

Challenge and the Strategic Way Forward for PEA's Smart Grid Effort

Chakphed Madtharad, Ph.D.

**Provincial Electricity Authority (PEA), Thailand
chakphed@gmail.com, chakphed.mad@pea.co.th**

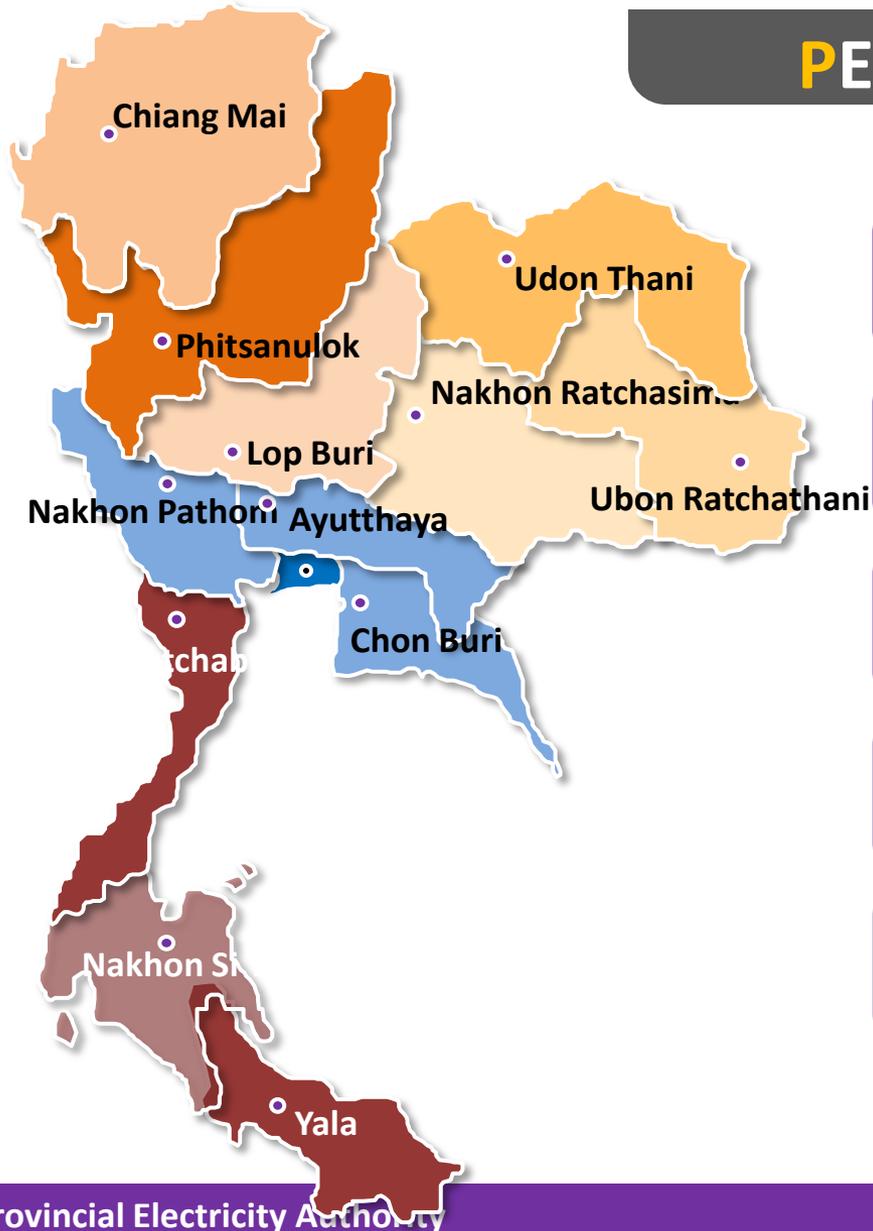
PEA HIGHLIGHT

VISION



To provide efficient and reliable electricity services for quality of life and sustainability of economy and society

PEA HIGHLIGHT



PEA's AREA : as of 31 DEC 2014

AREA : 510,000 km²

REGIONS : 12 Region offices

PROVINCE : 74 Provinces

VILLAGE : 76,121 Villages (98%)

OFFICES : 927 Offices

PEA HIGHLIGHT

ELECTRICITY SERVICE : as of 31 DEC 2014



Maximum Demand :

• 17,724 MW

Total Customers:

• 17.55 Million Customer

Total Sales of Electricity :

• 112,606 Million Unit (kWh)

Total Electricity Revenue (2013)

• 13,656 MUSD (434,070 MTHB)

SAIFI

• 5.16 times/customer/year

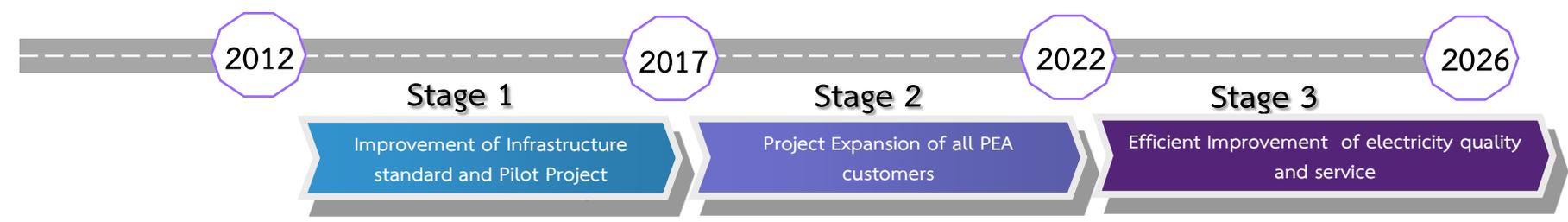
SAIDI

• 179.97 minutes/customer/year

Distribution Loss

• 5.84 %

First of PEA Smart Grid Roadmap (as announcement in 2011)



Smart Energy

- Electricity networks in 4 cities with automated system
- Network supports of DG
- Micro grids (Community power networks)
- Energy Storage
- The integration of enterprise system
- Mobile Workforce in 4 cities
- Renewable energy development in communities

- Optimal asset management
- Completion of MWM
- Completion of unmanned substation
- Expand fully automated network covering major
- The penetration of renewable energy sources and energy storage in communities

- Automates electricity networks nationwide/self-healing feature enabled
- Smart community network integrated with a large renewable energy resources
- Perfect cyber security system
- The balanced and forecast system production corresponds to energy utilization
- Virtual power plants created

Smart Life

- Network supports of DG
- Smart meter infrastructure (AMI) completion in central region and 10 other large cities
- Smart & Green PEA
- Demand response management

- AMI development completion
- Energy Management completion in all large/medium cities
- The system provides power usage information via the internet (Virtual office)
- Domestic consumers can produce their own electricity; surpluses can be sold to the utility
- Home/building energy management automation reduces electricity bills

- Power consumers can buy or sell electricity in real time
- Users can choose to buy electricity from different suppliers
- Optimal energy management

