

D3.3 Requirements of potential future users working in emerging topics

- Report on the results of WP3.3 of the project “Use.AT”

Contributors: Peter Müller¹, Laura Mainetti¹, Benedikt Becsi², Romana Berg³, Michael Brenner-Fließer⁴, Marianne Bügelmayer-Blaschek³, Matthias Themessl¹, Simon Tschannett⁵, Tanja Tötzer³

1: GeoSphere Austria

2: BOKU University

3: AIT Austrian Institute of Technology GmbH

4: JOANNEUM RESEARCH Forschungsgesellschaft mbH

5: Weatherpark GmbH

Table of contents

Introduction	2
Objectives of the focus group discussions	3
Methodology and key questions	3
Results & Analysis	6
Current use cases.....	6
Current sources	8
Current challenges.....	10
Future challenges.....	13
In an ideal world... ..	15
Discussion & Interpretation	20
Summary of key learnings.....	21
Sources.....	23

Introduction

Use.AT is a research project funded by the Austrian Climate and Energy Fund as part of the ACRP funding program. It aims to systematically harvest learnings from Austria's current national climate scenarios, ÖKS15, and comparable international approaches. Thus, it contributes as an accompanying research project to the development of new Austrian climate scenarios as part of the Climate Scenarios.AT initiative (see www.klimaszenarien.at).

This report summarizes the results of the activities in WP3.3 of Use.AT. The aim was to learn from potential future users of ÖKS15 and the new Austrian climate scenarios in 5 emerging topics: 1) EU taxonomy, 2) climate proofing, 3) energy crisis, 4) AI, 5) climate communication & media.

Climate proofing: The topic climate proofing refers to the integration of climate information in planning and permit procedures. Generally, this means norms and standards as well as evaluation criteria for environmental impacts assessment. The envisioned target groups included consultants, planners and evaluators in all levels of public administration, scientific research and the private building sector.

Artificial Intelligence in Climate Services: This topic explores the potential role of artificial intelligence (AI) in the context of climate services. Climate services aim to provide climate-related information tailored to the needs of decision-makers in sectors such as public administration, infrastructure, urban planning, or risk assessment. Given the increasing use of AI tools in both professional and everyday context, this topic investigates to what extent AI models can support access to climate change information. The focus lies on evaluating the types of information provided, the sources referenced, and the limitations and challenges associated with using AI-generated content in climate-related contexts.

Energy Sector: This topic addresses the use of climate services in both operational and strategic planning within the energy sector. Stakeholders such as energy providers and grid operators face increasing climate-related risks and require high-resolution data tailored to their specific contexts. The focus group examined the role of climate information in short-term risk management (e.g. in response to extreme weather events) and in long-term infrastructure investment decisions, as well as the limitations of current datasets in meeting these needs.

EU-Taxonomy: This topic focuses on the role of climate services in supporting regulatory climate risk assessments required under the EU Taxonomy and the Corporate Sustainability Reporting Directive (CSRD). These regulations are driving demand for climate-related data and analyses, particularly in sectors such as finance, consulting, and SMEs. The discussion explored the types of climate information currently used in this context, the regulatory requirements for site- and activity-specific data, and the challenges related to data granularity, interpretation, and integration into reporting processes.

Climate Communication & Media: This topic investigates how climate information is used by journalists, NGOs, and other communicators to contextualize and communicate climate change to the public. Participants discussed their needs for localized and understandable data, challenges in visualizing scientific information for different audiences, and the importance of credible sources. The role of uncertainty, the risk of misinformation, and the potential of formats like storylines, interactive tools, and gamification were also addressed.

Objectives of the focus group discussions

The involvement of stakeholders from emerging, currently prioritised policy fields can yield important insights and guiding rails for usable, useful and user-friendly climate services. Therefore, Use.AT takes a look at potential users to assess their requirements, challenges and the overall potential for the use of the new Austrian climate services in such emerging topics.

Initially, three emerging topics were in the central focus of Use.AT, those being EU taxonomy, climate proofing and the energy crisis. These have proven to generate a lot of commotion, change and demand in the climate service community by setting new standards and parameters for planning, societal, and economic development.

However, by interacting with users and non-users (survey and in-depth interviews in WP 3.2) as well as providers (in-depth interviews in WP 2), two other topics emerged as highly relevant for the future use of the Austrian climate scenarios. One of these is AI, its use for climate modelling as well as people using it to access climate information. On the other hand, climate communication & media was identified as crucial when it comes down to communicate with non-users, users and potential future users.

Therefore, 5 focus group discussions (FGD) were held with participants relevant to the five emerging topics to identify their requirements in terms of climate services, current and future challenges, and the ideal climate service to solve their work-related issues.

Emerging topics

- EU taxonomy
- Climate proofing
- Energy sector
- AI
- climate communication & media

Methodology and key questions

Focus group discussions (FGD) serve as an excellent method in the social sciences to bring various stakeholders together, identify common issues, challenges, and requirements, as well as emerging ideas and insights, that have not been considered before.

As the emerging topics cover a variety of thematic fields and also within the topics attract people from various professional fields, the methodological approach of focus group discussions is fitting to provide a space for discussion of manifold perspectives. The conversational character between participants is well suited to elaborate on their experiences and share different points of view.

Moreover, other than interviews, focus group discussions allow for new ideas to emerge through the exchange between the participants.

Two of the focus group discussions were held in person, while two were conducted online. The in-person setting has the advantage of a lower inhibition threshold to enter a conversation and is less likely to suffer from technical difficulties such as a potentially bad internet connection in an online meeting. On the other hand, the online meetings allowed for participants from various geographic areas to participate and thus decrease the time effort for the participants.

Wherever possible, the focus group discussions were connected to existing events. In case of the **focus group on climate communication & media**, the FGD was part of a regular monthly meeting of the network on climate journalism. The network is an initiative with the goal to connect journalists and people working in media on climate topics.

For the **FGD on EU taxonomy**, several people that work in that field were invited to a "regular's table". The participants included people that work as consultants, in the insurance sector or for infrastructure company that needs to report on their activities in terms of their exposure to climate risks and their related vulnerability.

