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Feasibility study Hydropower – pumped storage plant in a artificial circle wall embankment

PROJECT: RES-CHAINS
PROGRAM: SOUTH BALTIC PROGRAM
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Study of WEMAG, regional public energy supplier

picture 1 pump storage hydro power plant with circular wall
(http://www.ringwallspeicher.de/images/Ringwallspeicher-Hybridkrafwerk-m.jpg)

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Summary

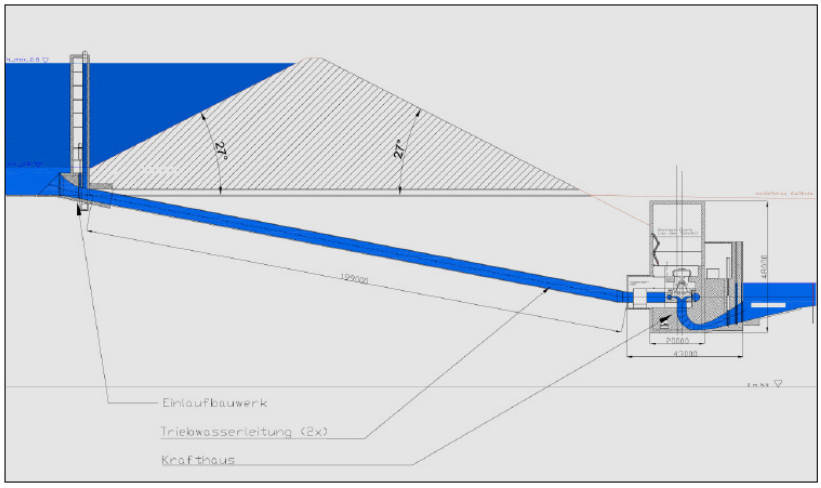
With a feasibility study WEMAG analysed possible location and costs for a circular pump stored hydro power plant as tool for storage surplus RES power and selling these power as balance energy on special market.

Current situation

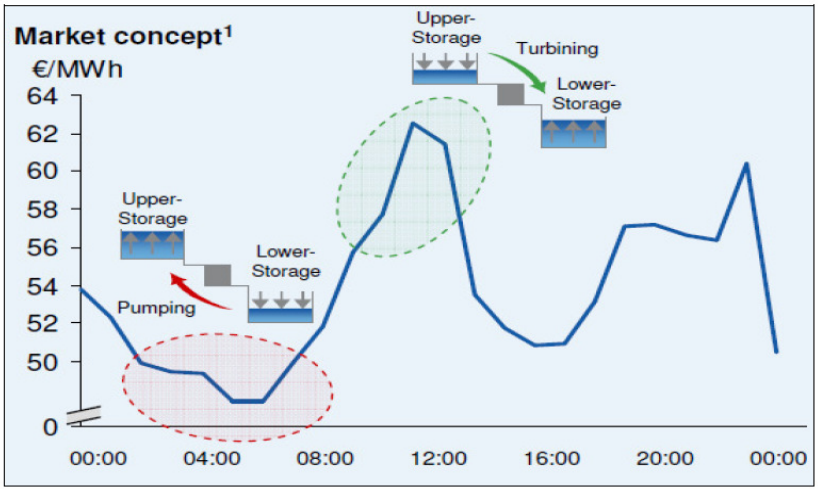
WEMAG, a regional public supplier, is responsible for electrical power grid (distribution net) in region West Mecklenburg. There are connecting consumer, like private households and commercial user, but even more and more producer, like RES plant, e.g. PV and Windmills. This plants producing volatile power, depending on wind or sun. Due to our rural area, it's happens frequently, that more power is in grid, than can consumers using in time. But when transmission grids are heavily loaded as well (because wind or sun producing electrical power in a greater region), for safety (beware of blackouts) some plants have to disconnect and turn down. In case of RES plant, like PV and Windmills there will electrical power wasted. To use this wasted power, WEMAG made a feasibility study of a pump stored hydro power plant, due to a lack of mountain ranges in West Mecklenburg, study researched a artificial high water basin.

