

# 太陽光電管理系統建置經驗

陳朝順 教授  
義守大學

July 21 2017

# 再生能源管理示範系統建置

- 針對中大型再生能源系統，進行發電量及電壓品質監控。
- 降低再生能源併網系統衝擊，維持良好供電品質。
- 提升台電配電系統之再生能源併網容量。
- 評估再生能源發電系統輔助服務能力。

# Inverter

PV inverter converts DC energy from solar modules in to AC energy and interface the PV system with electricity grid



**DC Power**



**AC Power**



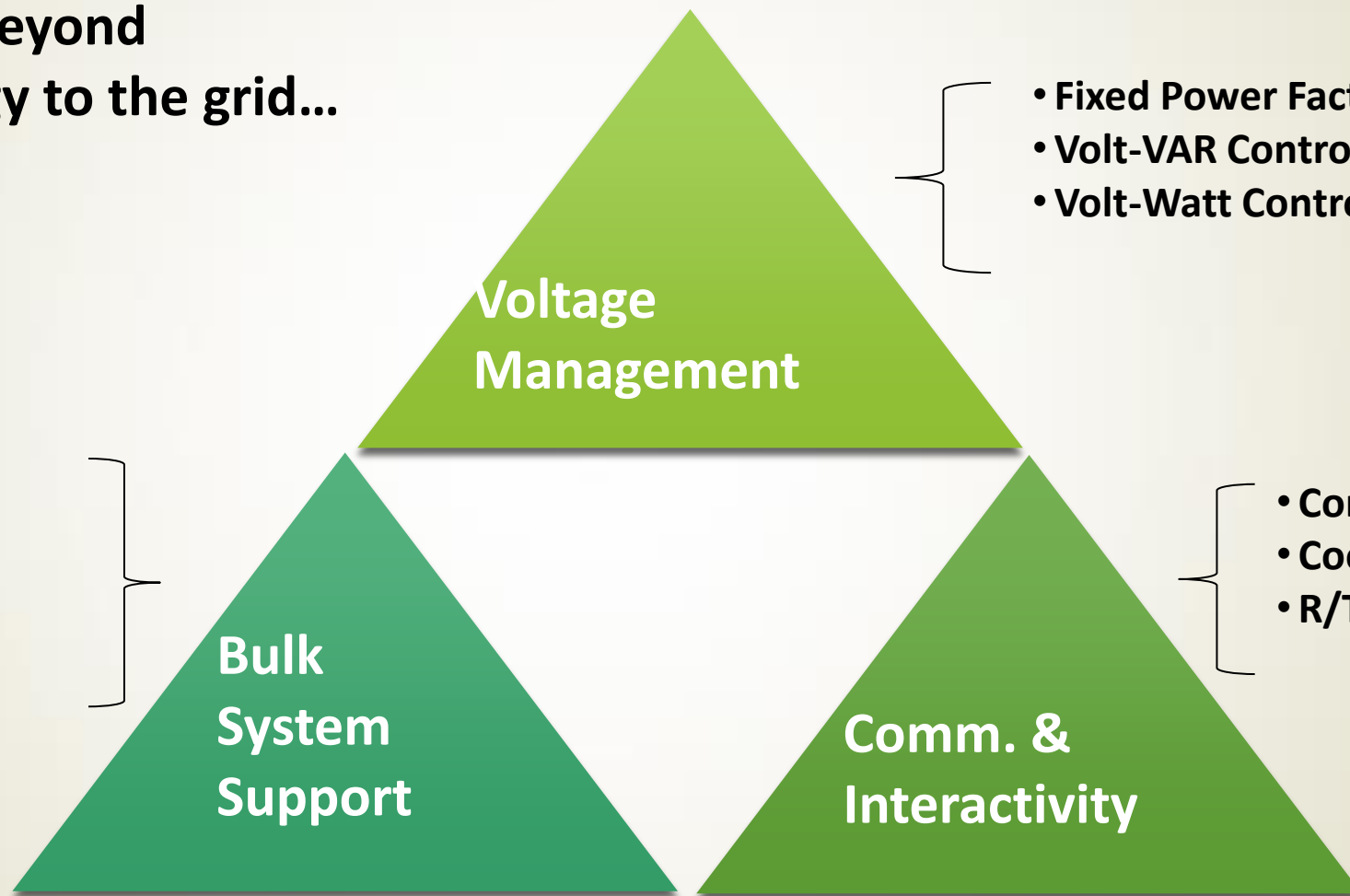
## Primary Responsibility Inverter

- Matching plant output with grid voltage and frequency
- Providing unintentional islanding protection
- Harvesting maximum power from PV array

# What Makes a “Smart” Inverter?


Provides benefits beyond delivering PV energy to the grid...

- Voltage Ride-through
- Frequency Ride-through
- Frequency-Watt Control



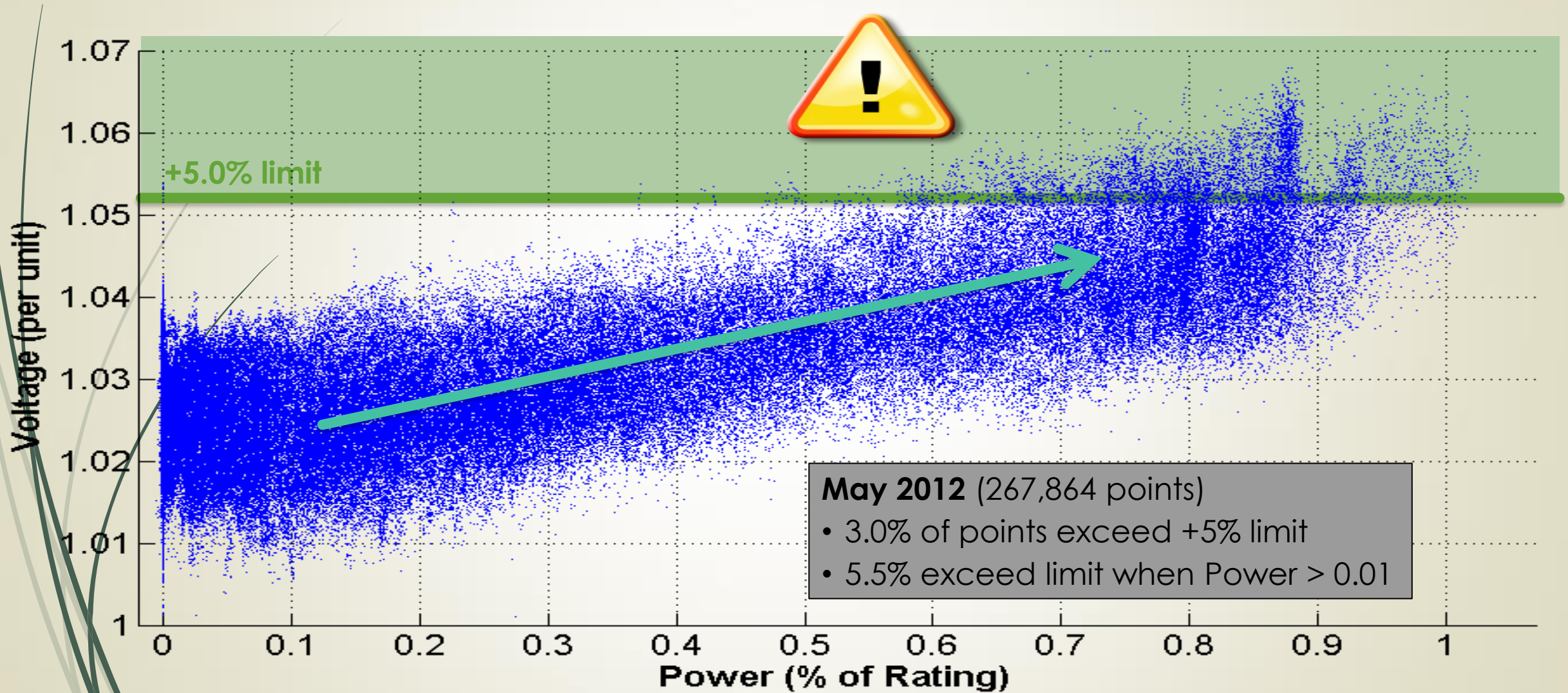
# Outline



1. What makes inverter “smart”
  - 2. Voltage and Reactive Power Control**
  3. Voltage and Real Power Control
  4. Frequency-Watt
  5. Maximum Generation Limit
  6. L/H Voltage and Frequency Ride Thru
- 

