Deliverables 2.3 and 2.4

Protocol for Designing Incremental Scenarios

WP2 final report

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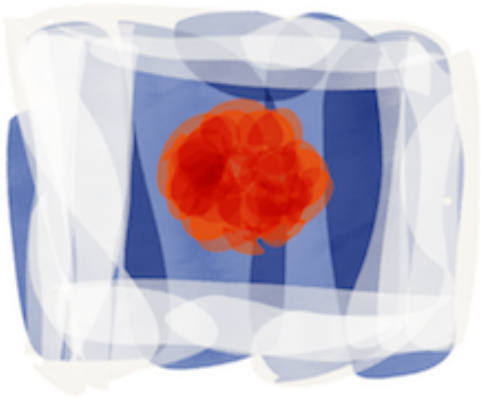

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Contents

Executive summary/summary

We developed, tested and refined a novel incremental participatory scenario approach. This method allows for the development of normative scenarios, pathways that lead to desirable futures, with local communities, through a non-linear approach. Developments in the real world rarely follow straightforward linear paths. The approach inventories 'hinge points': critical moments in time where things might lead to a better or worse future. The hinge points facilitate the inventory of critical challenges and ambitions relevant to the local situation: climate-related as well as key socio-economic, legal, policy/political, and technological ones. They also allow for exploration of key needs for information or climate services that might be useful to local actors at a given point in time. The method was ground-tested and refined in five case studies in the Netherlands, Norway, France, and Germany. The cases showed that the new approach could be applied and tailored successfully in a variety of situations.

Goal/Purpose of the document

- Document the novel participatory incremental scenario approach developed by the CoCliServ project.
- Detail how locally embedded visions, scenarios, hinge points, and climate information needs can be derived, together with local communities.
- Provide guidance and examples to others who might want to use this incremental scenario approach.

Relationship to the Description of Work (DOW)

CoCliServ Work Package 2 (Scenario Design) first developed a draft scenario protocol (M2.1), which was empirically tested in the five case studies (D2.1, D2.2). This deliverable presents the ground-tested final scenario protocol (D2.3), which has been refined and supplemented with examples from the empirical work. The DOW also included an overview of 'research highlights' of WP2 (D2.4). Instead of

publishing these separately, these are included in this document as text boxes, in order to provide practical examples and help illustrate our approach.

1. Introduction

There is a vibrant literature on the benefits of using scenario approaches for climate adaptation at the global and national scales (Hulme & Dessai, 2008; Girod et al., 2009; O'Neill et al. 2014; Rothman et al., 2014). Despite their focus on a relatively large scale, the currently dominant climate scenarios may be useful to apply at smaller scale too, to ascertain potential future climate forcing. However, the empowering nature of such a 'top-down' approach for local communities, is debated (Ensor & Berger, 2009; Shaw et al., 2009). In the CoCliServ project, we've advanced scenario-based approaches by employing an alternative strategy to scenario design: one that is incremental and community led. CoCliServ developed local-level scenarios rooted in the local communities' concerns, aspirations and goals (Wardekker et al., 2019). Such a 'bottom-up' approach may in turn lead to new insights into what information and climate services might be relevant to support local needs and to adapt.

This document presents the Protocol that we have used and refined in CoCliServ Work Package 2: Scenario Design & Development. In CoCliServ, we've aimed to develop new methods to explore and co-design climate services with local communities. We've grounded our efforts in exploring the local narratives of change (WP1); people's perceptions of the past and present and hopes for the future (Krauß et al., 2018a,b, 2019). The results of this exploration have been published in a special issue of *Climate Risk Management* (Baztan et al., 2020; Bremer et al., 2020; da Cunha et al., 2020; Krauß, 2020; Marschütz et al., 2020). WP2 expands on that, building on these local narratives to co-design visions of 'desirable futures' and pathways and critical moments that may lead to (or hinder) those. This in turn provides a starting point to discuss what climate information, services and tools would help communities achieve those futures (WP3 and WP4) (Gerkensmeier et al., 2018; Meinke et al., 2019, 2020; Wardekker et al., 2020).

The Protocol was applied, tested and refined in five case studies: Dordrecht (Netherlands), Bergen (Norway), Jade Bay (Germany), Gulf of Morbihan (France), and Kerourien in Brest (France). See Table 1. The preparation & scoping for the case studies is reported in Deliverable D2.1 (Wardekker et al., 2018), the empirical results of the case studies are detailed in Deliverable D2.2 (Wardekker et al., 2019).

Table 1. CoCliServ case studies.

	**Dordrecht (NL)** Dordrecht is a city of ca. 120.000 inhabitants, surrounded by rivers and close to the sea. As locals describe it: "water comes from all directions" (north, east, south, west, above, below). Consequently, the city is highly sensitive to issues around weather, water, and climate. It also struggles with socio-economic issues, and faces a housing development goal of 10.000-15.000 houses within current city limits. CoCliServ focused on the Reeland/Vogelbuurt neighbourhood. The area has been affected by flooding through heavy precipitation evens in recent years. The municipality and neighbourhood are exploring on how to cope with weather-related issues and climate change through adaptation. Furthermore, large scale restructuring and maintenance (e.g. replacement of social housing estates), sewer replacements, and redesign of public green spaces and sporting facilities are planned.
	**Bergen (NO)** Bergen city sits encircled by seven mountains on the west coast of Norway, described as the 'Gateway to the Fjords.' It is Norway's second largest city and has a long history (950 years-old in 2020) influenced by international trade (notably as part of the Hanseatic League from 1360 to 1775) with European countries including England, the Netherlands, Germany and France. Today Bergen is the country's busiest freight and passenger port and a marine industry hub, a centre for higher education and research, and in 2000 it became a European City of Culture. Bergen also has a long-standing identity as a 'city of weather' and is often portrayed as Europe's rainiest city.
	**Jade Bay (DE)** The Jadebusen (Jade Bay) is a bight of approx. 190km2 at the German North Sea coast in Lower Saxony, between the Weser delta and Wilhelmshaven. The Jade Bay is a result of storm floods in the Middle Ages, and it received its final shape at the end of the 19th century, when Wilhelmshaven became the first German deep sea port. Today, it is contained by a dike line of 52km. The districts of Wesermarsch, Friesland and of the neighboring Ammerland are a mix of marshes, moors and Geest (alluvial from the Ice Age). The most dangerous effects from climate change are sea level rise and extreme rainfall in the inland, which is drained land, partly beneath sea level.

	**Gulf of Morbihan (FR)** The Gulf of Morbihan used to be a small estuary joining three small rivers (Vannes, Auray et Noyalo), which has been persistently inundated (Flandrian transgression) since 10,000BP (Before Present). Nowadays, it is undergoing climate change and extreme events. The Golf will be impact by the sea level and temperature rising, fresh water shortage as well as storms. The Golf of Morbihan is geologically composed of a main city, Vannes, and 12 smallers municipalities composed mostly by secondary housing, implying that everyday life is linked to season. The population rising on summer and weekend and the socio-economic characteristics of this population influence the economic and social activities of the territory as well as land-use planning. The Golf du Morbihan everyday life is also link to weather as the economic and leisure activities are strongly influence by it.
	**Kerourien, Brest (FR)** Kerourien is in the St. Pierre quarter in the urbanized area of Brest, France is mostly structured around post-war housing projects, with landscape transformation from rural to peri-urban that has occurred in this area from the 1950s to the present day. During World War II, the city of Brest was one of the worst damaged areas on France's west coast. From 1940-1944 the Kerourian farming area was greatly impacted. According to the 2013 census, Kerourien has 1200 inhabitants. It is a priority area within St. Pierre, asindicated in city policystatements since 2014. Kerourien is rooted in a place with fragile economic conditions, 32% of residents between the ages of 15 -64 are unemployed. For those between the ages of 15 -24, the rate jumps to 46 %. Thirty-two percent of women are unemployed. Only 35 % of young adults ages 18 –24 are enrolled in universities or other academic institutions.

2. Role of the protocol

The scenario protocol has multiple roles and goals, within the CoCliServ project, for the communities that the project works with, and for external audiences that may want to work with this protocol for their own purposes.

2.1 Role for CoCliServ

The objective of CoCliServ Work Package 2, as stated in the research plan is: "Development and testing of a protocol that structures and facilitates the participatory design and analysis of local incremental scenario scenarios." The WP presents the second step in the CoCliServ approach: bridging between WP1 (narratives of change) and WP3 (climate services). Consequently, a key role in the project is to build on the narratives and result in something that can be used to reflect on and design new climate services.

The WP2 process consistent of five stages. First, a Draft Scenario Protocol was developed based on a review of the literature on participatory scenario design, and the emerging notions of 'incremental scenarios' (M2.1; Wardekker et al., 2018). Second, we inventoried the local situation, desires and needs for scenario processes within our case studies and the communities we work with (D2.1; Wardekker et al., 2019). Third, we applied our novel incremental scenario method empirically in the five case studies and drew both case-related and methodological lesson from that (D2.2; Wardekker et al., 2020). Fourth, we improved the now ground-tested Scenario Protocol based on our experiences (D2.3, present document). Fifth, and overarching synthesis was drawn up (D2.4, as a first draft for a scientific paper, due late 2020).

The role of the Protocol for CoCliServ's scientists is that it should provide a novel way to do participatory scenario analyses, grounded in local narratives of weather and climate, and to provide a novel way to explore the need for new climate services and other information.

The role for CoCliServ's local case study teams is that the Protocol should provide an approach to explore futures/visions and scenarios in a way that is locally embedded and less technocratic/top-down than traditional scenario approaches.

The Protocol will also be embedded in a course and training material on 'climate service co-development', which will be developed in WP6.

2.2 Role for local communities

A central theme in CoCliServ is that we aim to support local communities; that our process, results and climate services that we (suggest to) develop are rooted in local needs and ambitions. The protocol should help local communities, involved in our interviews, workshops and other events, make their perceptions, values and interests explicit, in order to help them explore their visions for the future and actions and information that might supports them in getting there. In turn, that would help climate service providers in developing tools that address local needs.

2.3 Role for external audiences

The ground-tested Protocol for Designing Incremental Scenarios documents our methodological approach in a practical way. It serves as a guide for others to adopt this approach and tailor it to their own needs, as a publicly available tool that is usable in a wide range of situations, by diverse users. Therefore, the setup is relatively general: it is an overview of the approach, not a standardized recipe that can or should be applied the same in any location. Rather, the specific emphases on different steps or the methods employed should be tailored to local needs. Examples are shown on how CoCliServ applied it in the specific contexts of the case studies, which range in focus from urban to rural/regional, from water management to energy to social problems, and from short term interventions to long term planning.

