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FEASIBILITY STUDY TO UTILIZE RENEWABLE (SOLAR / WIND / HYBRID) ENERGY SYSTEMS FOR RUNNING ICE PLANTS & COLD STORAGES

THE UNION TERRITORY OF ANDAMAN & NICOBAR ISLANDS

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NFDB

EXECUTIVE SUMMARY:

NFDB officials during the visit to Andaman and Nicobar Islands (ANI) visited the ice plants & cold storage facilities and felt there is a need for support and development of alternate energy to sustain the ice plants and cold storage. Solar and wind hybrid energy can simultaneously support the energy need, replacing the dependency on fuel (diesel) generated energy and charging the batteries continuously, thus increasing the system's life. For the same NFDB intended to conduct a feasibility study to utilize the Solar-wind Hybrid systems to run the ice-plant & cold storage in ANI. The study includes the current energy scenario, productivity, financials in ice plants, and cold storage. Also involves the financial implications of the implementation of hybrid technology, action plan for the creation of better and higher quality infrastructure in the A&N Islands.

The productivity of ice plants and cold storage are reduced as there are intermittent power outages, power fluctuation, etc. In a week, a complete power outage is noticed, due+ to which the plants are forced to run at reduced capacities. The dependency on diesel generator sets is high, thus increasing the production costs. Power fluctuation in the contracted load is rampant in all areas, due to which the maintenance of the motors must be frequently scheduled. This has increased the production costs.

90% of the energy is derived from the diesel-operated plants in the ANI. The industrial tariff for the power is Rs 8/unit and for commercial, it is Rs 12.00/unit; provided the consumption is more than 500 units/month. In the ice plants and cold storages which are having higher capacities like blast freezers (-40ºC), cold storage (-20 ºC), etc, the major loads will be from the motors (45 HP to 75 HP) which are used to convert the coolant from vapour stage liquid stage. Such systems require 150 KW Hybrid systems which require higher investments (more than Rs 1-2 Crore). Space is another limitation for these units. The energy generation from these hybrid systems depends on its space. Hence Hybrid On-Grid systems are viable for higher capacity plants as they will reduce the power consumption from the grid. For smaller units which would be around 15tonns -20tonns of capacity, Hybrid off-grid systems are more beneficial as 90-95% of the power requirement will be covered by these systems and are supported by the batteries.

As per the Electricity Department, the cost of generation of 1 unit is Rs 32 including transmission losses, but calculations in this study are made on Rs 29.5 excluding transmission losses. When the savings are calculated based on the cost of generation, then the return of investment is 2-3 years. The hybrid on-grid systems provide better

RoI as the investment in the battery system is nil compared to the off-grid systems proposed. It is found feasible to utilize the Solar-Wind Hybrid energy source for running Ice Plants and Cold storages in ANI.

The tonnage of 12 cold storages in ANI is 480 tonnes. The Hybrid System requirement is 3.3 MW. The installation cost for the same is Rs 34.2 Crores for the On-Grid System and 46.2 Crores for the Off-Grid System. This system will generate an approximate savings of Rs 11.65 Crores, with the RoI ranging from 3-4 years. Further, the total tonnage of 15 ice-plants in ANI is 206 tonnes. The Hybrid System requirement is 2.2 MW. The installation cost for the same is Rs 22.3 Crores for the On-Grid System and 30.2 Crores for the Off-Grid System. This system will generate an approximate savings of Rs 7.52 Crores, with the RoI ranging from 3-4 years.

Assuming that all the 12 cold storages and 15 ice-plants use DG sets to support for energy during the 3-4 hours power cuts in ANI, by installing the hybrid systems, the direct savings are Rs 2.57 Crores w.r.t cold storages and Rs 4.25 Crores for 15 ice plants in ANI.

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I. BACKGROUND

Fisheries and Aquaculture constitute an important economic activity, with a vast potential for sustainably harvesting a wide variety of inland and marine fisheries resources in the country. NFDB, with the guidance of the Department of Fisheries, Ministry of Fisheries, Animal Husbandry & Dairying, has been playing a vital role in the enhancement of fish production and productivity in the country and in coordinating fisheries development in an integrated and holistic manner. NFDB officials during the visit to Andaman and Nicobar Islands visited the ice plants & cold storage facilities and felt there is a need for support and development of energy to sustain these ice plants and cold storage.

Andaman and Nicobar Islands (ANI) is a filamentous stretch of 572 islands, having a coastline of 1500kms and a continental shelf area of 35000 km^2. Andaman and Nicobar Islands has an area of 8249 Km^2, spread over about 780 KM from North to South in the south-eastern part of the Bay of Bengal. Of these, only 37 are permanently inhabited. The islands extend from 6° to 14° North latitudes and from 92° to 94° East longitudes. The Union Territory has sovereign rights to a sea area of nearly 6lakhs km^2, from which a substantial amount of fish can be taken annually. The estimated fishery potential of the Andaman and Nicobar Islands is estimated at 0.4 lakh tons as compared to 37.27[1] lakh tons for India. There are 169 fishing villages in the ANI, having an approximate population of 26,500 fishermen. There are 16 fish landing centres in the ANI, 7 in South Andaman, 6 in North and Middle Andaman, and 3 in the Nicobar Islands. There are 15[2] ice-plants in the ANI with 4 under the fisheries department, 9 in the private sector, and 2 in undertaking with Andaman and Nicobar Islands Integrated Development Corporation Limited (ANIIDCO). The total tonnage of these ice plants is 206 tonnes. The list of ice plants in the ANI are given below:

Location		Capacity (tons/day)	Ownership	Year of construction
Fisheries Department				
i)	Rangat	10	Department of Fisheries	2005-06
ii)	Hutbay	10	Department of Fisheries	2006-07

[1] Handbook on Fisheries Statistics 2020 - https://dof.gov.in/sites/default/files/2021-02/Final_Book.pdf
[2] ANI – At a Glance Report

Location	Capacity (tons/day)	Ownership	Year of construction
iii) Campbell Bay	10	Department of Fisheries	2015-16
iv) Mayabunder	10	Department of Fisheries	2019-20
Total	40		
Private Ice Plants			
i) Dhanikhari	11	Monsoon Fisheries	2015
ii) Sippighat	30	M/s Rubin Sea Foods	2010
iii) Sippighat	30	M/s Rubin Sea Foods	2010
iv) Dandaspoint	10	D.S.N Ice Plant	2005
v) Garacharma	15	M/S Andaman Ice Plant	2010
vi) Dolly Gunj	10	M/S Aplomb Marketing	2010
vii) Mayabunder	15	M/S Balaji Ice Factory	2011
viii) Prothrapur	20	M/S TSG Ice Plant	2012
ix) Prothrapur	15	M/s TSG Ice Plant	2017
Total	156		
Undertaking			
i) Swaraj Dweep (Havelock)	5	M/s ANIIDCO	
ii) Durgapur(Diglipur)	5	M/s ANIIDCO	
Total	10		
A & N Islands	206		

The cold storage facilities in the island started in the year 1955, consisting of a 5 tonne/day capacity ice plant and 15 tonnes of cold storage. The Department of Fisheries is establishing cold storage at different places in the Islands to preserve the quality of fish caught by the fishermen and to enhance the shelf life of the farmers' farm produce. There is currently 12 cold storage in the fisheries sector having an installed capacity of 480 tons. 5 cold storages are run by the fisheries department, 6 by the private sector, and 1 undertaking by ANIIDCO. The list of cold storage in the ANI are given below:

Location	Capacity (tons/day)	Ownership	Year of construction
Fisheries Department			
i) Port Blair	15	Department of Fisheries	2003-04
ii) Rangat	15	Department of Fisheries	2005-06
iii)Hut bay	15	Department of Fisheries	2006-07
iv)Car Nicobar	10	Department of Fisheries	2014-15
v) Campbell Bay	15	Department of Fisheries	2015-16
Total	70		

Location	Capacity (tons/day)	Ownership	Year of construction
Private Cold Storages			
i) Lambaline	25	Andabar Cold Storage	2014
ii) Lambaline	60	Andabar Cold Storage	2014
iii) Dhanikhari	200	Monsoon Fisheries	2015
iv) Sippighat	40	Rubin Sea Foods	2010
v) Dollygunj	50	Era Fishery Product Pvt. Ltd.	2012
vi) Dunduspoint	25	D.S.N Ice Plant	2014
Total	400		
Undertaking			
i) Durgapur(Diglipur)	10	ANIIDCO	
Total A & N Islands	480		

II. RENEWABLE ENERGY SYSTEMS:

Renewable energy can effectively replace fossil fuels creating crucial environmental, social, and, economic benefits. The capacity of renewable energy is enormous. The earth receives 23,000 terawatts of solar energy, while the global energy consumption is approximately 16 Terawatt only. Therefore 100% renewable energy could be possible even if we capture only 0.07% of solar energy. The combination of renewable energy sources, wind & solar, is used to generate a power called a wind-solar hybrid system. This system is designed using solar panels and small wind turbines generators for generating electricity. It also includes a battery which is used to store the energy generated from both sources. NFDB desires to implement renewable energy systems in the fisheries sector, especially in Andaman & Nicobar Islands. For the same NFDB intends to study the feasibility of renewable energy in the continuous running of the ice plants and cold storage units in the A&N Islands and reduce the usage of fossil fuels.

