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Prospects of floating photovoltaics in the green hydrogen production process

A literature review

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Introduction

With the increasing energy demand and GHG emissions in urbanised areas, innovative solutions are necessary to facilitate a sustainable energy system. Given the spatial constraints of cities, floating photovoltaics (FPV) may provide a practical solution due to increased efficiency, reduced evaporation and effective area usage [1-2]. However, renewables require stabilising measures to compensate for their intermittency. Consequently, there seems limited doubt about the essential role of green hydrogen in achieving sustainable energy systems. Yet, several technical and financial challenges remain in the development and scale-up of green hydrogen production. Therefore, this study discusses the potential complementarity of FPV systems in the green hydrogen production process.

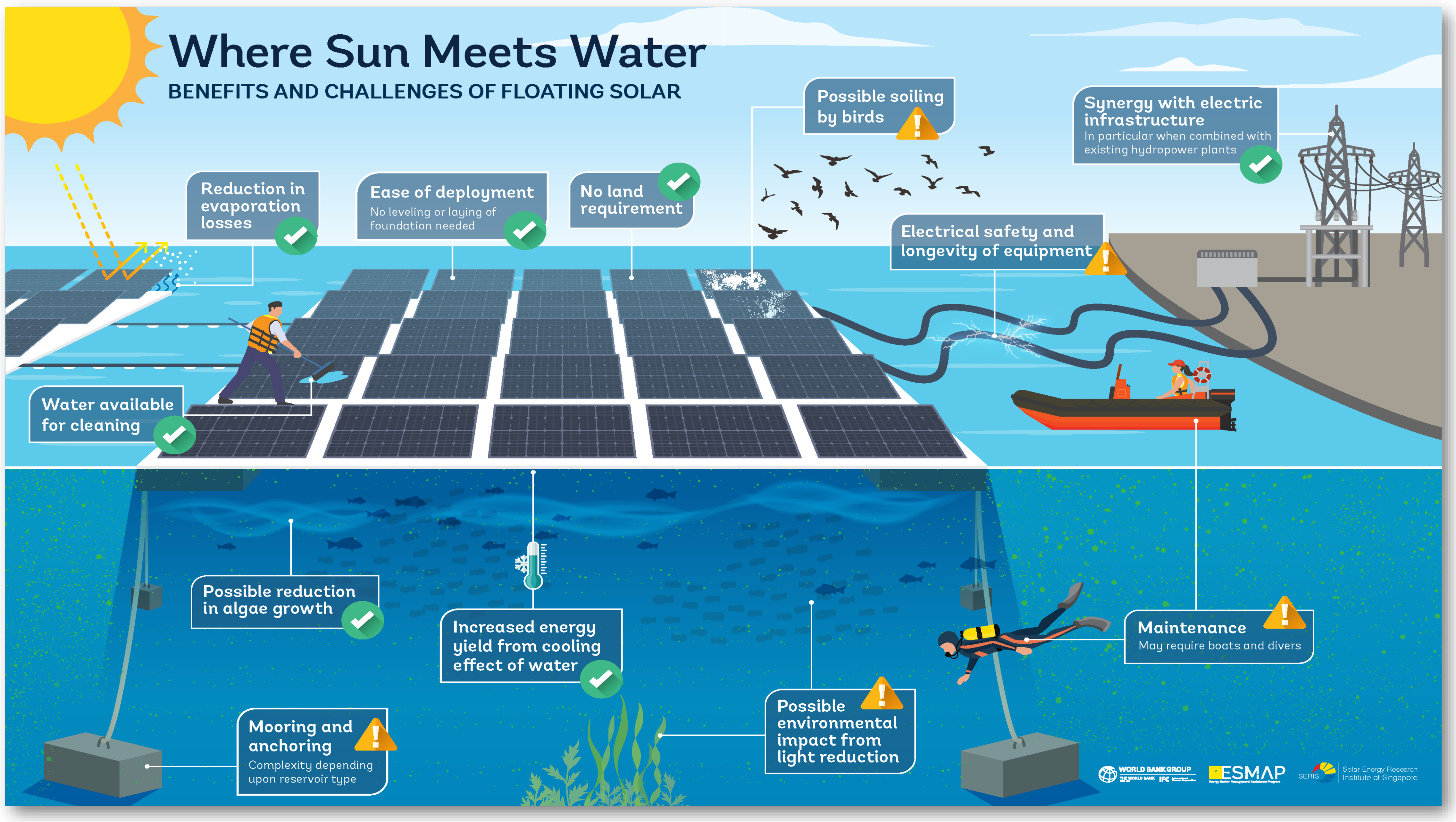

Figure 1. Schematic overview of floating photovoltaic systems [3].

Floating photovoltaics

Photovoltaic systems have developed significantly over the previous years, making them financially attractive sources of renewable energy. Compared to other types of PV systems, however, FPV systems encompass some unique advantages such as:

- Higher PV efficiency (up to 15%);
- No contested land use;
- Reduced water evaporation (up to 40%);
- Potential ecological benefits.

Electrolysers

The three most prevailing electrolysis technologies are *Alkaline Electrolyte Membranes (AEM), Proton-Exchange Membranes (PEM),* and *Solid Oxide Electrolysis Cells (SOEC)*. With the use of renewable energy, purified water can be converted into hydrogen and oxygen. Given the flexible operation of PEM electrolysers, these are currently the most suitable for producing green hydrogen with the use of renewables [4].

Proposed system

Given the advantages of FPV, it can fulfil a useful purpose in the production process of green hydrogen. For example, the increased efficiency of FPV helps to make the process of producing green hydrogen more economically viable by reaching higher yields. Such a combined system would encompass the necessities for green hydrogen production at a safe distance from people.

Main challenges

Floating photovoltaics

- Higher investment costs (CAPEX) when compared with other PV systems.
- Marine FPV systems require even more durable equipment and additional maintenance to cope with harsh weather conditions (i.e. increased OPEX).
- More extensive research is needed on the ecological side effects of FPV systems [1-2].

Electrolysers

- Relative low efficiency (60-80%) reduces economic viability.
- Expensive and unethically mined materials are used in electrolysers which emphasises the need for better alternative materials.
- Technical advancements are needed to improve lifespan and compatibility with the intermittency of renewables [4].

Combined systems

- To improve financial viability, large-scale renewable energy production is essential.
- Remote and off-shore locations are more advantageous than urban areas due to scalability.
- Wind energy is also a suitable alternative for producing green hydrogen and opens the avenue for hybrid solar and wind systems which can be more reliable [5].

Conclusion & discussion

Stemming from this research, FPV systems for producing green hydrogen show significant potential. Yet, whereas the FPV technology is rather well-developed and affordable, more research is needed on its ecological side effects. Moreover, an efficient production method for green hydrogen is still lacking. Through technological advancements in electrolysers and large-scale FPV system deployment, the feasibility of such a proposed system could be improved. Overall, the economic viability heavily depends on the available excess renewable energy which is deemed to become increasingly more volatile in the following years. Hence, hybrid solar and wind systems, supplemented by (financial) political support, can result in a more achievable and reliable sustainable energy system.

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