance**: political relevance, public/media coverage and relevance;
    - **Meta assessment**: validity and representativeness of the key figure, as well as comprehensibility (Schlomann et al., 2016).

Documentation system: Three types of documents for transparency and replicability:

1. **Indicator factsheets** justify the indicator and locate them in the overall indicator system. They describe the explicit calculation procedure, referencing the data sources. Furthermore, they review the strengths and weaknesses of the indicators regarding interpretation, data availability, comprehensiveness and administrative responsibility.

2. **Indicator data sheets** are based on a spreadsheet table. They comprise all necessary data for calculation and graphical representation. In many cases, they also include metadata. Not all input data are crude data, and some are instead more complex and pre-processed separately.

3. **Sectoral indicator background sheets** are necessary because indicators should be based on existing data. Due to data gaps or quality constraints, this was not always possible. Some indicator developments therefore failed. This failing process had to be well documented because of repeated requests from the policy domain. Such 'dead end roads' had to be well documented to avoid renewed requests. Furthermore, the background reports were a valuable source of information for persons who joined the development process at a later stage.

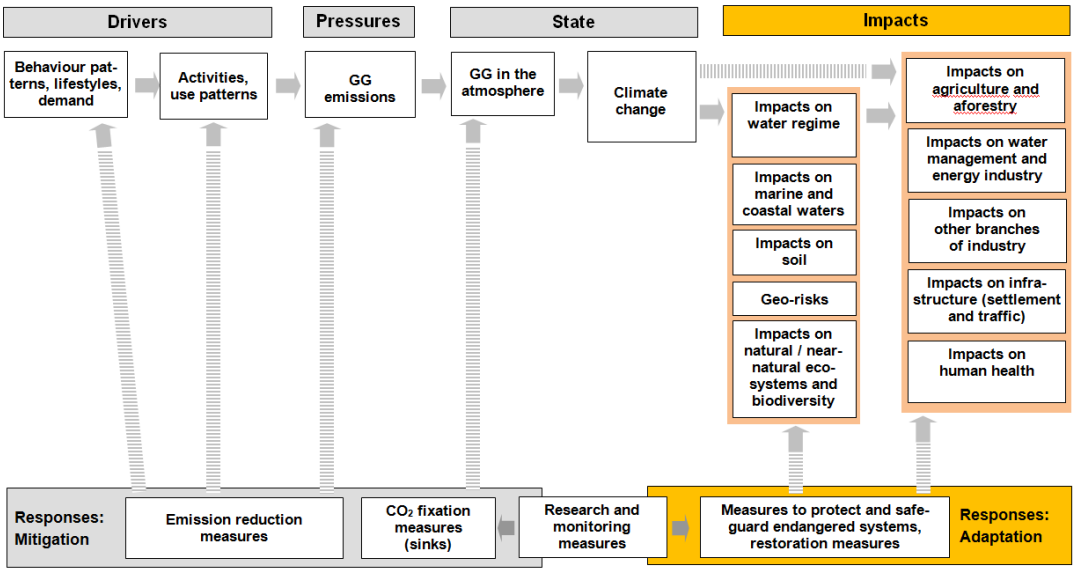

Figure 6: Impact and response category in the DAS Indicator System. Source: (Schönthaler et al., 2015a)

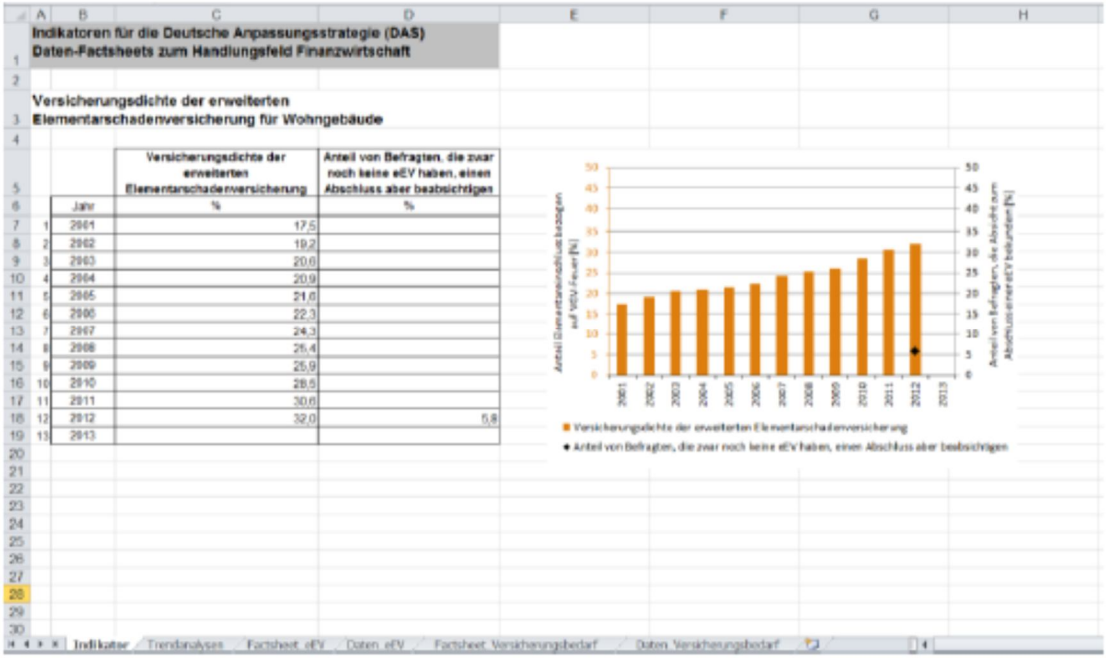

Figure 7: First table of the data sheet – Indicator. Source: (Schönthaler et al., 2015a)