The **FGD on the energy sector** was combined with the AIT-led research project **ROBINE**^[1], that aims to assess the region-specific impact of climate change for a **robust** and **integrated energy infrastructure** in Austria). In the project, stakeholders from the energy sector were intensively involved in two stakeholder workshops and bilateral interviews. The questions for the focus group discussion were asked especially in the second workshop, conducted in the beginning of March. Nevertheless, insights gained from the first workshop as well as the interviews are included for answering the questions for Use.AT, to make the best possible use of the synergy effects that exist in both projects.

[1] <https://projekte.ffg.at/projekt/4875808>

The **FGD on climate proofing** was held online. Five experts from the sectors building consulting, water management, communal water supply, climate adaptation and information for cities and forest research discussed the actual and potential use of climate information for their work.

For the **FGD on AI** a special set-up was necessary: Initially, it was planned to conduct this FGD also with AI experts. However, since the response rate was zero, the project team decided to interview AI itself. Instead of the usual approach of conducting a focus group discussion, a comparison of three AI models was carried out by directly posing the same set of questions to each system, in order to systematically compare their responses.

Topic	mode	Participating organisations
EU taxonomy	in person	• ey Denkstatt • UNIQA Sustainable Solutions GmbH • ÖBB
climate proofing	online	• building consulting • water management • communal water supply • climate adaptation of cities • forest research
energy crisis		• Netz Burgenland • Netz Niederösterreich • Salzburg AG • Verbund • Wien Energie • Stadtwerke Amstetten • Stadtwerke Klagenfurt • PV Austria • Verein Kleinwasserkraft • Austrian Gas Grid Management (AGGM) • E-control • Österreichs Energie
AI	Virtual interviews with AI-Models	• ChatGPT 4o • DeepSeek-V3 • Gemini 2.0 Flash
climate communication & media	in person, connected to a regular Netzwerk Klimajournalismus meeting	• APA • KurzschlussRedaktion (tv, online social media) • ORF Sound + Ö1 • Freelance journalist • Freelance environmental communicator • Freelance journalist • Researcher IIASA • Journalist at World Water Watch and Zukunftsallianz

In order to be able to identify key challenges of stakeholders in these emerging topics, their requirements towards climate services and the potential for the use of the new Austrian climate scenarios, five key questions were developed to guide through the focus group discussions. These serve as a guideline for the project members to focus on points of relevance. However, it also allows for alternative topics to come up. In some cases, the key questions were modified to facilitate in-depth questions on a specific topic or issue relevant to the particular FGD.

Key questions for the focus group discussions

- Where/in which use cases do you already use/would you need climate services?
- Which sources do you currently draw upon?
- What are current challenges?
- What are future challenges?
- In an ideal world: What kind of information, products and services would help you to solve your problems in your everyday working life?

The FGDs were typically conducted by two project team members, unless they were held in the course of a workshop, e.g. on the subject of energy. This allowed for one person to focus on the moderation of the discussion, while the other person could take notes.

Results & Analysis

In exchange with the stakeholders, valuable insights were collected on current use cases, sources, current challenges as well as future challenges, highlighting the different requirements and struggles of stakeholders in the five emerging topics. Moreover, optimisation potential was identified by together exploring ideal world solutions.

Current use cases

EU taxonomy

The **typical use case** for the participants of the EU taxonomy FGD is to conduct climate risk analyses: When looking at SMEs, the focus is more short term for the next 2-3 years on providing advice for protective measures. Therefore, information on changes in climate in the next years and acute hazards is relevant. Data used to this end needs to be as granular as possible. However, in some cases also chronic hazards are in the main focus. This includes risks arising from an increase in heat days and heat waves. The focus within this field depends on the industry though, as different challenges arise when dealing with heat e.g. between tourism, steel industry, or agriculture.

The driver behind conducting climate risk assessments is clearly regulatory: Due to the implementation of the EU taxonomy and the CSRD guideline and the following reporting duties for enterprises, climate risk analyses have become relevant for activities such as transition planning, risk assessments, or the development of measures and solutions. Depending on the regulatory framework, different information on assets is required: For CSRD reporting purposes, information on assets can be clustered. The EU taxonomy in turn requires site- and activity-specific information.

Currently, climate information and CS are used more for long term planning.

Climate Proofing

Participants of the climate proofing FGD agreed that climate information is already a central aspect of planning in their respective fields. The fields of communal water supply, building consulting, and climate adaptation planning for forests and cities share a far planning horizon, often beyond 50 years into the future. The required information included short term extreme precipitation (10 minutes and below), evapotranspiration, wind, radiation components, humidity, dew point temperature, water balance, persistence of dry periods, energy demand for heating and cooling, extreme weather events like thunderstorms, heat waves, wet snow and hail as well as climate risk assessment.

Often the required spatial and temporal resolution is distinctly higher than the scale of the existing climate scenarios. The participants agreed that the existing products lack ready-to-use solutions for their application, and that further processing, translation, and application-specific guidance is necessary to enhance the usability of climate information for their work.

Energy Sector

Stakeholders from the energy sector, including grid operators and energy providers deal with both operational planning (day-to-day work, short-term, dynamic) or strategic planning (long-term, adaption to possible worst-case scenarios). Additionally, grid operators being responsible for transmitting energy to the customers focus on different aspects than energy providers, who need to ensure that enough energy is available to supply the customers' needs. Therefore, grid operators and energy providers deal with completely different use cases. In general, for **daily operations**, weather events play a much more crucial role than climate scenarios. For instance, the transmission grid operator must consider future climate risks when planning generation capacity, while energy providers currently focus on short-term (extreme) weather events in order to secure safe operation. E.g. in case of heavy precipitation, hydropower plants may need to be operated differently or even shut down to prevent grid overload or damage to infrastructure. In order to be prepared for such events, short-term weather-forecasting is crucial to make timely decisions and coordinate actions as the whole energy system is interdependent from various sources and infrastructures. For the planning of energy network infrastructure, stakeholders reported that climate scenarios are not used for the design of photovoltaic systems, instead planners use current hail maps, maps of snow and wind loads. For **strategic planning**, the energy providers tend to be specific and localized, they need information on how a particular location or valley might be affected by climate change and therefore collaborate with scientific institutions that simulate, analyse and evaluate future conditions to have high-resolution data and information about certain areas of interest.

