

Innovative Technology— Smart Grid Application

Yang Jin-Shih

Taiwan Power Company

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Introduction

- In order to deal with greenhouse effect, every government is focusing on developing **renewable energy and green energy**, and establishing **smart grid** could help achieve the goal above.
- Smart grid integrates **generation, transmission, distribution and customers**. It has the advantage of automation and data-base tracking; it has the functions of self-monitoring, diagnosis and repair; it can provide **high-reliability**, high-quality, high-efficiency and clean electricity.
- For less stable **solar power and wind power generation**, when they become more commonly applied or integrated into the system, the stability could be guaranteed if they are connected to **energy storage**.
- Smart meter connects customers with two-way communication to integrate smart appliance. It could operate demand controller, control **peak-hour power consumption**, elevate **energy use efficiency** and reduce power consumption effectively.

Golden Decade–Sustainable Environment Strategies and Vision

Main goal of the policy : **Green energy**..., promote **low-carbon home** and green life of energy/water saving.

1. Promote the “ Master Plan of Energy Conservation and Carbon Mitigation”.
2. Promote demonstration communities of smart energy saving and carbon mitigation; building a low-carbon demonstration city.
3. Build **smart energy-saving infrastructures**.
4. Promote smart green architecture and execute green architecture evaluation.
5. Propose “low-carbon products exchange project”, encouraging people to switch to energy efficient products.
6. Public sectors take the lead in promoting petroleum/water/**energy**/paper saving to encourage non-governmental circles to do the same.
7. Promote Eco-Mark, carbon labeling, green procurement and **carbon neutrality**.

Low Carbon Home



Green consumption

Green marketing

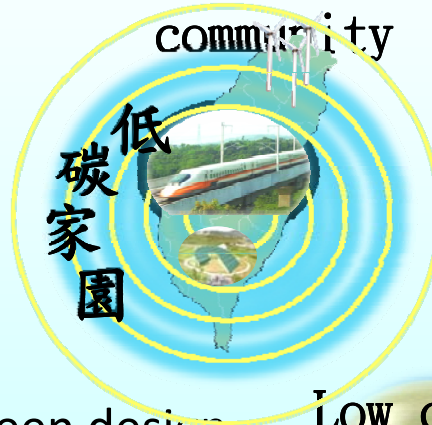
Green procurement



Low carbon economy



Low carbon community



Green design
Green production
Green supply chain

Low carbon culture



Low carbon city



Low carbon life

Build Green Communities

❑ Consult other successful examples

- ❑ The Government of Freiburg encourages people to ride on bikes or walk. It reduces the waste of petroleum and CO2 emission caused by cars. If it is necessary to use energy-consuming products, they minimize the harm by “sharing” with each other. Their efforts and insistence for sustainable environment could be seen everywhere.
 - ✓ Carpooling, in some communities, even home appliance and electric appliance could be shared.
 - ✓ More than 10 households share 2 to 3 washing machines, refrigerators and other appliance.



Green Architecture

- 6 Major Goals

- Encourage mutualism between architecture and environments; create sustainable living environments.
- Practice energy-saving of architecture; reduce CO2 emission.
- Develop indoor environment technologies and quality; create comfortable and healthy indoor living environment.
- Encourage reduction of construction waste; reduce environmental pollution.
- Improve efficient energy use technologies; maintain ecological balance.
- Reward and establish mechanism of green architecture market; develop the new look of local architecture.

- 9 Major Indexes

1. green base index
2. water retention index
3. water resource index
4. daily energy-saving index
5. Reduction of CO2 emission index
6. reduction of waste index
7. improvement of sewage/garbage index
8. biodiversity index
9. indoor environment index

Interrelationship Diagram of Green Technologies



Source :K-C Chen 2010 Green ICT development trend and application seminar

Green Business Opportunities under Climate Change

- In order to lower environmental impact and develop the industry at the same time
- Green energy and green industry has already become the emerging industry which is highly respected and developed

Field

Business Opportunities

◆ Green industry	
• Clean energy	Solar power, wind power, biomass energy, energy-saving facilities
• Green energy	Smart cars, green constructing materials, water resource, carbon trade, ESCO...
• Green competence of the industry	Non-toxic, waste reduction, recycling, carbon footprint, carbon disclosure...
◆ Extended green business opportunities	Ecological industry, green finance, energy-saving service industry

Challenges : different types of customer energy demand, evaluation of energy-saving policies of quality life, dynamic pricing mechanism, economic effects, workflow, standardizing, brand management

