CDM Feasibility Study for Wind Power Generation for Hambantota International Convention Centre in Sri Lanka

By Takasago Thermal Engineering Co., Ltd.

1. Project Participants:

- Sri Lanka Sustainable Energy Authority (SLSEA) : Authority on sustainable energy projects; regulatory agency of the Hambantota Solar Park where the project is proposed to be carried out.
- Ministry of Power and Energy (MPE) : Sri Lanka's nationwide planning and administrative body for power and energy planning
- Ceylon Electricity Board (CEB) : Manager of Sri Lanka's nationwide electricity network and purchaser of electricity from independent power producers (IPP)
- Urban Development Authority (UDA) : Government body responsible for planning and carrying out development in the Hambantota region; UDA is also looking into how the renewable energy generated by this project can be used to obtain green building accreditation
- Ministry of the Environment, Climate Change Secretariat (the Designated National Authority of Sri Lanka, DNA) : The government body that handles the authorization, application and bilateral talks for CDM projects in Sri Lanka
- Board of Investment (BOI) : Government body that acts as the front desk for foreign investment into Sri Lanka and authorizes tax holidays
- Mitsubishi-UFJ Morgan Stanley Securities Co.,Ltd. (MUMSS) : Provides support for the CDM study; assisted in the preparation of the Project Design Document (PDD) and the Project Idea Note (PIN); calculated the grid emission factor; assisted in dealing with the Sri Lankan DNA.
- P.I. CONSULTANTS & CO. (PIC) : Deals with the Sri Lankan government, coordinates field work, conducts studies into the condition of the local infrastructure, etc.

2. Summary of Project Activity:

(1) About this project activity:

The proposed project is a 4 MW wind power generation facility that will deliver electricity to the CEB grid for the International Convention Centre (ICC) that is currently being constructed at the UDA-supervised southern development area of Hambantota. By using a renewable energy source where otherwise, grid electricity would have been utilized, the project activity is expected to contribute to CO_2 emissions reduction. The implementation of the project will contribute to the alleviation of poverty and promote development in one of the poorest regions of Sri Lanka.

Based on the results of this study, CO_2 emissions reductions from Phase 1 are estimated to be approximately 4,599 tCO_2/year.

Takasago Thermal Engineering Co., Ltd. anticipates that it will commence plant operations at the end of 2013.
After the completion of this study, it will be necessary to review the project schedule and make adjustments for a more concrete schedule in coordination with the CEB and SLSEA. Special consideration will be given to the measures to eliminate sources of instability to the grid.

(2) Methodology applied:

Small-scale CDM approved methodology AMS - I.D., "Grid connected renewable electricity generation" (Version 17)

3. Contents of this Study

(1) Issues Studied:

As the project is implemented under the Clean Development Mechanism (CDM), the following subjects and issues were considered.

- Collection of basic information on the project activity and assessment of the applicability of the CDM methodology, etc.
- Analysis of the reasons why the registration of CDM projects in Sri Lanka has not taken off.
- Validation/CDM project approval process in Sri Lanka
- Requirements for conducting environmental impact assessment (EIA).
- Approaches for demonstrating the project's additionality.
- Collection of data to estimate the grid's emission factor in order to calculate the reduction in greenhouse gas (GHG) emissions.
- Commercialization of project activity.

(2) Contents of this Study:

- Collection of basic information on the project activity and assessment of the applicability of the CDM methodology, etc.

  We carried out literature reviews and discussions with the Sri Lankan DNA, UDA and other cooperating institutions prior to commencing the study. We also studied the suitability of the methodology to be applied and gathered basic intelligence for our proposal.

- Reasons why the registration of CDM projects in Sri Lanka has not taken off.

  In addition to the complex regulations governing CDM project approval, other reasons identified include businesses' lack of experience, local consultants' lack of sufficient CDM skills and knowledge, as well as international investors' lack of sufficient comprehension of the situation in Sri Lanka. As a result, crucial information for CDM project development cannot be properly collected and analyzed. There are many cases when the quality of the PDD does not satisfy the requirements for registering a project under the CDM, resulting in the project activity being halted in the validation process and being rejected for registration. Up until now, there have only been 7 project activities registered, 3 of which were proposed by the World Bank and 3 of which

were proposals by Japanese enterprises, thus showing that local consultants lack the ability to register CDM projects on their own.

- Validation/CDM approval process in Sri Lanka

  As the Sri Lankan DNA has already approved numerous project proposals, the approval process is considered adequate.