AI

Artificial intelligence (AI) is increasingly being integrated into both professional workflows and everyday information-seeking behavior. As large language models (LLMs) such as ChatGPT and Deepseek become widely available and user-friendly, they are likely to be consulted for a broad range of topics—including complex issues such as climate change. Particularly in situations where users seek

quick, accessible, and seemingly authoritative answers, LLMs may serve as a first point of reference, potentially replacing traditional sources such as scientific reports or expert consultation.

Given this development, it is essential to examine how reliably and accurately these models deliver climate-related information, especially considering the high relevance and sensitivity of the topic. Furthermore, understanding the limitations and biases of such tools is crucial when assessing their potential role in climate services and science communication.

Climate communication & media

Most use cases revolve around contextualising and confirming relevant information for a feature. Other use cases are to use climate information and climate services to inform lectures and talks about climate politics, to provide information for NGOs or for news coverage and reporting in various projects, e.g. developing manuals on how to act on climate change.

Especially when it comes down to explaining specific events or patterns, e.g. in terms of precipitation, climate information and services are used as background information. To this end, some of the participants directly analyse and visualise the data. It is also important for the participants to break down information on a local and/or regional scale. Data on a federal states level helps them to illustrate how affected singular federal states are. Another focus is explaining the situation in Austria in terms of climate change, mostly for very specific topics that have personal relevance in the sense of constructive climate journalism. That often goes hand in hand with using concrete examples.

Current sources

EU taxonomy

Depending on the spatial context, the participants use different sources of information:

For activities in Austria, they use ÖKS15, which they sometimes analyse themselves or buy in a processed format. They also draw on the Natural Hazard Overview & Risk Assessment Austria platform HORA (2024). When they are internationally active, they draw on COPENICUS data as well as on EURO-CORDEX. Data and information of re-insurances such as Munich Re and Swiss Re are mentioned too. One participant who is operating in Germany draws on data and information of federal states and the Deutscher Wetterdienst.

Other tools and platforms mentioned include the AON platform, AXA, Climate X (especially for vulnerability analyses), the EY Cap Tool (building on data such as EURO-CORDEX, CMIP, etc.) or also Chat GPT (mostly to find sources for information).

Climate Proofing

The currently used climate services include HORA, MeteoNORM, GIS-enabled map services for future projections of climate impacts (e.g. ClimaMap), regional climate models like EURO-CORDEX and the local ÖKS15. Design rainfall tables were mentioned several times as important planning instrument, but in Austria they are based on the climate of the past and not adopted for climate change.

Energy Sector

In general, we received feedback that the energy stakeholders are currently using practical experience of technicians and on-site personnel operating and dealing with the energy infrastructure for many years. Risk maps play a minor role in daily operations, although they reported that publicly available data is used. A few larger energy utility companies have begun integrating climate-related regulatory frameworks, such as the EU taxonomy in their strategic planning, they use for example Copernicus data directly to assess their heating degree days. Additionally, risk maps provided by the federal states as well as the HORA service are also being used. For strategic planning they also mentioned the “climate projection tool” from Munich RE, which helps to identify long-term risk zones for water, solar and wind supply. For the short-term evaluation, extreme weather events are monitored either internally by in-house meteorologists, who assess the potential risk for the next few days, or in collaboration with external weather services such as Geosphere Austria and Ubimet.

AI

In contrast to human participants in conventional focus groups, who typically refer to specific and verifiable datasets (e.g., EURO-CORDEX, ÖKS15, HORA, or national meteorological services), the three AI models consulted in this study – ChatGPT, Deepseek, and Gemini – provided their own descriptions of the sources they claim to draw upon for climate-related information.

All three models referenced a range of scientific literature, international organisations (including the IPCC, WMO and UNFCCC), and official climate data providers (e.g. NASA, NOAA and the Copernicus Climate Change Service). Furthermore, the following national institutions were cited: GeoSphere Austria, Deutscher Wetterdienst, Klimadashboard.at, Carbon Brief, and Our World in Data. Deepseek in particular provided an extensive list of source categories, ranging from peer-reviewed journals to media outlets and public data portals.

Despite these seemingly comprehensive references, it must be noted that the underlying data sources used by the models are not directly verifiable, and source attributions are often general rather than tied to specific statements. This lack of transparency is inherent to large language models, as they do not retrieve real-time data or cite sources in a traditional academic sense, but generate responses based on patterns in their training data. As such, while the models provide useful overviews and often name credible institutions, the reliability and traceability of their information remain limited compared to curated datasets or expert-based assessments.

Climate communication & media

Very prominently named are the CCCA where they draw directly on raw data (ÖKS15 in NetCDF format) as well as the newsfeed or the *Klimastatusbericht*, along with Klimaszenarien.AT.

They also draw on data and information of various research institutions, such as GeoSphere Austria, the Wegener Centre, CCCA factsheets, Copernicus, IIASA or PIK. Drawing on studies that are not necessarily peer-reviewed but published by “trustworthy” research institutions and universities is another way. But also, other media articles are a prominent source of information. When they need processed data, they additionally draw on Copernicus data.

Other sources of information are public institutions such as Statistics Austria, the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology or the Environmental Agency Austria (figures on emissions, land use, spatial planning). When drawing on information of governmental institutions, however, it is important to keep in mind that numbers and reports might have a different **framing** than from experts. This also goes for information from NGOs, as they are often seen to have a specific agenda and want to bring across a certain point. Therefore, back-checking information is important, and it is interesting to also take a look at what is not said.

A direct exchange with experts is mentioned as a very important source of information for journalists. Although usually not the first point of contact, one person says it’s the most important one.

Other sources include the Klimadashboard.at (n.a.), Eni Windkraft, Science.orf.at and Chat GPT. An example given for the use of Chat GPT is to ask the AI what the 10 most prominent problems are in terms of land use in Austria.

In terms of the data that participants draw on, one of the participants prefers data being available on the level of federal states. Datasets are used to generate figures, which the journalists often do by themselves.

Current challenges

EU taxonomy

Currently only short-term events can be insured, leaving out chronic hazards. In order to ensure assets, capital is a requirement. This in turn depends on the enterprise’s portfolio: Depending on where the assets are located and by which risks they can be affected, different risks can be insured.