International Green ICT Solutions

ICT solutions	Description
智慧城市規劃(Smart city planning)	使用軟體模擬城市設計與規劃，提昇能源使用效率最佳化。
智慧電網(Smart Grid)	整合資訊與電力系統，使能源效率最大化。
智慧運輸(Intelligent transport)	整合資訊、通信、控制、車輛及機械等技術於各種運輸系統上，提升運輸效率，進而增進運輸系統之安全、效率與舒適。
智慧建築(Smart buildings)	應用軟體模擬分析，提升建築設計與使用智慧儀器及控制系統，提升能源使用效率。
整合再生能源(Integrated renewable)	利用ICT技術，提升再生能源使用效率。
IT虛擬化服務(Dematerialization)	利用虛擬化技術，取代有形產品，例如無紙化。
智慧工作(Smart work)	利用網際網路以及其他通訊工具，進行遠端工作以降低通勤所造成CO2排放量。
智慧工業(Smart industry)	利用ICT技術，促使生產流程最佳化，以達到降低成本與溫室氣減量。
智慧車輛(Smart vehicles)	發展智慧車輛，提高車輛對能源使用效率。
智慧感測元件(Smart appliances)	利用感測元件結合ICT監控產品使用狀態與履歷資訊，清楚能源耗量，警示能源不當消耗環節。

Source : WWF(2008), "The potential global CO2 reductions from ICT use."

Development Strategies of Taiwan ICT



Source: TAIWAN Digital Convergence Industry Development Forum, 2011/10/14

Promotion of GREEN ICT

- Green Communications and Green Computing
 - Total energy efficiency!
 - Not just power efficient
- Practice advanced prototype design of smart grid, create domestic ICT, power electronic, and home appliance industry's international competence.
- Rebuild the paradigm of innovation focusing on green sustainability
- Taiwan's ICT manufacturing industry plays an important role in the globe. Policies help improve Taiwan's Green IT industry chain's brand image and competence, driving Taiwan's ICT industry and brand advantages.

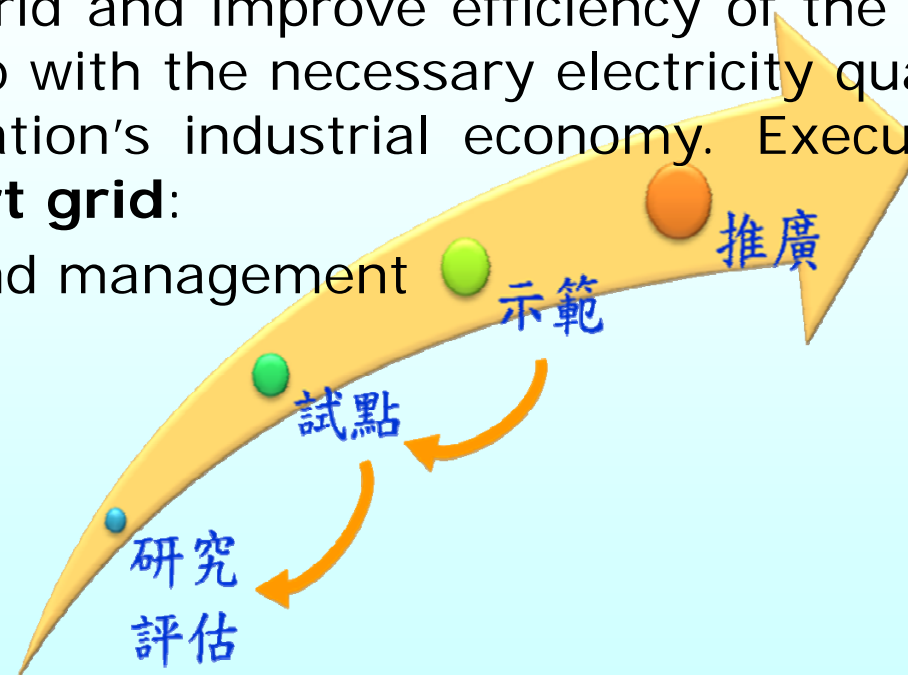
Initiation of Taipower's Smart Grid Project

- Taiwan Power Company established “Smart Grid Project Team” in 2007. Now it has developed from strategy planning to execution of the project. Taipower again established “Smart Grid Project Execution Team” in 2011.
- The situation and goal of smart grid development varies in every country or area; there are differences among their smart grid projects. Most of them focus on AMI of smart meter, small renewable energy or distributed energy, and integrate them via smart communication facilities into a grid which could be auto-controlled. Real-time monitor offers energy info to customers and electricity industry; it could almost adjust the supply-and-demand balance in no time to reduce peak-hour demand.
- For the time being, there are climate change, imbalance of supply-and-demand between the north and the south, alternative energy and development of renewable energy. The electricity industry not only has to solve the problems, but also has to keep up with the times and develop strategies. Thus, smart grid has become the focus of innovative development nowadays.