3. Theoretical background

CoCliServ developed a scenario approach and scenarios that explore how local communities might reach the future they desire and what kind(s) of information might be helpful to them (at different moments) in that process. We build on the existing literature on scenario approaches, but develop a novel incremental approach that can be linked directly to knowledge needs.

3.1 Scenario approaches

Within the scenario literature related to environmental and climate science and policy, two major types of scenarios can be identified (e.g. Vervoort et al., 2014; Dammers et al., 2013a,b; Dammers, 2017). Firstly, '*environmental scenarios*', also called exploratory or descriptive scenarios. These describe how the future is likely to evolve. I.e. *things that may happen to the community*. Climate scenarios such as those developed by the Intergovernmental Panel on Climate Change (IPCC) are an example of this approach. These scenarios can be used to reflect on the impacts of a specific change, its drivers, and potential options to respond. Secondly, '*policy scenarios*', also called normative or prescriptive scenarios. These describe how the future should preferably evolve. The aim of these is to describe desired futures and the 'pathways' (strategies and actions) that could be taken to reach those. The focus therefore is on placing the community in the driver's seat: *what does the community want and how can they make it happen*? Examples include regional development plans, neighbourhood designs, plans to reach the Sustainable Development Goals, or disaster response plans. Sometimes, both approaches are combined (cf. Kok et al., 2015; Vervoort et al., 2014, 2015). While complex, in real-life situations there often are both uncertain changes in the context (environmental scenarios) and multiple policy routes to deal with these changes (policy scenarios), and a combination yield concrete insights for decision-makers. This scenario protocol focuses primarily on the latter type: policy scenarios. However, environmental scenarios (particularly climate scenarios) do play an

important role at the start and at the end of the scenario design process. At the start, they form the backdrop and context in which new plans are developed. Most case studies have explicitly addressed them at the start of the scenario development, in order to set the scene for designing policy scenarios. At the end, the participants will need to reflect on how climate change and other environmental scenarios might impact their plans, and what specific information (including scenarios and specific scenario variables) are most relevant to the local situation.

3.2 Methods

A wide range of specific scenario methods has been developed over the years, ranging from desktop studies, surveys, statistical methods, workshop methods, and model-based methods (e.g. Quist et al., 2007; Carter et al., 2013; Dammers et al., 2013a,b; Dammers, 2017; Evely, 2013; Vervoort et al., 2014, 2015; Kok et al., 2015; Van Bers et al., 2016; Hew et al., 2018; Van den Ende et al., 2020). CoCliServ is a transdisciplinary project, collaborating with local communities, and aiming to place the community in the drivers seat. The Protocol therefore emphasises *participatory approaches* to scenario design. In particular, the Protocol builds on knowledge co-development (Hegger et al., 2012; Bremer & Meisch, 2017; Bremer et al., 2019), design thinking (Brown, 2008), and participatory visioning and backcasting (e.g. Quist et al., 2007; Alänge & Holmberg, 2014; Wiek & Iwaniec, 2014; Brunner et al., 2016; Van Bers et al., 2016; Van den Ende et al., 2020).

3.3 Incremental scenarios

The CoCliServ scenario approach will also be 'incremental' (Vanderlinden, 2015). Many classic policy scenarios are gradual, often linear or sometimes exponential sequences of actions or events. Regular policy scenarios present a set of separate, uniform storylines that reach a specific future. However, developments in the real world rarely follow straightforward linear paths. At critical moments in time,

sudden changes are possible, whether for good or bad in relation to reaching the desirable future. Incremental scenarios describe a sequence of possibilities, where one scenario might branch off from another. See Figure 1 for a comparison.

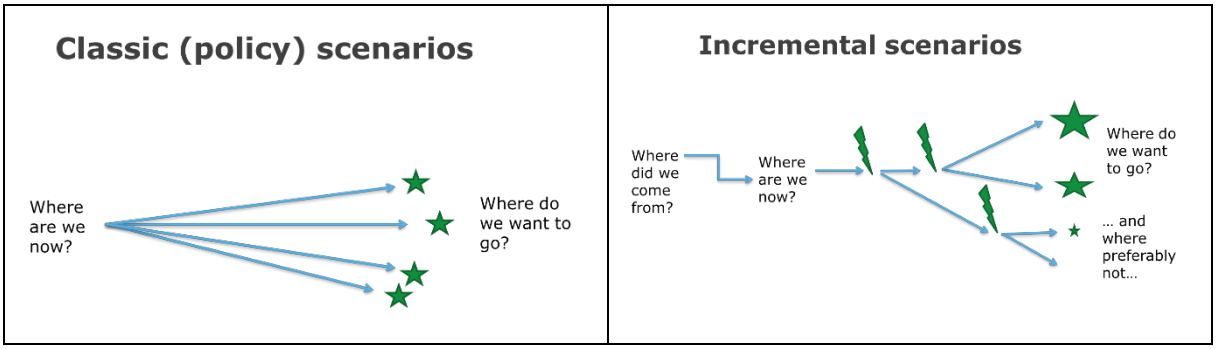


Figure 1. Classic policy scenarios (left) compared to CoCliServ's incremental scenarios (right), with hinge points that lead to branches in the scenario.

Such moments or points, where non-gradual change might happen, are discussed in different literatures. In the scenario literature, an early example is the concept of 'assumption-based planning' (Dewar et al., 1993), which was used to critically reflect on developed business plans in order to identify key assumptions, test these and reflect on (and respond to) alternative and unexpected outcomes. Similar, detailed methods have been developed in the environmental assessment literature as well to inventory and critically reflect on key assumptions (Kloprogge et al., 2011; De Jong et al., 2012; Van der Sluijs & Wardekker, 2015). These assumptions may be related to the underpinning of calculations or models used in the assessment, as well as to the scenarios used to inventory uncertainties or to describe policy pathways. Building on Dewar (1993), the approach of 'Dynamic Adaptive Policy Pathways' was developed (Haasnoot et al., 2013, 2019). This approach systematically reflects on the moment where one preferred policy pathway/scenario might become untenable due to the actual developments, and where a transition to another approach might be needed and might (still) be possible. Another branch of literature that deals with such points, discusses the possibilities of 'imaginable surprise' and 'wild card scenarios' (Schneider, 2004; Steinmüller & Steinmüller, 2004; Smith & Dubois, 2010; Wardekker et al., 2010; Wardekker, 2011), or 'critical transitions' and 'tipping points' in systems (Lenton et

al., 2008; Scheffer et al., 2012). CoCliServ builds on these two literatures. We refer to the points where an event happens that turns the development in a city or region towards another future, as 'hinge points' or 'branching points' (Vanderlinden, 2015).[1] See Figure 1. Incremental scenarios are a relatively new, non-standard approach. CoCliServ's novel incremental scenario approach combines participatory scenario planning with the innovation to use hinge points as a vehicle to explore information needs.

[1] In CoCliServ, we favored the term 'hinge points' over 'branching points'. Hinge point suggests one or the other. At these points, the developments can turn either in a desirable or undesirable direction (the hinge flips up or down). Branching point, on the other hand, entails the joint existence of both possibilities, even when one has already occurred and one path has been taken. Given that we're discussing real social or physical developments, hinge points was the more meaningful term.

4. Protocol

The Protocol for Designing Incremental Scenarios takes a stepwise approach, guiding the user through key phases of the scenario process. These range from determining the goals of the exercise for the specific case study to wrapping up and embedding the results. The steps are:

1. Preparation and scoping
2. Visioning
3. Scenarios & hinge points
4. Coupling to information & climate service needs
5. Synthesis & dissemination

4.1 Step 1: Preparation & scoping

The first step is for the case study team to develop a good awareness of their goals with the scenario exercise and the details of the case study area in which they will apply it.

A key issue is to establish *why* scenarios are designed in the first place:

- Why is the case study team interested in doing a scenario exercise? What's the goal?
- Why might the wider community in the area be interested in it? What would benefit them in terms of (a) the results of the exercise, or (b) the process of the exercise?
- How does the scenario exercise link with current local issues and processes?
- What parts or aspects of the exercise would be most important for the community?

This step is often forgotten in scenario exercises, but it is one of the most critical factors in determining the setup of the scenario design and the usefulness and impact it will have for the local community (e.g. Vervoort et al., 2014, 2015; Van den Ende et al., 2020). Scenario processes work best if they are collaborations, driven by and serving the needs of the community, rather than top-down, technocratic exercises. The goals of the scenario work might be very practical and specific. For instance, in the Dordrecht case study, a neighbourhood adaptation plan is being developed by the municipality and the case study team (including the

municipality) wants to help local residents and actors make their interests, fears, and dreams explicit. It might also be more implicit, or more process-oriented. E.g., to stimulate a community to develop a positive vision for the future. Ideally, one or more central themes or challenges form the focus of the exercise. These can be based on interviews. In the CoCliServ case studies, Work Package 1 collected local 'narratives of change' that formed the basis of the scenario exercise. These focal themes will differ between case study areas. They could be, for example, about 'creating a climate-proof and inclusive neighbourhood', or 'finding a good way to keep a sector healthy under both impacts of climate change and impacts of climate policy', et cetera.

An important question is *who* we will involve in the exercise:

- Who is the 'case study team'? Does this include the local scientists? Who else? E.g. local artists, specialists, policymakers, entrepreneurs, citizens, et cetera. It determines who has a direct say in how the scenario exercise is set up.
- Who is 'the community' in the case study? How do the case study team and the community relate to each other?
- How diverse is the community, in terms of problems, dreams, vulnerabilities, strengths, etc.?
- Are there specific loud voices or usual suspects? Who isn't heard?
- Does the community, or groups within that, have specific goals or agendas? And how do we relate to that?

The organisational details of the exercise will also need to be established: *where, when, and how*?:

- What are the constraints of the case study team in terms of e.g. time, meeting space, funding, contacts and so on?
- What are the constraints of community members that might want to participate?
- How can the process best be embedded in local processes?

