

Report on impact of external events and academic papers.

AUTHORS: Q. PLANA (EUT) AND L. BEIRÃO (ESCI)







Technical References

Project Acronym	NextGen
Project Title	Towards a next generation of water systems and services for the circular economy
Project Coordinator KWR	
Project Duration	01/07/2018 - 30/11/2022

Deliverable No.	6.5 Report on impact of external events and academic papers
Dissemination level 1	PU
Work Package	WP6
Task	T6.2 and T6.9
Lead beneficiary	EUT
Contributing beneficiary(ies)	ESCI
Due date of deliverable	30/11/2022
Actual submission date	

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

V	Date	Beneficiary	Author	Action
1	27/10/2022	EUT	Q. Plana	Deliverable elaboration
2	10/11/2022	ESCI	L. Beirão	Internal review
3	20/11/2022	QA	Jos Frijns Quality check	
4	23/12/2023	EUT, ESCI	Q. Plana and L. Beirão	Address comments from PO

On version 4, the adaptations made to address the PO's comments are:

- In Section 1, a picture has been added to illustrate the activities on citizen engagement carried out along the NextGen project.
- In Section 2, a detailed explanation has been provided about the engagement of NextGen partners to publish papers as Open Access.
- On Table 2, a new column including the journal impact factor has been added to emphasise the high-impact journal and the high-quality publications
- A new section on the policy briefs on which NextGen has been involved including the links to the referred documents and further details on each policy brief.
- Former Section 4 (new Section 5) has been restructured and newly written to present the dissemination and communication of the events and papers. This section is complementary to D6.3.
- The conclusions have been updated to stress the impact achieved within the publications, events, and their dissemination during the NextGen project, as well as the audience reached.





Summary

The NextGen project aims to demonstrate the feasibility of technical, business and governance solutions towards a circular economy in the water sector. Communication, collaboration, and engagement activities are key factors to support NextGen goals and reach the broadest possible audience.

To support the dissemination of the demonstrated innovations during the NextGen project, engagement and knowledge sharing was actively promoted between the 10 demonstration sites, project partners, end users, a range of professional stakeholders, and citizens. Along the project, boosting the external communication and promotion was also considered as crucial to widely promote the principals of NextGen.

Work Package 6 (WP6), named *Communicate, Connect, Create Synergies and Support Learning*, was coordinated by ESCI and with substantial strategic input from EUT, WSSTP, KWR and IVL, and support from all partners. A range of public and accessible content using visual, digital, video, and journalistic techniques aimed to stimulate targeted expert and non-expert audience including communities of stakeholders, living labs and citizens.

In this report, we gathered the scientific publications, external events, and its related communications efforts to create and support the impact of the demonstrated innovations during the project.





Disclaimer

Any dissemination of results must indicate that it reflects only the author's view and that the Agency and the European Commission are not responsible for any use that may be made of the information it contains.







Table of Contents

TEC	CHNICAL REFERENCES	2
DO	CUMENT HISTORY	3
SUI	MMARY	4
DIS	SCLAIMER	5
TAE	BLE OF CONTENTS	6
LIS	T OF FIGURES	7
LIS	T OF TABLES	8
<u>1.</u>	INTRODUCTION	9
<u>2.</u>	SCIENTIFIC PUBLICATIONS	11
<u>3.</u>	EXTERNAL EVENTS	15
<u>4.</u>	COMMUNICATION AND DISSEMINATION OF EVENTS AND ACADEMIC P	APERS19
<u>5.</u>	SCIENTIFIC POSTERS	22
5.1 5.2 5.3 5.4 5.5 5.6 5.7	SOCIO-TECHNICAL PERFORMANCE BUSINESS WATER-ENERGY POLLUTION REDUCTION OPPORTUNITIES FOR INDUSTRY	23 24 25 26 27 28 29
6	CONCLUSIONS	20



List of Figures

Figure 1 Community of Practice in Gotland	9
Figure 2. Percentages of scientific publications, events, and communications of the Next	gen
project	10
Figure 3. Percentages of types of scientific publications	11
Figure 4. Types and percentages of external events participated	17
Figure 5 Interview Recording at Water Europe	19
Figure 6 Example of post on LinkedIn about one of our published papers	20
Figure 7 Example of blog entry related to a scientific publication on NextGen's website	21





List of Tables

Table 1. Summary of scientific publications	11
Table 2. Summary of peer-reviewed scientific publications	
Table 3. Summary of the organised and participated events. Note: more than one type of	
audience might participate in an event	18
Table 4. Summary of the selected demonstration cases for knowledge transfer and the	
designed topics	22





1. Introduction

The NextGen project aims to demonstrate de viability of technical, business and governance solutions towards a circular economy (CE) in the water sector. In the context of the project, dissemination and communication activities have been performed during the project to transfer and share the information and knowledge acquired. These activities are essential to support the objectives of the NextGen project creating impact among the scientific community, policy makers, industry, and general public.

Work Package 6 (WP6) has been in charge, promoting active engagement and knowledge sharing among the demonstration sites, project partners, end users, stakeholders, and citizens; communicating and promoting externally the project evidence base, case studies experiences and outcomes; and establishing a knowledge legacy beyond the project.

In this deliverable, *D6.5* report on impact of external events and academic papers, it resumes the work related to tasks *T6.2* Targeted case studies for effective knowledge transfer and *T6.9* External events and academic outreach.