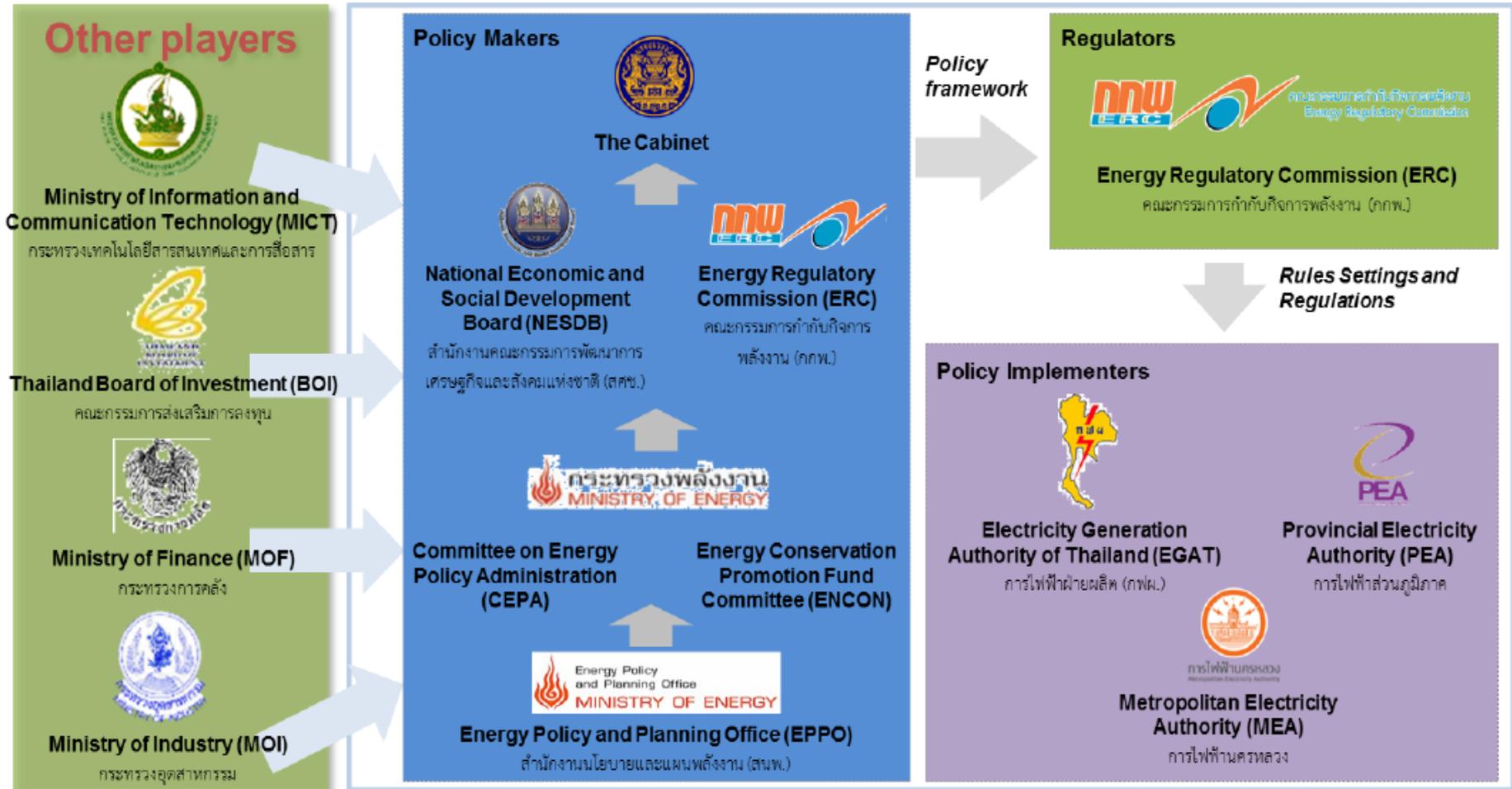
Smart Community

- Public charging station
- Energy savings for public street and community lighting

- The extensive use of electric transportation
- The penetration of intelligent public street and community lighting in communities
- Bundled services with other utilities (common billings etc.)

- Intelligent electric vehicle charging to reduce peak demand
- Two ways power supply of electric vehicle (V2G)

Government Parties



Smart Grid Regulatory Players

PEA Smart Grid under Power development plan



THE 11th NATIONAL ECONOMIC AND SOCIAL DEVELOPMENT PLAN (2012-2016)



Smart Grid Development Project,
Phase 1 (4,860 MTHB)

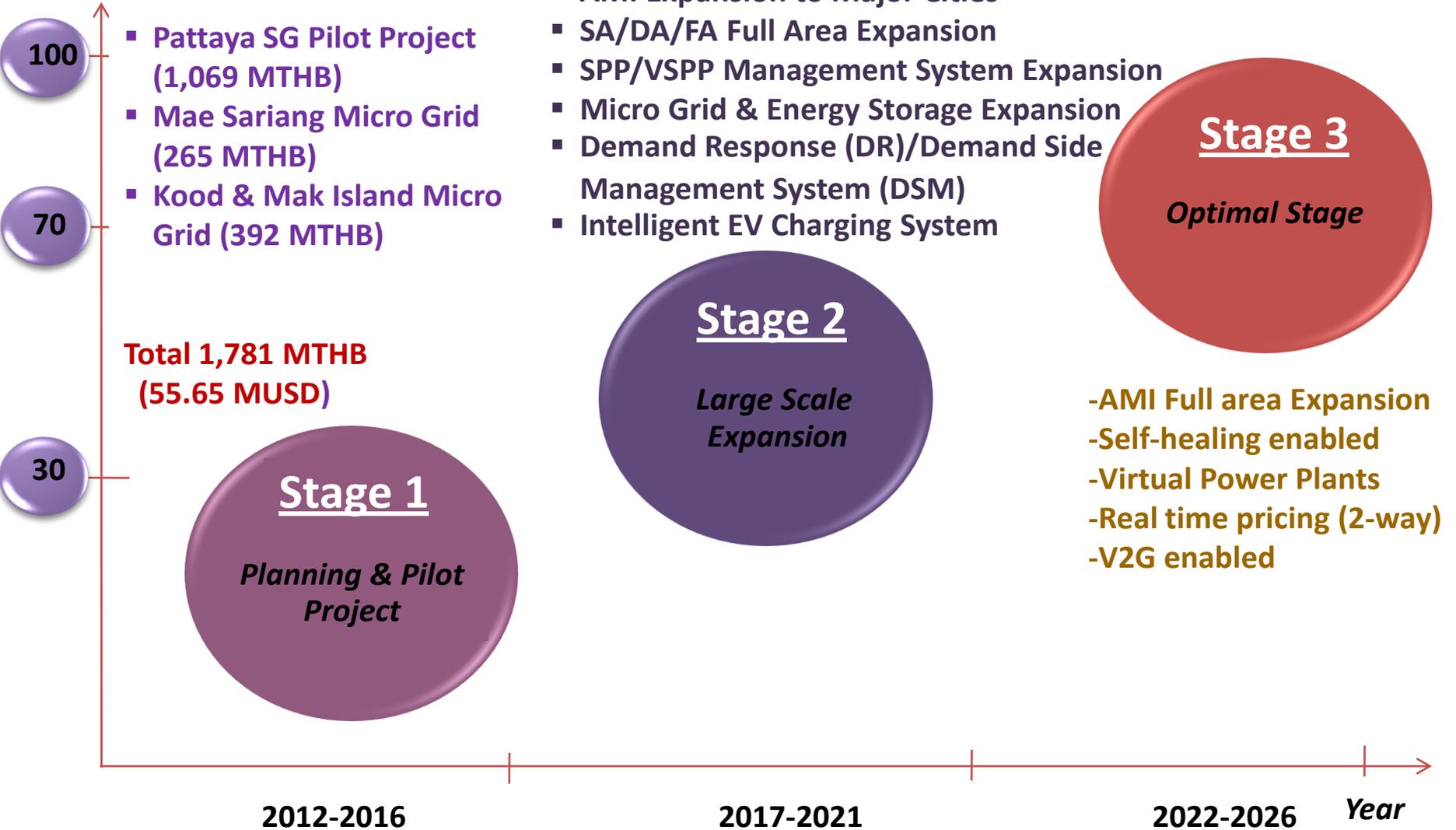
AMI Development Project, Phase 1
(5,350 MTHB)



PEA should implement 1-2 pilot projects of all Smart Grid's functions and evaluate the expected benefit from the pilot project to support the implementation of PEA Smart Grid all over country in the future