1. SOLAR WIND MILLS:

The SolarMill, a hybrid system is based on a modular, scalable, distributed renewable energy system designed and optimized for On and Off-grid installations. At its core is a highly efficient wind energy device, utilizing three (3) low-profile vertical axis wind turbines (VAWT) mounted on a single base. The units can be interconnected to increase a user's Energy production capability in low speed and turbulent wind environments commonly found at lower elevations. The SolarMill incorporates P.V.

technology and Wind Technology within a compact footprint, creating higher energy generation density than any other renewable energy product in the market. The

hybrid concept of the SolarMill is unique, seamlessly utilizing wind and solar energy generation in one unit. This allows the product to be an effective solution in markets where both natural resources are available.

2. HYBRID OFF-GRID SYSTEM

An off-grid system is not connected to the electricity grid and therefore requires battery storage. Off-grid solar systems must be designed appropriately so that they will generate enough power throughout the year and have enough battery capacity to meet the requirements. In a Hybrid Off-Grid system, the load will be completely taken care of by the hybrid system and batteries for most of the time. Whenever there is a power outage, the load will be purely supported by the batteries. When the batteries are in a deep discharge state and wind and solar are unavailable, only the grid will take over, which is the last option.

3. HYBRID ON-GRID SYSTEM

An on-grid system does not need batteries and use either solar inverters or micro-inverters and are connected to the public electricity grid. Any excess solar power that you generate is exported to the electricity grid. Also, the excess consumption will be taken from the grid. Thus, the energy slab rates will be reduced as excess units are subtracted from the power bill.

4. *HYBRID GRID-INTERACTIVE SYSTEM*

Hybrid solar systems combine the best from Hybrid on-grid and off-grid systems. The hybrid system is a combination of energy storage with grid connection. This system provides the flexibility of being able to store the power into batteries that the Hybrid system generates. The same energy can be used instead of sourcing from the grid at a higher price. If the system is producing more power than is being consumed, the surplus is fed into the main electrical grid via solar net metering.

5. *ADVANTAGES OF HYBRID ENERGY SYSTEMS*

- More energy density (more energy per sq. area)
- Best Suitable for distributed energy
- Solutions can be custom designed based on the needs
- Prolong storage life as there will be continuous power generation (smooth battery charging and discharging).
- 100% Environmentally friendly with zero Carbon Emissions and Zero noise pollution.
- 24-hour power production capability.
- Applications: Off-Grid and On-Grid
- Easy Maintenance as compared to Diesel Generator.
- Compact Design- Easy to mount on any kind of structure.
- High Power Density per square feet area of the earth.
- Cost Effective with 30% higher reliability compared to Only Solar.
- Customizable colours and visually engaging.

III. PURPOSE OF THIS STUDY

The purpose of the study is to assess the use of solar energy / hybrid systems as an additional energy source to ice plants and cold storage in Andaman & Nicobar Islands. This includes the energy requirement of ice plants, cold storage units for continuous running, current energy scenario, energy utilization, financials, etc. The study shall also focus on the energy sector, which includes the current energy scenario, access to electricity (industrial/commercial), charges to electricity, usage of other modes of fuel (diesel) and its expenditure, constraints on energy to run the ice plants and cold storage units. The study shall bring about the feasibility of using different renewable (solar/wind/hybrid etc) energy systems to run the ice plants and cold storage to support the energy requirements. This shall bring about the following recommendations:

- The renewable energy technology to be put in use to support the ice plants and cold storage.
- The financial implications of the implementation of such technology. The schemes or methods to meet such financial implications
- An action plan to develop and spur the creation of better and higher-quality infrastructure.

For the study, ice-plants, and cold storage in the ANI both in the Government and Private sector were selected. Conducted complete review w.r.t to the running of selected ice-plants & cold storages. The review focused on the current energy requirements, procurement of energy, demand & supply, cost analysis (industrial/commercial rates), energy sourced from other modes like diesel, financial implications, etc.

The feasibility study focused on augmenting the energy supplied to these plants through solar wind Hybrid energy systems. For each of the plants visited, the solar-wing hybrid technology to be installed is recommended. The energy systems can be solar - wind hybrid model or solar – regular energy model. The study shall also bring out the possible improvements of the intervention w.r.t financials, stakeholder participation, backward and forward linkages, etc. The duration of study at ANI was for 3 days. One official from NFDB was deputed along with the Consultant for coordinating with Fisheries Department, ANI Administration to conduct the study in A&N Islands.

IV. ENERGY SECTOR IN ANDAMAN & NICOBAR ISLANDS

Out of the total of 572 islands, 37 islands are inhabited. Of which 19 inhabited islands have been electrified and remaining inhabited islands are electrified by captive power plants of agencies like Armed Forces, Police, Lighthouse & Lightships, and Forest Department. The power sector in Andaman and Nicobar Islands is managed by the Electricity Department of Andaman and Nicobar (EDA&N). These islands are managed by isolated systems powered by diesel generators. The power generation and distribution system in these islands are stand-alone systems i.e. without connection to any grid of other islands. The power distribution system of Andaman and Nicobar Islands is a Stand-Alone System, with each island having its distribution

system. The South, Middle & North Andaman Islands have a 33 kV distribution and no transmission system while other islands have an 11 kV distribution system. The islands have an installed capacity of about 109.45 MW, out of which, the Diesel based generation is around 99.20 MW, Hydro based generation is around 5.25 MW and Solar PV generation is about 5.0 MW. With growing consumption requirements, unless low-cost sustainable renewable resources are developed on the island, using diesel is likely to be extremely expensive in the long run.

1. POWER TARIFFS:

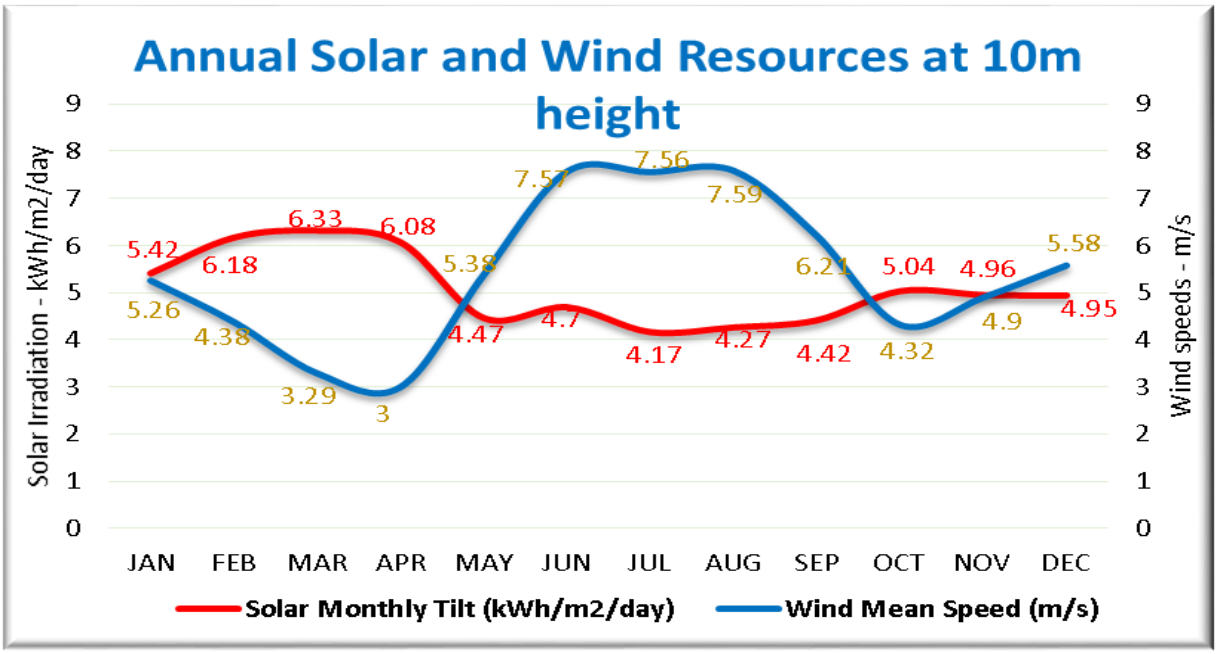
The Electricity Department of ANI (EDA&N) is operating & maintaining power generation, transmission & distribution systems and networks in these islands for providing electric power supply. The Power Tariffs as published by the Electricity Department of Andaman and Nicobar Island (EDA&N) are as follows.

Sl. No.	Category	Slab Rate	Fixed Charge	Energy Charge (INR/kWh)
1	Domestic Connection	0-100 units	INR 20/- per connection/month for single phase INR 70/- per connection /month for 3 phases	2.25
		101-200units		5.00
		201-500units		7.20
		>501 units		7.50
2	Commercial	0-200 units	INR 30/- per connection /month for single phase INR 125/- per connection/ month for 3 phases	7.50
		201-500units		9.5
		>501 units		12
3	Industrial	0-500 units	INR 50/- per KVA per month or part thereof	6.00
		>501 units		8.00

Tariff for Commercial Establishments with above 500-unit consumption: **12Rs/kWh** and Tariff for Industries with above 500-unit consumption: **8 Rs/kWh**. As per the information from the EDA&N, the average cost of power supply is **Rs 32/kWh.** Excluding the transmission losses, the cost of generation of 1 unit of energy is **Rs 29.50/kWh.** This cost of generation is being considered for the calculation throughout this study.

2. NATURAL RESOURCE AVAILABILITY

The Solar & Wind Resources availability at the Andaman & Nicobar Islands is as follows.