Execution of the Smart Grid Project

- In order to solve the problems of current electricity system and be prepared for the future green energy structure, improvement strategies and execution plans have been proposed after discussions, hoping to maintain efficient management of the grid and improve efficiency of the grid and energy to keep up with the necessary electricity quality for developing the nation's industrial economy. Execution strategies of the **smart grid**:

- (一) smart generation and management
- (二) smart transmission
- (三) smart distribution
- (四) smart customers



Strategies of Strengthening the Smart Grid System

1. Establish "Smart Grid Project Team", plan details of the smart grid project and proceed it in 6 target fields. Regular discussion and evaluation is made to fit demand of different phases. Besides, impact caused by distributed energy to the system is analyzed; all kinds of responding actions and solutions are evaluated.
2. Develop power facility testing technologies, establish platform of risk evaluation and skills to prolonging service life.
3. Before the liberalization, cultivate key technologies of client demand and simulate service industry's business model. After the liberalization, run the service model of "management of customer load and energy saving...etc".
4. Master practical experience overseas, establish auto measurement technique standard and open protocol.

Strategies of Promoting Renewable Energy

1. Cooperate with Bureau of Energy's scheme, execute annual highlights, continue installing new demonstration PV system for tests, add light equipments to compensate the insufficiency of sunlight around Taiwan, construct PV system database for analytical use, develop monitoring techniques, and after having enough practical experience, further promote and apply them.
2. Establish fan technique team to solve the problem of non-acclimatization by improving purchase specifications and maintenance.
3. Develop renewable energy and hydrogen storage techniques, import renewable energy storage techniques and proceed evaluation, and develop hydrogen-storage materials and containers.
4. Develop high-temperature and room-temperature fuel battery, along with coal-gasification-fuel battery combined-cycle power system and development of micro-grid, integrate hydrogen production and heat recycle system into low carbon generation system, improving efficiency of fuel use.

Energy Conservation - AMI

□ AMI

- Components: smart grid, communication network and control center.
- Function: replace manual meter reading, support real-time electricity price (control peak-hour load), provide electricity usage info to customers (encourage energy-saving), support signal transmission to control customer load, support fault detection, manage outage, and theft detection...etc.

