MOEJ/GEC JCM Feasibility Study (FS) 2013
Final Report

Hybrid Power System; Solar and Diesel for Mobile Base Station in Off-grid Area –JCM/BOCM Feasible Study

(Implemented by PricewaterhouseCoopers Co., Ltd)

Study partners		A-WING International Co., Ltd
Project site		Indonesia
Category of project		Renewable Energy
Description of project		・In this project, electricity supply from hybrid power system; solar power system, lithium Iron(III) phosphate-ion battery, and diesel generator, Sub-power will be installed to 50 mobile base station sites at the off-grid area. 50 sites location will be determined. ・Power supply from solar system by capitalizing abundant sunshine, CO2 emission from fossil fuel will be reduced as a result of reduction of fuel for diesel generator.
JCM methodology	**Eligibility criteria**	1. Project site should be mobile base stations (MBS) in off-grid areas. (All MBS covered in this project are in off-grid area) 2. Install a new solar power generation at a site where no renewable power generation was operated prior to the implementation of the project activity.(All MBS covered in this project are already existing ones) 3. In case of existing MBS, prior to the project, diesel generator directly supplies electricity to the mobile base station. 4. In case of new building MBS, diesel generator is installed as sub-power supply source. 5. Hybrid system is the combination of the devices and technology: diesel generator, solar power, and storage battery, and operated without personal at the off-grid area 6. Installed solar power generation system substitutes for a part of a power supply by diesel electric power generation.(In this project, 70% of electricity is supplied from solar power and 30% is supplied by diesel generator.) 7. Adopt environmental safety storage, except a lead storage battery and a nickel cadmium storage battery in consideration of "the risk of environmental pollution" (In this project, lithium Iron(III) phosphate-ion battery, which is environment friendly

		and long life, is used.)
	Default values	The most fuel efficient diesel generator's fuel consumption rate on the catalogue which is available in the market.
	Calculation of reference emissions	Diesel fuel consumption and CO2 emissions attributed to diesel fuel are used as reference emissions for calculation, provided that the total amount of power supply required by mobile base stations in off-grid areas is accommodated by diesel generators.
	Monitoring method	**Monitoring parameters:** After completion of project (both new building and existing).Amount of electricity by solar system as main system ● Amount of electricity by diesel system as Sub-power system. ● Fuel consumption of diesel generator ● Fuel amount consumed by diesel system **Monitoring Frequency:** (1)Project electricity output (power production) by solar power generation ● Collecting electricity output data with validated/calibrate electricity monitoring devices (data logger) continuously ● A Maintenance staff purchases stocked data from a data logger and input to a spreadsheet electrically in every 6 months. ● Verified monitoring devices are installed and they are calibrated (2)Project electricity output (power production) by diesel generation as sub-power supply ● Collecting electricity output data with validated/calibrate electricity monitoring devices (data logger) continuously ● A Maintenance staff purchase stocked data from a data logger and input to a spreadsheet electrically in every 6 months. ● Verified monitoring devices are installed and they are calibrated
GHG emission reductions		**Calculation of emissions reductions:** Emission Reduction amount, ER is calculated by the difference between Reference emissions and Emission amount from the project as below, ER ＝ RECO2 － PECO2 PECO2 of Renewable energy is 0, therefore, ER ＝ RECO2

	ER Emission Reduction [tCO2e/y] RECO2 Reference Emissions [tCO2e/y] PECO2 Project Emissions [tCO2e/y] **Expected GHG Reductions:** Using solar power generation as a substitute for diesel fuel is expected to reduce CO2 emissions at a rate of 2,905 tCO2/year.
Environmental impacts	There is no Legal requirement of environmental impact assessment for the proposed project.
Project plan	Project will be developed and planned by utilizing FY 2014 JCM Project Facility Subsidy Scheme.
Promotion of Japanese technologies	1. Japanese standalone technologies along with the system design technologies and knowhow that can combine such standalone technologies into a total system that will realize the optimal use of the individual technologies will be promoted. 2. Lithium-ion batteries and nickel-hydrogen batteries that are more environment-friendly, long-life, space-saving and lightweight than lead storage batteries, will be promoted.
Sustainable development in host country	1. Development of skilled human resources and creation of new jobs in Indonesia 2. Provision and expansion of distributed hybrid power generation systems in off-grid areas 3. Contribution to energy security in Indonesia

JCM Feasibility Study (FS) 2013
"Hybrid Power System; Solar and Diesel for Mobile Base Station in Off-grid Area –JCM/BOCM Feasible Study"

(Host country: Indonesia)

Study Entity: PricewaterhouseCoopers Co., Ltd

1. Study Implementation Scheme

Country	Organizations involved in the study	Description of contribution
Japan	PricewaterhouseCoopers	Designed and performed the study and organized the entire performance of the study. as the main organization of this study project. Also planned the JCM project, MRV (measurement, reporting and verification) methodologies and funding.
	A-Wing International	The system integrator and storage battery supplier of the proposed project. (Will be a JCM project international consortium member.)
Host country	Gobel Dharma Nusantara	Provided information concerning the study as the photovoltaic panel supplier of the proposed project. (Will be a JCM project international consortium member.)
Host country	Telkomsel	Provided information concerning the study as the user of the solar power generation systems for its own mobile telecommunications stations. (Will be a JCM project international consortium member.)
Host country	NESINDO	Provided information concerning construction and maintenance as a telecommunications facilities constructor

2. Overview of Proposed JCM Project

(1) Description of Project Contents:

(1) Project overview

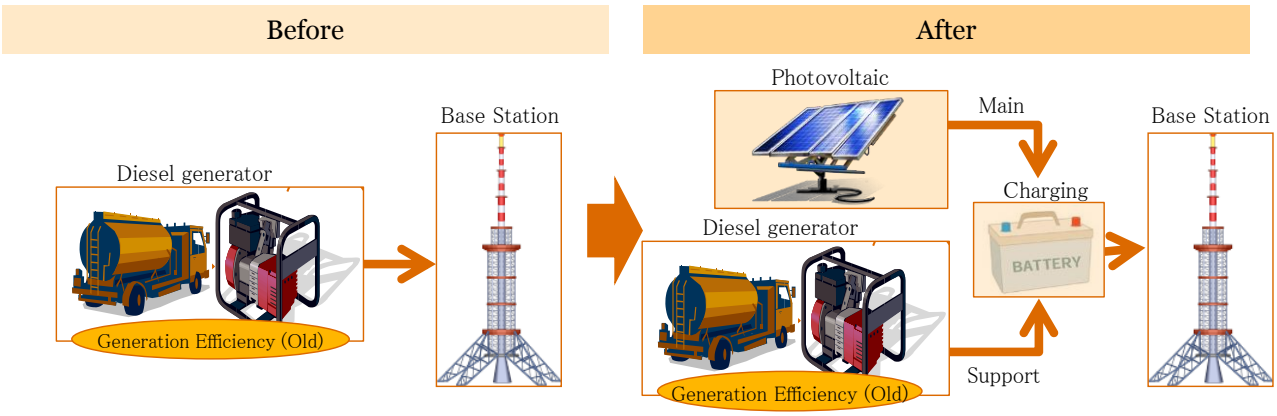
In Indonesia, the number of mobile base stations is increasing and telecommunications network traffic is becoming heavier, so that the energy consumption and CO2 emissions of mobile base stations are rising. Especially in off-grid areas, where the power supply of mobile base stations is dependent on diesel generators, needs for solar power generation systems and storage batteries are growing, not only for increase in energy efficiency and reduction in CO2 emissions but also for management cost reduction associated with power generators and fuel supply.

The owner of this present project is Telkomsel, which occupies the largest share among state-run telecommunications companies in Indonesia. This project is associated with the conventional mobile base stations powered by diesel generators. The proposal of this project is to introduce a hybrid system to such conventional stations at 50 locations at one time. The hybrid system will combine the conventional diesel power generator with solar power generation and an iron phosphate lithium ion battery. Solar power will substitute diesel fuel and reduce fuel consumption, thereby reducing the CO2 emissions attributed to fuel.

When such a hybrid system using solar power generation is introduced at 50 stations, CO2 emissions in the amount of 2,905 tCO2/year are expected to be reduced, because diesel fuel is replaced with solar power.

The project is scheduled on condition that it will be selected as a FY 2014 JCM Project Facility Subsidy Scheme. If this project is selected in July 2014, the start of construction is scheduled in September. The project will be divided into two terms, during each of which 25 stations will be transformed. The first 25 stations are expected to start operation in September 2015.

The project proposes the introduction of hybrid solar power generation to existing 50 mobile base stations; we attempted to design the MRV methodologies to make this project applicable to new mobile base stations as well, in consideration of the needs of new base stations in the host country.



(2) Situations of Host Country:

(1) Renewable energy policy

The Indonesian government includes the diversification of energy sources (an energy mix) as one of its political targets. In October 2009, the divisions related to renewable energy in the nation's Directorate General of Electricity were separated and the Directorate General of New Energy, Renewable Energy and Energy Conservation was established. The Indonesian National Energy Policy of Indonesia (2006) aimed to increase the ratio of renewable energy to 17% as of 2025; however, the Vision 25/25 strategy of the Ministry of Energy and Mineral Resources (MEMR) states a higher ratio of 25%.

The Regulation of the Minister of Finance No. 24/PMK.011/2010 was established to promote

power generation by renewable energy, in which the Indonesian government introduces tax benefits to power generation businesses using renewable energy. The solar power generation systems the present project proposes are classified to in-house power generation in this Regulation and the tax benefits will not be applicable to this project.

(2) Policy for supplying electricity to local regions

As of July 2010, 66.7% of the total area is electrified in Indonesia (according to *Electric Power Conditions in Overseas Countries 2011* issued by Japan Electric Power Information Center. The rates of electrification are different from area to area. Urban areas such as Java and Sumatra are highly electrified, while farming villages, remote mountainous areas, and eastern Nusa Tenggara and Papua areas include many areas that have not been electrified yet. In some areas only 20% to 30% is electrified. There is a regional gap.

The electrification of regional areas used to be handled only by the state-run company PLN (Perusahaan Listrik Negara, or State Electricity Company), but in 2009, Electric Power Law was established, liberating the electrification market to private businesses under the responsibility of the central government and regional governments, and independent power producers and other companies have entering the market.

In the areas outside PLN's power supply system, power supply by diesel generators and renewable energy are promoted.

(3) Telecommunications policies

To run a telecommunications business in Indonesia, the company is obliged to map out a medium- and long-run plan, apply to the national government, and receive approval. Through this transaction, specific obligations are placed on the company as specified in the Minimum Universal Service requirements, to provide a telecommunications environment in off-grid areas. However, rules or benefits concerning power supply such as the promotion of the use of renewable energy or energy efficiency are not established.

In Indonesia, the introduction of solar power generation systems to telecommunications base stations in off-grid areas has been started on a trial basis in some areas from the standpoint of diesel generator management cost reduction. According to the results of hearing surveys of the local construction and management companies that are highly experienced as the contractors of projects of the Ministry of Communications and Informatics (MCI), microcells have been installed at 100 locations as a project of state-run companies and picocells have been installed at 400 locations as a project directly run by the nation.