PEA Today's Smart Grid Roadmap

Smart Level



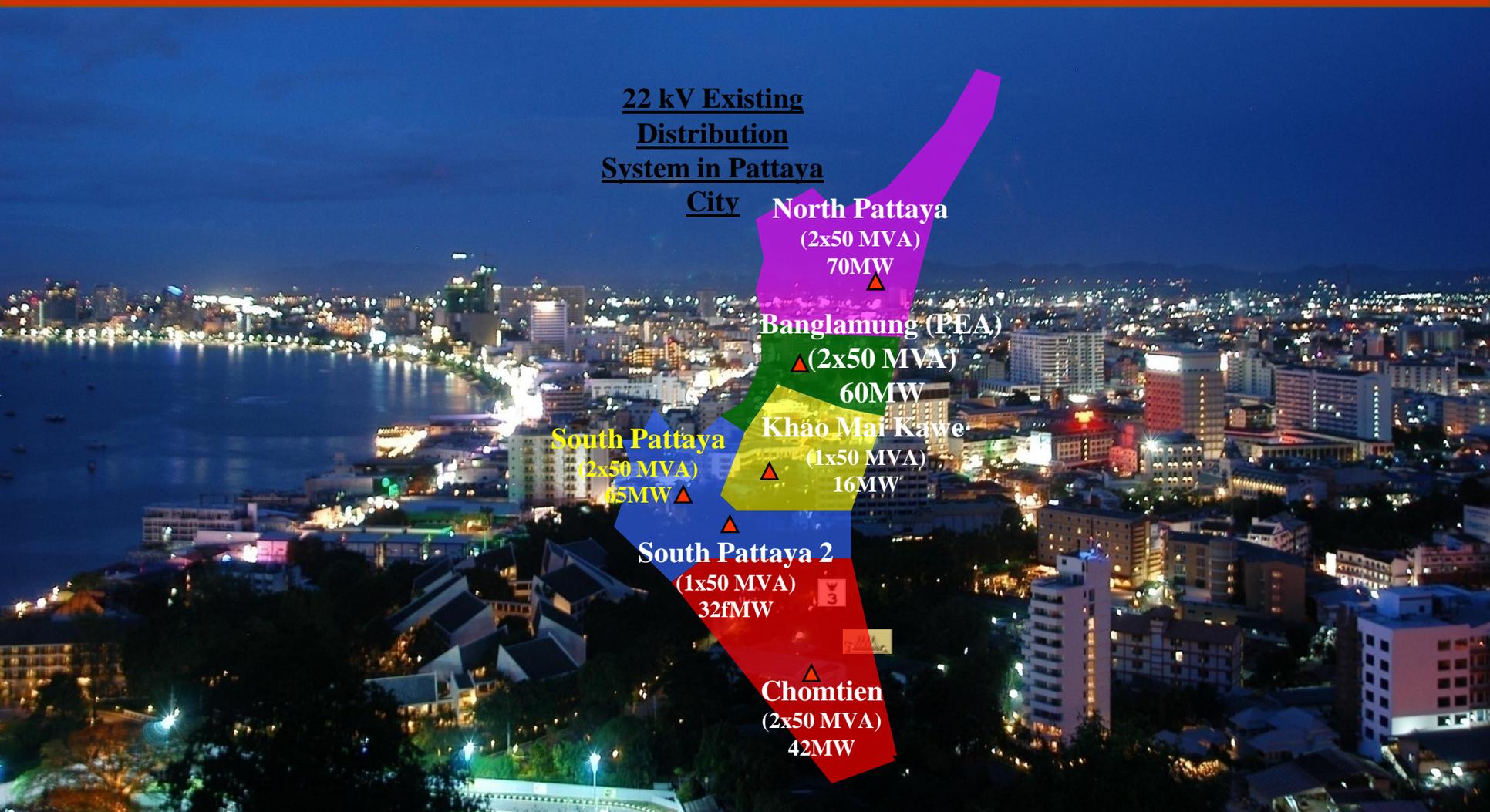
PEA Smart Grid Project

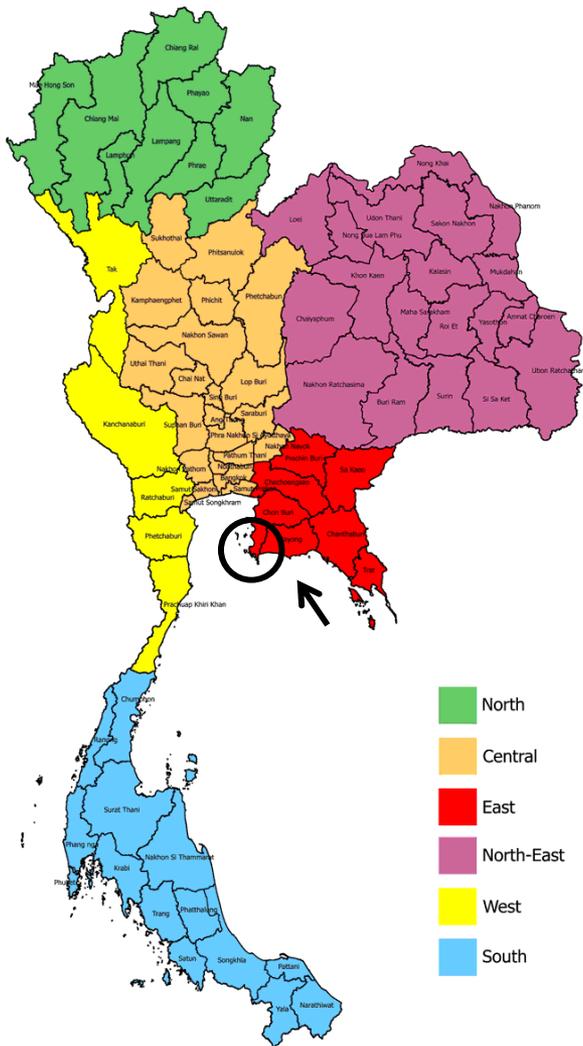
1 Smart Grid in Pattaya City Project, Chonburi Province (SGPC)

2 Micro Grid Development Project at Mae Sariang district, Mae Hongson province (MGDP)

3 Renewable Energy Generation Development Project at Kood and Mak Island, Trat Province (Micro Grid; REDP)

Smart Grid in Pattaya City Project, Chonburi Province (SGPC)





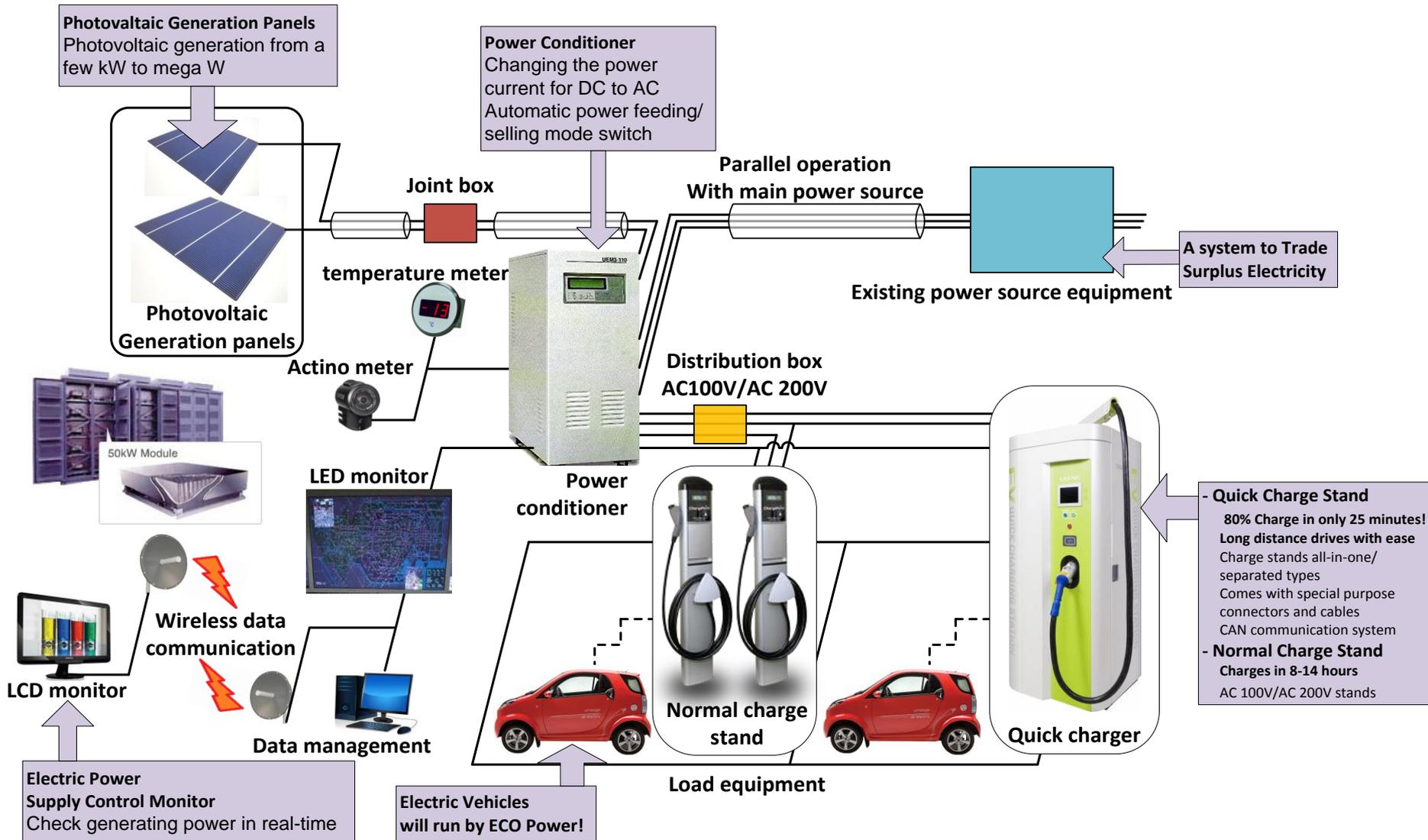
Purposes of Project :