- Requirements for conducting environmental impact assessment (EIA)

  Both the solar park and a wind-power plant located in the vicinity of the solar park have undergone environmental impact assessments. As such, there is a high probability that we will not be required to carry out another EIA for a project built within the solar park. We plan to reconfirm this during commercialization, when we apply to be recognized as a formal enterprise.

- Approaches for demonstrating the project's additionality.

  We reviewed the applicability of the two different guidelines approved during the EB63. The project activity does not fall under the positive list included in "Attachment A of Appendix B of the Simplified modalities and procedures for small-scale CDM project activities" as additionality is automatically confirmed for solar technologies (photovoltaic and solar thermal), off-shore wind technologies and marine technologies. As the project activity is not an off-grid plant and its capacity is above 1.5MW, as long as the project activity does not fall under the category of technologies recommended by the Sri Lankan DNA and approved by the CDM EB, the "Guidelines for Demonstrating Additionality of Microscale Project Activities" cannot be applied. Although we started to discuss with the Sri Lankan DNA the recommendation of our project type to the CDM Executive Board as additional in October 2011, we have not yet received any formal approval.

- Collection of data to estimate the grid's emission factor which is used to calculate the reduction in greenhouse gas (GHG) emissions.

  After talks with CEB, we formally obtained the most recent past 3 year grid data (2008 to 2010) which was used to calculate the grid emission factor.

- Commercialization of project activity.

  From our fieldwork, we determined that the following procedures need to be carried out as part of the project's commercialization process:

  1) Submission of proposal – Submit proposal showing basic plan and feasibility study (FS) report on the project's scale, etc. to the Sri Lanka Sustainable Energy Authority (SLSEA)

  2) Application for allocation of proposed site – Prior to commencing the project submit applications for the proposed site to the Sri Lanka Sustainable Energy Authority (SLSEA). We were informed by SLSEA to look into carrying out this project activity at the solar park.

  3) Submission of Environmental impact assessment – Submit the assessment to Sri Lanka's Ministry of Environment. As there is an existing wind-power plant operating in the vicinity of the solar park, there is a high possibility that the assessment will not be necessary.

  4) LOI (Letter of Intent) - Submit LOI to the Ceylon Electricity Board (CEB)

indicating intention to enter the market as an IPP. The LOI will also declare our intention to supply sustainable energy to the International Convention Centre (ICC) in order for the ICC to be certified as a green building (by obtaining Leadership in Energy and Environmental Design (LEED) certification).

5) Obtain approval from SLSEA.
6) Conclude Letter of Intent Agreement / Power Purchase Agreement with CEB, and conclude Letter of Intent Agreement with the ICC.
7) Submit the above Agreements to the Public Utilities Commission of Sri Lanka (PUCSL) for approval.
8) Obtain approval for proposed site (Site Allocation Certificate).
9) Submit the CDM project application to the Ministry of Environment, obtain approval for the environmental impact assessment and submit the project for registration to the United Nations Framework for Climate Change Convention (UNFCCC).
10) Register with the Board of Investment (BOI), set up company and commence operations.

4. Results of study on CDM project implementation

(1) Baseline monitoring methodology

The project conforms with the eligibility criteria stipulated in the small-scale methodology AMS-I.D. “Grid Connected Renewable Electricity Generation” (Version 17) and the relevant tools:

- The project activity supplies electricity to the national grid owned by the Ceylon Electricity Board (CEB).
- The project activity proposes the installation of a new renewable energy generation facility.
- As the project activity’s generation capacity is 4MW, it is below the 15 MW limit for small-scale projects.
- The project activity does not involve the installation of a cogeneration facility.

For this project, we applied the “Tool to calculate the grid emission factor for an electricity system” (Version 2.2.1) in order to calculate the grid emission factor.

(2) Baseline scenario and project boundary

We have taken the power facilities connected to the electricity system as the baseline scenario. Without the project activity, this electricity would have been supplied by the power facilities to the electricity system.

Under AMS-I.D., the project generation facility and all generation facilities connected to the CEB grid are included in the project boundary. The main sources of greenhouse gas emission within the project boundary are fossil fuel power plants connected to the CEB grid.

Initially, instead of trading surplus electricity generated in the night on the grid, we had

looked into directly supplying surplus electricity to fishing villages in the vicinity of the UDA-owned site located near Hambantota Bay. The electricity was intended to power refrigerator freezers to store the fishermen's haul. However, after consulting the CEB, we were informed that Sri Lankan laws do not permit the delivery of electricity to a specific group of consumers (wheeling). As such, all surplus electricity will be supplied to the grid, leaving the project boundary unchanged.