Letzte Aktualisierung:	Datum	*Person(en) (unter Angabe des Namens und der Institution), die das Factsheet bearbeitet haben.* *Dieses Feld wird bei einer Aktualisierung nicht überschrieben.*
	Datum	*Für jede Aktualisierung wird eine neue Zeile hinzugefügt.*
Nächste Fortschreibung:	Datum	*Anlass einer voraussichtlichen Fortschreibung (z. B. wenn es in den einzelnen Ressorts Weiterentwicklungen im methodischen Bereich oder in der Datenerhebung gibt)* *Dieses Feld wird bei einer Aktualisierung überschrieben.*

I Beschreibung

Interne Nr. *Gemäß Konvention (s. Kap. 4.2)*	**Titel:** *Kurztitel des Indikators („Listentitel")*
	Wenn es sich um eine Fallstudie handelt, hier Angabe, für welchen Raum diese gilt.
Einheit: *Einheit, für die der Indikator berechnet wird (inkl. abweichende Einheiten für Indikatorteile und Indikator-Zusätze)*	**Kurzbeschreibung des Indikators:** *Langtitel des Indikators* *Wenn es sich um einen Proxy-Indikator handelt, wird hinter der Überschrift „Kurzbeschreibung des Indikators" ein „(Proxy)" eingefügt.*
	Berechnungsvorschrift: *Mathematische Formel zur Berechnung des Indikators, sofern es sich nicht um eine einfache Übernahme von Daten handelt* *Berechnungsvorschriften für Indikatorteile und Indikator-Zusätze werden separat aufgeführt und als solche gekennzeichnet.*
Einheit: *Einheit, für die der Indikator berechnet wird (inkl. abweichende Einheiten für Indikatorteile und Indikator-Zusätze)*	*Nur für Proxy-Indikatoren, sofern sich diese Angaben bereits machen lassen:* **Kurzbeschreibung des Indikators (perspektivisch):** *Langtitel des Indikators*
	Berechnungsvorschrift: *Mathematische Formel zur Berechnung des Indikators, sofern es sich nicht um eine einfache Übernahme von Daten handelt; im letzteren Fall wird diese entsprechend vermerkt (z. B. Daten können unmittelbar vom DWD übernommen werden)* *Berechnungsvorschriften für Indikatorteile und Indikator-Zusätze werden separat aufgeführt und mit Zwischenüberschriften als solche gekennzeichnet. Gibt es mehrere Indikatoreile, auf die sich Indikator-Zusätze beziehen können so ist dies entsprechend zu kennzeichnen („Zusatz zu Teil A").*
Interpretation des Indikatorwerts:	*Als Hilfestellung zur Interpretation insbesondere komplex berechneter Indikatoren oder von Indikatoren ohne Maßeinheit erfolgt hier eine Erläuterung, in welche Richtung hohe oder niedrige Indikatorwerte weisen. Dieses Feld trifft keine Vorgaben für eine inhaltliche Interpretation oder Bewertung des Indikators. Für Indikatorteile und Indikator-Zusätze werden hier differenzierte Aussagen getroffen.*

II Einordnung

Handlungsfeld:	*Angabe des Handlungsfelds der DAS, dem der Indikator zugeordnet wird (ist der Indikator für mehrere Handlungsfelder relevant, werden hier und in den beiden unten stehenden Feldern mehrere Angaben gemacht).* *Es können auch mehrere Handlungsfelder genannt werden; in diesem Falle sind diese durchzunummerieren (z.B. „1. Menschliche Gesundheit").*
Indikationsfeld:	*Angabe des Indikationsfelds, dem der Indikator zugeordnet wird; es können auch mehrere Indikationsfelder genannt werden; in diesem Falle sind diese durchzunummerieren und es ist über die Nummerierung deutlich zu machen, welchem Handlungsfeld das Indikationsfeld oder die Indikationsfelder zuzuordnen sind (z. B. „1.1 Gesundheitliche Auswirkungen von aerogenen Stoffen").*

Figure 8: Excerpt from the indicator fact sheet. (Schönthaler et al., 2015a)

The DAS indicator system as a whole should be led by the following constraints:

- All action fields and cross-sectoral topics should be represented
- The DAS indicator system should not overlap with existing specialised monitoring systems by the federal or state level, but instead be complementary

Table 5: Indicators for action fields and the cross-sectional themes

Action Fields and Cross-sectorial Fields	**Indicators**		
	Impact	Response	Total
Human Health	6	3	9
Construction	2	3	5
Water balance, water management, coastal and marine protection	10	3	13
Soil	2	3	5
Agriculture	3	2	5
Woodland and forestry	7	6	13
Fishery	2	-	2
Energy sector (conversion, transport and supply)	4	4	8
Financial services industry	3	1	4
Transport, transport infrastructure	2	-	2
Trade and industry	1	1	2
Tourism industry	7		7
Spatial regional and physical development planning	-	6	6
Civil protection	1	4	5
Sum	**55**	**42**	**97**
Overarching indicators	5		102

3.1.1 Discussion

A major concern was how to separate adaptation monitoring from other political climate change processes, such as the vulnerability assessment. With this example, a normative temporal split assisted with differentiation, as follows: Vulnerability describes the impacts of climate change from the present until the future, while adaptation monitoring describes the change triggered by climate change from the past to the present.

