5TH GENERATION DISTRICT HEATING AND COOLING IN THE BALTIC STATES

11:00-11:20	**Welcome and introduction to Agent-GIS-5GDHC project**	Anna Volkova, Tallinn University of Technology, Estonia
11:20-11:35	**Technical performance analysis of 5GDHC**	Pei Huang, Dalarna University, Sweden
11:35-11:45	**GIS map of 5GDHC agents and potential for the Baltic region**	Kertu Lepiksaar, Tallinn University of Technology, Estonia
11:45-12:00	**Barriers and drivers for 5GDHC implementation**	Lina Murauskaite, Lithuanian Energy Institute, Lithuania
12:00-12:15	**Business models for 5GDHC**	Ieva Pakere, Riga Technical University, Latvia
12:15-12:35	**5GDHC good practice examples from the projects D2grids and CollecThor**	Gert Moermans, VITO, Belgium
12:35-13:00	**Discussion**	

TALLINN UNIVERSITY OF TECHNOLOGY

5TH GENERATION DISTRICT HEATING AND COOLING IN THE BALTIC STATES

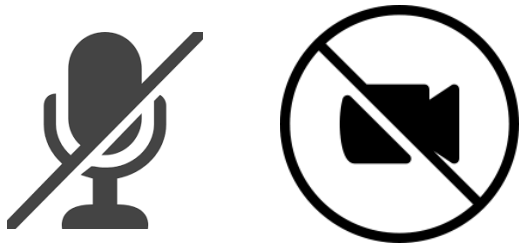
prof.Anna Volkova

Tallinn University of Technology, Department of Energy Technology

Nordic Energy Research

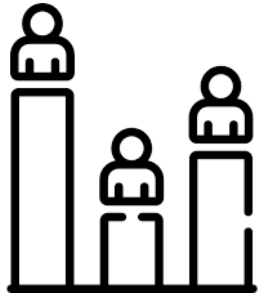
TECHNICAL INFORMATION

- Switch off your microphone and camera



- Ask questions in the chat

- Participate in the polls



AGENDA

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WELCOME!

This project is made possible thanks to funding from Nordic Energy Research

Nordic Energy Research

The Joint Baltic-Nordic Energy Research Programme

The overall aim of the programme is to promote energy research and analysis in the Baltic States and inspire intra-Baltic and Baltic-Nordic co-operation.

Agent-GIS-5GDHC

Techno-economic performance and feasibility study of the 5GDHC technology using agent based modelling and GIS

TALLINN UNIVERSITY OF TECHNOLOGY

PARTNERS

- Tallinn University of Technology, Estonia
- Dalarna University, Sweden
- Riga Technical University, Latvia
- Lithuanian Energy Institute, Lithuania