The combined margin emission factor for wind power projects connected to the CEB grid is estimated to be CM = 0.6564 tCO_2/MWh.

(3) Monitoring

The monitoring plan for this project activity was designed based on small-scale methodology AMS-I.D. "Grid Connected Renewable Electricity Generation" (Version 17). The main data to be measured are the electricity exported to the grid and the electricity imported from the grid. From these two sets of data, we can derive the net electricity export necessary to calculate emissions reductions.

Although there are meters that can automatically compute the net electricity export, in Sri Lanka's case, the feed-in tariff is not imposed on the net electricity export, but on the gross electricity export instead. As such, there is no need for specific equipment to measure the net electricity export. Instead, individual equipment to measure the gross electricity supply and the gross electricity import will be installed. Data will be collected intermittently and will be aggregated monthly.

The monitoring plan for this project activity is designed based on information gathered from fieldwork as well as the actual performance and results of project activities registered mainly in India and Sri Lanka. We also studied the best location to install the electricity meters, the frequency of measurement, calibration of instruments and QA/QC methods to cross-check the electricity sold.

(4) Reduction of greenhouse gas emissions

Baseline emissions

According to the small-scale methodology AMS-I.D., the baseline is the product of the net electricity supplied (EG_{Bly}) multiplied by the grid's emission factor ($EF_{CO2,grid,y}$).

Project emissions: None
Leakage: None
Emissions reductions: $ER_y = BE_y$

The projected annual emissions reductions are as shown in the table below.

Year	2014	2015	2016	2017	2018	2019	2020
Wind-generated electricity (tCO_2)	4,599	4,599	4,599	4,599	4,599	4,599	4,599
Total (tCO_2)	4,599	4,599	4,599	4,599	4,599	4,599	4,599

(5) Project cycle / Crediting period

The average lifetime of wind-power generation facilities manufactured is generally over 20 years. Therefore, a crediting period of 7 years which is twice renewable will be selected so that emission reductions can be claimed until the end of the project's operational lifetime. Our aim is to implement the project activity after the completion of this study and bring it into operation in 2013.

(6) Environmental Impact / Other Indirect Impact

In general, installing a wind-powered generator will have very little environmental and/or biological impact on its surrounding area. There is an existing wind-power plant operating in the vicinity of the proposed site, the solar park. According to the report of a study carried out by the University of Moratuwa on wind-powered electricity, and another study carried out by the neighboring Hambantota Airport on the relationship between the airport's landing strip and the location of the wind power plant, the project activity does not appear to pose any threat to migrating birds or give rise to noise. However, as both studies are between 3 to 7 years old, we will check with the Sri Lankan Ministry of Environment whether the studies are applicable to the current situation when we carry out the project activity.

(7) Comments from Stakeholders

For the purposes of this study, we engaged in discussions with government bodies (in the 1st to 4th round of fieldwork) and held stakeholders' meetings with the neighboring population to gather feedback from the stakeholders.

The Urban Development Authority (UDA), the initiator of the wind plant proposal was extremely cooperative. As the ICC is very close to the originally proposed location of the wind plant, the CEB and SLSEA verbally agreed to an alternative proposal to relocate the plant to the grounds of the existing solar park. However, installing a wind-only power generation plant is not favored as it could result in instability to the grid. The CEB and SLSEA noted that as there are currently frequent disruptions to the grid, it may be difficult to obtain approval to install such a facility. We also received feedback welcoming the possible installation of a hybrid wind-solar thermal system for thermal storage and power generation as such a system would promote more stable supply of electricity to the grid.

As the solar park (with a total area of 600 acres) is located on government-owned land and there are no residential areas surrounding it, there is no necessity to factor in the impact of the project activity on residents living in the vicinity. As an existing wind plant has already been in operation since 1999, no issues exist with the project activity's impact on the landscape.