The above figure is taken from www.Powernasa.com; Location: Port Blair, Andaman & Nicobar Islands. The average Solar Irradiance is 5.08 kWh/m^2/day and the average Wind Speeds are 6.1 m/s, which are adequate for energy generation. As shown in the graph, the Solar and Wind Resources are complementing each other throughout the year. This helps to maintain the battery state of charge (if only a Solar or only Wind system is used, the battery will either be overcharged or undercharged half of the year, which severely affects battery state of charge and lifetime).

V. MAJOR LOADS IN ICE PLANTS & COLD STORAGES

The major loads in Cold storage are mainly Blast Freezers, Cold Rooms, and chillers.

Blast Freezer: Initial stage of fish preservation. The fishes are brought into these freezers and are preserved here at -40 degrees Celsius. Thick fish would take 6-8 hours to reach such temperature and thin fish takes 4-6 hours to reach the same temperature.

- Peak momentary current: 100A
- Normal running current: 12A - 16A

Cold Storage: This is the Second stage of fish preservation. The fish which are initially stored in the Blast freezer are thereafter stored here at -20 degrees Celsius. Fish can be stored for two years at this temperature. The operating hours of the cold room depend on the amount of received fish. The capacity of Small cold storage is around 15 Tons- 20Tons/day of fish storage while big Cold storage has 80-100 Tons of capacity.

- Peak momentary current: 100A
- Normal running current: 10A -15A

Chill Room: This is used to preserve veggies and fish too. This chill room is maintained at +4° to +5° Celsius temperature.

VI. MAJOR LOADS IN ICE PLANT

Among the visited sites, Era Fisheries, DNS Ice factory, Monsoon fisheries, and BRR Seafood have Ice plants. The loads in these ice plants are majorly

- 45-75Hp Motor
- Agitator motor – 5 Hp
- Condenser pump – 5Hp
- Lights and other equipment

The loads would operate mostly during the daytime and with high wattage loads as per the information given by plant operators.

VII. ICE PLANTS & COLD STORAGES STUDIED

1. *MOHANPURA FISH MARKET:*

The Mohanpura fish market is a double storied building with a plinth area of 720 sq. mtrs (7500 sq ft) in which 50 fish outlets on the ground floor and 8 outlets for dry

fish vendors on the first floor. The design of the fish market has been made to meet the requirement of hygienic conditions while there will be cold storage inside the market where fish vendors can store their left-out fish for subsequent marketing besides facilities like electronic weighing machine compartments where consumers can check the weight of the fish purchased. The total cost of the project is Rs. 175.08 lakh, of which 55% funding i.e., Rs. 96.29 lakh is funded by NFDB, Hyderabad, and the balance 45% by the ANI Administration.

Loads: The following loads are observed in the Fish Market.

Item	Watts	Quantity	Total Load in Watts
Tube lights	40	12	480
Lights	36	6	216
Cold Storage (3 Tons)	3500	1	3500
Freezer	200	1	200
Exhaust fans	100	24	2400
Insect killers	50	8	400
Air blowers	750	3	2250
Total Load			**9446**

From the above table, the total load considered is 9.4kW and the unit's consumption per day is 156 units/day. The Market area is facing 4 hours' power cuts on an average per day. As there is a power outage for 4 hours it is proposed to have a 40kW Hybrid system.

Proposed System: 40kW Hybrid Grid-Interactive System with the Solar Module capacity of 35kW, Windmill capacity of 5kW, Battery capacity of 240V-300Ah, Inverter Capacity: 30KVA @ 240V DC, 3Ph, 50Hz. The area required for such installation is 200 Sq.m, which is available on the rooftop.

Cost-Benefit Analysis:

As per the information given by the Market authorities, the power bill is 60,000-70,000 Rs/Month. The present tariff for commercial establishments is 12.00 Rs/Unit for consumption above 500 units. With the power bill, the total units consumed in the market yard is estimated to be 5000 units/month @ Rs 12.00/- (i.e. approximate 156units/day). The consumption of units is more than 500. Further, as per EDA&N the actual cost of one unit of electricity is Rs 29.51/kWh. The 40KW Hybrid system performance and the saving generated from the system is given below:

Particulars	Savings for the Mohanpura Fish Market	Savings for EDA&N, ANI
System capacity	40kW Hybrid Grid-Interactive system	
Units Generated per day	160-170 units/day	
Units per month (30 days)	4920 (164 units /day on an average)	
Tariff	12.00 Rs/unit	17.5 Rs/unit
Total savings/ month	Rs 59,040	Rs. 86,100
Savings/ Year	Rs 7,08,480	Rs. 10,33,200
TOTAL SAVINGS	**Rs 17,41,680**	

The total savings per year is Rs 17.41 lakhs considering the actual cost of electricity. By installing the hybrid system, the Mohanpura Fish Market will have savings of Rs 7 lakhs/year and Rs 10.3 lakhs/year savings to the EDA&N Department, ANI.

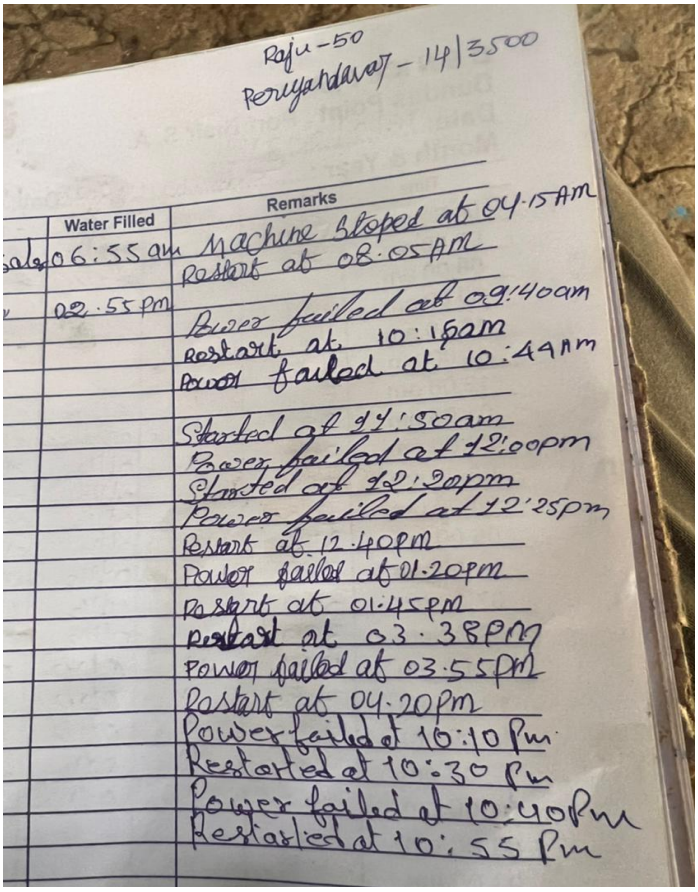
Recommendation: A 40kW Hybrid system is producing 4920units/month which is equal to an amount of 59,040 Rs/ month @ Rs 12.00/unit. This amount is almost equal to the actual power bill paid by Mohanpura Fishmarket. Close to 90%-95% reduction in power bill can be achieved. Also, it can be observed that the slab rate will fall into the lower category due to reduced consumption from the grid. Hence there will be a reduction in the power bill. Other major benefits include, Independent operation of the hybrid system, minimizes the grid dependency, grid export & import, Eco-friendly and aesthetic system, etc. The battery backup is sufficient enough to provide the backup for the system during a power outage.

Project cost: For 40kW Hybrid Grid-Interactive System - The total approximate cost of the project is around Rs. 47,53,000/-. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

2. DSN ICE PLANTS AT DUNDUS POINT, PORTBLAIR:

The DSN ice plant is located at Dundas Point and very near to the sea. This is an ice plant having two different capacities. Once the ice plant makes 150 kg block ice,

which is of 18-ton capacity, the other one is supported under PMMSY for 12.5-ton capacity, which makes 50 kg block ice.



The power outage is high in this area. The one-day outage is there per week in this area. The outage is recorded day-wise in the logbook. The sample of the outage per day is given here. The outage is at regular intervals, and it is hampering the production process. The energy bills are Rs 150,000/-. The unit is nearer to the sea and has more potential to tap the wind energy available continuously. The DSN Ice factory power bill is 1.5 lakhs Rs/Month which is approximately when divided by the present tariff unit rate Rs 9 a consumption of 18,000 units/month is observed. To accommodate a Hybrid System that can generate 18,000 units /month a system of around 120kW -150kW system is required which requires around 1000sqm of shadow-free area. As per the power bill units consumed by the ice plants, is 550-600 units/day. To generate 550-600 units/day, we need a 136.4kW system.

Diesel generator sets are being used for the support of energy. Currently uses 40 litres of diesel per day and incurs a cost of Rs 100,000 for diesel expenses only. The loads considered under the DG set are as follows.

Item	Watts	Quantity	Total Load in Watts	Duration in hrs
Tube lights	40	5	200	4
Lights	36	3	108	4
Agitator Motor	3730	1	3730	4
Condenser Motor	3730	1	3730	4
Evaporator Motor	33750	1	33750	4
		Total Load	**41518**	

To operate a 41.5kW load on the battery for 4 hours we need approximately 240V-1000Ah Battery, and it takes around 33.6kW to charge the battery. So, together 170kW (136.4+33.6) Hybrid system is required to run the entire load and provide backup for 4 hours during power cuts.