In off-grid areas, the central government provided funds for the construction of solar power generation stations, and local governments take charge of their construction bidding and management. New photovoltaic power stations were established at 118 locations in 2012 and at 156 locations in 2013.

The results of the hearing surveys of local companies that run EPC (engineering, procurement and construction) businesses associated with local telecommunications stations and related facilities, it

can be estimated that Telkomsel subsidiaries have needs for new telecommunications stations at one thousand locations and needs for solar-power introduction at existing 4,000 stations.

(4) Off-grid areas measures in telecommunications sectors

In Indonesia, with the spread of mobile phones, an increasing number of telecommunications stations are being built. Under such circumstances, the MCI established a law that prohibits telecom companies from owning telecommunications towers. The tower companies that build telecommunications stations supply the steel towers and power. The land use fees and energy cost are included in the rental fees paid by telecom companies.

Telecom companies do not own new towers but it is possible for telecom companies' subsidiaries to own telecommunications towers. Existing telecommunications towers are high in maintenance cost, and an increasing number of towers seem being sold.

In off-grid areas, Telkomsel and companies directly run by the nation install telecommunications stations in off-grid areas as the Minimum Universal Service requirements. Private telecom companies do not promote the construction of telecommunications stations in off-grid areas because they are not profitable. Thus built telecommunications stations in off-grid areas are powered by diesel generators, and some of them are provided with lead storage batteries depending on the locations and circumstances.

The introduction of photovoltaic generation systems has been limited to trial use in a hybrid model that uses a diesel generator and lead storage battery together. In some cases, some photovoltaic generation systems have been removed due to low profitability or failures. (In case of Imprima, one out of two systems has been removed. The picture in the following page shows a currently operating mobile base station.)

The hybrid system combining a solar power generation system, diesel power generator and storage battery has just started to be used, and there has been no case where a solar system and ion phosphate lithium ion battery are combined. The above information is based on hearing surveys conducted as part of the first and second field studies of telecom companies (Telkomsel and Indosat), tower companies, and MCI.

Photograph of a typical solar power generation system built by Imprima

Location : Sangatta, East Kalimantan, Indonesia Operational : June 2012 Components : 3 x Outback Flexmax 80 MPPT Solar Charge Controller 1 x Outback VFX 3048 Inverter 3 x Solar PV arrays (total of 60 panels, Evergreen 205Wp) 24 x 2VDC @ 2000Ah OPzV batteries (48VDC bank) Specification : 12,300 Watt-peak total 105.6 VDC MPPT input voltage 48 kWh/day Average energy input	Loads: 3G BTS : 925 Watt 2G BTS : 400 Watts OBL : 24 Watts Microwave : 125 Watts Site Light : 50 Watts Shelter Light : 12 Watts 28kWh/day average usage

(5) Telecom sector's measures for off-grid areas

The authorities in Indonesia, including the national government, MCI and MEMR, have been retaining their conventional attitude about the introduction of renewable energy and solar power generation to the telecom industry, as indicated by an opinion that authorities establish policies and private companies perform business.

On the other hand, a state-run company (Telkomsel), private company (Indosat) and

telecommunications tower company (Bersama) are interested in, and are inclined to invest in, the introduction of renewable energy such as solar power generation, as a measure to reduce the management and fuel cost of diesel generators for telecommunications stations in off-grid areas. In off-grid areas, photovoltaic stations were newly built at 118 locations in 2012 and at 156 locations in 2013, as a result of the central government's funding for solar power generation stations and local governments' handling of bidding and management.

While contribution to CO2 reduction is understood as CSR efforts, Telkomsel, a state-run company, is the most positive for CO2 reduction in the industry, and is interested in the research and development of hybrid systems that combine solar power generation, diesel generators and storage batteries.

According to Telkomsel, the local telecom company, the new introduction or updating of diesel generators at telecommunications stations has not been performed since 2008. The company regards the service life of diesel generators as at least ten years. When it builds more stations in the future, the company plans to use new systems such as a hybrid system.

3. Study Contents

(1) JCM methodology development

a. Eligibility criteria

Criterion 1	Project site should be mobile base stations in off-grid areas.

- The project shall be about the introduction of solar power generation systems to mobile base stations not supplied with electric power from national or local grids. The ratio of electrification is about 70% in the entire country. In the eastern part of the country, 30% to 40% of the area has been electrified.
- In the medium- to long-term plan of the state-run power supply company PLN, the target electrification rate is 83.4% in 2016. In consideration of the problems of geographic problems and insufficient funding for power generation and transmission, electrification is expected not to make rapid progress in off-grid areas. (* Refer to "Collected data—Eligibility.")

Criterion 2	Install a new solar power generation at a site where no renewable power generation was operated prior to the implementation of the project activity.

- We learned in the second field study that, concerning the introduction of solar power generation to mobile base stations in off-grid areas in Indonesia, the MCI's Universal Service Obligations measures and Telkomsel's efforts have been launched and that the second-place telecom company Indosat also plans to introduce solar generation. Technically, the introduction is on the trial or investigation stage, but both the governmental and private sectors are positive about the introduction, and solar generation is expected to disseminate in the future.
- The criterion is that a solar power generation system will be newly introduced to a newly built mobile base station or to an existing station power by diesel generator, the station being built where no renewable energy, such as solar, hydraulic, or wind power, has been introduced. The MRV methodologies are planned to make this project applicable both to new mobile base

stations and to existing mobile base station in which diesel generation operation has been reduced.

Criterion 3	In case of existing MBS, prior to the project, a diesel generator directly carries out the electric power supply to a mobile base station.