- More understand relevant technologies and test all Smart Grid's functions in the project as test base to support the implementation of PEA Smart Grid all over country in the future.
- Evaluate expected benefits from each part of the Smart Grid Project.
- Develop and improve operation efficiency



- **AMI System**
 - **Smart Meter** **116,308 Meters**
 - **Data Center System** **1 System**
 - **Communication Infrastructure** **1 System**
- **Mobile Workforce Management** **1 System**
- **IT Integration system** **1 System**
- **Substation Automation System** **3 Substations**
- **Solar Rooftop** **3 Sets**
- **EV and Charging Station (3 EV, 1 Bus)** **7 Stations**
- **Energy Storage System** **2 Sets**

SGPC Scope of Work: Proposed





NESDB



Concern on

- EV Charging Station
- EV Car, EV Bus



PEA should delay the implementation of EV because :

- Discuss authority of Pattaya City, MEA, Car manufacturers for planning to maximize benefit
- Public relations for all stakeholders, especially consumers in the area of Pattaya
- Coordinate with Ministry of Energy and all stakeholders to push Demand Side Management

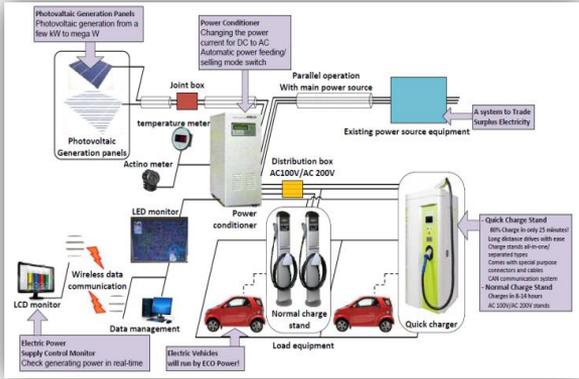


- Concerns on
- Energy Storage
 - Solar Rooftop



PEA should delay the Implementation of Energy Storage because :

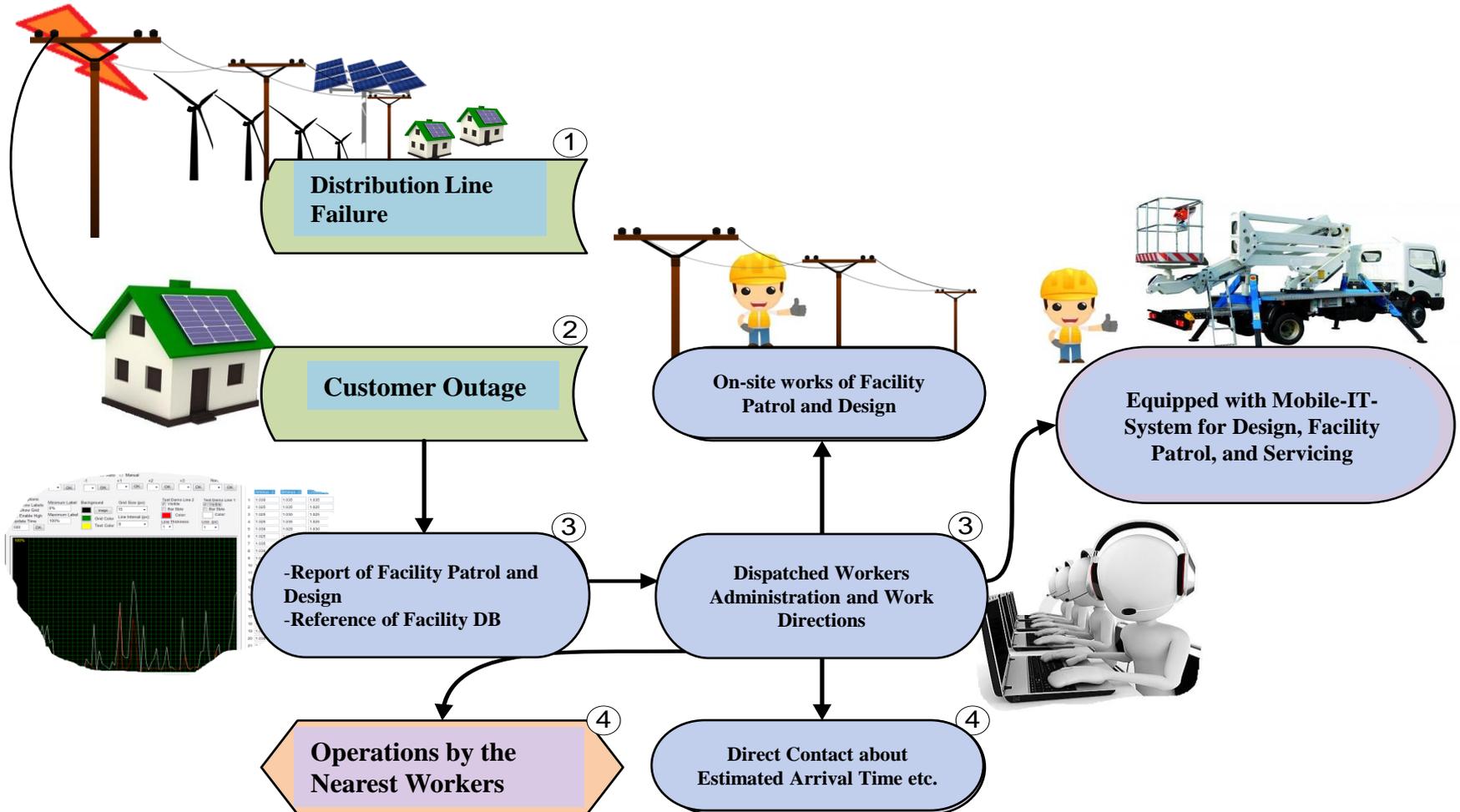
- No economic benefit.
- Trend of equipment prices much more lower in the future
- May be not effectively evaluated because of small capacity of energy storage in this project



