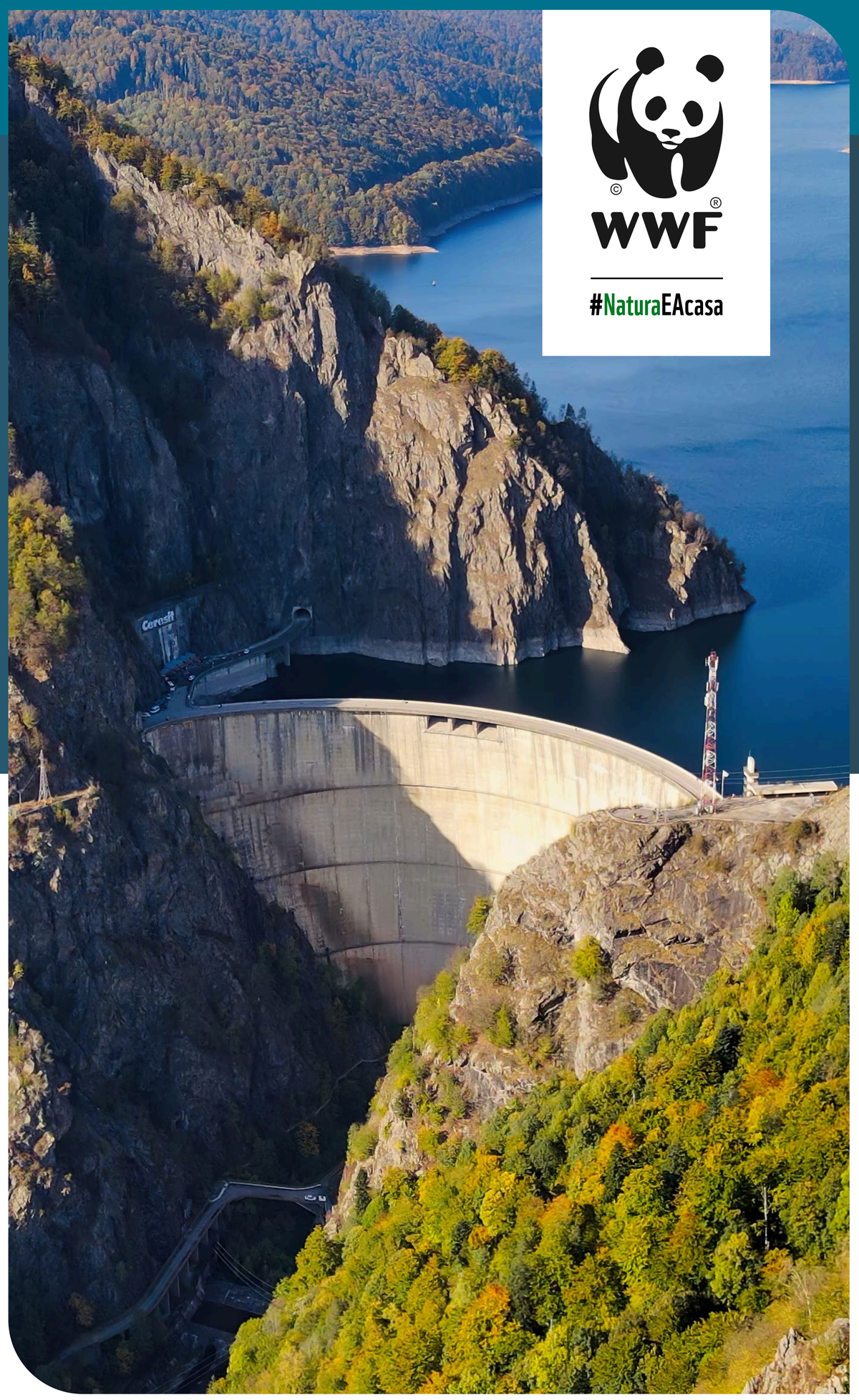
PUMPED-STORAGE HYDROPOWER POTENTIAL IN ROMANIA



Romania, like all other EU member states, must increase its production of wind and solar renewable energy to meet climate and energy security objectives. However, these sources are variable, and therefore energy storage solutions are needed to maintain the stability of the energy system.

Pumped Hydro Energy Storage (PHES) represent an alternative solution and, if they comply with strict environmental criteria, can improve grid stability, energy security, and the transition to a low-carbon economy. **PHES** plants store surplus energy when production exceeds consumption and release it during periods of high demand.

Romania has certain geographical conditions and existing hydropower infrastructure that could allow the development of such projects. However, for these investments to effectively contribute to energy security and the energy transition, it is essential that their development respects several key conditions.

Some Benefits of PHES

- Energy efficiency of approximately 70–80%
- Lifespan of over 80 years
- Large-scale energy storage capacity
- Operating costs 50–75% lower than thermal power plants and 20–50% lower than many battery storage systems

Key conditions for maximising the benefits of PHES

For PHES projects to contribute to power system stability and the integration of renewable energy, their development must be based on rigorous planning and the integration of technical, environmental, and social criteria from the earliest stages of the project.

Core principles:

- **PHES development must be aligned with the national energy strategy and decarbonization goals.**
- **Projects must minimize environmental impact through strict mitigation measures and avoid protected natural areas and water bodies with good or high ecological status.**
- **Such projects must support the interests of local communities.**
- **Site selection is essential to ensure PHES projects are efficient, safe, and have a low environmental impact.**

The sites selection process must consider:

1

Topography and elevation difference

needed for efficient energy storage: plants require a significant height difference between two water reservoirs and must be located outside protected areas (e.g., Natura 2000 sites) and high-biodiversity zones.

2

Stable geological conditions:

infrastructure must be built on stable ground to avoid landslides or water leakage, be well integrated into the landscape, and ensure that affected areas are restored after construction.

3

Access to water resources:

projects require a water source but should not affect existing water uses or downstream ecosystems; natural water flow must be maintained, and issues such as sedimentation or water quality degradation must be prevented.

4

The use of existing infrastructure:

dams, lakes, or existing hydropower facilities should be used to reduce environmental and landscape impacts.

5

Grid connectivity:

locations must allow easy connection to the power grid so that the energy produced can be efficiently delivered to consumers.

6

Reducing nature impacts:

projects must include measures to reduce environmental impact and restore affected habitats, for example through reforestation or wetland restoration, as well as environmental impact assessments before construction.

7

Community involvement:

local communities must be involved in the planning phase through transparent information, genuine consultation, and fair compensation if projects affect land use or local activities.

Conclusions

Romania has potential for developing pumped-storage hydropower plants (PHES), which can contribute to grid stability and the integration of a larger share of renewable energy. However, maximising the benefits of these projects depends on how they are planned and implemented.

In the Romanian context, smaller and decentralised projects (up to around 300 MW) are generally better suited to geographical and environmental conditions than very large projects, which may involve high costs, long implementation periods, and greater impacts on nature and local communities.

By carefully selecting sites, using existing infrastructure, and integrating environmental and social criteria from the early stages, PHES can become an important component of Romania's energy transition and energy security.

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