Each scenario exercise has different situational constraints: time, funding, type of case study and actors, expertise, etc. This will impact the setup and methods used, leading to different implementations and tailoring of the protocol to each case study site. E.g. sites might use workshops, interviews, questionnaires or desktop work depending on what is feasible and meaningful for the case. For examples of

practical methods and tools that might be used, see CoCliServ's empirical report (Wardekker et al., 2020) or a practical tool catalogue (e.g. Evely, 2013; Van den Ende et al., 2020).

The final aspect to establish, is *what* the scenario work will focus on:

- What are the problems that the community faces, has faced, or will face in the future?
- Are these related to climate change or weather, directly or indirectly, or not?
- Are they things that they can control, directly or indirectly, or not?
- What are the values that members or groups in the community hold dear?
- What might they want to strengthen into the future?
- What information would we need to conduct the scenario exercise?

Lessons learned in CoCliServ

CoCliServ works on climate services, and therefore climate and weather related aspects were one of the focal points. However, climate change was not the only problem that our case study areas face, and often not the most pressing or urgent problem either. Other problems encountered in our sites included for instance: marginalization, poverty and unemployment, resource depletion, loss of community due to demographic or urban planning changes, crime, sense of powerlessness, health, housing, education, cultural erosion. Some communities are facing short-term challenges for which all their energy is mustered. Such other stressors matter – both as issues that necessarily compete with climate change for attention and as issues that in turn also impact climate vulnerability, resilience and adaptation (e.g. Ahmed et al., 2016; McCubbin et al., 2015). Yet these communities are and will be facing climate change and its impacts. It is quite likely they are already in a position where climate change adaptation may be necessary. They may thus need climate science attuned to their specific challenges, however they are not yet part of the visible "demand side" of climate services such as climate information. Therefore, climate-related aspects are still directly relevant, even in such communities. However, taking a broader focus was of key importance to align the scenario exercise with local needs and interests.

For CoCliServ, these 'issues of interest' ranged along two axis. Firstly, as noted above, some issues were directly climate-related (thus could easily be related to needs for climate services), while others were not or indirectly climate-related. Secondly, some issues were clearly local developments or events, where it might be possible to tackle the root causes and drivers locally. Other issues related more to external trends and events, happening in neighbouring locations, or at national or global levels. These of course still have local impacts and responses may be designed locally, but it may involve different types of strategies or options. One key observation in the CoCliServ case studies is that these delineations are far from clear-cut. What one person relates to climate, another person may not. Similar for local versus non-local. We emphasise that these aspects should not be used as a categorization tool, but only as a brainstorming tool that highlights that the scenario exercise is open to a wide variety of local concerns and ambitions. For each of these issues, the case study team could reflect on the problems, vulnerabilities, opportunities, local values & strengths, and the communities' interests regarding the future. See Table 1.

Table 2. Scoping the focus of the scenario work.

	Things that happen locally and that we can control locally	**Things that happen outside our location, which we can't easily control locally**
Directly climate-related	- Problems & vulnerabilities - Values & strengths - Interests for the future	
Not or indirectly climate-related		

For a detailed overview of how CoCliServ approached this step, see Deliverable 2.1 'Case study situation inventory report' (Wardekker et al., 2019).

Example: starting points for Gulf of Morbihan (FR)

- The goal of the participatory, community-led work in the Gulf of Morbihan was to stimulate the local population to take ownership of the question of climate change. So, we aimed to engage people so they could think about incremental scenarios and identify pathways and hinge points
- Narratives facilitated the researchers' understanding of the local context, by making sense of a great deal of data, issues, history and stories, allowing them to better grasp the experience of people in the Gulf of Morbihan. Analysing our data through the lens of narratives made it possible to highlight the salient points of the territory, to outline two incremental scenarios and hinge points, and to stimulate reflection within the art and science experimentation.

Example: starting points for Bergen (NO)

- In Bergen, we did not have a specific decision-making process or issue to connect with, and rather opted for an open visioning exercise for a resilient Bergen in 2050. This allowed for boundless creativity around climate and non-climate related developments in the city, but also saw the discussions stay at a very abstract level, and made it difficult to identify specific information needs. One lesson for us was to ground the issue in concrete challenges.
- These concrete challenges, linked to for instance specific topics, sectors, or neighbourhoods, can guide the organisers in inventorying which participants might be interested in and relevant to the exercise. Our open exercise sought to include people from the science-policy networks engaged in ongoing discussions and plans for a (climate) resilient Bergen, but also sought to include voices from outside these networks. However, given our lack of tight focus, the other participants were selected somewhat at random, according to a simple strategy of maximizing diversity according to role, gender and age; including NGOs , consultants, retirees, and business representatives. The workshop composition did work well, and stimulated meaningful discussions that participants enjoyed. However, a more targeted focus would enable a more targeted participant selection. Or alternatively, a set of semi-homogenous workshops, each targeted to a different social group (i.e. one workshop for NGOs, one for the private sector…)
- We designed a workshop that built on previous fieldwork eliciting narratives of Bergen as a place. This both enriched the process – giving groups a base to start from – and constrained the discussion.
- We attempted to conduct all of the work in a single 5 hour workshop, and designed the workshop to be as time efficient as possible. But the amount of work demands a longer set-up than that, or a chain of two or more workshops.

4.2 Step 2: Visioning

In this step, participants and the case study team codesign a clear set of desirable futures, as the community might see them. If necessary, these can be contrasted with undesirable futures. However, most attention should be on the desirable ones, as these tend to be more engaging, positive, and empowering. A 'desirable future' is a potential overall situation that might be achieved – it should be ideal, but possible. Note that this is much broader than a single goal target; it is about the total situation, likely involving multiple goals and constraints.

Goal of the visioning step is to ask: *Given the trends in our region/city/area: what do we value, what do we see as problems, and what would we really like to achieve?*

Single or multiple, contrasting or joined visions

Given the diversity of actors and issues in any community, one can assume that there will be multiple answers to that question. In some cases, a local or regional vision may have already been developed and may be supported by a broad coalition of local actors. The scenario process could build on that. This does require caution: if used to early in the process, there is a risk that newly designed visions are anchored purely on the official one, which neglects other potential visions and inhibits free thinking on what might be desirable. The scenario team should purposefully reflect on whether that is appropriate, and who was involved and who supports this vision or not. However, in most cases, a set of desirable futures will need to be developed, rather than a single one. These can be contrasting and exclusive, describing radically different values or desires or framing of the challenges ahead, or they can be complementary or describing variants of the same core dreams. How to deal with mutually exclusive visions or visions that might seem unrealistic, strongly depends on the case study and methods chosen. E.g., in a workshop setting, different subgroups could develop scenarios for different (exclusive) scenarios. These can then be discussed to see how they might affect/compete with each other and whether they might constitute

a hinge point for each other. However, it is also possible to combine elements from the perceptions of different actors into visions, for example focused on different themes, such as 'community' or 'healthy neighbourhood', or specific topics, such as water, ecology, food, or infrastructure. The possibility of contestation and contrasting interests can then be an internal element, and depending on the case study, it can be worthwhile to reflect on this issue with participants.

Time horizons

A key issue at this stage, is to select what time horizons might be appropriate to local decision-making. Many climate scenarios work with time horizons of 30 to 100 years or even longer. For local decision-making, shorter time horizons may be more appropriate, e.g. 10 to 20 years, and at the neighbourhood level the scale of several years can be particularly relevant. It depends on whether local action will be strategic versus practical, whether action is urgent or not, the stage of decision-making (e.g. early agenda setting or implementation of plans), and the people involved. Long time horizons may feel to abstract to participants, too remote from the present and beyond the more imaginable human lifespan. On the other hand, they may help participants to move from current and individual concerns to broader and collective hopes and fears. It is possible to use multiple horizons and purposefully play with these: take a central horizon that is most relevant to the community's needs and contrast that with shorter and longer scales.

Starting material

It is possible to start this process with a blank sheet. This gives participants full freedom to design the visions they like. However, it is also very challenging for most people to describe their vision for the future, without any cues or starting material. One way to do this is to design a set of guiding questions that starts with familiar aspects, e.g. what they value or dislike in the past or present, and then gradually move from there to the future. Another option is to link the timeframe

discussed to human timeframes, for example that one's children may still be alive (and parents or grandparents themselves). In general, the longer the time horizon, the more difficult it will be for people to imagine what that future may be like. Ideally, some starting material is used and presented. In the CoCliServ project, we first collected 'narratives of change' that highlighted the issues, changes, hopes and fears that people in a community had regarding their local or regional area (Krauß et al., 2018a,b, 2019; Baztan et al., 2020; Bremer et al., 2020; Krauß, 2020; Marschütz et al., 2020). This involved mostly semi-structured interviews, focused on broad questions and some more specific to the role of weather, water, and/or climate. In many cases, stakeholders evoked climatic changes mostly spontaneously. These narratives were then used to 'seed' the visioning process (Wardekker et al., 2020). One thing to consider, was: to what extent are these purely individual imaginaries and to what extent do they describe imaginaries that are shared by the community or groups and organisations within the community? In other cases, the narratives provide valuable stories on the values, hopes and fears in the community, which could provide some first clues on potential desirable futures. They were used, for example, to draw first rough sketches of the visions with some quotes from the interviews, or to design 'poker cards' or similar tools that could be used to reflect on potential elements to build the vision. Creative methods such as collage building, drawing, or plays can be used as well, as can 'gamified' methods such as roleplaying, card-based exercises or competitive games. These stimulate engagement by the participants and produce a lighthearted atmosphere during the sessions. Participants can then creatively build on that material. This approach does require a carefully discussed balance between providing concrete starting material (easier, but it also steers the participants, both consciously and subconsciously) and leaving participants the freedom to design their own visions.

Lessons learned in CoCliServ

Each case study independently developed two or three core storylines based on the narratives collected in each case study site (Table 3). Most of these storylines are highly integrative. They contain elements strongly related to climate change and adaptation, but also focus on broader challenges, transitions and themes, such as community, social justice, migration, innovation & technology, urbanisation, and climate change mitigation. We found that basing vision-development on local narratives of change helped build such integrated visions and scenarios, and that local collaborators found these more relevant to the local situation than purely climate-related scenarios.

