



Decision Support Tool for Decarbonisation Assessment of District Heating Systems

Annual report on dissemination, communication, mobility and training activities, and progress and risk monitoring: 2021
(Deliverable D4.2.)



Prepared within the project “Decision Support Tool for Decarbonisation Assessment of DistRicT Heating Systems (START), Nr. 1.1.1.2/VIAA/4/20/604

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Content

1. GENERAL INFORMATION ABOUT THE POSTDOC PROJECT	3
2. DISSIMINATION, EXPLOITATION AND COMMUNICATION ACTIVITIES	4
3. MOBILITY AND TRAINING ACTIVITIES	6

1. GENERAL INFORMATION ABOUT THE POSTDOC PROJECT

The scientific aim of START project is to develop a decision support tool for identifying the decarbonisation level for scenarios in the transition towards the 4th generation district heating (4GDH) system. The 4GDH includes the sectors coupling or cross-sectoral interconnection (SC/CSI), transition to low-temperature system and 100% RES. Thus, this tool will present various development scenarios for decarbonisation and select the most sustainable option for the development of the studied systems under various conditions. **The novelty of this project** is to connect Life Cycle Carbon Assessment with the System Dynamics model of the district heating system that provides the transition from the existing system towards 4GDH.

Results of the project: Four activities are planned in the project:

1. Definition and validation of the SD model for the reference DHS,
2. Scenario development and conceptualisation of their comparative assessment,
3. Development and application of the hybrid SD-LCCA-MCA model for ranking of scenarios,
4. Knowledge transfer, mobility, and training.

At least two peer-reviewed papers in scientific journals indexed in international scientific databases will be published during this project. International cooperation with European universities in the field of energy planning and smart energy systems will be developed.

As a result of the project, the postdoctoral researcher will significantly improve her scientific, managerial and communication skills, which will help her achieve the status of an independent, mature researcher.

The proposed study is directly related to the two areas of the Latvian Smart Specialization No. 3 "Smart Materials, Technologies and Engineering Systems" and No. 4 "Smart Energy". The planned result of the research will impact the innovation capacity of Latvia, mitigate climate change, promote business competitiveness and ensure the resilience of the local energy system.

Project period: 01.015.2021. – 30.06.2023. (30 months)

Project costs: 111 504.90 (94 779.16 EUR from EU as ERDF funding; 5 575.25 EUR – the share of the University of Latvia)

Source of funding: European Regional Development Fund Specific Objective 1.1.1 "Improve research and innovation capacity and the ability of Latvian research institutions to attract external funding, by investing in human capital and infrastructure" 1.1.1.2. measure "Post-doctoral Research Aid". Project application selection round No.4.

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2. DISSIMINATION, EXPLOITATION AND COMMUNICATION ACTIVITIES

The project was started on January 1, 2021.

The scientific aim of the project is to develop a decision support tool to determine the level of decarbonization for the DH system by developing scenarios to assess the transition from the current system to the 4GDH system. At the beginning of the project, consultations were held with industry and experts (JSC “Rīgas Siltums” and Ltd “Rīgas Ūdens”) for gaining an insight into the interaction of the system’s elements. Jelena Ziemele participated on January 28, 2021, in a meeting with industry experts, where the project objectives and planned results were presented to obtain input data on the interaction between the district heating reference system and wastewater (WW) industry. Representatives of the industries later sent the necessary input data for modelling.

As a results, the following tasks were performed:

- Conceptualization of the system, behaviour mechanisms and feedback loops.
- Formulation of the SD model.
- Determination of DHS’s affecting factors (indicators) for development towards 4GDH, and SC and/or CSI solutions.
- Building SD sub-models of case-specific SC and/or CSI solutions.

Two scientific articles have been envisaged to report the results of the project. In the first year of the project, one article “A methodology for selecting a sustainable development strategy for connecting low heat density consumers to a district heating system by cascading of heat carriers” has been published in the journal Energy (Elsevier, ISSN: 0360-5442, Impact Factor 7.147, CiteScore 11.5, <https://doi.org/10.1016/j.energy.2021.120776>). The article can be found in the SCOPUS database <https://www.scopus.com/record/display.uri?eid=2-s2.0-85107702087&origin=resultslist&sort=plf-f>. The paper presents a methodology for supporting the decision making on how to sustainably develop an existing district heating system when remote consumers are connected to the system. Several scenarios are proposed where a multi-generative system is assessed by implementation of industrial heat pumps, solar photovoltaic system (PVs), and low-temperature regime into an existing district heating system in various combinations. The methodology is based on multi-criteria analysis allowing for energy, economic, exergy, and environmental (4E) assessment. The results show that in such a system, the most sustainable scenario for connecting remote consumers is to transition from the use of natural gas to biomass as a fuel in addition to installing booster HP coupled with solar PV panels and implementation of energy efficiency measures. That allows reducing primary energy factor, increasing the share of avoided CO2 emissions, and decreasing the levelized cost of heat.