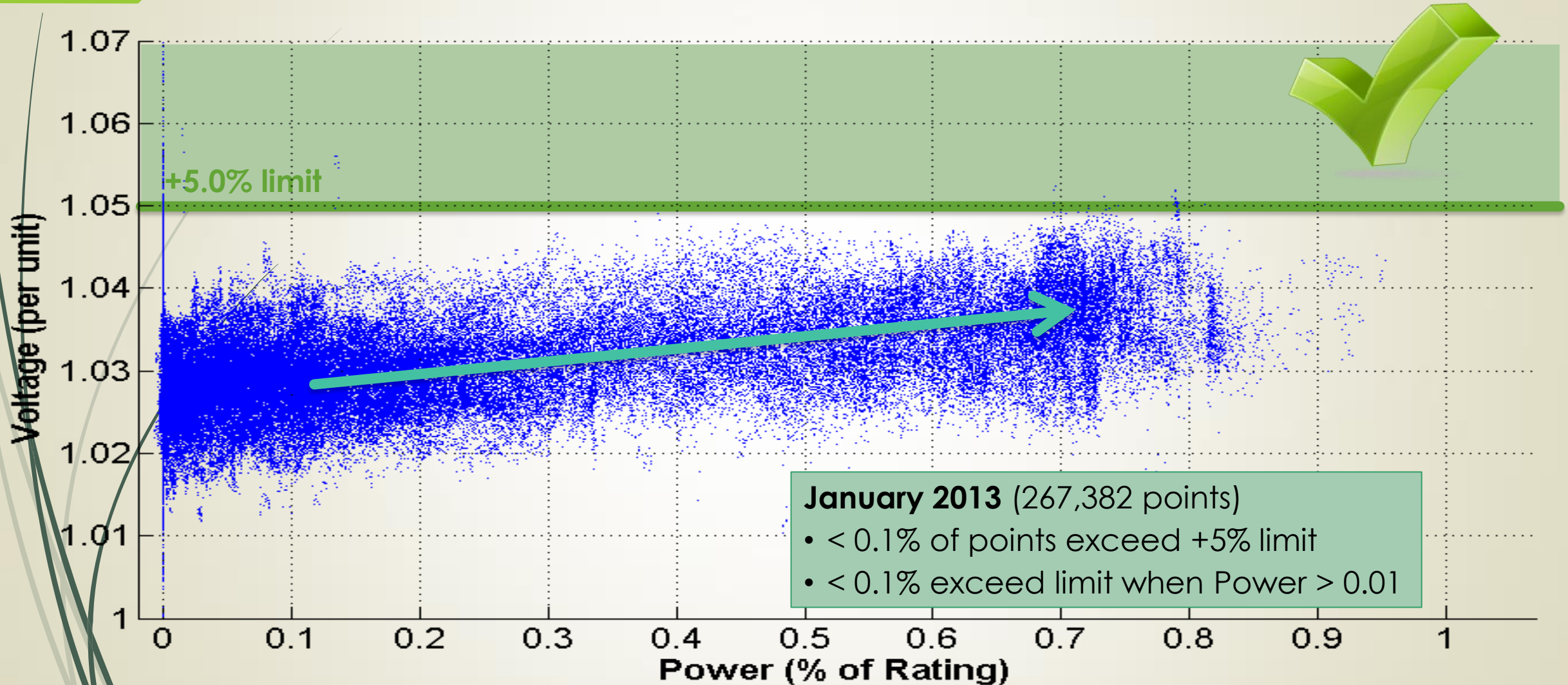
# Voltage Exceeds Planning Limit

10-second average PV plant service voltage often above +5% at midday



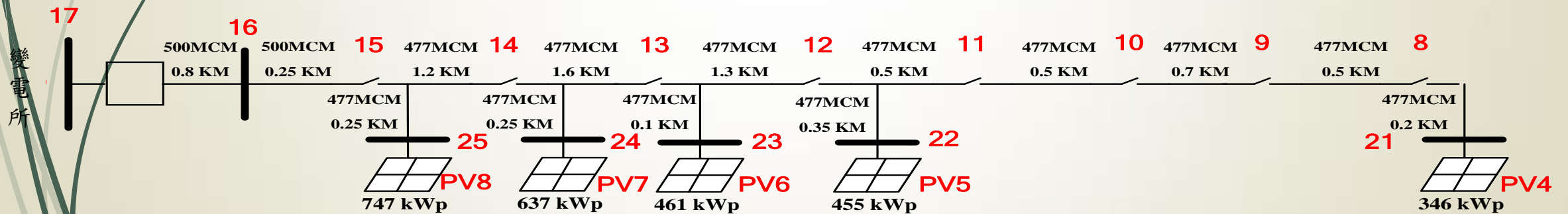
# Voltage after Power Factor Adjustment

January 2013



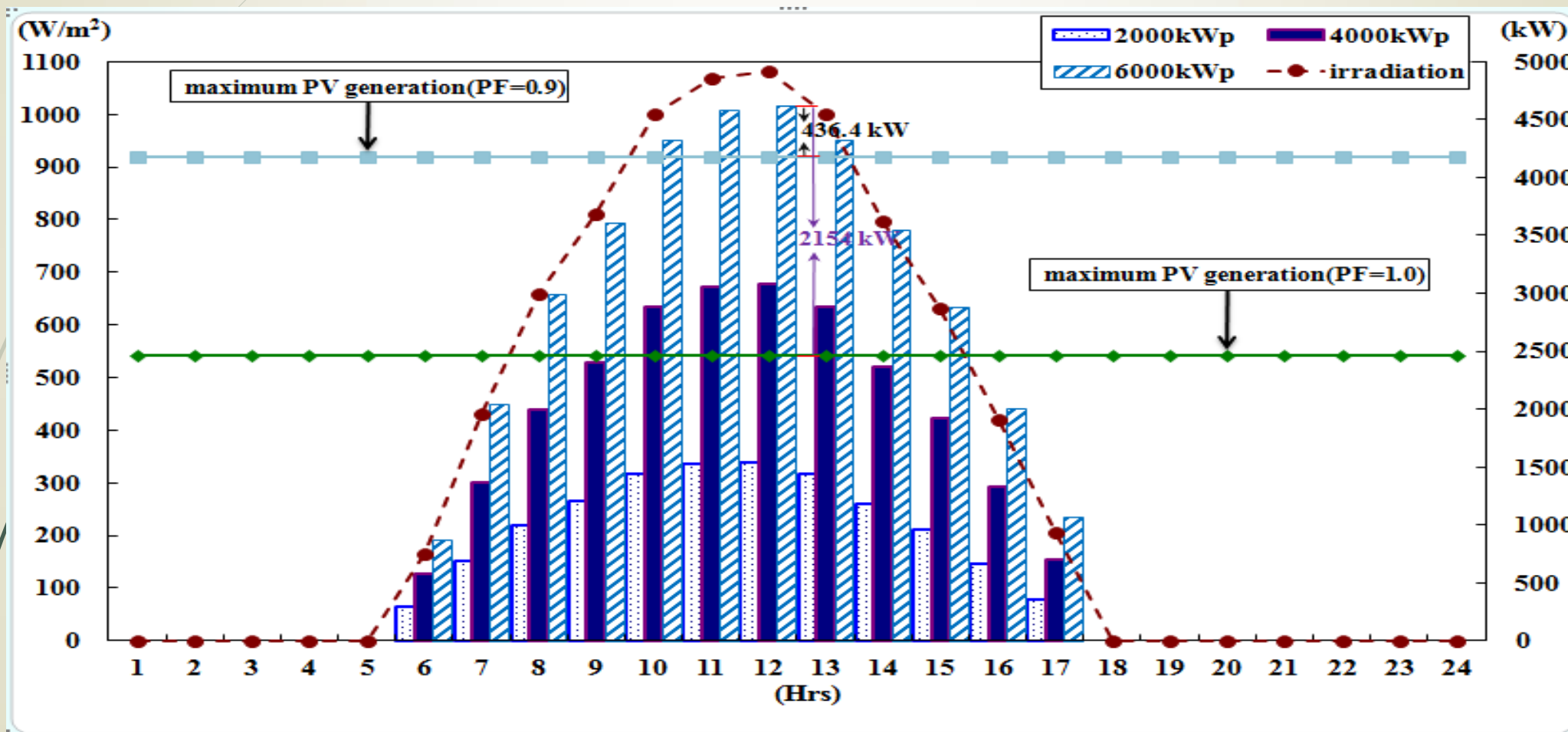
# 智慧電網 Smart Inverter 功因控制提升 PV 併網容量

- ▶ 台電配電饋線 8.5 公里，既設 PV 總併網量 2646 kWp。
