nextGen
Circular Water Solutions

D3.5 CoP's cross-fertilisation report

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[1] PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services)
CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

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Updates from previous version

Comment	Correction
The deliverable presents a clear and consolidated picture of the activities performed within the various CoPs which followed a harmonised structure and format. In total 37 CoP meetings were held and the team also had cross-fertilisation workshops. Due to COVID many CoP meetings were shifted to an online format. The participation of stakeholders from different sectors was overall well balanced. Outcomes of the 2 cross-fertilisation meetings and the conclusions are clearly presented and show that people and communication skills are in the core of driving CE adoption.	-
However, it is not clear why CoP #4 on Upscaling and evaluation has not taken place in all 10 demos (table 4.1).	The topic of Upscaling and evaluation has taken place in all 10 demo cases, however in some this was done at their final CoP#3; see the topics tables in section 4.2. This is better explained in section 4.1.
The number of participants in some CoPs remained rather low (e.g. La Trappe, Altenrhein, Costa Brava). The justification should be provided.	Indeed these CoPs were so-called technology-CoPs: with an emphasis on technologies confined to a local-scale application. The participants were mainly limited to engineering companies. The explanation is provided in section 5.1.
It is not sufficiently addressed how stakeholder feedback from CoPs and other engagement measures was integrated in e.g. the toolbox and other project activities (see recommendation of the previous project review).	At the end of section 4.2 the synergies with WP topics used and discussed in the respective CoPs is added. Based on the previous project review, the revised D2.5 described the stakeholder feedback (input by partners) on the toolbox.

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Summary

The transition to a circular water economy requires the active engagement from relevant stakeholders. This engagement can be organised through Communities of Practice (CoPs) in which circular water solutions are discussed in their institutional context. These communities extend beyond the exchange of information to actual consultations, making it possible to co-design the technologies and fit the innovations to the local needs and settings.

In NextGen, stakeholders are involved through CoPs meetings at the demo cases. The CoPs aim at creating an engagement environment around the demonstrated circular water innovations in which stakeholders across the water value chain interact and collaborate. At the ten NextGen demo sites, stakeholders regularly meet in CoP workshops to: (a.) set a common vision; (b.) identify opportunities for further closing the water, energy and materials cycle; (c.) reflect on the economic and environmental benefits; (d.) address governance barriers; and (e.) discuss upscaling of the demonstrated technologies. As part of D3.1, a guideline and roadmap was prepared to support the CoP meetings at their early stages:

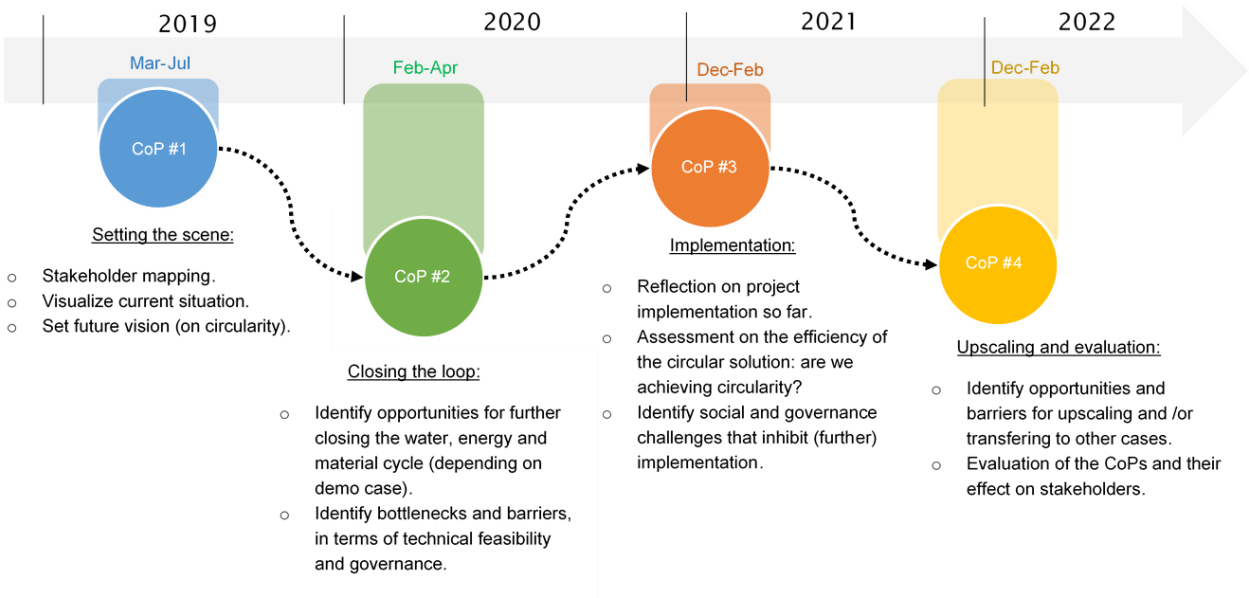

Figure: Overview of key topics and roadmap of the suggested CoP meetings

In total, during the NextGen project time, 37 CoP meetings have been organised. In 2020-2021, due to Covid-19 restrictions, most facilitators opted for online meetings and some of the CoP#2 and #3 meetings were merged.

Around 300 people participated in the CoP meetings, with a wide representation of the different stakeholder groups: water industry experts (15%), technology providers (9%), research organisations (21%), end users (22%), representatives of other sectors, such as agriculture, industry, energy (11%) and policy / governance actors (22%).

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As part of the NextGen project, a novel evaluation framework has been developed that evaluates CoPs in terms of their effectiveness in enabling social learning and achieving the CoP- and project-objectives. It evaluates the activities and outcomes of CoPs to improve stakeholders' willingness to collaborate, facilitate a fair representation of all relevant stakeholders, support the convergence toward a shared issue frame, and improve the quality of knowledge co-produced through stakeholder engagement and interaction in CoPs.

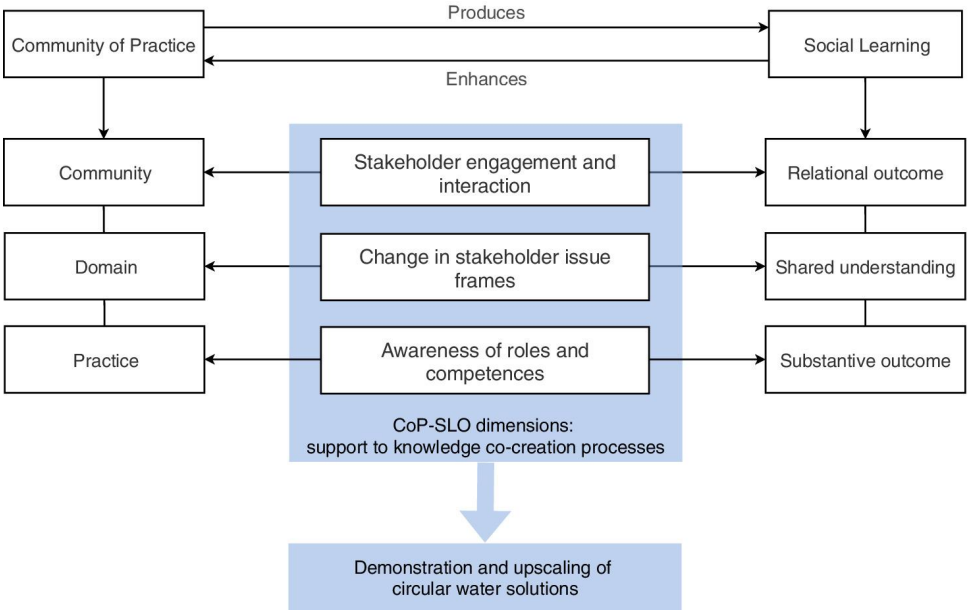

Figure: CoP evaluation framework for social learning outcomes. *Source: Fulgenzi et al., 2020*

The evaluation results from the participants of the CoP meetings show very good scores, average between 4.2 and 4.5 (from 1.0 lowest to 5.0 highest) for all factors that contribute to social learning and hence engagement achieved through the CoPs.

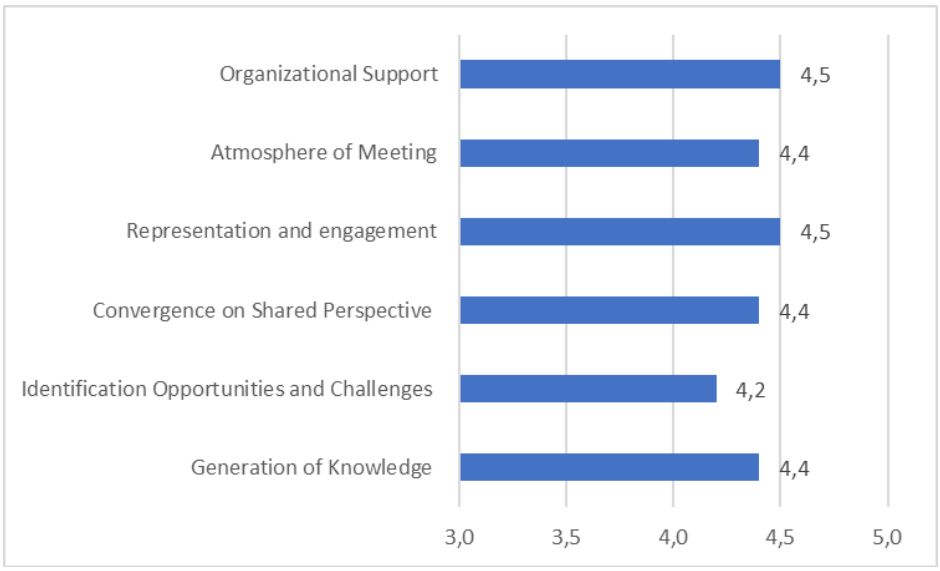

Figure: Evaluation scores of the key success factors for CoPs (from 1 lowest to 5 highest).

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The CoP meetings were organised in such a way that there was scope for open dialogue through all six key success factors:

1. Organizational aspects of the meeting: prior information, materials, duration.
2. Atmosphere: presentation clarity, behaviour, communication.
3. Stakeholder representation and engagement: opportunities to discuss, conflict resolution, inclusion of ideas.
4. Convergence towards shared perspective: topic inclusion, stakeholder understanding, moderation
5. Identification of new opportunities and challenges: time to reflect, clarity of outcomes
6. Generation of knowledge: matching expectations, increase of awareness on circularity.

It can be concluded that the CoPs positively contributed to engagement and interaction of stakeholders, change in stakeholders issue frames, and stakeholder awareness of their own role and competence and of those of other members.

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1. Introduction

1.1 Communities of Practice in NextGen

The EU H2020-project NextGen demonstrates innovative technological, business and governance solutions for water in the circular economy in ten high-profile, large-scale, demonstration cases across Europe. The involvement of stakeholders in the development of water technology and management solutions for the circular economy is an important success condition (Strategic Objective #5).

NextGen (Task 3.1) actively involves and engages stakeholders through Communities of Practice (CoPs). The CoPs aim to create an engagement environment around the demonstrated innovations in which stakeholders across the water value chain interact and collaborate. At each demo case, CoP meetings are organised and moderated by a local project partner.

The relevant stakeholders differ for each demo case. In general, these include the water industry (operators), authorities (regulators, policy & decision makers), engineering companies, consultants, research institutes, representatives of non-governmental organizations, and potential end-users. In general, the NextGen CoPs do not target the general public, unless they are directly involved as end-users. Public engagement in NextGen is organised through public outreach activities, augmented reality and serious games (Task 3.2).

In this report, the results of the CoP meetings are presented and the added value of CoP's to the development and transferability of circular water solutions is assessed. General lessons learned are derived based on a novel social learning evaluation framework and reflexive learning between the different CoPs through cross-fertilisation meetings.

1.2 Outline

After an introduction on the importance of stakeholder engagement in Chapter 2, the approach taken in NextGen for organising CoPs at the demo cases is described in Chapter 3. This approach was introduced in *D3.1 CoP Roadmap and Facilitation Guidelines*. These guidelines provide for a consistent approach and at the same time allow for flexibility to align to the local and demo case specifics.

Chapter 4 presents the NextGen CoP results. All CoP meetings produced meeting reports and these are collected and made assessable to all project partners on the NextGen SharePoint. Specific CoP results are used within the development of the NextGen solutions at the demo cases. In this report only the general outcomes are presented.