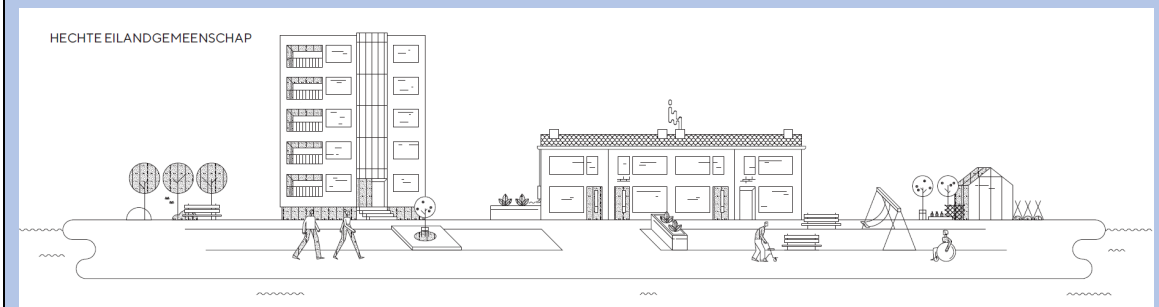
Table 3. Scenario foci/storylines of the case study sites.

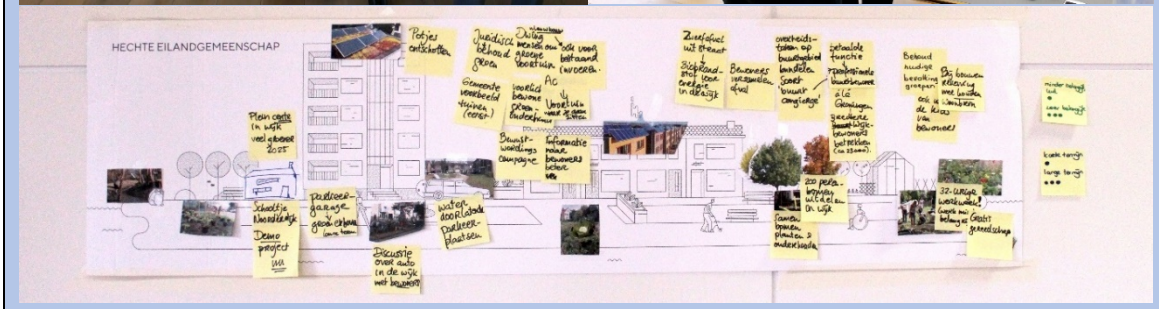
Dordrecht (NL)	Jade Bay (DE)	Bergen (NO)	Golfe du Morbihan (FR)	Kerourien, Brest (FR)
Close-knit island community Innovative connections Water safe & water wise (left undeveloped)	Oldenburger Land & climate change Jade Bay 50% carbon emission reduction Ammerland & climate change (climate democracy)	A 1.5 degree city Let it rain High-tech haven	Shore-centred adaptation Inland-based adaptation	Social justice Migration Housing & urbanisation

Our visions and scenarios dealt with timelines of 2030, 2050, and 2200. The shorter timelines were relatively easy to work with for local actors. In particular, 2030 is often used on local planning and visions and is easy to connect to near-term and medium-term local actions. The longer term was seen as more abstract. An advantage is that it may draw people out of their present situation and actions, and include large scale change and transformations, but it does require methods that help make it more concrete. We designed and applied several creative methods to facilitate this, such as card drawing / poker methods (Bergen, Morbihan), mapping (Morbihan), and collage creation (drawing, cutting and pasting assorted images, etc.) (Dordrecht). Participants appreciated these and could use them to move from abstract visions to concrete actions.

Example: participatory visioning in Dordrecht (NL)

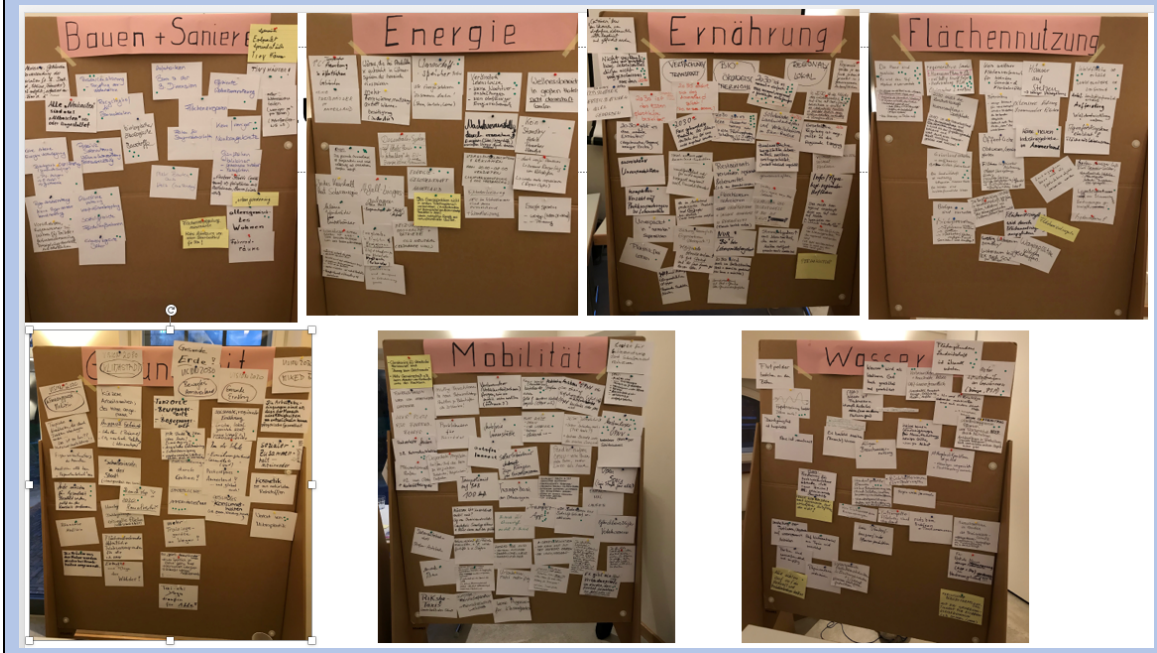
Based on narrative interviews, three themed starting sketches were developed, combining narratives from local policymakers and residents: 'close-knit island community', 'innovative connections', and 'water safe & water wise'. Participants received hand-outs with short descriptions and interview quotes. In subgroups, they elaborated on these sketches using magazine photos, cut-out materials, post-its, and free drawings. This moved the process quickly from a generic vision to concrete options for their neighbourhood.





Example: option scan workshop Ammerland, Jade Bay (DE)

This workshop took a relatively free, open-ended approach. The main question was: How does a climate friendly Ammerland look like in 2030? Discussions were organised along seven topics: nutrition, health, land use, energy, water and habitation / construction. Many ideas were collected on post-its and paper. The organising team further grouped and analysed these, after the workshop. A follow-up workshop is planned to discuss how to integrate such ideas into the municipal agenda. This approach allowed for a large number of participants. It was co-hosted with an NGO. The collaboration with CoCliServ and University of Bremen helped to improve the legitimacy and broaden the agenda.



4.3 Step 3: Developing scenarios and hinge points

The scenario and hinge point development is the core step in WP2. It should be as interactive as possible, for instance in the form of a workshop or similar event.

Scenarios

The future visions from the previous step set the stage for discussing how to get there: the scenarios for action. The goal of this step is to make the developments over the coming years, more concrete and make them actionable, in order to empower the local community to take steps towards such a future. In relation to Table 2, the focus of the scenarios should be on '*Things we can control*' (whether climate-related or not). The '*Things we can't control*' can be used as boundary conditions, where relevant. The scenario work can be a form of 'backcasting' (Quist, 2007; Alänge & Holmberg, 2014; Brunner et al., 2016; Van Bers et al., 2016) or method inspired on that approach. In the visioning stage, participants may have made (very likely did make) the visions concrete by describing them as concrete options. Option scans can be seen as an intermediate step. The goal of the scenario design is to describe concrete *pathways*: sequential, or at least, ordered options that form one or more concrete storylines of how to reach the desired future. This can be done by ordering options on a timeline and discussing how options are connected; see Figure 2.

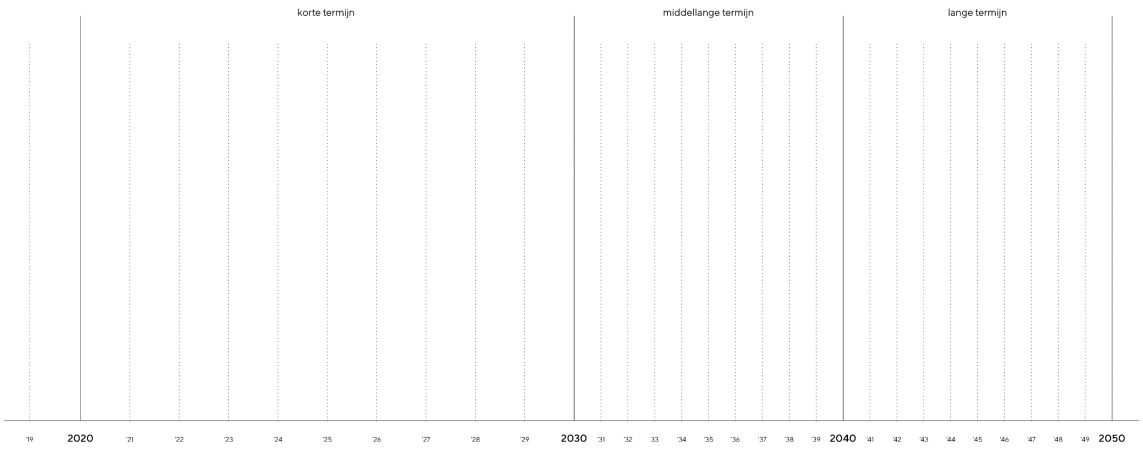


Figure 2. Example of a timeline that can be used to order options into pathways. (figure by Studio Lakmoes).

The specific setup of such scenarios depends on the case study, and in particular on the specific desirable futures that have been formulated. One example would be to develop an action plan for climate-proofing a specific neighbourhood (for a desirable future of a climate-proof city). Other examples might focus on how to involve partners and sponsors to enhance community resilience in a city or region (if the desirable future focuses more on e.g. community cohesion) or developing communication and networking (if the vision is more about enabling the community to make themselves heard in local or regional decision-making).