- In the first and second field studies, we found that most of the mobile base stations owned by the government and private companies in off-grid areas directly receive power supply from diesel generators, and that the fuel transportation cost and the management cost of diesel power generation and lead storage batteries are problematic. We also confirmed that there are needs for renewable energy such as solar power generation, which can be maintained and controlled easily and can supply power stably.
- The criterion is that, when this project is applied to an existing mobile base station, the station has a power system dependent totally on a diesel generator and is directly supplied by the generator before the implementation of the project.

Criterion 4	In case of existing new building, a diesel generator should be installed as Sub-power system.

- When the project is applied to an existing base station, it is more reasonable that solar power is added as an auxiliary power supply and that the labor and cost for the removal of the already installed diesel generator is not generated. When the project is applied to a new base station and when both solar power generation and a diesel generator are introduced, the initial investment is greater than that the conventional investment of diesel-generator installation or the investment of adding solar power to the existing diesel generator.
- Concerning this issue, we heard during an interview with Telkomsel conducted as part of the second field study that the host country and local companies prefer the research and development of an hybrid system that will use solar power and diesel power not only for existing stations but also for newly built stations. The total of the initial cost and maintenance cost during operation will need to be evaluated in reference to the life cycle cost. Nevertheless we included this as a criterion for the application to a newly installed base station.

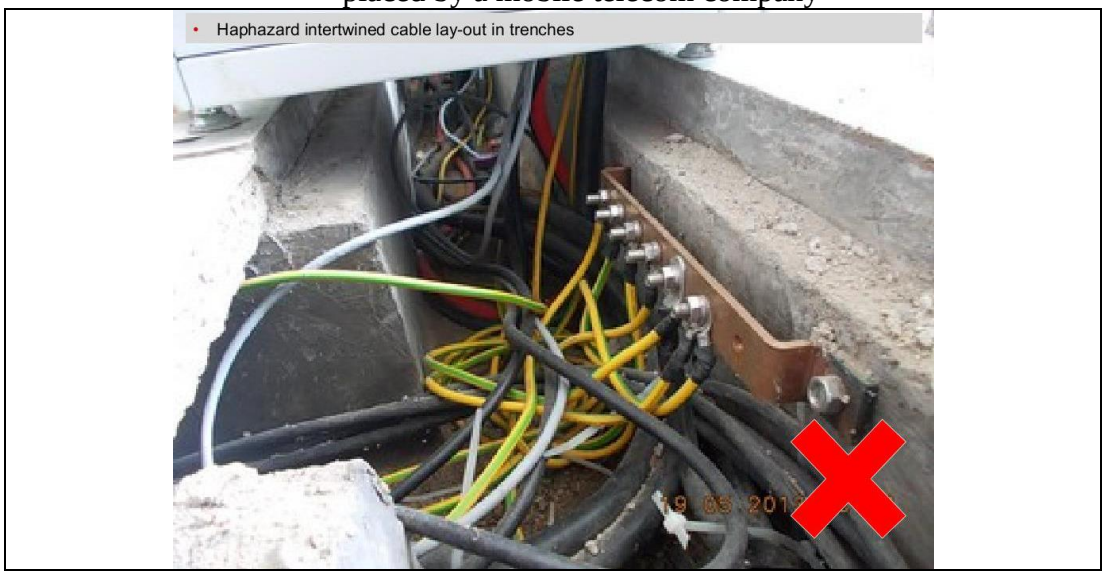
Criterion 5	To make the unmanned system operational in off-grid area by combination of each technologies and products such as diesel generators, solar power systems, and storage battery systems as “hybrid systems”.

- One of this project’s aims is to recommend and promote the excellence of Japanese technologies, including standalone technologies along with the system design technologies and knowhow that can combine such standalone technologies into a total system that will realize the optimal use of the individual technologies.
- As a result of information collection from local telecom companies and installation and control companies in the first and second field studies, we learned that there are companies that can supply individual technologies such as diesel generators, solar power generation and storage

battery, but that there is only one local system integrator, which can design, install, manage and maintain a hybrid system, which is Imprima.

- We present photographs presented by Imprima. They show the installation of a solar power generation system by a company that won a bid placed by a mobile telecom company. The photographs show that the installation technology is poor and that the construction is not performed carefully. Bid winners are not selected based on the comprehensive evaluation of technologies and cost but on the cost alone. Indonesian mobile telecom companies prefer low initial cost and are rather unconscious about failures resulting from low-price, low-quality facilities.

Photograph Installation of a solar power generation system by a company who won the bid placed by a mobile telecom company



- We believe that there is an opportunity for Japan in the following respects: meticulous technologies designed for easy maintenance and usefulness, reduced lifecycle cost thanks to the longtime use of facilities realized by high technical and installation expertise, and comprehensive services that include not only sales but also construction management and maintenance, including design, installation and operation.
- Accordingly, the criterion is that a hybrid system that combines individual technologies and products, such as diesel generators, solar power generation systems and storage batteries, is operable without human attendance in off-grid areas, such that Japan can compete with local or international companies that sell individual facilities independently and promote its combined design of multiple technologies and expertise as a system integrator. (* Refer to “Collected data—Eligibility.”, Imprima’s installation example)

Criterion 6	Installed solar power generation system substitutes for a part or all of a power supply by diesel electric power generation.

- Whether this project is applied to a new mobile base station or existing station, the main power

supply of the stations will be solar power generation; the power generated during daytime hours is stored in the storage battery, and the power saved in the battery is used during nighttime hours. To accommodate part of power with diesel power generation whose unit cost is low, and to keep the battery full and thus enable the longtime use of the battery, a hybrid system, which uses diesel generation as an auxiliary system on rainy or cloudy days when sunlight is not sufficient, will be used.