To facilitate cross-fertilisation between the demo cases, the CoP organisers exchanged lessons learned in two dedicated meetings, and these are reported in Chapter 5.

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Chapter 6 discusses the added value of CoPs in stakeholder engagement processes for the successful implementation and upscaling of circular water solutions. A new evaluation framework has been developed within NextGen that emphasises social learning processes for fruitful stakeholder engagement. Part of this report is based on the published paper on this evaluation framework (Fulgenzi et al., 2020[1]). The evaluation results and key success factors of the NextGen CoPs are presented.

Finally, chapter 7 presents the conclusions and recommendations.

[1] Fulgenzi, A., Brouwer, S., Baker, K., & Frijns, J. (2020). Communities of practice at the center of circular water solutions. WIREs Water 7:e1450.

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2. Stakeholder engagement

2.1 The importance of stakeholder involvement

For a successful transition from the linear economy to a circular one active involvement from all members of society and strong levels of collaboration is key (Ghisellini et al., 2016). Involving stakeholders in an early stage of technology development contributes to an effective design and implementation of new technologies, while also building up trust. Several authors argue that active involvement of society and industry can facilitate the uptake of new technologies (Ormerod & Scott, 2013; Peake et al., 2018), the adoption of resource-saving practices (Hartley, 2006; Peake et al., 2018), and ensure investments in appropriate and effective technologies (Stahel, 2016; IWA, 2016; Smith et al., 2018).

Stakeholder involvement is seen as particularly relevant for managing complex (also referred to as "wicked") socio-technological problems (Cuppen 2010). This term refers to problems that are very difficult to resolve because scientific uncertainty and value differences are both at the cause (Rittel & Webber 1973, Dunn 1998, Hisschemöller & Hoppe 2001). Scholars in this field have underscored the importance of stakeholder participation in early phases of developing solutions to ensure that all perspectives are taken into account in the knowledge development, design, and implementation process, so that the developed solutions make maximal use of all types of knowledge and is considered legitimate and fair by actors affected (Maasen & Weingart 2005, Callon et al. 2009).

In the move towards a circular economy, technological challenges and social innovations go hand in hand; circular solutions need to take account of both aspects to ensure their successful implementation. Therefore, the implementation of circular solutions can be seen as a complex socio-technological problem. This also means that stakeholder participation could be crucial for developing effective solutions. However, how far should stakeholder participation reach?

There are various degrees, of participation. A classic reference point in this discussion is the participation ladder by Arnstein (1969), identifying eight different degrees of participation. The degrees vary from low level involvement at the lowest rung, described as manipulation, to the slightly higher rung of therapy, which Arnstein defines as essentially symbolic efforts or types of "non-participation" in which stakeholders are "educated" or "cured". The next rung, informing, provides stakeholders with knowledge, yet the flow of information is usually one-way. The consulting rung aims to involve the opinions of stakeholders, but gives no guarantee that their input will in practice also be taken into consideration. In the placation case, this is somewhat less of a problem, for instance through including stakeholder representatives on decision-making boards, but the project's initiators may still have exclusive decision-making power through a larger number of votes or the right to ignore given advice. At the partnership level, stakeholders are given a more direct influence on the content of a project: rules regarding participation are laid down and may thereafter not be changed without consensus across actors. Only the highest two levels, delegated power and citizen control, would award stakeholders real power. The differences between the different degrees of participation depend on what kind of information is given to stakeholders, what

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kind of options they get to voice their opinion, and most important, what kind of power they get to actually influence decision-making (Arnstein 1969).

Alongside the evolution of participatory techniques in co-decision making, there has also been a development in the range of knowledge co-production processes. Several initiatives focusing on knowledge co-production have been extensively applied in the water sector to effectively deal with complex policy issues (Pahl-Wostl et al., 2008). The rationale behind these processes is they stimulate and support social learning, which is believed to improve decision-making functions, relationships among stakeholders and their problem-solving capacity (Cundill & Rodela, 2012). New alternative concepts and ideas have emerged around social learning and knowledge co-production processes, including, very prominently, the idea of Community of Practise (CoP) (Lave & Wenger, 1991; Reed et al., 2010; Wenger, 1998). Focusing on participation in community life as a basis for learning and identity construction, CoPs are based upon social learning theories. Over time, the usage of the term CoP has shifted substantially and has been used to explain learning and knowledge generation across a variety of work, organisational, and spatial settings (Amin & Roberts, 2008; Cox, 2005).

2.2 Introduction to CoPs

The concept CoP was first coined in 1991 by the cognitive anthropologist Jean Lave and the educational theorist Etienne Wenger (Lave & Wenger, 1991) as a new approach to understanding learning, focusing on informal and situated social interaction whereby learning from other learners is central. More recent conceptualisations treat CoPs as the informal relations and understandings that develop in mutual engagement on an appropriated joint enterprise (Wenger, 1998), to groups with the specific purpose to learn, create and share knowledge (Wenger et al., 2002). Communities of Practice are defined as follows (Wenger et al. 2002):

> "Groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis."

Accordingly, in this later work, the CoP concept becomes more viewed as a management tool through which geographically dispersed actors can be connected. By being mutually engaged with one another, CoP members share insights, may critique or adopt each other's practices, share frustrations, and co-produce knowledge (Iverson & McPhee, 2002).

Wenger (2011) considers three elements as constitutive dimensions of CoPs: the domain, the community and the practice. To cultivate a CoP, the combination of the three must be developed in parallel.

- Domain: A CoP distinguishes from other networks since its members identify themselves by a shared domain of interest. Membership involves a commitment to the domain and a shared competence.
- Community: While showing their interest in their domain, community members develop and share information, help each other and join activities and discussions. In

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this form of interaction, members build relationships in order to learn from each other and to support each other.

- Practice: Members of a CoP do not only share a common interest, they are engaged in common practice, as an iterative social process, where they develop and utilize a shared repertoire of resources that builds together toward a common goal. These can be experiences, stories, tools or ways of addressing recurring problems. To develop this kind of a shared practice it takes time and continuous interaction.

A CoP can evolve naturally due to the members' common interest in a specific field, or it can be created deliberately with the goal of gaining knowledge related to a particular domain. When applied intentionally as a learning concept, the overall goal of a CoP is to maintain the already existing knowledge about a specific topic and use it to create new ideas through an ongoing exchange of information. Through the process of sharing information and experiences with the group, members learn from each other and have an opportunity to develop personally and professionally (Lave & Wenger 1991). The community offers the opportunity to learn about already established standards but also about new techniques and approaches.

2.3 CoPs and social learning

CoPs can be viewed as a social learning system (Wenger, 2010), whereby members engage in social learning processes. These eventually lead to the building up of (i) a shared problem definition, in particular when the problem is complex and largely ill-defined (but this does not imply consensus building), and (ii) trust as the base for a critical self-reflection and to identify interdependencies and potential synergies among stakeholders (Pahl-Wostl, 2003). Although it cannot be assumed that participation inevitably implies that social learning takes place, there is ample evidence that participatory processes may stimulate and facilitate social learning (Reed et al., 2010). Stakeholder involvement is seen as particularly relevant for managing complex or so-called "wicked" socio-technological problems, difficult to resolve because scientific uncertainty and value differences are both at the cause (Cuppen, 2010). The water sector has many wicked problems which are predicted to increase in the future with climate change and increasing urbanisation. CoPs accommodate diversity and try to realise innovative combinations between highly different stakeholders, representing different knowledge resources, interests and ambitions (Edelenbos & Van Buuren, 2006).

The move towards a circular economy includes both technological challenges and social innovations; circular solutions need to take account of both aspects to ensure their successful implementation. Therefore, the implementation of circular solutions can be seen as a complex socio-technological problem, in which stakeholder participation and social learning can be regarded as essential (Pahl-Wostl, 2002). It is fair to hypothesize that CoPs may be of great importance to develop effective solutions towards the circular economy. In addition, it is of paramount importance to evaluate whether knowledge co-production processes are effective, efficient, and which outcomes can be attributed to stakeholder participation.

However, there is currently no consensus in the literature about the processes that stimulate and support social learning and about which outcomes can be attributable to

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specific processes. The current literature, in fact, lacks an adequate framework establishing causal relations between processes, outputs, and outcomes of CoPs. Within NextGen a new evaluation framework has been developed (Fulgenzi et al, 2020) that structures the evaluation of CoPs as the interrelation between social learning outcomes and CoP dimensions, and analyses how and to what extent they contribute to the achievement of specific CoP-objectives, see chapter 6.

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3. NextGen CoP Approach

Within NextGen, a CoP Roadmap and Facilitation Guideline has been developed (D3.1), providing general guidelines for CoPs, information on moderation techniques, reporting format, evaluation, and consent forms. Also a general roadmap, with key topics and a time planning, has been developed. Although this general roadmap has been developed, the guideline allows for flexibility to align to the unique local and demo case specifics and tailor the CoP meetings to the nature and needs of each demo case. This chapter summarises the NextGen CoP approach.

3.1 Designing the CoPs

The overall approach for setting up and maintaining the NextGen CoPs is structured along a number of elements (in line with World Bank Group, 2017):

1. Set-up and launch:
   - Planning the community
   - Design the operating practice
2. Support and manage:
   - Moderate the CoP meetings
   - Monitor outcomes

Design principles
Based on the literature numerous design principles for stakeholder involvement can be identified, including Responsible Research and Innovation (RRI) Tools[2] and the core values of the International Association for Public Participation (IAP2)[3]. Below, we summarize a series necessary stakeholder participation conditions, that have emerged from the prominent OECD Water Governance Initiative, an international multi-stakeholder policy forum created to share policy and practical experiences on water governance (Akhmouch & Clavreul 2016). All conditions are followed by the practical implementation within the NextGen CoPs.

- Inclusiveness and equity: Map all stakeholders who have a stake in the outcome or that are likely to be affected, as well as their responsibility, core motivations and interactions. *In the NextGen CoPs, the stakeholders are partly mapped prior to CoP#1, and partly during CoP#1*.
- Clarity of goals, transparency and accountability: Define the ultimate line of decision making, the objectives of stakeholder engagement and the expected use of inputs. *In the NextGen CoPs, the goals, and expected use of inputs will be explicitly discussed during CoP#1.*

[2] e.g.: https://www.rri-tools.eu/-/step-by-step-guide-to-planning-your-public-engagement-activities
[3] e.g.: Public Participation Pillars", International Association for Public Participation (IAP2): https://www.iap2.org/page/resources

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- Capacity and information: Allocate proper financial and human resources and share needed information for result-oriented stakeholder engagement. *In the NextGen CoPs, the organiser is encouraged to share information and organise capacity*.
- Efficiency and effectiveness: Regularly assess the process and outcomes of stakeholder engagement to learn, adjust and improve accordingly. *In NextGen, all CoPs are evaluated after each meeting.*
- Institutionalisation, structuring and integration: Embed engagement processes in clear legal and policy frameworks, organisational structures/principles and responsible authorities. *The CoPs provide for a structural approach with a clear set of principles.*
- Adaptiveness: Customise the type and level of engagement as needed and keep the process flexible to changing circumstances. *The NextGen CoP guideline allows, or rather calls, for flexibility to align to the unique local and demo case specifics*.

Planning the community

An important role in setting up and running the CoPs is given to *the organiser* (coordinator) who is responsible for managing the CoP. The CoP organiser helps the community to focus on its domain, maintain relationships and develop its practice. The CoP organiser is responsible for the preparation and facilitation of the meetings. In the case of NextGen, the CoP organiser is, unless otherwise agreed, the formal contact person of the demo case, i.e. either a representative of the demo case end-user or of the related research organization.

Next to the CoP *organiser*, with their crucial role of managing the meetings, a second role can be defined, i.e. the role of the CoP *moderator*. The moderator should be an 'independent expert', who is given the authority to lead, imposing clear rules and roles with the aim of generating an environment of trust and acting as a 'neutral' mirror when necessary. At the meetings, the role of the moderator will be essential to apply the knowledge management model. For the NextGen CoPs, the CoP organiser is responsible for selecting a moderator, or if possessing the right skills, may choose to fulfil this task by him or herself.

