After the RISEnergy Transnational Access, Users are required to submit a User Report. This should be done within 4 weeks after the Access is completed unless otherwise agreed. The User Report will be given to the User(s) by the WP2 leader. The report contains sections related to the work performed, the main results and observations that were achieved.

This document should be completed, signed, and sent by e-mail to risenergy@for.kit.edu.

Summary questionnaire for Users who have been granted Transnational Access (TA) under the RISEnergy project Horizon Europe TA scheme. More information on RISEnergy TA can be found in "General Rules" and in "Access Policy" which can be found on the RISEnergy webpage.

Please complete, sign, and send this form, together with the Cost claim by e-mail to risenergy@for.kit.edu with title: RISEnergy APPXXX - reports.

General information about the project	
Project title (as used in Application)	Evaluation of performance and Live demonstration of Electric vehicle and heating technologies in Multi-Energy Network Test Setup
Project number (APPXXX) and acronym (max 15 characters)	APP139 – ELEMENTS
RISEnergy RI(s) accessed	PowerLabDK (Denmark)
Keywords (up to five, free text)	District heating network, grid code, power distribution network, power system faults, temperature control
Arrival date (in town where RI is located)	29 September 2025
Departure date (from town where RI is located)	18 October 2025
Starting date of Access (first day at RI)	30 September 2025
Finishing date of Access (last day at RI)	17 October 2025
Number of days not using the RI (during the above period)	4
Reason for not using RI those days (describe)	weekends
Number of days using the RI	14
Number of Users granted Access (group size)	1
Comments	-

User	
User group leader or sole applicant (user group member 1)	
First name	
Last name	
Affiliation / Employer	
Country of Employer	
E-mail	
User travelling to RI?	
Comments	

Access Summary Report - work performed and initial results

Brief description of the objectives of your project (up to 200 words)

[Please describe short the main objectives of your project]

This project is aimed at investigating the operating performance of different energy flexibility resources, such as electric vehicle technologies (namely, electric vehicle onboard and offboard chargers) and heating technologies (namely, heat pumps, electric boilers, and combined heat and power), in an integrated multi-energy system. This aim has been achieved through the following objectives: (1) selection of different electric vehicle and heating technologies based on their generation and demand profiles to capture diverse energy profiles; (2) connection of these electric vehicle and heating technologies to the integrated multi-energy system testing environment; (3) live demonstration over a range of disturbance scenarios representing under- and over-voltage and frequency operating conditions, significant changes in generation and demand profiles, and variations in temperature; and (4) comparison of experimental results with grid code requirements. Hence, this project demonstrates whether the operating performance of different electric vehicle and heating technologies complies with those requirements in an integrated multi-energy system testing environment.

Activities performed (up to 600 words)

[Please summarise the work carried you (steps taken, instrumentation used, techniques employed, data sources consulted etc.)]

Tests were performed to investigate the impact of voltage and frequency deviations, power supply interruptions, and temperature changes on the electrical and thermal components connected to the power and heating networks. The integrated power and heating test network included different combinations of power and thermal components connected through valves and circuit breakers in different configurations. Connected components included electric vehicles, electrical and thermal dump loads, a combined heat and power unit, a heat pump, a booster heater, and a flexible house load.

The analysis of voltage and frequency deviations and temporary faults in the power network consisted of the following steps: network initialisation, interruption, reconnection, data collection, and evaluation. Active and reactive power and voltage measurements (root mean square values) were collected by the electrical switchboard.

Voltage set-points were defined between 355 and 445 V at 10 V steps, whereas frequency set-points were defined between 47 and 53 Hz at 0.5 Hz steps, with rated values at 400 V and 50 Hz.

The analysis of temperature changes in the heating network consisted of the following steps: network initialisation, start-up of heating sources, switch-off of heating sources and stabilisation, data collection, and evaluation. Temperature, flows, and thermal energy measurements (root mean square values) were collected by the component meters.

The analysis of permanent faults in the power network and effects on the heating network consisted of the following steps: network initialisation, start-up of power and heating sources, supply interruption, reconnection, data collection, and evaluation. Active and reactive power, voltage, temperature, flows, and thermal energy measurements (root mean square values) were collected by the component meters and electrical switchboard.

All the results were saved for further analyses and checked against grid code requirements and thermal settings of low-temperature district heating networks. In Denmark, these specifications are defined respectively by:

- Green Power Denmark, Guide for grid connection of demand installations to the low-voltage grid (≤ 1 kV), 2022.
- Energiteknologisk Udviklings- og Demonstrations Program, Guidelines for low-temperature district heating, 2014.

Scientific results (up to 800 words)

[Summarise the (initial) outcomes of your study at the RI(s).]