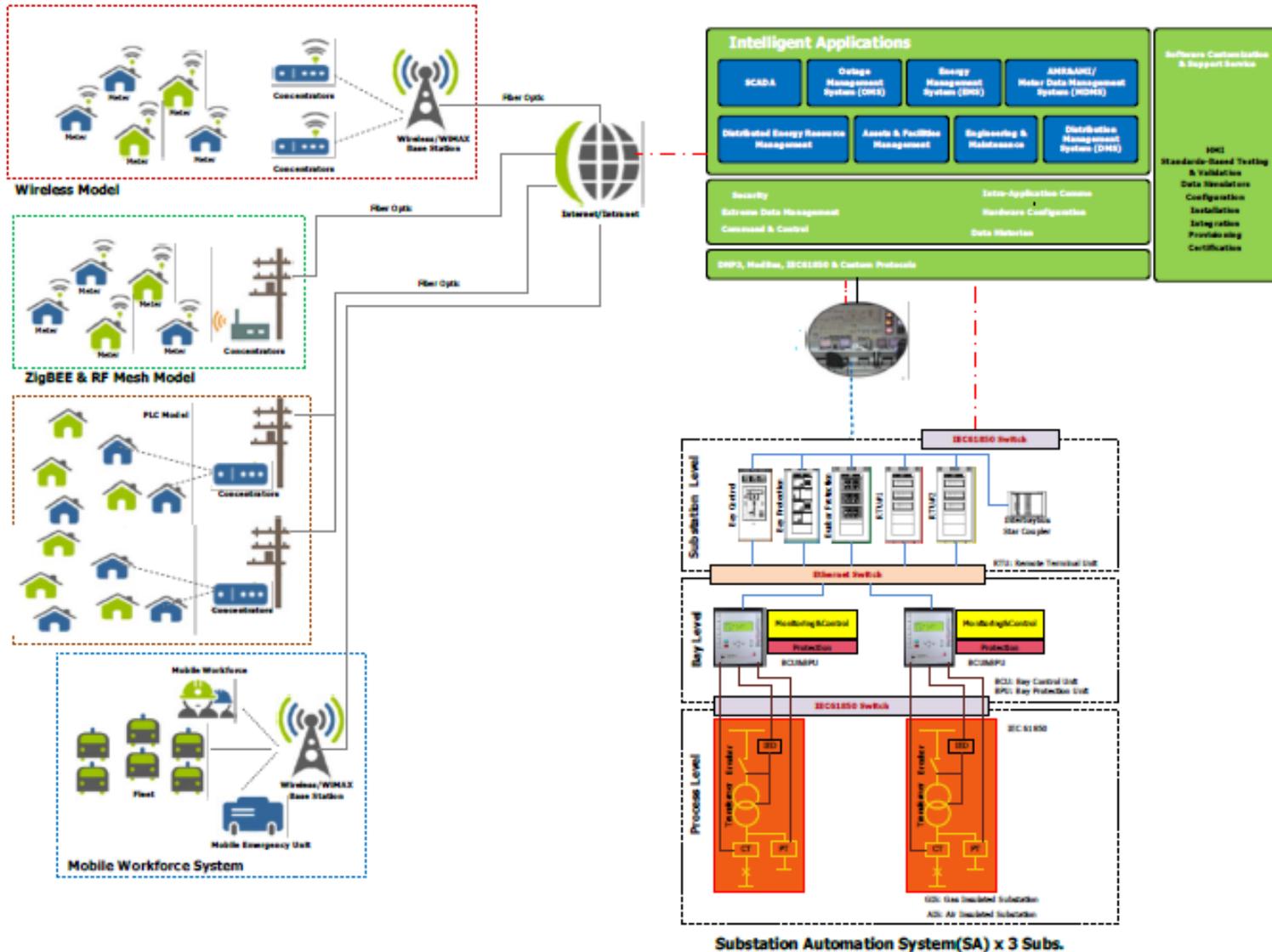
PEA should delay the Implementation of Solar Rooftop because :

- Because it's part of with EV charging system.