Starting a CoP requires that the overall ambitions are set. Based on these ambitions the *relevant stakeholders* will be invited to become a member of the CoP. Importantly, these members should then agree on the common goals and shared values of their CoP and the domain (key topics) to address. As CoPs are designed to be flexible, the scopes and goals may adapt over the duration of the project due to the needs identified in the communities.

The CoP organiser is responsible for mapping all the potential stakeholders involved, ideally prior to organizing the first CoP meeting – starting at organization level and zooming in to individual level. The CoP members will be invited to join the CoP based on stakeholder networks and relationships. In NextGen the relevant stakeholders differ for each demo case. In general, these will include the water industry (operators), authorities (regulators), engineering companies, consultants, research institutes, representatives of non-governmental organizations, and potential end-users. It is in particular important to ensure

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the active involvement of policy representatives and decision-makers, at least when exploring themes directly relevant to policy-making.

In general, the NextGen CoPs do not target the general public, unless they are directly involved as end-users. Public engagement in NextGen is organised through public outreach activities, augmented reality and serious games (Task 3.2).

As a result of the first CoP meeting, the ambition and desired goals are refined together with the members of the CoP, to ensure that these are in line with members' expectations. Working towards a shared objective is critical to community development. Questions that have to be answered by the community are: What are the main challenges we face? What is the desired outcome of the CoP? What topics and issues do we really care about? The answers to these questions will help a community to develop a shared understanding of its objective, find its legitimacy in the organization and engage the passion of its members.

All participants in the CoP meetings will be given information about the project, together with a consent form informing them of how the data collected will be used, of their right to withdraw at any time as well as the follow up anonymization procedures. To this effect, a template of an *informed consent form* for participating in NextGen meetings/interviews was produced (see Annex I).

Designing the operating practice

Within CoPs, conditions have to be created to facilitate knowledge exchange. The CoP has to agree on specific ways to operate and to build relationships. Activities that generate energy and develop trust need to be organized. To capture and exchange the (mostly tacit) knowledge that is shared in the CoPs, a knowledge management model is proposed. NextGen aims to go beyond informing and rather use the CoPs for active consultation and collaboration with stakeholders. The *proposed knowledge management model is based on social learning and open dialogue* whereas individuals collectively develop new knowledge by making use of the diversity of perspectives and understandings at hand. This model is only presented as a generic guideline, which can be adjusted to local circumstances and requirements.

To engage CoP-members in an open dialogue, the following principles can be applied (Medema et al. 2014):

- listening and speaking without judgement
- identification of underlying assumptions
- acknowledgement and respect for all contributions and ideas
- recognition of differences in perspectives and positions
- flexibility towards discussion topics

CoP meetings should be designed in such way that participants are willing to collaborate and learn together. To create such conditions aimed at social learning, Medema et al. (2014) emphasize the importance of building trust and mutual understanding, facilitating ongoing reflection by embracing an intentional learning approach, and creating an enabling environment for informal and open discourse and dialogue.

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Transparency needs to be maximised so that the different stakeholders can take advantage of their differences and mutual dependence. The size of the learning group allows continuous feedback and the subject matter must be as concrete as possible. Those involved should be stimulated to think in systems and to critically analyse their own norms, values, and assumptions explicitly. The moderator should support creativity, critical reflection and thinking outside the box.

Moderating CoP meetings

The CoP meetings have to be organised: arrange venue and facilities, prepare an agenda, invite the members, etc. For the face-to-face CoP meetings, suitable venues need to be chosen that match both the resources needed (e.g. IT) and available budget (see further below for the change to online meetings due to the Covid-19 pandemic). The duration of the CoP meetings are determined by the organiser. Experience learns that the optimal duration of such meetings is different for different projects and cultural contexts. Where feasible CoP meetings are linked to regular stakeholder meetings or additional NextGen activities, including technical workshops.

During the meetings, the main task of the CoP moderator is to provide structure, and to create a conducive environment for the learning process. Regarding the structure, the moderator has to help define common work goals and clarify working methods. The conducive environment for learning should ensure that values and assumptions can be discussed amongst the participants.

An open dialogue requires that participants are willing to discuss their opinions and perspectives as equals. The moderator's task is to explicate such differences, as this is an important element of shared learning and a collaborative response. The moderator can guide this process by diverting from defensive reasoning and advocating appreciative inquiry. An appreciative approach can be facilitated by reframing problems to a focus on strengths and successes, e.g. by asking participants to identify what might work well and could contribute to the challenge discussed. Likewise, the participants can be asked to question the validity of the existing situations and underlying principles and use this for the identification of potential alternatives.

Thus, the moderator of a CoP should encourage the participants to articulate the reasoning and meaning underlying their thinking. This is done by stimulating self-generated explanations, self-evaluation, reflection and interaction between participants. Moreover, the moderator can model constructive behaviour by thinking and reflecting aloud and summarising progress. A suitable methodology, both for the moderator and in group assignments, is active listening, summarising & elaborating (further questioning).

Depending on the purpose of the CoP meeting, i.e. problem definition, brainstorming, translating tacit knowledge into explicit knowledge, discussing complex issues, and decision making, the moderator can apply different moderation techniques. An overview of *moderation techniques* was provided to the moderators (by the WP3 task leader).

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Monitoring outcomes
In order to ensure that the CoP meetings bring value, both for individuals attending and the organizations they represent, success measurement is defined as the collection and display of outcomes deriving from the CoPs. Therefore, a system of qualitative measurement of the outputs and outcomes of the CoP is set in place, as well as reporting on the value of the outcomes for the CoP members.

Following each CoP meeting, a report is generated. A *meeting report format* (see Annex II) was provided to the CoP organisers, covering both the activities and achievements as well as the reflexive notes. The collected meeting reports are used to present the overall results of the CoP meetings (chapter 4).

As announced in chapter 2, a new evaluation framework has been developed looking at the interrelation between social learning outcomes and the CoP dimensions. Based on this framework, a dedicated *evaluation form* (see Annex III) was developed for all participants of the CoP meetings to use. The evaluation results are used to access the added value of CoP's to the development and transferability of circular water solutions (chapter 6).

Online CoP meetings due to Covid-19
The first round of CoPs was organised as face-to-face meetings at the demo cases in 2019. However, due to the Covid-19 pandemic from early 2020 onwards, the following CoPs had to be postponed and eventually organised as online meetings. This faced the CoP organisers with quite some challenges. The WP3 task leader provided support with guidelines for online meetings, addressing both technicalities (of e.g. Zoom sessions) and practicalities (e.g. ensuring interaction). The evaluation form was converted to an online feature.

Although most online meetings went quite well, it is obvious that personal interaction and social learning is very much hampered. Moreover, having these CoPs online only, made it impossible for the stakeholders to visit the site and experience the circular water technologies at the demo cases. The implications of this will be taken into account in the assessment of the added value of CoPs.

Another important implication has been not only delays but also less CoP meetings as originally planned. At a number of demo cases, the two rounds of CoPs were merged into one meeting. This change in number of face-to-face meetings has been addressed and approved in Amendment#3.
Fortunately, from early 2022, the improved Covid-19 situation allowed for face-to-face meetings for the last round of CoPs.

3.2 Key topics of the CoP meetings

CoP Roadmap
The objective of the NextGen CoPs is to discuss CE water solutions in the institutional context of the demo cases, i.e. taking into consideration strategic discussion elements such as technical feasibility, economic and environmental impacts, as well as policy and governance frameworks, bottlenecks and barriers. To facilitate this and link these elements

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with the overall theme of CE, a general roadmap, with key topics and a time planning, has been developed. Based on the NextGen objectives and activities at the demo cases, the following key topics have been identified and are offered to the CoP facilitators:

- *CoP#1 Setting the scene*: during this stage, each demo case sets the framework for the CoPs that will follow and gets all participants acquainted with the case, its vision and links with circular economy. Basic tasks are suggested for this stage, such as stakeholder mapping, visualising the current situation and setting a future vision on circularity that will be shared among stakeholders, regardless of their professional perspective.
- *CoP#2 Closing the loop*: in this stage, the CoP may first identify opportunities for further closing the water, energy and material cycle. Moreover demo cases may identify technical feasibility bottlenecks and governance barriers (policy & regulations, CE interactions) that might inhibit the vision set in CoP #1.
- *CoP#3 Implementation*: this stage comes at a later phase of the demo cases, where CE developments are more likely to have been (partly) realised. It thus offers the opportunity of reflection on project implementation so far. Depending on the nature and context of each case, more specific reflection exercises may take place, such as assessing the efficiency (economic and environmental benefits) of the circular solution or identifying social and governance barriers that have inhibited or are likely to inhibit implementation.
- *CoP#4 Upscaling and evaluation*: at this late stage, there is the opportunity to reflect on the (completed) demo case. Having CE in mind, the stakeholders may also identify opportunities and barriers for upscaling and/or transferring to other cases. This stage is also accompanied by an evaluation of the CoPs and their effect on stakeholder engagement.

Figure 3.1 presents the sequence and key topics (with further details) of the 4 CoP meetings:

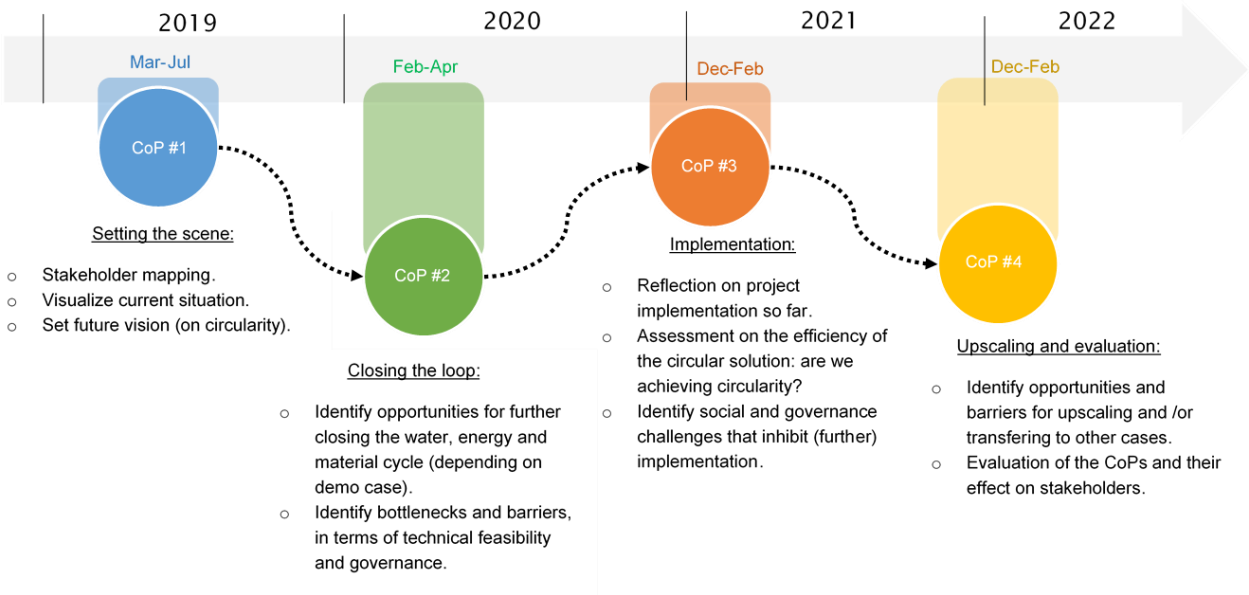

Figure 3.1: Overview of key topics and timeline of the suggested CoP meetings

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Outline of the CoP meetings

For these four CoP meetings, information on the planning, the participants, the aim(s), related WP, method and central questions are presented in Table 3.1. Please note that due to Covid-19 related delays, rounds of CoPs have been merged at some demo cases.

