Background

Bangladesh is a rivarian country with almost 800 rivers and total length of waterway is around 24,140 km. So, river way is one of the major means of transportation in Bangladesh. Currently, transportation between nearby riverside villages is commonly undertaken by diesel driven boats as well as a huge numbers of diesel driven boats are used for fishing purpose. Existing engines of diesel driven boats are very energy inefficient and used imported diesel fuel.

With this view, UNDP Bangladesh and GEF are supporting Government of Bangladesh (GOB) through Sustainable Renewable energy Power Generation (SREPGen) project for the development of Solar PV based Boats in Bangladesh. Five (05) solar pilot boats have been developed under the financial support from SREPGen with assistance of government agency Sustainable & Renewable Energy Development Authority (SREDA).

GOB is taking various initiatives, implementing measures that will reduce energy consumption and GHG emissions. No doubt, the application of PV solar based boat and increasing deployment of energy efficiency retrofits for water transport sector provides an important pathway for increasing energy security, reducing or even decreasing energy demand and hence reducing GHG emission in Bangladesh.

Brief on Solar Boats:

Currently all five boats are operational. These boats have been handed over to SREDA and SREDA leased those to Hatirzheel at Dhaka, Panama Lake at Narayanganj and Foy's Lake at Chittagong for demonstration effect. Honorable Prime Minister will inaugurate these boats soon. Prime Minister's Office (PMO) has huge interest in these solar boats up scaling.

Table-1: Five boat at a glance.

	Solar boat - 1	Solar boat - 2	Solar boat – 3 (Business model-1)	Solar boat - 4	Solar boat – 5 (Business model-2)
Passenger capacity	20	18-20	30	15	12-14
PV solar panel capacity	1820 Wp	2080 Wp	2340 Wp	1560 Wp	1430 Wp
DC motor	3 X 700 W	2 X 1.5 kW	2 X 2.5 kW	2 X 1.5 kW	1.5 kW

size					
Max. speed	12 km/hour	10 km/hour	10 km/hour	12 km/hour	14 km/hour
Estimated travel distance	50-60 km	45-50 km	40 km	45-50 km	45-50 km

Business Model:

A sustainable financial model has been developed based on loan, grant and owner's equity composition. The method of the Life Cycle Cost (LCC) with Net Present Value (NPV), Internal Rate of Return (IRR) and Pay Back Period (PBP) were formulated to evaluate the financial viability of the project. A financial model of 40% grant, 40% loan and 20% owner's equity is recommended for influencing the popularization of PV power integration of passenger boats at the commercial scale. With this recommended business model, the payback period has been calculated to be between 3.0 to 4.0 years approximately. Two business models have been proposed and it is coherent to Infrastructure Development Company Ltd. (IDCOL)'s existing financial model for different PV based projects.

Table-2: Financial model of solar boat.

Financial Model					
	Total cost (USD)	**Soft loan (6% interest)**	**Grant**	**Equity (10% interest)**	**Payback period (years)**
Model-1	8000-10000	40%	40%	20%	2.9
Model-2	5000-6000	40%	40%	20%	3.7

GHG reduction:

There is a potential of converting about 500000 diesel run country boat including fishing boats with such solar powered boats. The $C0_2$ reduction from the perspective of diesel fuel consumption saving from diesel driven boat is calculated as 6 tonnes/per solar boat/ per year.

Environmental and Climate Impact:

There are enormous benefits on both human health and the environment of replacing diesel run boats by solar powered boats as diesel exhaust, as a Class 1 carcinogen, contains more than 40 toxic air contaminants primarily including particulate matter, carbon monoxide, nitrogen oxides, hydrocarbons, volatile organic compounds and greenhouse gases.

Furthermore, use of diesel engines in waterways inevitably causes the release of diesel fuel into the marine environment. The eco-toxicity of diesel on marine life is well known and the use of diesel driven boats is believed to be one of the reasons responsible for marine life death as being witnessed in the waterways of Bangladesh through anecdotal reports.

Social impact:

The showcase of our pilot solar boating project was a great success; it garnered positive attention from several media outlets and we anticipate that there will be widespread uptake of this technology when we release the solar powered boat for commercial use. Currently, transportation between nearby riverside villages is commonly undertaken by diesel driven boats and as such the replacement of these boats with solar boats is a welcome replacement considering its cost effectiveness and benefits for the environment. This technology is aimed

to benefit in particular the low and middle income parts of the population. Furthermore, it is expected that with use of the solar boats, the village residents with experience a noticeable improvement in air quality and subsequently in the health.