Even more difficult is identifying the additionality of climate change from 'regular' climate variability or other impacting influences. This is particularly important because adaptation indicators are primarily a means of communicating and documenting change. The indicator 'BO-I-1 soil moisture in agricultural soils' clearly reflects climate changes and is an indicator for drought; however, how can one separate the climate change part of the signal from climate variability? Another example is fire guards and civil and disaster protection services that help during heavy rains and floods. But what is a 'normal' flood and where does the 'climate change additionally' begin? Was the flood more severe due to poor spatial planning? This phenomenon happens with response indicators.

Over time, the existing indicators reveal how meaningful they are. New indicators based on new insights could be useful. The indicator system should thus be open for further development alongside scientific advances. This does, however, pose a monitoring challenge – to ensure comparability, indicators should be standardised and remain stable over time.

3.2 Vulnerability and Risk

The concepts of vulnerability and risk are central for tackling adaptation to climate change. Accordingly, they are important building blocks in the IPCC assessment reports. But between the IPCC AR4 (2007) and the IPCC AR5 (2014), the concepts changed fundamentally, creating a dilemma. In 2008, the DAS was released, with its European equivalent published in 2013. In 2008, the Saarland was the first German state to publish a climate protection and adaptation concept. Bavaria and Bremen published their own concepts in 2017 and 2018, respectively. This means that over the decade in which most states wrote their adaptation concepts, a major conceptual shift, or paradigm shift, occurred.

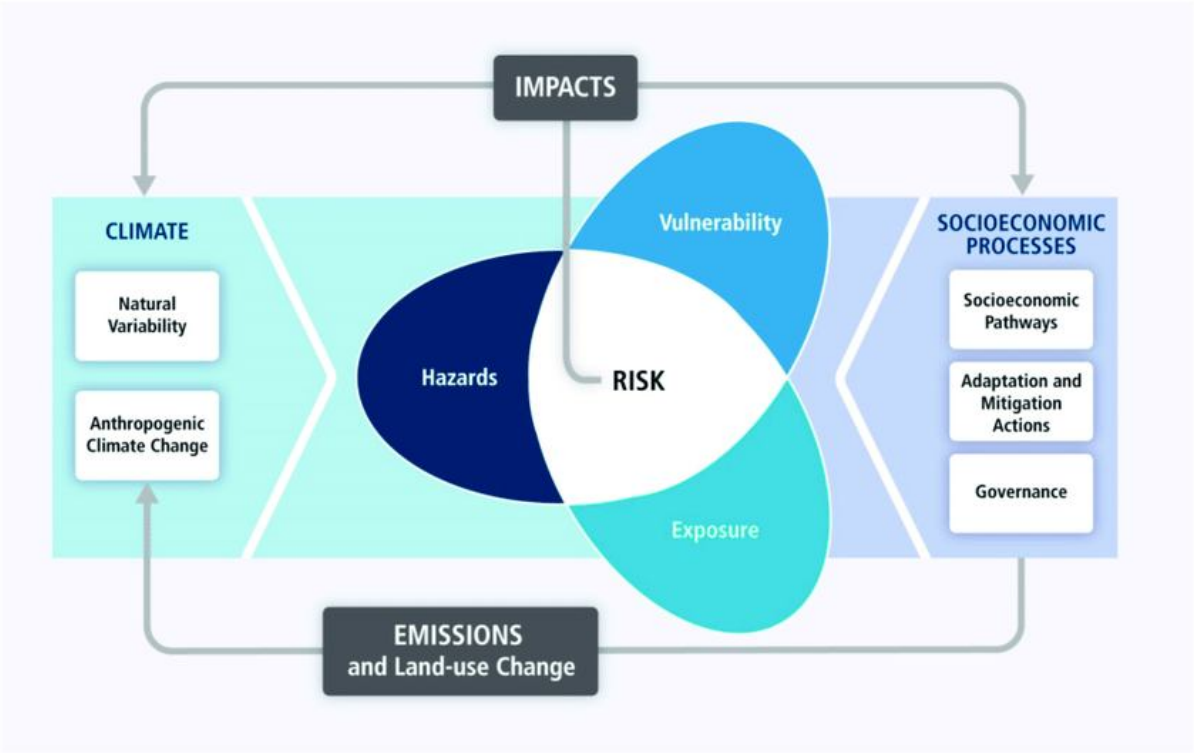

Figure 9: Graphical representation of Climate Change Risk in IPCC 5th Assessment Report (Oppenheimer et al., 2014)

IPCC AR4 2007	IPCC AR5 2014
Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. [p 29]	Vulnerability is the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. [p 39] Risk results from the interaction of vulnerability, exposure and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts. [p 40]

