05 - WaveWings Integrated Airborne Wind and Wave Energy Converters

Climate change is currently one of the greatest societal problems. Electricity generation is a large emitter of greenhouses gases, thus being a major contributor to climate change. It is imperative to expand renewable energy sources, such as wind and wave energy. Airborne Wind Energy (AWE) is a promising new technology to produce renewable electricity, especially in areas where conventional wind turbines struggle, such as deep offshore. The WaveWings project aims to combine wave energy converters and airborne wind energy in order to capture possible synergies.

Mission Objective

WaveWings aims to exploit the synergy between coupled airborne wind energy and wave energy devices in order to construct a 1 GW renewable energy farm in an effort to contribute to the European Union's net-zero 2050 goals.

System Design

The design of the WaveWings system is performed at two levels, the farm level and the single unit level. The farm contains 400 individual units and the infrastructure, such as inter-array cabling, 5 offshore collection stations with multi-link high-voltage AC power transmission to the 5 onshore stations. On the single unit level, the main focus of this project, the system consists of a buoy, to which all the subsystems are attached. The airborne wind energy system (AWES) consists of a leading-edge inflatable (LEI) kite with a preliminary surface area of 450 m^2, connected to the buoy by a 1150 m long tether. Thus, 2.3 MW of power can be produced by the AWES with a preliminary capacity factor 57 %. The kite is launched and retrieved using a telescopic launch tower. The wave energy converter (WEC) consists of the main buoy and a submergible buoy, thus being a point absorber capable of generating 200 kW of rated power. The power take-off is achieved using a hydraulic system for both the AWES and the WEC. During the last phase of this project, the estimates of the technical parameters will be refined using appropriate simulations in an iterative design approach.
Choosing the west-coast of Ireland as a potential site location, the Irish electricity market is the envisioned business environment. Based on a custom-developed economic model, several key financial indicators of the WaveWings system are estimated, among which a levelised cost of electricity (LCOE) of 65 €/MWh. This is similar to that of conventional floating wind turbines, thus promising to be a viable contribution to the availability of renewable electricity in the Irish market.

Based upon the United Nations Sustainable Development Goals goals, sustainability has been an important consideration for both the organizational and the technical aspects. In particular, sustainability has played a major role during site selection of the wind farm. In the farther progress of the project, a life cycle assessment (LCA) will be performed in order to estimate, among other sustainability indicators, the global warming potential (GWP).