Proposed System: To meet the complete demand, 170kW Hybrid Grid-Interactive System with a Solar Module capacity of 150kW and Windmill capacity: of 20kW. The battery of 240V-1000Ah capacity is required for operating 41.518 kW load for 4 hours backup. The inverter Capacity of 150KVA @ 240V DC, 3Ph, 50Hz is required.

The Grid-Interactive system is a combination of Off-Grid System and On-Grid System. It uses solar energy to generate power that charges batteries for use during power failures and exports power to the electrical grid. A grid-interactive solar system generates power when the solar is available, the PV system charges the batteries and supports the complete loads and feeds all excess power after consumption and battery charging into the electricity grid via the inverter.

Cost–Benefit Analysis for the Proposed Grid–Interactive System

As per EDA&N, the actual cost of one unit of electricity is Rs 29.51/kWh.The present tariff for industries is 8 Rs/unit for consumption above 500 units. The total savings from the 170KW system is given below:

Particulars	**Savings for the DNS Ice Plant**	**Savings for EDA&N**
System capacity	170kW Hybrid Grid-Interactive System	
Units Generated per day	765-780 units on an avg	
Units per month	22,950(765units/day)	
Tariff	8 Rs/unit	21.5 Rs/unit
Savings/ month	Rs 1,83,600	Rs 4,93,425
Savings/ Year	Rs 22,03,200	Rs 59,21,100
TOTAL SAVINGS	**Rs 81,24,300/Year**	

An approximate to Rs 22 lakhs/year could be saved by installing a 170KW system at the premises and Rs 59.2 lakhs/year for EDA&N. Total saving per year by installing 170kW hybrid system is Rs. 81.24 lakhs.

Recommendation: The 170KW Hybrid Grid-Interactive system is recommended for meeting the entire energy bill. The benefits of this system include, it uses solar

energy to generate power that charge battery during power failures and exports power to the electrical grid.

Diesel Generator Sets: The diesel generator (DG) sets are used approx. 4 hrs a day. The load considered under the DG sets is 41.5KW. If the load 41kW is to be operated on DG Set for 4 hours, the Diesel consumption and its cost for 4 hours operation of 41kW load on DG Set is given below:

Load operated & Capacity	41kW; 75 KVA
Duration	4 hours
Diesel consumption for load	13.5 lit/hr
Total Diesel consumption for 4 hours (13.5*4)	54litres
Diesel rate in ANI	77 Rs/Litre
Cost incurred to run the load for 4 hours on DG	4,158 Rs/day
Cost of Diesel/ month (4,158*30)	1,24,740 Rs/month
Cost of Diesel/year	14,96,880 Rs/year
Maintenance cost of DG set/year	70,000-80,000 Rs/year
Total cost	Rs15.66 –16.46 lakhs per year

From the above table, it can be concluded that to operate only a 41.5kW load for 4 hours on DG Set during power cuts, the cost incurred is 15,66,880 – 16,46,880 Rs/year excluding the transportation, manpower, and other costs. If the same load is operated on the Hybrid system with Battery backup the above amount (15,66,880 – 16,46,880 Rs/year) can be saved.

Project cost: The total cost of the 170kW Hybrid Grid-Interactive with Battery system project is approximately around Rs. 21257840.00 (Rs. 2.12 Cr). The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

Estimate Based on Available Area: The available shadow-free area on the ice plant shed is 140sqm. Within this area is available a 17.5kW Hybrid System (SOLAR 15kW + WIND 2.5kW). The cost-benefit of installation of 17.5 KW Hybrid System is given below:

Particulars	**Saving for the DNS Ice Plant**	**Saving for EDA&N**
System capacity	17.5kW Hybrid On-Grid System	
Units Generated per day	70-75 units on an average	
Units per month	2,100(70units/day)	
Tariff	8 Rs/unit	21.75 Rs/unit
Total savings/ month	Rs 16,800	Rs 45,150
Savings/ Year	Rs 2,01,600	Rs 5,41,800
TOTAL SAVINGS	**Rs 7,43,400 / year**	

Thus, by the installation of a 17.5kW Hybrid On-Grid system, the customer can offset a minimum of 2,01,600 Rs/year in the Power bill and Rs 5.41 lakhs savings for the EDA&N. Total saving per year by installing 17.5kW hybrid system is Rs. 7.43 lakhs. The total cost of a 17.5kW Hybrid on-grid system project would be Rs.20,46,000. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

3. ERA FISHERY PRODUCT PVT LTD, DOLYYGUNJ, PORT BLAIR:

This is a fish processing unit with cold storage and an ice plant. The ice plant is of 12 tons which are used for their purpose. The cold storage unit of 60-ton capacity, 3 blast freezers of 1-ton capacity, and 1 chilled room of 4-ton capacity.


There is an average of 3-4 hours of power outage experienced by the unit. The Diesel Generator sets are being used currently for support of energy. The current energy bills are Rs 1.5 to 2 lakhs. The approximate unit consumption would be 18,000units/month.

Since the unit is a fish processing unit, most of the time both the ice plant and cold storage will be running simultaneously. In this context considering the heavy nature of loads in both the facilities, a Hybrid System with Grid Synchronization (NET METER) is proposed in ERA fisheries Private Limited. Under net metering, electricity generated by the Solar Rooftop System is first utilized by the consumer to meet their internal/captive requirements. Excess electricity, if any, is exported to the grid. Subsequently, during deficiency the consumer imports power from the grid, the exports are adjusted against the imports, lowering the electricity bill.

Proposed System: To meet the complete demand (18,000 units), a system of around 120-150kW Solar system is required. This system occupies a 1000Sq.m shadow-free area. 150kW Hybrid-On Grid System is proposed with Solar 135kW and wind 15kW. The Inverter Capacity: 150 KVA @ 415V AC, 3Ph, 50Hz.

Cost-benefit analysis: As per EDA&N the actual cost of one unit of electricity is Rs 29.51/kWh. The proposed 150kW Hybrid On-Grid system can generate around 600-650 units/day and whose savings are shown in the table below.

Particulars	**Saving for Era Fishery Processing Unit**	**Saving for EDA&N**
System capacity	150kW Hybrid On-Grid system	
Units Generated per day	600-650units/day on an avg	
Units per month	18,000(600 units/day on an avg)	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	Rs 1,44,000	Rs 3,87,000
Savings/ Year	Rs 17,28,000	Rs 46,44,000
TOTAL SAVINGS	**Rs 63,72,000**	

An approximate to Rs 17.28 lakhs/year could be saved by installing a 170KW system at the premises and Rs 46.44 lakhs/year for EDA&N. Total saving per year by installing 170kW hybrid system is Rs. 63.72 lakhs/year.

Recommendation: The 150KW Hybrid on-grid system is recommended for meeting the entire energy bill. The benefits of this system include Grid Import & Export facility, consumption from the grid the respective tariff rate reduces and thus electricity bill will be reduced, and the cost on diesel savings

Project cost: The total cost of the 150kW Hybrid On-Grid (135kW Solar +15kW Wind) project is approximately around Rs. 1,55,31,000. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

Estimate Based on Available Area: As per the available space on the rooftop of the Era fisheries shed, the approximate available shadow-free area is found to be 120 sqm which can accommodate a maximum of 15kW (SOLAR 12.5kW + WIND 2.5KW) Hybrid System. This 15KW On-Grid system can generate around 60-65 units/day and whose savings are shown in the table below.

Particulars	**Saving for the Era Fishery Processing unit**	**Saving for EDA&N**
System capacity	15kW Hybrid On-Grid System	
Units Generated per day	60-65 units on an avg	
Units per month	1800(60units/day)	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	14,400	Rs 38,700
Savings/ Year	1,72,800	Rs 4,64,400
TOTAL SAVINGS	**Rs 6,37,200**	

Thus, by installing a 15kW Hybrid On-Grid system, the customer can offset a minimum of 14,400 Rs/month and 1,72,800 Rs/year in the power bill. Also, it provides a savings of Rs 4.64 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 6.37lakhs/year.

A 15 KW Solar system will generate 60 to 65 units which will cover the lighting and other basic energy requirements of the unit. This system is proposed as the unit has no other open space to install the solar / wind / hybrid energy systems. The approximate total cost of the 15kW Hybrid On-Grid project would be Rs 19,62,481. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

4. BRR SEA FOODS, DOLYYGUNJ, PORT BLAIR:

This is a fish processing unit with Cold Storage, Ice plant, Effluent treatment plant, Water purifier, etc. This unit is built under the PMMSY scheme. The ice plant (45 tons) could produce up to 1500 kg flake ice per hour. This ice is commercially traded by the unit. The cold storage unit with 1 cold storage of 100 Ton capacity, 2 blast freezers of 6-ton capacity, and 1 chilled room of 1-ton capacity. Apart from these, the unit has lifts, chilling units, a water treatment plant, an effluent treatment plant, and lighting in the unit.

The DG sets are being used currently for support of energy. Approximately 40 litres of diesel are used by the unit per day. The total cost of using DG sets would come to Rs 1 lakh/month. The total cost of the power is approximately in the range of 2.5 to 3 lakhs. As the power consumption of the building is observed to be high due to heavy loads and a high-capacity battery will require to provide backup for such loads. To supply these high wattage loads an On-Grid Hybrid System that can accommodate approximately a 150kW capacity is proposed to meet the Power demand at the site.