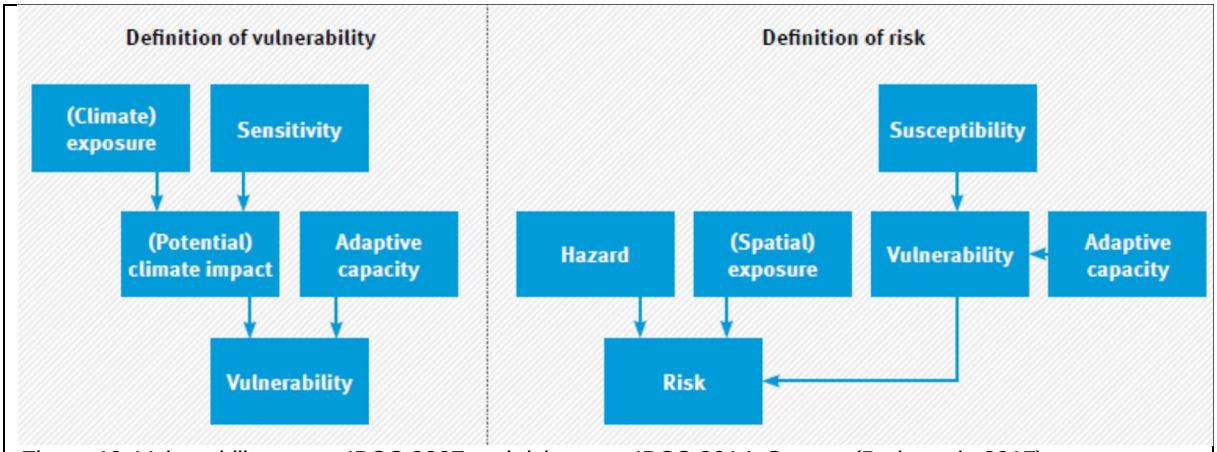

Figure 10: Vulnerability as per IPCC 2007 and risk as per IPCC 2014. Source: (Buth et al., 2017)

The vulnerability concept of AR4 focused more on the long-term incremental changes (long onset events) than hazards and risk. As a basic concept, risk is the probability of occurrence times the damage. As such, it is related to short onset events (hazards and disasters), which in the beginning were not strictly part of adaptation. The AR5 integrated the term 'risk' in the adaptation approach in order to integrate climate change-caused hazards into the concept (see: Figure 9). This combines the short and long onset events. Risk was thus also a feature of long onset events and consequently the probability of occurrence. This changed the long onset vulnerability analysis. Specific time reference and probability of occurrence are new requirements in the long onset analysis. This did not, however, need to be broken down into the 'engineering level'. Furthermore, the new definition of spatial exposure adds focus to the entity subject to change: Human beings, ecosystems, economic systems and resources. This increases the relevance of geography. These are the advantages, particularly for specific spatial infrastructures like a bridge or a harbour. With more dynamic systems such as cities, districts or (food) supply chains, vulnerability analysis is more complex and ambiguous.

The German Environment Agency (UBA) created a synthesis of both (see: Figure 11), which points out the relevance of adaptive capacity to deal with climate risk. This graphical presentation more clearly displays the difference of being able (or not being able) to (re)act to climate change (adaptive capacity) than the visualisation of the IPCC (see: Figure 9).

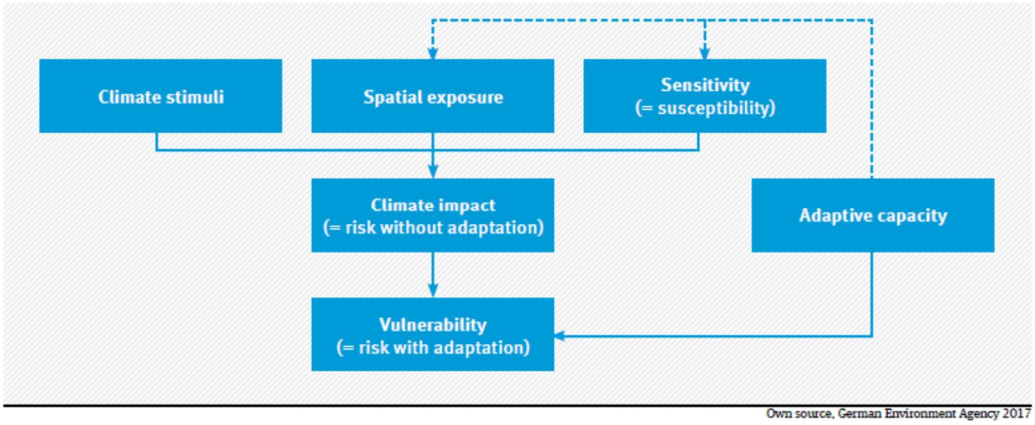

Figure 11: Combination of IPCC 2007 and IPCC 2014 Definitions. Source: (Buth et al., 2017)

Many of the federal states wrote their adaptation reports with the AR4 mindset. The GIZ Vulnerability Sourcebook, published in 2014 – weeks before the fifth assessment report with the major conceptual change – clearly highlights this dilemma.