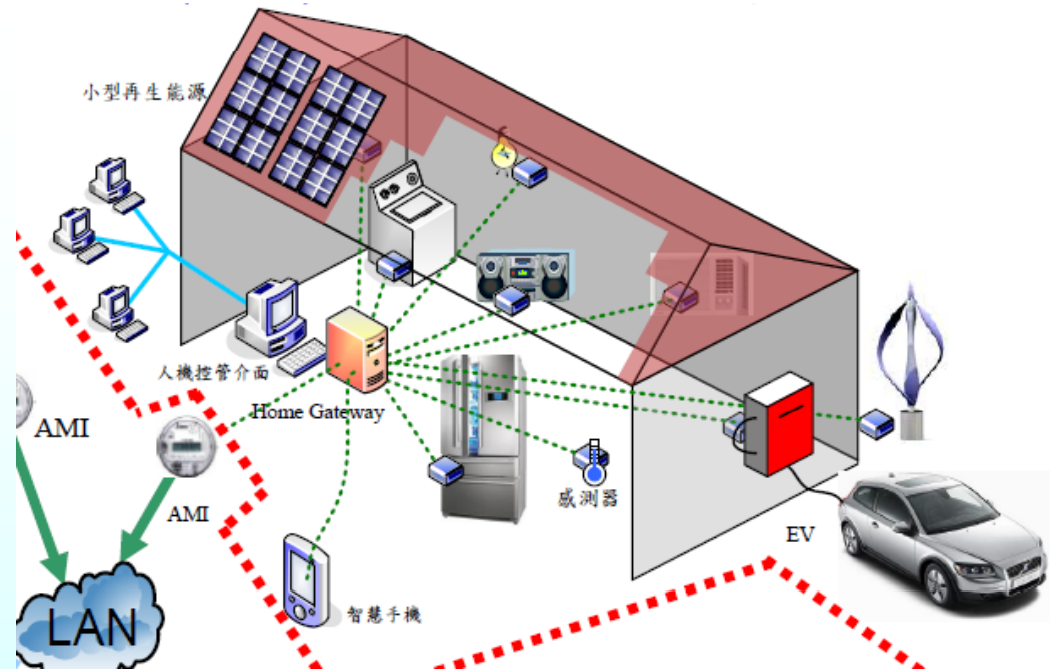
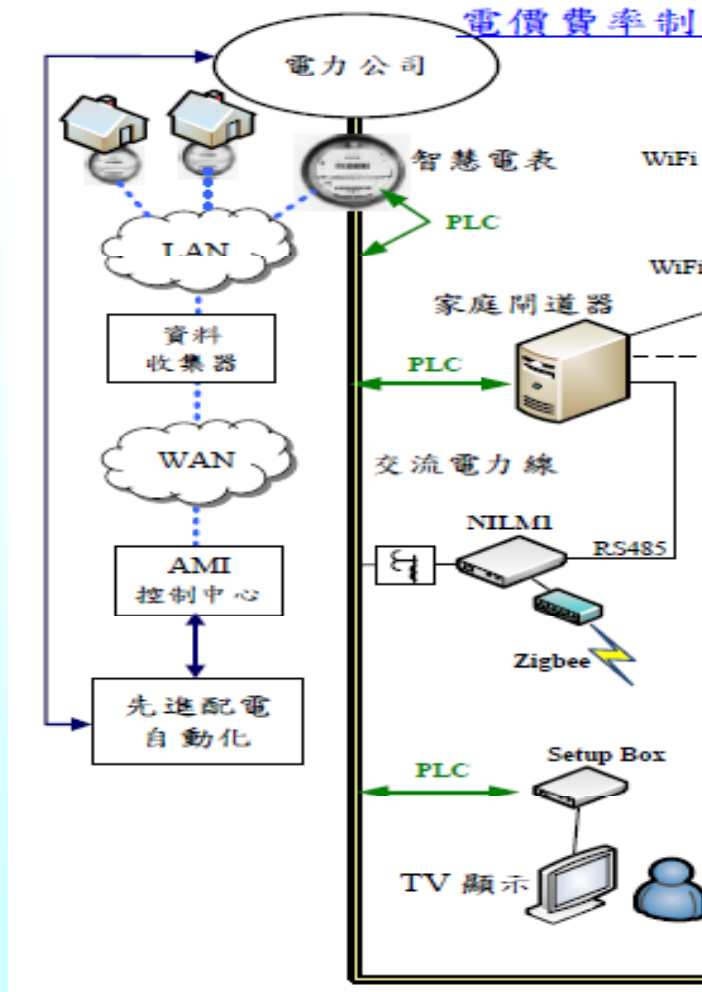
□ Smart customers–customer demand management:

- Smart grid infrastructure promotion project: set price rate for periods which are pro-energy saving according to the government, reduce peak-hour load, reduce electricity consumption. All (23,000)high voltage AMI facilities and 10,000 low voltage AMI facilities are expected to be installed by 2012. The schedule of promotion of low voltage AMI for 6 million households would be revised according to the cost-effect evaluation results.

□ Benefits

- Together with the specific rate, demand reaction and load management...etc, it can efficiently control peak-hour load, encourage energy-saving, reduce manpower needed for manual meter reading and boost the meter industry.
- Energy saving goal: 5% per household

Energy Management of Smart Homes (Architecture)



- Research items:
- Research of the technique standards and regulations
 - Control interface of the load and communication models
 - Monitoring software by people and computer

Innovative Strategies for Green Energy

- **Global warming, energy saving have already become problems the electricity industry has to deal with.** Taipower has to adjust its management strategies and development directions, take responding actions, improve internal management efficiency and improve operation efficiency by establishing strategies and goal systems.
- As for our **vision**, we expect ourselves to become "pioneer of low carbon energy", "operate of highly-efficient energy", "constructor of smart grid", "server of high-quality energy", "practitioner of corporate social responsibility "; we hope to become the most reliable life partner of our customers.