The scenario work should by high preference be interactive, for instance a workshop. Some authors have argued that remote scenario development, e.g. via internet, is also possible (Hew et al., 2018), but in many cases face-to-face interaction will be preferable. Case studies may however have relatively little time for developing in-depth strategies and action plans. Many traditional scenario and backcasting methods are time-intensive, which may be feasible for settings where such exercises are seen as part of day-to-day work, but much less so for working with local communities. Consequently, it may be better to opt for an approach inspired on back-casting, in a form that allows for a rapid exploration of potential actions and the timeline for that (e.g. a one-hour exercise). The aim in the context of CoCliServ is to use this method as an easy and accessible tool for a local community, rather than a formalised policy planning approach.

Depending on the case study, this might involve multiple subgroups each exploring a separate 'desirable future'. In principle, it would be possible to explore multiple scenarios for each desirable future: there's often more than one way to achieve what you want. We could also develop branching scenarios using the hinge points, e.g. how to recover from an identified potential setback. Given the time constraints, however, we will likely need to limit ourselves to one main scenario per desirable future, unless the participants prefer something else.

Hinge points

The hinge points (or alternatively, 'branching points' or 'critical moments') are critical moments in time: junctures in which the developments can lead to/from a specific desirable future (e.g. Dammers et al., 2013a; Haasnoot et al., 2013; Vanderlinden, 2015; Wardekker et al., 2018, 2020). The core assumption in CoCliServ is that these are the moments for which information and tools, such as climate services, are needed in order to navigate them and prevent the community's action plans from crashing. We ask the community:

There are points in our plans where something really essential needs to be done (will we do this well or not?), or where our plans could run into trouble (there can always be surprises). We'll need to anticipate these, and respond in time.

Given the action plan you've developed, what could go wrong in this process? (and when/how/why/etc.?). What could you do and what would you need to keep on track?

A hinge point is a development that can steer the community, system, city, region, neighbourhood, et cetera towards either a more desirable future or an undesirable one. They can originate through choices by the actors in the region (internal; can be influenced) or through developments from outside (external; can't be influenced directly/meaningfully). They can be events (shocks), trends (gradual changes), or combinations of these. They may be easy to pinpoint in time (e.g. a specific decision deadline) or more difficult (e.g. a tipping point in the climate system or wildcard/surprise scenario). Likely, a major choice of options is needed, and information is required to make the right choice.

Each vision and scenario provides a storyline of how a community might build a desirable future; a model of the world and actions that could steer it in the right direction. Like any model or plan, this involves a number of assumptions, which can be critically assessed (cf. e.g. Dewar et al., 1993; Kloprogge et al., 2011; De Jong et al., 2012; Van der Sluijs & Wardekker, 2015). Hinge points are such core

assumptions. They could be specific decision moments, e.g. "in 2030 the inner city will be redeveloped – this can result in either a higher or lower climate-proof area depending on how it's done". It might also be a more gradual event or trend. They could be issues that we can control (whether the occurrence of the event or the impact it has) or cannot control. They could be directly or indirectly climate-related, or not climate-related (but important for the community in of their vision of a 'desirable future'). See Table 41 for some examples.

Table 4. Examples of hinge points.

	Things we *can* influence locally ("are our plans resilient enough?")	**Things we *can't* influence locally ("surprises from outside")**
Things that *are* directly climate-related	In X years, we'll have a new sewer system in our neighbourhood. It'll easily be there for dozens of years. - We'll need to decide on how large the sewer will be. If it's too narrow, future heavy rain showers will flood the streets. - A little while before construction, we will need information on how much water the sewer should cope with in the (far) future.	What if sea level rises more quickly in the future and the dikes and other flood defences can't cope with it anymore. - How quickly would this become a real problem for us? What are the consequences? - Could we think of something innovative to protect our neighbourhood? And what information would we need to make the right choices in this plan?
Things that *aren't* directly climate-related	In our plans, we want to account for vulnerable groups. E.g., we need cooling, shade in/around retirement homes and spaces where elderly people could meet and stay involved in the community. - How flexible are current plans for the neighbour-hood? When should we pin these matters down, and make a final decision on how to implement them? - When do we need info on how many elderly will live in the neighbourhood in the future (therefore: how many homes and recreation are needed)?	What if there's another economic crisis in the future? How could that impact our plans? - Which plans are most vulnerable to such a crisis? Are there groups in the neighbourhood that would be hit extra hard? - Are there alternatives to our current options, and how easy would it be to change our approach? What consequences might it have for the affordability of our plans and the cost of living in the neighbourhood?

A leaflet was developed to describe the concept of hinge points to collaborators and workshop participants. See Appendix A1.

Hinge points are important because they show potential weaknesses and windows of opportunity in the plans. They can be negative (something goes wrong), but also positive (moment were we can do even better), and emphasising this can be important for developing positive future visions.

The hinge points can be inventoried and discussed during the same event/workshop as the scenario development. They are directly tied to the scenarios and options that the community developed. E.g., a group that developed a specific scenario might have ideas on what could go wrong with their plans. However, it can also be interesting to gather insights from outside that group: other people might spot other risks to the action plans than the group that proposed it. As noted above, hinge points can be tied to individual options, to groups of options or to a general time frame. See Figure 3.

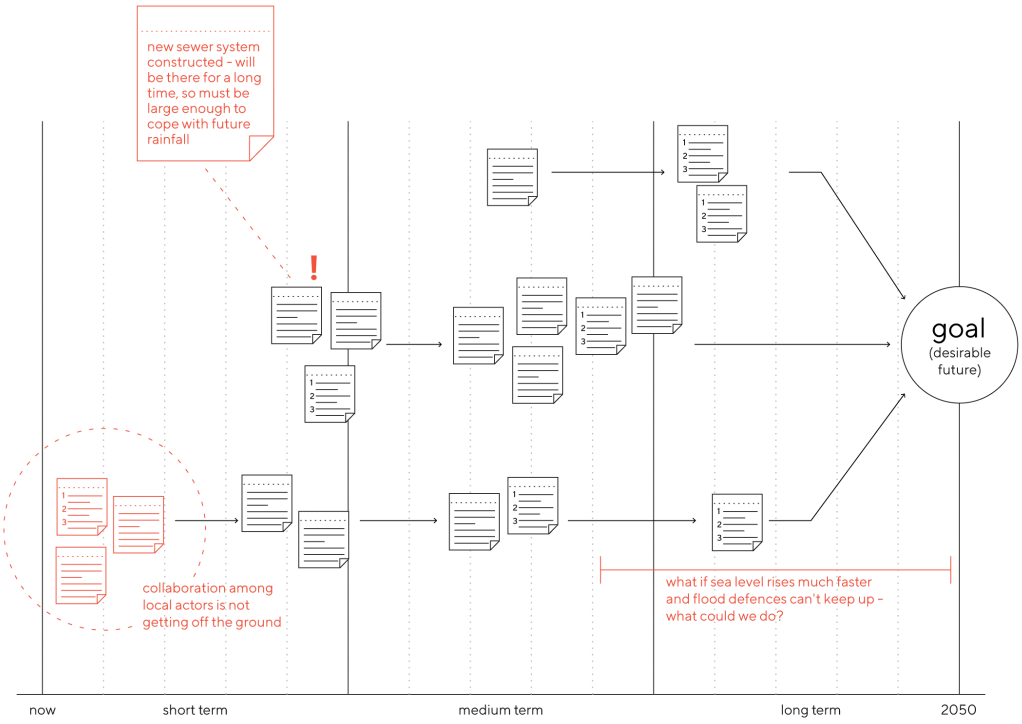


Figure 3. Developing hinge points for a scenario. Hinge points (in red) can be related to specific options, to groups of options, or to a time range. (Figure by Studio Lakmoes).

Lessons learned in CoCliServ

Our visions and scenarios dealt with timelines of 2030, 2050, and 2200. The shorter timelines were relatively easy to work with for local actors. In particular, 2030 is often used on local planning and visions and is easy to connect to near-term and medium-term local actions. The longer term was seen as more abstract. An advantage is that it may draw people out of their present situation and actions, and include large scale change and transformations, but it does require methods that help make it more concrete. We designed and applied several creative methods to facilitate this, such as card drawing / poker methods (Bergen, Morbihan), mapping (Morbihan), and collage creation (drawing, cutting and pasting assorted images, etc.) (Dordrecht). Participants appreciated these and could use them to move from abstract visions to concrete actions. The scenario step can be a fairly time-consuming one, leaving some groups out of time to work on the hinge points. We suggest to limit the depth of this exercise. It is not yet necessary to develop detailed action plans; just the general pathways with some concrete options. It should be noted that these pathways tend to be multiple: it is often not just a single uniform path or plan that leads to the desired future. Rather, options can be grouped into different themes, which form multiple storylines, which sometimes interlink.

The work on hinge points was successful. The Dordrecht team in particular did a detailed participatory hinge point analysis, and the participants (policymakers, researchers and residents) could – with some prompts and examples – worked very well with the hinge points matrix in Table 4. Bergen gathered hinge points in a second workshop with the project team. We felt that this was less satisfactory. It resulted in many hinge points, but the team was constantly hesitant on whether the local actors might have had other ideas. The Jade Bay and Morbihan deduced hinge points from the discussion notes, which was relatively successful, but this is dependent on detailed notetaking and a lively discussion that does address these

points (which may require some prompting from moderators). Interesting aspect in Morbihan was that it explicitly included major past hinge points, which can provide good examples of what a hinge point means and might be expected in the future. Interesting in Dordrecht was that it explicitly included positive hinge points – developments that local actors could use as a window of opportunity to move to an even better situation. This aspect was highly appreciated by local actors, as it allowed for a more positive discussion of the future. While the individual hinge points are case dependent, we can observe some similarities. Particularly, while there are many climate-related hinge points, many more locally relevant ones are related to events and trends in politics, decision-making and legal aspects (at local, regional, national and EU levels), social dynamics, public imagination and concerns, and to technology. This was a very prominent feature in all case studies. One relevant point of discussion in the Jade Bay case was the difference between 'directly climate-related' and 'not directly climate-related' hinge points. This distinction is often very murky in debates on local visions and scenarios. For instance, residents may have different (often broader) ideas of what is climate related than climate scientists (and other fields of science and policymakers may again have other ideas). There are also many aspects that are indirectly climate related. Similarly the axis of 'locally controllable' versus 'not locally controllable' may depend on which actors are at the table. Consequently, using the hinge points matrix as *analytical tool* results in somewhat forced or artificial divisions. Rather, it should be used as a *discussion tool*, with the explicit understanding that the intention is that it should open up the discussion for participants, to allow them to mention all aspects they deem relevant to their local situation, to go beyond the ones that may be climatic.