A vulnerability analysis is only partially a scientific task and consists of the four following steps:

1. Climate and climate impact research
2. Climate impact evaluation
3. Adaptive capacity evaluation
4. Vulnerability evaluation

The vulnerability evaluation can only be done against a 'desirable state' – a condition that cannot be derived scientifically because it is a normative value-based foundation.

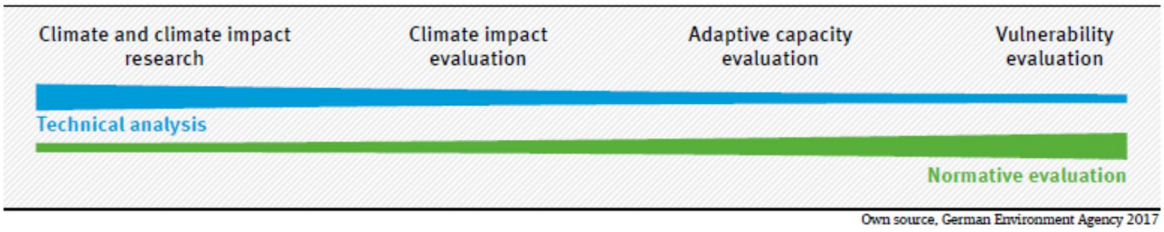

Figure 12: Balance between scientific analysis and normative assessment. Source: (Buth et al., 2017)

The IMAA 'Guidelines for Climate Impact and Vulnerability Assessments' summarises the experiences from the first Federal German Vulnerability Analysis, including the lessons learned from the vulnerability analyses conducted by the federal states. This report targets and seeks to facilitate the work of implementing agencies at the federal and state levels.

The difficulty that arises is that a significant part of the objective refers to normative values, which must be made transparent and visible.

4 Conclusions, outlook and transferability

The German adaptation process began informally in 2007. It quickly resulted in the formally adopted German Adaptation Strategy (DAS). In November 2019, the publication of the Monitoring Report even made it to the evening news! This should be considered a great success for the actors involved. The two leading committees, the Interministerial Working Group Adaptation (IMAA) and the Federal Ministry and the Standing Committee for the Adaptation to Climate Change Impacts (StA AFK) could now move the process forward.

The IMAA met 35 times over 12 years, amounting to about three meetings per year. The high investment on the part of the staff and the reports they produced is a major asset of the DAS. This would not have been possible without the professional services provided by the German Environment Agency (UBA), which hosted and supported the overall process, particularly the public service's Climate Adaptation Network. The setup of the adaptation monitoring system with 102 indicators was completed over six years. The sectoral background reports documenting the 'dead end roads' highlight the hard negotiations between the political and technical domains. This also resulted in a very well documented and openly communicated adaptation monitoring system, which has until today launched its second report. The reduction from 15 'action fields' to six clusters shows that a stronger differentiation is less beneficial than a reduced set of 'clusters' that help government agencies cooperate in this field.

Vulnerability, the second major process in the field of adaptation, suffered from its novelty – the necessary conceptional shift between the fourth and fifth IPCC assessment reports. The vulnerability assessments of most federal states and municipalities relied on the older conceptual framework. The 'Guidelines for Climate Impact and Vulnerability Assessments', a 'lesson learned' outcome of the first German federal vulnerability assessment, is a valuable source for future assessments. It is also important to mention that adaptation is always local, which is why the municipality and community levels, covered by the factsheets, are important.

Adaptation in Germany nevertheless lacks its own budget. It is limited by the capability and political will of the sectoral departments. A target-based financing scheme[11] behind which the ministries congregate would better focus the adaptation results. Currently, the monitoring system is used to document change. But how and where would this change result in political action? Could it trigger a new climate risk assessment? Could monitoring enhance the coherence between ministries or between the federal and state levels?

The transferability of the 'German case' must be discussed openly. Relevant key questions are:

- ***Is an orientation along policy cycles possible?***
- ***Can cross-departmental thinking and working be triggered?***
- ***Is a mutual cooperation between the federal and state levels possible?***
- ***Is it possible to create climate adaptation networks between Government agencies?***

At the EU Commission the Green New Deal appears to become a game changer. It sets the goal of a climate neutral European continent in 2050. The role of the proposed adaptation strategy is broader towards an approach to assess and cope with knowledge gaps and climate risks. By this, the Green New Deal follows the changes from vulnerability to risk in the AR5. This might be an indication for adaptation in China.

In the past, the first adaptation strategy focuses on a) research and knowledge management and b) funding of structural change by its different development funds. Especially the research produced methods and applications, like the risk topology, which should be reviewed for consideration. Since the responsibility for implementation is fully with the EU member states and not with the EU Commission, the situation is not easily comparable to China with its more centralised political and administrative structure.

[11] The BMZ made the shift from county based to action field (special initiative) based finance scheme in development cooperation

References

adelphi, PRC, & EURAC. (2015). Vulnerabilität Deutschlands gegenüber dem Klimawandel. In Umweltbundesamt. Climate Change 24/2015. Dessau-Roßlau. doi: 10.1017/CBO9781107415324.004

BMU. (n.d.). *KLiVO Portal - Steckbrief*. Retrieved from https://www.klivoportal.de/SharedDocs/Steckbriefe/DE/UBA_APUG/APUG_steckbrief.html

BMU. (2005). *Nationales Klimaschutzprogramm 2005*. Berlin, Germany.