From a data perspective, ÖKS15 indicate values and parameters that are sometimes already superseded by reality, e.g. in terms of the number of heat days. Moreover, the handling of the ÖKS15 data is mentioned as a challenge, as the descriptions are using technical and expert language, abbreviations are seen as unserviceable by some participants, and there is a lack of filtering options. Data is currently not visualised in a WebGIS. Models and tools that draw on globally available data sometimes show results of a granularity that is not compatible with the coarseness of the input data.

In general, the complexity of correlations and unexpected impacts is challenging. Often interpretations of climate hazards and information on impacts are missing, e.g. how heat affects

people. Value chains cannot be completely assessed, as information on suppliers – especially when not located in Austria – is often missing. Also, if one location is affected, this can have implications on other locations.

Other challenges include conducting vulnerability assessments, especially for SMEs. Accountants often lack expertise in terms of what is the best suitable climate information in which context and other relevant know-how. Enterprises in turn lack awareness for the importance of climate risk analyses and implementing measures to reduce risk. Reporting requirements are currently too complex to cover all aspects with the expertise of just one (consulting) company.

Climate Proofing

The common theme in the climate proofing FGD was a general lack of guidance regarding how to include and handle existing climate information in the participants' daily work. More specifically, a mismatch between the detailed information needed for planning and consulting and the available resolution and parameters of existing climate datasets was perceived. This was especially seen as problematic when climate scenarios are prescribed by regulations like the EU taxonomy because of missing definitions and standards. This climate service gap leads to a wide landscape of custom-made solutions, e.g. cities running different micro-climate models with different input data and parametrizations, making it difficult to compare outcomes. Also, uncertainties were seen as difficult to handle and communicate, with a perceived trade-off between credibility and comprehensibility for clients and target audiences.

Another challenge was mentioned concerning the usefulness of norms in consulting. They are not seen as matter-of-fact, evidence-based groundwork, but rather as political instruments influenced by the interests of big players. Knowing this, pragmatic approaches predominate in daily work life and norms play a minor role. Participants agreed that usable guidelines and recommendations concerning climate scenarios would be more helpful than climate-proof norms. This insight can be relevant for setting priorities in Klimaszenarien.AT.

Energy Sector

One of the main challenges for energy stakeholders is that long-term climate projections are often insufficient for operational planning. What matters most for them are the most critical “ten minutes” that the infrastructure needs to withstand. An extreme weather event can have a far greater impact on an infrastructure than annual mean values, therefore climate scenarios are perceived as too “soft” for practical implementation and should also focus on worst case events. Additionally, another topic is the duration of product life cycles, which, e.g. is around 20-30 years in case of wind turbines. Infrastructure that is being built in 20 years will more likely be built with advanced technologies to be better adapted to worst case weather extremes.

Yet, for investment decisions climate scenarios are highly appreciated in order to justify higher upfront costs today, such as investing more in infrastructure that is not currently needed. Without these foresights, it is difficult to argue for more resilient – and more expensive – designs and infrastructures. Examples of such infrastructure that should already be built for future conditions include elevated

substations to withstand flooding, cooling systems for transformer stations designed to cope with overheating caused by higher temperatures or more robust rotor blades for wind turbines in order to run at the same speed at higher wind gusts and generate the same amount of power. Accurate and reliable climate scenarios provide the evidence base needed to design infrastructure that is above-average today in order to prevent damage or failures in case more extreme events come.

Stakeholders are also facing increasing difficulties with the frequency and intensity of extreme weather events and their cascading effects, such as floods followed by landslides or heat waves followed by droughts. The unpredictability of extreme events and short advance warning times limit the ability to prepare and act in time. Shifts in seasonal precipitation patterns also poses challenges for energy providers as they cannot predict the amount of water available for energy production anymore, which can lead to energy shortages and the necessity of importing energy from other sources.

AI

The use of AI models as sources of climate-related information presents several limitations in their current form. One of the main challenges is the lack of source transparency. While all examined models (ChatGPT, Deepseek, and Gemini) refer to credible institutions such as the IPCC, NASA, and Copernicus, they typically do not provide traceable citations or verifiable links to specific datasets or studies. This stands in contrast to established climate services, which rely on documented, quality-controlled sources.

A second key limitation is the inconsistent depth and scientific precision of the answers. While basic questions were answered correctly across all models, differences were observed in the regional specificity, clarity of explanations, and degree of technical detail. In some cases, overly simplified descriptions risk obscuring important scientific nuance.

In addition, uncertainties are rarely addressed in a meaningful way. Unlike scientific assessments that routinely discuss confidence levels, model assumptions, and ranges of possible outcomes, AI-generated content tends to present information as factual and conclusive. This can be misleading, especially in fields like climate science, where uncertainty is integral to interpretation.

From a practical perspective, there are also technical limitations to consider. For instance, Gemini is currently unable to read or interpret PDF documents directly, which restricts its ability to process external materials—such as scientific reports or technical annexes—that are often central in climate-related work.

Furthermore, the static knowledge cutoff of AI models represents a significant constraint, particularly in the context of a fast-evolving scientific and policy landscape. Most general-purpose models, including those used in this study, are trained on data available only up to a certain point in time and are not automatically updated. As a result, they may lack information on the latest IPCC findings, recent climate events, evolving EU regulations, or newly published datasets—an important limitation for applications that require up-to-date knowledge.

Lastly, a notable challenge is the lack of user-specific tailoring. While AI models provide linguistically fluent and generally coherent answers, they do not adapt their responses to the background, needs, or context of different user groups. In the domain of climate services, however, the quality and

usefulness of information are closely tied to its relevance for specific audiences—such as local authorities, SMEs, policymakers, or the general public. For example, a municipality may require regionally differentiated adaptation measures, while a business might seek guidance on climate-related financial risks. In contrast, AI-generated content tends to follow a one-size-fits-all logic, offering broadly framed explanations without considering the intended use or level of prior knowledge. This limits the practical applicability of AI models in settings where context-aware communication and stakeholder-specific interpretation are crucial.

Climate communication & media

One journalist argues that ÖKS15 are not useful for their purposes anymore because RCP 8.5 and RCP 4.6 are not relevant anymore.

Another challenge revolves around the estimation and communication of uncertainties.

Translating figures of scientific journals into figures that are suitable for media can be challenging. Visualisations can be too complex for a non-scientific audience. Therefore, what some journalists wish for is that journals, authors and editors would already think about the translation of figures for a non-scientific audience beforehand. Another challenge in terms of figures is that it is sometimes not clear what data is included and which is not. One example is (not) including the contribution of VOEST emissions, which can make a difference of several percent, according to the journalists.