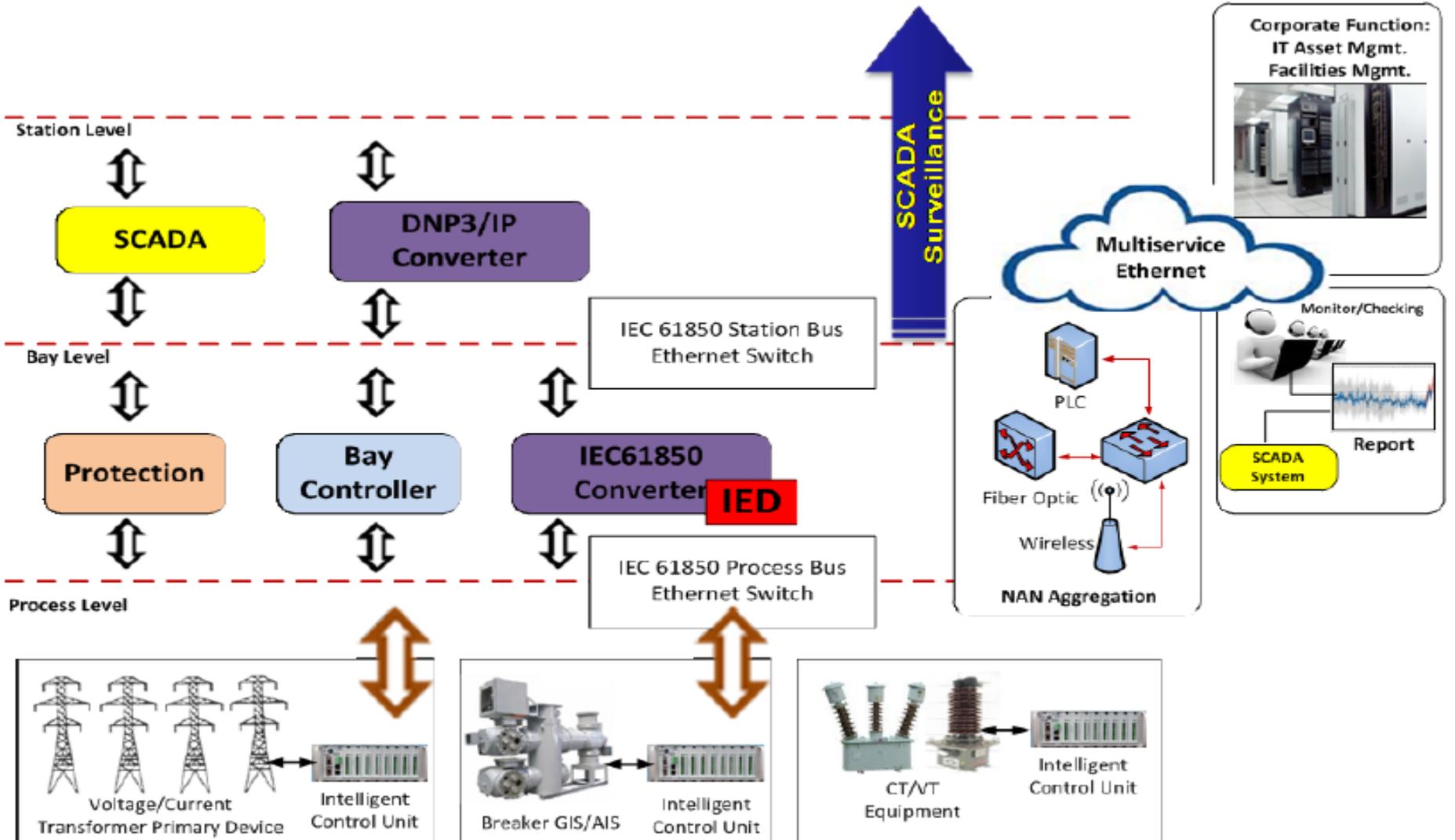
2. Install Mobile Workforce Management



3. Install IT Integration System

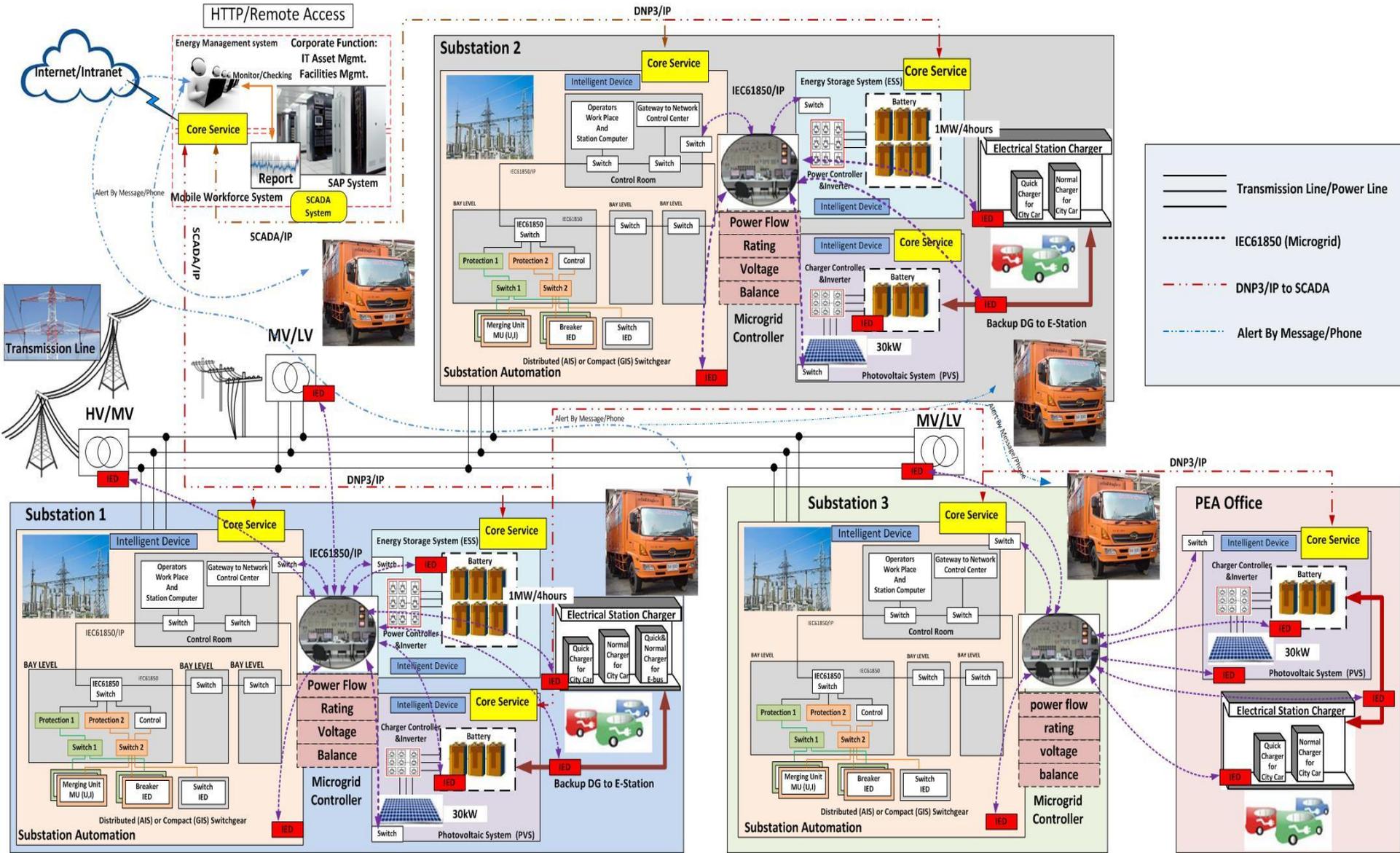


4. Install Substation Automation 3 Stations



Smart Grid in Pattaya City, Chonburi

Total Smart Grid Diagram



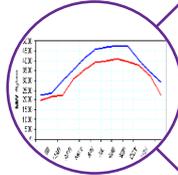
Benefit



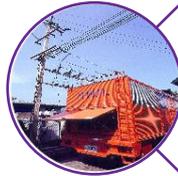
**Reduce costs reading /
connection and disconnection**



**Reduce Non-technical Losses/
Technical Losses**



Reduces peak load of system



Reduce outage cost



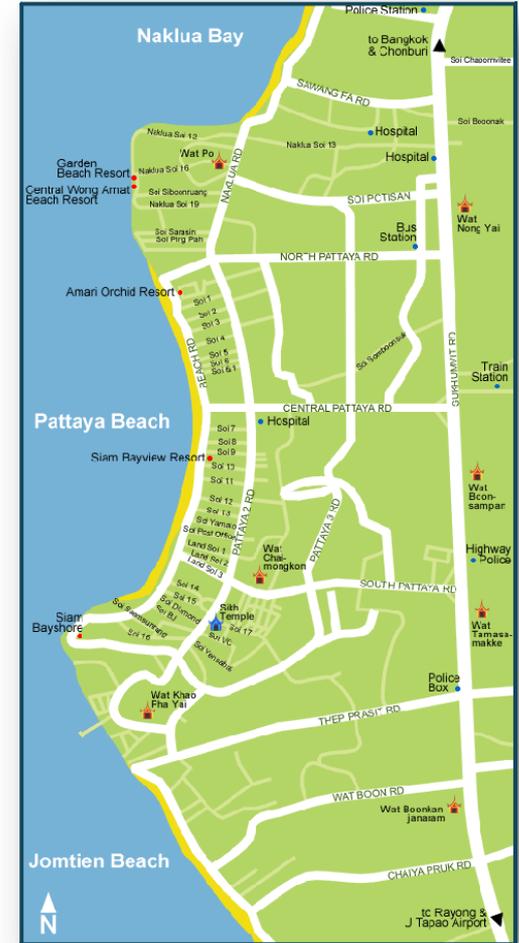
**Reduce costs of operations and
maintenances**

SMART GRID IN PATTAYA CITY, CHONBURI PROVINCE

Status :

Cabinet approved the project and budget on Dec 23, 2014

We are on the process to hire a consultant for bidding document



Overall Architecture of Consultant: Ex

Evaluate
Initial
Technical
Bids

Submit
Preliminary
Bid
Evaluation
Report

Identify Bid
Clarification
Issues

Conduct
Bidder
Identification
Meetings

Evaluate
Subsequent
Updated
Bids

Submit Bid
Evaluation
Report

Prepare
Notification
Letters

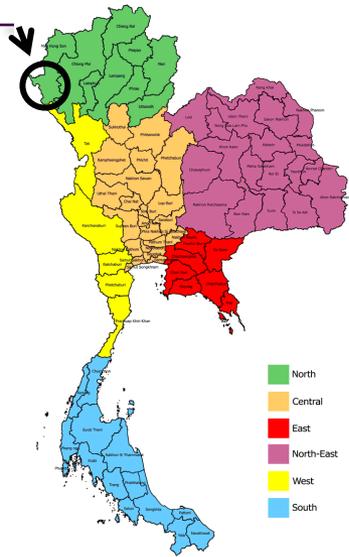
Enter into
E-Auction
Process



**Micro Grid Development Project at Mae Sariang district,
Mae Hongson province (MGDP)**



Micro Grid Development Project at Mae Sariang district, Mae Hongson province (MGDP)