During the project, all partners and demonstration sites capitalised on available outreach opportunities at events for professional, academic, and public audiences. Local, national, and international events were critical to:

- Build awareness and trust in NextGen actions and solutions to accelerate replication
 of circular economy solutions among professional audiences and supportive citizens
 alike.
- Facilitate knowledge exchange and transfer in academia, research, and policy spheres.
- Inspire a broader public to move towards long-term sustainable behaviour change and assist adoption of new technologies and services (like in Figure 1).



Figure 1. Community of Practice in Gotland





Related to the external events and academic outreach, more than 400 dissemination activities have been realized during the NextGen project. These activities have been divided in three subgroups: scientific publications, events, and communications. The distribution of the activities is as presented in Figure 2. Meaning 40 scientific publications, 80 events, and 324 communications open to general public.

Type of dissemination activities

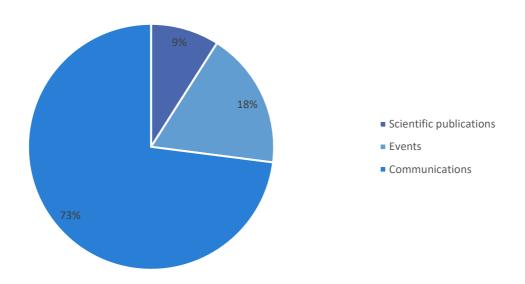


Figure 2. Percentages of scientific publications, events, and communications of the Nextgen project

For an effective knowledge transfer, seven demonstration cases within the NextGen project have been selected among the ten NextGen sites. These selected cases have been required to prepare a flyer on a diversity of topics.

Further details on the main results obtained from each task are presented in separate sections in this report.



2. Scientific publications

During the NextGen project, as mentioned in Section 1, 40 scientific communications have been published in different formats. These scientific publications have been separated in articles in journals, publications in conferences or workshops, chapters in books, and thesis or other dissertations. The percentages distribution of the publications is presented in Figure 3.

Article in journal Publication in conference/workshop Chapters in books Thesis/ dissertations

Scientific publications

Figure 3. Percentages of types of scientific publications.

The percentages of the scientific publications realised during the NextGen project can be translated into 14 articles in journals, 23 publications in conferences and workshops, 1 chapter in a book, and 2 thesis and dissertations. A summary of the scientific publications and their accessibility are presented in Table 1.

Type of publication	Number of publications	Open Access	International publications
Article in journal	14 (3 still under review)	10	12
Publication in conference/workshop	23	5	16
Chapters in books	rs in books 1 0		1
Thesis/dissertations	2	2	0
Total	40	17	29

Table 1. Summary of scientific publications.

The articles in journals, 11 of them have already been published at the date of the submission of this deliverable while the other three are still under review. Remarkably, the 12 articles have been published or are expected to be published in English and in international journals. And only two have been presented at regional level journals using the official regional





language. In addition, over the published articles, 10 of them are open access, only one is a private publication.

According to H2020 rules on the Open Access Policy, Open Access (OA) refers to the practice of providing online access to scientific information that is free of charge to the end-user and reusable. Regarding research data, open access refers to the right to access and reuse digital research data under the terms and conditions set out in the project's Grant Agreement.

To comply with H2020 mandate for publications we deposited our published version or final peer-reviewed manuscript and data accepted for publication in a repository for scientific publications.

We published in high-quality and high-impact journals for environmental and circular economy research such as the Journal of Environmental Management and the Journal of Circular Economy and Sustainability. The peer-reviewed scientific publications are listed in Table 2 together with the Impact Factor of the journal in 2021.

Table 2. Summary of peer-reviewed scientific publications.

Type of publication	Title	Authors	Journal or equivalent	Year of publication	Journal impact factor
	Optimal storage sizing for indoor arena rainwater harvesting: Hydraulic simulation and economic assessment	Jung Eun Kim, Eng XiangTeh Daniel Humphrey & Jan Hofman	Journal of Environmental Management	2021	8.91
	Evaluation of harvesting urban water resources for sustainable water management: Case study in Filton Airfield, UK	Jung Eun Kim, Daniel Humphrey & Jan Hofman	Journal of Environmental Management	2021	8.91
Article in journal	A five-stage treatment train for water recovery from urine and shower water for long-term human Space missions	R.E.F.Lindeboo, J.De Paepea, M.Vanoppen, B.Alonso-Fariñas, W.Coessens, A.Alloul, M.E.R.Christiaens, C.Dotremont, H.Beckers, B.Lamaze, D.Demey, P.Clauwaert, A.R.D.Verliefde, S.E.Vlaeminck	Desalination	2020	11.21
	Optimization of thermal hydrolysis process for enhancing anaerobic digestion in a wastewater treatment plant with existing primary sludge fermentation	PeijunZhou, Mohamed N.A.Meshrefa, and Bipro Ranjan Dhar	Biorescource Technology	2021	11.89





