Wind power is the largest renewable energy resource available today. Traditionally, a wind turbine consists of an electrical machine attached to rotating blades and mounted on top of tower infrastructure. An alternative concept is also available, which involves fostering the high altitudes of the sky where wind speed is much larger and consistent. This concept is called pumping cycle high altitude wind energy generator. The system consists of a flying kite attached to a ground station by a strong tether. The ground station—which includes an electric machine and a frequency converter—must operate as a generator to transfer the kite power to the grid during the reel-out phase, and as a motor to pull the kite from the sky once the tether has reached its full length during the reel-in phase.

This generator/motor operation combined with the low inertia of the system creates a highly fluctuating power profile that brings new challenges for grid integration as well as operation in island mode. Therefore, the aim of this thesis is to investigate the incorporation of energy storage units to smoothen the generated power profile, provide a backup energy source in case of emergency stop and to support the system during grid fault conditions.

The expected tasks of this thesis are as follows:

- Dimensioning and modelling of the energy storage system (Storage + DC-DC converter + Control) according to power profile filtering and fault ride through (FRT) requirements using MATLAB Simulink/PLECS.
- Development of a central power management controller that coordinates the operations of the machine-side, grid-side and the energy storage converters.
- Investigating the HAWE system performance under grid faults with and without the ESS.