What is missing is a common glossary with consistent terms, e.g. when it comes to reference periods (*Referenzzeiträume*). Moreover, the same parameters can be used in different thematic fields, which makes a translation difficult. The translation of expert language into information that is understandable for a non-scientific audience is also mentioned as challenging. And when looking for information, journalists sometimes struggle with using keywords that are too amateurish to actually find what they are looking for.

Another question is how the data and the information can be interpreted. Having them in combination with examples would be much appreciated. This also goes for having extensive explanations versus striking statements, both not necessarily helpful for journalists, especially when there is little time for research. It can also be challenging to rewrite existing text. Therefore, storylines that explain what the key statements are, what is the news and having the “raw” information in bullet points would help them the most.

Journalists also face the challenge of how to get good and reliable data. Traceability of sources in articles can be difficult.

Future challenges

EU taxonomy

One major challenge for the future is to assess financial damages. Currently companies are in a transition phase, but in the future reporting requirements will be more detailed. A temporal assessment of damages – e.g. when an area is flooded for a longer time – is currently only based on

experience. For the future, better information would be required. The complexity of value chains (as mentioned in the section about current challenges) is supposed to increase. Risks connected to groundwater cannot be assessed yet. Assessing measures is already posing a challenge today but is supposed to become even more relevant in the future.

Climate Proofing

As the key questions of current and future challenges were discussed together in this FGD, see the previous section.

Energy Sector

Rising temperatures not only affect energy efficiency and transmission capacity, but also become more and more critical for electronic components. Measurement technology is already reaching its limits and temperature limits lead to a need for updated equipment standards and regulations adapted to higher temperatures. Damage through extreme weather events will also require new strategies in terms of on-site repair personnel. Some of the energy stakeholders already secure more personnel, especially during heat waves, for additional repair work based on their experiences that damage occurred more frequently in the past years. They are also strengthening regional collaboration with emergency services such as the fire brigade or military to remain resilient and capable to continue their operations during extreme weather events. Another pressing topic is the lifespan of the energy infrastructure, for example, the transmission grid is being built for a 50 to 70-years horizon, but current standards for wind speed, snow loads, and other aspects would need to be adapted in order to meet future conditions.

Ultimately, one of the most frequently mentioned future challenges is financing the necessary adaptations. Infrastructure that is built to withstand future extremes often comes with significantly higher costs. As already mentioned in the current challenges, this will most likely intensify in the future. Scientifically proven, scenario-based climate data could support to help justify investments for the future.

AI

Looking ahead, the increasing use of AI in climate services raises a number of open questions and structural challenges that will require further consideration. One such issue concerns the establishment of transparent and reliable referencing mechanisms. While current models can name reputable institutions, it remains unclear how future AI systems will ensure traceable, source-specific attributions that meet the standards of scientific or policy-relevant communication.

Another important aspect is the temporal reliability of AI-generated content. As of now, most language models operate on static knowledge bases with defined cut-off dates. Even if technical solutions for continuous updating become available, questions will persist regarding version control, the documentation of updates, and how users can recognize the timeliness of the information provided.

Moreover, it is not yet resolved how AI models could be adapted to serve the highly differentiated needs of various user groups. In climate services, communication is not only about accuracy, but also about context: different actors require different levels of technical detail, regional specificity, and actionable insight. The development of AI tools that can reflect this complexity remains a major challenge.

The risk of uncritical use also poses a concern for the future. The persuasive tone and linguistic fluency of AI outputs can create a perception of authority, even when the content is outdated or simplified. It will therefore be essential to develop safeguards, interfaces, or user guidance to support critical interpretation and responsible application of AI-generated content.

Lastly, the integration of AI tools into existing climate service structures raises both technical and organizational questions. While AI has potential to complement traditional services—e.g., by assisting with initial information access or educational content—its role, reliability thresholds, and interaction with expert validation procedures still need to be clearly defined.

Climate communication & media

Journalists ask themselves how to deal with scenarios, especially because currently predictions and scenarios on how e.g. the number of heat days will develop are already exceeded. Therefore, they would wish to have information on how a change of + 2 degrees on a global level would impact Austria without setting a time frame. The same goes for tipping points and how they will possibly affect Austria. Uncertainties in general and how to communicate is becoming more and more relevant for them too.

Another challenge the participants see intensifying is desinformation, how to handle and finally tackle it. They also express their concern in terms of changes in politic relationships and governments and how that might affect media coverage.

From a technical perspective, the format of figures from scientific sources is challenging when using it for different purposes such as slides (transverse format) or for social media like Instagram (upright format). Therefore, a responsive format would be ideal.

In an ideal world...

The last question revolves around their vision of an ideal world in terms of climate services. Being faced with no limitations in terms of resources, finances or technical aspects, the participants would wish for the following:

EU taxonomy

The participants make a strong case for developing scientific guidelines on how to conduct a risk analysis. They also mention the exiting KlimTAX guideline (CCCA n.a.) as a good practice example. Also,

a standard-catalogue of climate risks would be much appreciated, as well as having sources available that are scientifically sound and citable. This extends to the development of trustworthy tools and an international info hub for trustworthy data.

There is also a strong wish for better comprehensibility of information: More explanations, pictograms, colourful and creative applications are mentioned. A WebGIS platform that provides information on locations and sites is mentioned, as is a chatbot that can provide explanations on the most important aspects of climate hazards.

Improving awareness for climate information is noted too, as are trainings for experts on how to successfully communicate climate information to a non-scientific community.

Climate Proofing

Many participants re-iterated the need for ready-to-use climate information for their applications. Ideally, future projections should be included in the information systems they currently use (HORA, MeteoNORM). Dream-solutions aside, a more practicable approach would be to establish standards regarding the available climate services and products, as well as guidelines and capacity building for handling them. This could help fence the growing proliferation of custom-made solutions and make the planning, consulting and research activities more consistent across sectors.