Abwasse	m lassen wir er nicht (mehr)	Interview with Dr. Fanziska Gromadecki	Lausitzer Wasserzeitung	2021	-
Communi at the ce	rrieseln? ities of practice nter of circular er solutions	Andrea Fulgenzi, Stijn Brouwer, Kate Baker, Jos Frijns	WIREs Water	2020	7.43
distribute for wa materials econom der environ world de	Mining as a ed intervention ater-energy-s in the circular as suitable for ase urban ments: A real monstration in ty of Athens	Plevri A., Monokrousou K., Makropoulos Chr., Lioumis Chr., Tazes N., Lytras Efth., Samios St., Katsouras G., Tsalas N.	Water. Special Issue Safeguarding the Provision of Good Quality and Adequate Quantity of Water Today: Answering to Challenges, Threats and Dilemmas	2021	3.53
	rückgewinnung Abwasserstrom	Kleyböcker, A., Kraus, F., Conzelmann, L., Remy, C., Miehe U.	Wasserwirtschaft Wassertechnik (WWT)	2019	-
Suppo Engagem	red Reality (AR) rting Citizen nent in Circular conomy	Tina Katika, Ioannis Karaseitanidis, Dimitra Tsiakou, Christos Makropoulos & Angelos Amditis	Circular Economy and Sustainability	2022	*
Assessme for Trans Cii	ntegrated ent Framework sition to Water rcularity	Afghani, N., Hamhaber, J., Frijns, J.	Sustainability	2022	3.89
Water Stra Ch	r Economy of :: Definition, tegies and allenges	Morseletto, P., Mooren, C.E. & Munaretto, S.	Circular Economy and Sustainability	2022	*
of circul mana modeling redesign	g the resilience larity in water agement: a g framework to and stress-test nal systems	Bouziotas, D., Stofberg, S.F., Frijns, J., Nikolopoulos, D. & Makropoulos, C.	In submission		-
testbed t the Circu	v modelling o Demonstrate lar Economy in text of Water	B. Evans, M. Khoury, L. Vamvakeridou- Lyroudia, O. Chen, N. Mustafee, A.S. Chen, S. Djordjevic, and D. Savic	Journal of Cleaner Production	Under review (2022)	11.07
Game circular e	EN: a Serious showcasing economy in the water cycle	Mehdi Khoury, Barry Evans, Otto Chen, Albert S. Chen, Lydia Vamvakeridou- Lyroudia, Dragan A. Savic, Slobodan Djordjevic, Dimitrios Bouziotas, Christos Makropoulos, and Navonil Mustafee	In submission		-





Chapters in books	A water-sensitive circular economy and the nexus concept	Christos Makropoulos, Sandra Casas Garriga, Anne Kleyböcker, Charles-Xavier Sockeel, Clara Plata Rios, Heather Smith and Jos Frijns	Handbook on the Water-Energy- Food Nexus	2022	-	
-------------------	--	---	--	------	---	--

^{*} Journal of Circular Economy and Sustainability started in 2021. The impact factor cannot be estimated yet.





3. Policy briefs

During the project, NextGen partners contributed into the production and discussion of several policy briefs. Within the context of the project, the policy briefs produced (three of them in collaboration with other CE projects) and discussed with EU policy makers during WE workshops are the following:

- H2020 Water Innovations for Sustainable Impacts in Industries and Utilities (2019)
- For a Green, Circular & Smart urban Wastewater Treatment Directive (2020 & 2021)
 - Water Europe included NextGen project as example in the policy document.
 - The document was used to reply to the public consultation on the Urban Wastewater Treatment Directive
 - The document was disseminated by Water Europe on its social media and via its mailing list (included several EU policy makers from the different institution)
 - The document was also directly shared and used as the strawman for a bilateral (stakeholder exchange) with the DG ENVI in October 2020). The document will be used also for communication with MEPs and Member States during the legislative process of the Urban Wastewater Treatment Directive in 2023.
 - The document remains available on Water Europe website in addition to NextGen website.
- Water in the Circular Economy Policy Development (2021)
 - The document was disseminated on social media and via the mailing list of Water Europe
 - The document is and will be used in the future policy development of water Europe as a resource.
 - The document remains available on Water Europe website in addition to the European Union's website.
 - The document was communicated to the MEP Water Group and also to the internal policy group of Water Europe.
 - The document is also available in its paper version during the last Water Europe's event.
- <u>Nutrient Management: Create a Water-Smart Action Plan for Closing Nutrients Cycles</u> (2022)
 - Water Europe replied to the public consultation to disseminate the information to the European Commission, particularly to stress the activities of the EU projects.
 - The document was broadly communicated via the Water Europe's mailing list.
 It was also disseminated on social media and remain available on Water Europe's website
 - The document is and will be also used as a resource by Water Europe in terms of ad hoc communication on the nutrient management or in other policy documents. (eg. <u>PP on soil health law</u>).
 - o The document was also shared during Water Knowledge Europe 2022.





- Solutions for Water-Smart, Circular and Resilient UWWTD and SSD (2022)
 - The policy brief was shared with the Policy Advisory Committee of Water Europe.
 - o The policy brief was also shared via WE's mailing list and on social media.
 - The document remains available on Water Europe's website.
 - Additional communication expected: The document will be exploited in the context of the revision of the UWWTD with the different policy makers of the European Parliament and the member states in 2023.
- <u>Community of Practices: a tool for stakeholder involvement in complex technologies</u> (2022)
 - This policy brief was developed particularly in the context of the zero pollution stakeholder's platform's activities. The document was communicated to EnoLL as the leader of the flagship 7 but also to the Commission on this dossier.
 - The document is available on Water Europe's website, in addition to NextGen's website.
 - The document was also disseminated on social media and in the winter edition of Water Europe newsletter in 2022.

