



Construction and Establishment of the Smart Micro-grid Demonstration Park in Linbain Township

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Outline

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Background

Taiwan, formerly known as "*Formosa*", which makes up over 99% of its territory, as well as Penghu, Kinmen, Matsu, and other minor islands, is at East Asia, lies between the Eurasian Plate and the Philippine Sea Plate.

Taiwan has the one of the best electricity infrastructure in the world. Taiwan power company is the only one utility, which provides excellent and stable power quality for all the citizens in main island and outlying islands. Due to the unique geographical location states above, Taiwan faces very seriously impact of natural disaster including typhoon, floods etc.. The annual statics of typhoons is shown as below, this is one of the most important reason why Pingtung County Government intends to establish the micro grid demo site, with the target for 100% of electricity supply via renewable energy combined with battery storage system, as the landmark to try to solve the electricity issues during natural disaster in Taiwan.

Taiwan Typhoon Database

Year	Total *1	Percent *2
2015 (1-8)	5	80%
2014	3	33.3%
2013	6	50%
2012	8	62%
2011	5	60%
average	5.4	57%

*1 : be hit by typhoons

*2 : strength $\geq$ intermediate level

Source : Taiwan Central Weather Bureau

Origins

- Due to long term land subsidence, a lot of land are situated under sea level in Linbain township. Guanglin and wen'an Districts, situated just behind the Linbain train station, are the worst effected areas of the storm in 2009. Both regions were flooded for more than two weeks, with the water levels rising up to two meters.
- The Costal Industry Transformation Plan
 - 「Water and electricity cultivation」 Promoting solar energy and bio-gas generation, reducing carbon footprints.
 - 「Innovative usage of green energy」 Establishing the Smart Micro-grid Demonstration Park as a part of the county's Smart City Vision.

Plots-applications and services

- The purpose of the demonstration park is to elevate energy efficiency through usage of self efficient bio-energy.
- The power grid supplies regional loads, lowering the lost of electricity that happens with long distance transmission; it can also be used as an emergency energy backup in times of need.
- Reaserch and establishment can demonstrate that micro-grids can self organize tasks like generation, storage, load balance, and connecting with the city's grid.
- Emphasizing the development of clean energy by establishing an educational platform.

Plots-park internal designs

- The establishment (**Park**) is situated behind the Linbain train station, combining a total of fourteen properties in Guanglin district. The area of the Park was calculated to be 63280.43 m²(19142 square feet 、 6.328 hectares)



Aerial Photograph



Plots-park internal designs

- Implementing **bio-energy generators** like solar panels and wind turbines into a **natural footpath** with **gayanas** and an **ecological pond**