- ▶ 末端 (21) 增設 PV，可允許最大併網容量。





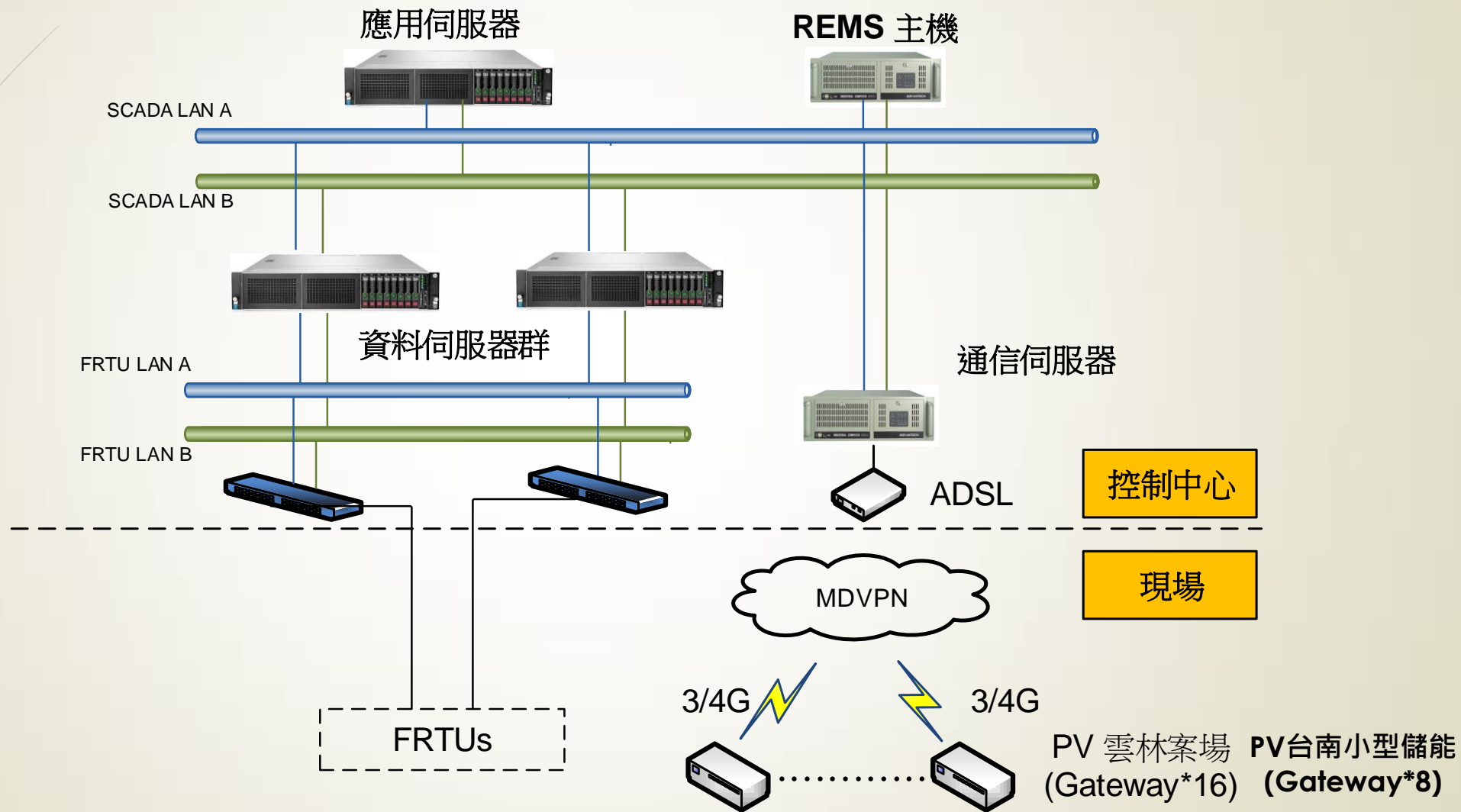
# 功因控制與最大 PV 併網容量



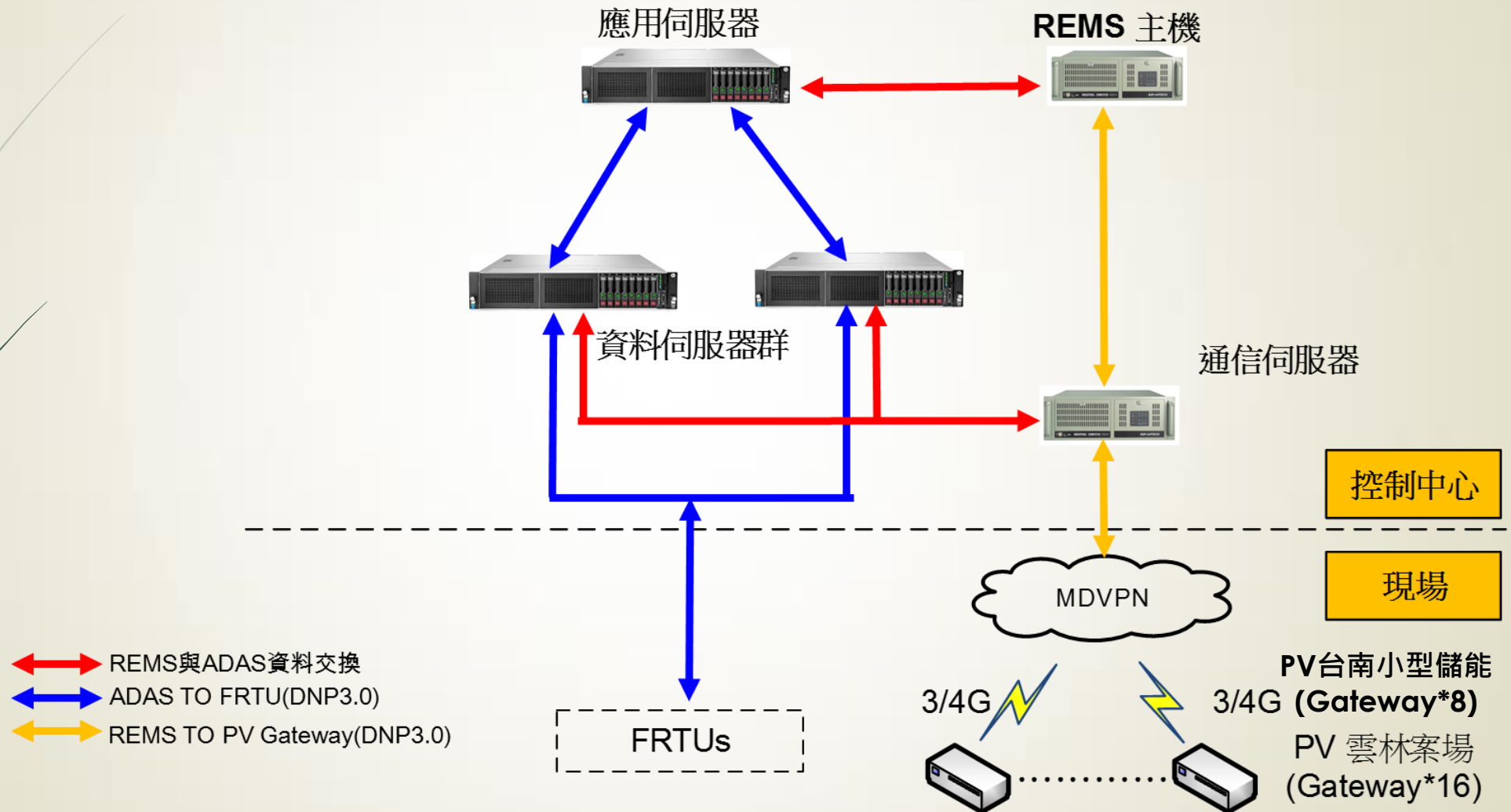
# REMS/ADAS系統功能概述

- 系統主要功能在配電系統發生故障，執行故障偵測、隔離及下游復電之負載轉供條件下，能先行支援饋線及轉供後之供電區段內所併網之PV系統，並應用混合式通信系統，執行智慧變流器之虛功與實功調控，以有效維持電壓品質。
- REMS與ADAS系統透過資料交換可共享資訊，以獲得供電來源資訊，進行更精確的虛功與實功調控，同時藉由所獲得之PV系統供電資訊，可提供更精準的停、復電及轉供計畫。