- While solar power generation is the main power supply, the solar system is not designed to substitute fully for the diesel generator. Accordingly, the criterion is that the solar system partially substitutes for the power supply by the diesel generator.

Criterion 7	Adopt environmental safety storage, except lead storage battery and nickel cadmium storage battery in consideration of "the risk of environmental pollution".

- This criterion is that the storage battery (secondary battery) should not be a lead storage battery or nickel cadmium storage battery, both of which are environmentally hostile but are common in developing countries. The criterion makes it possible to use iron phosphate lithium ion batteries, at which Japan is strong, and nickel hydrate batteries (e.g., Eneloop).
- A-Wing, the joint project company, plans to introduce iron phosphate lithium ion batteries, produced by Rocket Batteries, a Korean company by OEM. In Japan, a manufacturer sells industrial storage batteries with a large capacity of 6.0 kWh, which will enable a standalone storage system when built in solar power generation even in off-grid areas, making Japan superior in the market of storage battery technology.

b. Data and parameters fixed *ex ante*

The source of each data and parameter fixed ex ante is listed as below.

Parameter	Description of data	Source
FCR	Unit : L/kWh Fuel consumption rate of diesel generator which is generally used in host country, Default value	The most fuel efficient diesel generator's fuel consumption rate on the catalogue which is available in the market.
$EF_{CO2,\,fuel}$	Unit : kg-CO2/L CO2 emissions factor of fuels	IPCC guidance 2006, or own emissions factor of fuels in host country

To use the fuel consumption rate of a diesel generator that is common in the host country as the default value, we collected information from telecom companies that use diesel generators at mobile base stations and from Indonesian company Sewatama, which is an energy provider that rents power generators for such uses as construction sites and private in-house generators.

Telkomsel has the greatest share in Indonesia, which has experienced in building government-sponsored stations and its own base stations in off-grid areas. We confirmed the two manufacturers of diesel generators the company uses, and were thus introduced to Kubota and Olympia, and collected catalogs. Because the two companies are the top two manufacturers of diesel

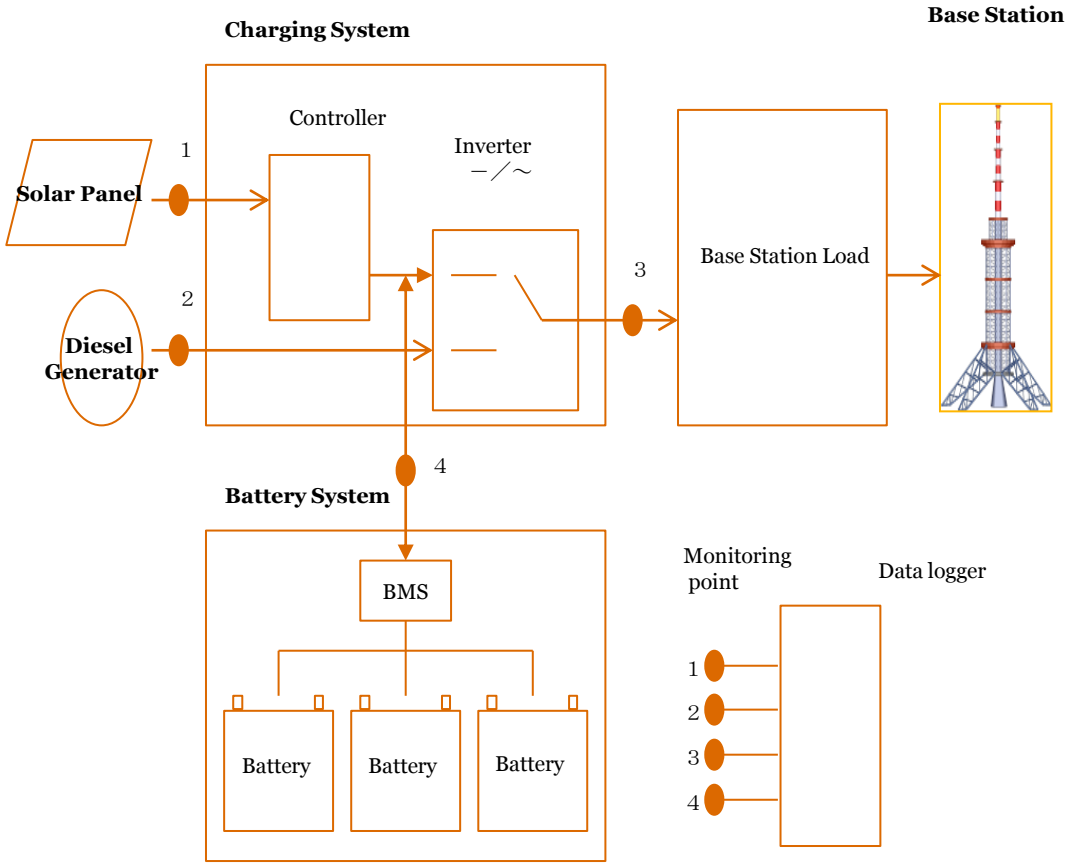
power generators at Telkomsel's telecommunication base stations in off-grid areas and because thus the numbers of manufacturers and models are limited, we find the specification values of the two company's models optimal as default values.

c. Calculation of GHG emissions (including reference and project emissions)

C.1. All emission sources and their associated greenhouse gases relevant to the JCM project.