Facts of planned installation

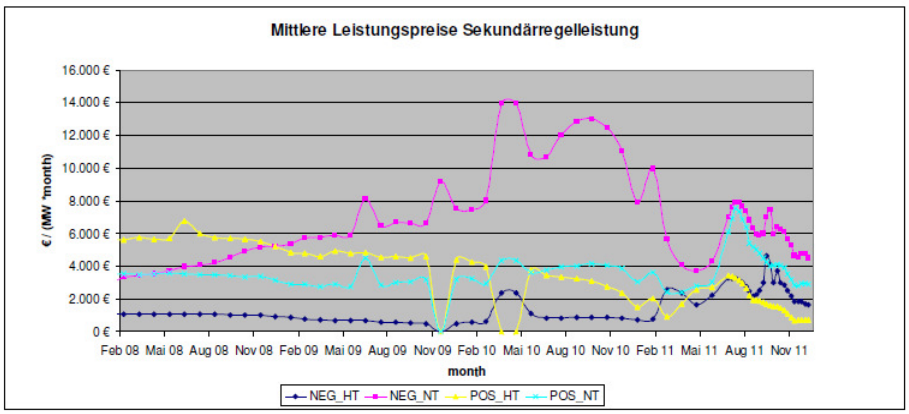
Type of hydropower	Artificial circular reservoir
What type of turbine is used?	Francis vs Deriaz
How has the grid connection been established?	High voltage grid, 110 kV
Installed capacity? (kW)	Max 128 MW_{el} turbine, Max 134 MW_{el} pump
Brutto storaged electricity? (MWh)	950
Max flow (m3 / s)	192
Difference in head between upstream intake and downstream outlet	63.4 m
capacity water (m^3)	5,500,000
Water loss due to flood, bypass requirements or leakage	No declaration
Load of sediment	Needs for detailed study of natural lake, should not most likely, due to two-way using (pumping and running)



picture 2 section of wall with technical buildings



picture 3 normal market concept of pump storage



picture 4 possible emoluments for secondary balancing power

Impact on environment and climate

An investigation about environmental- and water-legal aspects for using a natural lake in Mecklenburg-Vorpommern was not included in this study.

Financial aspects

The costs need be roughly estimated so as to reflect the total annual cost of the plant. The fundamental assumption is that the total annual cost comprises capital costs + O&M costs but if there is anything more important, please add that under the heading "Other costs" so as to make up 100 %.

What are the overall investment costs and interest rate?	**157,423,750 €**
What are the operational and maintenance costs?	**430,000 €/a**
Personnel costs?	**300,000 €/a**
mean specific power costs	**1,327,000 €/MW**
mean specific storage costs	**165,000 €/MWh**

Other important information

estimated time to built: 4 years

amount to dig: 9,75 Mio m³, used as material for circular wall of high water basin

Conclusion

To built a mountain to storage water, to produce electrical power sounded strange. But in this case a high demand for storage electrical power in this area is existing. So regional energy supplier have to figure out costs for building more efficiency grid (with even impacts in environment and problems of acceptance by inhabitants). Due to the fact, that more RES-plant are planned and will build, the grid has to takes higher peaks, caused by wind and solar power. Building a grid for peak load will be an over sophisticated grid for remaining time without peaks of volatile RES-power and economically preposterous to common sense.

As alternative this study analysed technical and financial aspects for a storage system. Smart idea is, to earn even money with a demanded installation. So this study takes research aspects for fast change of running direction, to take part in a special market (offer energy as replacement reserve (primary, secondary, one-minute balancing power). This market allowed higher prices per kWh, that a artificial pump storage will be profitable. As a second aspect, in Mecklenburg-Vorpommern are no installation, to start a grid after blackout. A pump storage has a ability to generate power for itself (black start). This will improve service of public supplier.