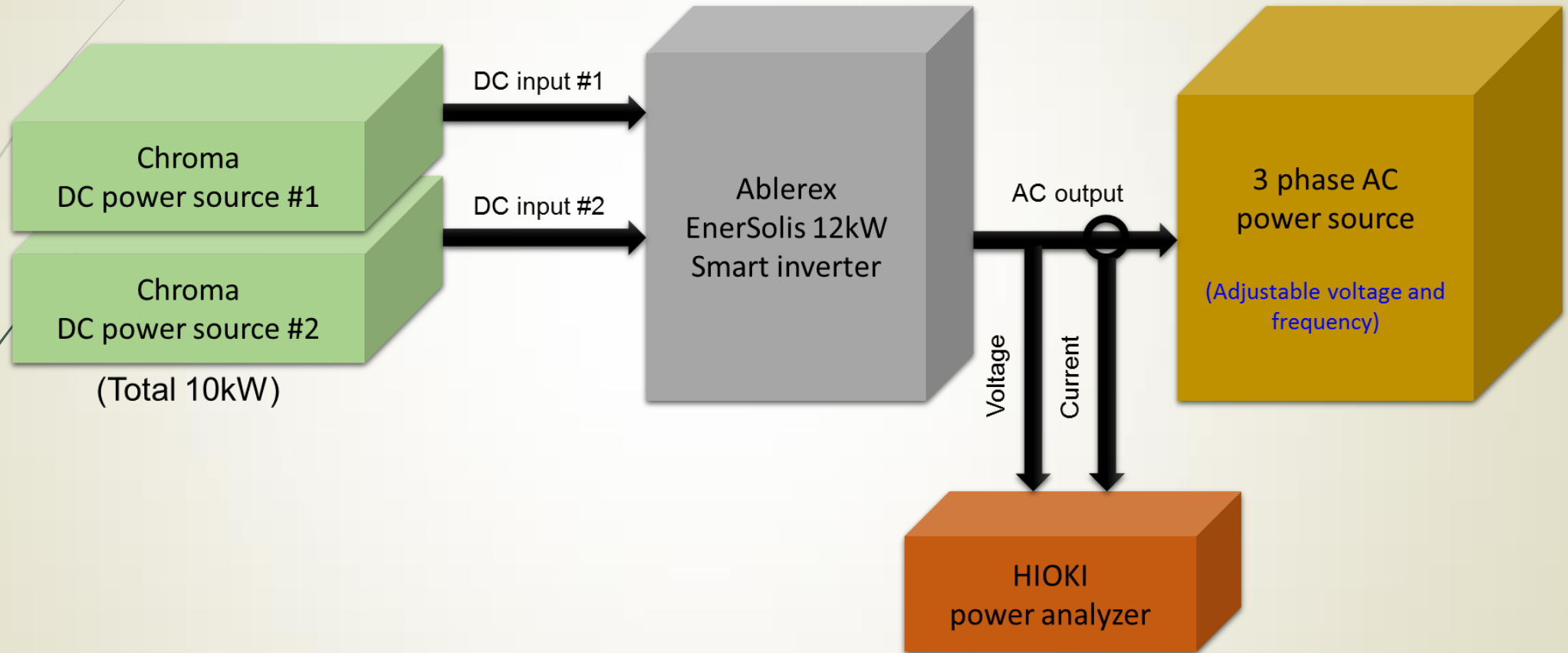
# REMS與ADAS系統架構



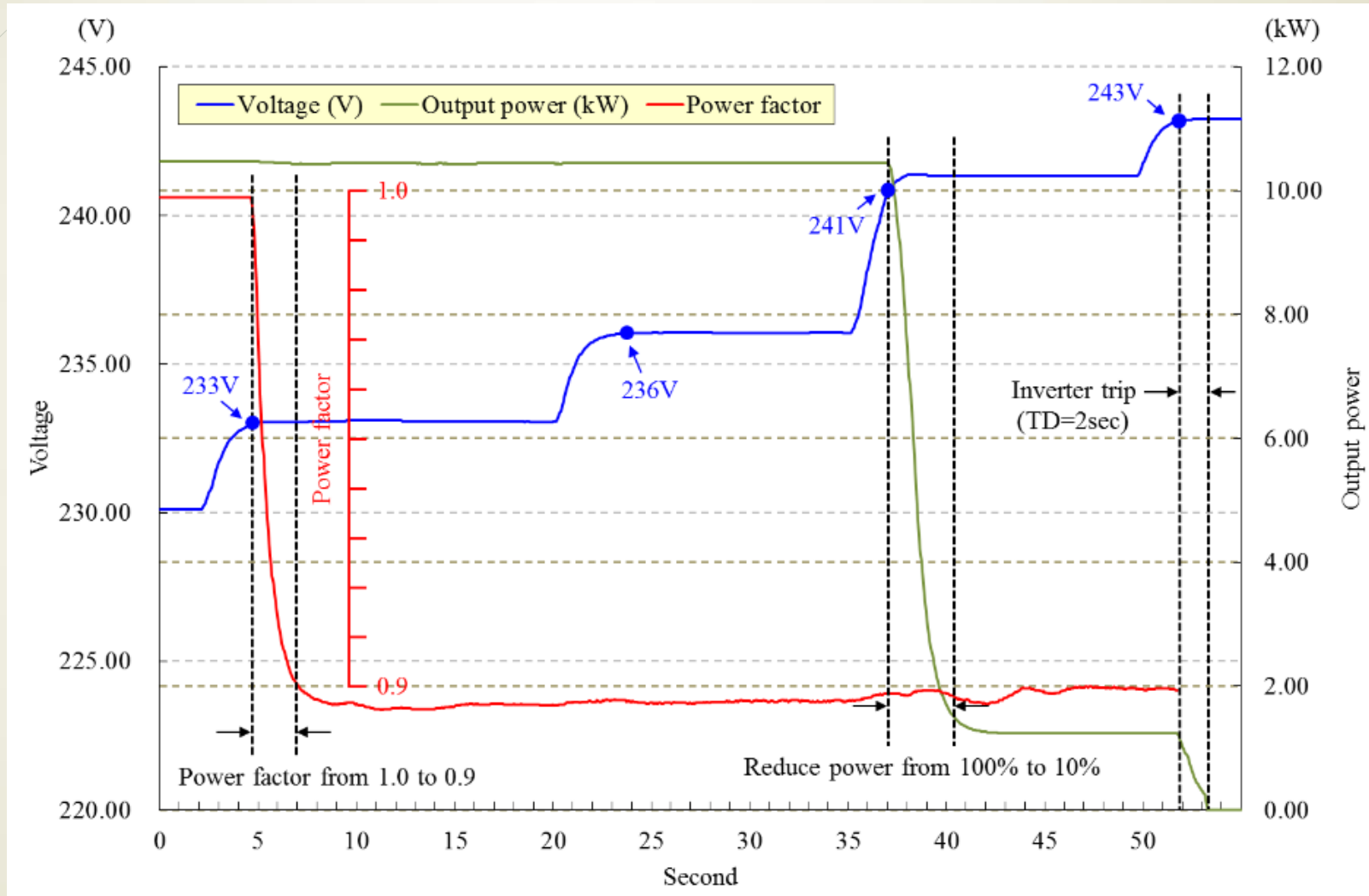
# REMS與ADAS通訊架構



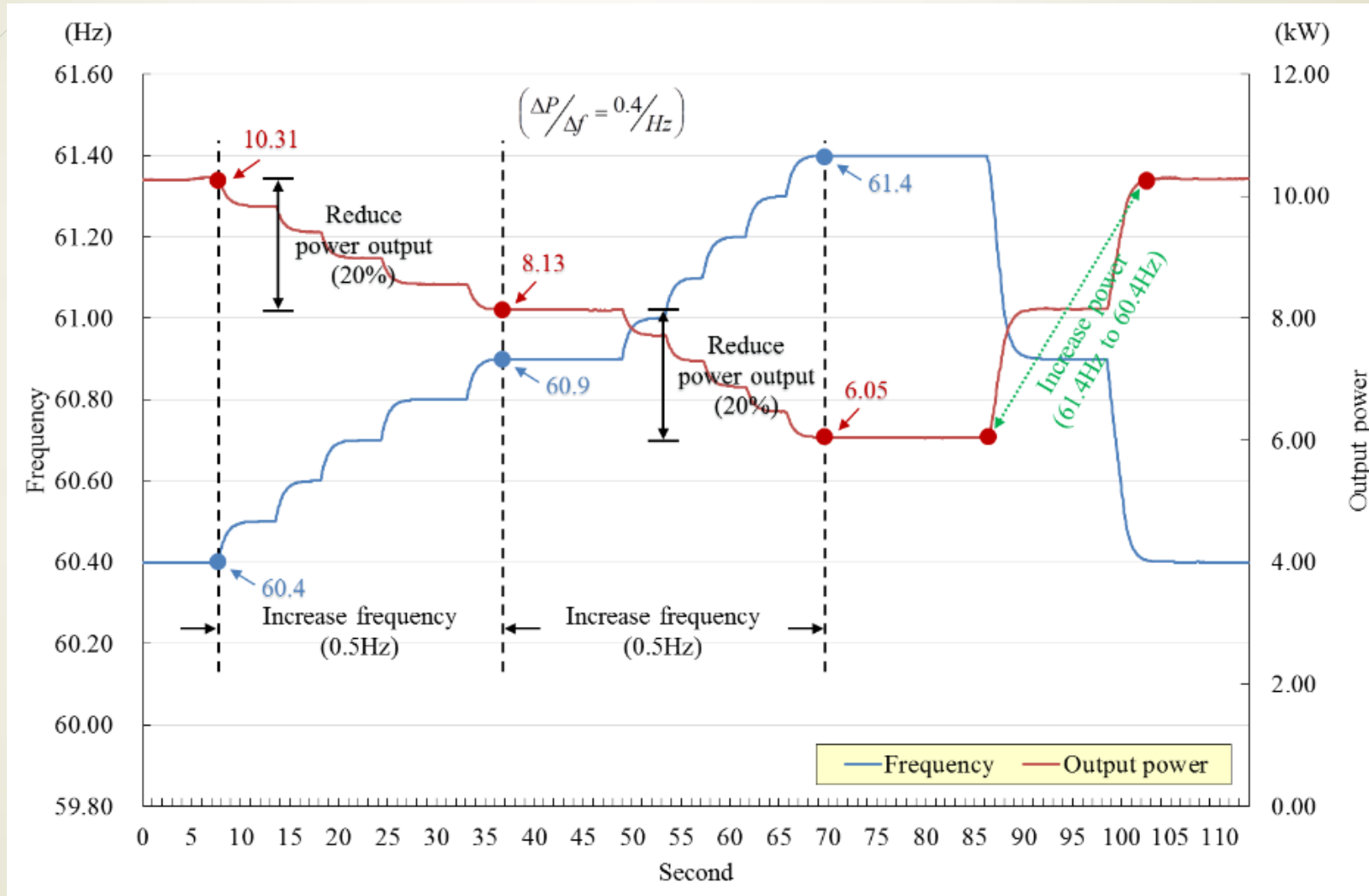
