

SUBMISSION FORM

Please fill out this form and return it to info@esci-ksp.org and d32375@tier.org.tw

Pillar

- Smart Transport
- Smart Building
- Smart Grids
- Smart Job and Consumers
- Low Carbon Model Town

Basic Information

Program name:

Please provide the program title. The title should be brief, unique, and informative.

Responsible organization:

Please enter the name of the responsible organization.

Strategy:

Innovativeness

In 2009, Typhoon Morakot, more than 3000 mm of rainfall, muddy stroke Pingtung coastal subsidence area seriously, caused the orchards and fish farms reconstruction difficult. With the reconstruction, Pingtung County Government rethinks the relationship between the natural environments. In order to find a way out for the affected area, to promote "raise water grow electricity" plan, Pingtung is the largest commercial solar energy area in Taiwan. Farmers and fishermen get incomes by selling solar energy. Fish farms also become home detention ponds. Pingtung County Government integrate solar energy, wind energy, biogas power generation and other renewable energy sources further, development "radiance wetland smart micro grid" plan , establish the regional autonomy renewable energy and smart supply mode, create a climate change and renewable energy wetland education park. By implementation of the low carbon living, Pingtung County becomes the green innovative leader's city in Taiwan.



Typhoon Morakot

Inspiration

Pingtung County, Taiwan, was one of 100 cities or other jurisdictions selected to receive a Smarter Cities Challenge grant from IBM as part of its citizenship efforts to build a Smarter Planet, 2013. During three weeks in November 2013, a team of five IBM experts worked to deliver recommendations on a key

challenge identified by PingTung County Government. According to the report, Pingtung County Government should have the long-term strategy for renewable energy.

Based on the establishment of smart micro grid demo site in Linbain Township, Pingtung County becomes the green innovative leader's city in Taiwan, which utilizes the self-sufficient renewable energy to improve the energy utilization, strive to increase the renewable energy benefit, and optimize the quality of the life. Through the development of micro grid, biogas generation and solar farm to reserve water, Pingtung County continuously promotes the relevant projects, implements the renewable energy, and plans the long-term blueprint for 2020 years, towards the green innovative leader of the city.

It is expected that the capacity of photovoltaic system will rise up to 100MWp including solar farm to reserve water in phase II and sunshine community in Pingtung County. After the integration of micro grid system, the reliance on the outsourcing electricity can be reduced, and the constraint of installed capacity can be improved. In doing so, the vision of million sunshine rooftop plan proposed in Taiwan is reachable. The long-term development not only mitigates the importing energy, but keeps the promise of carbons reduction in the world. It can accelerate the green industry to become more and more mature in the world.

Clearness

Pingtung County Government development " radiance wetland smart micro grid " plan , all power in the area come from renewable energy, including solar energy and wind energy, is the first community operation of smart micro grid system in Taiwan. Not only to reduce the cost caused by the long-distance power transmission, it also has both black start and off grid-connected mode, converting micro grid smoothly between off grid-connected and on grid-connected modes, and also ensuring micro grid power uninterrupted. Merging public art designs with solar energy creates not only a public recreational park, but also provides a developmental and educational platform for clean energy.

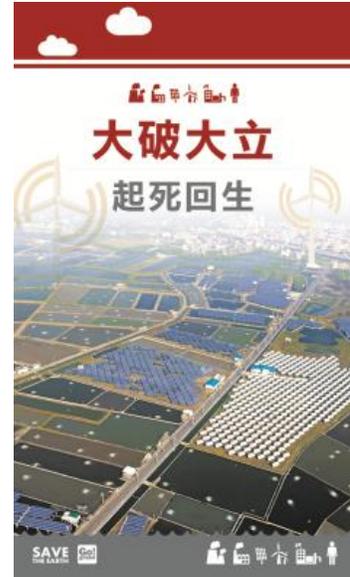
Please refer to the attached criteria to provide further information.

Measure:

Practicability

Goal :

Due to the budget and environment limits, the request for proposal (RFP) in the demonstration park requires to install at least capacity. The goal of photovoltaic is at least 50 kWp and energy storage is at least



Reconstruction



150kWh. The system integrator companies proposed the optimal combination of photovoltaic and energy storage based on their solutions. After the competition, the selected company planned and installed 78kW photovoltaic and 159kWh energy storage.