The project envisages three presentations at International scientific conferences on their results. In order to develop the transition to the 4GDH system scenario, the potential interaction of the water supply (WW) management company and DH company and also their dynamics were analyzed, taking into account all interconnected energy flows. The mathematical model of the district heating reference system in PowerSim Studio 10 was supplemented with a sector coupling block. The obtained calculation and modeling results were presented at the 7th International Conference on Smart Energy Systems in September 21-22, Copenhagen.

At the national level, the project results were to be disseminated in two events, seminars, or conferences organised by different professional organisations to promote the use of the project results in the industry. One of such event took place on August 5, 2021, where the potential interaction between the water supply (WW) management company and DH company was discussed with the representatives of JSC “Rīgas Siltums”, Ltd “Rīgas Ūdens” and Riga Municipal Agency “Riga Energy Agency”. The presented results of the study could be exploited for the development of sustainable energy action plans.

A dedicated section has been developed at the website of the University of Latvia (<https://www.lu.lv/zinatne/programmas-un-projekti/es-strukturfondi/1112-pasakums-pecdoktoranturas-petniecibas-atbalsts-4-karta/lemumu-pienemsanas-atbalsta-riks-centralizeto-siltumapgades-sistemu-dekarbonizacijas-novertesana/>), that informs visitors about the project’s aims, tasks, and progress, while also providing links to all results published as an outcome of the project (information is provided in Latvian). Also, the website of the Computational Systems Biology Group (<https://www.biosystems.lv/start>) holds a section dedicated to the project (information is provided in English). In addition, a project has been developed at ResearchGate (https://www.researchgate.net/profile/Jelena_Ziemele) where periodic updates of the project’s progress are published. Information about the START project and its results was posted on the professional web sites of the postdoctoral researcher LinkedIn (<https://lv.linkedin.com/in/jelena-ziemele-77835b5b/>).

At the beginning of the project, an information plate (A3 size) about the project and funding provider was placed in the premises of the University of Latvia – the House of Nature. The plate will be maintained for the whole project, thus informing employees and visitors of the House of Nature and acknowledging the funder of the research project.

3. MOBILITY AND TRAINING ACTIVITIES

Risk and progress monitoring has been performed on a regular basis to assess the progress of the project, correspondence with the project's timeline and evaluate the possible risks in coming phases of the project. The needed mitigation and contingency plans have been initiated and implemented by rescheduling some of the planned activities (e.g. mobility visit).

In the first year of the project, mobility and training activities have been carried out in the shadow of the global pandemics. Therefore, only the risk related to the pandemic affected mobility activity. The planned mobility in accordance with the previously agreed program from 19 to 26 July 2021 to the DH company AB "Vilniaus šilumos tinklai" was canceled due to the pandemic restrictions. That why virtual mobility visit to Lithuanian Energy Institute, Laboratory of Energy systems research was implemented from October 4 until October 24, 2021. Topical issues in the field of district heating system transition towards 4th and 5th generation, innovative technologies implementation, and the district heating sector impacts to city decarbonization policy (in accordance with a previously agreed program), as well as possibility for cooperation in applying for European-funded projects. Additionally, the possibility for cooperation in the creation of a scientific article with a draft title "Comparative assessment of treated wastewater heat recovery into district heating systems of the three Baltic capital cities" was discussed. The topics discussed during the mobility are set out in more detail in the report. The previously approved virtual mobility visit program was completed, and it is confirmed by Arvydas Galinis (Head of Laboratory of Energy systems research Lithuanian Energy Institute) and Lina Murauskaitė (researcher at the Laboratory of Energy systems research).

Additionally, competence enhancing measures were performed - a certificate was received for completing the course about system dynamics modelling from the Worcester Polytechnic Institute.

The planned milestones and deliverables of the project were achieved on time. In the first year, all planned tasks have been completed and results achieved:

M1.1. DHS key performance indicators are selected. M1.2. First sub-model for case-specific SC and/or CSI solutions is built.

D1.1. Model's boundaries, indicators, dynamic nature stated in 1 report. D1.2. Description of SD sub-models of SC and/or CSI solutions given in 1 report. D1.3. 1 Presentation of sub-model given at the 7th International Conference on Smart Energy Systems in September 21-22, Copenhagen.

D2.3. The article "A methodology for selecting a sustainable development strategy for connecting low heat density consumers to a district heating system by cascading of heat carriers" has been published in the journal Energy (Elsevier, ISSN: 0360-5442, Impact Factor 7.147, CiteScore 11.5, <https://doi.org/10.1016/j.energy.2021.120776>).