Table 3.1: Outline of the four CoPs

CoP #1	Setting the scene
Planning:	M9-M13 (March-July 2019)
Participants:	All stakeholders already involved in the demo case. Direct stakeholders (technology providers, site holders etc.) are prioritised.
Aims:	1. Mapping out the current CE demo case situation, along with a future vision 2. Inquiry of important stakeholders to engage 3. Identification of the key issues and defining the common objectives and benefits for all the stakeholders of the CoP
Related WP:	WP3
Method:	Round table discussion, appreciative inquiry, Annex I 'CoP Group Interview Template', Annex IV 'Consent Form', Annex III 'Reporting Format & Evaluation Form'
Central questions:	1. From a CE perspective, how do the different stakeholders value the demo case current situation, and how do they envision the future? Appreciative Inquiry questions: *a. Describe what you value most about the demo case?* *b. If you could further close the water, energy and material loop of the demo case in any way you wish, what would it look like?* 2. Who are the most important stakeholders to engage when further closing the loop? 3. What are the key issues and goals of the CoP for all stakeholders? Appreciative Inquiry questions: *a. Describe a time when you were part of an extraordinary display of cooperation between diverse organizations or groups. What made that cooperation possible?* *b. Describe your three concrete wishes for the future of this CoP.*

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CoP #2	Closing the loop
Planning:	M20-M22 (Feb-April 2020)
Participants:	All stakeholders involved in CoP #1 + new stakeholders identified during CoP #1 and as a result of the fellow CoP#1 reports. Ensure the participation of policy/decision makers.
Aims:	1. Identify opportunities for further closing the water, energy and material cycle 2. Identify technical feasibility bottlenecks and governance barriers (policy & regulations, circular economy interactions)
Related WP:	WP1 and WP4
Method:	Round table discussion, open dialogue, Annex II 'Moderation Techniques', Annex III 'Reporting Format & Evaluation Form' Use of *Policy Survey* (to be developed in WP4) to guide the discussion on governance barriers. Ensure the participation of policy/decision makers. Use of *CE Infographic* (to be developed in WP1) to guide the discussion on CE interactions and economic aspects.
Central questions :	Address again with the new participants the key issues and goals of the CoP for all stakeholders. Use the *CE Infographic* to put the demo case solution within a broader CE perspective by discussing: 1. What opportunities and (technical feasibility + governance) barriers do the different stakeholders see for further reducing the use of freshwater resources, i.e. for further closing the water cycle? 2. What opportunities and (governance) barriers do the different stakeholders see for further maximising the recovery of energy and heat, i.e. for further closing the energy cycle? 3. What opportunities and (technical feasibility + governance) barriers do the different stakeholders see for the additional valorisation of materials from wastewater streams to replace conventional sources, i.e. for further closing the materials cycle? Use the *Policy Survey* to reflect on the governance (policy & regulations) barriers by discussing whether the following areas of policy and regulation were helping or hindering the development of the demo case: • Discharge to / pollution of water, abstraction of water, quality of water for (non) drinking water purposes • Waste handling, end of waste status, sludge management, agricultural land management & development • Gas production, electricity production, air quality & emissions, energy usage & efficiency

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	• Certification of chemical products, health & safety of workers, procurement of public goods, planning & building.

CoP #3	Implementation
Planning:	M30-M32 (Dec 2020 - June 2021)
Participants:	All stakeholders involved in CoP #2. Ensure the participation of policy/decision makers.
Aims:	1. Reflect on implementation of the demo case technology 2. Placing the technology in its wider social and governance context 3. Assessment of the efficiency (economic and environmental benefits) of the circular solution by optimising toolbox development and discussing the value of the technology in the wider CE context
Related WP:	WP2 and WP4
Method:	Round table discussion, open dialogue, Annex II 'Moderation Techniques', Annex III 'Reporting Format & Evaluation Form' Use of *NextGen Toolbox* (developed in WP2) to discuss the economic and environmental benefits.
Central questions:	1. What is needed to (further improve the) implementation the demo case technology in practise? 2. What are the most important social and governance challenges and opportunities facing the (further) implementation of the demo case technology? 3. What are the wishes, questions and needs of the stakeholders regarding the *NextGen Toolbox*, including its functionality and required level of detail? 4. What is the efficiency of the demo case CE solution with respect to the economic and environmental benefits (using the *NextGen Toolbox*)?

CoP #4	Upscaling and evaluation
Planning:	M42 - M44 (January 2022 - September 2022)
Participants:	All stakeholders involved in CoP#2 and CoP#3. Ensure the participation of policy/decision makers.
Aims	1. Upscaling opportunities demo case technology 2. Evaluation CoP

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Related WP:	WP3 and WP4
Method:	Round table discussion, Annex II 'Moderation Techniques', Annex III 'Reporting Format & Evaluation Form'
Central questions:	1. Which opportunities and (governance) barriers do the different stakeholders see for up-scaling solutions and transferring them to other geographic areas? – Technology transference 2. To what extent and how has the demo case/NextGen challenged the thinking and practises of each stakeholder? 3. To what extent and how have the stakeholders been able to challenge and add value to the demo case? 4. How do the different stakeholders evaluate the merits of the different COPs?

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4. CoP Meetings Results

All CoP meetings produced meeting reports and these are collected and made assessable to all project partners on the NextGen SharePoint. Specific CoP results are used within the development of the NextGen solutions at the demo cases. In this chapter only the general outcomes are presented.

4.1 Number of CoPs and participants

Number of CoP meetings at the demo cases

Table 4.1 presents the number and dates of the CoP meetings at the demo cases. In 2020-2021, due to Covid-19, most meetings converted to online (sometimes split in two). Some of the CoP#2 and #3 meetings were merged, i.e. addressing both closing the loop challenges and implementation assessment, and those with only 3 meetings addressed upscaling and evaluation in CoP#3. As the Timisoara demo case started later in the project, their first CoP took place later.

Table 4.1: CoP meetings held at the demo cases

Demo Case	Name	CoP#1	CoP#2	CoP#3	CoP#4
1	Braunschweig (DE)	13-6-19	5-3-20	10-9-21	23-6-22
2	Costa Brava (ES)	13-3-19	4-3-20	22-4-21	23-9-22
3	Westland Region (NL)	21-5-19	21-9-20	30-5-22	
4	Altenrhein (CH)	17-5-19	27-4-21	16-8-22	
5	Spernal (UK)	12-7-19	9-11-21	29-9-22	
6	La Trappe (NL)	20-6-19	10-6-20 8-7-20	4-10-22	
7	Gotland (SE)	19-10-18	12-12-19 16-1-20 17-4-20	28-9-20 26-10-20	18-5-22
8	Athens (EL)	21-2-19	5-11-20	22-9-22	
9	Filton Airfield (UK)	25-6-19	26-1-21	2-11-22	
10	Timisoara (RO)	17-6-21	19-1-22	7-10-22	

In total, 37 CoP meetings were held. Obviously, next to these dedicated CoPs, additional meetings with (selected) stakeholders took place at the demo cases, e.g. in technical workshops.

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Stakeholders participation

Figure 4.1 presents the number of people that participated in the CoP meetings at the demo cases. Please note that a large group of end users (farmers, land owners, local residents) attended CoP#1 of Gotland (in total 67).

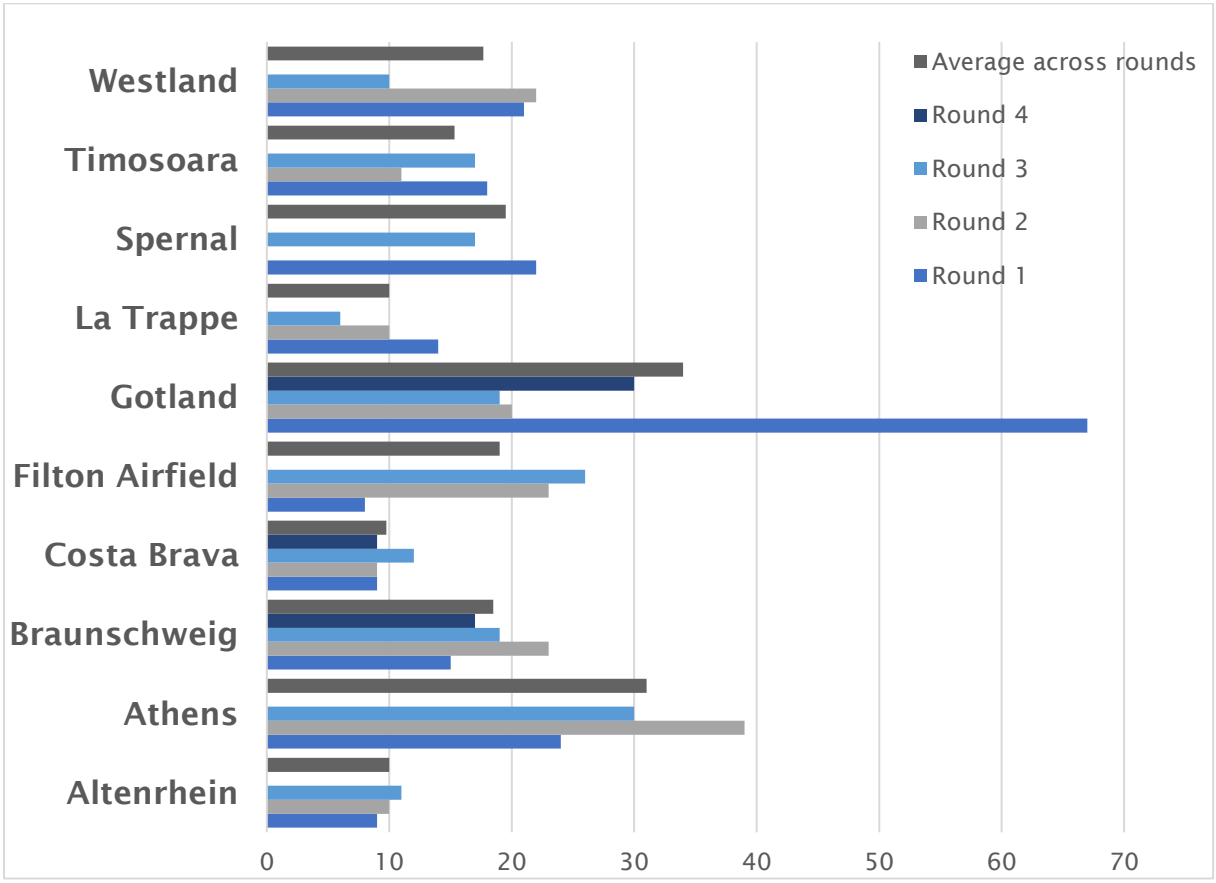

Figure 4.1: Participants' attendance in the CoPs

Assuming that most participants attended more rounds of CoP meetings, we estimate that the total number of participants in all CoP meetings has been **around 300** (a minimum of 254 based on the highest number of participants at a CoP meeting at each demo case).

Figure 4.2 presents the representation of the different stakeholder groups at the CoP meetings (average across all CoP rounds at all demo cases). We managed to achieve the objective to broaden the stakeholder presentation, not only having the 'usual suspects' such as the water industry, technology providers and research organisations. Also end users, representatives of other sector (such as agriculture, industry, energy) as well as a significant representation of policy / governance actors (from national, e.g. Ministry of Environment and/or Health, regional, e.g. water authority, environmental agency, and local level, e.g. municipality).

The gender distribution was 63% male and 37% female.