# 智慧變流器測試架構



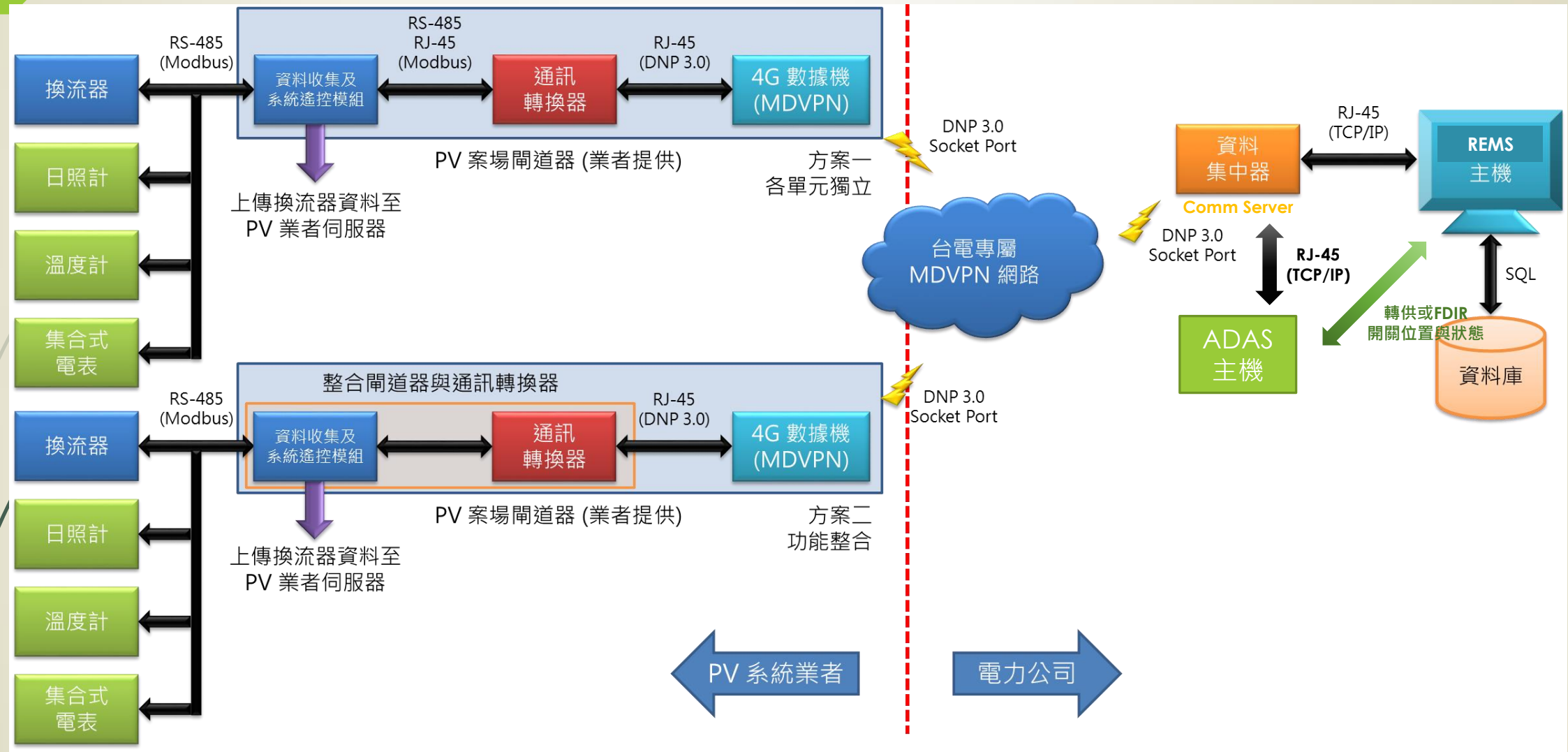
# 自主調控實測曲線



# 過頻降載實測曲線

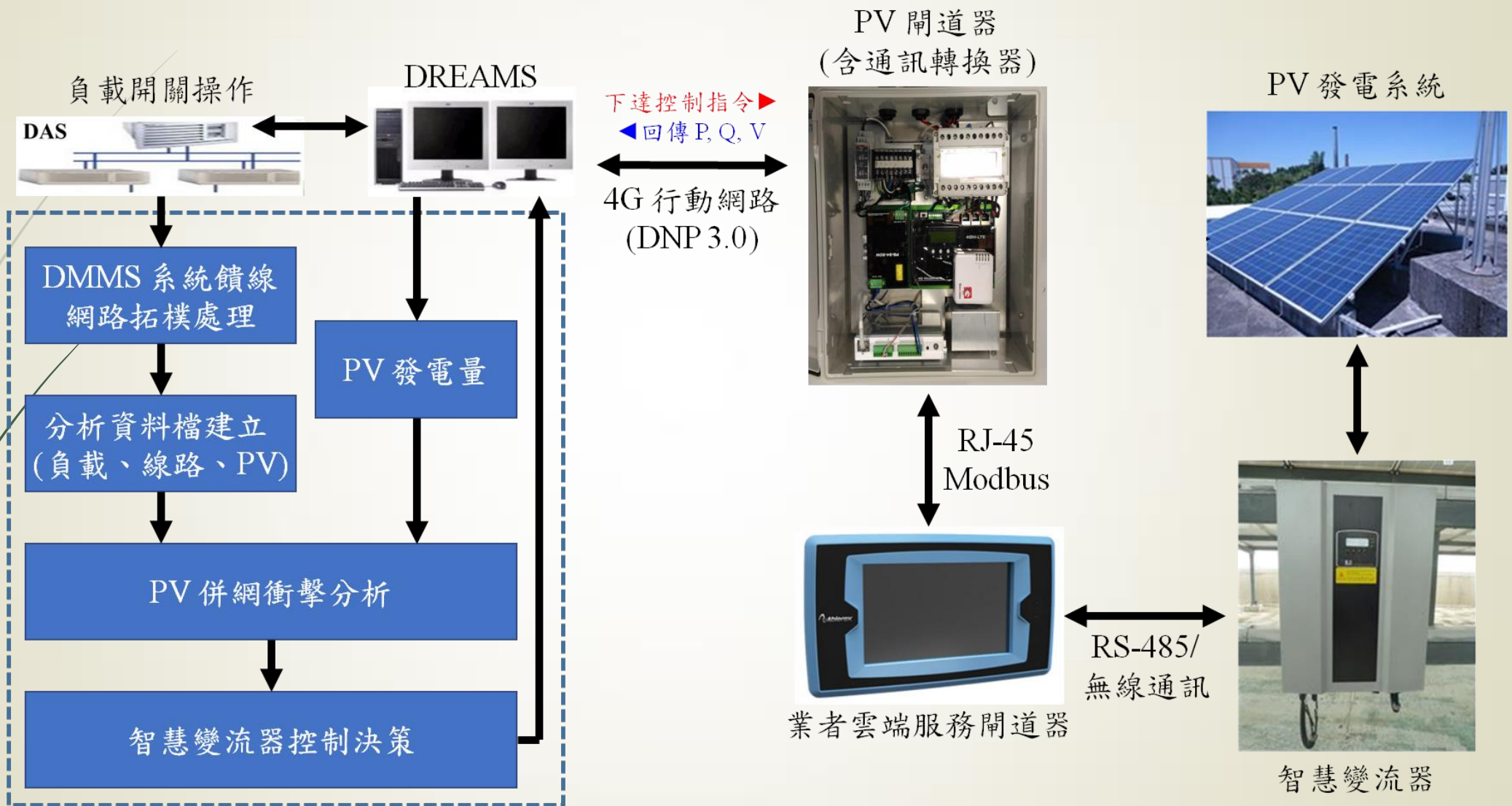


# REMS主站及通訊系統架構

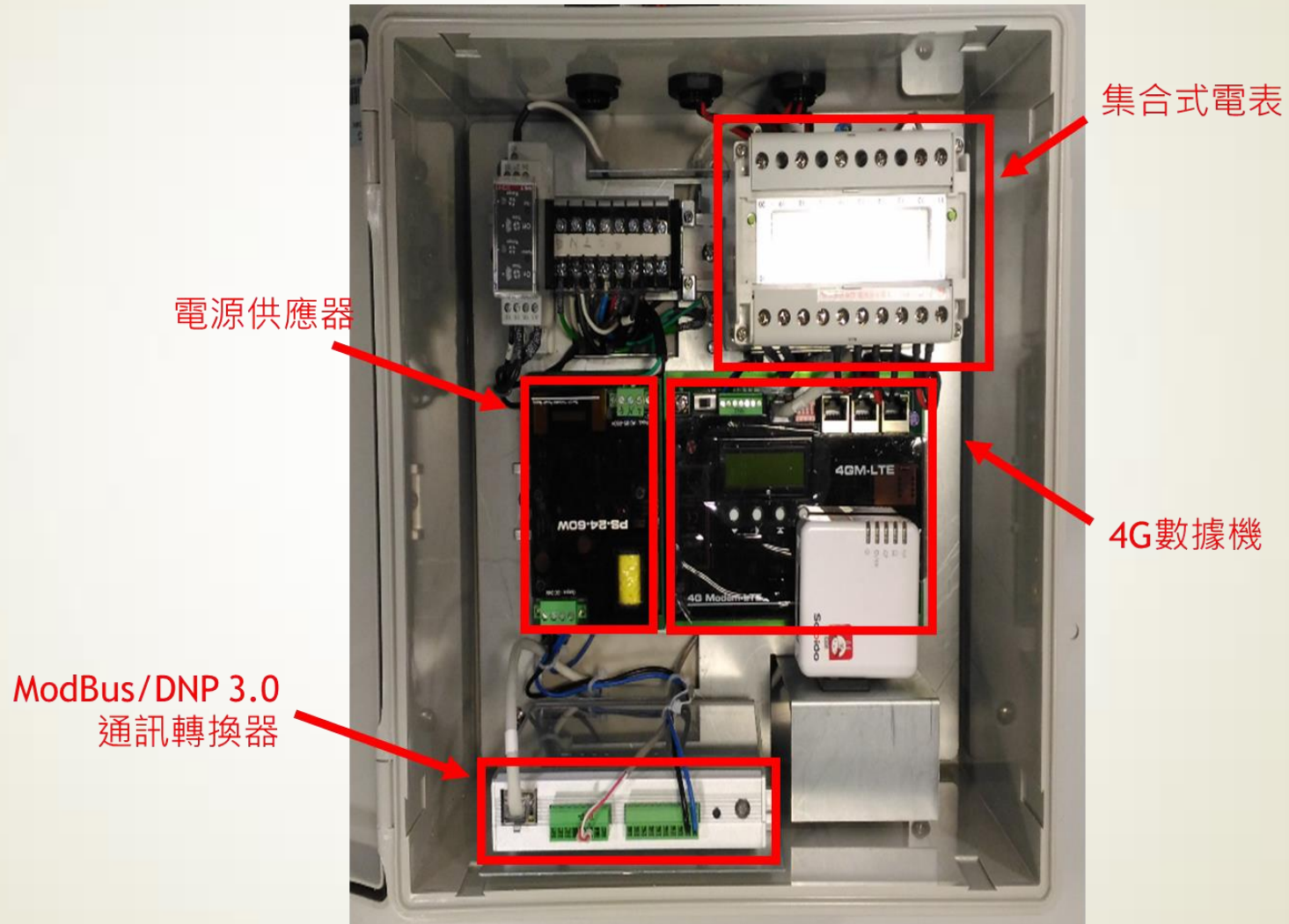