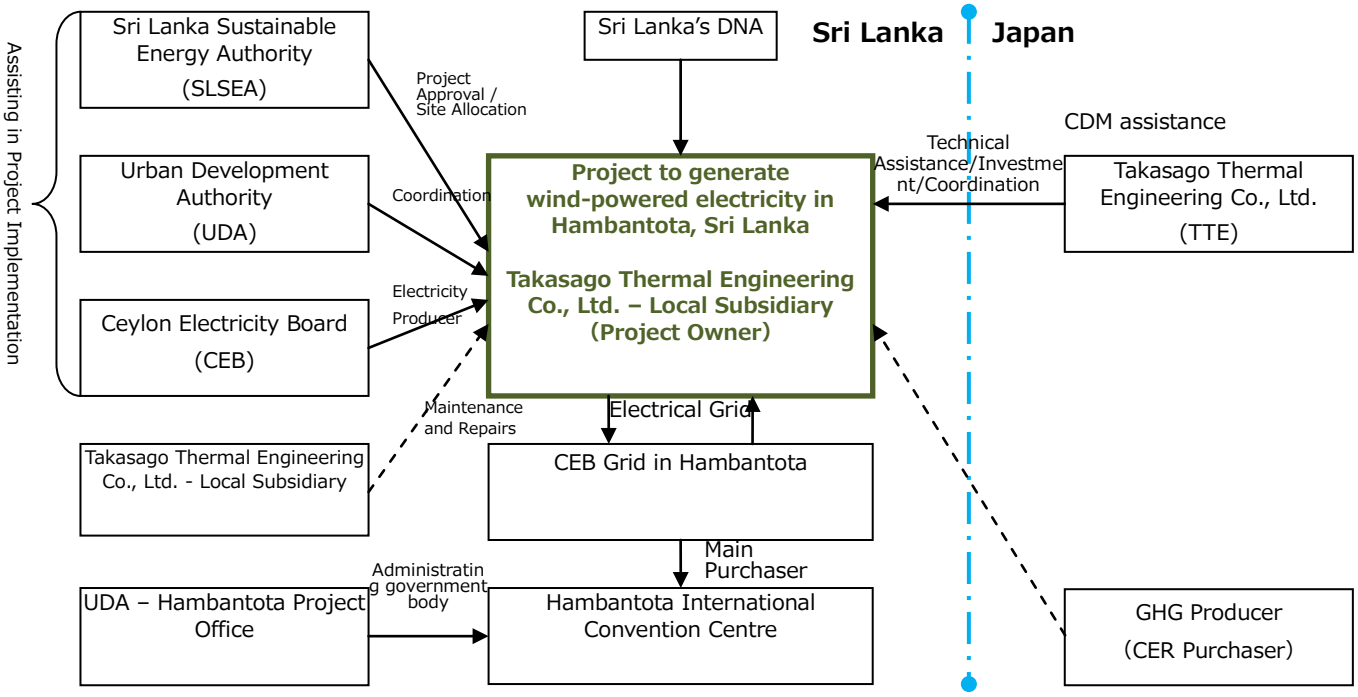
(8) Project Organization

Takasago Thermal Engineering Co., Ltd. is the main participant, sponsoring local IPPs with project financing. At the present time, equity investments / the rate of lending from financial institutions has not yet been decided on. However, the current plan is based on the premise that Takasago Thermal Engineering Co., Ltd. will contribute 100% of the investment money.

The UDA Hambantota Project Office is one of the organizations implementing this project

activity. It supported the fieldwork for this feasibility study. The UDA Hambantota Project Office is the government body in charge of designing, building and managing the ICC, which will be the main regional consumer once the wind-powered generator has been connected to the grid.

The project organization is shown below:



(9) Financial Plan

The current plan is to install two units of 2 MW-class wind-powered generators and to lay down transmission lines. We are currently proposing that 100% of the investment in the initial period will be provided by Takasago Thermal Engineering Co., Ltd. through equity investment. In addition to the initial investment, we estimate that US$666,000.00 (this figure may vary by equipment manufacturer) is needed to cover annual operations and maintenance costs.

We are looking at Japan Steel Works (JSW) as the potential manufacturer of our wind-powered generators. From our discussions with JSW, it has become the norm to use state-of-the-art 2MW high efficiency blades that can respond to low wind speed. Although we are awaiting the results of our inquiry into the proposed site, we are looking into introducing the generators in phases, with two units of 2 MW generators to be introduced in Phase 1 and another two units in Phase 2, resulting in a final output of 8 MW (4 units X 2 MW). We will look into the implementation of Phase 2 once the Phase 1 generators are operational. This would allow us to assess the actual operating conditions.

Funding for Phase 1

If 2 units of 2MW -class wind-powered generators are installed		
Initial investment for wind power plant : Wind-powered generators (2 units)	USD	3,900,000
Civil engineering		410,000
Engineering and management		890,000
Total :	USD	5,200,000

If a private finance initiative (PFI / in Japan's context, a special purpose company) is set up with project financing by Takasago Thermal Engineering Co., Ltd, it will qualify as a company under Section 17 of Sri Lanka's Board of Investment (BOI) Law.