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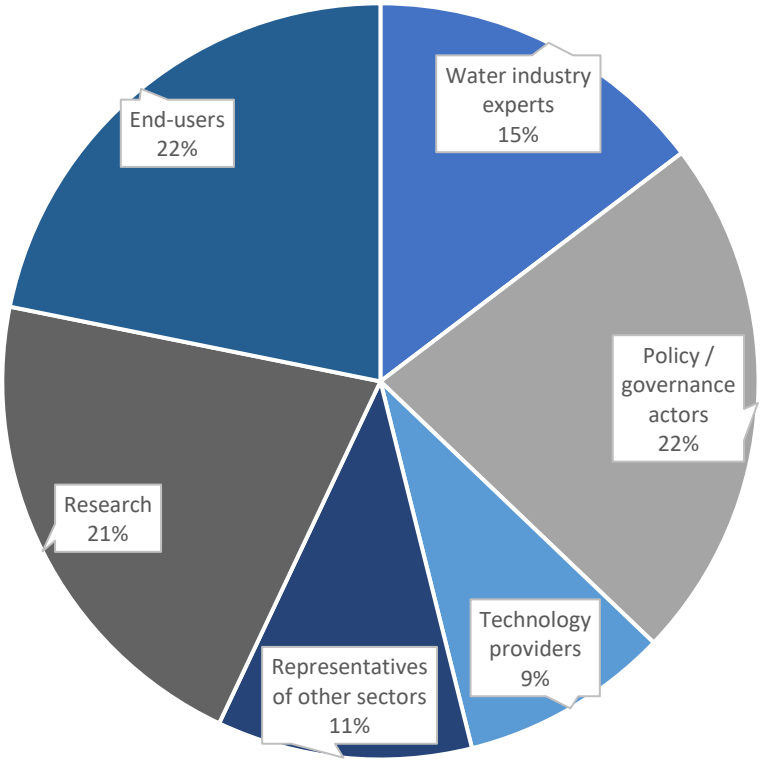

Figure 4.2: Stakeholder groups representation in the CoPs

Figure 4.3: Impressions of CoP meetings

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4.2 Topics covered

The CoP meeting reports provide detailed information of the topics covered and discussed with the stakeholders at each demo case. In this paragraph, the objectives of all CoP meetings are presented for each demo case, resembling the topics covered in the CoPs:

Demo case 1	**Braunschweig (DE)**
Circular technologies	Two-stage digestion and sludge hydrolyses; nutrient recovery (ammonia stripping and struvite precipitation)
CoP#1	• To concretise farmers' and fertiliser industry's *idea* of the ideal secondary fertiliser for application and sale so that it meets their expectations • To discuss with farmers and authorities *opportunities and challenges* of changing agricultural sewage sludge application to nutrient recovery and close cycles
CoP#2	• To compare farmers' fertiliser demand with the yearly production of recovered nutrients of the WWTP Braunschweig. • Discuss the *legal* framework for the reutilisation of secondary fertiliser products and potential approaches for *marketing* the products to the agricultural sector.
CoP#3	• Progress update on site experiments • Discussion of application possibilities in ecological agriculture • Identification of *policy* and *cost* related open topics
CoP#4	• Presentation of NextGen *tools: LCA, risk assessment* • Demonstration of attributes of processed struvite • Recommendation of practical *applications*

Demo case 2	**Costa Brava (ES)**
Circular technologies	Multipurpose water reclamation and reuse; membrane filtration with regenerated RO membranes
CoP#1	• Mapping out the current CE demo case situation, along with a *future vision* • Inquiry of important stakeholders to engage • Identification of the key issues and defining the *common objectives* and benefits for all the stakeholders of the CoP
CoP#2	• Review of results and pilot plant tests • Identify opportunities for *further closing* the water cycle • Identify *policy and technological* bottlenecks and barriers
CoP#3	• Update on the *LCA* carried out for Tossa de Mar • Identification of *policy* opportunities and bottlenecks • Discussion on *Serious Gaming* results • Visit to Costa Brava site
CoP#4	• Discussion on opportunities to *upscale* and apply technology in other sites • Identification of *policy and governance* barriers for upscaling and transfer • Overall CoP evaluation

Demo case 3	**Westland Region (NL)**
Circular technologies	Closing the regional water cycle (urban water management, ASR for horticulture); HT-Aquifer Thermal Energy Storage and regional energy balance; material brokerage
CoP#1	• Presenting an overview of circular water initiatives • Discussing options for *further closing* the water cycle • Incorporating the energy and materials perspective • Sharing of strategic aims: towards a *common vision* • Identifying stakeholders to involve
CoP#2	• Reflect on the potential of a circular water system • Discuss potential *scenarios* for *further closing* the water cycle in Delfland

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	• Identify *governance* barriers (policy & regulations) for circular initiatives
CoP#3	• Update on the development on provincial water circularity • Present results of the Westland *UWOT model tool* • Discussion of key aspects for transition and *upscaling*

Demo case 4	**Altenrhein (CH)**
Circular technologies	Ammonium membrane stripping; P recovery by thermochemical treatment of sludge; granulated activated carbon via pyrolysis
CoP#1	• To inform key stakeholders about the NextGen project and why a CoP is done • To gather expert knowledge from various experts concerning the direct goals and experimental design of the GAC demo case Altenrhein • To discuss knowledge gained from various *experiments* and to improve test methods by gathering ideas and inputs from all participants • To present *test results* regarding GAC from sewage sludge and biomass
CoP#2	• Identify challenges of production • *Market* introduction and *policy* for ammonia stripping • Site visit
CoP#3	• Ammonia stripping, application issues: deepening of technical understanding • *Market* and cost of application • Site visit

Demo case 5	**Spernal (UK)**
Circular technologies	Multi-stream anaerobic MBR for district-scale reuse applications; energy recovery from anaerobic MBR; nutrient recovery from AnMBR via adsorption and ion exchange
CoP#1	• Stakeholder mapping and engagement • Identifying *future vision* • Review of AnMBR process and application in the case study
CoP#2	• Design & build challenges of AnMBR case study & learnings
CoP#3	• Update on pilot progress • Discussion on Design and Technology Challenges • *Dissemination* of AnMBR results

Demo case 6	**La Trappe (NL)**
Circular technologies	Metabolic network reactor to produce of fit-for-purpose water; protein production in Bio-Makery
CoP#1	• Mapping out the current CE demo case situation, along with a *future vision* • Inquiry of important stakeholders to engage • Identification of the key issues and defining the *common objectives* and benefits
CoP#2	• Technical progress in the case study • Positioning the La Trappe demo case in the water, energy and material *nexus* • Identify *governance* barriers (policy & regulations, circular economy interactions)
CoP#3	• Results in the case study • Outline of the main lessons learned and *future steps*

Demo case 7	**Gotland (SE)**
Circular technologies	Rainwater harvesting and decentralised membrane treatment; energy efficient reclamation of wastewater
CoP#1	• Present the project to the public • Public and landowner communication and participation
CoP#2	• Informing stakeholders of project progress and future vision • Identification of bottlenecks and barriers in terms of technical *feasibility* and governance, in collaboration with local actors, regional authorities and municipality

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CoP#3	• Reflection on implementation so far • Assessment on the *efficiency* of circular water solutions • identification of social and governance challenges
CoP#4	• Update with regards to the progress of NextGen implementation, *next steps* • Discussion on the circularity concept, social and governance challenges • Pilot plant tour

Demo case 8	**Athens (EL)**
Circular technologies	Sewer mining mobile wastewater treatment for decentralized reuse; heat recovery from MBR; nutrient recovery for urban agriculture
CoP#1	• To inform key stakeholders on the necessity of circular water interventions and the goals of NextGen as a whole, as well as the pilot of Athens as a demo case in it. • To inform key stakeholders on the technological aspects of the pilot and the needs of the end user. • To engage the participants on *integrated circular water frameworks*, in order for them to be able to identify their role in the circular water value chain • To promote circular water interventions as part of a broader water-aware *policy* to key authorities and legislation bodies to ensure long-term solutions for all users.
CoP#2	• Demonstration of the pilot application • Presentation of the set of NextGen circular economy *tools* to get feedback from the potential end users of the tools (*Marketplace* and *Augmented Reality* application). • Group discussion on opportunities, prospects, constraints and barriers
CoP#3	• Overview of results from the Athens pilot • Status update and showcase on the NextGen circular economy tools (NextGen *Marketplace, SG, AR*) • Site visit

Demo case 9	**Filton Airfield (UK)**
Circular technologies	Integrated drainage systems for urban water reuse; heat recovery from sewer; eco-sanitation systems with nutrients recovery
CoP#1	• To map the current water CE situation and *future vision* • To identify potential stakeholders to include in future CoP meetings
CoP#2	• Introduce rainwater harvesting and heat recovery at Filton Airfield • Identify opportunities for *further closing* the water and energy cycle • Discuss technical feasibility and *policy* bottlenecks to create circular solutions
CoP#3	• Status update on demo case developments • Presentation of UWOT *model* results • Discussion on the upscaling and *transfer* in Filton and beyond

Demo case 10	**Timisoara (RO)**
Circular technologies	Sludge management with production of by-products and/or energy; reuse of effluent for urban, industrial and agricultural applications
CoP#1	• Improve current knowledge on CE for water in the case • Inform stakeholders on the vision for the case study • Inform stakeholders on the technological aspects of the Aquatim pilot
CoP#2	• Present preliminary results of the case study • Increase knowledge on CE for water from other NextGen cases (Athens) • Present the NextGen *Serious Game* for water • Discuss *financing* options for implementation
CoP#3	• Presentation of the approved CE strategy in Romania • Increase network of stakeholders in Timisoara area • Discuss the circular water vision developed at the County Council level (incl. regional stakeholders)

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From this overview of topics covered we can see a mix of demo case specifics (related to the circular water technology demonstrated) with CoP guided elements such as open discussions on feasibility, policy challenges and upscaling. Depending on relevance for each demo case, outcomes from the NextGen WPs, such as technology options (WP1; all), environmental and risk assessment (WP2; Braunschweig, Costa Brava), design tools (WP2; Costa Brava, Westland, Filton Airfield), Serious Game and Augmented Reality (WP3; Costa Brava, Gotland, Athens, Timisoara), policy survey (WP4; Westland, Spernal, La Trappe, Filton Airfield) upscaling (WP4; all), value chain (WP5; Braunschweig, Altenrhein, Westland), and marketplace (WP5; Athens), have been used and discussed in the CoPs. The outcomes were consequently used by the relevant WPs.

4.3 Overall feedback

After each CoP meeting, the participants evaluated the meeting with regard to overall satisfaction and engagement. Specific evaluation elements related to social learning and engagement are discussed in detail in chapter 6. Here, the overall appreciation by the participants is presented (see Figure 4.4).
Please note that a few CoP meetings did not receive evaluation results, which had to do with having online meetings in the Covid-19 period.

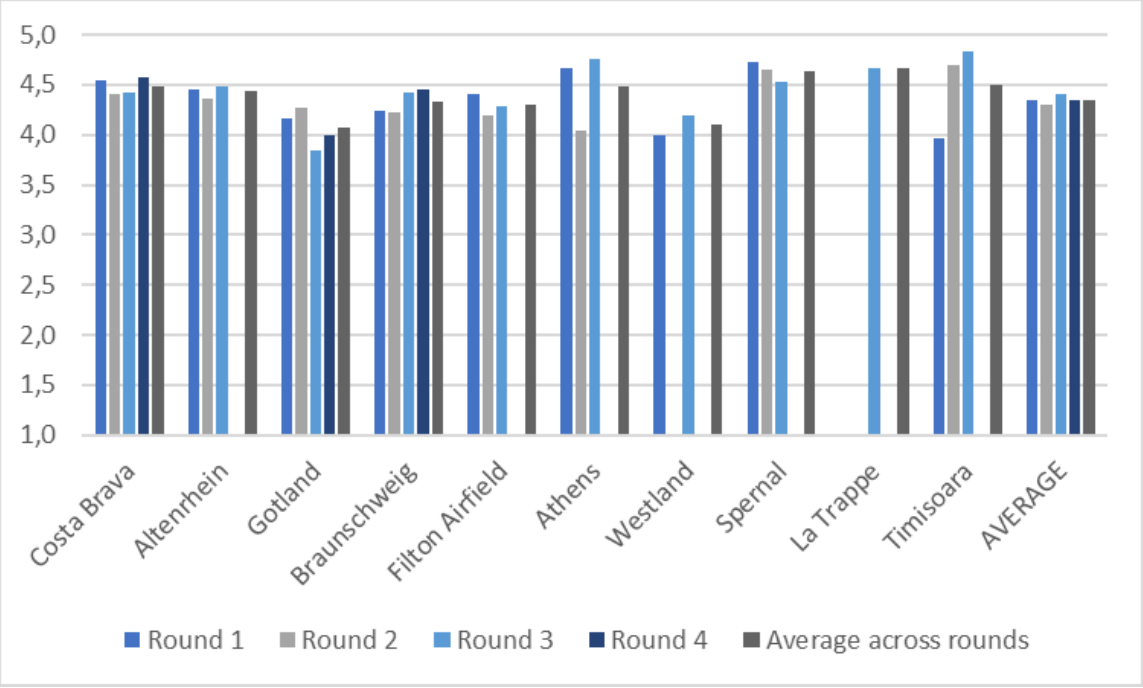

Figure 4.4: CoP average evaluation score (from 1 lowest to 5 highest).

On a score from 1 (lowest) to 5 (highest), the average score of all CoP meetings is 4.4. A high score that was consistent over all CoP rounds.