# REMS/ADAS整合控制系統



# PV案場閘道器架構



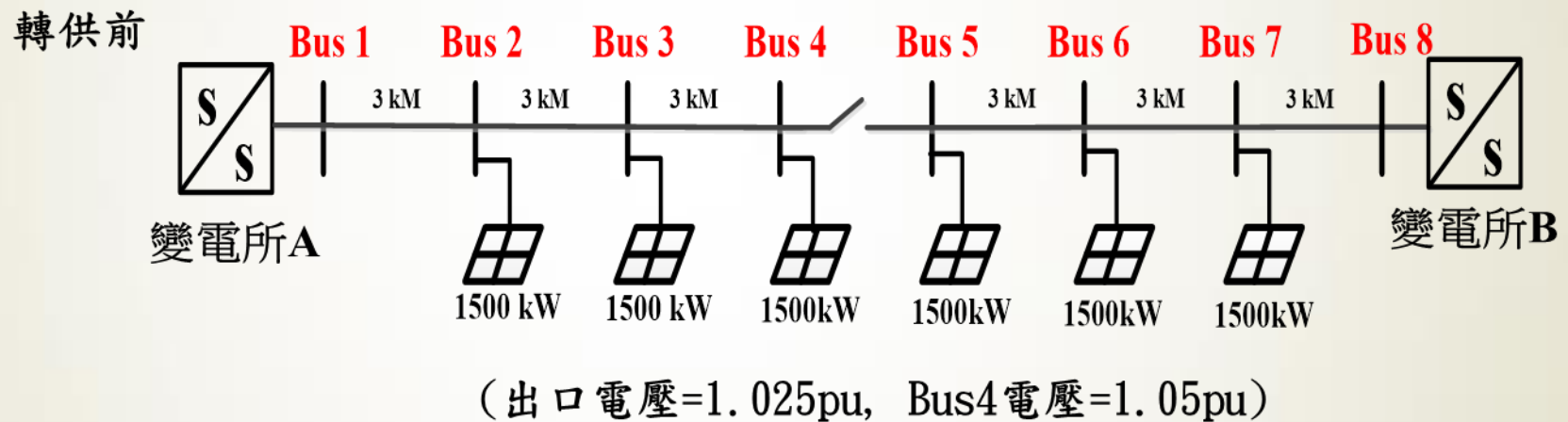
# 台南屋頂型PV/儲能系統測試

- ➡ 結合智慧變流器及小型儲能系統，進行PV發電最佳化控制。
- ➡ 配合儲能系統調控，決定儲能系統最佳化放電時機，達成用戶PV發電自產自用，降低PV併網衝擊。