Bundesregierung. (2008). *Deutsche Anpassungsstrategie an den Klimawandel*. Berlin, Germany. Retrieved from http://www.bmub.bund.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/das_gesamt_bf.pdf

Buth, M., Kahlenborn, W., Greiving, S., Fleischhauer, M., Zebisch, M., & Schauser, I. (2017). *Guidelines for Climate Impact and Vulnerability Assessments*. Dessau-Roßlau.

Climate-ADAPT Website. (n.d.-a). Retrieved from https://climate-adapt.eea.europa.eu. Access 29.07.2020

Climate-ADAPT Website. (n.d.-b). Retrieved from https://climate-adapt.eea.europa.eu/#t-adapt. Access 29.07.2020

Climate-ADAPT Website. (n.d.-c). Retrieved from https://climate-adapt.eea.europa.eu/#t-started. Access 29.07.2020

European Climate Adaptation Platform Climate-ADAPT. (2012). In Climate -Adapt. doi: 10.2834/49551

European Commission. (2007). Green paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Adapting to climate change in Europe - options for EU action. In Official Journal of the European Communities. Brussels. Retrieved from https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52007DC0354

European Commission. (2013). An EU Strategy on adaptation to climate change. COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS. In COM(2013) 216 final. Brussels. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0216

The European Green Deal, 53 European Commission 24 (2019). Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019DC0640&from=EN

Gemmer, M., Wilkes, A., & Vaucel, L. M. (2011). Governing climate change adaptation in the EU and China: An analysis of formal institutions. *Advances in Climate Change Research*, *2*(1), 1–11. doi: 10.3724/SP.J.1248.2011.00001

IPCC. (1992). *Climate Change: The 1990 and 1992 IPCC Assessments*. Geneva, Switzerland.

Ministerium für Landwirtschaft und Umwelt des Landes Sachsen-Anhalt. (2015). *Sachsen-Anhalt Stand der Umsetzung der Strategie des Landes Sachsen-Anhalt*. Magdeburg.

Oppenheimer, M., Campos, M., Warren, R., Birkmann, J., Luber, G., O'Neill, B., & Takahashi, K. (2014). IPCC-WGII-AR5-19. Emergent Risks and Key Vulnerabilities. In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge. doi: 10.1017/CBO9781107415379

Schlomann, B., Reuter, M., Eichhammer, W., & Ziesing, H.-J. (2016). *Methoden- und Indikatoreneentwicklung für Kenndaten zum Klimaschutz im Energiebereich*. Dessau-Roßlau.

Schönthaler, K., Andrian-Werburg, S. von, Nickel, D., Pieck, S., Tröltzsch, J., Küchenhoff, H., & Rubenbauer, S. (2011). *Die Entwicklung eines Indikatorensystems für die Deutsche Anpassungsstrategie an den Klimawandel (DAS)*. Dessau-Roßlau: Umweltbundesamt. Retrieved from http://www.umweltbundesamt.de/publikationen/entwicklung-eines-indikatorensystems-fuer-deutsche

Schönthaler, K., & von Andrian-Werburg, S. (2015a). Evaluation of the German Strategy for Adaption to Climate Change (DAS) – Reporting and Closing Indicator. In Umweltbundesamt. Dessau-Roßlau.

Schönthaler, K., & von Andrian-Werburg, S. (2015b). *Handbuch zur Verstetigung der indikatorbasierten Berichterstattung zur Umsetzung der Deutschen Anpassungsstrategie an den Klimawandel (DAS)*. München.

Umweltbundesamt. (2015). *CLIMATE-ADAPT – European Climate Adaptation Platform*.

Annex

Annex A: DAS principles and pillars

Principle 1: Openness and cooperation[12]

Adaptation to the consequences of global climate change is a social challenge and task that affects not only governments and administrations, but a wide range of actors. The action plan identifies priorities for the contribution of the Federal Government. These are intended to provide orientation and serve as a basis for the ongoing dialogue and participation process on the DAS, as well as for the further development of the national adaptation process.

Principle 2: Knowledge-based, precautionary orientation and sustainability

As the adaptation strategy is further developed, the DAS promotes the broadening and deepening of the analysis of the possible effects of climate change and their interactions. As new findings and requirements for action are incorporated, the DAS will be adapted accordingly. An important focus of the action plan is improving and updating the knowledge base.

The APA I builds on DAS. It is based on the precautionary principle and an integrated, balanced sustainability approach. It prioritises early identification and assessment of risks and a good trade-off between economy, social responsibility and environmental protection. The goal is to remain future-oriented under changing climate conditions. According to the personal provision responsibility, every citizen must take on responsibility.

Principle 3: Subsidiarity, own resources, adaptation capacity and proportionality

The risks and opportunities of climate change will affect economic sectors, regions and people's lives in different ways. Adaptation must thus address this diversity by following the German subsidiarity approach. In many cases, this entails the local or regional level. The responsibility for adaptation to climate change ultimately lies with citizens and companies themselves. The Federal Government will assume its responsibility for adaptation and support other actors in fulfilling their responsibilities. The DAS and subsequent plans create the framework and conditions for the adaptation measures of other stakeholders.