Proposed System: At ERA Fisheries, both the ice-plant and cold storage will be running simultaneously. Considering the heavy nature of loads in both the facilities, a Hybrid System with Grid Synchronization (NET METER) is proposed in ERA Fisheries Private Limited. In case of Power cuts at the facility, the system has to rely upon DG Set because the Hybrid Inverter will remain in sleep mode due to the anti-islanding effect. Anti -Islanding is a way for the inverter to sense when the power grid is struggling or has failed. It then stops feeding power back to the grid nor it will support the load. An inverter connected to a grid and outfitted with anti-islanding protection is designed to disconnect the electrical supply from the grid if a blackout/Power outage occurs to avoid any electrical accidents. Anti-Islanding protection is required as per UL1741/IEEE 1547 standards. Under net metering, electricity generated by the Solar Rooftop System is first utilized by the consumer to meet their internal/captive requirements. Excess electricity, if any, is exported to the grid. Subsequently, during deficiency the consumer imports power from the grid, the exports are adjusted against the imports, lowering the electricity bill. To meet the complete demand of the unit, 150kW Hybrid On-Grid System with Solar – 135kW & Wind -15kW. The Inverter Capacity: 150 KVA inverter/inverters@ 415VAC, 3Ph, 50Hz.

Cost-benefit Analysis:

The power bill of the BRR Fish processing plant is Rs 1.50-2.00 lakh per month. The fish processing centre is in the Dolygunj industrial area with the present power tariff for above 500 units as 8 Rs/unit. The total savings from the 170KW system is given below:

Particulars	**Saving for the BRR Sea Foods**	**Saving for EDA&N**
System capacity	150kW Hybrid On-Grid System	
Units Generated per day	600-650units/day on an avg	
Units per month	18,000(600 units/day on an avg)	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	Rs. 1,44,000	Rs 3,87,000
Savings/ Year	Rs. 17,28,000	Rs 46,44,000
TOTAL SAVINGS	**Rs 63,72,000/Year**	

An approximate Rs 17.28 lakhs/year could be saved by installing a 170KW system at the premises and Rs 46.44 lakhs/year for EDA&N. Total saving per year by installing 170kW hybrid system is Rs. 63.72 lakhs/year considering the tariff of Rs 29.5 /unit.

Recommendation: The 150KW Hybrid on-grid system is recommended for meeting the entire energy bill. The benefits of this system include Grid Import & Export facility, consumption from the grid the respective Tariff rate reduces and thus electricity bill will be reduced, and the cost on diesel savings

Project cost: The approximate total cost of the 150kW Hybrid On-Grid System project is around Rs. 1,55,31,000. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

Estimate Based on Available Area: Even though a 150 KW system is feasible, the approximate available shadow-free area is found to be 700 Sq.m and a Hybrid On-Grid system of 87.5kW (Solar 80kW +Wind 7.5kW) can be accommodated in the BRR premises. The savings from the system is as given below:

Particulars	**Saving for the BRR Sea Foods**	**Saving for EDA&N**
System capacity	87.5kW Hybrid On-grid System	
Units Generated per day	350-400 units on an avg	
Units per month	10,500(350units/day)	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	Rs 84,000	Rs 2,25,750
Savings/ Year	Rs 10,08,000	Rs 27,09,000
TOTAL SAVINGS	**Rs 37,17,000/Year**	

Thus, by installing an 87.5kW Hybrid On-Grid system, the firm can offset a minimum of 84,000 Rs/month and 10,08,800 Rs/year in the power bill. Also, it provides a savings of Rs 27.09 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 6.37lakhs/year considering the tariff of Rs 29.5 /unit. This 87.5 KW solar wind hybrid system could support the continuously used chilling unit, lifts, water treatment plant, effluent treatment plant, and the lighting in the unit.

Project cost: The approximate total cost of the 87.5kW Hybrid On-Grid System project is around Rs. 94,49,610. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

5. RMC AKSHAY URJA, DOLLYGUNJ, PORT BLAIR

This is a private cold storage unit with 1 cold storage of 20 Ton capacity, 1 blast freezer of 1-ton capacity, and 1 chilled room of 5-ton capacity. The plant is under the final stages of completion. The unit is installing a DG set of 63 KVA to support the power.

The following loads are considered for the unit:

Item	Watts	Quantity	Total Load in Watts	Duration in hrs	The total load in WH
Tube lights	40	10	400	4	1600
Lights	36	4	144	4	576
Cold room	3500	1	3500	4	14000
Freezer	200	1	200	4	800
Exhaust fans	100	12	1200	4	4800
air blowers	750	3	2250	4	9000
Total Load			**7694**	**Total WH**	**30776**

From the above table, the total load considered is 7.6kW and to run such load for respective hours the cumulative units required is around 30units. The following system is designed to meet the considered load:

Proposed System: 10kW Hybrid On-Grid System with Solar Module capacity of 7.5kW and Windmill capacity: 2.5kW. The inverter Capacity: 10KVA @ 120V DC, 3Ph, 50Hz

Cost-Benefit Analysis: Since the unit is under installation, the exact power consumption of the cold storage unit is not available. The present power tariff for Industries is 8 Rs/unit for consumption above 500 units. Hence the savings of the 10 KW Hybrid system is given below:

Particulars	Saving for the RMC	Saving for EDA&N
System capacity	10kW Hybrid On-Grid System	

Particulars	Saving for the RMC	Saving for EDA&N
Units Generated per day	40-45 units/day	
Units per month	1200 units	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	Rs 9,600	Rs 25,800
Savings/ Year	Rs 1,15,200	Rs 3,09,600
TOTAL SAVINGS	**Rs 4,24,800/Year**	

Thus, by installing an 87.5kW Hybrid On-Grid system, the firm can offset a minimum of 9,600 Rs/month and 1,15,200 Rs/year in the power bill. Also, it provides a savings of Rs 3.09 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 4.24lakhs/year considering the tariff of Rs 29.5 /unit.

Recommendation: A 10KW Hybrid on-grid system is recommended to cover the power usage in this unit. This system will minimize the dependency on Grid/ DG Power, diesel savings and thus reducing the electricity bill for the unit.

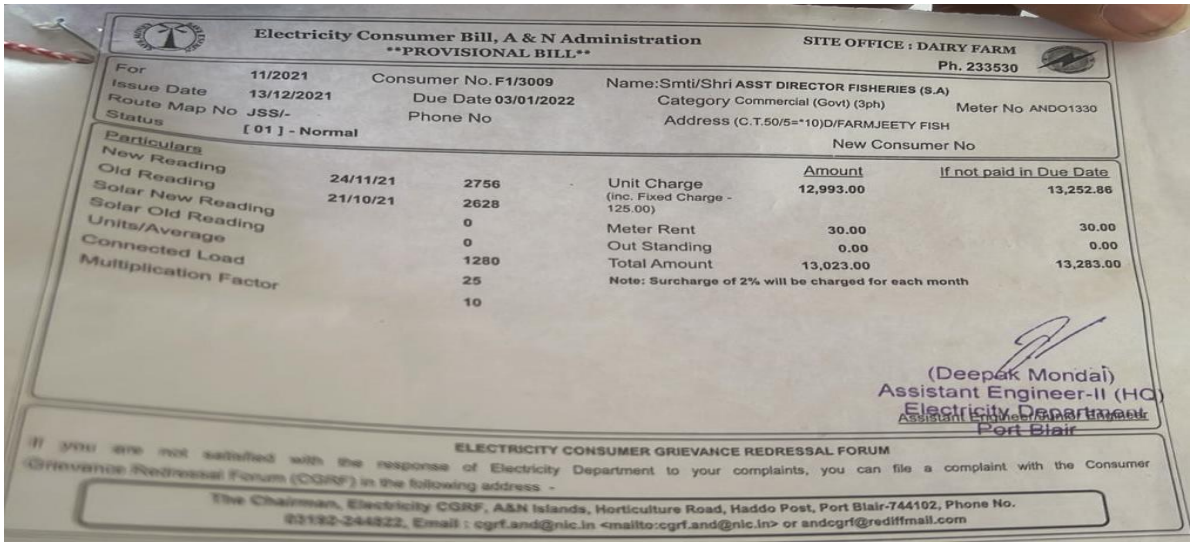
Project cost: The total cost of the 10kW Hybrid On-Grid System project is approximately around Rs. 14,31,262. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

6. *JANGLIGHAT FISHING HARBOUR, PORT BLAIR*

The Janglighat Fishing harbour is under the Department of Fisheries, Administration of ANI. The Fishing Harbour has a landing centre, two net mending centres, one fuel

station, an overhead water tank and street lights. All these are currently powered from the grid.

Fish Landing Center Building: The electricity bill for the lightings in the Fish landing centre, lightings for the fishing harbour, motor for pumping water and diesel pump is as given below:



Electricity Consumer Bill, A & N Administration
PROVISIONAL BILL
SITE OFFICE : DAIRY FARM
Ph. 233530

For 11/2021 | Consumer No. F1/3009 | Name:Smti/Shri ASST DIRECTOR FISHERIES (S.A)
Issue Date 13/12/2021 | Due Date 03/01/2022 | Category Commercial (Govt) (3ph) | Meter No ANDO1330
Route Map No JSS/- | Phone No | Address (C.T.50/5="10)D/FARMJEETY FISH
Status [01] - Normal | New Consumer No

Particulars				Amount	If not paid in Due Date
New Reading	24/11/21	2756	Unit Charge (inc. Fixed Charge - 125.00)	12,993.00	13,252.86
Old Reading	21/10/21	2628			
Solar New Reading		0	Meter Rent	30.00	30.00
Solar Old Reading		0	Out Standing	0.00	0.00
Units/Average		1280	Total Amount	13,023.00	13,283.00
Connected Load		25	Note: Surcharge of 2% will be charged for each month		
Multiplication Factor		10			

(Deepak Mondal)
Assistant Engineer-II (HQ)
Electricity Department
Port Blair

ELECTRICITY CONSUMER GRIEVANCE REDRESSAL FORUM

If you are not satisfied with the response of Electricity Department to your complaints, you can file a complaint with the Consumer Grievance Redressal Forum (CGRF) in the following address -

The Chairman, Electricity CGRF, A&N Islands, Horticulture Road, Haddo Post, Port Blair-744102, Phone No. 03192-244822, Email : cgrf.and@nic.in <mailto:cgrf.and@nic.in> or andcgrf@rediffmail.com

On average the plant consumes 1280 units/month which is equal to 42 units/day.