Drivers of the Project

1. Power System Reliability Problem

The highest of Thailand, > 200 km of distribution line

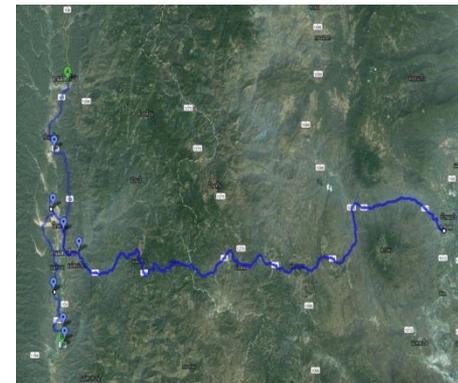
2. Power Losses in Distribution Line

25,300 kWh/day, 1,000,000\$/yr

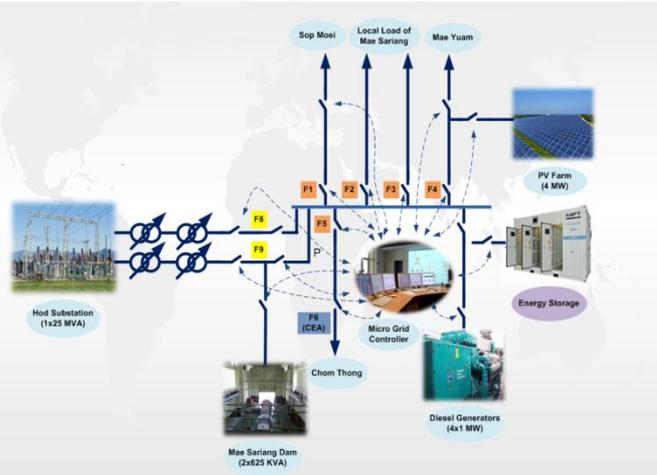
3. Voltage Drop in Distribution Line

4. Expansion of Renewable Energy (RE)

4 MW of PV (Peak load: night time 5 MW, day time less than 4 MW)



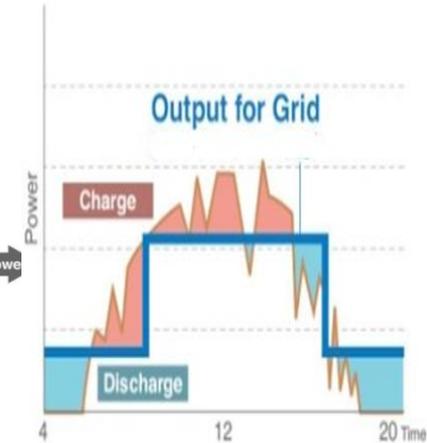
PEA Micro-Grid three modes of operation



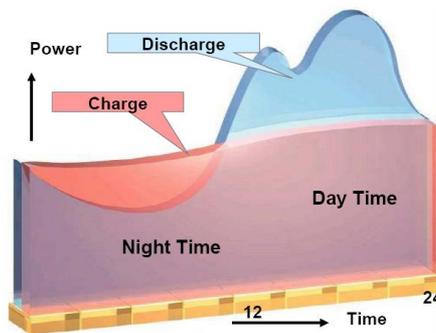
1. Islanding



Energy storage



2. Intermittent Resources Integration

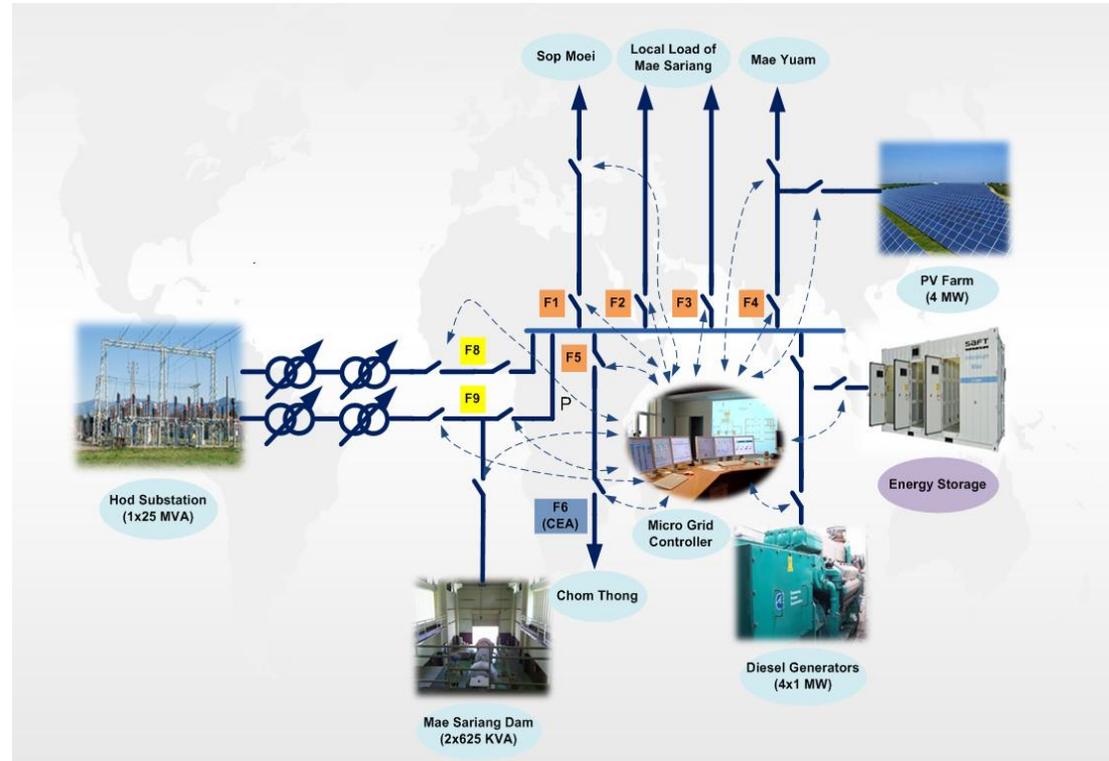


Leveling of Load Demand & Power Supply

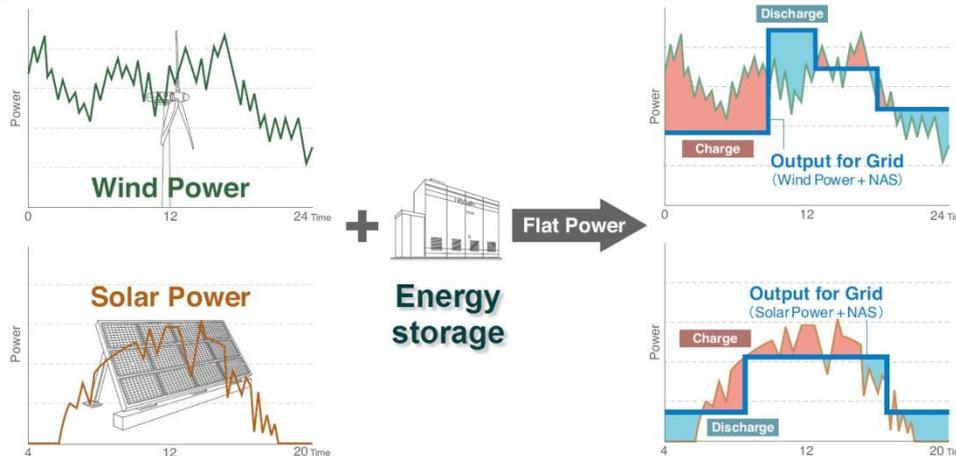
3. Peak Shaving

1 Islanding

Micro-Grid operate in parallel with the bulk supply system during normal conditions and transition to islanded (stand-alone) operation during abnormal conditions.



2 Intermittent Resources Integration

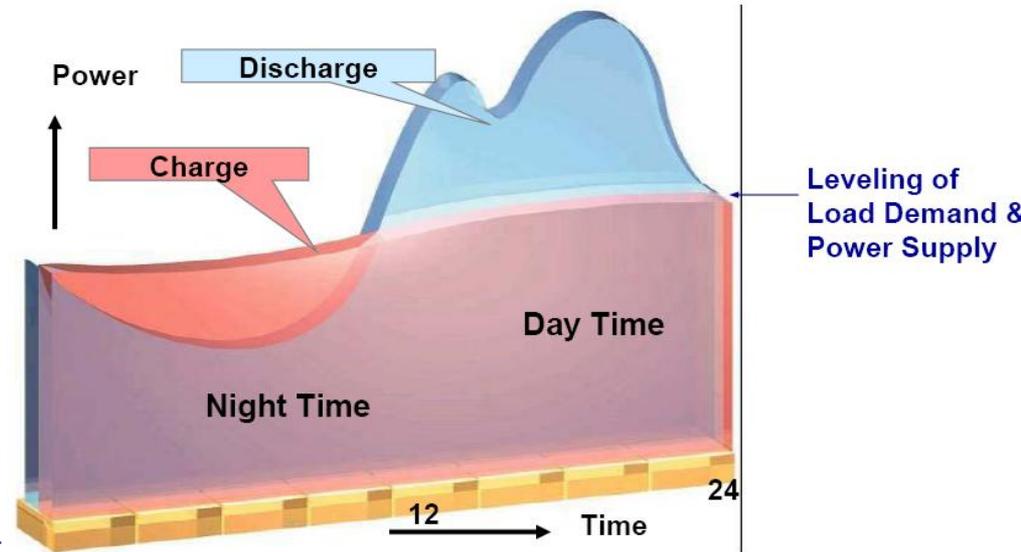


Although renewable energy resources are environmentally beneficial; the variable output of solar (PV) causes voltage and frequency fluctuations on the power network.

Energy Storage system smoothes the output from PV, bringing increased benefits to society.