Apart from these policy briefs, we have also provided input to several EU policy reports. For example, on Energy Efficient WWTP and Zero Pollution Action Plan, and WE will distribute the final report to EU policy makers. For instance, some information about NextGen Case studies was shared with EU-ASE (the European alliance for energy efficiency) for its activities on the energy efficiency directive.

Consequently, more than 50 European policy officers and stakeholders were (or will be) targeted by different channels such as:

- Meetings: (e.g., bilaterals with the members of the European Parliament, member states' representatives on the dossier for the urban Wastewater treatment directive),
- Internal WE events with policy makers (eg. Water Europe's event such as Water Project Europe, Water Innovation Europe, or Water Knowledge Europe),
- External events with policy makers (eg. Danube Water Forum 2022, World Impact Summit 2021) to promote NextGen project and the achieved results.

As the main objective of the policy briefs was to support the inclusion of NextGen conclusion into the debate on the revision of the Urban wastewater treatment directive, the aforementioned document will be used in the coming months to support the discussions with the European Parliament and the member States on this specific dossier. At least, NextGen might have contributed to the approach suggested by the European commission in its legislative proposal released in 2022. Moreover, we will continue to exploit the outcomes of the project in line with the relevant stakeholders, particularly on the resource recovery aspects.





4. External events

NextGen was represented in a series of national and international workshops and conferences. Partners attending these events engaged with specialist groups of stakeholders and were confident ambassadors of the project.

By connecting with these audiences, NextGen disseminated information about the solutions demonstrated and developed at the relevant level of detail. Representatives actively participated in relevant events to provide an opportunity to exchange experience and ideas about all aspects of the project and allowed for detailed and personalised contact with specialists. These events were a fruitful dissemination platform for the project's results.

Along the project, partners have been participating or organising conferences, workshops, and other events. In total, project partners have been in 80 external events. The different types of events and the proportion over the total number of events are presented in Figure 4.

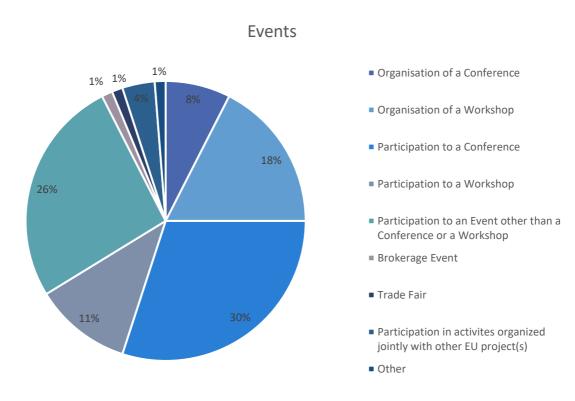


Figure 4. Types and percentages of external events participated.

NextGen partners have mainly been involved on participating and organizing conferences and workshops representing the 92% of the total number of registered events, where a 25% is part of the organization of these events, and the 67% left, has been only participating on the workshops and conferences. A summary of the events and the audience is presented in Table 3.

Within the different events the NextGen partners have been participating, a broad audience sectors were also represented such as industry, stakeholders, policy makers, scientific





community, and general public. In some activities, different audiences have been participated as presented in Table 3.

Table 3. Summary of the organised and participated events. Note: more than one type of audience might participate in an event.

Type of	#					Audiend	ce	
events	events	International	Regional	General Public	Scientific Community	Industry	Stakeholders	Policy makers
Organisation								
of a conference	6	3	3	1	3	2	2	1
Organisation of a Workshop	14	5	9	-	6	-	8	-
Participation to a conference	24	16	8	3	17	1	-	3
Participation to a workshop	9	8	1	2	6	1	-	2
Participation to an Event other than a Conference or a Workshop	21	6	15	2	9	3	3	5
Brokerage Event	1	1	-	-	1	-	-	-
Trade Fair	1	-	1	-	-	1	-	-
Participation in activities organized jointly with other EU project(s)	3	1	2	2	1	-	-	-
Other	1	-	1	-	-	-	1	-
Total	80	40	40	10	43	8	14	11





5. Communication and Dissemination of events and academic papers

NextGen aimed to achieve a maximum transfer of information and shareable research results to the professional audiences that can best make use of it. Project outputs created awareness, understanding and incited action to accelerate take up of water systems and services for the circular economy.

At a pan-European level, *NextGen* played a leadership role in reaching a broad audience of professionals, practitioners, policy makers and the scientific community, fuelled by the significant outputs and publicly available deliverables. The project has a rich set of dissemination channels and opportunities to exploit and empower with key messages, communications resources, and engaging content.

Whether online, at an event or in person; original, insightful content was at the heart of NextGen strategy. A variety of **editorial, video, and visual content** was developed to share on digital media channels, media multipliers (newswires, sector press, institutional and partner communications teams), championed by stakeholders and social media.

Before, during and after the events, we advertised NextGen's partners and actions broadly on social media. When needed we found ways to improve attendance and make events as attractive as possible through engaging content in our social media and website.

We also aimed at making the most of key talking points and lessons learned shared at those events, by sharing videos, adding presentations to our SlideShare, and sharing links after the event.

