

## Supervisor's contact details

- Name: Jari KAIVO-OJA
- E-mail: jari.kaivo-oja@utu.fi
- Department: Finland Futures Research Centre

## Title of the project

Islands energy transition with hydrogen production and consumption for economic development

## MSCA-PF Research Panel

- Chemistry (CHE)
- Social Sciences and Humanities (SOC)
- Economic Sciences (ECO)
- Information Science and Engineering (ENG)
- Environment and Geosciences (ENV)
- Life Sciences (LIF)
- Mathematics (MAT)
- Physics (PHY)

## Description of the project

The development of an energy system based on variable renewable energy sources (wind and solar) requires the use of storage capacity and demand flexibility to balance the production and consumption system. Pumped hydro storage and batteries are potential storage options but also hydrogen (H<sub>2</sub>) can be seen as a resource of flexibility for the system providing additional possibilities for sector coupling.

Hydrogen is a carbon-free energy source, which makes hydrogen attractive for decarbonising electricity consumption and mobility in the energy system. Flexible H<sub>2</sub> production by electrolyzers can be used for balancing power production and consumption. Hydrogen can be utilized as a stored energy carrier, in the process of Power to X to Power P2X2P, and for further production of easily storable e-fuels.

There are no comprehensive life cycle studies of H<sub>2</sub> production and consumption. Also, its dynamizing role in economic development and energy transition towards 100% renewable system requires more research.

Additionally, H<sub>2</sub> can be used as a raw material for chemical production, ammonia (NH<sub>3</sub>), methane/methanol (where CO<sub>2</sub>, for instance from biomass or waste combustion, is needed), fertilizers production, and for the production of fuels for heavy transportation, marine, and

aviation. These types of sector coupling, within the energy sectors (heat, power), integrating the food production through the domestic production of fertilizers, potential couplings to industrial processes, and generally all economic couplings (such as import substitution and export-led growth solutions) require multisectoral planning of the interlinked systems too.

The planned research will provide novel methodological and empirical results for the construction of hydrogen strategies for the island economies. This research project will cover the existing research gaps in this important field of sustainable green transition research.

## **Research objectives or research questions of the project**

1. To develop new methods and utilise the energy planning methods developed in previous research projects, to analyse the role of hydrogen in Cuban island economy in the system theoretical PESTEC (Political, Economic, Social, Technical, Environmental and Cultural) framework.
2. To develop forecasting and backcasting scenarios for future development paths in Cuba with the interlinked PESTEC systems to develop the interdisciplinary approach and multi-sectoral economic planning.
3. To evaluate island pathways for the energy transition and its Climate, Land, Energy and Water systems (CLEWs) relations.