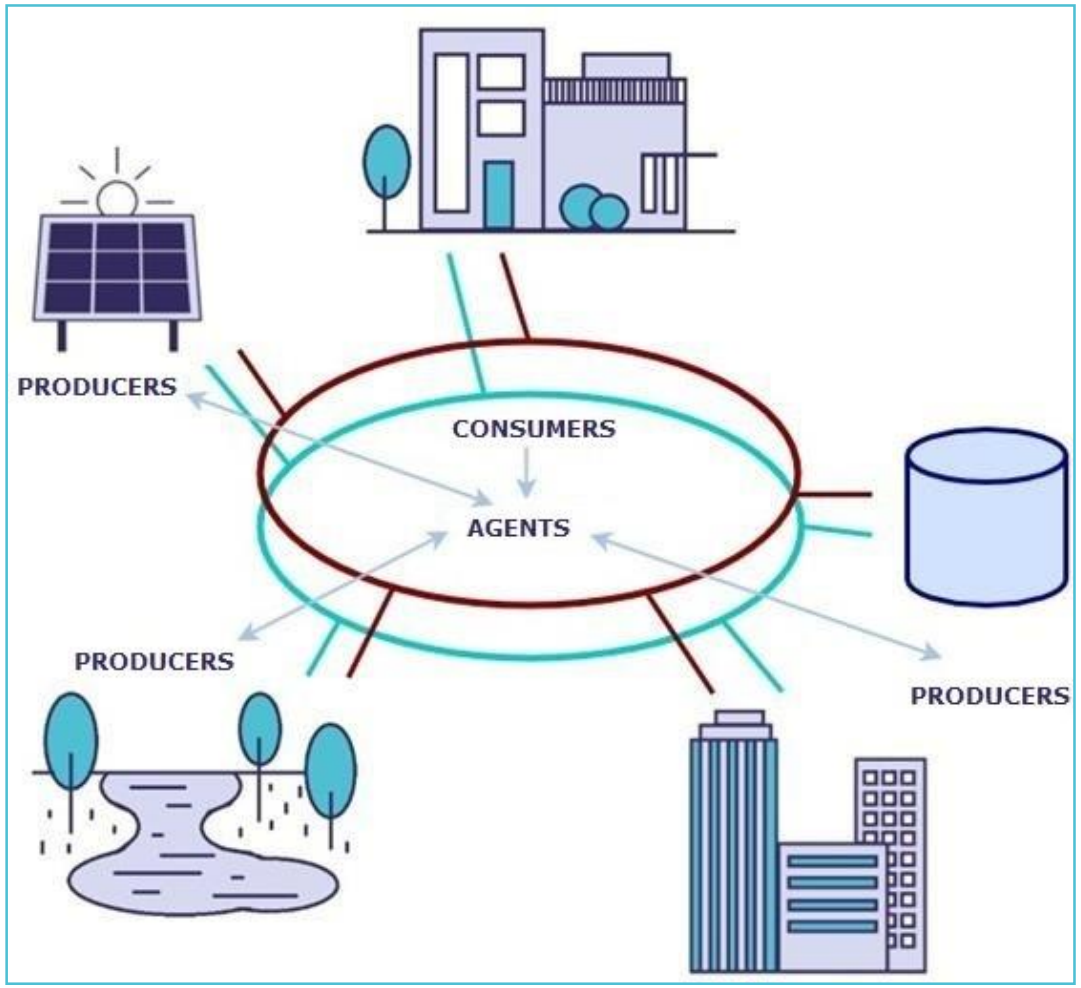
MEETINGS

- ~25 online meetings
- 2 meetings in person, bilateral meetings


Poll

5TH GENERATION DISTRICT HEATING AND COOLING

- close to ground/ambient temperatures
- decentralised energy flows
- bi-directional operation
- combined heating and cooling
- heat/cold sharing