Principle 4: Integral approach and consideration of climate impacts in planning and decision-making

To prevent conflict of use and promote synergies with other policy objectives, adaptation work must adopt cross-sector policies and horizontally- and vertically-integrated approaches. The appropriate instruments for such measures include the strategic environmental assessment and the Environmental Impact Assessment (EIA) for infrastructure.

Principle 5: Implementation and uncertainty

[12] Quote (shortened) from APA I, translation by the author.

Adaptation prepares for an uncertain future. The systemic effects of climate change are not predictable. For sound decisions despite uncertainty, the DAS supports three approaches:

1. Extension of the scientific basis;
2. Knowledge-based method development;
3. Pragmatic straight-forward implementation and start with no-regret measures.

Principle 6: International responsibility

The Federal Government is addressing its responsibility towards 'adaptation to climate change' as the topic gains relevance in international and bilateral cooperation.

Pillar 1: Providing knowledge, informing, enabling

The Federal Government initiates the development of knowledge and information by enhancing dialogue and participation and building networks. This relates to Principle 2.

Pillar 2: Framework-setting by the German Federal Government

This pillar describes the federal projects for developing the necessary legal basis and technical standardisation.

Pillar 3: Activities for which the Federal Government is directly responsible

This pillar is related to situations in which the Federal Government is the owner of property, real estate or infrastructure, or situations in which it acts as the infrastructure developer.

Pillar 4: International responsibilities

This pillar elaborates Germany's contribution to the United Nations Framework Convention on Climate Change (UNFCCC), the Cancun Adaptation Framework (UNFCCC) and International Climate Initiative (ICI). It also presents joint international research and activities conducted between the European Union (EU) member states. Pillar 4 corresponds to Principle 6.

Annex B: Clusters in APA II with related actions fields from DAS

These action fields were clustered, resulting in the following topics:

Health cluster

- Human health

Water cluster

- Water balance, water management, coastal and marine protection
- Fishery

Land cluster

- Soils
- Biological diversity

- Agriculture
- Forestry

Infrastructure cluster
- Traffic and transport infrastructure
- Energy sector
- Building industry

Economy cluster
- Finance and insurance sector
- Industry and commerce
- Tourism

Spatial planning and civil protection cluster
- Spatial, regional and urban development planning
- Civil protection and disaster control

Annex C: EU Green Paper Action Areas

The Green Paper describes four main action areas:

1. Development of adaptation strategies to ensure optimal resource allocation and efficient resource use, linkages to specific sector regulation such as the Water Framework Directive (WFD) and integration into existing funding programmes;
2. External dimension of climate change impacts and adaptation. This refers to new alliances with partners around the globe, namely developing countries, neighbouring countries and international organisations;
3. Reducing uncertainty by expanding the knowledge base: Improved methods for the assessment of climate impacts, prediction and downscaling. Furthermore, the EU Commission promises to compile a synthesis report on climate change adaptation and vulnerabilities every 4-5 years. The report shall be carried out by the European Environmental Agency and the Joint Research Centre (JRC). It will summarise scientific progress of the EU Research Framework Programmes and national research done by the member states;
4. Mainstreaming climate change and adaptation: Involvement of European society, business and public sectors in the preparation of adaptation strategies.

Annex D: List of Indicators of the German Adaptation Strategy

No	Indicator Code	Name
	Action field "Human health"	
1	GE I-1	Heat stress
2	GE-I-2	Heat-related mortalities
3	GE-I-3	Ragweed-pollen related stress
4	GE-I-4	Risks from oak processionary moth infestation
5	GE-I-5	Pathogen carriers
6	GE-I-6	Contamination by cyanobacteria of bathing waters
7	GE-R-1	Heat warning service
8	GE-R-2	Success of heat warning system
9	GE-R-3	Information on pollen
	Action field “Construction”	
10	BAU-I-1	Heat stress in urban environments
11	BAU-I-2	Summer-related heat-island effect
12	BAU-R-1	Recreation areas
13	BAU-R-2	Specific energy consumption for space heating by private households
14	BAU-R-3	Funding for building and refurbishment adapted to climate change
	Action field “Water Regime, Water Management, Coastal and Marine Protection”	
15	WW-I-1	Quantitative groundwater condition
16	WW-I-2	Mean discharge
17	WW-I-3	Flooding
18	WW-I-4	Low water
19	WW-I-5	Water temperature of standing waters
20	WW-I-6	Duration of stagnation period in standing waters
21	WW-I-7	Start of spring algal blooms in standing waters
22	WW-I-8	Marine water temperature
23	WW-I-9	Sea level
24	WW-I-10	Intensity of storm surges
25	WW-R-1	Water use index
26	WW-R-2	Structure of water bodies
27	WW-R-3	Investment in coastal protection
	Action field “Soil”	
28	BO-I-1	Soil moisture levels in farmland soil
29	BO-I-2	Rainfall erosivity
30	BO-R-1	Humus content of arable land
31	BO-R-2	Permanent grassland
32	BO-R-3	Organic soil areas