This work has performed a live demonstration and evaluation of operating performance of electrified transport and heating technologies in an integrated energy system test setup. Evaluation results over a range of operating conditions using different electrical and thermal components indicate that:

1) Electrified transport and heating technologies do not fully comply with voltage and frequency ride-through and cease-to-operate requirements. All technologies were able to remain in continuous operation between 48 and 50 Hz at 400 V and between 365 and 415 V at 50 Hz. However, some of these technologies did not comply with the grid code requirements when further away from the rated values, especially at the upper and lower voltage and frequency extreme values used in the tests (frequency at 47 Hz minimum and 53 Hz maximum and voltage at 355 V minimum and 445 V maximum).

2) It could be noticed that some technologies presented a much narrower operating range than others, which shows the influence of manufacturer / manufacture year and technical requirements from across different EU countries. Overall, the best performance over the full range of operating conditions under test was achieved by the recently acquired heat pump, while the worst performance was from a combined heat and power unit from Germany.

3) The district heating network temperature is naturally subject to an exponential decay due to the thermal exchanges between the pipes and the external ambient. Different heat sources had a role in increasing the internal temperature and compensating for this decay in the tests, such as the combined heat and power,

heat pump, and booster heater. In the absence of heat sources, the temperature drops were higher and faster.

4) The dynamic behaviours associated with electrical and thermal components are significantly different, ranging from milliseconds on the electrical domain to minutes on the thermal domain. These differences could be explored in different settings in the evaluation and live demonstration. In particular, the benefits provided by the district heating network were noticeable during the tests with long-duration power supply interruptions. Results indicated that the low-temperature district heating network could survive for several hours after the power outage, as long as the temperature remained within the recommended operating range.

Interpretation of the results (up to 400 words)

[Discuss the data obtained and describe the major scientific conclusions drawn.]

Overall, findings show the risks associated with new energy behaviours introduced by electrified transport and heating technologies, and the value of integrated energy system approaches to increase availability and alternatives of supply. The fact that many of the tested electrical technologies did not comply with grid code requirements suggests that, outside the laboratory environment, they may bring serious risks for a stable and safe power grid operation. Conversely, the evaluated long-duration power outage scenarios did not have an immediate effect on the district heating network, which remained within the acceptable operating range for several hours.

Findings indicate that an integrated power distribution and district heating network could increase availability and alternatives of supply to customers in the event of a fault. In addition, it can provide a feasible and desirable alternative to electrification for customers and locations with critical thermal loads, constrained power networks, and high energy network availability requirements. In comparison with the power network, the slow dynamics from the district heating network is less prone to disturbances and stability problems and could also help mitigate further problems caused by non-compliance with grid code requirements.

Main achievements during the TA related work (up to 250 words)

[Describe the main achievements during your stay at the site(s), Outputs (results, publications, models, etc.), conclusions, next steps, potential impact]

This work provided background information for the analysis of disturbances and fault propagation in integrated power and heating networks, including the problem formulation and live demonstration environment and results over a range of scenarios. Results will be submitted to a prestigious scientific journal (e.g., Energy, Scientific reports or similar). They will also be used to influence future planning and regulations around power distribution networks, district heating networks, and electrified transport and heating technologies in the EU and UK.

Data Management

[Describe the further usage and storage of project data. State where the data will be kept and name a person responsible for the data. Define data]

The project data will be stored in an open-source data repository for further usage and replicability of the results. Collected data include measurements of active and reactive power and voltage of electrical components and temperature, thermal power, and energy generated or consumed by the thermal components over a range of scenarios. Both the user group leader and provider will be responsible for the data.

Difficulties during the TA related work (up to 250 words)

[List problems and issues, you had, completing out your research project: Did you get access to all the necessary equipment, facilities, databases, etc.? If not, please specify the problems that occurred and list equipment the was not working or accessible.]

No problems.

Intended publications

[Explain where and how you expect to publish the outcomes of your project work. Include also anything already published (What and where?)]

I expect to publish the outcomes of my project work as a prestigious journal article (e.g., Energy, Scientific Reports) describing the experiments, results, scientific contributions, and wider pathways for impact. I also intend to write a policy briefing for further dissemination in the EU and UK; and exploit wider pathways for impact with key energy stakeholders, such as system planners and operators, regulators, and manufacturers.

Expected impact

[The impact the expected results will have on current and future research or practice, public safety, European standardization, competitiveness, integration and cohesion and on sustainable growth. any follow on proposals, projects, collaborations, commercialisation]

Research outputs from this work will be submitted to a prestigious scientific journal (e.g., Energy, Scientific reports or similar) and support future research and industry practice in different ways. Planned activities include follow on Horizon Europe proposals, projects, collaborations, and efforts towards research commercialisation and innovation services.

