

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 **Guangxuan Wang**

The public defense will take place on **Tuesday 10th December 2024 at 5pm** in room **D.0.08** (Building D, VUB Main Campus)

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OPTIMAL DESIGN OF LOW CARBON, MULTI-ENERGY SYSTEMS

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Abstract of the PhD research

Transitioning to sustainable energy systems is crucial for mitigating climate change and reducing reliance on fossil fuels. My research focuses on designing low-carbon energy systems that integrate renewable energy sources with advanced storage technologies, balancing environmental and economic goals. By incorporating solutions such as solar energy with short-term storage (batteries) and long-term storage (hydrogen), the research aims to make renewable energy more reliable and cost-effective.

A key focus was optimizing these systems to achieve significant emissions reductions while controlling costs. Hybrid energy storage systems are particularly effective at stabilizing energy supply and supporting ambitious decarbonization targets. By analyzing uncertainties—such as fluctuating capital cost of components—the research ensures these systems are robust and economically viable under varying conditions.

Additionally, the study explores Positive Energy Districts (PEDs), which are urban neighbourhoods that produce more energy than they consume. Strategies like renewable energy integration, electrification, and demand-side management reduce emissions, enhance energy self-sufficiency, and provide a sustainable blueprint for urban development.

This work highlights the potential of innovative technologies and uncertainty analysis to design energy systems that are both resilient and sustainable. It offers practical guidance for policymakers, industries, and communities transitioning to cleaner, more reliable energy solutions.