When ESCI was present, we further took the chance to create videos and interviews with those present to better use the opportunity. As an example, we have our Marketplace launch in Brussels, at the beginning of 2022 at the Water Market Europe 2022.



Figure 5 Interview Recording at Water Europe





We launched the Marketplace and created videos and interviews to advertise the Market Place and NextGen's actions on Policy reviews. We further promoted connections with the Ultimate Project that will continue to develop and promote the product.

Regarding academic papers our strategy was to get them in front of other specialists and interested parts as much as possible. Using our website and our more than 3500 followers on social media, we developed eye-catching content to promote our research.

As scientific publications can sometimes be hard to grasp, we made blog posts and sometimes interviews with the researchers to be published in our website. We also made social media cards with photos and quotes from the researchers about their science.

Posts with someone's face is known to perform much better than normal posts, and in our social media, it wasn't difference. The post with researchers' faces and quotes performed much better than normal ones, bringing many to read and click on our scientific articles.

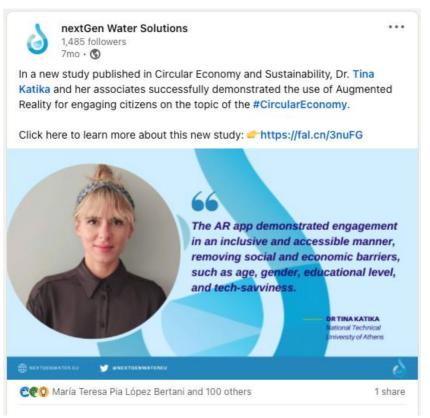


Figure 6 Example of post on LinkedIn about one of our published papers

That was an effective way to stand in the crowd and use the author's own network to push our scientific article to other people. Some of those posts were the best posts during a whole year in term of views and reaches, reaching over 3,5 people (Figure 6).

They were also responsible to bringing people to our website which had more than 17,000 visits last year alone. Finally, those were essential to keep the website relevant, and interesting; always populated with new articles.





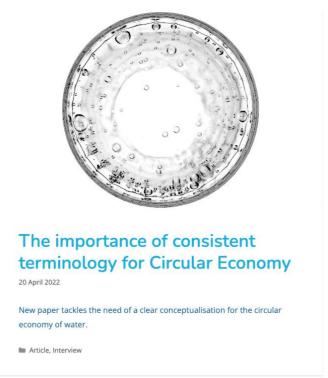


Figure 7 Example of blog entry related to a scientific publication on NextGen's website

More on the topic of content and metrics will be available on deliverable D6.3 Report on impact of external events and academic papers.



6. Scientific Posters

As presented for an effective knowledge transfer gained within the technology implementations or studies among seven demonstration cases, flyers have been prepared on a diversity of topics beyond the technical aspects. The aim of these flyers is to widely disseminate key takeaways and best practices central to circulate throughout the water sector through EU and international instruments. The designed topics to each demonstration case are presented at Table 4.

Table 4. Summary of the selected demonstration cases for knowledge transfer and the designed topics.

# Site	Demonstration site	Topic
#1	Braunschweig	Policy, Regulations and Acceptance
# 2	Costa Brava	Socio-Technical Performance
# 3	Westland	Business
# 5	Spernal	Water-Energy
# 4	Altenrhein	Pollution Reduction
# 6	La Trappe Opportunities for Industry	
# 7	Gotland	Communication with Stakeholders and Citizens

The flyers will be uploaded to the project website and disseminated through the project communication channels such as LinkedIn, Twitter or Instagram. The flyers of each demonstration sites are also presented in this section.





6.1. Policy, Regulations and Acceptance



Circular solutions for





Energy Materials

Policy, Regulations and Acceptance of the application of recyclates as fertilizers in Braunschweig

Nutrient recovery plant in Braunschweig

Current load of 350,000 PE exceeds design capacity of 275,000 PE

- → New nutrient recovery unit:
 - → decreases the nitrogen and phosphorus load of the return load
 - → ensures high effluent quality
- → closes the nutrient cycle via the production of struvite and ammonium sulphate solution
- → New thermal pressure hydrolysis unit
 - → increases the faction of soluble organic compounds
 - → enhances biogas yield in subsequent anaerobic digestion
 - → closes the energy cycle



NextGen solution: Policy, Regulations and Acceptance





Community of Practise

with relevant stakeholders from agriculture, authorities, fertiliser industry and research institutes

Main outcomes of discussions:

- Struvite is a high quality product
- Chemical risk assessment suggests: well suited for organic farming
- High interest/acceptance by farmers due to significantly increased fertiliser prices

Policy gap:

 Amendment of (EC) No 889/2008 necessary: struvite recovered from wastewater needs to be included as fertiliser for organic farming











Socio-Technical Performance



Costa Brava Region: High seasonal water demand in the area due to touristic season

Current problem: Frequent water scarcity episodes, also causing saltwater intrusion

Population: 5,800 → during Summer season: 15,000 Dry period: June-August (July is the driest month with an average of 33 mm of precipitation)

Currently, reclamation is applied for public garden irrigation, new uses need to be explored (e.g. private garden irrigation and infiltration)

Averaged treated wastewater: 300 Mm³/month (October 2020 – June 2021), 650 Mm³/month (July – September 2021)

NextGen solution: socio-technical performance

Innovative water reclamation system evaluated Institutional engagement - key for success

