FLOATING PHOTOVOLTAIC PANELS IN THE REPUBLIC OF MOLDOVA

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Abstract. *In these decades, the production of energy from renewable sources has become a necessity for most countries in the world, this being necessary due to the increasingly volatile climate changes recorded in recent decades caused by pollution and the energy crisis.*
One of the most important sources of electricity production from renewable sources is certainly the energy produced by photovoltaic panels, being relatively cheap and less polluting. Unfortunately, these installations occupy a large area of land that can also be used for agriculture, that's why it is necessary to find other surfaces where we could install them, such as on the surface of the water. Even though the Republic of Moldova is a country with a relatively small area, we could use artificial reservoirs as well as natural ones for water accumulation. In this context, a relatively new technology that could reduce the use area of agricultural land, the floating photovoltaic panels, appears in sight. The primary benefits of floating photovoltaic (FPV) systems deployed on pre-existing reservoirs include the proximity of reservoirs to established grid systems, the cooling properties of water can bolster energy conversion rates, while FPV panels/floats also mitigate reservoir water loss due to evaporation by obstructing radiative energy and reducing water temperatures.

Keywords: *energy crisis, floating photovoltaic systems, photovoltaic panels, pollution, renewable sources.*

Introduction

The climate challenge is essentially about energy, both as the root cause and as a possible solution. A significant part of the greenhouse gases responsible for trapping heat in the atmosphere comes from energy production, mostly from the burning of fossil fuels such as coal, oil, and gas.

As shown in Fig. 1 [1], fossil fuels account for the largest share of global greenhouse gas emissions, accounting for more than 75% of greenhouse gas emissions and nearly 90% of carbon emissions. Addressing this challenge requires a clear path to almost halve emissions by 2030 and reach zero emissions by 2050. Achieving these goals requires moving beyond fossil fuels and investing in alternative, simple, flexible, and cheap energy sources. Efficiency, stability, and reliability.

Renewable energy sources, which are abundantly available near us from the sun, wind, water, waste, and the Earth's heat, are naturally replenished and produce little or no greenhouse gases or air pollution. for more than 80% of the world's electricity production, clean energy sources are increasing. Currently, about 29% of electricity comes from renewable energy sources.

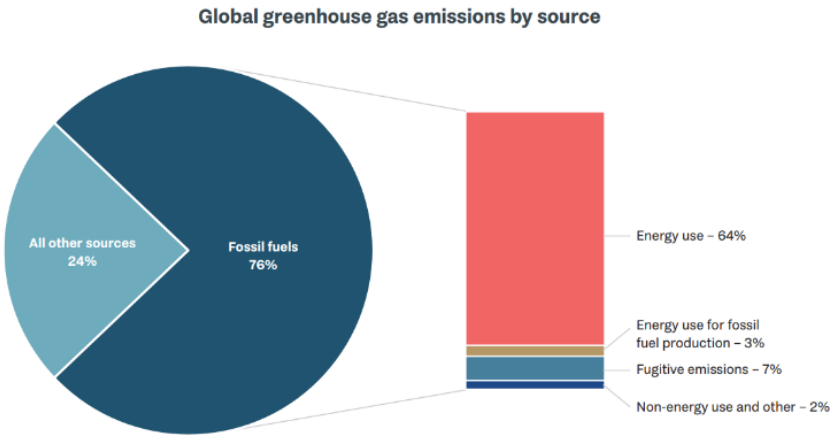

Fig.1 Global greenhouse gas emissions

Solar Energy

Solar energy is solar radiation that causes heat, chemical reactions or electricity generation. The total amount of solar energy on Earth is greater than the current global demand. If used correctly, this decentralized energy source can meet future energy needs. In the 21st century, unlike coal, oil and fossil fuels, solar energy is expected to become more attractive as a renewable energy source due to its unlimited and pollution-free supply. The sun is a very powerful source The sun is considered the largest source of energy that the Earth receives, but its energy is very weak on the Earth's surface. This is because solar radiation travels very long distances. More damage comes from Earth's atmosphere and clouds, which absorb or scatter up to 54% of solar radiation. The Sun reaches Earth with 50% visible light, 45% infrared radiation and small amounts of ultraviolet radiation and other forms of electromagnetic radiation. The sun's energy is abundant. In fact, the Earth receives 200,000 times more solar energy each day than the sun itself. However, although solar energy is free, the high cost of its collection, conversion and storage still limits its use in many areas. When sunlight hits a solar cell, electrons are released due to the photoelectric effect. Two different semiconductors have different properties, allowing electrons to flow through an external circuit to drive an electrical charge. The current results from the properties of the semiconductor and is driven entirely by the light that falls on the cell.

Floating Photovoltaic System

A new power generation system that has attracted widespread attention due to its multiple advantages is called Floating Photovoltaic Technology (FPVT). FPVT system to help minimize water evaporation and increase energy production. The solar panels are installed on floating platforms at a certain distance from each other to allow the development of flora and fauna. Space is also left between the blocks to allow water aeration and sunlight to penetrate the lake life. In addition, air systems can be installed to ensure the necessary level of oxygen in the water. A solar panel consists of several elements, including an aluminum frame, protective glass, and an encapsulant (an encapsulant that protects the solar cells from moisture, dust, and other contaminants that can damage the solar cells) and the solar cells, the second layer of the encapsulant, back paper, and distribution box [2]. A typical FPV system usually consists of: PV modules to collect solar energy, floats for buoyancy, a support structure for the PV panels, a mounting system to prevent the plant from moving freely, electrical components, and optional performance systems.