Besides, the operational function of smart micro grid is defined in the request for proposal (RFP) including black start, smoothly changing between off grid-connected and on grid-connected modes, continually operating off grid-connected mode at least 72 hours, and etc.

Replicability

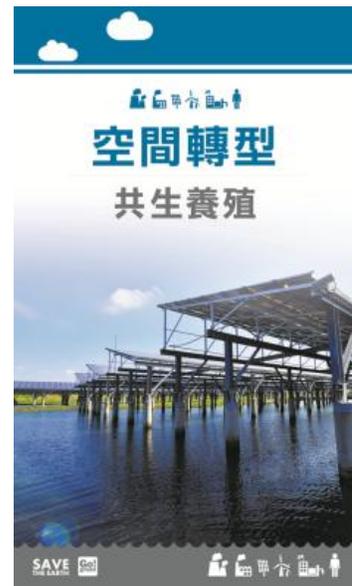
1. International:

From the report of International Energy Agency in 2012, one of fifth people about 26 million living in Southeast Asia lacks water and electricity. Micro grid plays an important role for them to establish the locally reliable and independent energy. Electrification can be easily achieved by the individual villages, not by the nation's huge investments of power plant and transmission power line.

Micro grid is considered as a new business opportunity, especially for the village-based scale, which is hundreds of kilowatt. The demonstration park is the typical village-based micro grid and suitable to duplicate.

2. SOP:

In the view of the present law in Taiwan, there exists the renewable energy paralleling rule to require the safe operation of power system. However, micro grid, which can be viewed as load or generation, cannot be suitable to any law in Taiwan's energy regulation. The demonstration park is only seen as load and can't transmit electricity back to utility. The procedure of energy management in the park is prior to local production and local usage. If there is more generation than load, the surplus energy will be stored in the energy storage. Until the storage is charging fully, the additional load will turn on to consume the extra energy. For example, water pumping is designed to circulate the pool.



Spatial Transition

Cost-effectiveness

1. Cost effective :

- Economic benefit: The local renewable energy is utilized to generate and consume by itself, battery management system is adopted to reduce the outsourcing electricity, and energy loss in transmission from a long distance can be reduced effectively.
- Environmental benefit: Reduction of the outsourcing electricity is indicated that the emission of exhaust gas produced from the fossil fuel generation is also reduced, and alleviates the greenhouse effects.
- Energy-saving benefit: The photovoltaic energy, wind power and biogas power replacing by the traditional fossil fuel energy can improve the independent energy and proportion of clean energy, and really achieve the goal of energy conservation.
- Social benefit: The park is about to become the first national certification through to climate change and renewable energy as the theme of environmental education park. Combination of the micro grid and garden environment to promote the marketing together can increase the

local tour resources, attract the visitors, drive the economic development, and achieve the goal of education.

- Industrial benefit: The effect of the micro grid demo site popularizes its achievement to other areas, gradually improves system popularity, increases the investment from other fields, makes the micro grid become the local industry's characteristic, attracts more manufacturers to participate in, and eventually increases the local employment opportunity.
- Reliability benefit: In the grid-connected case, the micro grid can self-manage locally, and increase the penetration of renewable energy. In the off-grid case, micro grid can independently operate in the islanding mode, which still supplies power without usage of outsourcing electricity, and makes the great contribution to improving the reliability of supply.

2. Reduction of emission :

- According to the announcement of BOE(Bureau of Energy) in 2014, carbon emission is 0.521 kg/kWh, photovoltaic generation in Pingtung County is 3.14 kWh/day. The photovoltaic and wind energy in the demonstration park can reduce carbon emission of 46.575 and 13.692 ton/year, respectively.
- Bio-diesel generator is designed to use when the specific activity will be held. It is assumed that the activity is held monthly, each period is 4 hours, and generator operates in half-load mode. Under this condition mentioned above, power production of 60kW installed capacity is 1440 kWh/year. Considering the equipment specification and diesel fuel characteristics, 1 kWh consumes 0.2531 kg in diesel, 1 liter diesel weights 0.86 kg, and 1 liter diesel produces 2.615 kg in CO₂. Eventually, B20 (20%) biomass is adopted to reduce diesel fuel, and reduction of carbon emission is 0.2216 ton/year.