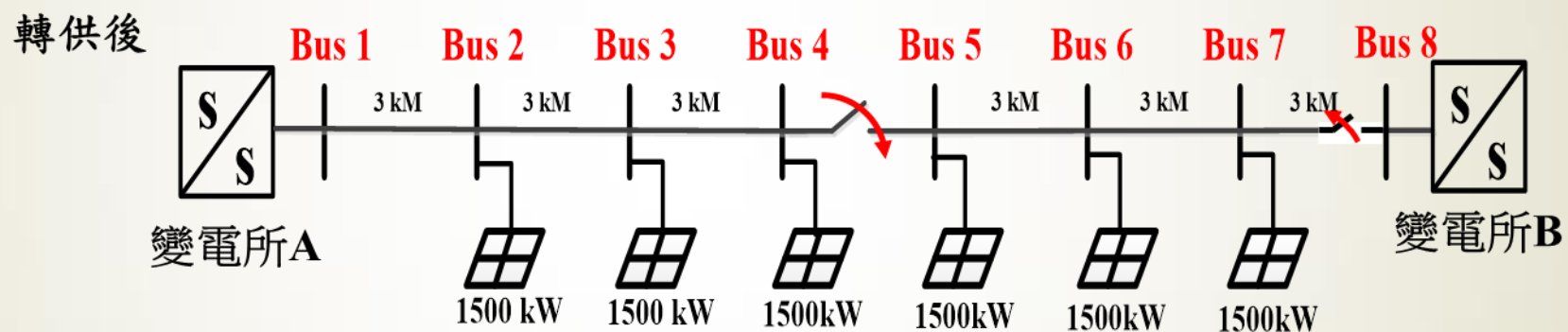
# 台南Rooftop PV/儲能系統測試案場



# 測試饋線系統架構及末端電壓 (負載轉供前)



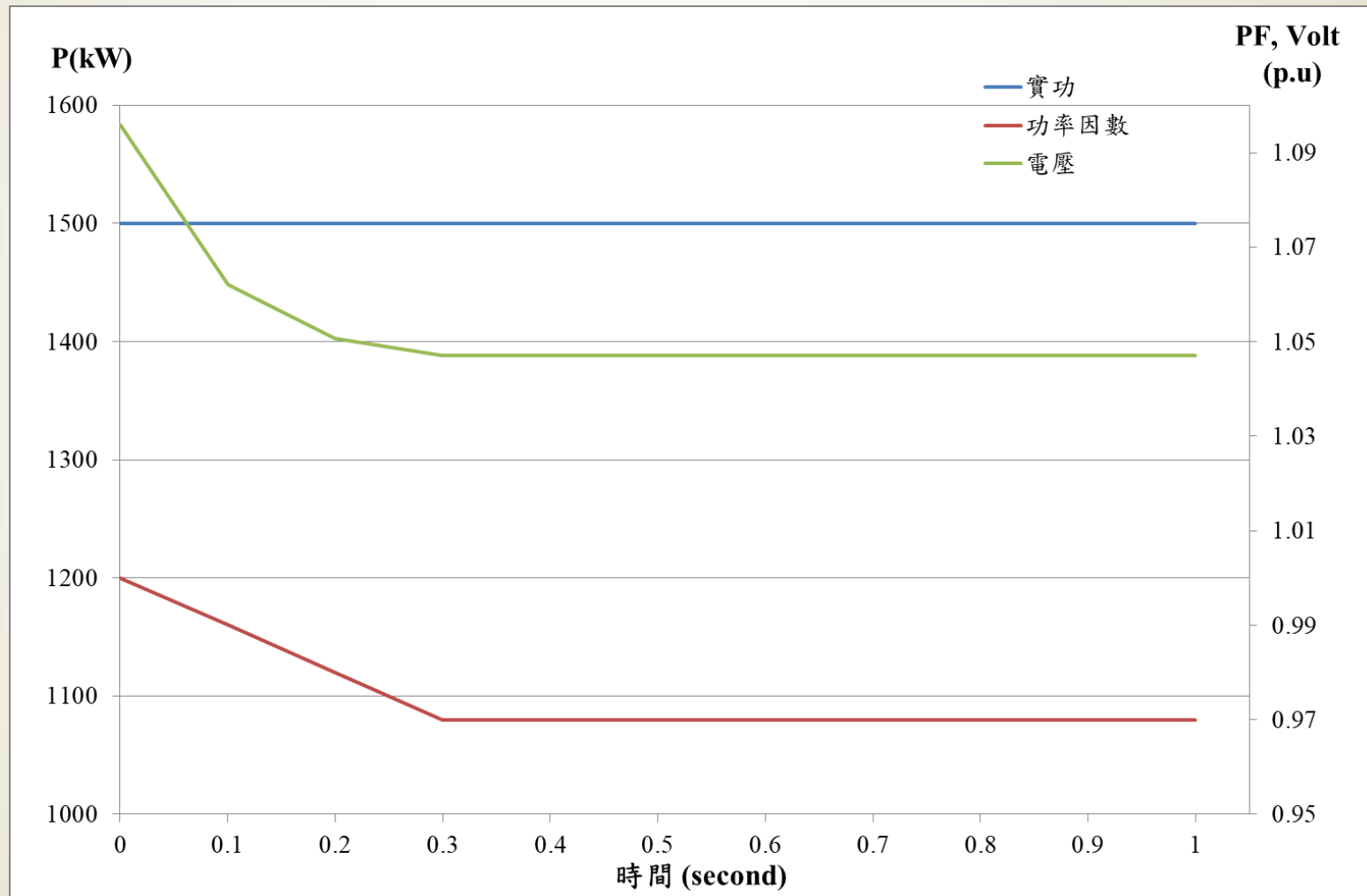
# 測試饋線系統架構及末端電壓 (負載轉供後)