(10) Investment Analysis

At the current stage, the investment analysis shows that initial investment will amount to US$5.2 million, with annual operations and maintenance costs estimated at US$660,000.00. Revenue from the sale of CERs is projected at US$7.00 per unit (current market rate for 2013 vintage CERs as of February 2012), with the benchmark set at 13.62% of Sri Lanka's commercial lending rates (weighted average interest rate) as at 30 September 2011. We are planning to apply for the longest tariff period applicable for the flat-rate feed in tariff of LKRs 19.7/kWh. Although we initially proposed to install three units of 1 MW wind-powered generators, we are now looking into installing two units of 2 MW generators for a total generation capacity of 4MW.

The IRR from the project is calculated as follows:

	IRR (%)		Benchmark (%)
Without revenue from CER sales	9.77	<	13.62
With revenue from CER sales	10.54	<	13.62
With CER revenue and a 15% increase in the revenue from electricity sales	14.83	>	13.62

(IRR = Internal Rate of Returns)

Even though we revised the IRR based on current market rates, the IRR still does not cross the benchmark. However, if the revenue from the sale of electricity increases by 15%, then the IRR will cross the benchmark.

We are looking not only into build-own-operate (BOO) financing, but also build-own-transfer (BOT) project financing where the project will be transferred to the Sri Lankan government after 20 years. We are also studying the three-tier feed-in tariff option, the project's eligibility for BOI tax holidays (the number of years of tax holiday is based on paid-up capital) and other approaches for the approval and implementation of the project activity.

We are surveying risks in the political climate, foreign exchange and inflation as well as conducting research on issues where the associated costs cannot yet be determined, such as the handover conditions for the allocated site and grid expansion works. It is projected that the benchmark will need to be revised in response to changes in the politico-economic situation.

The increasing size of the latest wind-powered generators, rising costs, and expenses incurred for grid connection and land allotment are factors contributing to the rising cost of initial investment. On the other hand, the electricity generated by high-efficiency generators and higher reductions in CO_2 emissions are promising. For this reason, as we have secured a site with excellent wind conditions and velocity, it can contribute additionally to the increasing internal rate of returns (IRR) that accompany higher CO_2 emissions reductions.

（11）Demonstrating the Project Activity's Additionality

As this is a small-scale CDM project, "Attachment A of Appendix B of the Simplified modalities and procedures for small-scale CDM project activities" (demonstrating the project would not have happened due to barriers to investment) or "Guidelines for Demonstrating Additionality of Microscale Project Activities" can be applied.

If the "Attachment A of Appendix B of the Simplified modalities and procedures for small-scale CDM project activities" is applied, it is necessary to identify the barriers to investment by checking the investment data and calculating IRR of the project activity accurately.

On the other hand, if the microscale guidelines are applied, it is necessary for the project activity to implement technologies/measures recommended by the DNA in order to meet the requirements of the 'Guidelines Verifying the Additionality of Microscale Projects'.

We have yet to obtain approval for the proposal demonstrating the project activity belongs to a technology recommended by the Sri Lankan DNA in order to demonstrate additionality based on the microscale guidelines. Although the Sri Lankan DNA prepared a recommendation to the CDM Executive Board in October 2011 following our talks with the DNA, as at the end of February 2012, the CDM Executive Board has yet to approve our proposal. Therefore, in this report, we are applying the small-scale guidelines to demonstrate the additionality of the project activity by identifying barriers to investment.

We first considered two alternative scenarios if there were no project activity.

Alternative 1: Supply of electricity from the CEB grid (continuation of the current practice)
Alternative 2: Construction of a 4 MW wind power plant (the project without the CDM)

The implementation of Alternative 1 is prevented by an investment barrier as demonstrated below. At the same time, supply of electricity from the CEB grid does not require any additional investments and is not prevented by the investment barrier. Therefore, this more carbon intensive alternative will be more financially viable in the absence of the CDM.

To demonstrate the investment barrier, benchmark analysis is applied. The equity IRR (pre-tax) will be calculated for the period of twenty years, which is the expected project lifetime. The IRR will be compared against a benchmark of 13.62% which is the average weighted lending rate for commercial bank lending in Sri Lanka, as announced on 30 September 2011[1]. This is also a suitable benchmark as the "Guidelines for assessment of investment analysis" state that commercial lending rates can be a suitable benchmark for project IRR.