Item	Watts	Quantity	Total Load in Watts	Duration in hrs	The total load in WH
Lightning, Fan & Motor	10500	1	10500	4	42000
Total Load			**10500**	**Total WH**	**42000**

From the site survey at Fish landing centre premises, it is found that the site has regular power cuts for 4 hours and the site owner runs 10.5kW as the continuous load on DG Set. The proposed Hybrid system is designed to provide a backup of 4 hours thus offsetting the DG Set requirement. To supply 42 units/day it is recommended to have 12.5kW Hybrid System.

Proposed System: 12.5kW Hybrid Off-Grid System with Solar Module capacity of 10kW and Windmill capacity: 2.5kW. The battery capacity: 120V-500Ah shall be installed along with an invertor with a capacity of 10KVA @ 120V DC, 3Ph, 50Hz

Cost-benefit analysis: Based on the available information, the power bill for the fish landing centre is observed to be consuming 1280 units/month. Assuming the fish

landing centre is a commercial establishment, the present tariff for commercial establishments is 12.00 Rs/Unit for consumption above 500 units, and the savings with the system are estimated to be as follows.

Particulars	**Savings for the FLC building**	**Savings for EDA&N**
System capacity	12.5kW Hybrid Off-Grid System	
Units Generated per day	40-42units/day	
Units per month	1140 units	
Tariff	12.00 Rs/unit	17.5
Savings/ month	Rs 13,680	Rs 19,950
Savings/ Year	Rs 1,64,160	Rs 2,39,400
TOTAL SAVINGS	**Rs 4,03,560 / Year**	

Thus, by installing a 12.5kW Hybrid Off-Grid system, the firm can offset a minimum of 13,680 Rs/month and 1,64,160 Rs/year in the power bill. Also, it provides a savings of Rs 2.39 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 4.04lakhs/year considering the tariff of Rs 29.5 /unit.

Recommendation: 12.5kW Hybrid Off-Grid System is recommended for reducing the dependency on the DG sets. The major benefits of this system are Dual Energy generation within the same footprint area, battery backup for the system and Grid power consumption reduces and thus electricity bills will be reduced

Project cost: The total cost of the 12.5kW Hybrid Off-Grid System project approximately is around Rs. 25,32,000. The ROI for the system will be in 4-5 Years considering the tariff of Rs 29.5 /unit.

Cold Storage in Junglighat Fishing Harbor:

The department has installed 15-ton cold storage and is also planning to install a 12-ton ice plant on the premises. The 15-ton cold storage is installed in one of the net mendings shed. The cold storage is currently non-operational. As per the available space on the rooftop of the Cold Storage (142 Sq.m), it can accommodate around 17.5kW system. As the net mending shed has only a cold storage load, therefore an On-Grid Hybrid System is proposed here.

Proposed System: 17.5kW Hybrid On-Grid System is proposed with solar of 15kW, a windmill of 2.5kW and an inverter of 15KVA,3Ph,50Hz.

Recommendation & Savings from the system: As the cold storage is ready to be opened, the savings from the system in future can be estimated as follows

Particulars	**Savings for the Cold Storage**	**Saving for EDA&N**
System capacity	17.5kW Hybrid On-grid system	
Units Generated per day	70 units/day	
Units per month	1960 units	
Tariff	12.00 Rs/unit	17.5 Rs/unit
Savings/ month	24,990	Rs 34,300
Savings/ Year	2,99,880	Rs 4,11,600
TOTAL SAVINGS	**Rs. 7,11,480/Year**	

Thus, by installing a 17.5kW Hybrid On-Grid system, the firm can offset a minimum of 24,990 Rs/month and 2,99,880 Rs/year in the power bill. Also, it provides a savings of Rs 4.11 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 7.11lakhs/year considering the tariff of Rs 29.5 /unit. Further study needs to be done as the department is yet to install an ice plant of 15 tons. The energy consumption pattern of the two plants needs to be studied as both are yet to be operational.

Project cost: The total cost of the 17.5kW Hybrid On-Grid project approximately is around Rs. 20,46,000. The ROI for the system will be in 4-5 Years considering the tariff of Rs 29.5 /unit.

7. MONSOON FISHERIES, DHANIKARI, PORT BLAIR

This is a fish processing unit with Cold Storage, Ice plant, Effluent treatment plant, Water purifier etc. The ice plant is of 10-ton capacity. This ice is mostly used for fish processing in the unit. There is two cold storage unit with 75 tons and 35-ton capacity, 2 blast freezer of 5.5-ton & 3.5-ton capacity, a flake ice unit of 2-ton capacity and 1 chilled room of 5-ton capacity. The DG sets are being used currently for support of energy. The average consumption of diesel per day is 40 litres. The expense of the same would be around 1 lakh. The energy bills are 2.5 to 3 lakhs. The total power bill will be 3.5 to 4 lakhs. For the cold storage, ice plant, chilled room, blast freezers, the coolant is coming from a single source. There are 3 (three) 75HP motors used for supporting evaporators and are used simultaneously. One 75 HP motor is on standby. The solar-wind hybrid system shall be huge to support the energy needs of this plant. Hence, it is proposed to support those systems which are

using comparatively lesser loads. i.e. the lightings, blowers, 1-5HP motors used to run ETP, Water treatment plant, cooling towers etc. Hence a system of 6.5KW system is designed for this plant.





This plant designed with the following loads which constitute up to 6.5kw such as Tube Lights, Fans, Small blower (0.5Hp) etc. considering 20 hours of operating hours and water pumps each of 1Hp capacity running hours would be close to 2 hours in small intervals close to a minimum of 20min to a maximum of 30min for each pump. To operate lighting loads and 1-5HP motors on the site.

Item	Watts	Quantity	Total Load in Watts	Duration in hrs	The total load in WH
Lighting load	5000	1	5000	4	20000
Motor	750	2	1500	2	3000
Total Load			6500	Total WH	23000

The Monson fisheries operate Lighting load and Motor of 1Hp for about 4 hours as the continuous load on DG Set. Therefore, to offset the DG Set operation, the system is designed to provide backup for 4 hours on the above-mentioned loads.

Proposed System: 6.4kW Hybrid Off-Grid System with Solar Module capacity of 5.4kW & Windmill capacity of 1kW, Battery capacity: 96V-300Ah for 4 hours' backup and Inverter Capacity: 6/7.5KVA @ 96V DC, 1Ph, 50Hz with RMS.

Cost-Benefit Analysis:

Based on the available information, the building power bill is observed to be 3-4 lakhs Rs/Month. Assuming the Monsoon building as the commercial establishment, the present tariff for commercial establishments is 8 Rs/unit for consumption above 500 units, and the savings for the proposed system are estimated to be as follows.

Particulars	**Savings for the Monsoon Fisheries**	**Savings for EDA&N**
System capacity	6.4kW Hybrid Off-grid system	
Units Generated per day	25-30 units/day	
Units per month	750 units / month	
Tariff	8 Rs/unit	21.5 Rs/unit
Total savings/ month	Rs 6,000	Rs 16,125
Savings/ Year	Rs 72,000	Rs 1,93,500
TOTAL SAVINGS	**Rs 2,65,500/Year**	

Thus, by installing a 6.4kW Hybrid Off-Grid system, the firm can offset a minimum of 6,000 Rs/month and 72,000 Rs/year in the power bill. Also, it provides a savings of Rs 1.93 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 2.65 lakhs/year considering the tariff of Rs 29.5 /unit.

Recommendations: 6.4 KW Hybrid off-grid system is recommended, which will provide Rs 72,000 on power bills. The system recommended can be used for running the lighting loads and the motors with less than 1 HP. The major benefits are: the system will minimize the dependency on Grid/ DG Power for entire running hours, the battery provides the backup for the system during 4 hours of a power outage, diesel saving and reduction in the electricity bill.

Project cost: The total cost of the project including installation & transportation is around Rs. 13,53,250/-. The ROI for the system will be in 4-5 Years considering the tariff of Rs 29.5 /unit.