Real demonstration of reuse - End-user feedback

Collective acceptance of the proposed solution Innovative solutions supporting circular economy

- Innovative technology evaluated: Regenerated end-of-life osmosis membranes to be reused for water reclamation for added-value purposes
- Focus: High-water quality produced for private garden irrigation and infiltration for indirect potable use
- Evaluated in a pilot plant (2 m3/h), Main results:
- Ready for private gardens irrigation (comply with RD1620/2007) Good performance on emerging compounds removal (e.g. TrOCs averaged 70%
- Less energy consumption with regenerated membranes due to lower Transmembrane Pressure (TMP) requirement for a same flux production and %

Local institutions and organisations engagement is crucial for successful implementation:

- Engagement of WWTP operator, municipality, Water Catalan Agency and Health Dept. to collect their feedback on the new uses and define the framework.
- Important to define the framework for the assessment of possible risks on health and environment (parameters to be monitored and limits allowed)

Uses of the reclaimed water produced by the innovative system:

- Private gardens of targeted users
- Positive feedback. No impact on salinity of soil and increase of water availability

Social and governance actions to support acceptance:

- Public survey on water reuse in the area. The results showed:
- nce on the use of recycled water for drinking purposes and the use of recovered nutrients to grow food Low acceptance on increasing the asing the cost for water regeneration for drinking water
- Local engagement in supporting decision groups (CONCENSUS)
- Dissemination and Communication in social network and local media is necessary to increase awareness











Lead partners









6.3. Business

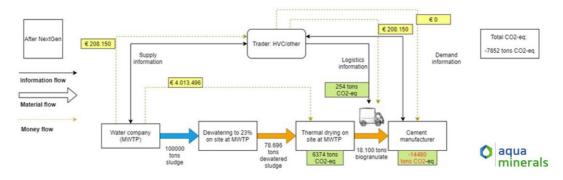


Westland Region: integrated approach for a regional circular water system

- · Alternative water sources for the horticulture sector: rainwater storage
- · Contribution of Aquifer Thermal Energy Storage systems to the heat balance
- Material recovery from drinking water production and wastewater treatment

NextGen solution: circular material value chains

- Use of sewage sludge in the cement industry
- Use of aluminum sludge (from drinking water treatment) in building blocks



Failure factors

- Technically not yet sufficiently developed
- The user still opts for linear raw material
- Insufficient availability of secondary raw material
- Insufficient funding for (follow-up) project

Critical success factors

- Use of KPIs regarding 3R
- Top-management dedication towards circularity
- · Design for circularity
- Active communication with partners in value chain
- · Quality control of residuals
- Adopting E-billing, E-ordering and E-procurement
- Financial support from government for R&D

Findings

- Small SME is most common organization type for manufacturers and transporters in the CE
- The obligation to 'blend' will effectively promote resource recovery

Lead partners:











6.4. Water-energy



Circular solutions for







Energy

gy Water

Materials

Water-Energy nexus
of anaerobic membrane and ion exchange processes for resource recovery
Spernal case study

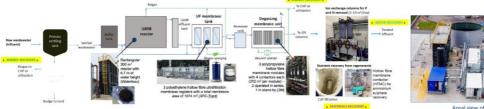
Spernal WWTP: lacks of capacity

Current problem: Medium size WWTP that needs upgrading

Energy: COD/BOD/NH₄ removal takes place in an activated sludge process with high energy demand
Materials: Wastewater contains significant concentrations of nutrients, but these are not recovered and resources are lost.
Water: treated effluent is currently discharge to river, but there is potential for its re-use
Spernal can act as a showcase wastewater treatment plant demonstrating multi-stream technologies and that be linked as single flowsheet or incorporated with traditional processes

NextGen solution: Water-Energy

- Settled wastewater is treated in an anaerobic membrane bioreactor (AnMBR), that combines an upflow anaerobic sludge blanket reactor (UASB) with ultrafiltration (UF) for solid-liquid separation and membrane contactor for gas-liquid separation. This results in organic contaminant removal from wastewater with biogas production for energy recovery. Biogas is also produced in the processing of primary sludge in the existing anaerobic digester
- In the ion exchange (IEX) process the nutrients are selectively removed from the wastewater, concentrated by up to 10 fold on the regenerant and then recovered as salts (ammonium sulphate and calcium phosphate).



Description of the Spernal Water-Energy flowshee

Innovation on water recovery:

- Combined innovative technologies for complete effluent treatment
 Main results: COD: 70 mg/l: ROD: 5.3 mg/l: TSS <10 mg/l: to
- Main results: COD: 70 mg/L; BOD: 5.3 mg/L; TSS <10 mg/L; total nitrogen: 1.56 mg/L; total phosphorus: 0.93 mg/L
- High quality final effluent produced for potential re-use in irrigation and local industrial uses
- The results from public surveys showed high acceptance of recovered products.

Recommendations:

- There are no water reuse guidelines, and no specific guidelines for fertigation in the UK
- Engagement with local institutions and organisations is crucial for successful implementation. NextGen Community of Practice Meetings allowed for engagement of WWTP operator, multiple water utilities, the The Water Services Regulation Authority (OFWAT), UK Environment Agency, local industries, national associations Water UK. Results are promising but clear national guidelines are needed to reach water reuse locally in practice.