With the exception of one CoP meeting in Gotland (3.9), all other CoP meetings scored higher than 4.0. The highest score received a CoP meeting in Timisoara (4.8).

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5. Cross-fertilisation

To facilitate cross-national learning between the CoPs, all CoP reports are exchanged on NextGen's digital platform SharePoint. Moreover, two so-called cross-fertilisation meetings are held in order to enhance and re-enforce mutual learning between the CoP organisers. This chapter reports on the outcomes of these two meetings.

5.1 Cross-fertilisation in the beginning of NextGen

The first face-to-face cross-fertilisation meeting with the CoP organisers took place after the 1st round of CoPs and during the 2nd PSB meeting (25 September 2019). The main learning outcomes exchanged in the meeting are presented below.

CoP#1 performance
In the first round, CoP meetings took place at 9 demo cases (the 10nd demo case in Romania was at that time not operational). The CoPs proved to be a good way to involve stakeholders and engage with the circular water solutions. All CoP#1 meetings received in general very positive feedback from the participants.

Addressing circular water solutions
At each demo case, their specific circular water solution approach was at the heart of the CoP workshops. These approaches vary considerably going from e.g. demonstrating one technology within a water plant to solutions embedded in the region and/or connected to other sectors.

In fact, two 'types' of CoPs could be identified:

- Management-CoPs: on the one hand, some demo cases aim at implementing the CE framework in the water policy and management sector (e.g., Gotland, Westland). These CoPs largely rely on water authorities and local/regional administrative bodies and are usually representing a region-wide approach.
- Technology-CoPs: on the other, some demo cases have the specific aim of demonstrating and upscaling circular water technologies (e.g., Altenrhein, La Trappe, Costa Brava). These CoPs largely rely on engineering companies and end-users and are usually confined to a local-scale application (i.e. having a limited number of participants).

The 'management-CoPs' seem to have a stronger 'NextGen identity' where the value of the CE framework is recognised in its socio-economic and political context. The 'technology-CoPs,' are more focused on the potential application of the circular water technologies.

CoP objective and stakeholder representation
One of the objectives of the CoP meetings is to invite relevant stakeholders so that the perspective from every involved party is incorporated in the practice of the circular water solutions. Prior to CoP #1, all stakeholders already involved in the demo case were invited.

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During the first meeting, the group collectively mapped the most important stakeholders to engage when further closing the loop.

In total 205 people participated in the first round of CoPs, representing a wide range of stakeholder organisations. The relevant stakeholders differ for each demo case. In general, these include the water industry (operators), authorities (regulators), engineering companies, consultants, research institutes, representatives of non-governmental organizations, and potential end-users.

All CoPs#1 are dedicated to the central NextGen topic *Setting the Scene*. However, additional aims can be included, taking into account the needs and wishes of participating stakeholders and demo-specific characteristics. As a result, the objectives of the meetings and thus the stakeholder representation differed between the demo cases, also related to the above mentioned circular water solution approach.

Meeting preparation & logistics
From all elements that reflect the performance of CoP meetings, there appeared scope for improvement in the use of materials during the meeting to support the session. The CoPs that performed better on this applied the following actions:

- Actual materials used during discussions and presentations:
    - e.g., pin boards, maps, software
- Symbolic materials used to stimulate a shared "CE identity" among CoP participants:
    - e.g., documents, handouts, site visits

In particular the site visits organised in Athens, Braunschweig and La Trappe, were very much appreciated by the CoP participants. A general recommendation is thus to elicit imagination and identity through "infrastructures" with a symbolic value such as site visits.

Stakeholder engagement
The agenda of the meetings and the role of the facilitators contributed to a collaborative atmosphere and opportunity for individuals to provide input in the discussions. Two striking examples:

- Spernal: excitement and enthusiasm of the group; the different private water utility companies showed a shared interest and commitment towards the NextGen project, and recognised an opportunity to collaborate and work together for shared benefits.
- Costa Brava: the differences in stakeholders perspectives and positions were recognized and perceived as enriching dissimilarities. Time-controlled interventions ensured participation from everyone.

Discussion and outcomes
For CoP#1, general discussion statements were provided for all demo cases to use and/or adjust according to their needs. Moreover, several moderation techniques were suggested to the facilitators. This might very well have contributed to the good discussions held.

For example:

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- Athens: the discussions contributed to the promotion of CE concept as broader water-aware policy to key authorities and legislative bodies.
- Altenrhein: valuable and wide range of inputs, very open and fruitful discussion.
- Braunschweig: open discussion allowed all participants to collaborate and identify key issues, goals and future challenges. Contrary or diverging opinions were discussed professionally and it stimulated open dialogue
- Filton Airfield: the good collaborative environment for discussion resulted in practical ideas and clear understanding of outputs and inputs required.

Prolongation
For NextGen, organising dedicated CoP meetings alongside an ongoing demo case in which project meetings are already organised is quite a challenge. There is need to strike a balance between the project objectives, e.g. enlarging the scope of the demo case to the whole circular economy, and the local demo case specifics.

In any case, the CoP participants should be able to identify key take-home messages as outputs of the discussion(s), including follow-up actions in preparation of the next steps in the project and/or next CoP meeting. This will be different for each demo case. CoP#1 showed some positive results regarding this:

- Gotland: high engagement and curiosity of stakeholders (especially end-users and local farmers association). The CoP is part of ongoing public engagement activities for increasing farmers' willingness to participate in project.
- Westland: open and collaborative dialogue, interdisciplinary group of different organisations and sectors. There is follow up in establishing a "Water Alliance" group to further discuss the water system in the Delfland region.

5.2 Cross-fertilisation towards the end of NextGen

The second cross-fertilisation meeting with the CoP organisers took place after the final round of CoPs (12 & 13 October 2022, online). All CoP coordinators presented the results of their meetings, addressing both challenges and success factors (see Table 5.1).

Based on the overview of Table 5.1, it can be concluded that the CoPs were challenged by the Covid-19 restrictions, not allowing for face-to-face meetings and site visits. Yet, all demo cases reported positive feedback from the stakeholder engagement organised through the CoP. Broad representation, increased understanding and different perspectives are listed as success factors.

In our cross-fertilisation discussion, it was highlighted that:

- It was useful to have the CoP guideline, so that participants new what to expect from the meetings.
- CoPs worked well for creating a shared ambition and identifying new opportunities and challenges

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- (face-to-face) CoPs have a positive atmosphere that establishes stronger relationships.

Finally, it was stressed that it proved to be beneficial to have broad representation with a cross section of stakeholders, that brought different perspectives and views. It was positive to discuss with them openly (outside our own 'silo'). As a result, discussion moved from the implementation of the demo case specific technology to a broader perspective of moving towards a circular water economy.

Table 5.1: CoP challenges and success factors

	Challenges	Success Factors
Braunschweig	• Legal framework not clear (registration of WW struvite as fertilizer) • Need to increase yield from that technology • Need to increase usability (physical appearance, chemical composition)	• High acceptance in Braunschweig, • Better understanding of the technology through CoPs and exchange of knowledge
Costa Brava	• Online meetings are difficult for discussion • Difficulty to discuss topics in depth • Challenge to define correct stakeholders and include actors that contribute to the replication potential.	• Interaction of the stakeholders, free space to exchange different points of view and to address topics of concern for each actor/point of view • Good framework for the creation of relations • Useful to collect opinions and suggestions for results interpretation • Success on the agreement of criteria for emerging compounds selection for the case, which can be a limitation for the implementation at real scale • Increase of the visibility and regional impact of the project, set the basis for future regional projects.
Westland	• Limited engagement in-between CoP meetings • No continuation in the form of a 'water alliance'	• Open dialogue (social learning) • Broad representation, all relevant stakeholders consulted • Shared vision and a shaping of circular solutions across stakeholders • Valuable for circular water policymaking at a provincial level
Altenrhein	• Renewable GAC and micropollutant removal not driven by profitability, thus policy and authority regulation is important. • For ammonia stripping, the market is still under development (production techniques, quality requirements, price, knowledge by clients). • Also, legal framework is not adapted to it (lack of recognition, not standardized)	• Technique and cost benefits are now documented • Authorities and market has been informed through project

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Spernal	• High CAPEX of technology • Lower TRL of certain technologies (dissolved methane recovery, membrane degassing) • Long asset lives of existing technology • Regulation & market development for recovered resource a challenge	• High engagement of participants • Good cross-section of water companies, regulators/policy makers, technology providers and research institutes • Desire to establish/improve a culture of innovation amongst water companies, • Regular knowledge sharing on anaerobic treatment amongst utilities which translated to additional projects • Highlighted need to better understand the potential of new technologies and how to get stakeholder support including customers • Shared learning of challenges in scaling up technology from pilot to demonstrator scale • Highlighted concerns for affordability and public acceptability
La Trappe	• Brewery as location of the demo case not as project partner • Covid and travel restrictions • Staff turnover and challenging transfer of project content, progress, relationships and knowledge	• Team building • Understanding of roles and challenges across different perspectives • Optimal use of available resources • Visibility
Gotland	• Stakeholder groups can be heterogenic • Stakeholders can suddenly change their mind • Covid situation • High expectations	• Good function of a core group discussing topics • Full transparency of the process and technologies • Use of the experts for communication
Athens	• Cooperation of many institutions / bodies is needed to organise a CoP • CoP dynamics slowed down by the covid pandemic and CoPs had to adapt	• Increased participation & wide dissemination of the project results beyond Athens • Balanced participation across parties • High interest shown by stakeholders • Site visits • A prospect of continuation of the pilot after the end of NextGen was given
Filton Airfield	• Number of participants to the meeting • Need to meet with a wider variety of stakeholders • Site visit hindered by covid situation • Results-based discussion on energy and material recovery was limited	• In-depth and active discussion of desirable/feasible circular water solutions • Identification of technical and regulatory requirements for the demonstrated technologies • Interactive polling session (evaluation) • Opportunity to understand and discuss policy barriers and challenges
Timosoara	• Lack of cooperation between local institutions • Lack of financial support from government • Difficult to exchange ideas in online meetings	• Raising local awareness • Increased knowledge transfer between local organisations • Potential cooperation on future projects • Development of a network of local specialists • Integration of CE in smart city strategy of Timisoara

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6. Added value of CoPs

To enhance reflexive learning from the CoPs, an updated evaluation framework (see Annex III) has been developed and used after the first CoP rounds. The framework was provided to the facilitators in both online (i.e., using an online survey) and offline (i.e., using a word document) versions to ensure ease of deployment during the evaluation rounds of each CoP. This updated framework evaluates CoPs in terms of their effectiveness in enabling social learning and achieving the CoP- and project-objectives.

6.1 Social learning in CoP's

The development and upscaling of the CE creates many positive opportunities but also challenges of uncertainty resulting from the increasing complexity of circular systems of materials and nutrients. The establishment of CoPs to stimulate and support social learning and knowledge co-production offers promising new ways to deal with issues of complexity and uncertainty arising from the upscaling of water-CE.

There are three dimensions through which CoPs can support knowledge co-production processes for upscaling CE in the water sector. This includes the following:

1. Support participation and interaction of all relevant stakeholders

This first dimension is the establishment of an effective and efficient CoP. It is also necessary for upscaling the CE concept in the water sector, because it can allow for the identification of synergies and interdependencies that can further close the loop of water, materials and nutrients. This is materialised in practice through processes of "vertical and horizontal integration" (Ghisellini et al., 2016), which presupposes some level of agreement and trust among stakeholders at different scales and levels.

The degree of organisational support available to CoPs can support stakeholder participation and equal representation. Measures of organisational support include technical aspects such as meeting venue and duration of the meeting, but also includes other aspects such as the creation of a safe space to help initiate collaborative relationships and understanding. Measuring these two factors can therefore ensure that participating stakeholders are willing to collaborate, and that there is adequate structural support.

However, stakeholder participation and interaction does not directly result in all stakeholders being represented, or that the CoP develops an identity that members share. In addition, the classification of stakeholders as relevant depends on the governance and technological context of the CoP, which can result in some stakeholders having more decision-making power than others.