Innovative Strategies to Promote Smart Grid

- Power supply: innovative techniques are adopted to improve energy management system and highly-efficient **units**, and improve the **grid's efficiency**.
- System reliability: advanced **electronic electricity facility** techniques have been practiced, automation system has been improved to elevate the grid's safety and reliability. ,
- Excellent facility maintenance techniques: use advanced sensors, information and communication integrated smart change and convey system, maintenance work transformed into **CBM**, reduce maintenance cost and equipment failure rate.
- Develop **demand management**: establish smart meter and micro-grid to control peak-hour load, and renew customer value adding service.
- Explore renewable energy: develop renewable energy and green energy; **combine them into innovative technologies of the grid** to improve the capacity.

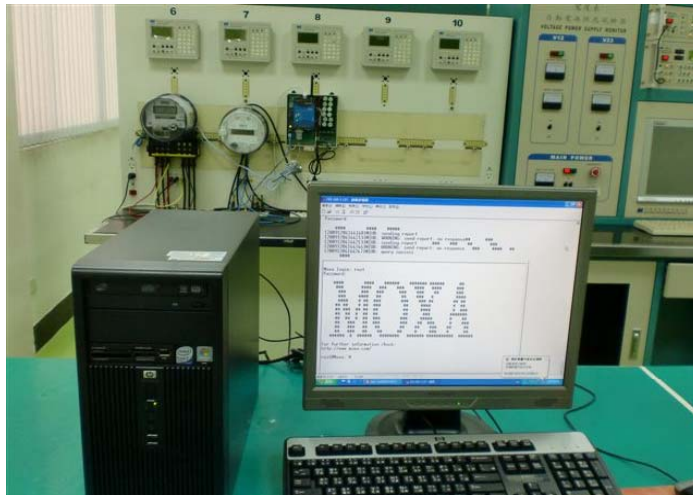
Installation of AMI and ADAS Testing Field

- Cooperate with the AMI Project
 - Meter performance testing
 - AMI system testing(meter→concentrator→headend→MDMS)
- Cooperate with Taipower's feeder automation testing system
- Cooperate with national energy plan: Master Plan of “Special Project of Smart Grid and Advanced Meter”
 - Pioneer ADAS project
 - Develop ADAS-related key compartments and application performance testing of main monitoring center

Taipower's Innovative Smart Grid Testing Field

Developments:

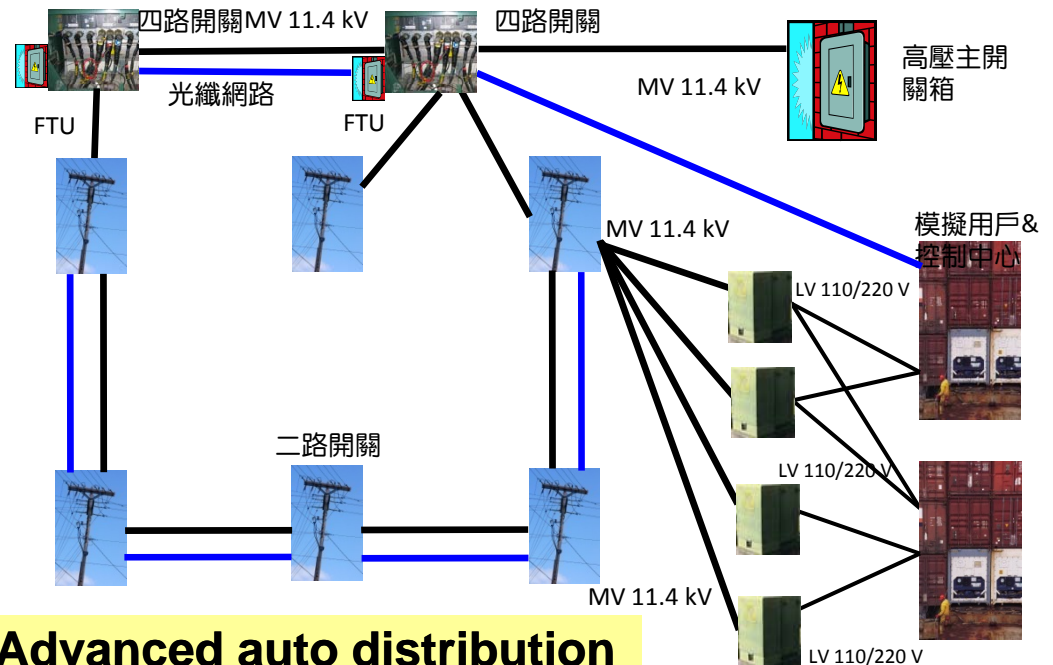
- Integration and development of communication techniques
- Application of AMI tests
- Advanced auto-distribution tests
- Provide facilities and system tests
- Discussion of solutions
- System operating staff training



