



## WP 4

### Pumped storage plants

Reversible pump turbines (RPT) are well suited for load governing and also for grid support regarding frequency and voltage governing.

In Norway there are quite a few pump storage plants in operation. They were initially built to store energy from season to season. The change in the marked situation with increasingly difference in price night and day, they are already more active in utilizing both turbine and pump mode of operation.

At the European continent, there are several reversible pump turbine plants which operate mainly for grid support, hence helping to stabilize both frequency and voltage. With increased amount of non-governing power will result in a major change in operation of the Norwegian RPT-plants.

Today's RPT plants are not able to meet the challenge of changing between pump-turbine and condenser mode fast enough to meet the demands on the grid. Topics to be investigated are:

- Evaluate the demands for change in modes of operations
- System dynamic evaluation of existing RPT-plants
- Develop effective systems for altering between pumping and turbinning

There are strong links to WP5, WP6 and WP7. Technical consequences and related additional costs of frequent start/stop of hydropower plants, and operation outside optimum (design) levels are studied in the BIP/EBL project 'Verdiskapende vedlikehold innen vannkraft' (Value adding maintenance in power production). A link between HYDROPEAK and the BIP project will be established.