

## SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

**Action number: CA17133**

**STSM title: The role of NBS in urban planning: Feasibility study of sludge treatment reed bed (STRB) in Sub-Polar climate condition**

**STSM start and end date: 07/09/2021 to 07/10/2021**

**Grantee name: Amir Gholipour**

### PURPOSE OF THE STSM:

The general objectives of the study falls within the COST Action on circular cities (CA17133) which aims at gathering scholars and practice-oriented experts to discuss and develop Nature-based solutions (NBS) to cope with challenges cities are facing because of current social, economic processes, environmental degradation, and climate change. The research is based on qualitative methods: content analysis of planning documents and semi-structured interviews with experts (Vögeli and Finger, 2021), urban planners, representatives of city councils, and civic organizations in Reykjavik, Iceland. The interviews were transcribed and analysed using a semi-open-coded method. Conventional dewatering systems for sewage sludge are not considered any more to be sustainable and compatible with climate transition and urban challenges. This triggers the need to figure out how alternative solutions, for example Sludge Treatment Reed Beds (STRBs) or other green infrastructure can substitute the existing grey infrastructures. The present study explored the factors influencing the decisions in urban planning and city council policies, in order to better understand the implementation and/or the non-adoption of NBS in urban planning. The challenges and opportunities of the implementation of NBS have been discussed and the interviewees provided technical information and their perspective of how CW technology can be perceived in the current practices of sewage sludge dewatering in urban area in sub-polar climate.

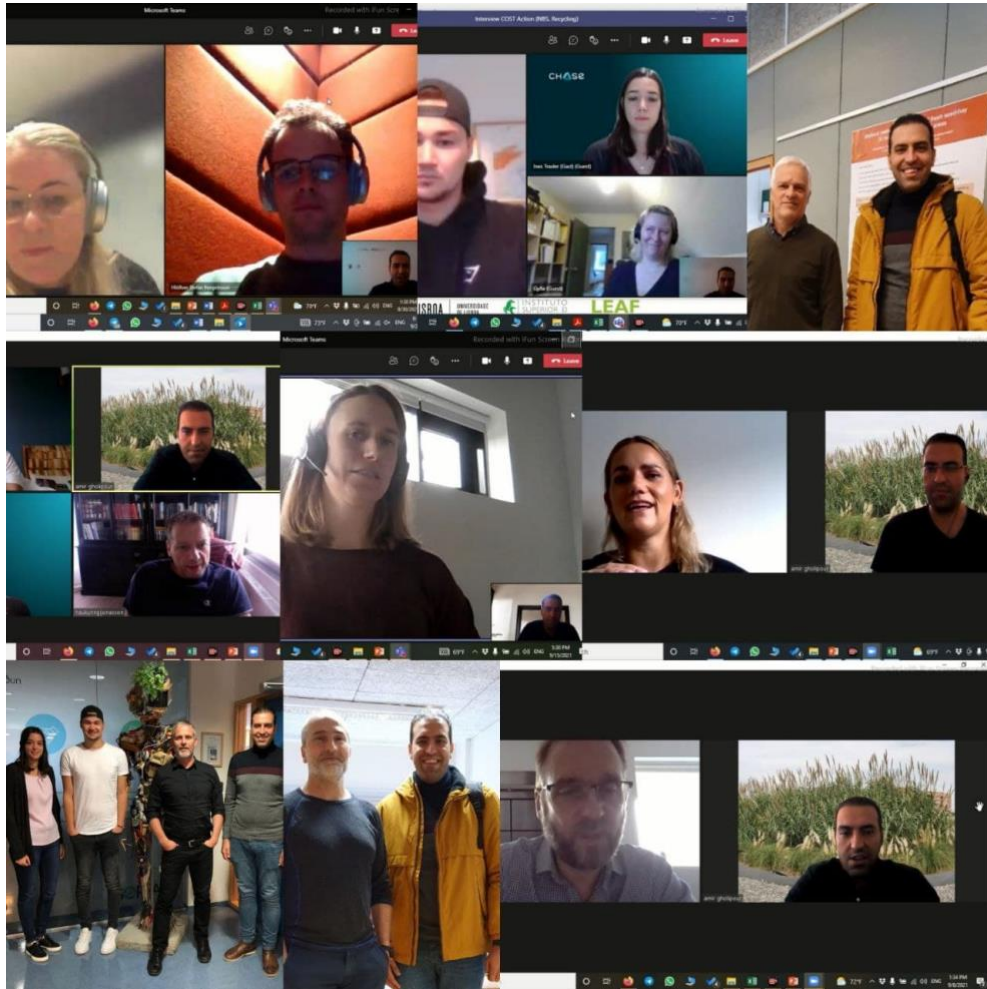
### DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