NEXT-GEN Spernal treated effluent displayed at the IWA Water World Congress in Copenhagen, Sep 2022

Innovation on energy recovery:

 The energy balance for all the process units (i.e.: UASB, UF, IEX-P, IEX-P, N recovery, P recovery) was estimated at 0.43 kWh/m³, which was lower for the state of the art (i.e., combination of a BNR and tertiary filter with 0.65 kWh/m³).

Recommendations:

- Influent septicity and a low BOD (particularly low in this trial with an average 45 mg/L) impacted the energy balance and consequently energy neutrality was not achieved. Influent BOD>150 mg/L is recommended
- Energy recovered can be exported via electricity back to grid or used on the WWTP in treatment processes
- The use of surplus heat (low grade and high grade) should be further explored.

Lead partners









6.5. Pollution reduction



Circular solutions for





Water Materials



AVA Altenrhein: Climate heating, regulation on micropollutants and on phosphorus recycling

Residential drainage-, wastewater- and sludge treatment of 17 municipalities The treated water reaches Lake of Constance via the mouth of the Old Rhine, both priority water bodies for protection.

Sludge that is being treated in Altenrhein originates from their own water treatment 100 000 person equivalent (pe) and is also being transported to the site from others WWTPs.

Advanced energy-efficient sludge management technologies for 300.000 pe of sludge: sludge is dried on site and is co-incinerated in cement works. Sludge is dried using waste heat from the power producing engines fed by sewage gas and heat recovered from wastewater using heat pumps.

NextGen solution: pollution reduction

Ammonia membrane stripping

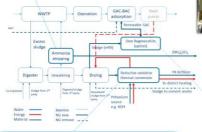
Reduction of nitrogen in the secon and simulations indicate **reduced** N_2O emissions by 5.8 t/a (= 1500 t CO_2 eq/a). Reduction of nitrate in effluent also expected. munity of Practice success factor for roll-out:

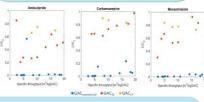
- Diverse stakeholder groups (end users, water & agri sectors, research institutes, authorities, engineering companies)
- Information exchange and situation analysis
- Roadmap for implementation
- → Documentation of sound economics and environmental
- impact of production and application Lobbying authorities to improve framework conditions → Lobbying authorities to improve traineworks
 → Open house for engineering firms and training of users

Renewable GAC performance

Swiss Water Protection Ordinance (WPO 814.201) imposes elimination of organic micropollutants (OMPs). Ozone and GAC is one technology with long standing time.

- Technical feasibility of production and use of GAC from sewage sludge (GAC_{ss}) shown
- GAC_{ss} eliminates 28% of OMPs at standard contact time (20 min EBCT) over 28'000 BV and more (42%) at onger contact time (50 min EBCT).
- GAC_{ss} standing time until regeneration is shorter (-65%) and ozone dosage to reach the required total elimination of 80% is higher (+200%) than for conventional GAC.
- Phosphorus and heavy metals emissions from GACss are low and below limits of WPO





PK-fertilizer production by thermal conversion

Swiss waste ordnance 814.600 requires phosphorus recovery from sewage sludge.

Removal of volatile heavy metals in product. No sludge ash landfill. Product fulfilling European fertilizer regulation pollutant limits. Pilot trials (50 kg/h) in previous national project indicate:

- · Stable daily operation over two weeks
- Complete burnout, low organic content.
 Simulation and assessment of full-scale plant (40,000 to dewatered sewage sludge/a) in NextGen:
- Economically viable in EU context. Cost 80 EUR/t dewSS lower than standard disposal in mono-incineration (105

Renewable GAC perspectives

- GAC_{ss} has poore economic and environmental performance (cost +23%; more GWP)
- First cost estimations show considerable savings (>50%) for a regional regeneration of Swiss GAC based on sewage sludge.
- GAC_{cc} could be a pre-treatment before conventional GAC to prolong its standing time



Fore more info find all project deliverables on NextGen community page

- https://zenodo.org/depostr/new/cenextgen/see especially:

 D1.5 New approaches and best practices for closing the materials cycle

 D1.7 NextGen Technology Evidence Base

 D2.1 Environmental Life Cycle Assessment and risk analysis of NextGen
- D2.2 Economic assessment and cost efficiency analysis of NextGen

Project partners: $\mathbf{n}|w$











6.6. Opportunities for Industry



Circular solutions for





Water Materials

BioMakery: Biological wastewater treatment system based on modular and functional reactor-based ecological engineering coupled to advanced circular space technology.

La Trappe: Circularity of industrial water from beer and cheese production

Current problem: Transformation of a linear wastewater treatment operation to a circular one using the BioMakery and MELiSSA technology.

On site the brewery and the cheese factory produce approximately 360 m³ per day of food and beverage waste water. The municipal wastewater originates from about 22 monks continuously present at the abbey. Additionally, on average approximately 400 visitors arrive each day to the restaurant and there are about 140 additional employees working for the brewery and cheese factory. In total, a municipal flow of 15-18 m³/day is produced under nominal conditions (pre-, post covid).