2. Bridge gaps in stakeholders' knowledge bases through facilitating alignment

The second dimension is the extent to which stakeholder engagement and interaction leads to some degree of alignment of issue frames and knowledge bases. Alignment can be hampered in numerous ways. Firstly, differences in stakeholder issue frames can hamper the

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knowledge co-production process and decrease the potential of the CoP in effectively upscaling the CE framework in the water sector, especially when stakeholders' perspectives on the specific issue(s) at hand are conflicting. Secondly, uneven knowledge bases can lead to different expectations among stakeholders on the outputs and outcomes of the CoP. This in turn can decrease the motivation of stakeholders to be active members of the CoP and their perception of the value created by its outputs and outcomes.

The alignment of stakeholders' issue frames can be measured by the level of representation and engagement of relevant stakeholders in the CoP and by their convergence towards a shared perspective on the issue(s) at hand. These two factors are interdependent, because CoP-members may prefer to only involve stakeholders with similar issue frames, which could make it easier to share resources among them and reach for agreement. The alignment of stakeholders' issue frames and their fair representation does not always result in agreement and collaboration, especially when conflicts among stakeholders may hinder the policy- or decision-making process. The literature gives much importance to the need for a shared culture that is constructed among CoP-members through iteration and negotiation (Pahl-Wostl et al., 2007).

3. Facilitate the identification and definition of role and responsibilities

The third dimension focuses on stakeholders' identification and awareness of their role and responsibilities and that of other members. It assesses how this contributes to the development of a shared (organisational) culture and willingness to build collaborative agreements or partnerships based on shared opportunities and challenges. Inherent to this CoP-dynamic are processes of negotiation and sustained mutual interaction, which in turn lead to the co-generation of knowledge. Even when conflicts emerge, these processes are critical for supporting the construction of a water-CE practice shared among and accepted by CoP-members.

The formulation and identification of opportunities and challenges should deliver useful knowledge to support the integration of the CE framework into the current water management regime of specific governance contexts. This process relies upon a shared understanding on the current water management context and a shared vision for the future circular water system. CoP-members should therefore be engaged with workshops or feedback sessions where they have the opportunity to evaluate whether the information they gathered is useful and usable, if new expectations were created, and if their perspective on the issue(s) at hand has changed after participating to the CoP.

6.2 NextGen CoP evaluation framework

To assess and support social learning in CoPs, NextGen developed a new evaluation framework, building on the three dimensions presented above (Fulgenzi et al., 2020). Our framework structures the evaluation of CoPs as the interrelation between social learning outcomes and CoP dimensions, and analyses how and to what extent they contribute to the achievement of specific CoP-objectives. The framework draws together a consensus on the methods used for evaluating water knowledge co-production and social learning processes in the transition towards the CE. It aims at evaluating the added-value of CoPs for creating

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an adequate multi-stakeholder environment for effectively enabling social learning processes.

Analysing social learning outcomes in CoPs

The development of a CoP, in terms of improvement in its effectiveness and efficiency, can be conceptualised as the parallel development of CoP dimensions (Wenger, 2011) and social learning outcomes (Scholz et al., 2014). CoP dimensions are defined by Wenger (1998) as:

- Mutual engagement of participants (community)
- Development of a shared repertoire (domain)
- Negotiation of a joint enterprise (practice)

Three outcomes of social learning processes can be identified, based on the definition of social learning by Reed et al. (2010):

- Learning occurs through social interaction (relational outcome);
- Learning is situated within wider social units or CoPs (shared understanding); and
- Learning implies a change in understanding in the individuals involved (substantive outcome).

By associating the two concepts of CoP dimensions and social learning outcomes (SLO), it is possible to identify three key elements:

- Engagement and interaction of stakeholders,
- Change in stakeholders issue frames
- Stakeholder awareness of their own role and competence and of those of other members.

As shown in Figure 6.1, these three elements support knowledge co-production processes and connect CoP dimensions with their related social learning outcome. Analysing this interrelation can give insight into how CoPs can stimulate social learning, and how this contributes to the upscaling of the CE framework into the water sector.

The evaluation of CoPs should therefore consist of assessing the extent to which the development of CoP-dimensions and the achievement of social learning outcomes supports the overall objective behind the establishment of knowledge co-production processes. The proposed evaluation framework consists of an assessment of six key success factors (KSFs) (Figure 6.1) and thirty indicators (Table 6.1).

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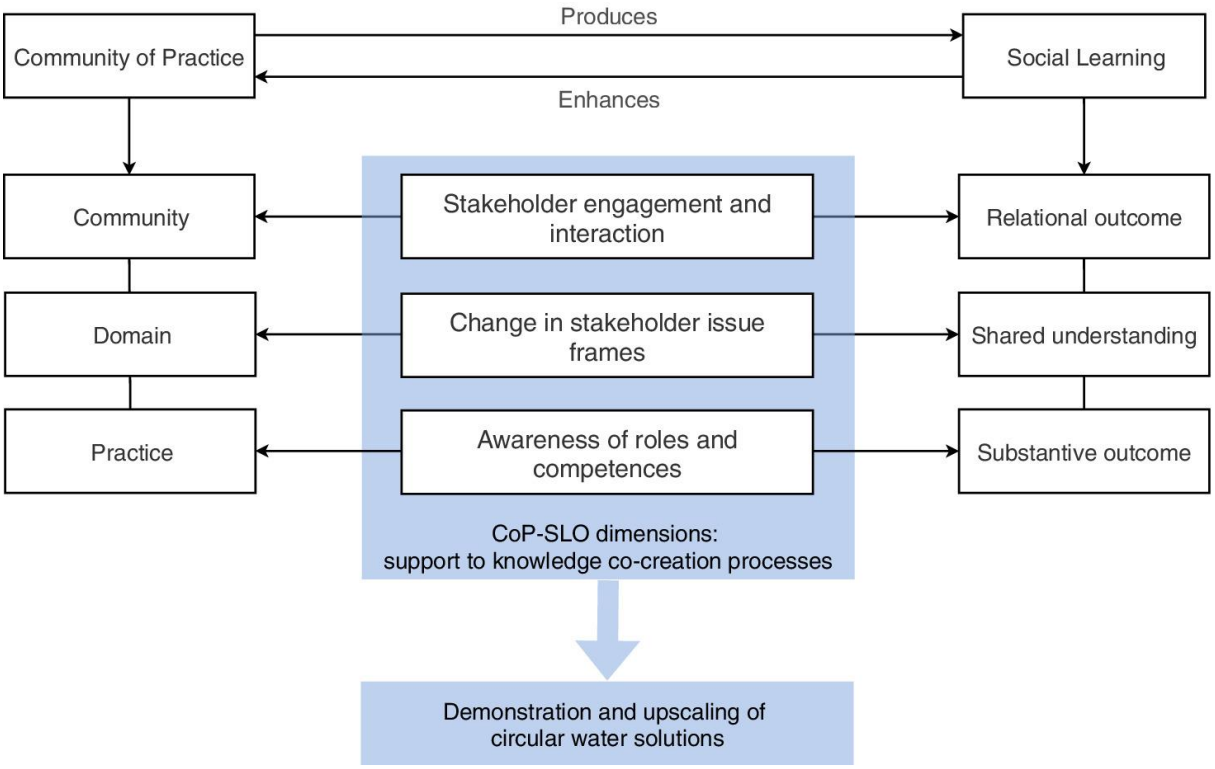

Figure 6.1: CoP dimension related to social learning outcomes.

Source: Fulgenzi et al., 2020

Key success factors

Six KSFs were formulated following the same methodology of previous studies adopting success factors and indicators. In order to acquire additional information and practical implications of the KSFs for the water CE and preliminarily test the validity of the framework, four NextGen CoP facilitators were asked to provide constructive feedback on the relevance of the success factors and indicators.

The six KSFs are:

1. organisational support
2. atmosphere of the meeting
3. representation and engagement
4. convergence on a shared perspective
5. identification of opportunities and challenges
6. generation of knowledge

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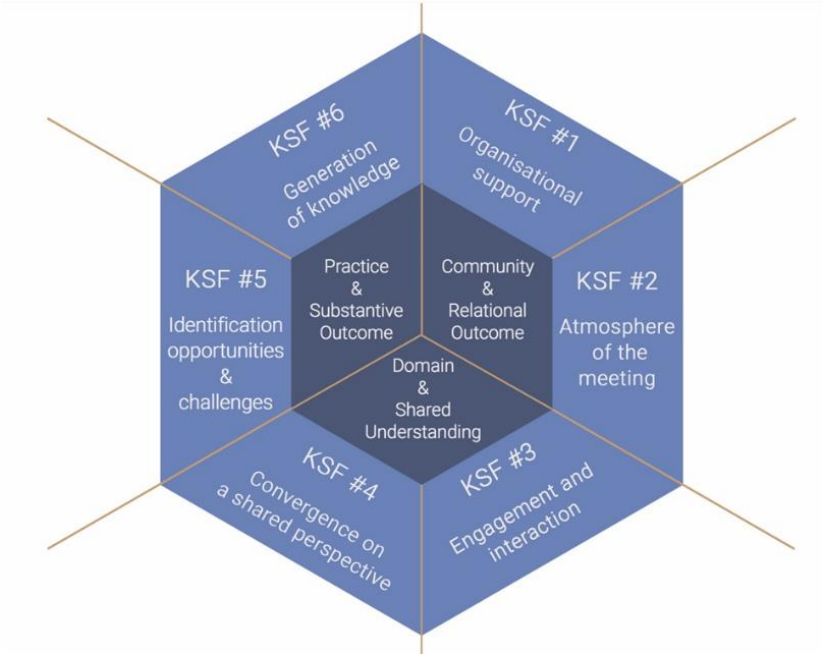

Figure 6.2: Six CoP key success factors

Indicators

Each KSF is measured by a set of indicators, which include specific CoP dynamics and characteristics that provide an overall assessment of each CoP dimension and social learning outcome. The indicators were selected, through a literature review, from a pool of existing indicators from the water resource management, CoPs, and social learning literature (e.g., Wenger, 1998). The current set of indicators contains specific CoP dynamics and characteristics that provide a quantitative measurement of each KSF, as shown in Table 6.1. The indicators are measured through a Likert-type questionnaire administered to CoP-participants, ranging from 1 to 5. The score of each KSF corresponds to the average of its indicators.

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Table 6.1: List of the six KSFs and their related indicators.

Key Success Factors (KSFs)	*Indicators*
1) Support to stakeholder engagement and interaction from **organisational** aspects, tools, and other artefacts.	1.1. Advance provision of meeting information and materials 1.2. Adequacy of the meeting venue 1.3. Adequacy of the duration of the meeting 1.4. Presence of outputs/materials acting as culturally symbolic infrastructure 1.5. Presence of leadership figures
2) Adequacy of the meeting **atmosphere** for enabling stakeholder interaction mutual engagement.	2.1. Improvement in working relationships with other participants 2.2. Existing relationships and new connections 2.3. Clarity of presentations and speakers 2.4. Spontaneous behaviour and communication 2.5. Trust in others' openness in communicating own opinions, concerns, interests, goals
3) **Representation and engagement** of all relevant stakeholders and interest groups in relation to the issue(s) at hand.	3.1. Opportunity for individual participation and input 3.2. Participation and inclusion of newcomers 3.3. Constructive management of (potential) conflicts and differences 3.4. Representation of all relevant stakeholders and interest groups 3.5. Inclusion of all relevant perspectives in the discussion
4) Convergence on a **shared perspective** on the issue(s) at hand.	4.1. Agreement on what will be discussed 4.2. Awareness of interdependencies of actions and desired outcomes 4.3. Awareness of presence/lack of resources available to the community 4.4. Changes in own perspective 4.5. Quality of the moderation of the discussion
5) Identification of **opportunities and challenges** for implementing joint action.	5.1. Opportunities to reflect and talk about collective experiences and processes of the project 5.2. Formulation of conclusions to the discussion and the meeting 5.3. Formulation of actions to address problems and capitalise on opportunities 5.4. Inspiration for follow-up/embedding in own organisation 5.5. Ability of participants to influence agenda or procedures
6) Generation of useful **knowledge** in relation to the topic at hand.	6.1. Increased knowledge on the issue(s) at hand 6.2. Generation of new terms and language 6.3. Creation of new expectations 6.4. Awareness of own role and role of other participants 6.5. (Potential) Improvement in personal/organisational performance

Source: Fulgenzi et al., 2020

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6.3 Key Success Factors of the NextGen CoPs

The NextGen evaluation framework that specifically addresses social learning outcomes, is beneficial in assessing the added value of CoPs in the implementation and upscaling of circular water solutions. In this section the NextGen CoP evaluation results are used to ascertain the key success factors.

