

Summary

This thesis focuses on spatial planning for energy-resilient territories and cities. It addresses the energy transition in line with the climate-neutral 2050 strategy by integrating energy systems development within urban areas. The goal is to help mitigate climate change and achieve decarbonization goals. The strategic importance of incorporating the energy issue into the decision-making process is widely recognized, particularly by the 2016 Urban Agenda within the framework of the European SDGs.

The energy sector produces two-thirds of global emissions of climate-changing gases. Around 80% of energy consumption and CO₂ emissions in Europe are linked to urban activities. Therefore, the energy sector is the primary source of global emissions, which holds the key to solving the issue of climate change.

The solution to achieve a more resilient energy system is to change the paradigm of spatial energy management from centralized to **diffused energy production systems**. The research, therefore, focused on renewable energy sources, resources practically inexhaustible but limited for dispersed nature of energy sources with considerable dimensions, limited availability in time and discontinuity of generation, and accessibility related to the presence of constraints of a different nature. Highlighting that trend that foresees RES growth **must be planned** on the territories.

Energy communities are an **opportunity** to guide the energy transition of territories and increase the integration grade between energy and spatial planning. The European Clean Energy for All Europeans package supports this transition through measures to improve the energy system's security, sustainability, and competitiveness.

The work focuses on the Italian context, where energy topics and spatial planning are treated sectorally without communicating. The policy implications imply a **restyling** of the architecture and methodological approach of ordinary planning to foster better integration between energy and spatial planning. In particular, applying an energy-oriented plan that uses the **territorial spatial partition** as a guiding structural element to implement specific strategies based on the characteristics of the territories. The goal is to find the intersection between

energy and spatial planning by implementing energy-driven spatial planning instruments and actively engaging citizens.

The work sets technical and planning goals. The **technical goals** are working on models and tools for analyzing energy systems at an urban scale with a place-based approach, such as finding the optimal dimension and spatial distribution of Energy Communities throughout territories and identifying the most effective energy policy for each territory through future scenarios evaluation. The **planning goals** are planning spatial-energy strategies to enhance multilevel coordination among public authorities, such as defining different policies to encourage the creation of energy communities and integrating the Energy Communities into spatial planning as a driver of the energy transition.

The research work is composed of four main sections. The work constructed theoretical (Part I) and cognitive framework (Part II) bases that allow the implementation of a decision-making tool. Then (Part III), analyzes best practices, examining the Emilia-Romagna region applications, with two energy plan cases (Bologna and Modena) and the Danish case, concerning community energy applications. The conclusion (Part IV) outline the results for the next generation energy plan. The meta-plan **proposal** establish a framework for future energy plans. The results show the implemented approach to integrate the energy component into ordinary spatial planning.

In conclusion, in order to overcome energy planning barriers the next-generation energy plan must be based on four **pillars**. As highlighted in the relevant bibliography, these core characteristics must be the primary focus when developing a plan that integrates energy issues with spatial planning concerns. The four pillars are conforming territorial dimension, reference territorial partitions, integrating energy into the plan, and fostering public-private relationships. The plan proposal integrates energy and spatial planning by focusing on these pillars, going into them, and trying to add new elements and insights from the application case study. These pillars provide a valuable foundation for future energy plans and identify solutions to help territories achieve sustainable and efficient energy management.