In this study, there were two main streams of activity: desk research and field studies. During the desk research, I tried to obtain relevant information about the Reykjavik status quo on wastewater management, including Reykjavik location and its climate condition, the general main goals of Reykjavik city to reach carbon neutrality and circularity until 2040, and the main goals and circularity actions for the next five years. In addition, I collected information about the sewer collection system, policy and urban planning in Reykjavik, which yielded data of the sewer system coverage, number of pumping stations and treatment plants, and the population served. In addition, the location of the sewage pumping stations and the system of treatment were looked for, which enable us to have a better understanding of the current system and policy taken. We also assembled a list of the green projects in the area of wastewater management, resource recovery and carbon reduction that were realized in Reykjavik city. Some information about the mass flow of wastewater and sewage sludge was obtained together with the quality of the wastewater inflow throughout of the year to the treatment plants. A quick study was also performed on the natural wetlands in Iceland and the relevant organizations responsible for their preservation. In general, there were some investigations as well to find native wetland's plants of Icelandic climate and the availability of required materials for the constructed wetland implementation in term of built environment.

Several interviews were conducted with representatives of the different groups of interests like state, politicians and government, relevant companies in wastewater management and resource recovery, NGOs, academics and researchers, and local interest groups. Table below provides detailed information about the interviews.

Interview No.	Group category	Date of interview	Time of interview	Type of interview	Interviewee's name	Interviewee's organization	Interviewee's position	Interviewee's speciality
1	Governmental and state	28/09/2021	13:00	Persential	Lif Magneudóttir	Reykjavik city	Chairman of Committee of Environment and Public Health	Politician
2	Wastewater companies	23/09/2021	13:00	Persential	Guðmundur Tryggvi Ólafsson	Sorpa	Operations Manager, Recycling centres	Recycling engineering
3		17/09/2021	10:00	Online	Sigríður Ósk Bjarnadóttir	Green building council	Board member	Structural engineering
4		8/9/2021	13:30	Online	Björgvín Sævarsson	Yorth group	CEO	Environmental engineering
5		30/8/2021	13:30	Online	Hlöðver Stefán Þorgeirsson and Arndís Ósk Ólafsdóttir Arnalds	Veitur	Wastewater engineer and project manager	Wastewater engineering
6		06/9/2021	13:30	Online	Gyða S. Björnsdóttir	Sorpa	Sustainability expert	Sustainability
7		Environmental NGOs	15/09/2021	14:00	Online	Lea Böhme	Sorpa	Environmental engineer
8	Academics and researchers	22/09/2021	12:30	Persential	Emmanuel Pierre Pagneux	Agricultural University of Iceland	Assistant Professor	Surface water and urban planning
9		22/09/2021	11:00	Persential	Hlynur Oskarsson	Agricultural University of Iceland	Associate Professor	Surface water and water resources
10		9/9/2021	14:30	Online	Haukur Ingi Jónsson	Reykjavik University	Associate Professor	Natural processes

The interviews lasted about an hour mostly and the interviewees were asked to express their personal and professional opinions on NBSs based on the questionnaire already prepared by STSM group. The method of questioning was semi-structured which means that the interviewees were flexible in replying to any of the questions or skipping them. Also, the interview allowed the interviewees to extend their views to additional other issues that they considered relevant. The interviews were in two modes of presential and online. The audios were recorded in presential ones and the online meetings were recorded through screen recorders. Photo below shows some of the interviews conducted during the STSM.



One step to analyse the interviews is to transcribe them through transcription software like ATALS.ti, e.g. I visited several pumping stations and wastewater treatment facilities distributed around Reykjavik (photo below).