High voltage AMI testing platform

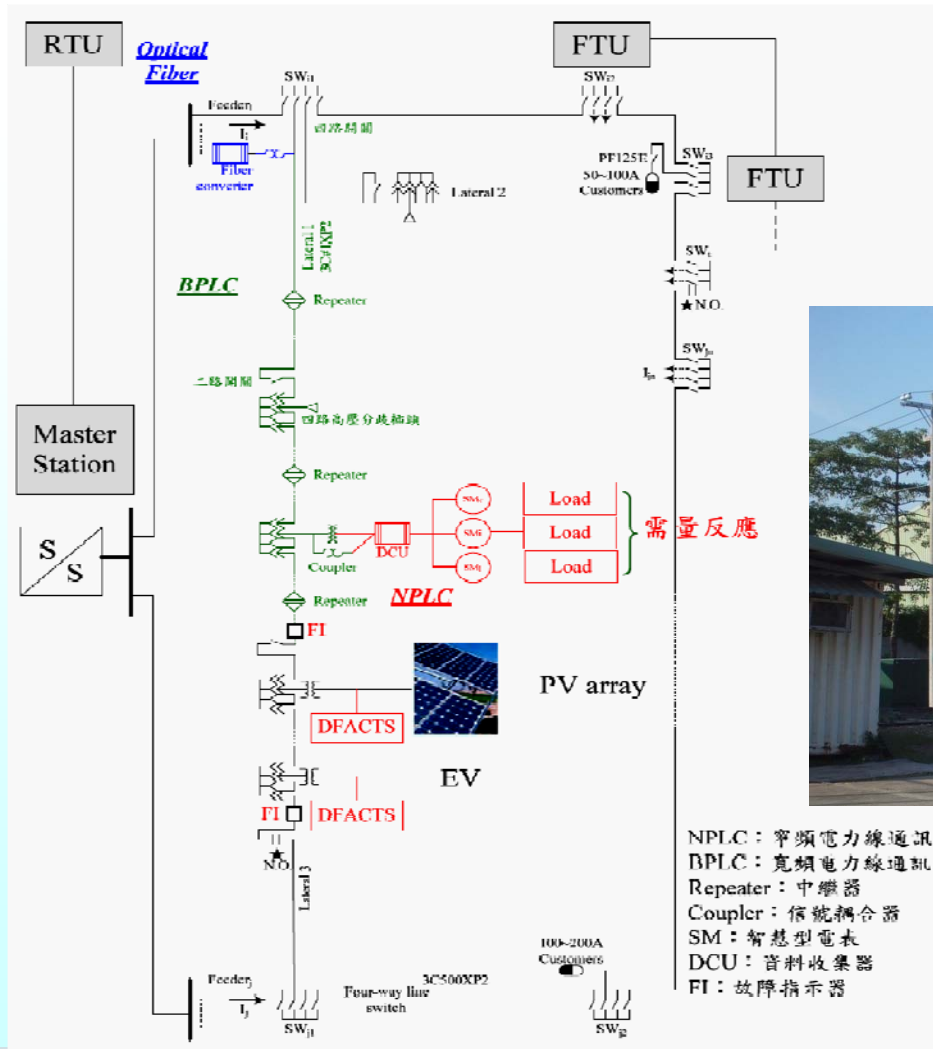
Structure of the Testing Field:

- 1 control center
- Contains 120 meters
- 4 adaptors
- 1~4 data concentrators
- 2 fiber cables



