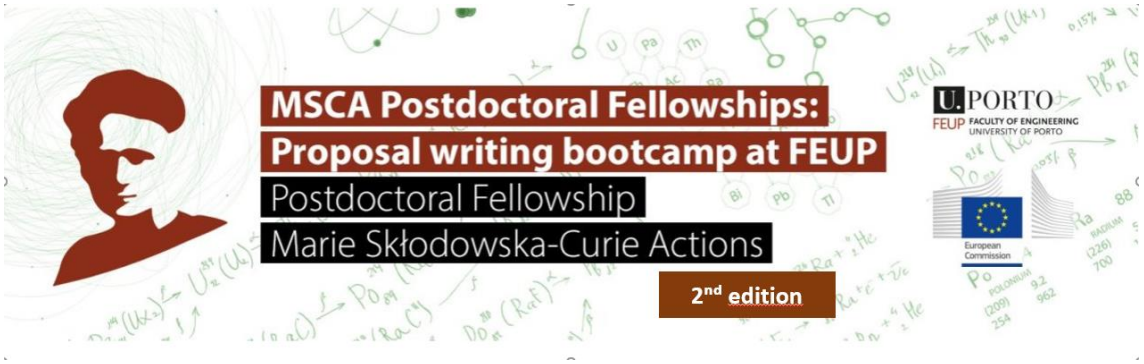


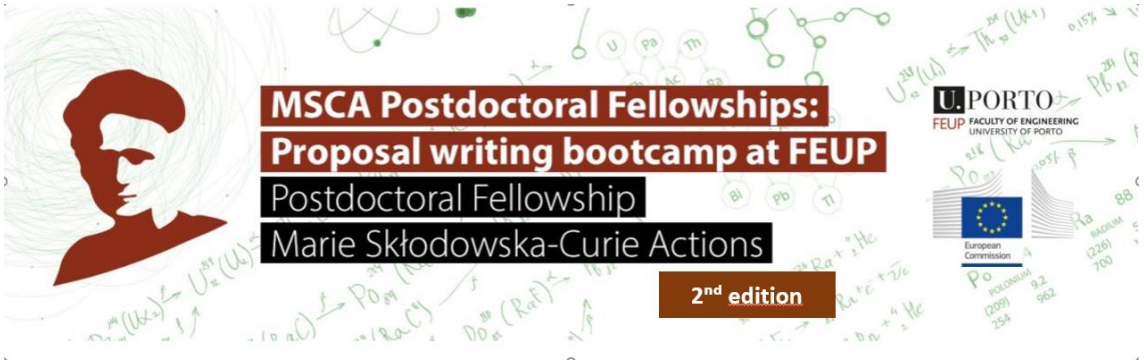
SUPERVISOR INFORMATION	
First and Last name	Tiago Soares
URL of supervisor webpage	https://www.inesctec.pt/en/people/tiago-andre-soares
Department	DEEC - Department of Electrical and Computer Engineering
Field(s) of research	Multi-energy systems; active network management; consumer-centric energy markets, Distributed optimization
PROJECT PROPOSAL	
Title (optional)	AI4MES – Advanced AI for Decentralized Multi-Energy Systems

Brief project description

The integration of distributed energy resources (DER), particularly renewable energy sources (RES), into multi-energy systems demands a paradigm shift in how distribution systems are managed and operated by distribution system operators (DSOs). As industrial and domestic consumers, along with prosumers, increasingly prioritize sustainable growth, their behaviors are evolving to seek solutions that address the energy trilemma of affordability, reliability, and sustainability. In response, system operators are exploring strategies to harness end-users' flexibilities and leverage synergies in multi-energy systems to enhance multi-energy distribution grid management (MEDGM).

The **AI4MES** project aims to design and develop new solutions, based on advanced optimization models and tools, for improving MEDGM, accommodating:

- **Intelligent Multi-Energy Grid Management (MEDGM):** Facilitating the integration of electricity, heating, cooling, and gas systems while accounting for diverse energy behaviors and uncertainties. This approach will improve energy efficiency and minimize flexibility costs through advanced modeling and computational techniques. Notably, hydrogen will be incorporated as a pivotal energy vector for storage and sustainability.
- **End-User Energy Flexibility:** Enabling the participation of end-users (primarily prosumers) in MEDGM via innovative business models and market mechanisms, such as peer-to-peer (P2P) negotiation frameworks, to foster a more dynamic and responsive energy ecosystem.
- **AI-Enhanced Computational Performance:** Employing advanced artificial intelligence, including AI-driven distributed optimization and reinforcement learning, to overcome computational challenges associated with complex multi-energy models. This will ensure scalability, efficiency, and reliability while addressing computational burdens effectively.



AI4MES will bring new advances in the integrated operation and management of multi-energy systems at the energy communities, neighborhoods and district levels. It will produce new and improved methods and algorithms to tackle the problem more effectively and efficiently, operating in a decentralized manner.

A key outcome of **AI4MES** is the development of a comprehensive set of models and tools to support decentralized MEDGM, accommodating the diverse perspectives of stakeholders in the energy ecosystem. These tools will benefit system operators, retailers, and end-users by raising awareness of decentralized operations and flexible generation and consumption. Moreover, the project will create the basis for advanced flexibility services tailored to the unique characteristics and needs of end-users, fostering a more sustainable and adaptive energy future.