Reference emissions	
Emission sources	GHG type
Diesel fuel consumption by diesel generator used as a power supply of a mobile base station	CO2
Project emissions	
Emission sources	GHG type
Electricity generated by solar power generation system used as a main power supply of a mobile base station	CO2
Diesel fuel consumption by diesel generator used as a sub-power supply of a mobile base station	CO2

C.2. Figure of all emission sources and monitoring points relevant to the JCM project



Monitoring Point 1：Electricity Generation amount from solar power
Monitoring Point 2：Electricity Generation amount from diesel generator
Monitoring Point 3：Actual Electricity supplied amount to mobile base station via charging system
Monitoring Point 4：Point to figure out battery life

Monitoring is conducted coincident with maintenance every 6 months following to internal rules of Telkomsel. Maintenance staff of the local maintenance company outsourced by Telkomsel Regional office collets USB which saves data from data logger.

C.3. Estimated emissions reductions in each year

Year	Estimated Reference emissions (tCO_{2e})	Estimated Project Emissions (tCO_{2e})	Estimated Emission Reductions (tCO_{2e})
2015 *1	4,150	1,245	2,905
2016	4,150	1,245	2,905
2017	4,150	1,245	2,905
2018	4,150	1,245	2,905
2019	4,150	1,245	2,905
2020	4,150	1,245	2,905
2021	4,150	1,245	2,905
2022	4,150	1,245	2,905
2023	4,150	1,245	2,905
2024	4,150	1,245	2,905
Total (tCO_{2e})	41,500	12,450	29,050

*1: The first year of calculation is based on the assumption that this project will be selected as a JCM/BOCM project in July 2014.

(2) Development of JCM Project Design Document (PDD)

(1) Designation of project sites and regions

This project plans to introduce a photovoltaic generation system to the existing mobile base stations (diesel generators at 800 locations) and new stations of Telkomsel, which owns the largest share in Indonesia, according to the company's plan of expanding telecommunications networks to cover 33 states, 54,000 regions, and a population of 120 million. Because of the company's business strategy, the project area is mentioned only as the eastern part of Indonesia (designation of a broad area); however, as the negotiation for the contract proceeds, it may become possible to disclose more specific locations.

(2) Necessity of environment assessment

This project is not subject to the environment assessment that is required for public projects and

large-scale development projects. Telkomsel explained us that the space needed newly for a photovoltaic generation system and storage battery is about 9 m^2. The risk of damage to the natural environment in the installation, construction, transportation, removal of mechanical facilities is small, but the biggest considerations need to be taken to conserve the natural environment. Concerning the removal, transportation and disposal of existing facilities (such as lead storage batteries), instructions to contract companies and on-site check will be necessary for proper considerations to be provided in case of battery electrolysis leakage and for proper handling of removed lead batteries, to prevent environmental contamination due to harmful chemicals and heavy metals.

(3) Designation of stakeholders who will participate in the negotiation among local stakeholders, and how to perform the negotiation

Concerning stakeholders consultation, we conducted negotiation through hearing surveys and interviews. The main stakeholders who are actually associated with this project are marked with a black circle.

Public Sector	• MCI, Agency for the Assessment and Application of Technology (BPPT), Ministry of Energy and Mineral Resources (MEMR), etc.
Project Partner	Project Owner: Telkomsel (mobile telecom company) Partner as a supplier: Gobel Dharma Nusantara (photovoltaic panels) EPC candidate: Japanese trading house
Local Community	• Locals near project sites * Because project candidate sites were not designated at the time of this study, our understanding is based on the results of hearing surveys conducted on local residents and contract companies when we visited already built stations sites (third field study).
Industry sectors	PLN (state-run electric power company), NESINDO (construction and maintenance), Imprima (competitor), telecom and tower companies, telecommunications base station investment companies, etc.
Association, /NGO	• Indonesia renewable energy Association (IREA), Indonesia chamber of commerce (KADIN), etc.

(4) Monitoring plan (including the monitoring system and the storage of obtained data)

This project is intended for the telecommunication base stations that are Telkomsel's assets. Therefore, the participation of Telkomsel in the monitoring system, data collection and saving is essential. It is highly likely to farm out periodical monitoring to the maintenance company that is a contractor of Telkomsel's Regional Office. Telkomsel explained that, when it participates in the JCM project, it intends to use the current monitoring system that is not used for JCM, build an in-house system and ensure human resources about the MRV of CO2 emissions reduction.

(5) Matters concerning the use of measurement facilities

We were explained by NESINDO, the telecommunication construction and maintenance company, to consider the following: equipment for measuring power consumption is not provided for current diesel generators and telecommunications stations, that additional equipment will be necessary to

measure the power generation by the photovoltaic system installed in this project and the power supply to the telecommunication base station, and a logger system that sends data by communication will be costly.
This project intends to provide a data logger as part of monitoring equipment, and to use a reasonable method by which accumulated data will be collected by USB or other methods at the time of regular maintenance.

(3) Project development and implementation

a. Project planning

In Indonesia, the number of mobile base stations is increasing and telecommunications network traffic is becoming heavier, so that the energy consumption and CO2 emissions of mobile base stations are rising. Especially in off-grid areas, where the power supply of mobile base stations is dependent on diesel generators, needs for solar power generation systems and storage batteries are growing, not only for increase in energy efficiency and reduction in CO2 emissions but also for management cost reduction associated with power generators and fuel supply.
In this project, the hybrid system of solar power generation in which the diesel generator is incorporated with iron phosphate lithium ion batteries will be installed to diesel generator dependent mobile base stations at 50 locations, reducing diesel fuel and thus reducing energy-attributed CO2 emissions.