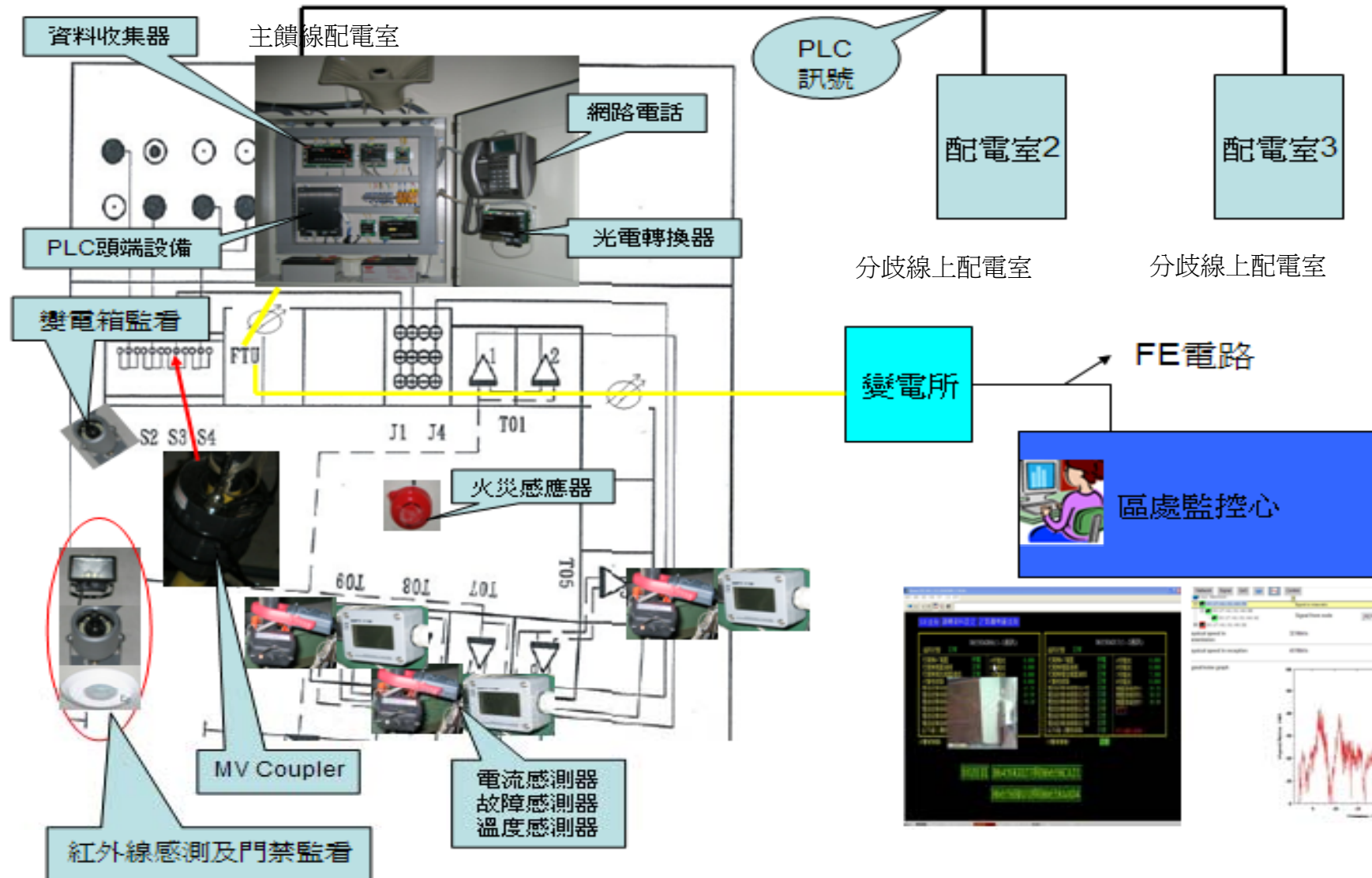
Advanced auto distribution testing field