Item	Capacity (kW)	Energy (kWh/year)	Reduction of CO ₂ emission (ton/year)
Photovoltaic ¹	78	89395.8	46.575
Wind ²	10	26280	13.692
Biomass ³ (B20)	60	1440	0.2216

Note: 1. $78\text{kW} \times 3.14\text{kWh/day} \times 365\text{day} = 89395.8 \text{ kWh/year}$
 $89395.8 \text{ kWh} \times 0.521 \text{ kg/kWh} = 46575 \text{ kg}$
 2. $10\text{kW} \times 24 \text{ hour/day} \times 365\text{day} \times 30\% = 26280 \text{ kWh/year}$
 $26280 \text{ kWh} \times 0.521 \text{ kg/kWh} = 13692 \text{ kg}$
 3. $60\text{kW} \times 50\%\text{usage} \times 4 \text{ hour/month} \times 12 \text{ month} = 1440 \text{ kWh/year}$
 $1440\text{kWh} \times 0.2531 \text{ kg/kWh} \div 0.86\text{kg/L} \times 2.615 \text{ kg/L} \times 20\%(B20) = 221.6 \text{ kg}$

Consistency

In order to know the consistency of the demonstration park, National Central University had involved to analysis the activities in the park, the relationship between renewable energy, Energy storage and the load consumption. National Central University also provides the plan of the micro grid in further.

Please refer to the attached criteria to provide further information.

Performance:

Completeness

1. Renewable Energy:

Primary energy is locally produced from the diversity of photovoltaic (78kW), wind energy (10kW), and bio-diesel generator (60kW) to support its own local usage. This integrated energy system can operate independently without the existing utility's grid.

2. Energy Storage:

High-voltage (DC 633V) and high-capacity (159kWh) energy storage made of lithium iron phosphate (LiFePO₄) is adopted to accommodate all energy production and load consumption in the demonstration park. The charging /discharging strategy is based on the efficient energy management.

3. Load consumption:

The smart electricity meters are deployed to monitor the whole load consumption of 40kW in the park. Each participant can see his/her own energy usage and the overall energy status. The demand-side management achieves the load shedding and load shifting from peak to off-peak hours. The priority of load shedding and the uninterrupted load in the park can be defined.

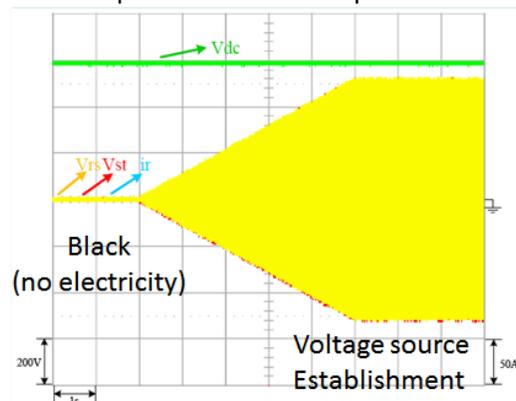


Smart Micro Grid

Verifiability

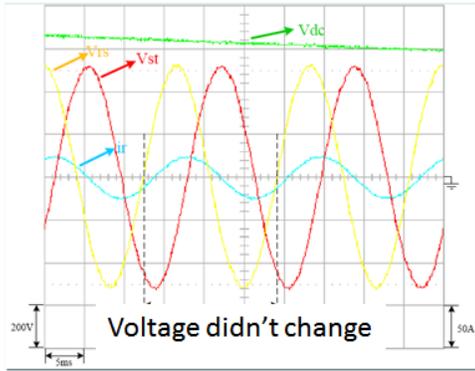
1. Black start:

From the beginning of no electricity, the electric power in the park can be established without the power source from utility's grid and diesel generator. In the event of a blackout, the reliable and quick recovery of power supply is the most important issue in the park.

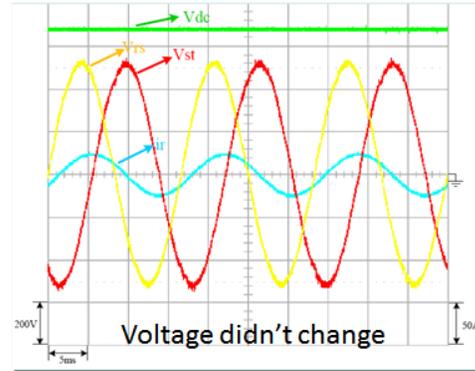


2. Off/On Grid-Connected Mode:

Smart micro grid in the demonstration park can operate either in the off grid-connected mode, which is not connected to a local utility's grid, or on grid-connected mode, which is integrated into the utility grid. Two modes are changing smoothly without any load interruption.