Project organizing body	Telkomsel, A-Wing International, Japan-based EPC operator consortium Project owner (entity to which facilities will be introduced): Telkomsel		
Initial investment	186,450 (thousand yen)	Scheduled start of construction	September 2014 * When this project is selected as a JCM project in June 2014, two months will be required for Telkomsel in-house transactions.
Yearly maintenance and running cost	3,000 (thousand yen)	Lead time	12 to 14 months * 6 months for measurement and design investigation, construction, installation and trial operation 6 to 8 months (two terms each 25 locations; one term for 3 to 4 months)
Intention of investment	Yes (Start of operation in fiscal 2014)	Scheduled start of operation	Sep. 2015 (locations covered in term 1)
Funding method	Both initial investment and maintenance/running cost will be covered by Telkomsel's own funds. For initial investment, FY 2014 JCM Project Facility Subsidy Scheme Program is planned.		

GHG reduction	Diesel fuel substituted by solar power generation 2,905 (tCO2/year)

b. MRV structure

As the Project organizing body in the table in section a. above indicates, negotiation will be performed with A-Wing and Telkomsel, on condition that a project will use JCM Project Facility Subsidy Scheme.

An EPC company will be a Japanese company that will be selected from among those that will accept participation in the JCM scheme. Regarding the MRV methodologies used by an international consortium in which the EPC will take part in, all of Telkomsel, GDN, and A-Wing understand that there will be no problem about the resources of the monitoring implementation and the construction of the monitoring system. The point of contact with the JCM joint committee will be A-Wing or EPC company as a Japanese company. However, PricewaterhouseCoopers intends to support PDD preparation and monitoring and reporting until the point of contact understands the rules and transactions of JCM and becomes able to function as the point of contact smoothly.

Table MRV Monitoring System (proposal)

Responsible personnel	Role
Project Manager (EPC)	Responsible for project planning, implementation, monitoring results and reporting
Project Owner (Telkomsel)	Appointed to be in charge of approving the archived data after being checked and corrected when necessary.
Facility Managers (A-Wing Indonesia)	Appointed to be in charge of monitoring procedure (data collection and storage), including monitoring equipments and calibrations, and training of monitoring personnel.
Operators (Local Maintenance Company)	Appointed to be in charge of collecting data from data-logger and checking the archived data regularly

c. Permission and authorization for the project implementation

According to Telkomsel's procurement rules, the photovoltaic panels and iron phosphate lithium ion batteries used in this project need to be approved and authorized by the Indonesian government's Agency for the Assessment and Application of Technology (BPPT). Regarding photovoltaic panels, Gobel Dharma Nusantara, a candidate company for the consortium, has already obtained the authorization and approval of Panasonic modules by the BPPT. The authorization and approval of iron phosphate lithium ion batteries will be applied for about the time of the introduction of the equipment after the contract with Telkomsel is almost completed. There will be no technical problem, but coordination is ongoing for the authorization and approval of the batteries

to be obtained when the facilities will be introduced

As described section a. above, we intend to proceed with the negotiation with Telkomsel in the future to reach a comprehensive, all-inclusive contract, which will realize a business model that will be a total package of facility sales and O&M. We intend to negotiate with those concerned with the project such that the introduction of solar generation to stations at 50 locations will be realized.

d. Japan's contribution

Based on interview and document studies, Japanese can make contributions by transferring excellent Japanese technologies and products, investing in the host country, creating jobs and developing human resources.

- Technical transfer: For photovoltaic panels and lithium batteries (storage batteries), Panasonic and other Japanese companies' production in Indonesia will be surveyed and research and analysis will be performed about the transfer.
- Battery technology: In consideration of environmental contamination risks, we intend to investigate the application of iron phosphate lithium ion batteries, about which Japanese companies are superior, as well as nickel hydride batteries (e.g., Eneloop), as storage batteries (secondary batteries). Lead storage batteries and nickel cadmium batteries will be excluded from the investigation (these are common in developing countries but very hostile to the environment).
- Amount of investment in the host country: We intend to interview related parties such as Telkomsel and Indonesian Renewable Energy Society and estimate the total investment on condition that Telkomsel and entire telecom companies introduce solar power generation systems.
- Employment effects: As a country where petroleum is abundant, engineers specializing in renewable energy have not been trained. We will study the required number of engineers and placement for the installation of photovoltaic panels and storage batteries, maintenance, etc., and will analyze and evaluate employment effects.

e. Environmental integrity

To ensure the integrity of the environment, we checked the following to make sure that the implementation of this project will not damage the environment or increase environmental hostility:

(1) Cares to be taken for the environment

Regarding the base station installation and construction in off-grid areas, consideration is necessary for the conversation of the natural environment. In the interview with Telkomsel, 9 m^2 equipment introduction space can be provided at each station. According to NESINDO, which will install and maintain stations, the placement of photovoltaic panels in the stations can be installed without damaging the natural environment, such as cutting trees in the mountains in the vicinity.

Currently Telkomsel uses lead storage batteries. When they are left outdoors for a long time, electrolysis liquid may leak. When lead storage batteries are disposed of, lead contamination risks are concerned. Using lithium storage batteries as storage batteries, which will have a longer service

life and do not include harmful lead or sulfuric acid, hostility to the environment will be reduced.

(2) Measures for prevention of adverse influence

In the process of installation and construction, instructions should be provided for construction contractors not to damage the environment, such as inadvertent tree cutting in the vicinity of stations. The project owner will also check it using photographs to make sure unnecessary tree cutting is not performed.

When existing lead storage batteries are replaced with lithium storage batteries, the removal of lead storage batteries should be properly checked from the standpoint of the waste producer's responsibility and proper instructions should be provided for construction contractors. We should check the site, to make sure that lead storage batteries will not be disposed of illegally or they will not cause environmental contamination.