No	Indicator Code	Name
	Action field "Biological Diversity"	
33	BD-I-1	Phenological changes in wild plant species
34	BD-I-2	Community temperature index for bird species
35	BD-I-3	Recovery of natural flooding areas
36	BD-R-1	Consideration of climate change in landscape programmes and landscape framework plans
37	BD-R-2	Protected areas
	Action field "Agriculture"	
38	LW-I-1	Agrophenological phase shifts
39	LW-I-2	Yield fluctuations
40	LW-I-3	Quality of harvested products
41	LW-I-4	Hail-storm damage in agriculture
42	LW-I-5	Infestation with harmful organisms
43	LW-R-1	Adaptation of management rhythms
44	LW-R-2	Cultivation and propagation of thermophilic arable crops
45	LW-R-3	Adaptation of the variety spectrum
46	LW-R-4	Maize varieties by maturity groups
47	LW-R-5	Use of pesticides
48	LW-R-6	Agricultural irrigation
	Action field "Woodland and forestry"	
49	FW-I-1	Tree species composition in designated Forest Nature Reserves
50	FW-I-2	Endangered spruce stands
51	FW-I-3	Incremental growth in timber
52	FW-I-4	Damaged timber – extent of random use
53	FW-I-5	Extent of timber infested by spruce bark beetle
54	FW-I-6	Forest fire risk and forest fires
55	FW-I-7	Forest condition
56	FW-R-1	Mixed stands
57	FW-R-2	Financial support for forest conversion
58	FW-R-3	Conversion of endangered spruce stands
59	FW-R-4	Conservation of forest genetic resources
60	FW-R-5	Humus levels in forest soils
61	FW-R-6	Forestry information on adaptation
	Action field "Fisheries"	
62	FI-I-1	Distribution of thermophilic marine species
63	FI-I-2	Occurrence of thermophilic species in inland waters
	Action field "Energy Industry (Conversion, Transport and Supply)"	
64	EW-I-1	Weather-related disruption of power supply
65	EW-I-2	Weather-related unavailability of power supply
66	EW-I-3	Reduced power generation due to ambient temperature in thermal power plants

No	Indicator Code	Name
67	EW-I-4	Potential and actual wind energy yields
68	EW-R-1	Diversification of electricity generation
69	EW-R-2	Diversification of end energy consumption for heating and cooling
70	EW-R-3	Electricity storage options
71	EW-R-4	Water efficiency of thermal power plants
	Action field "Financial Services Sector"	
72	FiW-I-1	Claims expenditure and loss ratio in home-owners' comprehensive insurance
73	FiW-I-2	Claims ratio and combined ratio in home-owners' comprehensive insurance
74	FiW-I-3	Incidence of storms and floods
75	FiW-R-1	Insurance density of extended natural hazard insurance for residential buildings
	Action field "Transport, Transport Infrastructure"	
76	VE-I-1	Navigability of inland waterways
77	VE-I-2	Weather-related road traffic accidents
	Action field "Trade and Industry"	
78	IG-I-1	Heat-related loss in performance
79	IG-R-1	Intensity of water consumption in the manufacturing sector
	Action field "Tourism Industry"	
80	TOU-I-1	Coastal bathing temperatures
81	TOU-I-2	Bed nights in coastal tourist areas
82	TOU-I-3	Heat stress in spas used for their healthy climate
83	TOU-I-4	Snow cover for winter sports
84	TOU-I-5	Bed nights in ski resorts
85	TOU-I-6	Seasonal bed nights in German tourist areas
86	TOU-I-7	Holiday destination preferences
	Cross-sectional issue "Spatial, Regional and Physical Development Planning"	
87	RO-R-1	Priority and restricted areas reserved for wildlife and landscape conservation
88	RO-R-2	Priority and restricted areas for groundwater conservation or the abstraction of drinking water
89	RO-R-3	Priority and reserved areas for (preventive) flood control
90	RO-R-4	Priority and reserved areas for special climate functions
91	RO-R-5	Land used for human settlements and transport infrastructure
92	RO-R-6	Settlement use in flood-risk areas
	Cross-sectional issue "Civil Protection"	
93	BS-I-1	Person hours spent dealing with damage from weather-related incidents
94	BS-R-1	Information on how to act in a disaster situation
95	BS-R-2	Precautionary measures for protection of the public

No	Indicator Code	Name
96	BS-R-3	Training exercises
97	BS-R-4	Active disaster protection workers
	Cross-cutting indicators	
98	HUE-1	Manageability of climate change impacts
99	HUE-2	Usage of warning and information services
100	HUE-3	Federal grants for promoting research projects on climate change impacts and adaptation
101	HUE-4	Adaptation to climate change at local authority level
102	HUE-5	International finance for climate-adaptation

Author:
Dr. Gerhard Rappold, Berlin

Editing:
Michelle Balon, Berlin

Photo credits/sources:
Title photo: Tobias Nordhausen/flickr, Landschaft bei Tilleda, https://bit.ly/3iQeAY3, Creative Commons

Back cover photo: Marco Verch/Flickr, Baustelle zwischen Gereonswall und Kyotostraße mit Colonius und Kölnturm im Hintergrund, https://bit.ly/3myesyG, Creative Commons

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

Sitz der Gesellschaft
Bonn und Eschborn

Friedrich-Ebert-Allee 36 + 40
53113 Bonn, Deutschland
T +49 228 44 60-0
F +49 228 44 60-17 66

Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Deutschland
T +49 61 96 79-0
F +49 61 96 79-11 15

E info@giz.de
I www.giz.de