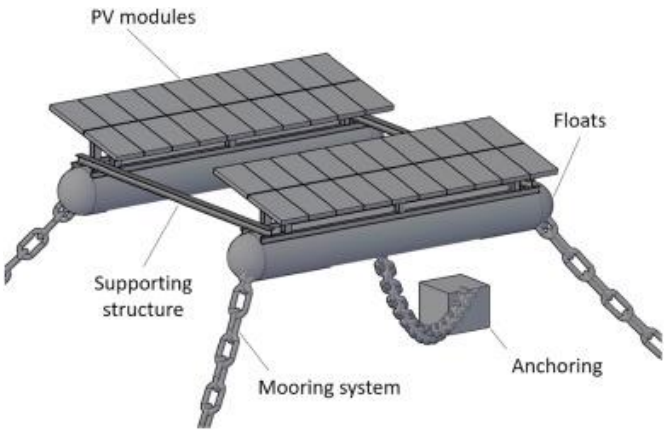

Fig.2 A generic FPV system

Benefits of Floating Photovoltaic System

- Improved land use: Floating solar panels use water bodies such as lakes, reservoirs, and ponds, thereby increasing land use efficiency.
- Reduction of water evaporation: By covering the surface of the water with solar panels, the rate of evaporation can be reduced. This is particularly useful for bodies of water used for irrigation, drinking water supplies, or reservoirs, where water conservation is essential. Water production. At ground facilities. A cooler environment helps mitigate heat-related efficiency losses, thereby increasing power generation.
- Improved panel performance: Floating solar panels can be installed with adjustable tilt or direction, optimizing their position to capture sunlight throughout the day.
- Algal bloom reduction: In some cases, floating solar power systems can help mitigate algal blooms in bodies of water by reducing the penetration of sunlight that contributes to algal growth.

The hydrographic basin of the Republic of Moldova

The hydrography of the Republic of Moldova refers to all the waters on its territory. The Republic of Moldova benefits from all types of aquatic units: rivers, lakes, and groundwater.

Surface waters, including small rivers and lakes, are an important part of the natural environment of the Republic of Moldova. The water resources of the Republic of Moldova are represented by 3621 rivers and streams, including 7 with a length of more than 100 km, 247 with a length of 10 km, 57 lakes and an area of 62.2 square km, with 3000 ponds and sources of water. It has a volume of 1.8 cubic kilometers and a water reflection surface of 333 cubic kilometers. There are 82 reservoirs in the Republic of Moldova, the largest being Costesti-Stînca on the Prut River (735 million cubic meters of water) and Dubăsari on the Dniester River (277.4 million cubic meters). These data are one of the most important factors for the management of water resources and the adequate protection of ecological conditions, the presence of monitoring systems, provides information on the quantity, quality, state, dynamics, and interaction of space and time. Prediction of degradation or improvement of quality, etc. [3].

The Costesti Reservoir

The Costesti reservoir is the second in size after the one in Dubăsari (Republic of Moldova). It stretches up the Prut River to the village of Viișoara for a length of 70 linear km, occupying an area of 59 square kilometers with a storage capacity of 1 billion 285 million cubic meters and a maximum depth of 43 meters. As can be seen in the Fig. 3, most of the reservoir area of 59 square kilometers is in the Republic of Moldova (more than 34 square kilometers). A

potential project that could benefit is the exploitation of the surface of the reservoir by installing solar energy systems.

Figure 3 The territory of the reservoir belonging to the Republic of Moldova

An implemented project, Floating Solar Farm, China-70MW

[4] One of the oldest entries on the list, construction of the CECEP floating solar farm began in 2017. The 70 MW project finally became operational when it was connected to the grid in March 2019. This floating solar farm is owned by China Energy Conservation and Environmental Protection Group (CECEP) and installed using Hydrelio technology by French floating solar specialist Ciel & Terre, who also oversaw the design, delivery, and installation. The project covers more than 60 hectares and includes 194,731 solar panels.

Fig. 4 The 70 MW project

Conclusions

The introduction highlights the important role energy plays in contributing to and mitigating climate challenges. Fossil fuels are responsible for a large proportion of global greenhouse gas emissions, so switching to cleaner alternatives is essential. Renewable energy sources seem to represent a promising solution since solar energy dominates due to its availability and sustainability.

- By utilizing bodies of water such as lakes and reservoirs, FPV systems offer numerous advantages, including:
  1. optimal land use,
  2. reduced water evaporation,

3. increased energy production,
4. potential environmental benefits.

- The water resources in Moldova, as highlighted by the hydrographic basin data, present opportunities for implementing FPV projects;
- The case study of the Costesti reservoir exemplifies the potential for such installations within the country;
- Furthermore, the success of the floating solar farm in China serves as a compelling example of the feasibility and scalability of FPV technology.

Gratitude

I would like to thank, first of all, the Technical University of Moldova, for offering me the opportunity to be a student in the field of energy, this being one of the main motivations to develop and immerse myself in this field. I also want to thank my coordinator of this scientific article, Mrs. Ala Jechiu, for being a master in supporting a beginner student who is just starting his way in this branch of engineering.

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