

## PhD in Mechanical Engineering

### Research Title: Planning and operation of high-RES energy islands

<b>Funded by</b>	EC-LAB/DIMEAS
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<b>Context of the research activity</b>	<p>In order for our society to achieve high environmental sustainability standards and ambitious decarbonisation goals, the energy self-sufficiency of local energy systems is arising increasing interest. The paradigm of urban and rural energy systems characterised by high-Renewable Energy Sources (RES) internal production and limited electricity exchange with national grids may indeed entail various benefits: fairly distributed environmental impacts, reduced grid congestions, high public awareness on the energy challenges and promotion of Renewable Energy Communities (REC) and of the energy citizenship principles.</p> <p>In this framework, geographical non-interconnected islands represent an interesting case study because of the high economic and environmental costs of their energy supply, which is often largely based on fossil fuels. Investments needed to achieve very high penetrations of RES and energy self-sufficiency targets are then more justified than elsewhere, and islands may represent fundamental test sites for the planning, realization and management of zero-emissions energy systems.</p> <p>For the study of the decarbonisation path and in the exploration of future energy scenarios of such systems, two key issues need to be addressed through adequate modelling tools: planning and operation.</p> <p>On one side, medium- to long-term energy planning is needed for selecting the type and capacity of energy production and energy</p>
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	<p>storage technologies needed for achieving the set environmental targets at the most affordable economic conditions. Local energy planning, also, can not disregard the location and distribution of energy production and storage plants, as well as the social acceptability of the proposed solutions and the citizens engagement (e.g., distributed generation, REC).</p> <p>On the other side, the identified medium- and long-term scenarios must be validated in terms of technical feasibility: this can be done through operational models, which can study the peculiarities of distribution grids and their short-term management to ensure security of supply.</p> <p>The main objective of the PhD research will be to develop a suitable framework for the combination of energy systems planning and operational models, to be applied to the study of the energy independence of local energy systems.</p>
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<b>Objectives</b>	<p>Keywords:</p> <ol style="list-style-type: none"> <li>1. Energy scenario making and analysis.</li> <li>2. Multi-Energy systems.</li> <li>3. Local energy planning.</li> <li>4. Energy systems operation and management.</li> </ol> <p>Objectives:</p> <ol style="list-style-type: none"> <li>1. Explore and classify the existing frameworks for energy systems planning and analyse the different aspects and criteria to be considered in the development of RES projects.</li> <li>2. Examine the integration of Geographic Information Systems in the energy planning field and investigate existing software and databases for the estimation of RES production.</li> <li>3. Explore energy system operation models and modelling tools and identify their key characteristics. Analyse the existing approaches for the interaction with energy planning tools.</li> <li>4. Develop a comprehensive framework for the study of future energy scenarios by the integration of energy planning tools, software and databases for RES estimation and energy system operation models.</li> <li>5. Apply the developed framework to the case study of Italian and European non-interconnected small islands and interact with local communities for the identification of suitable energy transition paths.</li> </ol> <p>The PhD research will build-up on previous experience on energy planning models of small islands developed at the EC-Lab.</p>
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**Skills and competencies for the development of the activity**

To compete for the PhD the candidate should preferably have the following specific knowledges and abilities:

- Ability to present a scientific work both in oral and written form.
- Proactivity, independent and parallel thinking.
- Inclination to multi-disciplinary team-working.
- Background in the field of energy system modelling.
- Knowledge of RES characterisation models.
- Good programming skills (e.g., Python, Matlab) and basic knowledge of GIS software.