Energy Sector

In the project ROBINE, a high-resolution climatological dataset for Austria, consisting of 41 hazard maps for the Global Warming Levels 1.0°C (corresponding to 2001-2020), 2.0°C, 3.0°C and 4.0°C was produced (data accessible online^[1]). The maps cover e.g. heat and cold stress, calm and storm days, extreme precipitation and floods, dry spells as well as lightning strikes and wildfires. We asked the stakeholders to evaluate their usability resulting in common agreement that the presented maps and tables would be usable for them. Figure 1 presents the results for the longest period of desert days as one of the heat indicators:

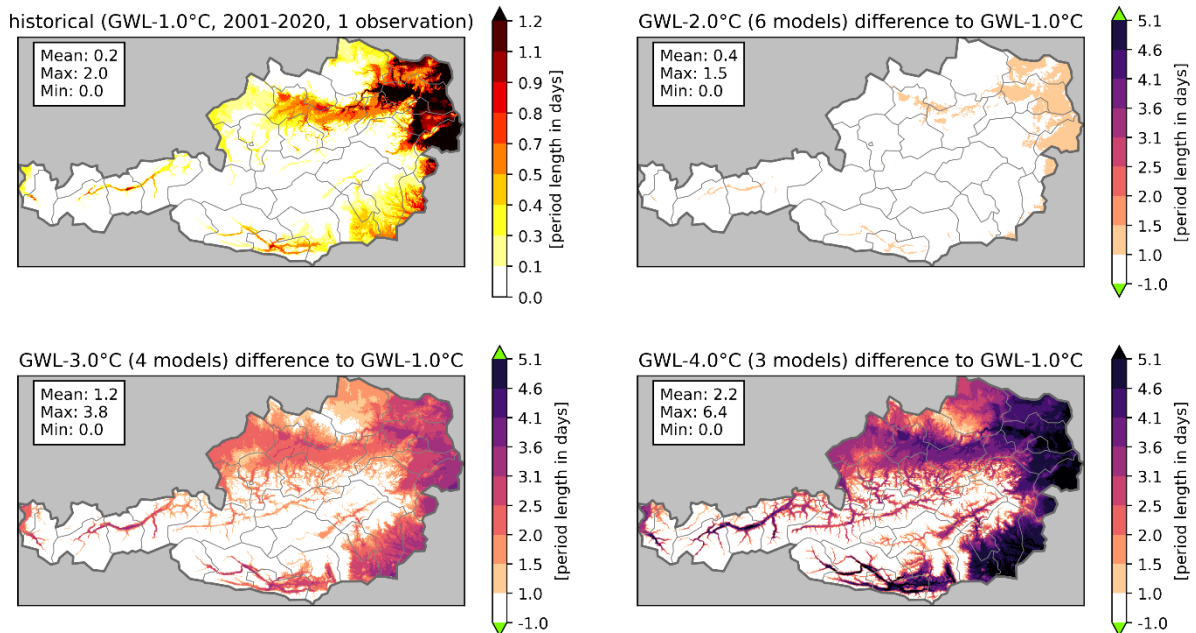


FIGURE 1: AVERAGE LONGEST PERIOD OF DESERT DAYS (MAIER ET AL. 2025)

In general, the feedback on which data format they would use focused on already prepared maps with a resolution of 1-5 km and 5-10 km. It is also important for them to translate hazards indicated in the maps into statements about what this implies for their operations, e.g. temperature rise would mean x % of efficiency loss of their energy infrastructure.

Besides the data format, it was discussed that required adaptation measures that would help to fulfil the Paris Agreement, as well as recommendations for adaptation would be useful for them. When using scenarios, it is important to include what can be expected in the next 20 to 50 years. Robust statements are taken into account when making investment decisions - assumptions are not.

[1] Maier, P., Liebmann, L., Hasel, K., Lehner, F., Formayer, H., Bügelmayer-Blaschek, M., & Suna, D. (2025). ROBINE-AT: Climatological hazard indicators for a ROBust and INtegrated Energy infrastructure in AusTria [Data set]. Zenodo. <https://doi.org/10.5281/zenodo.14697703>

AI

In an ideal scenario, AI tools would be designed and deployed in a way that fully supports the requirements and quality standards of professional climate services. This includes the ability to deliver scientifically robust, up-to-date, and traceable information, grounded in clearly cited sources and linked to version-controlled datasets. Ideally, users would be able to see when a given piece of information was last updated, which specific dataset or publication it stems from, and what level of uncertainty or model assumptions it entails.

Moreover, such systems would be capable of dynamically adapting their responses to different user needs and knowledge levels. This would mean providing simplified, action-oriented explanations for non-experts, while offering more detailed, technical insights—including data access or references—

for professionals in science, policy, or planning. Ideally, the AI would recognize the user's context and adjust its communication style and content accordingly.

Another core feature would be real-time data integration, allowing the AI to reflect recent developments—whether in scientific research, extreme weather events, or regulatory frameworks. To ensure quality, such integrations would need to be coupled with transparent mechanisms for validation and expert review.

Furthermore, the ideal AI would support responsible decision-making by making uncertainty visible, pointing to alternative interpretations, and avoiding overly deterministic statements. Rather than replacing human judgment, it would act as a supportive tool—especially in fields where complexity and nuance are central, as is the case in climate services.

Finally, such a system would be embedded within clear ethical and governance frameworks, ensuring accountability, data protection, and fairness. Its integration into climate services would be guided by principles of transparency, inclusivity, and complementarity—strengthening, rather than weakening, the role of human expertise in navigating the climate crisis.

Climate communication & media

Making outliers and the change of risk zones visible would help them to communicate this information and gain more trust in the public. One idea of a communication format for uncertainty would be to use corridors of uncertainty. This would help to build trust amongst the general public. However, the participants argue that it depends on the target group whether it would be better to communicate an average or a corridor of uncertainty. Another idea would be to communicating uncertainty by spanning a matrix from low risk – high impact and vice versa.

They would like to have information on different topics such as health integrated, e.g. in terms of air pollutants or combining a rise in temperature with the affected population. This goes hand in hand with also integrating multi-hazard information and examples of compound-risks that could occur. Examples are mentioned in general as very beneficial for communicating information. An idea mentioned would be to have storylines and personas to illustrate concrete examples, e.g. a 50-year-old woman living in Schladming suffering from an increase in heat days. The translation of scientific information into tangible impacts is key for the participants.