Plots

Reusable energy



Solar energy



Wind energy



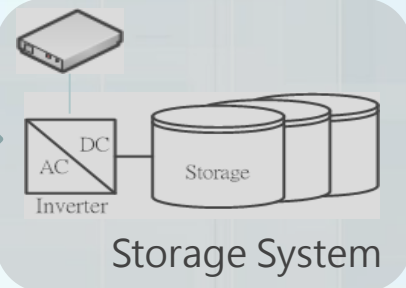
Energy Center



Control System



Security camera



Storage System



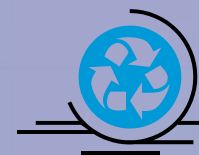
the Loads



Nipa Huts



Caretaker room



Water circulation



Taiwan Power Company

Plots-park internal designs

- **Basic Data**

Load : 40kW

Equipment : Battery 159kWh 、
PV 78kWp 、
bio-diesel 60kW,
Wind 10kWp



**100%
penetration
of
renewable
energy**

Renewable Energy Achievement



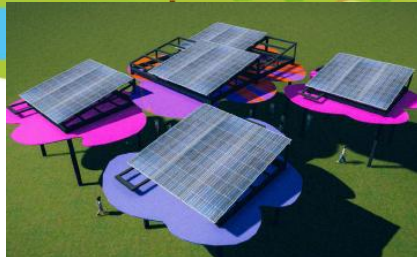
12 kWp



6 kWp



12 kWp



12 kWp



PV:36 kWp, Wind: 10kW

Energy Storage Achievement

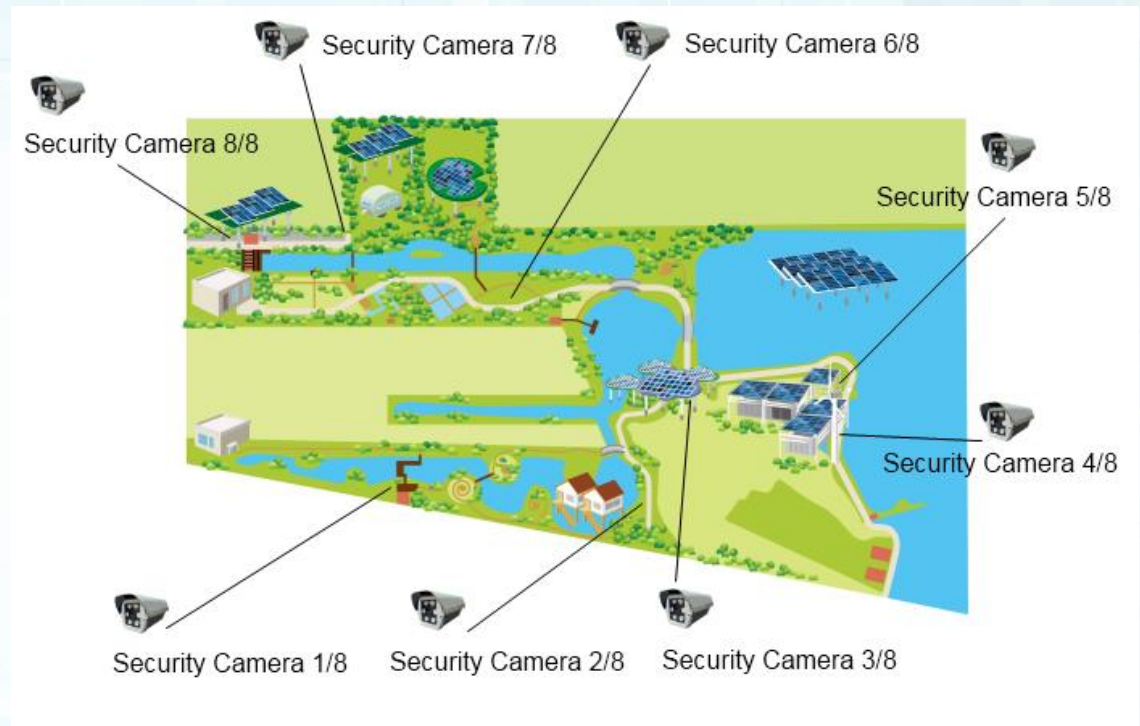


633V, 85Ah (53 kWh) per cabinet

Total energy storage is three cabinets containing 159kWh.

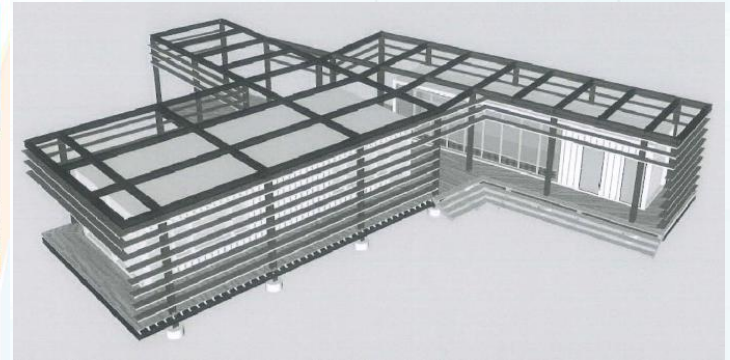
Plots-park internal designs

- **Park security**
 - Eight surveillance cameras are set throughout the park



Plots-park internal designs

- Demonstration center
 - Presenting the overall structure and active status of the supply system, loading system, and storage system.
 - A conference room and an educational platform.



Obstacles

- Conditions of supply system
 - The stability of bio-energy.
 - Generator activation predictions and micro-grid control systems help control the charge-discharge modes of the systems, stabilizing the overall change of power.
 - Independent operation, Being self sufficient
 - Combining the storage, generating, and control systems, power can be evenly distributed between different needs. The voltage and frequency are also stabilized through the system. Power generated is stored in the storage system, and released on demand. The control system switches the grid between charge-discharge modes and fine tunes the amount of power charged or released.

Obstacles

- An emergency reservoir for at least three days
 - Planning the priority loads in cases of emergency, and using smart electric meters to collect data for the control system to analyze. The control system can then predict the loads and distribute stored power accordingly, fulfilling the task of an emergency run for three days.
- Switching between individual operation and city grid supply, ensuring an uninterrupted supply.
 - The control and storage systems stabilizes supply voltage and frequency during and after switching between modes.

Obstacles

- Combining the grid with city power supplies, reducing and stabilizing the input of city supplies.
 - Smart electric meters and the control system can record data of city's supply, load demand, storage system, and generator's supply. The data is then analyzed and used as a reference in switching the micro-grid between modes, lowering the usage of city's supply and the impact caused by unstable power generation.

Waypoints

- Establishing an open demonstration system for multiple tests and research.
- Combining multiple sources of bio-energy, and developing an independent micro-grid.
- Implementing public art designs onto solar generators, providing a relaxing area for the weekends and also serving an educational purpose.
- Establishing a natural environment through the construction of the ecological lake and other greenery within the park.

Future plans

- Establishing a database for regional bio-energy research and application.
- Establishing evaluation basis for regional micro-grids and emergency adaptation.