System design of Hybrid Power Plant using Airborne Wind Energy in Grid-connected scenarios

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The largest contributor to the greenhouse effect are CO2 emissions of which the global energy system is the largest source. Reducing the emissions of energy generation is essential to keep the temperature rise within the goals of the Paris Agreement. In order to reduce emissions, fossil fuel based energy must be phased out and replaced by alternative renewable energy sources. Despite their capacities having grown dramatically in recent years, their combined global electricity generation share was only 8% in 2019. In order to increase this share of energy production from renewable sources there is a global effort to design energy systems using sources such as wind and solar. These sources are susceptible to intermittency and therefore require creative solutions to implement effectively in energy systems. Wind and solar have a complementary intermittency and as such combining these in a Hybrid Power Plant (HPP) is an effective way to set up an energy system. On top of that, Airborne Wind Energy (AWE) has the potential to increase the effectiveness of the HPP due to its versatility in operation.

Designing a HPP using airborne wind energy that is grid-connected will mean participating in various aspects of the electricity market. The effect of these market types on the effectiveness of the HPP system will depend on how this system is designed. Investigation into the configuration and sizing of the components of the HPP will be able to show what the effect of grid connection is on the optimal system. In order to investigate this the system components will be researched as well as models describing their operation expanded upon and integrated. This research will show what an effective HPP using AWE will comprise of when in grid-connected scenarios.

This thesis aims to give an insight in the system design of grid-connected HPP's using aiborne wind energy. In order to do this existing models describing the components of HPP systems using AWE will be integrated and the level to which they are affected by grid-connection evaluated. The integration and expansion of these models will show the objectives of a HPP to be explored to investigate the effect of grid-connection on the system. This analysis will reflect upon the added value of AWE in the grid-connected HPP.

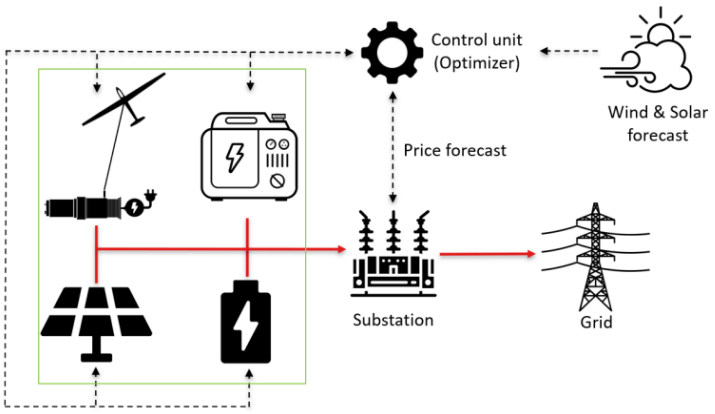

Figure 1 Hybrid Power Plant using Airborne Wind in grid-connection (S. Reuchlin)