VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Stanislav Chicherin**

The public defense will take place on **Wednesday 29th April 2026 at 4pm** in room **I.2.01** (Building I, VUB Main Campus)

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DESIGN OF 5TH GENERATION DISTRICT HEATING AND COOLING (5GDHC) SYSTEM WITH SEASONAL THERMAL ENERGY STORAGE VIA GIS ASSESSMENT

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Abstract of the PhD research

This thesis explores how to design 5th Generation District Heating and Cooling (5GDHC) systems using seasonal thermal energy storage and GIS-based assessment. 5GDHC networks operate at low temperatures and allow energy to be shared between buildings that both use and supply heat or cooling. This makes them different from older systems and potentially better suited to today's energy needs, especially with the growing use of renewable sources.

The work is guided by the following research questions:
1. Can a 5GDHC system be more beneficial than previous generations and standalone solutions?
2. How can a 5GDHC system be designed from scratch?
3. Can elements of the 5GDHC concept be integrated into existing or future urban or peri-urban environments?

To address these questions, the thesis first compares 5GDHC to 3rd and 4th generation district heating systems, as well as individual technologies like natural gas boilers and heat pumps, using benchmarks such as energy use and emissions. It then outlines a step-by-step design process that starts with identifying potential users and energy sources, and continues with the use of GIS tools to evaluate where and how such a system could be built. Finally, it looks at whether parts of the 5GDHC approach can be added to current or planned neighborhoods, district energy infrastructure, and ongoing developments, using the example of the Usquare project (Brussels, Belgium).

The study shows that 5GDHC systems can offer clear advantages in many settings, especially where there's a mix of energy needs and a chance to use local sources and storage. It also shows that GIS can play a key role in planning and decision-making from the start.