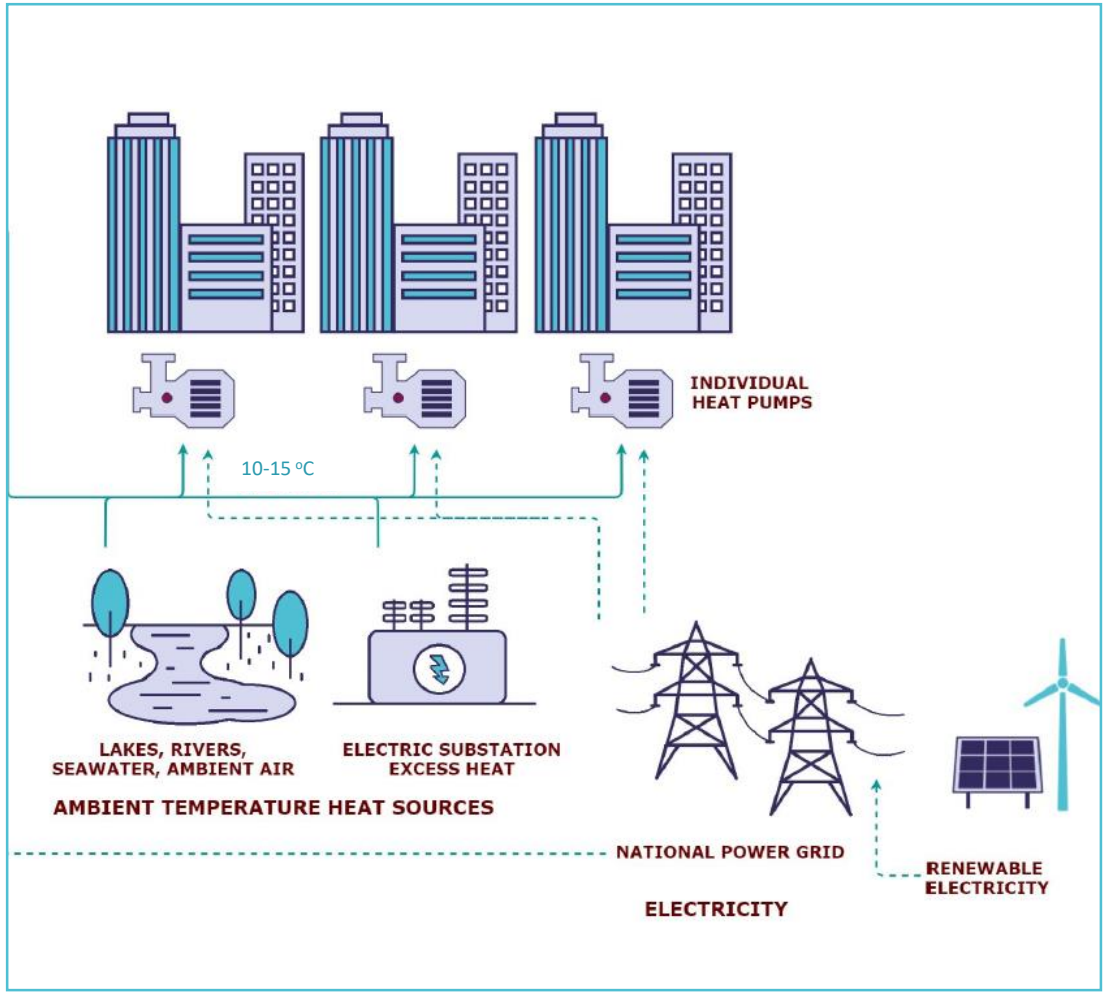


5TH GENERATION DISTRICT HEATING AND COOLING

- individual heat pumps
- renewable electricity
- consumers=>prosumer role

5GDHC AGENTS

- Office buildings
- Public buildings
- Industries
- Data centers
- Shopping molls/Retail stores
- Electric transformers