ADAS Testing Field

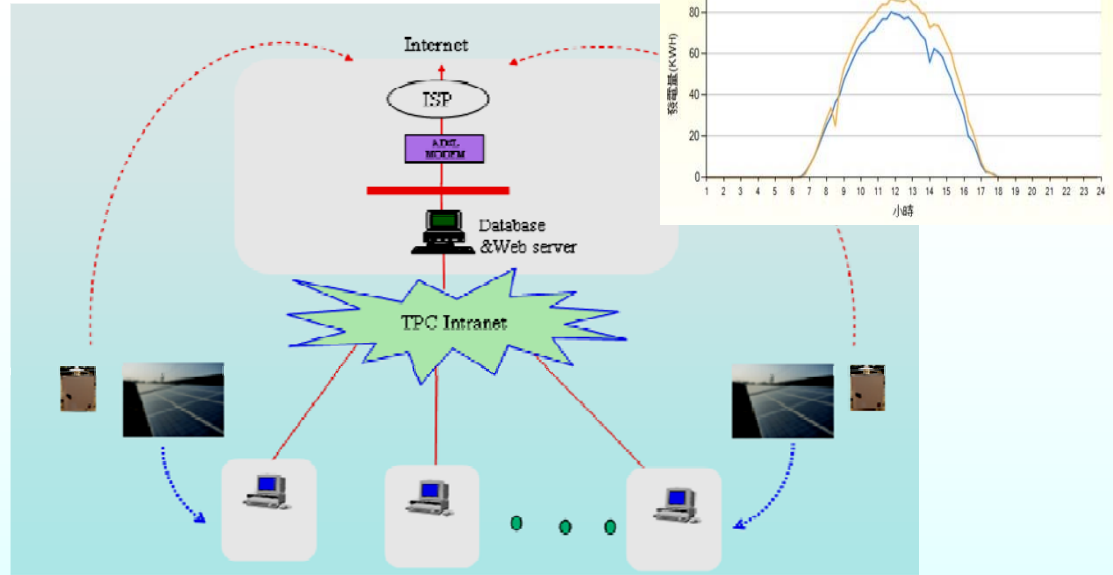


NPLC：窄頻電力線通訊
 BPLC：寬頻電力線通訊
 Repeater：中繼器
 Coupler：信號耦合器
 SM：智慧型電表
 DCU：資料收集器
 FI：故障指示器

Example of Innovative Application : Branch Feeder Monitoring system for Power Distribution Equipment

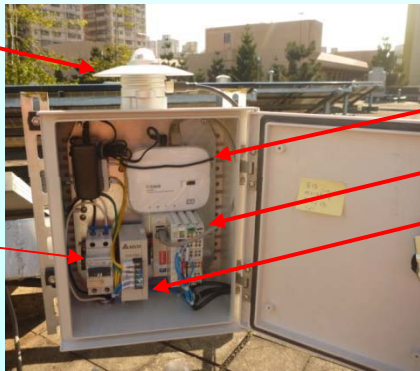


Innovative Application Example : PV System



日照計

110Vac
用NFB



3G 無線通信模組

資料蒐集器

110Vac/24Vdc
電源供應器

Application : strengthening non-governmental PV systems. Through comparison made by standard system, operators with better efficiency could be found. Their methods would be studied to become models of other PV system operators. They could also become reminders or examples for those with lower efficiency.

Innovative Services of Digital Convergence

- The trend of digital convergence appears in all kinds of communication products and services, and it is widely accepted by users. All kinds of smart devices are launched one after another, making the digital era change rapidly to “integration of hardware and software” and “innovative service models”.
- Development of digital convergence also includes the emergence of cloud industry. There are cloud digital services such as “enterprise cloud”, “health cloud”, “education cloud”, “bio-medication cloud”...etc.
- Following the trend, Taipower plans to offer “electricity cloud” digital convergence service in the future to reinforce interaction with our customers with cloud technologies and content. For example: combine advanced meter reading system and application facilities to provide our customers with real-time info of electricity price, combine with renewable energy generation system (ex: solar power, electronic car..etc) to provide our customers with the best energy generation/recharge time; develop innovative services.

Innovative Business Model Applied to Achieve the Vision of Smart Grid

- Who will pay of all smart grid investment?
- How to ensure the support function of distributed energy to maintain power factor and voltage stability?
- How to fairly proceed all the renewable energy generation applications which hope to be combined into the grid?
- Is it possible to consider storage project an enhancement service and provide special price for it? Will the benefited renewable energy operators, traditional operators or other enterprises be in charge of installing such an enhancement service?
- Subsidy policy for PV system, wave power and other renewable energy generation still need to continue, how will the problem be solved?

Unless the investment cost is guaranteed to be recovered, electricity industry won't invest in the solutions.

Conclusion 1/2

- Look at the future, the tests brought by climate change will become harder and harder. The electricity industry is facing challenges such as GHG reduction, safety of energy supply, generalization of distributed energy and smart grid value-adding. We have to be innovative to ensure the sustainable development of our environment, economy and society.
- Smart meter connects customers with two-way communication to integrate smart appliance and electronic car, controls demand and peak-hour power consumption with innovation, elevate energy use efficiency and reduce power consumption.
- For sales of the future smart grid market, whether Taiwan is a manufacturer of smart grid compartments or an integrator of smart grid system, it has to understand the standard and development direction of smart grid.

Conclusion 2/2

- To become a competitive smart grid system integrator, manufacturers can gain practical experience and become innovative by participating in Taipower's pilot projects such as AMI system tests and examination, feeder facilities and system operation tests, hybrid communication system integration tests..etc.
- Taiwan is at a leading position in ICT industry. We can grab the opportunity to control key techniques of smart green architecture industry.
- When installing smart grid or AMI, in order to achieve sustainable development, it is necessary to establish innovative business model, create benefits for stakeholders. For example: value-adding application of the convergence of communication industry, radio/TV and internet.

The End

Thank you