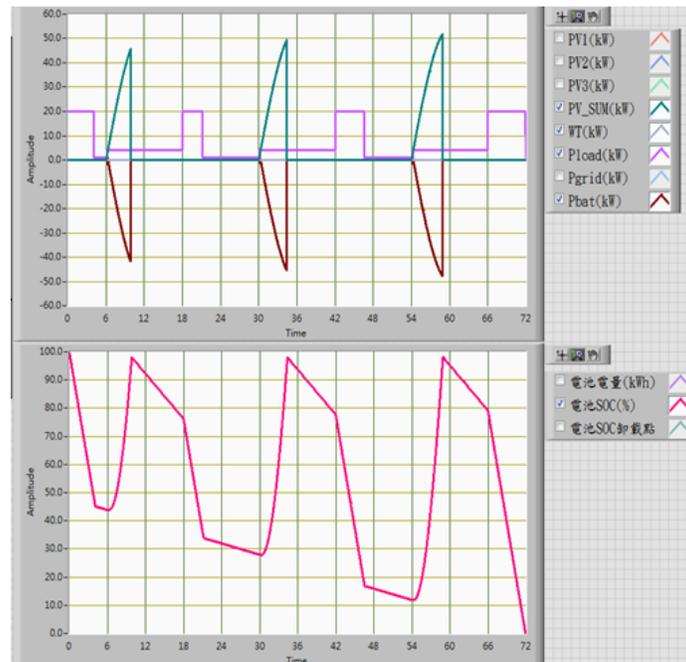
On grid mode transfers to off grid



off grid mode transfers to on grid

3. Off Grid-Connected Mode at Least 72 Hours:

In the off grid-connected mode, smart micro grid can operate at least 72 hours without the utility's grid and diesel generator.



Impact

1. Education :

The internal user in the park can see his/her own energy usage and the overall energy status. It helps people know the energy information visualization. In addition, the tourist guide in the demonstration park is training to introduce the whole park including smart micro grid and natural ecological environment. Since Oct. 2014, more than 3,500 of the outside visitors came to the demonstration park. It's expected that 8,000 people could visit the park annually.



2. Research :

National Taiwan University, National Central University, and Tatung University are interesting to do research on this micro grid demonstration park. It provides the significant test bed for academic research. ICLEI Europe (International Council for Local Environmental Initiatives) plan to visit the park next year.

3. Industry :

The smart micro grid established in Pingtung County gives an ideal platform for Taiwan smart grid industries to integrate their technologies, products and system. Companies can perform demonstration and integration testing in the park.

Main involving industry/research institute:



Renewable energy	Loads	Affect
<ul style="list-style-type: none"> photovoltaic energy wind power biogas power 	<ul style="list-style-type: none"> Nipa Huts Energy Center Works of Art 	<ul style="list-style-type: none"> environmental education demonstration and integration testing
	<ul style="list-style-type: none"> Water Circulation 	<ul style="list-style-type: none"> Aquaculture wastewater purification Eco-friendly Providing clean water for aquaculture nearby
<p>Additional: low-lying space for flood detention, flood channel, to reduce flooding</p>		

Please refer to the attached criteria to provide further information.

APEC Economies:

- Australia
- Brunei
- Canada
- Chile
- China
- Chinese Taipei
- Hong Kong
- Indonesia
- Japan
- Korea
- Malaysia
- Mexico
- New Zealand
- Non-APEC Economy
- Papua New Guinea
- Peru
- Philippines
- Russia
- Singapore
- Thailand
- United States
- Viet Nam

Additional Project Details

Image:

Please attach an image that represents this project, if one is available, to this email.

Upload:

LinBain Township Smart Micro-Grid-20150918.pdf

IBM1472_SCC_PingtungCounty_Report+(LR)-1.pdf

LinBain Township Smart Micro-Grid(photo)-20150918.pdf

Please attach a file associated with your project (e.g. pdf, ppt, video or image files) to this email.

Website:

Enter a project website.

Contact Information

Contact Name: Please enter your name so ESCI users can contact you with questions.

Lo, Chen-Yang

Coordinator
Research and Evaluation Department
Pingtung County Government, Taiwan, R.O.C.

Contact Email: Please enter your email address so ESCI users can contact you with questions.
a001627@oa.pthg.gov.tw