Estimate based on Available Area: The space available on the rooftop of the Monsoon Fisheries unit is 650 Sq.m. A Hybrid system of around 81.5kW can be accommodated on the rooftop o Monsoon Fisheries. The 81.5KW Hybrid on-grid system is proposed can be proposed with the available area, having Solar 74KW and Wind 7.5 KW and an invertor capacity of 80KVA, 3PH, 50Hz. The savings from this system is given below:

Particulars	Savings for the Monsoon Fisheries	Savings for EDA&N
System capacity	81.5kW Hybrid On-grid System	
Units Generated per day	325-340 units/day (on an avg)	
Units per month	9,780 (325 units/day as avg)	
Tariff	8 Rs/unit	21.5 Rs/unit
Savings/ month	Rs 78,250	Rs 210,270
Savings/ Year	Rs 9,38,880	Rs 25,23,240
TOTAL SAVINGS	**Rs 34,62,120/Year**	

Thus, by installing an 81.5kW Hybrid On-Grid system, the firm can offset a minimum of 78,250 Rs/month and 9,38,880 Rs/year in the power bill. Also, it provides a savings of Rs 25.23 lakhs/year to EDA&N. Total savings generated from installing this system is Rs 34.62 lakhs/year considering the tariff of Rs 29.5 /unit. The Total cost of the 81.5kW Hybrid On-Grid project is approximately is around Rs 86,90,337. The ROI for the system will be in 2-3 Years considering the tariff of Rs 29.5 /unit.

VIII. ISSUES IDENTIFIED

Productivity of ice plants and cold storages are reduced as there are intermittent power cuts, power fluctuation etc. The DSN ice plants are running at half the production capacity. The 150Kg ice blocks production has been stalled as it requires continuous energy for a long time.

Power Cuts: It is observed that the Power Cuts are very high. In a week a complete day power outage is identified in the places far from Port Blair, due to which the plants are forced to run at reduced capacities. The units running near to Port Blair (in Dollygunj Industrial Estate etc) have intermittent power cuts of 3-4 hrs/day.

Dependency on Diesel Generator Sets: The dependency in diesel generator sets are high (as high as 40 litres of diesel/day) with all the private ice plants / cold storage visited. This has increased the production costs. The cold storage with higher capacity, requires DG sets, as it can accommodate the peak momentary current requirement and the normal energy requirements.

Power fluctuation in the contracted load is rampant in all areas, due to which the maintenance of the motors, condensers, evaporators in cold storages and blast freezers have to be frequently scheduled. This has increased the production costs.

Pollution due to over-dependency in sourcing the energy requirements from the diesel sets affects the flora and fauna of the islands.

IX. PROJECTIONS FOR THE COLD STORAGE IN ANI

There is currently 12 cold storage in the fisheries sector, having an installed capacity of 480 tons. 5 cold storages are run by the fisheries department, 6 by the private sector, and 1 undertaking by ANIIDCO. The total tonnage of this cold storage is 480 tonnes.

1. WHEN ACTUAL LOAD IS CONSIDERED

The Hybrid renewable energy system is calculated taking the loads in 20 Ton Cold storage as a reference and for remaining Cold Storages, these loads have been extrapolated. The Cold storage is considered for 20hours of operation.

- Blast Freezer – 10kW
- 2 x Cold Storage – 11kW
- Chill Room – 4.8kW
- Lighting load – 0.5kW

The Hybrid renewable energy system capacity for all these cold storages are given below:

Location	Capacity (tons/ day)	Load considered (kW)	Hybrid On-Grid System		Hybrid Off-Grid System		
			Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off-Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
Fisheries Department							
1. Port Blair	15	20.62	105	108.74	105	240V-500Ah	147.00
2. Rangat	15	20.62	105	108.74	105	240V-500Ah	147.00
3. Hut bay	15	20.62	105	108.74	105	240V-500Ah	147.00
4. Car Nicobar	10	13.75	70	72.49	70	240V-300Ah	98.00
5. Campbell Bay	15	20.62	105	108.74	105	240V-500Ah	147.00
TOTAL Govt	70	96.23	490	507.44	490		686.00
Private Cold Storages							
6. Lambaline	25	34.37	170	176.05	170	240V-800Ah	238.00
7. Lambaline	60	82.5	412	426.67	412	240V-2000Ah	576.80

Location	Capacity (tons/ day)	Load considered (kW)	Hybrid On-Grid System		Hybrid Off-Grid System		
			Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off-Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
8. Dhanikhari	200	275	1375	1423.95	1375	240V-6500Ah	1925.00
9. Sippighat	40	55	275	284.79	275	240V-1300Ah	385.00
10. Dollygunj	50	68.75	345	357.28	345	240V-1000Ah	483.00
11. Dunduspoint	25	34.37	170	176.05	170	240V-800Ah	238.00
TOTAL Private	400	549.99	2747	2844.793	2747		3845.8
Undertaking							
12. Durgapur (Diglipur)	10	13.75	70	72.49	70	240V-300Ah	98.00
GRAND TOTAL	**480**	**659.97**	**3307**	**3424.73**	**3307**	**0**	**4629.80**

The savings and the RoI for these cold storages are as given below:

Particulars	**Hybrid On-Grid**	**Hybrid Off-Grid**
Cold Storages in ANI	12 cold storages	
Total tonnage	480 tonnes	
System Requirement	3.3 MW	
Estimated installation cost (Rs Crores)	34.2	46.2
Units saved per year	54.20 lakhs	
Average Cost of production of 1 kWh in ANI	21.5 / kWh	
Savings/year	11.65 Crores	
RoI	3	4

3.3MW Capacity of Hybrid Renewable system is needed to power 12 cold storages in ANI. The Budget for this capacity would be around 34.2 Crores for the On-Grid system and 46.2Cr for the Off-Grid system. The ROI will be within 3-4 Years considering the present tariff rates and Diesel consumption.

2. WHEN REDUCED LOAD IS CONSIDERED

The reduced load is calculated by considering one cold storage, chilled room and lighting loads of the unit. The Hybrid renewable energy system capacity for all these cold storages at the reduced loads are given below:

Location	Capacity (tons/ day)	Load considered (kW)	Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off-Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
Fisheries Department							
1. Port Blair	15	18	90	93.20	90	240V-400Ah	126.00
2. Rangat	15	18	90	93.20	90	240V-400Ah	126.00
3. Hut bay	15	18	90	93.20	90	240V-400Ah	126.00
4. Car Nicobar	10	13.75	68	70.42	65	240V-300Ah	91.00
5. Campbell Bay	15	18	90	93.20	90	240V-400Ah	126.00
TOTAL Govt	70	85.75	428	443.24	425		595.00
Private Cold Storages							
6. Lambaline	25	20	100	103.56	100	240V-500Ah	140.00
7. Lambaline	60	50	250	258.90	250	240V-1100Ah	350.00
8. Dhanikhari	200	150	750	776.70	750	240V-3500Ah	1050.00
9. Sippighat	40	30	150	155.34	150	240V-700Ah	210.00
10. Dollygunj	50	40	200	207.12	200	240V-1000Ah	280.00
11. Dunduspoint	25	20	100	103.56	100	240V-500Ah	140.00
TOTAL Private	400	310	1550	1605.18	1550		2170.00
Undertaking							
12. Durgapur (Diglipur)	10	13.75	68	70.42	65	240V-300Ah	91.00
GRAND TOTAL	**480**	**409.5**	**2046**	**2118.84**	**2040**		**2856.00**

To power all the Cold storage with reduced loads, Government needs a 2MW Capacity Hybrid On-Grid System and the budget for installation would be approximately Rs 21.18 Crores. For the Hybrid Off-Grid System of 2MW, the budget for installation would be Rs. 28.56 Crores.

3. DG SET SAVINGS FOR COLD STORAGES

Assuming each cold storage has 75KVA D.G Set and runs for 4 hours during a day. A 75KVA D.G Set with full load consumes 18 Litre/hour.

1 x D.G Consumption for 4 hours operation in a day	72 Lit/day
Diesel cost	77 Rs/litre
Diesel cost per day	5,544 Rs/day
Diesel cost per year	20,23,560
Maintenance cost	1,20,000
Total cost of 1 D.G Set	Rs. 21,43,560/year

Diesel consumption for 12 Cold storages per year	3,15,360 Litres/year
Cumulative cost for running 12 no. of 75KVA D.G sets	Rs. 2,57,22,720 /Year

The total savings on running DG sets is Rs 2.57 Crores and would directly save Diesel of 3,15,360 Litres/Year. Indirect cost on the D.G set maintenance, diesel transportation and pollution costs also would be saved, if these Cold storages are powered with the Hybrid Renewable system.

X. PROJECTIONS FOR THE ICE PLANTS IN ANI

There are 15 ice-plants in the ANI with 4 under the fisheries department, 9 in the private sector, and 2 in undertaking with Andaman and Nicobar Islands Integrated Development Corporation Limited (ANIIDCO). The total tonnage of these ice plants is 206 tonnes.

1. WHEN ACTUAL LOAD IS CONSIDERED

The following loads have been considered as a reference for the system design of a 10 Ton Ice plant and the remaining Plants, these loads have been extrapolated. The Ice plants are considered for 12 hours of operation in a day.