When this project is actually implemented, the following should be confirmed, to prevent environmental damage and hostility increase:

- When a generator is removed due to a shift from conventional generation facilities to a solar power generation system, the removed generators will not be used on other sites.
- When the existing generator remains installed as an auxiliary generator, the operating ratio of the generator should be checked to be sufficiently low after the implementation of this project.

f. Sustainable development in host country

Based on the results of field research and the opinions and instructions from third parties obtained through interviews with stakeholders, we have summarized about contribution to sustainable development.

(1) Skilled human resource development and employment creation in Indonesia

- Human resources who can do the maintenance of solar power generation systems and specialized skills are not sufficient. The BPPT has a training institute for human resource development, and it explained that it is experienced in organizing training programs for the central government. When needs for maintenance staff grow, capacity building programs by the government to develop human resources with specialized skills may be possible.
- By expanding solar power generation systems, domestic panel and other equipment manufacturers and installation and maintenance companies will increase in number, creating jobs and developing industries related to solar power generation.

(2) Spreading and expansion of distributed hybrid systems in off-grid areas

- To support the economic growth of Indonesia, the preparation of stable power generation facilities and establishment of power transmission lines are essential. The promotion and expansion of this project will realize a telecommunications network across the country by creating telecommunication base stations having power generation function in off-grid areas

where power is not supplied, and may create a foundation on which new industries and markets will be generated.

- Installing the solar power generation system-based telecommunication base stations like this not only in the off-grid areas where the stations are already provided but also in the areas where no stations are provided now, sustainable and environmentally friendly power generation facilities will be distributed in off-grid areas.
- In this project, solar power generation systems are provided to operate telecommunication base stations in off-grid areas; however, extra power to be used to operate stations, for example, may be used by people in the vicinity where the stations are installed. By building such a system, the life quality of the local people may improve, and it is highly possible that the "last one mile" problem that the external power network has not solved can be solved by the base stations.

(3) Contribution to national energy security

- The MCI we interviewed did not grasp the power consumption by the telecommunication and information industry currently (c.f., the Indian government understands the growth of energy consumption by the telecommunications and information industry and is taking measures), but the ministry understands that, with the growth of smartphone users, the information data traffic and energy consumption will grow.
- As an effort to reduce energy consumption in the telecommunication and information industry, this project may help lead social attention attention to telecommunication and information industry in terms of energy consumption, and the project will also contribute to the energy security to Indonesia, even if it may be slight.

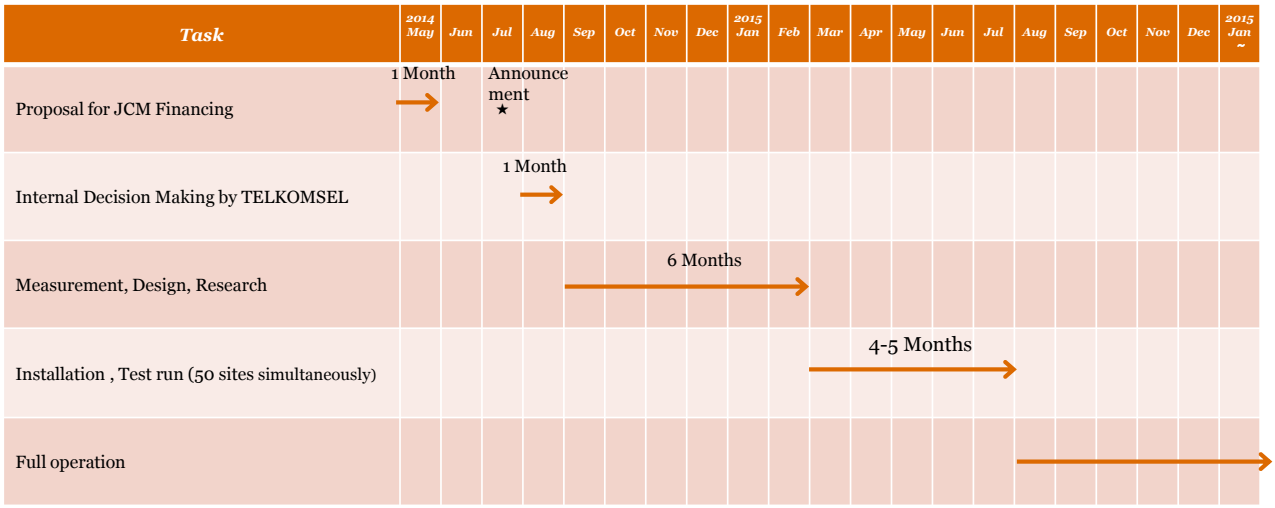
g. Toward project realisation (planned schedule and possible obstacles to be overcome)

(1) Investigation and discussion with Telkomsel for the project subsidized by the JCM/BOCM Facilities Subsidy Program

Telkomsel is positive about making this project to be subsidized by the JCM/BOCM Facilities Subsidy Program; however, the project plan designed by this feasibility study needs to be discussed and approved (for 50 locations, project scale, lead time including the period for the application, and funding plan).

Currently, we expect that this project will be designated as a JCM/BOCM project in July 2014, and maps out the following implementation schedule.

Schedule



There are the following three problems that will need to be solved in the future.

(1) Integration of Multiple sites

JCM scheme building to integrate 50-60 sites to one JCM project.

(2) Patterning Hybrid System Design

Tailor-made System Design per site increases cost, so patterning customization is required.

(3) Collaboration with Local company

Collaboration with local construction company is required for constructions, maintenance & monitoring. This can contribute to technology transfer of solar power system, system design and job creation.