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Supervisor Expression of Interest
MSCA-IF Marie Sklodowska Curie Action-Individual Fellowship 2020

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Department Name: Research topic: (https://www.polimi.it/en/scientific-research/research-at-the-politecnico/departments/)	Department of Energy Water and energy nexus analysis: accounting for natural resources in fragile context to inform national policies
MSCA-IF Research Area Panels	☐ CHE_Chemistry ☐ ECO_Economic Sciences ☐ **ENG_Information Science and Engineering** ☐ ENV_Environmental and Geosciences ☐ LIF_Life Sciences ☐ MAT_Mathematics ☐ PHY_Physics ☐ SOC_Social Sciences and Humanities
Politecnico di Milano Areas:	☐ Cultural Heritage ☐ Smart Cities ☐ **Territorial Fragilities** ☐ Health ☐ Industry 4.0
Brief description of the Department and Research Group (including URL if applicable):	The research group "Sustainable Energy System Analysis and Modelling" (SESAM, http://sesam.polimi.it/) is part of Politecnico di Milano, Department of Energy, and operates under the flag of the UNESCO Chair for Sustainable Development. SESAM's research goals is to assess the overall impact of energy scenarios and technology roadmaps in the frame of the energy transition requested by the Agenda 2030 and compliant with the different national energy, environmental and economic policies. Our research builds on the well-established potentiality of integrated and cross-sectoral (electricity, heat, transport...) energy system optimisation and simulation models by expanding their domain of application to multiple spatial and temporal scales. This is achieved through: - Technological characterisation based on thermo-fluid dynamics

	detailed models; - Operational and planning analysis of energy systems at the local and national scales based on energy systems models; - Investigation of inter-linkages between the energy sector and other productive sectors based on empirical models within the industrial ecology field (Input-Output models, Life Cycle Assessment) to estimate the economic-environmental impact of alternative energy strategies and policy options; - Formulation of the multidimensional complexity of the energy-development nexus in the energy access field, based on conceptual and simulation models (e.g. system thinking, system dynamics, impact evaluation frameworks)

Brief project description: **(max 1 page)**	Expected population and economic growth will likely result in an increase of energy demand, especially **in emerging and developing economies**. On the other hand, climate change will reduce the water available for cooling power plants and, particularly, for producing hydropower, traditionally considered a clean energy source. Since water is also used for agriculture and within the agri-food chain, this expected shortage may further exacerbate the competition on water uses and contributing to highlight the relevance of the so-called **Water, Energy, Food Nexus**. In such a changing world, the uncertainty on future demand and availability of water and the urgency to provide access to affordable and clean energy are among the main challenges for **planning resilient and sustainable infrastructures and an inclusive access to resources that could prevent risk of infrastructure failures or social turmoil**. In the scientific literature, many models are available to support policy makers either in the energy and the water sector. However, they usually **neglect the many interactions and feedbacks characterizing complex water-energy systems** as they are developed by single-discipline specialists. In this context, this research program aims to develop a new **Integrated environmental extended meso economic model.** Within the frame of the national economy and the specific industrial sector each characterized by a highly physical description of their technology mix, a focus on energy and water will be detailed to support case specific policy development. The model scope will cover networks of national economies, including the related trades and raw materials requirements. The model might cover the frame up to 2030 and beyond in order to capture shared socio-economic pathways, Agenda 2030 goals and Paris agreement commitments. The model will be applied within a planning exercise in a selected set of country-wide case studies in the African Context. The research will produce advancement on (1) *how to formulate* WEF management and planning problems within the framework of Sustainable Development paradigm, accounting for multiple sectors; (2) *how to implement* an ensemble of (open and transparent) modelling tools to comparatively evaluate integrated solutions and assess the economic and environmental implications of the associated policies within a WEF Nexus approach.

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