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LCORE factsheet

Solar Ice Making

Framework

The objective of "Promotion of Least Cost Renewables in Indonesia" or LCORE-INDO is to promote the application of renewable energy in Indonesia where they show the highest economic viability. The main tasks of LCORE-INDO are assessing the potential of waste-to-energy in the agro industry & assessing the potential from solar energy in case of on- and off-grid to find economic solutions in close cooperation with the private sector in order to substitute diesel fuel. Furthermore, it strives at enabling the Directorate General for New and Renewable Energy and Energy Conservation (NREEC) in Indonesia to develop practical policies and promote programs for the effective support of renewable energy implementations.

The following factsheet provides an overview of assesments and possible optimization measures in an ice block factory on Buru Island as one identified possible example for the PV integration in the fishery sector.

Background & Motivation

Ecspecially in the remote areas of Indonesia, the fishing industry is one of the main pillar for the livelihoods of the rural poulation. To ensure a high catch quality and thus a stable income for the fishermen, the constant supply of ice blocks needs to be guaranteed. Ecspecially in the remote areas of Indonesia the unreliable energy supply of PLN is leading to frequent grid-outages up to 4-8 hours daily. The energy back up is then provided by diesel generators significantly increasing the energy spendings. Furthermore the inadequate energy supply and thus a lack of ice production will result in a poor quality of fish catches or to the situation of dumping the decayed fish leading to lower or complete loss of income for the fishermen. PV applications are suitable to provide a stable energy supply in remote areas simuntanously increasig the sustainability and reducing the energy spendings.

Figure 1: Ice making bins and the assessed ice making factory

Technology of Ice-Making

An ice-making factory mainly consists of the cooling circuit and the brine tank where the ice making process itself takes place. The average size of an ice block is 50cm x 20cm x 10cm and an average small scale ice factory produces around one ton of ice blocks a day. The Ice bins are filled with water and freezed by the cooling circuit interconnected to the ice bins. The freezing time to produce one ton of ice is around 8 hours. The energy for the cooling circuit is consumed by the compressor as the main element to ensure the running process of absorpting the heat from the brine tank and releasing it to the environment.

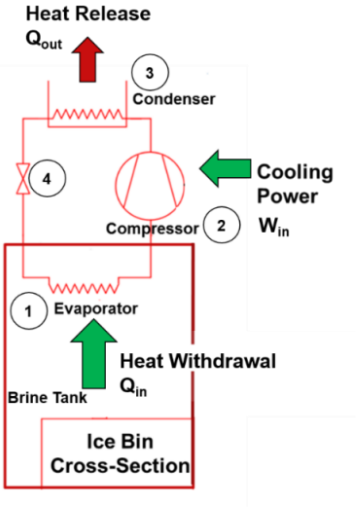

Figure 2: Cooling Circuit in an Ice-Making Proces

Energy Efficienct Ice machine

The easiest and least cost option to optimize ice making machines is the implementation of energy efficieny measures.

In the assesed factory, the on site measurements revealed that a lower energy consumption of 20% is sufficient to produce one ton of ice in the required time period of 12 hours. To lower the energy consumption, an adjustment in the compressor (motor pulley) has to be implemented requiring investment costs of around 1,000 EUR.

Assuming that the 20% energy savings would otherwise be supplied by 100% back up diesel consumption, the savings of anually 1,300 l diesel would lead to additionally 15 Mio IDR and to 4 ton CO_2 emission savings.[1)] The investment costs of the adjustment would be paid back within one year. We call this the **Improved Ice-machine.**

1) Based on 11.500 IDR/liter (10% increase p.a.)

Further calculations revealed that additionally replacing the condenser by a larger condenser unit will lead to total energy savings of 30%. The investment costs of 6,000 will be paid back within 3 years if 100% diesel fuel is used, after that leading to annual savings of 30 Mio IDR or 7 ton CO_2- emissions. We call this the **Optimized Ice-machine**.

The follwing graph shows of the saving potential of the two options in kWh/ton ice.