(出口電壓=1.025pu, Bus7電壓=1.091pu)

# 智慧變流器電壓設定自主調控

末端Bus7電壓(出口電壓=1.025pu,PF調控)

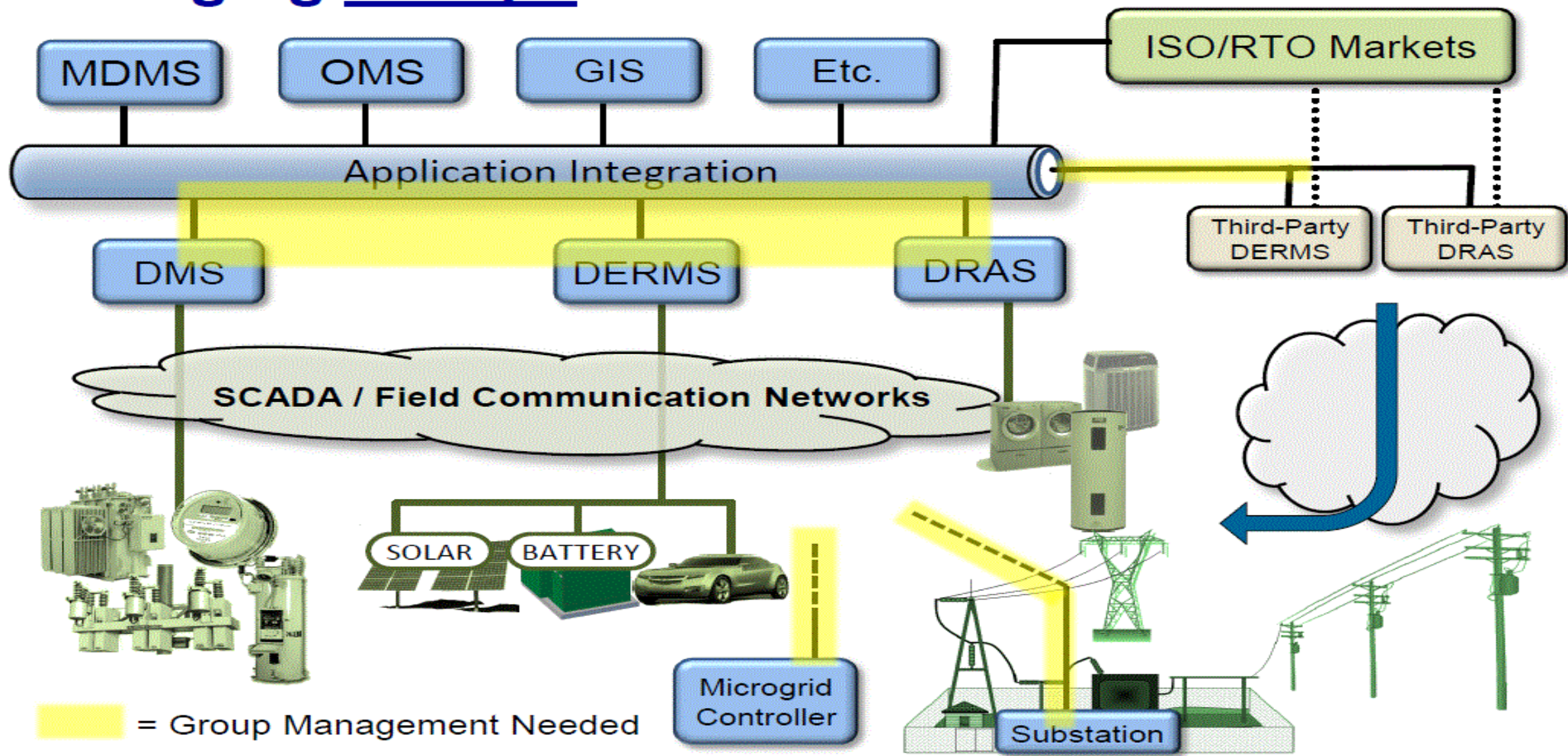


# 測試案場



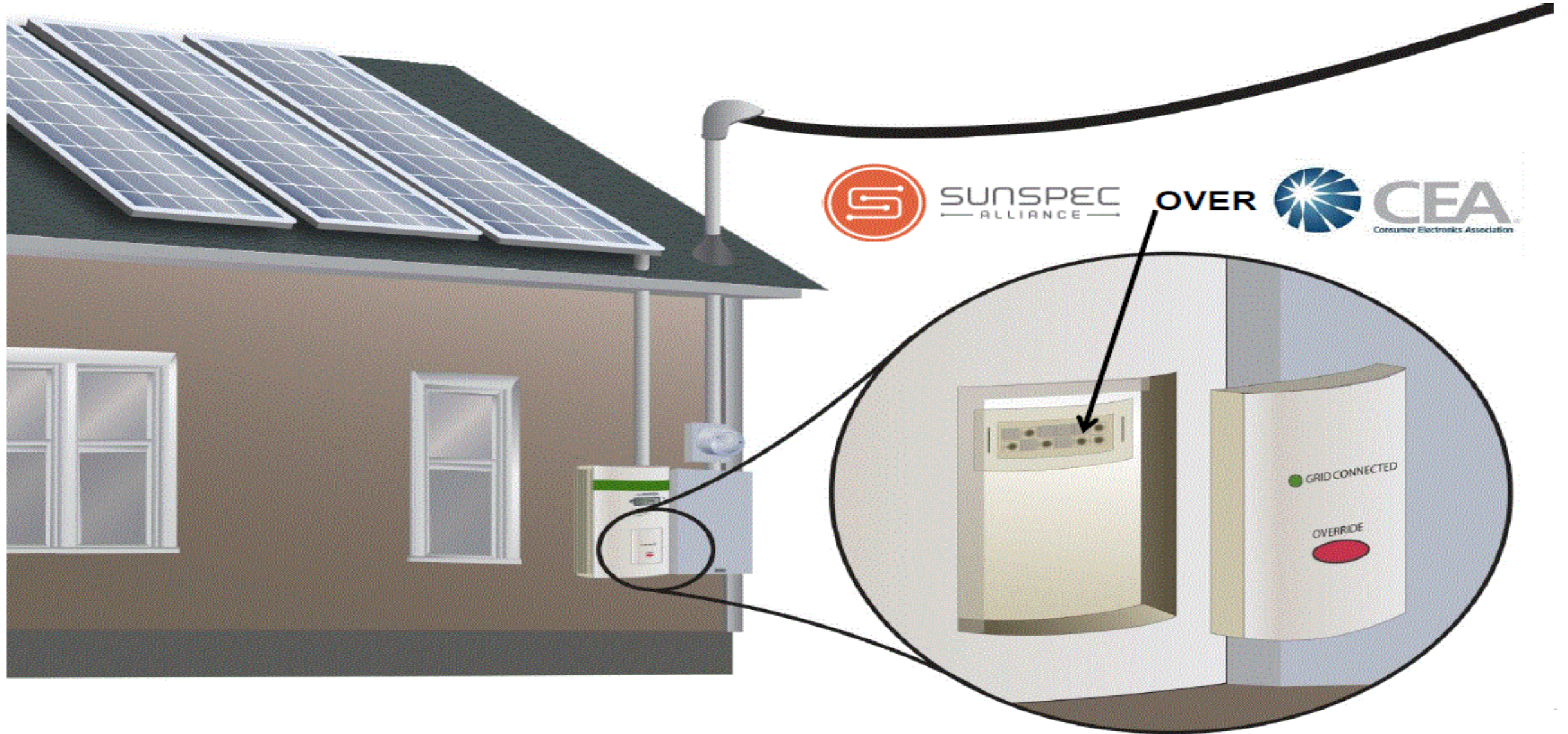


# New Focus of Standards Development - Managing Groups of DER



# Proposed Solution

*Use SunSpec Modbus over CEA-2045 Modular Port*



Thanks for your attention