NextGen solution: Opportunities for industry

Linear business model analysed and compared with different circular scenarios

Wastewater treatment technologies allows the production of water to be used in the brewery

Profitable circular business model

engagement – key for

success

La Trappe case is developing an innovation on its **business model** thanks to the combination of three technologies:

- Metabolic Network Reactor
- MELiSSA inspired membrane system
 MELiSSA inspired photobioreactor

Main results:

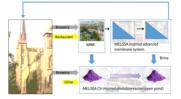
- Local water treatment systems (MNR & membrane system) allows the internal reuse of water (bottle rinsing & irrigation), decreasing both the cost of acquisition of water for the industrial process and the cost of wastewater disposal.
- Byproducts obtained from the water treatment processes are sources of nutrients that can be used as secondary raw materials in supplemental production processes via new technologies (such as the photobioreactor), helping to create and define new circular business models (production of plant fertilizer or animal feed).
- Innovation in circular business model implies the creation of ecosystems of complementary technologies and companies that close materials, water and/or energy loops.
- Regulation can become a barrier for implementation, since they set restrictions on the use of waste as a secondary resource.
- The success of new business models depends on local circumstances such as the price of water, energy, and regulations for reuse. It is important to analyse the environmental, social and regulatory conditions in order to establish a site specific business case.

Local institutions and organisations engagement is crucial for successful implementation:

- Strong will of La Trappe's board to become a circular site
- For the waterboard De Dommel, the site is a Living Lab exploring water management potential for future scenarios of extreme water scarcity.
- NextGen is part of a circular economy strategy of the region which goes beyond the project.

Social and governance actions to support acceptance:

- Dissemination and Communication in social network and local media is necessary to increase awareness.
- Society is increasingly asking for circular solutions and are willing to pay more for them.







MNR at La Trappe



Water Treatment unit breadboard that served as inspiration for the application at La Trappe



Lead partners







Pictures of the axenic MELISSA purple bacteria reactor (photobioreactor)





6.7. Communication with Stakeholders and Citizens



Circular solutions for



Water

Communication with stakeholders and citizens to solve the water challenges at the case study of Gotland

> Region Gotland: Water shortage due to long periods of droughts and limited possibility for storage of water

Current problem: Frequent water scarcity episodes and dependency on imported water

Population: 900→ during Summer season: 10,000 Dry period: May-September (March-June are the driest months with an average of 30 mm of precipitation per month)

Currently, desalinated water is imported from a source at 25 km distance. Sewage, containing large volumes of rainwater, is pumped in the opposite direction

NextGen solution: Communication with stakeholders

local team connected to the NGO addresses the challenges and opportunities

> are taken into account in decision and policy making at regional level

Research and development are communicated with the stakeholders and the citizens and gives collective acceptance of the proposed solutions

Lead partners

Stakeholder and citizens engagement.

- A NGO, Forum Östersjön, is coordinating a local core team
- The NGO connects the case study to the citizens
- Academic organisations, the Region of Gotland (municipality), industrial partners and the NGO has built a larger team for
- research and development activities in the frame of the testbed Region Gotland and IVL together with partners from the larger team develops the testbed and its infrastructure

Local institutions and organisations engagement is crucial for successful implementation:

- Engagement of WWTP operator, municipality, IVL, the industry to collect their feedback on the innovative ways to collect, and store rainwater as well the direct reuse of sewage
- Important to define the framework for the assessment of possible risks on health and environment (parameters to be monitored and limits allowed)

Potential users of the reclaimed water produced by the innovative systems:

- Irrigation of crops
- Production of green hydrogen gas by electrolysis with the use of sea-based wind-power

Social and governance actions to support acceptance

- Public survey during a coffee-dialog with the citizens on the use of reused wastewater. The results showed: High acceptance on the use of recycled water for drinking purposes
- Slightly lower acceptance on direct reuse of wastewater (without storage in a lake or by infiltration before usage)
- Dissemination and Communication in social network and local

media is necessary to increase awareness

Region OIVL















7. Conclusions

At the end of the project, a broad number of scientific publications and communications were done during the NextGen project to disseminate the progress and relevant outcomes. Moreover, partners were implicated either participating or organising events where NextGen results were also presented. The dissemination activities carried out, shown a good fundament of visibility and credibility of the achieved objectives. As overview, along the project 40 scientific publications, 80 events' participation, and organization and hundreds of communication and dissemination activities.

The number of submitted scientific publications and other communications has significantly increased during the last half of the project compared to the first one (5 articles delivered between M1 and M24). These publications (some peer-reviewed) together with the project deliverables have shown high-value of the outputs of the NextGen project. Further details on the publications between M1 and M24 can be found at *D6.2 Interim Report on Editorial, Video & Visual Content and Distribution*.

The participation and organization on different events (i.e., conferences, workshops, and others) helped to potentiate the visibility of the project and the large quality of the objectives achieved.

Furthermore, compared to the expected metrics, NextGen got a successful number of followers on relevant social media platforms such as LinkedIn or Twitter managed by ESCI (i.e., around 1500 followers at the end of the project where the expected were about 300-500 followers). This large number of followers means that these platforms have got the interest of a diversity of people beyond the partners involved on the project.

We have reached not only project partners or targeted audience like policy makers, industry, or stakeholders but also the general public.

To sum up, a dissemination strategic plan was essential and participation of researchers and partners throughout the project was fundamental in its success. We can safely say that after 4 years and half, NexGen has been an important player in spreading knowledge, new research and ideas surrounding the water circular economy.