The IRR (without CER revenue) is 9.77%.

This IRR is lower than the benchmark, which means that the project activity will be unattractive on a business as usual basis and the more carbon intensive alternative, the use of grid electricity will be implemented.

[1] See: http://www.cbsl.gov.lk/htm/english/_cei/ir/i_4.asp?date=&Mode=2&Page=1

In order to confirm the validity of the above, sensitivity analysis is carried out as shown below.

Case		Increased by 10%	10%
Case 1	Investment costs	8.43 %	11.35 %
Case 2	Revenue from electricity sales	12.71 %	6.59 %

From the results of the sensitivity analysis, in either case, the IRR is lower than the benchmark. Therefore, the project activity is not attractive to investment and has additionality.

（12）Commercial Prospects

Takasago Thermal Engineering Co., Ltd. (the organization submitting this study) is studying the early stage commercialization of the project activity. Takasago Thermal Engineering Co., Ltd. is proposing the introduction of wind-powered electricity generation as a CDM project, the Company which is a strong sign of the company's strong interest in the realization of this project activity. Not only is this project activity linked to the progress of the energy innovations field, the company will also stand to gain from a more positive corporate image.

At the current flat-rate sustainable energy feed-in tariff in Sri Lanka (19.7 LKRs /kWh) which is valid for 20 years, if the project activity produces income from the sale of CERs obtained through the generation of electricity produced by high-efficiency wind-powered electricity generators, then we can expect an IRR of about 14%. (The current benchmark is 13.62%). Taking into account the level of cooperativeness of the various Sri Lankan authorities and the market environment, we can conclude that commercialization prospects for the project activity are highly promising.

However, during our 4th round of fieldwork, we were informed that the problems with the CEB grid's stability were worsening and that the installation of a new only-wind plant may not be approved. We also received feedback encouraging us to look into a hybrid system incorporating a solar thermal system for thermal storage, as this would help equalize the supply of electricity to the grid.

At the current stage, in addition to determining the investment stance in 2012 and thereafter for Takasago Thermal Engineering Co., Ltd. and the local business entity (the local FPI to be set up with project financing from Takasago Thermal Engineering Co., Ltd.), the technical issues associated with the installation of a wind and solar thermal hybrid plant have yet to be resolved. Additionally, it is essential that the Sri Lankan government's new hybrid feed-in tariff be applied to the project activity's final commercialization model. We project that the above will be finalized after the Sri Lankan government's latest feed-in tariff (FIT) has been applied and bilateral talks in 2013 onwards have been concluded.

We are continuing our efforts to register the project under the CDM in 2012.

5. Results of Study on Project Co-benefits

After consulting the "Manual for Quantitative Evaluation of the Co-benefits Approach to Climate Change (Version 1.0)" we carried out a quantitative assessment survey in the following steps. According to AMS-I.D., when selecting the evaluation category, the proposed

power facilities and all power facilities connected to the grid must be included in the project boundary. We propose to supply all generated electricity to the grid. This case will be assessed under the 'Air Quality Improvement' category. As wind-generated electricity does not contribute significantly to carbon dioxide emissions, it does not result in the emission of greenhouse gases.

6. Results of Study on Contributions to Sustainable Development

After the conclusion of Sri Lanka's civil war, the spike in domestic energy demand and soaring prices of fossil fuels have led to the country's increasing dependence on imported energy. In light of such a situation, this project activity, which proposes the introduction of wind-powered generation facilities, is expected to improve energy self-sufficiency and improve the balance of trade.

The possible future installation of freezing and refrigerating facilities for the fishing industry is expected to help develop the industry and correct the regional income disparity. In the area surrounding Hambantota, where there are insufficient freezing and refrigerating installations, without proper storage, a great part of the fishing haul goes bad and has to be discarded. Also, without proper freezing and refrigeration, the fishermen are unable to transport their haul to Colombo and Galle, where a large portion of the market for their haul is located.

By utilizing the night-time electricity output generated by this project activity to supercool (at temperatures below -50°C) the haul, it is possible to prevent the haul from going bad without consuming day-rate energy and increasing the peak load. Not only does utilizing night-time output in this way prevent the haul from being wasted and expanding the market for the haul, it also acts as a buffer against excess night-time electricity output which is potentially damaging to the grid.

However, as of now, it is prohibited to use the grid to supply a specific group of customers with electricity. Therefore, it will not be possible to utilize the surplus electricity in this way.