In terms of visualisation, an interactive map is mentioned where information on a local and regional level could be seen as well as information on risk. Moreover, to be able to make data interactively editable such as already possible at Klimadashboard.at (n.a.) would be endorsed. To have a model where you can change one parameter and see, how the others are affected, illustrating limitations and also taking tipping points into consideration. Having specific maps on risk is mentioned too. Regarding the spatial resolution, the journalists argue for a stronger regionalisation, focusing rather on municipalities and districts instead of raster cells. That would make the information more tangible for them.

A gamification approach such as the “Can you reach net zero by 2050?” simulation game by the Financial Times (2022) could help to make impacts more tangible for people. Also in terms of offering an FAQ to unmask fake news they see a gamification approach as promising. Setting up an FAQ could go along with establishing a consistent glossary with coherent terms would also be much appreciated.

When thinking about dissemination, the participants wish for a planned phase before the actual release of the data. This would help them to prepare features and conduct thorough research beforehand and without time pressure, as the more complex the topic, the more research has to be done. As a good example, Copernicus is mentioned for announcing their press releases early. Having the opportunity to bring in feedback would also be much appreciated.

Going to the source, the participants would wish for one central platform with more filter and search functions, such as a “Google for climate data”. Moreover, the participants would like to have show cases to see how data can be processed in the sense of open data processing. As a good practice example, they mention the Open Data project of the Austrian Parliament (Parlament Österreich n.a.) which offer showcases on how data from parliament sessions can be used to do analyses. The journalists would like to have showcases both as text and/or python scripts along with information both on technological and methodological options.

Another wish would be to have a support available, preferable with specific contact persons, allowing journalists to back check their interpretations. Moreover, they would appreciate it if there was a prominent listing of experts that were involved to be able to directly follow up with them for questions.

Topic	Use cases	Current sources	Current challenges	Future challenges	Ideal world
EU Taxonomy	- Climate risk analyses, primarily short-term (2–3 years); - driven mainly by EU Taxonomy and CSRD; - requires location- and activity-specific information	- Mainly ÖKS15, HORA, EURO-CORDEX; - also AON platform, AXA, Climate X, EY Cap Tool, ChatGPT	- Insurance coverage currently only possible for short-term events; - some ÖKS indicators already outdated; - technical/expert language; - complex impact correlations	- Estimating financial and temporal damages for long-term events; - evaluating the effectiveness of adaptation measures	- Guidelines for risk analysis; - better explanations; - improved clarity through pictograms; - WebGIS with location-specific info; chatbot support; - awareness raising
Climate Proofing	- New construction and urban planning projects, and adaptation of existing structures; - also relevant for EU Taxonomy	Mainly ÖKS15, HORA, GeoSphere Data Hub, CLIMAMAP, urban climate modeling, regional GIS platforms	- Spatial resolution too low for small-scale planning; - temporal resolution partly too coarse; - future development data needed for model calibration	- Determining relevant planning horizons; - standardization of data (not yet for practical use); - dealing with diverse scenarios	- Best practice guidelines; - advice on handling available data; additional parameters (e.g. humidity, wind, radiation); - WebGIS with high-resolution analysis; - help navigating diverse climate scenarios; - standardized data
Energy Sector	- For daily operations, weather events are more relevant than climate scenarios; - strategic planning requires localized climate information	- Publicly available data; - risk maps from federal states and HORA; - Copernicus data; - Munich RE's climate projection tool	- Long-term climate projections often insufficient for operational needs; - immediate weather extremes more relevant; - reliable scenarios needed to design resilient infrastructure	- Securing funding for adaptation measures; - balancing investment with future resilience; - ensuring long-term data reliability	- Risk analysis guidelines; - visual aids and explanations; - WebGIS tools; - improved communication of relevance

AI	- AI models are increasingly used in everyday life, likely also for accessing climate change information; - can serve as an entry point for non-experts; - plausible use in climate services, but requires critical review	- Models cite IPCC, NASA, NOAA, Copernicus; - also GeoSphere Austria, DWD, Umweltbundesamt; - further sources include Our World in Data, Klimadashboard.at, Carbon Brief	- Lack of traceability and source attribution; no access to real-time data; - varying quality and depth of responses; - uncertainties not communicated; - no user-specific adaptation; persuasive language may lead to uncritical use	- Unclear how to achieve transparent source attribution; - challenges in integrating dynamic, updated data; - lack of user-specific communication; - need for integration into existing services; - risk of misinterpretation	- Up-to-date, verifiable, and traceable information; - automatic adaptation to user needs; - transparent communication of uncertainties and data sources; - real-time updates; - embedded in ethical and transparent frameworks
Climate Communication & Media	- Contextualization and verification of climate information for articles or media pieces; - e.g. in response to events or changes	- Primarily CCCA, Climate Status Report, Klimaszenarien.at, factsheets; - scientific institutions (e.g. Copernicus, Wegener Centre); - public institutions (e.g. Statistik Austria, BMK, Umweltbundesamt)	- Framing of information depends on organizational background; - outdated sources (e.g. ÖKS15); - challenge of translating scientific content incl. uncertainties for broader audiences; - need for interpretation and examples	- Dealing with scenarios and tipping points; - addressing misinformation and political influence	- Linking climate data to other fields (e.g. health); - use of examples and personas; - uncertainty communication; interactive maps and dashboards; - gamification; - unified glossary

Discussion & Interpretation

In the FGDs, several key points of discussion arose that highlight open questions of what to consider when designing climate services, how to (correctly) make use of them, what are current hinderances, and how these questions are embedded in a political context.

Since the (potential) users need climate services for specific professional tasks and activities, one key point of high importance revolves around **technical aspects** of climate services. Many of the FGD participants call for web-based services, so they can easily access it. Ideally, the information is site-specific, has a high temporal resolution and is already visualised. The "right" technical preparation and provision is therefore particularly important. To improve accessibility and foster the actual use of climate services – specifically the use of the Austrian climate scenarios – users call for an **interface between existing platforms and the climate service in question**. They mostly refer to platforms such as the GIS platforms of the Austrian federal states. To increase usability and ease the transfer of knowledge not just between platforms, but also between subject areas, the (potential) users wish for **linking climate information with relevant connected topics** such as health, biodiversity, spatial planning and others.