For the timeliness of this work, outputs are expected to have a significant influence on planning, standards, and regulations around power distribution networks, district heating networks, and electrified transport and heating technologies. This influence will be firstly exerted in the EU and UK to show the value of integrated energy systems and grid code compliance toward decarbonisation targets. Outputs will reach policy and industry practice through working groups, international organisations, knowledge exchange activities, academia-industry-government collaborations, among others.

Conclusions / additional comments

[Provide any other comments you might have on your work]
No further comments.

Did you complete the European Commission User questionnaire https://ec.europa.eu/eusurvey/runner/RIsurveyUSERS?
x *Yes* ☐ *No*

Feedback – HSE, Ethics and Satisfaction

Please rate on a scale from 1 (excellent) to 5 (poor). Feel free to provide additional comments

Practical information on how to apply for Transnational Access and the overall application process	1 (excellent)	2	3 (neutral)	4	5 (poor)
	x	☐	☐	☐	☐

Comment: The forms, instructions, and offers were significantly improved comparatively with previous related transnational access applications.

Information provided, once your project was accepted, on how to proceed	1 (excellent)	2	3 (neutral)	4	5 (poor)
	x	☐	☐	☐	☐

Comment: The email with all the relevant information was helpful.

Support received at the site(s) regarding technical/scientific matters and logistics	Have you got sufficient support from the RI staff during the project? If not, please, specify the problems. x *Yes* ☐ *No*

Please specify any problems: No problems.

RI extension / upgrades required	In your opinion, is the RI needed to be upgraded? If yes, please give an explanation. ☐ *Yes* x *No*

Please specify: No upgrades required at this point.

Problems with local regulations	Have you had any problems with regulations of the visited RI owner (HSE, lab working hours, etc.)? If yes, please, specify ☐ *Yes* x *No*

Please specify: No problems.

Health and safety issues	Did you encounter any health or safety issue during your research? Please provide details. ☐ *Yes* x *No*

Please provide details: No problems.

Environment & Ethics	Did your research involve the use of elements that may cause harm to the environment, to animals or plants? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Environment & Ethics	Did your research deal with endangered fauna and/or flora and/or protected areas? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Environment & Ethics	Did your research involve the use of elements that may cause harm to humans, including research staff? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Environment & Ethics – Dual use	Does your research have the potential for military applications? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Environment & Ethics – Misuse	Does your research have the potential for malevolent /criminal/terrorist abuse? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Environmental issues	Were any potentially dangerous substances (materials / gases etc.) released into the environment (atmosphere, water, or land)? Please provide details. ☐ *Yes* x *No*
Please provide details: Not applicable.	
Ethics issues	Are there any other ethics issues that should be taken into consideration? Please specify ☐ *Yes* x *No*
Please provide details: Not applicable.	
Overall impression of communication and interaction after finishing your TA and related work	

1 (excellent)	2	3 (neutral)	4	5 (poor)
x	☐	☐	☐	☐

Comment: The past two months have been extremely busy, but we have been in contact about required documentation and related works.

Suggestions for facilities not included in RISEnergy which you would use for your research

[Please provide suggestions for specific type of facilities missing (RI gaps) or measurement / experiments you would like to perform which cannot be done on current RISEnergy facilities.]
Combinations of physical and digital infrastructure representing both components and networks at high fidelity level.

Suggestions how RISEnergy can improve future TA programme, how to make the TA more impactful and how to enable the achievement of high TRL levels

[Your suggestions] I would suggest a stronger presence of the pro-active innovation support to identify business and technology transfer opportunities and knowledge exchange and impact activities together with providers and user groups. This could make the TA more impactful and enable user groups and providers to achieve higher TRLs.

Feedback – Pro-active Innovation Support

Awareness	Did you know about the pro-active innovation support of RISEnergy? ☒ Yes ☐ No

[Please specify how you learned about the pro-active innovation support]
Website.

Personal experience	Have you taken advantage of or benefited from the pro-active innovation support? ☐ Yes ☒ No

[*Please provide details]*
I have not taken advantage of the proactive innovation support before or during my visit but plan to follow up in a near future. I forgot to ask when I read about it, did not check it later, and did not see the information elsewhere.

Information/service provided by the pro-active innovation support?

1 (excellent)	2	3 (neutral)	4	5 (poor)
☐	☐	☒	☐	☐

[*Please provide details]*
I have not taken advantage of the proactive innovation support before or during my visit but plan to follow up in a near future.

I declare that the above provided information and especially that information on the number of days visited the RI is correct.

☒ *I have read the RISEnergy privacy policy for participation in the RISEnergy TA and consent to participation and the associated data processing.*