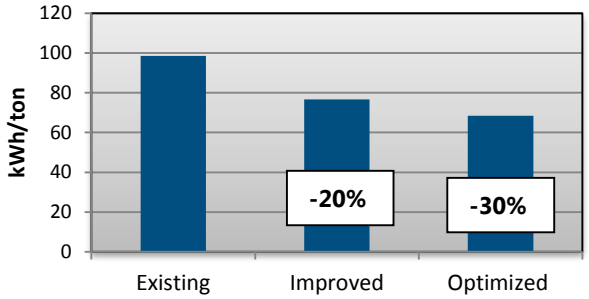

Figure 3: Energy saving potential of the Improved and Optimized process

We can conclude that even small investment cost concerning the energy efficency contribute to high energy savings and thus to a reduction of running costs.

Solar PV-driven Ice machine

Since the remote areas in Indoenesia are still not covered by a stable energy supply, installing an PV system can guarantee a continous ice making process and thus a stable income for fishermen.

For the simulation of a PV-driven ice machine the optimized ice machine was taken as a reference. It s assumed that 80% of the required energy can be supplied by solar energy and therefore a 20 kWp PV-System with batteries of 450 Ah is needed to be installed. The investment costs amount to 36.000 EUR. The figure below illustrates the return of investment in dependency of energy supplied by either diesel or PLN electricity.

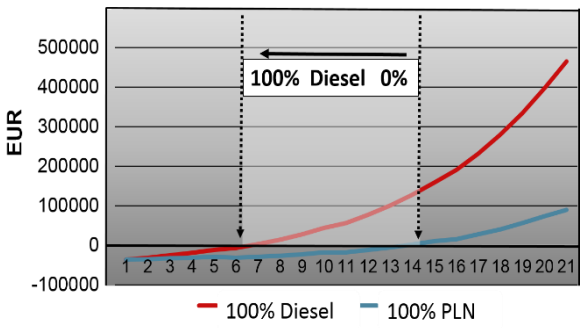

Figure 4: EBITA of the PV-driven Block-Ice Machine [2)]

The payback period of the recommended PV system ranges between 5-14 years. The more diesel being substitued by solar energy, the shorter the payback period and the higher the economic viability. Assuming a diesel substitution of 100%, the investment cost will be paid back within 5 years and after that leading to annual saving costs of more than 100 Mio IDR or 22 ton CO_2-emission savings.

Assuming a substitution of 50% diesel and 50% PLN annual savings of 60 Mio IDR ca be achieved and the solar system will be paid backwithin 9 years.

In the remote parts of East- Indonesia, PV energy is already competitive to conventional energy production due to high energy costs using diesel fuel. A high potential can further be stated in new exploited catch areas lacking grid connection or not beeing sufficiently supplied by diesel. With the increasing diesel and electrcity price the solar energy will further become an economic option for ice-making factories.

Up-Scaling potential

Based on the statistics of the Ministry of Marine Affairs and Fisheries, the total amount of small scale harbors in Indonesia amounts to ~1,000. It can be assumed that each harbor includes at least one ice-making factory. Covering most of small scale ice-making factories with PV systems, the saving potential in Indonesia amounts to:

- Annual savings of 5 million liters of diesel
- Annual CO_2- emission reductions of 22,000 tons

The substitution of diesel and highly subsidized PLN electricity with PV energy would not only lead to savings in the runnuning costs but furthermore contribute to a cleaner environment by yearly reductions of CO_2- emissions.

Project name	LCORE- Promotion of Least Cost Renewables in Indonesia
Commisioned by	Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, Germany (BMUB)
Country	Indonesia
Lead executing agency	Directorate General for New and Renewable Energy and Energy Conservation (NREEC) under the Ministry of Energy and Mineral Resources (MEMR)
Duration	2012 to 2015

2) Based on 11.500 IDR/liter (10% increase p.a.), PLN B-2 tariff 972 IDR/kWh (15% increase p.a.), 12% interest rate and 30%/70% equity/loan ratio.

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