- Motor – 45Hp
- Agitator Motor – 3.7kW
- Condenser pump – 2.2kW
- Lighting loads – 0.5kW

The Hybrid renewable energy system capacity for all these ice plants are given below:

Location	Capacity (tons/ day)	Load considered (kW)	Hybrid On-Grid System		Hybrid Off-Grid System		
			Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off-Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
Fisheries Department							
1. Rangat	10	35	105	108.74	105	240V-800Ah	147.00
2. Hutbay	10	35	105	108.74	105	240V-800Ah	147.00
3. Campbell Bay	10	35	105	108.74	105	240V-800Ah	147.00
4. Mayabunder	10	35	105	108.74	105	240V-800Ah	147.00

Location	Capacity (tons/ day)	Load considered (kW)	Hybrid On-Grid System		Hybrid Off-Grid System		
			Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off-Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
TOTAL Government	40	140	420	434.95	420		588.00
Private Ice Plants							
5. Dhanikhari	11	38.5	115	119.09	115	240V-900Ah	161.00
6. Sippighat	30	93.3	315	326.21	315	240V-2500Ah	441.00
7. Sippighat	30	93.3	315	326.21	315	240V-2500Ah	441.00
8. Dandaspoint	10	35	105	108.74	105	240V-800Ah	147.00
9. Garacharma	15	52.5	157	162.59	157	240V-1200Ah	219.80
10. Dolly Gunj	10	35	105	108.74	105	240V-800Ah	147.00
11. Mayabunder	15	52.5	157	162.59	157	240V-1200Ah	219.80
12. Prothrapur	20	70	210	217.48	210	240V-1600Ah	294.00
13. Prothrapur	15	52.5	157	162.59	157	240V-1200Ah	219.80
TOTAL Private	156	522.6	1636	1694.24	1636		2290.40
Undertaking							
14. Swaraj Dweep (Havelock)	5	17.25	52.5	54.37	52.5	240V-400Ah	73.50
15. Durgapur (Diglipur)	5	17.25	52.5	54.37	52.5	240V-400Ah	73.50
GRAND TOTAL	**206**	**697.1**	**2161**	**2237.93**	**2161**		**3025.40**

The savings and the RoI for these cold storages are as given below:

Particulars	**Hybrid On-Grid**	**Hybrid Off-Grid**
Ice plants in ANI	15 ice plants	
Total tonnage	206 tonnes	
System Requirement	2.16 MW	
Estimated installation cost (Rs Crores)	22.37	30.25
Units saved per year	35.00 lakhs	
Average Cost of production of 1 kWh in ANI	21.5 / kWh	
Savings/year	7.52 Crores	
RoI	3	4

To power 15 Ice plants in the ANI, it needs a capacity of 2.16MW Hybrid On-Grid Renewable system & 2.16MW Hybrid Off-Grid Renewable system. The budget would be approximately around Rs. 22.37 Crores for Hybrid On-Grid system and Rs.

30.2Crores for Hybrid off-grid system. The ROI will be within 3-4 Years considering the present tariff rates and Diesel consumption.

2. WHEN REDUCED LOAD IS CONSIDERED

The reduced load is calculated by taking into account the agitator motor, condenser motor and lighting loads of the unit. The Hybrid renewable energy system capacity for all these ice plants at the reduced loads are given below:

Location	Capacity (tons/ day)	load considered (kW)	Hybrid on-grid (kW)	Cost (INR lakhs)	Hybrid Off Grid (kW)	Battery @ 4hr backup	Cost (INR lakhs)
Fisheries Department							
1. Rangat	10	6.5	105	108.74	75	240V-150Ah	81.99
2. Hutbay	10	6.5	105	108.74	75	240V-150Ah	81.99
3. Campbell Bay	10	6.5	105	108.74	75	240V-150Ah	81.99
4. Mayabunder	10	6.5	105	108.74	75	240V-150Ah	81.99
TOTAL Govt	40	26	420	434.95	300		327.96
Private Ice Plants							
5. Dhanikhari	11	7.15	115	119.09	85	240V-200Ah	95.23
6. Sippighat	30	19.5	315	326.21	228	240V-500Ah	250.52
7. Sippighat	30	19.5	315	326.21	228	240V-500Ah	250.52
8. Dandaspoint	10	6.5	105	108.74	75	240V-150Ah	81.99
9. Garacharma	15	9.75	157	162.59	112	240V-200Ah	121.75
10. Dolly Gunj	10	6.5	105	108.74	75	240V-150Ah	81.99
11. Mayabunder	15	9.75	157	162.59	112	240V-200Ah	121.75
12. Prothrapur	20	13	210	217.48	151	240V-300Ah	165.02
13. Prothrapur	15	9.75	157	162.59	112	240V-200Ah	121.75
TOTAL Private	156	101.4	1636	1694.24	1178		1290.50
Undertaking							
14. Swaraj Dweep (Havelock)	5	3.25	52.5	54.37	38	240V-100Ah	42.23
15. Durgapur (Diglipur)	5	3.25	52.5	54.37	38	240V-100Ah	42.23
GRAND TOTAL	**206**	**133.9**	**2161**	**2237.93**	**1554**		**1702.92**

To power all the ice plants with reduced loads, Government needs a 2MW Capacity Hybrid On-Grid System and the budget for installation would be approximately Rs 22.37 Crores. For the Hybrid Off-Grid System of 1.5MW, the budget for installation would be Rs. 17.02 Crores.

3. DG SET SAVINGS FOR ICE PLANTS

Assuming each Ice Factory has a 100KVA D.G Set and runs for 4 hours during a day. A 75KVA D.G Set with full load consumes 24 Litre/hour.

1 x D.G Consumption for 4 hours operation in a day	96 Litre/day
Diesel cost	77 Rs/litre
Diesel cost per day	7,392 Rs/day
Diesel cost per year	26,98,080 Rs/Year
Maintenance cost	Rs. 1,38,000
Total cost of 1 D.G Set	Rs. 28,36,080/year
Diesel consumption for 15 Ice plants per year	5,25,600 Litres/year
Cumulative cost 15 no. of 75KVA D.G sets	Rs. 4,25,41,200/Year

The total savings on running DG sets is Rs 4.25 Crores and would directly save Diesel of 5,25,600 Litres/Year. Indirect costs on the D.G set maintenance, diesel transportation and pollution costs also would be saved, if these Cold storage are powered with the Hybrid Renewable system.

XI. RECOMMENDATIONS

The System designed for each site with capacity and w.r.t the capacity as per the space availability is given below:

S. No	Description	Location	Proposed Hybrid System Solution	Required Capacity (kW)	Capacity (KW) as per the space availability
1	Fish Market	Mohanpura	Hybrid System Grid Interactive (On-Grid + Off-Grid)	40	40
2	DSN Ice Factory	Dundas Point	Hybrid System Grid Interactive (On-Grid + Off-Grid)	170	17.5 Hybrid On-Grid System

S. No	Description	Location	Proposed Hybrid System Solution	Required Capacity (kW)	Capacity (KW) as per the space availability
3	Era Fishery Products Private Limited	Industrial Estate, Dollygunj	Hybrid On-Grid system (Only On-Grid)	150	15 Hybrid On-Grid System
4	BRR SEA FOODS	Industrial Estate, Dollygunj	Hybrid On-Grid system (Only On-Grid)	150	87.5 Hybrid On-Grid System
5	RMC AKSHAY URJA	Industrial Estate, Dollygunj	Hybrid On-Grid system (Only On-Grid)	10	10
6	Fishing Harbour, FLC	Junglighat	Hybrid Off-Grid system (Only Off-Grid)	12.5	12.5
	Cold Storage	Junglighat	Hybrid Off-Grid system (Only Off-Grid)	17.5	17.5
7	Monsoon Fisheries	Dhanikari, South Andaman	Hybrid Off-Grid system (Only Off-Grid)	6.4	81.5 Hybrid On-Grid System

XII. CONCLUSION:

It is found feasible to utilize the Solar-Wind Hybrid energy source for running Ice Plants and Cold storage in ANI. Based on the site visit and power supply analysis for the loads, it is found that some sites have had regular power cuts for about nearly 3-4 hours. The plant operators have been utilizing the DG Set as the backup source to run the important loads during power cuts for which they are additionally spending money apart from the Electricity bill. To address all the above problems, a Solar-Wind Hybrid system (**Grid Interactive system – Off-grid + On-grid**) with battery backup has been proposed in areas that have regular power cuts to offset the DG Set and to minimize the Grid import. For example, Mohanpura Fish Market, DSN Ice factory at Dundas point etc.

The **On-Grid Hybrid system** has been suggested in Era Fishery, BRR, Monsoon Fisheries etc. These ice plants & cold storage are running together and require higher loads. The usage of Diesel Generator cannot be avoided in these units as higher ampere requirement is there at the time of peak momentary/normal running power

requirement. Considering the heavy energy requirements, a battery system is not recommended. In an on-grid system, excess consumption will be taken from the grid. Thus, the energy slab rates will be reduced as excess units are subtracted from the power bill. Though the excess power is fed to the grid the main source is anyway coming from DG set for these islands. Locality transformers ratings have to be enhanced for grid export.

The **Off-Grid Hybrid system** has been suggested in RMC Akshay Urja, Junglighat Fishing Harbour etc. Load completely will be taken care of by the hybrid system and batteries for most of the time. Whenever there is a power outage, the load will be purely supported by the batteries. When the batteries are in a deep discharge state and wind and solar are unavailable, only then the grid will take over, which is the last option.

The **Solar-Wind Hybrid System** can harvest dual-energy from nature, has high energy density within the same footprint from both Wind and Solar and the battery life enhances due to opportunity charging from wind all day. This system thus provides a longer life of 25 years and battery life of 5-7 years which otherwise would have been normally 3 years. Proposed Systems has higher Solar proportion and lower Wind proportion, as the energy generated from Solar is high but only for a few hours and generation from Wind is continuous but for a longer period.

Considering frequent power cuts, **Grid-Interactive** with battery support systems are more beneficial in avoiding diesel generators. The other determinant of finalising the Hybrid system is the space for the installation and space required to accommodate a huge battery bank. In this study, the capacities are proposed w.r.t the available space on the ice plant / cold storage rooftop. The space requirement for the hybrid system is generally 30%-40% less than only solar equivalent capacity. The battery set and inverter can be accommodated within the space of the DG set if the DG set is removed.

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