Climate services often serve as a base for decision making. This often requires a defined goal or scenario, that should be achieved, with little to no space for deviation. Especially when climate

services are drawn upon as a foundation for argumentation with providers of funding, they often demand clear and unambiguous statements. Therefore, many users need to find a way **how to deal with uncertainties**. Similarly, decision makers often raise the question of **limits of adaptation**. For example, does it make sense to plan for extreme scenarios when calculating the dimensions of a city's sewage system? This has political implications that can range from time frames that are used for planning as well as the more general question of how much is invested in climate mitigation or adaptation measures.

The interpretation of data and information is a great challenge for many users. They wish for an **interpretation and a translation** of scientific information into applicable principles for planning, decision making, and dissemination. Basically, what is the key message? What can this information be used for? And what not? Especially in the **context of AI**, questions of **usage instructions** are crucial: Which sources does the AI draw upon? How up to date is the information? How reliable? And who is to be held accountable in case of desinformation?

That poses the question of **responsibility, mandate, and sovereignty of interpretation**, what statements can be made based on climate services. In easy terms, that means: How far can I rely on that information? Is it suitable to be drawn upon as a base for legal regulations? Is it the official reference, or is there other data that can be used just the same to derive the results and statements needed? Can anybody interpret the data correctly, or are specific knowledge and skills needed? Who is authorised to provide this data, to disseminate it and assess, whether it is being used in a scientifically sound way?

Summary of key learnings

What learnings can we “harvest” for the development of climate services in general and for the next generation of Austrian Climate Scenarios in particular? In this section we summarise our suggestions for the most relevant learning effects of the above-described assessment of challenges, needs and requirements of emerging topics. These revolve around implications for the further development of the new Austrian climate scenarios, the political dimension of decision-making, as well as the responsibilities of providers and users.

→ Learning 1: Designing climate services right

When developing climate services for potential users, it is crucial to make them fit to use for their purposes. That requires **addressing technical aspects** such as resolution, site-specificity, as well as potentially visualising key information. **Good accessibility**, e.g. via a web-based service, increases the usability for the users. It should also be considered, whether it is feasible and desired to have an **interface** between the GeoSphere Data Hub, Klimaszenarien.AT, and the GIS platforms of the federal states. Where possible, climate information should be integrated in other existing and conventionally used systems to increase the uptake. Moreover, the **contextual interface** with other relevant topics could be indicated by referring and linking to respective sources.

In the opinion of the project team, it is advisable for Klimaszenarien.AT to decide, to which extent they want and are able to provide such CS, and what can or should be left for business cases. That includes considerations regarding who is in the position to make interpretations of the data, and what one has to do to be able to do so.

→ Learning 2: Setting boundaries a.k.a. defining responsibilities

In order to address and attract users, providers should define for themselves, what they want their climate service to entail and what not. In the context of Klimaszenarien.AT, we suggest the following:

- **ÖKS** should remain publicly available and free to use.
- To help establish ÖKS as the **reference scenarios** in an Austrian context, it would have to become Klimaszenarien.AT's **sovereign task** to develop them. To that end, it is necessary to indicate why they should be the new standard.
- **Quantitative statements** derived from ÖKS15 and the new generation of ÖKS differ in their robustness. For example, temperature-related projections (e.g., mean warming) are generally considered robust, while precipitation changes, particularly at seasonal or regional scales, are associated with higher uncertainty. Therefore, Klimaszenarien.AT should position itself as the reference point for providing clear guidance on which statements can be considered robust and which require careful interpretation, supported either by expert input, consulting services, or clear methodological instructions.
- In addition, **qualitative statements** can be made, as well as **quantitative statements that come with a specific underlying uncertainty**. However, making qualitative statements goes beyond the remit of Klimaszenarien.AT and could therefore be allocated for example with experts and consulting companies.
- **Uncertainties** are an important aspect of future climate scenarios and need to be communicated with care. It should be made explicit, which decisions can be made based on the ÖKS next products, considering those uncertainties
- Therefore, the **bridging function** of people and institutions that make interpretations is particularly important. It would be helpful to consider installing mechanisms of **quality assurance**, both for the climate service itself (e.g. integrating ÖKS as standard in norms and politics) as well as for the use of it (ability and authority). Moreover, such interpretative functions can enable new economic activities and value creation, such as the development of adaptation measures, specialised consulting services, and data-driven solutions—thereby contributing to new business opportunities, tax revenues, and employment. This poses the question, which tasks and activities can/should be provided by public institutions and organisations and which by private actors.
- All in all, this poses the question of who has the ability and the authority to take which actions and make which statements.

→ Learning 3: Dealing with politics

As ÖKS are often used as base for planning, Klimaszenarien.AT already finds itself in the situation to position themselves in political discussions. This for example concerns discussions on how to take climate action, as the costs of climate change mitigation measures are far lower than those of climate change adaptation measures. Therefore, Klimaszenarien.AT should consider how to deal with such political inquiries, whether they want to position themselves actively or passively. In other words, should there be political action based on insights of Klimaszenarien.AT, or should the initiative wait to be asked for an opinion.

As ÖKS are often used as a basis for planning, Klimaszenarien.AT inevitably becomes involved in politically charged discussions—for example, regarding the balance between costs of mitigation versus adaptation. While climate science itself is not political, its implications often are.

Therefore, Klimaszenarien.AT should reflect on whether it sees itself as a **passive provider** of scientific information that responds when asked, or as an **active player** that proactively engages with policymakers and contributes to public discourse. This includes deciding whether and how to communicate the political relevance of its findings, and whether to actively advocate for science-based decision-making or rely on external actors to translate the data into policy action.

Sources

CCCA (n.a.): KlimTAX. <https://ccca.ac.at/wissenstransfer/klimtax> (accessed 9.12.2024).

Financial Times (2022): The Climate Game – Can you reach net zero by 2050? <https://ig.ft.com/climate-game/> (accessed 6.12.2024).

HORA (2024): HORA – Natural Hazard Overview & Risk Austria. <https://www.hora.gv.at/> (accessed 9.12.2024).

Klimadashboard.at (n.a.): Die Daten und Fakten zur Klimakrise in Österreich. <https://klimadashboard.at/> (accessed 6.12.2024).

Parlament Österreich (n.a.): Open Data. <https://www.parlament.gv.at/recherchieren/open-data/> (accessed 6.12.2024).