5TH GENERATION DISTRICT HEATING AND COOLING

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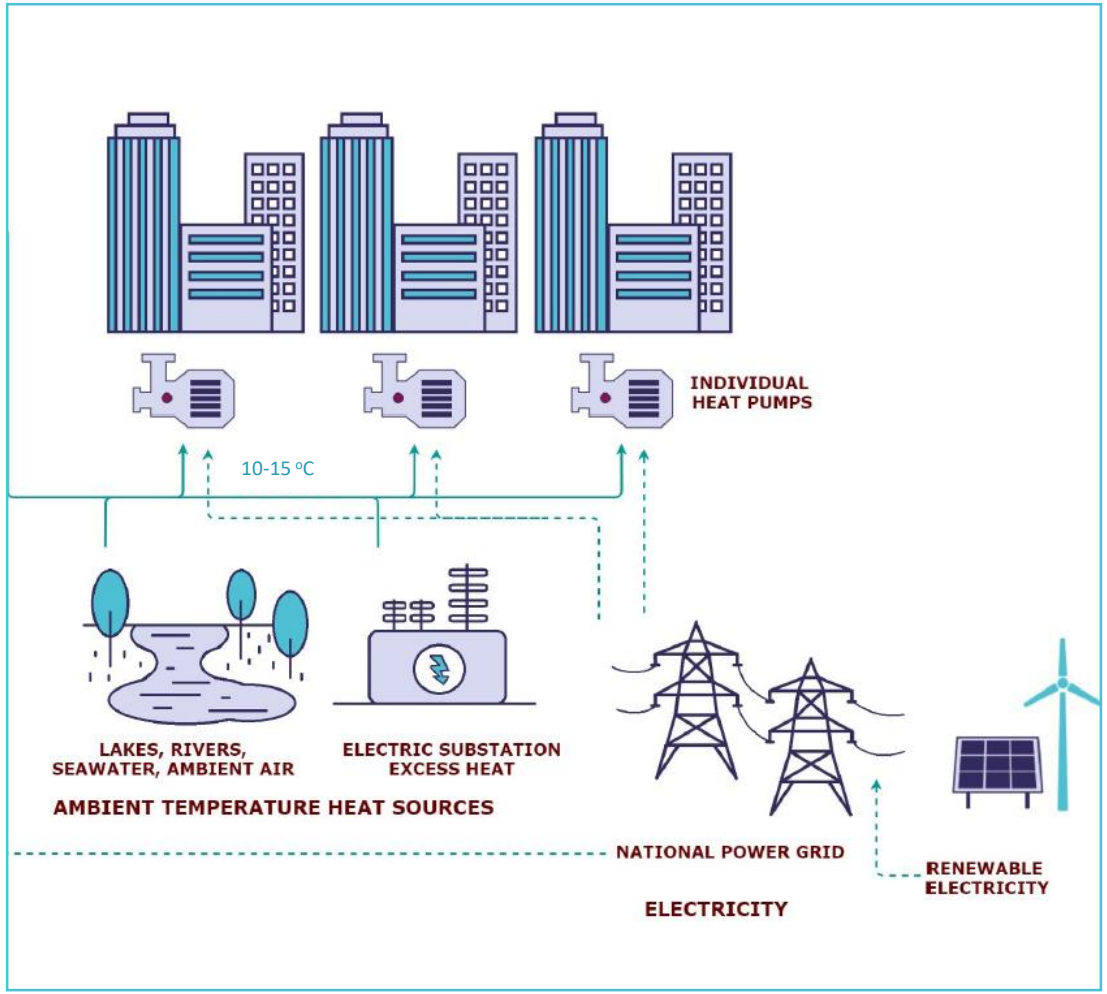

5GDHC AGENTS

- Office buildings
- Public buildings
- Industries
- Data centers
- Shopping molls/Retail stores
- Electric transformers

MOTIVATION

- High significance of district heating in the Baltic States
- Urban areas in the Baltic states are being actively built up with low-energy buildings
- Successful projects in Europe (i.e. D2GRIDS)
- Very high interest and limited knowledges about 5GDHC in the Baltic States

MAIN ACTIVITIES

- Data about three groups of 5GDHC agents has been collected and three layers have been added to low-grate heat sources map.
- Technical performance analysis of 5GDHC has been conducted
- Barriers and drivers for 5GDHC implementation in the Baltic States have been overviewed
- Business models for 5GDHC have been analysed

PAPERS AND PRESENTATIONS

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Comparison of Suitable Business Models for the 5th Generation District Heating System Implementation through Game Theory Approach

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Research paper

5th generation district heating and cooling (5GDHC) implementation potential in urban areas with existing district heating systems

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ABSTRACT

The 5th Generation District Heating and Cooling (5GDHC) network has great advantages in terms of integration of low-temperature resources, bi-directional operation, decentralised energy flows, and possible energy sharing. One way to develop the idea and concept of 5GDHC is to identify potential agents, including residential buildings, office buildings, shopping malls, data centres, electrical transformers, and so on, in 5GDHC in each target context. The prospects for 5GDHC have been assessed in light of the conditions in the Baltics. The multi-criteria analysis method was used to quantify the main identified barriers and drivers behind the implementation of 5GDHC systems. It should be noted that new urban areas in the Baltic states are being actively developed with low-energy buildings, so 5GDHS can be integrated to supply heat to these areas. The highest score in the multi-criteria assessment was achieved by Lithuania due to support availability and open heating market conditions. When all applied criteria are weighted equally, Estonia has the most favourable conditions for 5GDHC systems due to widespread use of heat pumps and greater excess heat potential.