### DESCRIPTION OF THE MAIN RESULTS OBTAINED

The desk and ground investigations of the city of Reykjavik show that sewerage sanitation plan of the city is of the sewage collection delivered to the sewer pumping stations and wastewater treatment plants (WWTPs). There are two WWTPs facilities, a pumping station (dælustöð) and a treatment plant (hreinsistöð) in Reykjavik, where primary treatment is applied involved in the entrapment and filtration of coarse materials through a mechanical system of grit removal followed by a separator of sand and grease. The settled particles in the separator are then disposed of to the landfill outside of Reykjavik. Therefore, there is not any further treatment stage like secondary or tertiary treatments in the treatment train in Reykjavik and the primary treated flow is directly pumped 4 km into Faxaflói Bay. Table shows the mass flow of the aforementioned WWTPs within 2010 to 2020.

Treatment plant	Flow rate (l/s) within 2010 to 2020											
	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	
Klettagörður	1.467	1.414	1.391	1.321	1.311	1.421	1.279	1.193	1.324	1.26	1.113	
Ánanausti	1.181	1.122	1.164	1.109	1.139	1.18	1.119	1.365	1.142	1.178	992	
Total	l/s	2.648	2.536	2.555	2.43	2.45	2.601	2.398	2.558	2.466	2.438	2.105
	m <sup>3</sup> /day	228.7872	219.1104	220.752	209.952	211.68	224.7264	207.1872	221.0112	213.0624	210.6432	181.872

Rain water pump stations are added when there is a high volume in which case the diluted drainage flows out into the sea. The Waste Water Department of Veitur is in charge of the sewer management in Reykjavik which is a part of Orkuveita Reykjavíkur/ Reykjavik Energy (OR). The sanitation plan serves over 99% of the Reykjavik sewerage. Based on the interviewees' perspectives, the current practice of wastewater management is not sustainable and requires further treatment in order to be able to reuse the treated wastewater. In this way, the treatment facility will trigger to the production of sewage sludge and the resource recovery of the sewage sludge is ponderable. Although, the present challenge of resource recovery of sewage sludge seems the lack of these resources due to the non-existence of secondary and tertiary stages, the other challenge would be the existence of sub-polar climate for the implementation of STRB technology. The interviews revealed that application of STRB in Icelandic climate is conditional. Some of the interviewees stated that the hot water resource can be integrated into STRB system to maintain the temperature of the reed beds in a favorable condition for the living organisms and plants to stay efficient most of the year. Therefore, the system should be constructed in controlled space like a greenhouse protected even from precipitations. On the other hand, there are no specific laws supporting and promoting the application of NBSs in Reykjavik and the main actors and responsible organizations have not been directed yet. Even

though a system of incentivization together with taxation may promote the use of STRBs in Reykjavik or other small communities in Iceland.

The city of Reykjavik has already been activated to recycle organic waste household into a biogas facility called Gaja. The products of Gaja include 12,000 tons of soil improver and 3 million Nm<sup>3</sup> of methane every year. The methane is sufficient to supply 4–6,000 passenger cars or approximately 60 city buses. It could also be used to generate electricity for about 2,000 households. There have been also some successful practices of composting which all show that a system of STRB is highly feasible in this particular climate although field studies are required to reach a standard guideline of design and implementation.

The holistic approach of Reykjavik in circularity in city has been determined 15 main actions to fulfil the circular city and green urban environment of which:

- Green city development
- Zero Waste
- Green construction industry
- Reclamation of wetlands
- Reykjavik climate forests
- Blue-green surface water solutions
- Flood control installations to become recreational areas and parks
- Collaboration with business and industry

are the actions that interests the current STSM general objectives.

In overall, the implementation of sludge treatment reed beds in Reykjavik urban environment to achieve circularity in cities is highly feasible which is conditional to several factors from technical aspects to the regulations and policies.

### **FUTURE COLLABORATIONS**

As collaboration between two parties was successful, the University of Reykjavik (specifically David Finger) will collaborate with the University of Lisbon (specifically Amir Gholipour) through different ways:

- scientific publications. A manuscript will be written on the sense of interviews analysis through drawing casual diagrams to identify the relevance of each elements influencing the application STRBs in Iceland.
- a step wise plan will be prepared in order to discuss with interest parties for the implementation of a field study.

#### Reference:

Vögeli, G. and D.C. Finger (2021) Disputed dams: Mapping the divergent stakeholder perspectives, expectations, and concerns over hydropower development in Iceland and Switzerland. Energy Research & Social Science. Volume 72. p. 1-23. <https://doi.org/10.1016/j.erss.2020.101872>