

Floating Solar Stations - World Experience for Georgia

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Abstract: Electricity is a vital resource for a developing country, and its shortage negatively affects all sectors. The utilization of **renewable energy sources** is particularly important.

This paper discusses the construction of **floating solar power stations** equipped with solar panels, a relatively new approach to utilizing solar energy. Floating solar panels can be deployed in seas, lakes, and reservoirs. The paper also reviews the global experience in this field and the potential for its implementation in Georgia

Key Words: Renewable energy, Solar energy, Floating solar panels, Hybrid hydro-power plants.

Introduction

Today, **energy** is a crucial element for the sustainable development and well-being of society [1]. In fact, energy sources are divided into two main groups: **non-renewable resources**, which we use and cannot recreate, and **renewable resources**, which can be easily replenished. Furthermore, renewable energy sources include: **solar energy**, which can be converted into electricity and heat, **wind energy**, **geothermal energy** from the Earth's heat, **biomass** from plants, and **hydro-power**

from dams.

Electricity is a vital resource for a developing country, and its shortage negatively affects all sectors. Currently, consumption in Georgia has increased, and the electricity generated by local stations cannot meet the demand, leaving the country dependent on imports. Lately, large waves of public protest have emerged against the construction of hydroelectric power plants (HPPs), resulting in the **stoppage of new power station construction**. **Solar energy**, which can be utilized without major issues, is being gradually adopted by large institutions, factories, and universities. Furthermore, many countries around the world share their experience in this area.

Hybrid Hydro-Power Plants

The utilization of hydropower facilities for tourism and alternative electricity generation is becoming increasingly popular in the 21st century. Placing solar panels in such locations would be a very interesting and important solution for a country like Georgia due to its **limited territory**. Furthermore, it is possible to convert existing stations to a **hybrid regime** (Figure 1) [5].

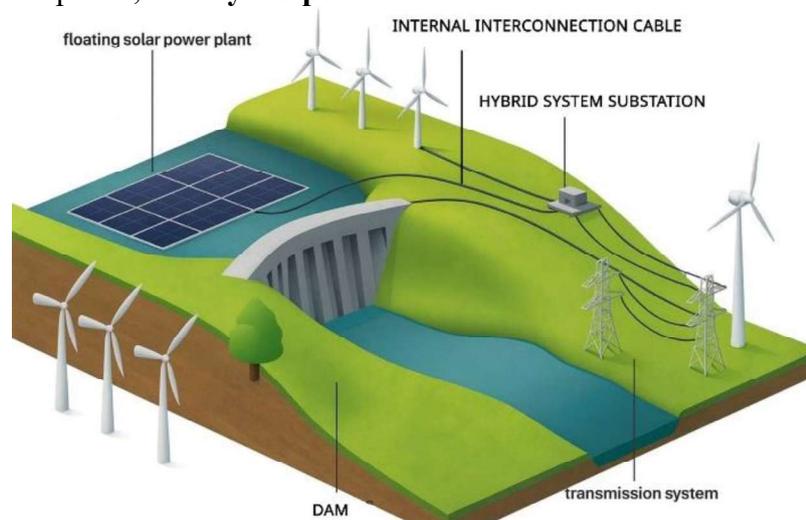


Figure 1: Integration of Floating Solar

Stations with Hydroelectric Power Plants. **Tourism** is one element at the power station for additional revenue, and the placement of solar panels—both on the reservoir and on the dam body—should be done in a way that does not impede this sector.

Utilization of Floating Solar Panels

Floating panels originated in Asia and Europe, with the first such model installed in Japan in 2007-2008. The largest projects in this area have been completed in China and India,

as well as in Brazil, Portugal, and Singapore. They are deployed in seas, lakes, and reservoirs [6].

The electricity generated by a floating solar power station is typically fed into the grid and sold. Additionally, on a seasonal basis, it supplies resources to the pumps of the storage system, protects the water from evaporation, and the panels are cooled, allowing them to operate optimally in this scenario.



Figure 2: Floating Solar Power Station in Georgia and the Netherlands (Beilen)

Covering Canals with Floating Solar Panels
For years, interest and focus were directed solely toward supplying residential facilities—houses, cottages, etc.—with solar electricity, and placing panels on the roof is still

considered the most profitable method today. In 2012, the world's first 1-megawatt pilot project was set up on a canal in India (Gujarat, India) using an appropriate structure [7]. The 750-meter-long power station essentially gave

rise to the idea of utilizing other canals in this manner (Figure 3).



Figure 3: Solar Power Plant Project Located on a Canal (Gujarat), India

Canals in Georgia are of various types. Primarily, they are utilized for irrigation or energy purposes. In order to distinguish where panels can be deployed using a constructive approach, certain details must be taken into account: the geographical area, the type of canal, whether the main part has a concrete

lining, its length, and so on. To search for the most optimal canals among the **over 700** based on **bed width** and **location**, GIS technologies offer an excellent solution. **Drone aerial photography** and subsequent calculation of **incoming radiation** create a good foundation for project development.



Figure 4: Georgia, city of Kutaisi, one of the canals with a concrete lining
Solar Power Plants on Dams

This floating solar plant of 218 kWp is installed on a hydroelectric dam, located in Montalegre, Portugal. The Hydrelío® floating solar system supports

840 panels (260 Wp REC modules), and covers about 0.01 % of the water surface (0.26 out of 2212 ha).



Figure 5: Alto Rabagao. Montalegre, Portugal

.We also have various types of reservoirs in Georgia where they can be utilized in a similar manner. This could involve vertical deployment on dams, or floating panels in the reservoir itself. It is necessary to consider the

hydrological regime of the river, the conditions for reservoir filling, and other nuances that allow for the installation of an additional power station.



Figure 6: Georgia, Enguri DAM. Floating Solar Photovoltaic Station Model

GIS Modeling

The appropriate location for the construction of a solar power plant must be selected in advance, based on various types of analysis. **GIS technology** allows us to determine and evaluate several details, for example:

- Meteorological and hydrological conditions,
- Observation of direct solar radiation, both with appropriate instruments and modeling on the relief,
- Determination of relief slope, exposure, and so on.

Conclusion

Georgia has great potential to utilize solar energy in all directions:

- Building rooftops (private/public sector),
- Canals, lakes, and reservoirs,
- Dams and barrages.

The lakes and reservoirs of Georgia are particularly noteworthy. There are around **860 lakes** in Georgia. Most are very small. Therefore, the total lake surface does not exceed 170 km^2 . However, floating solar panels can be constructed on the majority of them. Solar panels can also be deployed on most of Georgia's reservoirs, such as the Enguri and Zhinvali reservoirs, which would provide a certain **economic effect**.

GIS technologies can easily identify suitable locations, and electronic modeling can determine the appropriate modifications and parameters for the power plant. It would be beneficial to **restore direct solar radiation measuring stations** nationwide, as multi-year data would strengthen the development of this direction.

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