1. Introduction

District heating and cooling (DHC) technology has been widely recognised as a promising solution to reduce both primary energy consumption and local emissions (Rezaie and Rosen, 2012; International Energy Agency, 2014). The 5th generation district heating and cooling (5GDHC) network is the latest district heating/cooling concept, which is characterised by low temperature supply (i.e. close to ground temperature), bi-directional operation (i.e. it can provide heating and cooling simultaneously), decentralised energy flows (i.e. it allows multiple heat sources and heat sinks in the network), and heat sharing (i.e. it can recover waste heat and share it with different users) (Buffa et al., 2019). Unlike the 4th generation district heating (4GDH) technology, the 5GDHC technology is geared towards the consumer/prosumer. It only needs one thermal grid, but it serves multiple purposes for both heating and cooling distribution, including heat and cold storage, and thus provides flexibility in adopting local renewable energy and waste heat resources. As pointed out in Revesz et al. (2020), by integrating the low-grade heat with photovoltaic arrays, batteries, and vehicle-to-grid applications, 5GDHC systems also support the electrification of both the building and transportation sectors towards the broader concept of 'fifth generation smart energy networks'.

The distinction between 5GDHC and 4GDH has been studied in the past. For instance, Lund et al. (2021) performed a systematic comparison of 5GDHC and 4GDH in terms of goals and capabilities. According to their findings, 5GDHC has five of the same core capabilities as 4GDH: (i) the ability to supply different types of buildings, (ii) the ability to distribute heat with small grid losses, (iii) the ability to recycle heat from low-grade sources, (iv) the ability to be integrated into large smart energy systems, and (v) the ability to ensure proper planning and cost-effective investment. The main differences in 5GDHC are the strong emphasis on combined heating and cooling, as well as the use of a collective network close to ground temperature as a common heat source or sink for heat pumps (HP). After reviewing various literature, they also concluded that 5GDHC can be viewed as a technology with its own merits. It does not have to replace other 4GDH technologies. Instead, it can coexist with other 4GDH technologies. Ref. Gudmundsson et al. (2021) compared the levelised costs of heat from both 4GDH and 5GDHC in Denmark and the UK. The results of this study showed that, under current cost scenarios, 4GDH is more cost-effective compared to 5GDHC in both of these countries. This is due to three key factors: (1) economy of scale of central

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- I.Pakere, M.Kacare, L.Murauskaite, P.Huang, A.Volkova Comparison of Suitable Business Models for the 5th Generation District Heating System Implementation through Game Theory Approach, 2023, https://doi.org/10.2478/rtuect-2023-0001

UNDER REVIEW

- P.Kumar, P.Hauang, Simone Buffa, Juveria Shaha A.Volkova, X.Zhang Ambient temperature district heating system: Multi-objective analysis for a case study in heating-dominated climate, Energy

