



DOCTORAL RESEARCH TOPIC:

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Numerical investigation of premixed flame-turbulence interaction

RESEARCH FIELD:

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Energetics and Power Engineering (T 006)

BRIEF DESCRIPTION OF RESEARCH TOPIC:

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One of the EU's goals is to achieve that by 2050 the European continent would become climate neutral. One of the five announced missions of the EU's "Horizon Europe" programme is "Climate-neutral and smart cities". This mission is very important because cities are concentrated sources of pollution and climate change. Cities cover 3% of the Earth's surface, however, generate around 72% of greenhouse gas (GHG) emissions. This share may increase even more in the future as cities grow rapidly. It is projected that in 2050 almost 85% Europeans will live in cities.

In order to achieve these ambitious goals of climate neutrality, energy systems are undergoing a transformation: fossil fuels are being replaced by renewable energy sources (RES), energy-intensive consumers are emerging, and sustainable solutions for non-renewable energy generation are needed. The integration of energy systems plays a key role in this transformation process and the inevitable interactions between heating, cooling, electricity supply systems, RES, energy storage, hydrogen technologies, as well as the interfaces between energy systems and transport infrastructure (charging stations for electric cars), which will become a major consumer of energy, must be taken into account.

In order to have as many climate-neutral and smart cities as possible, it is important for cities to have a vision of what the urban energy sector will look like, to choose the right energy generation and storage technologies to ensure uninterrupted and reliable energy supply for citizens, businesses, transport and all urban infrastructure. To this end, models are needed that evaluate the performance of energy systems under different conditions and allow the selection of the optimal infrastructure for the urban energy sector. Various tools and models have been developed for modelling the operation of individual energy systems (electricity, heat, gas supply) as well as economic-technical evaluation of the energy sector. However, there is no uniform methodology, tools and models for detailed evaluation of integrated energy systems and their technical parameters, taking into account synergies between heating, cooling, electricity systems, RES, energy storage, hydrogen technologies and transport infrastructure. The developed methodology and new models would help to develop visions for smart, climate-neutral cities and serve them in the future, thus, creating a fundamentally new high-quality and sustainable environment for society.

The topic of the dissertation "Research on Energy Systems Integration for Smart Climate Neutral Cities" will aim to develop and test a methodology for modelling the performance of climate-neutral city integrated energy systems and evaluating their parameters, taking into account technologies interactions and possible disconnections of individual technologies and their support systems.

The following tasks will be addressed in the theme:

- Investigate scenarios for the development of smart low-temperature heating and cooling supply networks and their integration into the other sustainable energy systems, develop methodology and models for modelling their operation.
- Investigate scenarios for the integration of hydrogen technologies into sustainable energy systems, develop methodology and models for modelling their operation.
- Develop a methodology for modelling integrated energy systems and their operation, taking into account the parameters and interoperability of electricity, heating, cooling systems, RES, energy storage, hydrogen technologies, transport infrastructure and other potential systems.
- Carry out an assessment of the security of energy supply in various scenarios for the transformation and development of energy systems, taking into account the resilience of energy systems to extreme weather events and events caused by climate change.
- Develop and analyse a model of smart city demo project.
- Prepare models of alternative scenarios for the transformation of a specific Lithuanian city / city-district into a smart city.
- Evaluate the application of the developed methodology to various smart cities.

A methodology for modelling the operation of climate-neutral integrated energy systems in a smart city will be developed and tested, enabling the optimal selection of energy technologies according to the set of criteria and constraints.

SCIENTIFIC SUPERVISOR:

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**Dr. Sigitas Rimkevičius**  
**Laboratory of Nuclear Installation Safety**

Lithuanian Energy Institute  
Breslaujos 3, 44403 Kaunas  
Lithuania

Sigitas.Rimkevicius@lei.lt

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