Example: scenario & hinge point exercise in Morbihan (FR)

Eleven hinge points were identified. Eight of them described past situations and allowed participants to imagine related possibilities in the future and to identify potential actions. The three hinge points concerning the future correspond to the local issues: Urbanisation and spatial planning, Food and energy autonomy, and Demographic balance.

In Figure below, moving from left to right is the equivalent of advancing toward the future, although proportions do not represent any scale of time. Starting from the left, the identified local issues are displayed in the present time as the framework used by stakeholders to reflect on the desired future. For each issue, there is a horizontal line indicating the pathway from 2019 to 2200. Numbers in small rectangles represent the adaptation actions proposed by stakeholders. These actions are not displayed according to any prioritisation nor is any implementation order.

On the right side of the image, the rectangle "Consensual 2200 desired vision" compiles the visions of the future expressed consensually for nine out of ten local issues. Finally, those with each outcome from hinge point III results in the two incremental scenarios: shore-centred or inland-based adaptation.

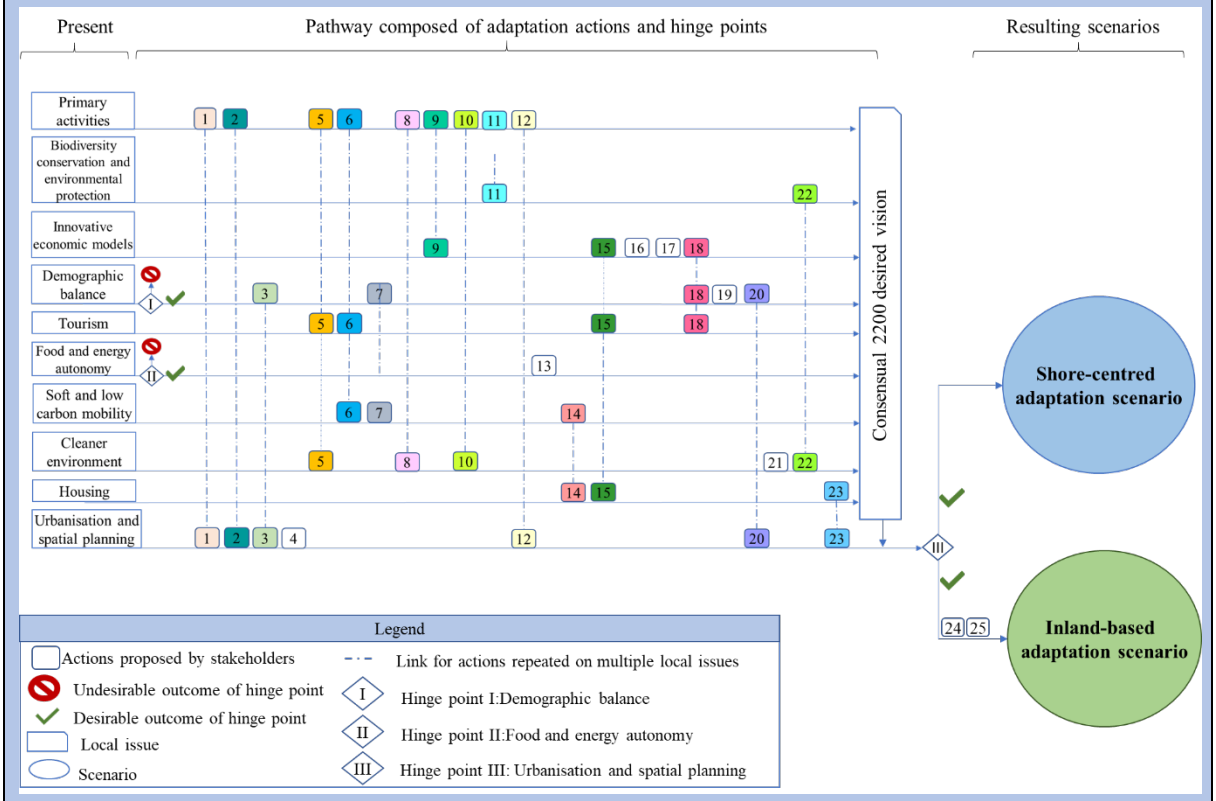
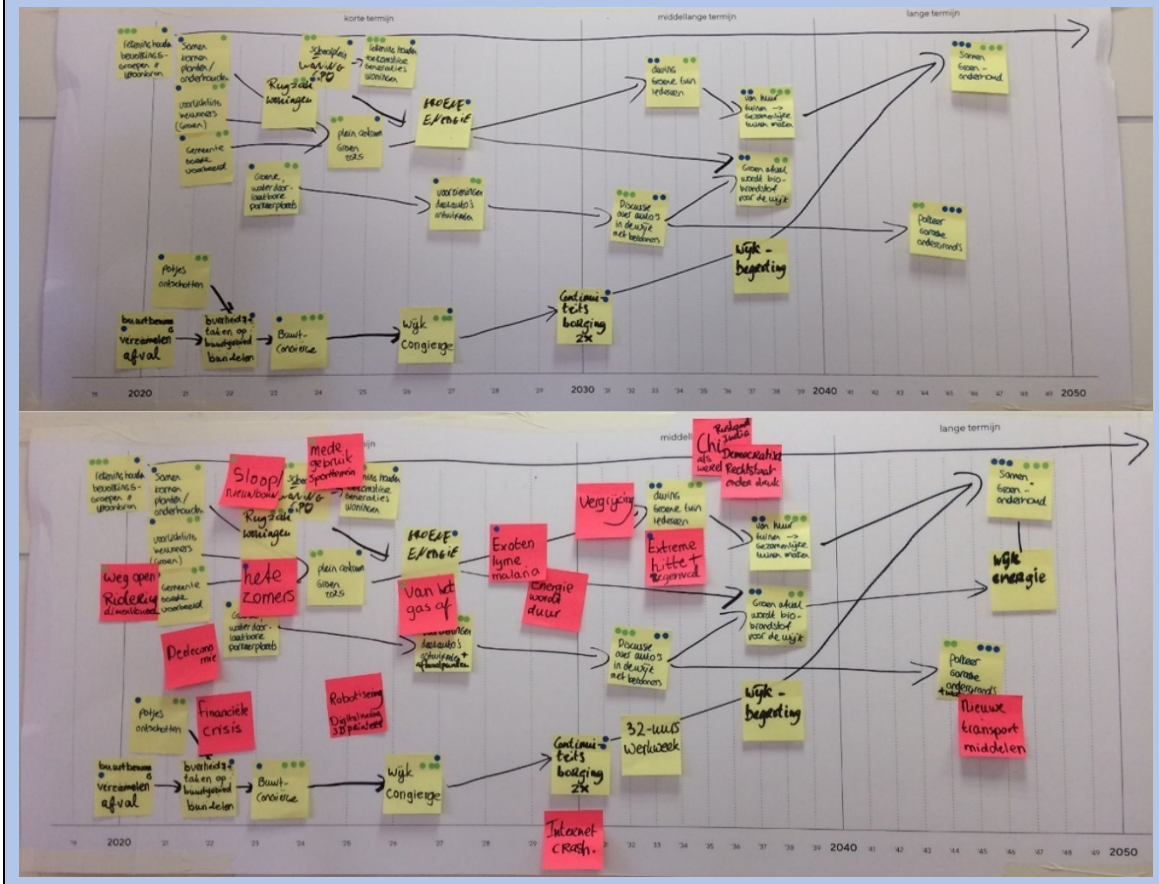


Figure: Integrated representation resulting from the implementation of the community-led foresight protocol in the Gulf of Morbihan.

Example: scenario & hinge point exercise in Dordrecht (NL)

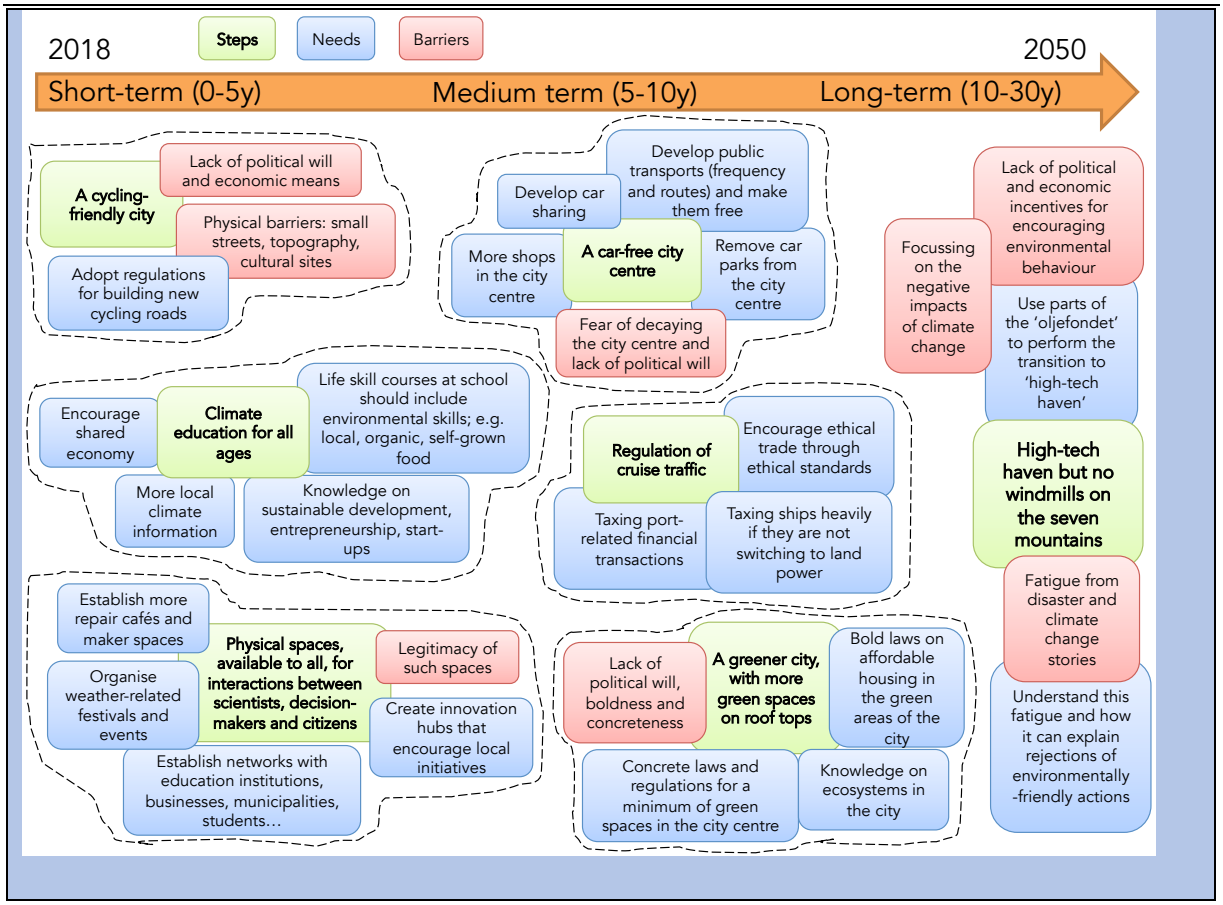
The Dordrecht exercise first translated all the options on the vision board into concrete policy options on separate yellow post-its. The subgroups then assigned them coloured stickers: to score the measures on whether they were 'essential' or 'not essential' (need-to-have versus nice-to-have) and 'short term', 'medium term' or 'long term'. The options were then placed on a timeline. We discussed how the options

related to each other, and whether some 'storylines' could be described: how do the options tell the story of the community reaching the future? These were drawn with arrows. Hinge points (both negative and positive) were then inventoried, using the hand-out shown in Appendix A.1. The hinge points were written down on red post-its and placed on the timeline as well, connected to specific options or groups.