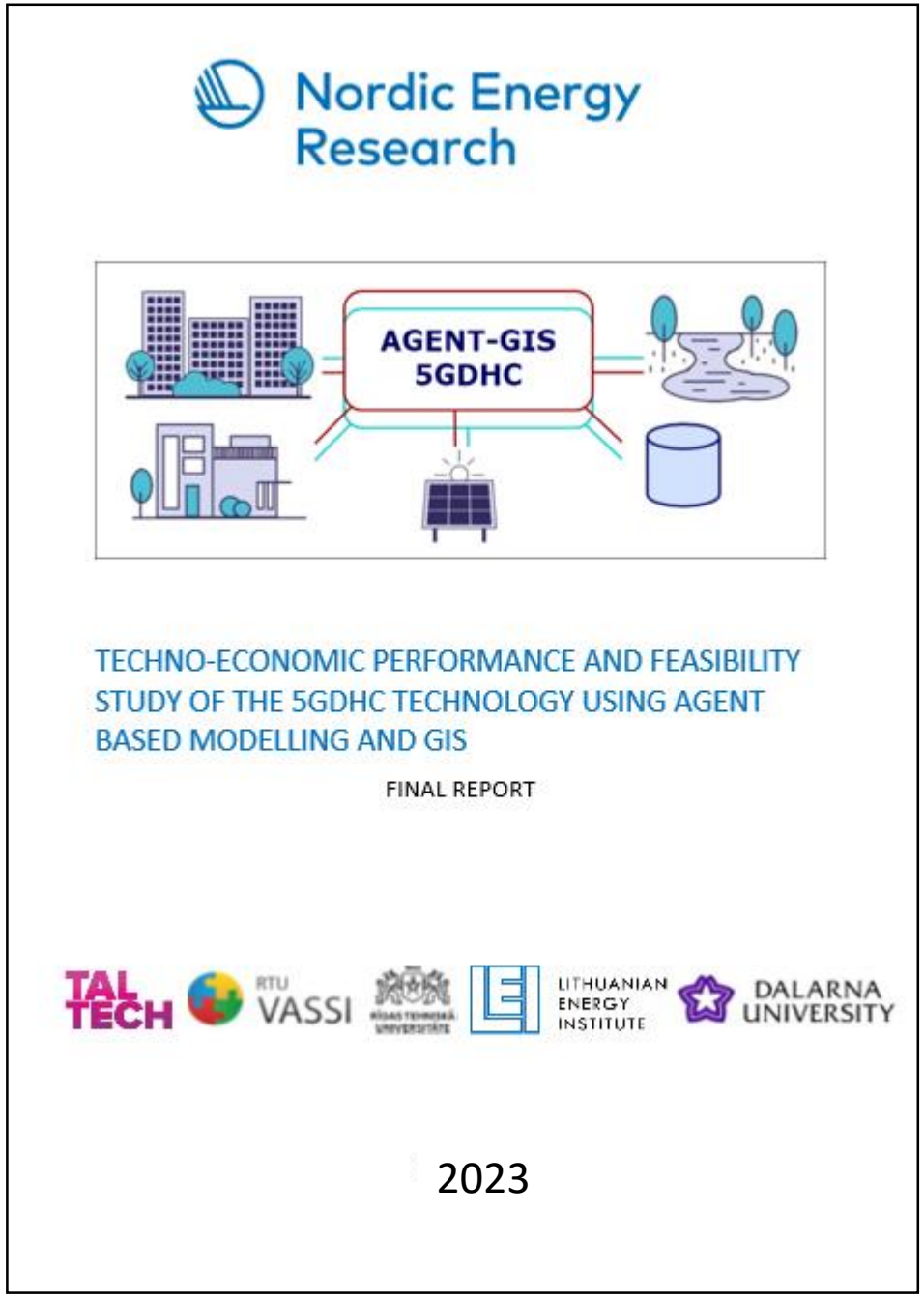
REPORT

Starting from 1st February, 2023

- Available to the Ministries of the Baltic states and NER
- Available by request

Starting from 31th March, 2023

- Publicly available



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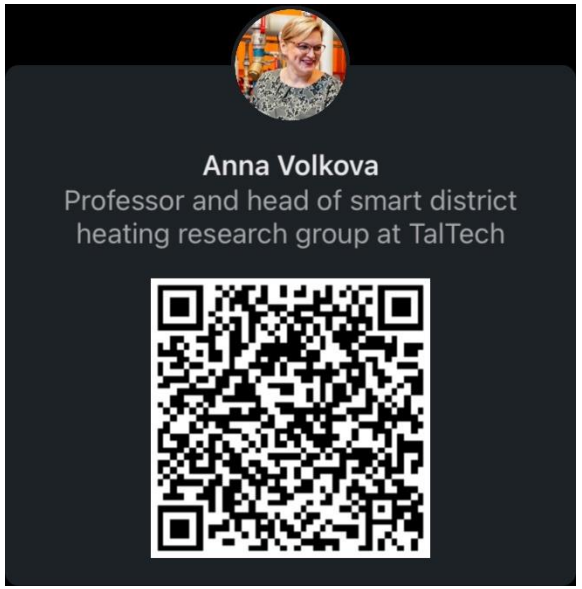

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