PROJECT SUMMARY

PROJECT NAME:
Blue-Cooking

CAPITAL COST:
$ 3 million

DEVELOPER:
University of Southampton

PROJECT HOST:
University of Southampton

GEOGRAPHICAL LOCATION:
Bangladesh

TYPE OF PROJECT:
Photovoltaics, Aquaculture, Clean-Cooking, Hydrogen

PROJECT TIMELINE: 3 years

Context: Bangladesh's population relies heavily on solid fuels for cooking, with >145 million people (particularly in rural areas) suffering from indoor air pollution. The use of polluting cookstoves results in 78,000 premature deaths annually, of which 70% are children. Furthermore, the dependency on biomass cooking leads to massive environmental degradation. The exposure from smoke from biomass cooking falls primarily onto the women (and by proxy their young children) of the community, as they are the primary and sole cooks in the indigenous population. Cleaner cooking can be achieved through electrical cookstoves such as electrical pressure cookers, or induction cookers. However, the supply of stable and clean electricity generation, is a key barrier to ensuring electric cooking can be established at a national scale. As women are the lead and often only cooks in the family, the solution to clean cooking, through renewable energy, will need to consider complex gendered issues.

The government of Bangladesh has set a target of 40% renewable energy by 2041 at COP26, and is further highlighted in their recent flagship Mujib Climate Prosperity Plan (MCPP). Whilst solar energy provides the largest potential for achieving this, key barrier to deployment remains in land scarcity for this densely populated country, in which land is at a premium for domestic food security as well as agricultural exports. To address land scarcity challenges for PV deployment, there is a drive towards utilizing the water bodies across the country as an alternative space for co-location and establish utility scale floating photovoltaics (FPV). However, FPV should ensure aquaculture thrives under such co-location, and support regeneration of marine life.

Aquaculture is at the heart of the Bangladesh economy and is ranked 5th in the world for aquaculture production. This is of no surprise, as Bangladesh has one of the world's largest active deltas, fed by three large rivers: the Padma, the Meghna and the Jamuna. This not only has huge potential for aquaculture but also for FPV, which can be achieved in sync. In addition, generation of clean renewable energy through the FPV systems, the co-location with water bodies provides clear opportunity for green hydrogen production as well. Green hydrogen has been identified as a key technology in Bangladesh's renewable energy future, particularly in the MCPP. This when scaled, can address the utility scale energy storage requirements for upgrading the national grid.

Solution: Floating photovoltaic systems, utilizing the coastal belt, the rivers, and large still water bodies across the country, can help produce the electricity needed for clean cooking at a national scale. However, this must be achieved through a holistic approach which brings aquaculture, renewable energy, and clean-cooking sectors together. This project will work with aquacultural farmers to understand the barriers and benefits to FPV systems integrated into the aquafarms, including mechanisms to improve income and farming yield. Additionally, the project will address any barriers towards clean cooking using electrical cookstoves powered from FPV. This includes working with women to understand socio-economic barriers and benefits, in addition to transitioning to new technologies and the wider health improvements.

This solution aligns well to the MARES holistic approach. Regeneration is at the heart of project which includes regeneration of clean air through reduced biomass cooking, regeneration of forestry through reduced deforestation, and finally regeneration of marine life through aquaculture. The solution provides a 'power to x' methodology that is scalable, in which the clean electricity from FPV is used for sustaining aquaculture, and then can meet the increase in energy demand for clean-cooking, and finally can produce green hydrogen for grid -storage. This solution will work closely with the indigenous community to ensure there is a just transition to new technology, e.g as new markets open for clean

cooking, this needs to be inclusive of solid fuel sellers. Likewise, by improving aquaculture farming through FPV systems, this should not displace poverty into other sectors.

Technology: The technological approach consists of Floating PV systems integrated into aquaculture farms, as a centralized power source, feeding into a local grid which supplies electricity for clean-cooking into rural houses. This system will have both a grid-back up, as well as local storage at times of load shedding. This whole-systems approach, which will be the first of it's kind, will help generate clean electricity from floating PV, that can be first used for improving aquaculture yield, then towards clean-cooking, and then finally used for green-hydrogen production. These blue clean cooking networks can be tested across the 3 aquaculture environments: River island communities in the north of the country, Lake communities in the rural midlands, and in the delta/coastal zones in the south of the country.

Business Model: Positive financial impact can be achieved across the 3 different sectors: aquaculture, Solar, and clean-cooking. In aquaculture, the farmers revenue can be improved by allowing access to affordable energy supplies, as well as leasing any water bodies for co-location with the solar distributor. Likewise, the solar distributor company will generate more revenue as they will save time and costs on land acquisition, as well as improved performance from cooled PV systems. Finally, this also opens up a new market for the sale of clean-cook stoves into rural areas, including the sale of electric pressure cookers and induction cookers. There is also an opportunity for selling excess electricity back to the grid, or selling green-hydrogen produced from FPV in the form of energy storage .

Financing*:* The total cost of the project will be $3 Million. There will be 3 blue clean-cooking networks across the country (covering the aforementioned aquaculture environments). Each network will consist of a 1 MW system, providing electricity to 3000 households, for clean-cooking. The costs will include: capital expenditure for the FPV system, including grid infrastructure ($1m); subsidized costs for clean-cooking appliances for each household($0.5m); electrolyzer kits for green-hydrogen production($0.5); labour costs for installation and O&M($0.5m), and finally consultancy costs for design and project management($0.5m).

Results: The outputs for this project align to the MARES holistic approach of regeneration, which includes cleaner air, deforestation, and regenerative marine life; a power to X approach through provision of clean electricity for sustainable aquaculture, then clean-cooking, and finally green hydrogen; scalable flood-resistant solutions that can grow from supplying to 10,000 households, to the 145 million that still rely on solid fuels; a just transition that works with the indigenous communities to ensure poverty is not displaced to other sectors; a gendered approach to tackle the socio-cultural barriers for transitioning to clean-cooking from FPV; and finally contribute to legislation and policy for renewable energy and clean cooking, which are currently being updated to align to new nationally determined contributions for the UNFCC.

Lessons Learnt: This project is based on the lessons from previous projects led by the developer: 1) Clean cooking from PV for slums in Dhaka; 2) FPV for flood resilient energy in river island communities in Bangladesh; and 3) Enhancing Renewable Energy Investments and Access to Land in Bangladesh.

Developer: The consortium will be led by the University of Southampton, and will consist of an in-country PV installer and O&M; an in-country aquaculture industrial group; a national manufacturer/supplier of electric cooking appliances; and finally, aquaculture and renewable energy ministries of Bangladesh

References: *[1] www.mecs.org.uk [2] https://www.ecs.soton.ac.uk/news/7050*
[3] https://www.rgs.org/geography/climate-change/39-ways-to-save-the-planet/floating-solar-power/