Example: scenario exercise in Bergen (NO)

The one-day Bergen workshop divided participants into three groups, and allocated each a prepared scenario for 'Bergen in 2050', based on research of public narratives in the city. Scenario A - 'A 1.5 degree city' - was drawn from the municipality's strategy to *control* emissions to keep global warming below 1.5 degrees Celsius. Scenario B - 'Let it rain' - embodied *living with* climatic change. Scenario C - 'High-tech haven' - emphasised *making the most of change* by exploring opportunities in renewable energy for example. Groups chose five key dimensions along which to detail their scenarios, then completed an assessment of the situation in Bergen today relative to their scenario and five chosen dimensions; 'along what trajectory is Bergen developing now, and to what extent is that trajectory likely to see Bergen land on the scenario?' The final task was to 'back-cast' steps that Bergen city needs to take to move towards a trajectory that achieves their detailed scenario by 2050. Participants wrote and drew a sequence of steps – each group taking a different approach - that they ordered according to the short, medium and long term. All groups noted a large number of steps, which were a mix of actions, decisions, processes and resources. Groups assessed what was needed for each step, including climate science and information, material resources and finance, political will, experience and expertise or laws for example. The back-casted below is for the High Tech Haven scenario.


2018
Steps
Needs
Barriers
2050
Short-term (0-5y)
Medium term (5-10y)
Long-term (10-30y)
A cycling-friendly city
Lack of political will and economic means
Physical barriers: small streets, topography, cultural sites
Adopt regulations for building new cycling roads
Develop car sharing
Develop public transports (frequency and routes) and make them free
More shops in the city centre
A car-free city centre
Remove car parks from the city centre
Fear of decaying the city centre and lack of political will
Focussing on the negative impacts of climate change
Lack of political and economic incentives for encouraging environmental behaviour
Use parts of the 'oljefondet' to perform the transition to 'high-tech haven'
High-tech haven but no windmills on the seven mountains
Encourage shared economy
Climate education for all ages
Life skill courses at school should include environmental skills; e.g. local, organic, self-grown food
More local climate information
Knowledge on sustainable development, entrepreneurship, start-ups
Regulation of cruise traffic
Encourage ethical trade through ethical standards
Taxing port-related financial transactions
Taxing ships heavily if they are not switching to land power
Establish more repair cafés and maker spaces
Physical spaces, available to all, for interactions between scientists, decision-makers and citizens
Legitimacy of such spaces
Organise weather-related festivals and events
Create innovation hubs that encourage local initiatives
Establish networks with education institutions, businesses, municipalities, students…
Lack of political will, boldness and concreteness
A greener city, with more green spaces on roof tops
Bold laws on affordable housing in the green areas of the city
Concrete laws and regulations for a minimum of green spaces in the city centre
Knowledge on ecosystems in the city
Fatigue from disaster and climate change stories
Understand this fatigue and how it can explain rejections of environmentally-friendly actions

4.4 Step 4: Coupling to information needs

The hinge points are critical moments - communities need to know well in time what choices to make during/regarding those, in order to navigate them safely and steer towards a desirable rather than an undesirable future. This provides us with clues on what the community might need to know (e.g. what climate services the community might need) and when, in order to make the right choices in time. The central question of this step is:

What kind of information, tools, or other services might we need to navigate the hinge points?

Some potential sub-questions:

- *What is this hinge point about? E.g. infrastructure, policy, social dynamics, finances, behaviour, etc.?*
- *If a decision is made on this aspect, how long will it have consequences. E.g., if a sewer system is in the ground, it will be there for several decades.*
- *How long ahead of time (before making a decision, implementing an option, etc.) would we need to have information available in order for it to be useful.*
- *What would the information be used for? E.g. to modify the system design, to develop a 'plan B' (ahead of time), to react to unforeseen circumstances (at the moment something goes wrong), to develop resilience to this hinge point (ahead of time), etc.?*

This should be part of an interactive brainstorm with local actors, having them reflect on the knowledge that they'd like to have to safely navigate the hinge points and what kind of climate services (in a broader sense than just information) could help them in that respect. Ideally, this is a continuation of the discussion from Step 2 and 3, possibly in the same event. Follow-up interviews or dedicated follow-up work by the case study team and potential climate service providers is also an option.

Information needs and climate services should be interpreted broadly (cf. Goosen et al., 2014). Much existing material revolves around climate data sets, modelling tools, and advanced maps. Those may be suitable to experts and professional users, but not necessarily to actors in local communities. Rather, it is about what

services would serve and empower the community; this could be software or data, as well as for instance workshops or discussion spaces.

The case study team should be aware that not all information needs will be climate-related (as per our scheme in Table 1-3). While non-climate services are beyond the scope of the CoCliServ project, it is useful to explore mixed climate & non-climate services, or to gather some first ideas on how to further help the communities with other services and partners. The information needs that are related to climate services could also be fairly broad: some will deal with climate change trends or impacts, others more with current climate and weather, and others perhaps more with information on climate policy.

Lessons learned in CoCliServ

We were able to elicit information needs in most case studies, based on the scenarios or hinge points. The latter was particularly successful in Dordrecht; this case study followed the Protocol fully. Each scenario subgroup discussed the nature of the hinge points and what consequences it might have for information needs. This resulted in a clear list of information needs that can be used to design or inform new climate services. The other case studies had relatively limited time for this step, conducting a scan for information needs afterwards, or conducting a quick-and-dirty inventory of information needs ('wishlist / shopping list') in the scenario workshop based on the general vision and scenarios. The Bergen team had good experiences with conducting individual reflexive work: they had a 10-minute reflexive pause at the end of the workshop, where they asked participants to think about what they discussed that day, and list: (i) what is for you the most important information Bergen needs to develop resiliently; and (ii) what information is most trustworthy for you. This elicited a rich list of information needs. The Morbihan team also noted that the collaboration between social and climate scientists helped communicate a coherent vision of the issues at hand composed of climatic and socioeconomic dimensions to the participants. This set

the tone of the collective discussions during the workshop and, as a result, the needs for climatic information started to emerge from the joint narratives/incremental scenario approach, so that desirable visions and adaptative actions to get there could be co-developed. The Dordrecht team had a similar experience: the fact that the workshop brought together researchers (social & natural science), policymakers and residents to jointly discuss climate-proofing a neighbourhood in itself brought valuable discussions on climate & adaptation science and local questions and information needs to the table.

Follow-up dedicated work was planned in several case studies, but the 2020 Corona crisis made face-to-face work impossible and hampered the process so far (in the final year of the CoCliServ project). The case study teams do intend to conduct some work post-project. Nonetheless, all cases managed to reflect on information needs with the community, partly because it was presented to collaborators as the main interest in the CoCliServ project.

While some specific and new climate science needs emerged from the discussions, three other points were very prominent across the case studies. Firstly, it is often not so much about what science is available. As participants in multiple cases noted: there is much available already. It is more about how climate knowledge is made available and presented (e.g. formats), communicated and used in decision-making. Secondly, there is a strong need for information services related to climate politics and decision-making (e.g. policy and legal developments). Thirdly, there seems to be a strong need for social spaces where different local actors can articulate and discuss their concerns and ambitions regarding climate change, local futures, and the way forward, involving a variety of actors and forms of knowledge.

Example: information/service needs in Dordrecht (NL), scenario Close-knit Island Community

- Visualisations of the neighbourhood that showed climate change impacts and made these more tangible to local residents. For instance, images of streets in the area with and without trees and the impact of that on local temperatures (cf. urban heat islands, heat waves).
- Communication should not focus only on 'doom stories', but be used primarily to create support for potential options: 'we're improving the neighbourhood, these are our plans'. Visuals of situations where no action is taken also help.
- Information on future energy prices is important to show the impact of sustainability measures and the cost of not improving energy efficiency. This could highlight that the future energy bill might be higher than the rent. Future price estimates of hot summers, invasive species and dike breaches could also be useful.
- Information on invasive species (plants, animals; e.g. oak processionary caterpillar, highly allergenic plants, etc.) is useful for people planning what to plant in their gardens. This is also important for community gardens, public green space. Which garden options worsen the situation and are better avoided, and which improve local biodiversity?