In total, 464 evaluation forms were received from the CoP participants. Figure 6.3 presents the results of the evaluation scores of the key success factors for CoPs (average scores, from 1.0 lowest to 5.0 highest).

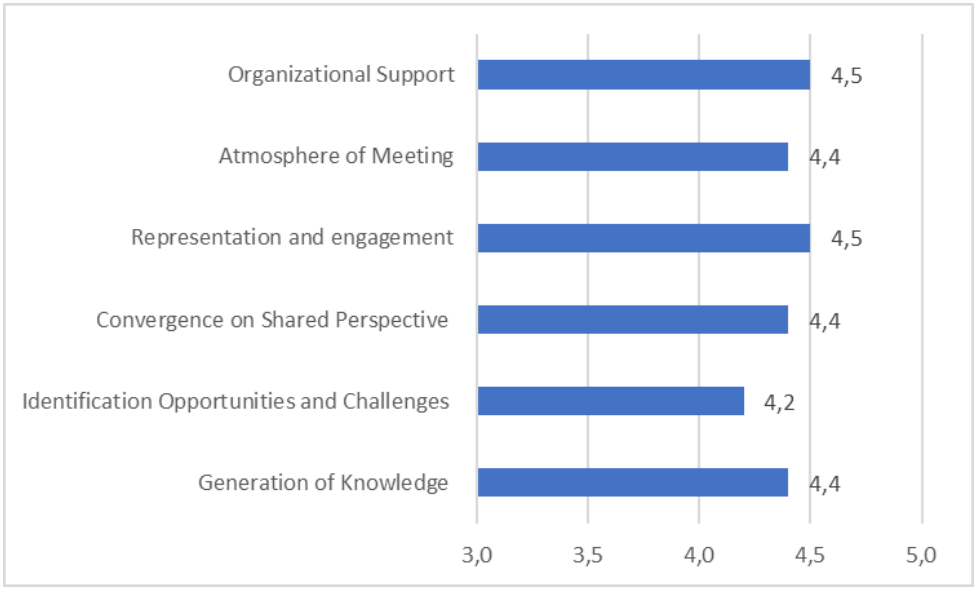

Figure 6.3: Evaluation scores of the key success factors for CoPs (from 1 lowest to 5 highest).

The results show very good scores, between 4.2 and 4.5, for all factors that contribute to social learning and hence engagement achieved through the CoPs.

The CoP meetings were organised in such a way that there was scope for open dialogue through all six key success factors:

1. Organizational aspects of the meeting: prior information, materials, duration.
2. Atmosphere: presentation clarity, behaviour, communication.
3. Stakeholder representation and engagement: opportunities to discuss, conflict resolution, inclusion of ideas.
4. Convergence towards shared perspective: topic inclusion, stakeholder understanding, moderation
5. Identification of new opportunities and challenges: time to reflect, clarity of outcomes.
6. Generation of knowledge: matching expectations, increase of awareness on circularity.

It thus can be concluded that the CoPs positively contributed to engagement and interaction of stakeholders, change in stakeholders issue frames, and stakeholder awareness of their own role and competence and of those of other members.

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7. Conclusions and Recommendations

Conclusions

Stakeholder engagement is essential for further upscaling and transition of circular water solutions. The CoPs proved to be an efficient way to involve diverse stakeholder groups and interact on different aspects of circular water solutions, including their implementation, evaluation, legislation and policy support, and replication/upscaling. CoPs can thus potentially support the diffusion of circular water solutions by stimulating and supporting the processes of knowledge co-creation, which in turn increases the effectiveness of CoPs as positive feedback. Specifically, CoPs can facilitate active interaction among stakeholders, support their engagement through social learning processes, and align potentially conflicting values and interests that can in turn increase stakeholders' involvement and acceptance of the circular water solutions developed at the demo cases.

The participation of stakeholders across policy sectors and geographical scales, and the inclusion of different perspectives, interests, and needs, are important requirements to effectively upscale the CE framework in the water sector. Engaging in knowledge co-production initiatives can increase stakeholder capacity at dealing with complex and interrelated issues, such as the diffusion of CE in a highly technical sector, support policymaking functions in potentially conflicting situations, and stimulate the establishment of collaborative decision-making platforms. CoPs are of great importance to develop these effective solutions towards the circular economy.

Besides hosting CoPs, it is of paramount importance to evaluate knowledge co-production processes so as to understand which outcomes can be attributed to stakeholder participation. A NextGen evaluation framework was developed based on the interrelation between the development of CoP-dimensions and the achievement of social learning outcomes. It evaluates the activities and outcomes of CoPs to improve stakeholders' willingness to collaborate, facilitate a fair representation of all relevant stakeholders, support the convergence towards a shared issue frame, and improve the quality of the knowledge co-produced through stakeholder engagement and interaction in CoPs.

Summarised, the main conclusions are:

- Stakeholder engagement is essential for further upscaling and transition of circular water solutions. Devising innovations in their institutional context will benefit from social learning processes in stakeholder collaboration.
- The move towards more circular water solutions is accompanied by both technological and social challenges for which stakeholder participation and social learning are essential. Enabling diverse stakeholders to engage and share different perspectives, interests, and needs, and ultimately to co-produce knowledge, CoPs are a suitable approach to discuss CE water technologies in their institutional context.
- Within NextGen, around 300 stakeholders from diverse backgrounds participated in 37 CoP meetings at the ten demo cases. In the CoPs, there was scope for engagement

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regarding the circular water technology options (feasibility, sustainability), social and governance challenges, and technology uptake and transfer.

- The CoP meetings were organised in such a way that there was scope for open dialogue, positively contributing to: (a.) engagement and interaction of stakeholders, (b.) a change in stakeholders' issue frames compared to the state prior to CoP participation, and (c.) increased stakeholder awareness of their own role and competence and of those of other members. These findings are concluded based on the outcomes of a novel CoP evaluation framework with high appreciation (scores of 4.2 to 4.5 on a scale from 1.0 low to 5.0 high) for organisational support, atmosphere of the meeting, representation and engagement, convergence on a shared perspective, identification of opportunities and challenges, generation of knowledge.

Recommendations

As the experience with CoPs in NextGen has shown, for a successful uptake of circular water solutions, organising stakeholder engagement through CoPs that facilitate social learning is highly recommended.

From the cross-fertilisation workshops, the following recommendations for CoPs are derived:

- Be mindful of the composition and objective of the meeting:
  The objectives of the CoP meeting should reflect inputs from participants and outputs from organiser.
  - Technical-engineering meetings aim at demonstrating and upscaling domain-specific circular water solutions
  - Social-managerial meetings aim at promoting a "CE approach" in the water management sector
- Facilitate active stakeholder engagement:
  The facilitator should create the conditions that support interaction and open dialogue.
  - Prepare an agenda and apply moderation techniques aimed at social learning
  - Use materials and site visits to stimulate a shared "CE identity" among CoP participants
- Clearly define requirements on inputs and outputs among stakeholder sectors:
  Participants should have a clear understanding of what is their role and how their competence can benefit the demo case.
  - Promote shared understanding and awareness of own/others role and which resources the CoP needs
  - Share meeting materials in advance (e.g., presentations, articles, documents) to help stakeholders preparing and defining which resources/information they can offer to the CoP.

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Annex I: Consent Form

CONSENT FORM

Title of Project: **NextGen: Towards the Next Generation of Water Systems and Services for the Circular Economy.**

Researcher in charge of meeting/interview: **[Name/Affiliation]**

Thank you for participating in this meeting/interview, which is intended for research purposes only, and aims at investigating **<purpose>**.

Please initial all boxes

1. I confirm that I have read and understood the purposes of this meeting/interview. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I agree to allow researchers of the NextGen project to record the meeting/interview and analyse an excerpt for internal reporting of the project, project deliverables, and to potential publishing of conference/journal papers. ☐
3. I understand that the data collection will not be linked to me as an individual, not even internally in my institution/organisation. ☐
4. I understand that at the end of the project (after 2022), all personally identifiable data will be anonymised and sources (audio recordings etc.) will be destroyed after 5 years. ☐
5. I understand that my participation is voluntary and that I am free to withdraw at any time, even after the completion of the meeting/interview (*but before my data has been anonymised*), by contacting the researcher/interviewer, without giving any reason. ☐
6. I give permission to the researchers to use the pictures taken during the meeting/ interview for the purposes of disseminating the NextGen project. ☐

Name & e-mail of participant	Date	Signature

Note: This consent form may be translated in the local language of each meeting in case the organiser considers it necessary for the participants; otherwise the English version will be used.

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Annex II: NextGen CoP Reporting Format

CoP Meeting Report

The CoP organiser is responsible to prepare and share a CoP Meeting Report after each CoP meeting.

Title of CoP Meeting (key topic):

- Organizing partner and moderator:
- Meeting Place and Date:

Agenda for the meeting

- Please insert the agenda from your meeting

Objectives

- Describe the CoP meeting objectives

Participants characterization

- **Table**The table below shows the number and respective sector of participants

Table: Overview of stakeholders

Institution / sector	No. of participants (registrations)		
	In total	Male	Female
Water industry			
Authorities			
Engineering companies			
Representatives of other sectors			
Research institute			
End-users			
Other: name			

Description of meeting´s activities

- Provide a summary of activities carried out. Were there plenary or working group sessions? Presentations by whom on what? (Provide presentations as appendices).
- Describe the moderation technique and method for open dialogue applied.

Main achievements

- Describe briefly the main outcomes and results from the meeting, as well as any actions to be taken by members, as agreed upon.
- Summarise the perspectives of the stakeholders (i.e. stories as anecdotal evidence).

Reflexive notes

- Describe your observations on stakeholder engagement
- Describe any relevant observations for further steps

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Annex

- List of Participants
- Presentations
- Evaluation by Participants: Summary

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Annex III CoP Meeting Evaluation Form

Place: _____ **Date:** _____

It was a pleasure to have you in this meeting. We would like to know your opinion, so that we can improve future events and meet your expectations. Thank you for your collaboration!

Name *(optional)*:_____

Organization *(optional)*: _____

Please rate the extent to which you agree with each of the following statements: (1=strongly disagree; 2=disagree 3=neutral; 4=agree; 5=strongly agree; N.A=not applicable)

1. Meeting logistics and interactions	
1.1 I received the information about the meeting and materials well in advance	
1.2 The venue was adequate for the purpose of the meeting	
1.3 The meeting had the right duration in time	
1.4 During the meeting I improved or made new connections for my professional network	
1.5 The presentations and speakers were clear and understandable	
1.6 During the meeting, I felt save to behave spontaneous and unfiltered	
1.7 I believe others were communicating openly with me	
Comments: *(optional)*	

2. Engagement and increased understanding	
2.1 I believe that all relevant stakeholders were present at the meeting	
2.2 I had sufficient opportunities to provide input to the discussion	
2.3 Differences and (potential) conflicts among us were addressed in a constructive manner	
2.4 All relevant ideas/perspectives were included and respected during the discussion	
2.5 I feel that the right topics were discussed during the meeting	
2.6 I now have a better understanding of the perspective of the stakeholders	
2.7 The way the discussion was facilitated and moderated supported the meeting objectives	
Comments: (*optional*)	

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3. Outcomes and conclusions	
3.1 There was sufficient time to reflect on our collective experience and functioning as a group	
3.2 I believe that clear conclusions were formulated at the end of the meeting	
3.3 I believe that clear actions were formulated to improve circular water solutions	
3.4 The meeting inspired me to take follow-up actions in my own organization	
3.5 Participating in the meeting increased my knowledge on circular water solutions	
3.6 My expectations on the outcomes of the meeting were met	
3.7 I am aware of my own and others role and how we can contribute to the projects goals	
Comments: *(optional)*	

Pros and cons of the CoP	
What is your overall rating of the CoP meeting (1 to 5)?	
In your opinion, what were the most positive aspects of the meeting? In your opinion, what were the less positive aspects of the meeting?	

Suggestions for improvement
What suggestions for improvement do you have for future meetings?

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