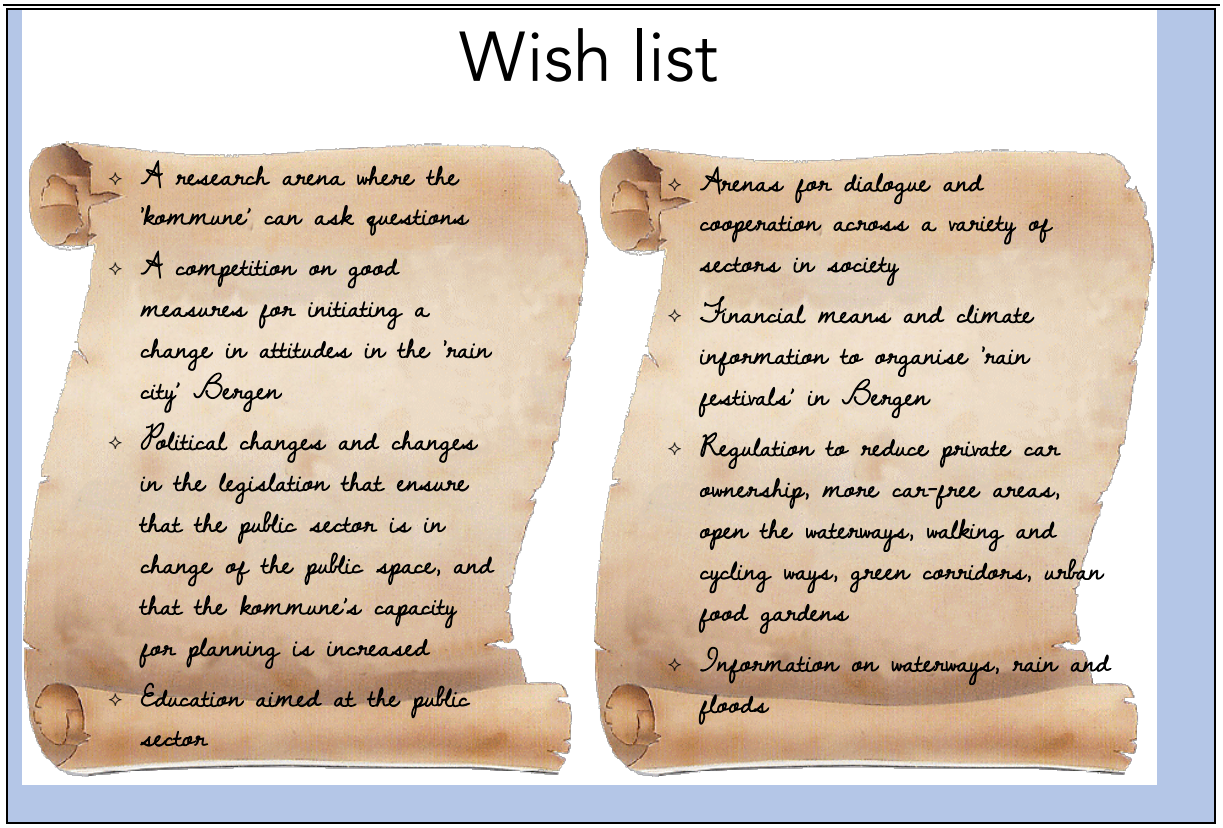
Example: Golf of Morbihan (FR) information needs

A preliminary evaluation was carried out to identify the climatic information needs expressed by local stakeholders during the semi-structured interviews and the prospective workshop. The results were:

1. Impact of storms, sea level rise and marine submersion for coastal risk management;
2. Occurrence of extreme events for agriculture, tourism and territory planning,
3. Seasonal changes for primary activities and tourism,
4. Temperature rise (air and water) for primary activities, tourism and, to some extent, territorial planning,
5. Pluviometry changes for agriculture.

A collaborative analysis between climate and social scientist detailed this information (format, timeframes, etc.) and worked on the identification of their potential sources. Some are display during art and science exhibition (July-august 2020).

Example: Bergen (NO) information 'shopping list', scenario Let it Rain



4.5 Step 5: Synthesis and dissemination

The results should be shared with the community. This includes the community members that were involved in the scenario work, but also those that were not or were involved at the fringes. For collaborators, a synthesis with some key results or action points and thoughts on follow-up activities is important. For the wider community, the results and ideas behind it should be disseminated. Other communities (e.g. other cities, regions or actors), and colleagues may be interested in the material or the approach in general. Synthesis and dissemination can take a wide range of forms, and depends heavily on the situation in a case study. However, it is important to pay explicit attention to it early on.

Lessons learned in CoCliServ

The case studies wrote short reports on the scenario work in the local languages to document the results. In many cases, the uptake was enhanced by presenting the results to local policymakers and by conducing follow-up events. The Jade Bay case led to requests from other communities to collaboratively conduct similar

workshops. Dordrecht is now exploring the design of new climate services for the municipality based on the information needs uncovered. They also upscaled their experiences into professional learning modules on participation and governance in climate adaptation. Other cases, such as the Gulf of Morbihan and Kerourien, Brest, involved science & art exercises which helped others reflect on the topics at hand and facilitated some community building. It was helpful to link up with existing processes from the initiation of the project. Gulf of Morbihan linked with long term planning efforts ongoing in the area, Dordrecht linked with the municipality's effort of developing climate adaptation plans, and Kerourien, Brest linked with the 50th anniversary of Kerourien. In general, we found that it was important to start community building from the start of the project, and looking for synergies with other efforts, where our experiences can be brought in.

Example: Gulf of Morbihan (FR)

- The co-development process carried out in the Gulf of Morbihan resulted in two scenarios, named "Shore-centred adaptation" and "Countryside-based adaptation". Each scenario is composed ten local issues for which participants conceived a desirable vision.
- The research team compile the potential actions proposed by the participants as components of the trajectory between present and future. Twenty-five actions were identified as part of this backcasting process, which can be linked to one or multiple local issues.
- An art and science exhibition is organized in a busy public place (July-august 2020 – conservatoire de Vannes). Local people and visitors who discover the artistic work are invited to visualize how the future might be reflected in their territory, through embedded scientific data and art, in order to foresee potential impacts and to become accustomed with what bold adaptation solutions could look like. Participatory exercises will be conducted during this exhibition.
- Advantages of the interdisciplinary nature of this methodology were observed. The artistic dimension of the poker design mobilised the participants' creativity and undoubtedly contributed to the quality of the final result. The collaboration between social and climate scientists allowed researchers to communicate to the participants a coherent vision of the issues at hand, composed of climatic and socioeconomic dimensions. This set the tone of the collective discussions during the workshop and, as a result, climatic information needs start to emerge from the joint narratives/incremental scenarisation approach, as desirable visions and adaptative actions to get there are co-developed. These results contribute to the development of action-oriented, demand-driven and science-informed climate services.

Example: Kerourien, Brest (FR)

Envisioning local climate change adaptation action, one may face the fact that for some communities climate change might not be high on the local agenda. The issue is not necessarily that such communities

negate the salience of climate change and its impacts. Some communities may have other challenges that are more pressing and not obviously climate related: marginalization, poverty, resource depletion, crime, sense of powerlessness, health, housing, education, cultural erosion, demographics depriving parents from their children. Some communities are facing short-term challenges for which all their energy is mustered. This has consequences for how to best approach 'co-developing climate services for action', including how to engage with communities on visions and scenarios.
In this case it entailed being mobilized to co-produce an anniversary celebration and the corresponding theatre play, along with a stronger partner community and the scenario exercise as a result. In order to engage with a community in a climate service co-production exercise despite the community's seeming lack of interest in climate issues, we took the long way around. We engaged in relationship-building and making our skills available for many purposes while progressively connecting with the community, its concerns, interests, and finding intersections with climate issues. We were transparent in terms of our interest in climate concerns, yet we kept that agenda on the back burner while accepting to mobilize ourselves around the community's more pressing issues.

Example: Bergen (NO)

We synthesised the workshop findings into a report which highlighted six key themes that participants raised as being important for developing Bergen's resilience. This 35-page report, including digitised version of their group work as appendices, was sent to all participants within three months of the workshop, and participants were invited to an optional 'coffee and cake' session at a local café, to sit and discuss the report. Four of the 18 participants did come and discuss this report.

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Appendices

A.1. Hinge points flyer

Hinge points – critical moments where our plans might turn out differently

What are hinge points?

There are points in our plans where something really essential needs to be done (will we do this well or not?), or where our plans could run into trouble (there can always be surprises). We'll need to anticipate these, and respond in time.

In designing future visions, plans, or scenarios, we've developed ideas on how to reach our vision(s) of a desirable future. Behind these ideas, there's certain logic: they form a (sort of) step-by-step story of how we think we might achieve our vision. Some of these steps may be 'essential'[2]. However, in practice, that story and the future in general might always take a different turn. The question in this exercise is: where could the story take an unexpected (good or bad) change?

Compare it to a route planner: we have the destination (our future vision), and a plan/route on how to get there (the scenario/options). However, during our trip, we might encounter red traffic lights, road works, or we remember that we also needed to do grocery shopping along the way. If we ever want to get to our destination, we'll need to keep that in mind: we'll need to take the right turn at the right moment, or find an alternative route.

Examples of hinge points.

	Things we *can* influence locally ("are our plans resilient enough?")	**Things we *can't* influence locally ("surprises from outside")**
Things that *are* directly climate-related	In X years, we'll have a new sewer system in our neighbourhood. It'll easily be there for dozens of years. - We'll need to decide on how large the sewer will be. If it's too narrow, future heavy rain showers will flood the streets. - A little while before construction, we will need information on how much water the sewer should cope with in the (far) future.	What if sea level rises more quickly in the future and the dikes and other flood defences can't cope with it anymore. - How quickly would this become a real problem for us? What are the consequences? - Could we think of something innovative to protect our neighbourhood? And what information would we need to make the right choices in this plan?
Things that *aren't* directly climate-related	In our plans, we want to account for vulnerable groups. E.g., we need cooling, shade in/around retirement homes and spaces where elderly people could meet and stay involved in the community. - How flexible are current plans for the neighourhood? When should we pin these matters down, and make a final decision on how to implement them? - When do we need info on how many elderly will live in the neighbourhood in the future (therefore: how many homes and recreation are needed)?	What if there's another economic crisis in the future? How could that impact our plans? - Which plans are most vulnerable to such a crisis? Are there groups in the neighbourhood that would be hit extra hard? - Are there alternatives to our current options, and how easy would it be to change our approach? What consequences might it have for the affordability of our plans and the cost of living in the neighbourhood?

Why are they important?

Just like the example of the route planner, you'll want to spot potential problems before it's too late. You'll want to account for it – steer the developments in the right direction – when we can still do something about it. Hinge points are important for two reasons:

- They show potential weaknesses (and 'windows of opportunity') in the plans.
- You can use them to think about what kind of information you'll need at what time.

[2] Note: in the Dordrecht scenario workshop, we've included an exercise where we scored all options as 'essential' (need to have) versus 'non-essential' (nice to have) and short term versus long term.