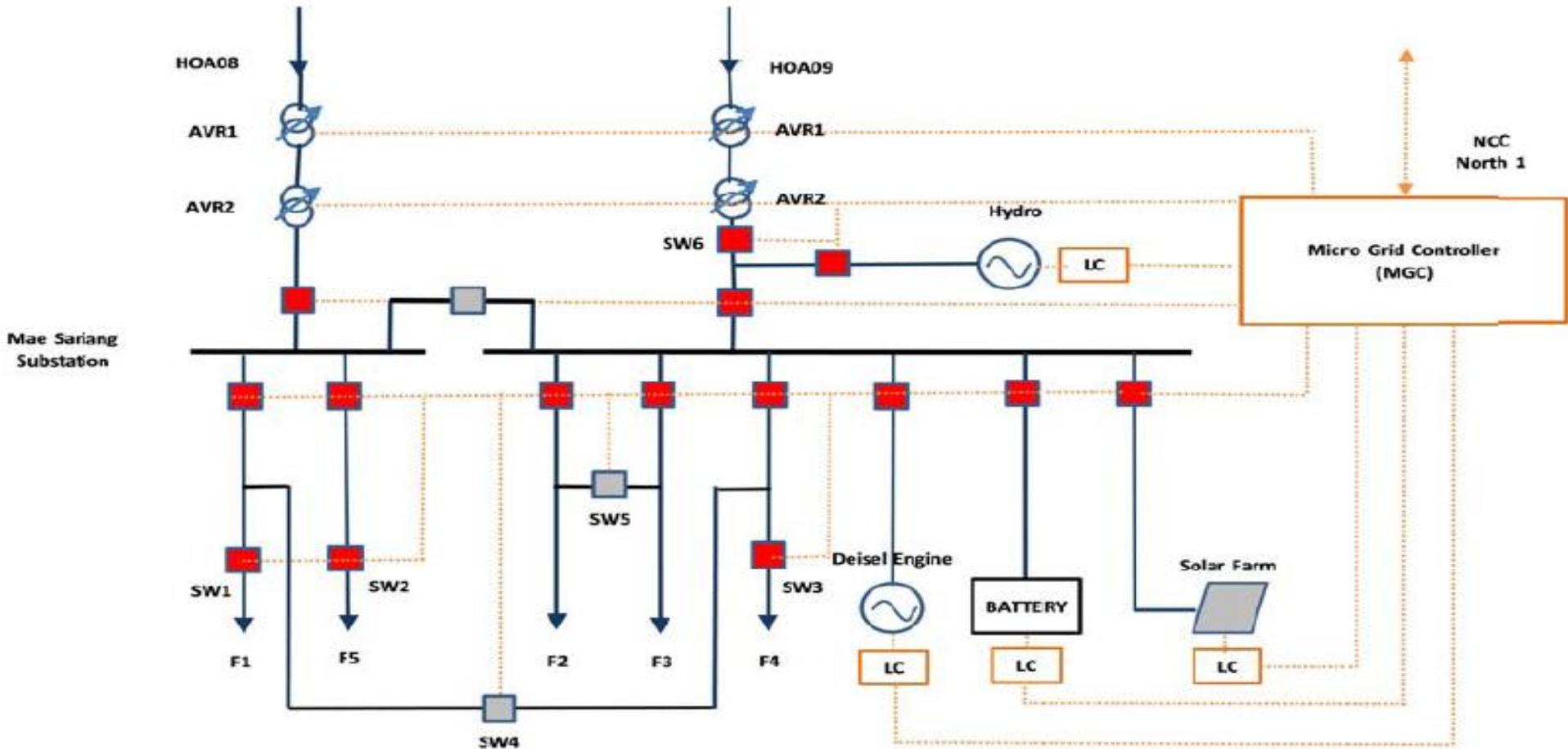
3 Peak Shaving

- To accumulate surplus energy produced by PV (Charge) and then re-dispatch (Discharge, at high price) it based on peak demand.
- Stores energy during off-peak periods (at a low price, if needed).



- System can replace other types of peaking generation or standby plant to meet growth in peak demand or replace retiring plants.

Micro-Grid Configuration



 Measurement Point and Protection

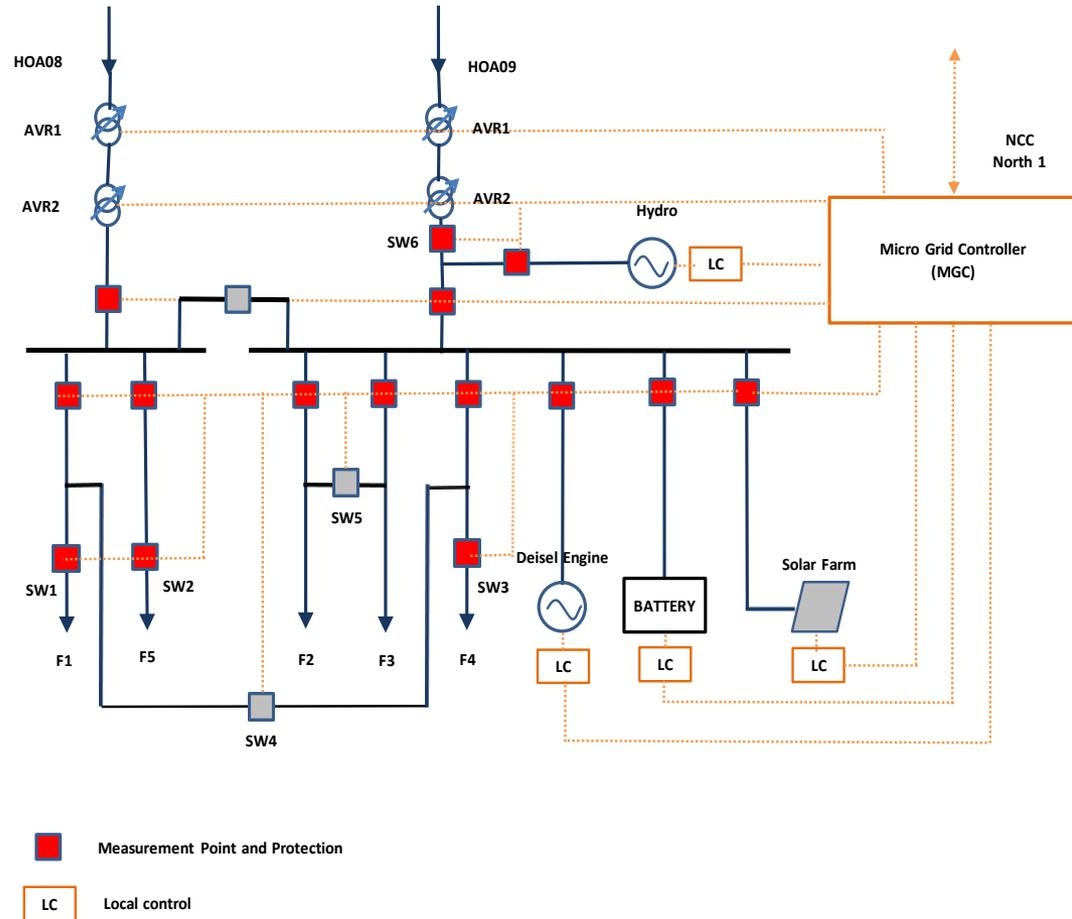
 Local control

Benefits of the PEA Micro-Grid

- **peak shaving cost,**
- **diesel generator usage replacement,**
- **carbon credit, Interrupted Energy Rate (IER),**
- **Interruption Cost Per Event (ICPE),**
- **substation/transmission system upgrade deferral, and**
- **power system technical losses.**

Scope of Work

- Install Battery Energy Storage 3 MW/1.5 MWhr
- Install Micro Grid Controller
- Install Diesel Generator 3 MW
- Improve Existing Diesel Generator
- Install Communication System



Status

Feasibility Study of Mae Sariang Project had been approved by PEA's Board of Directors on 26 August 2014



Mae Sariang Project is being approved by National Economic and Social Development Board (NESDB) and Energy Regulatory Commission of Thailand (ERC)

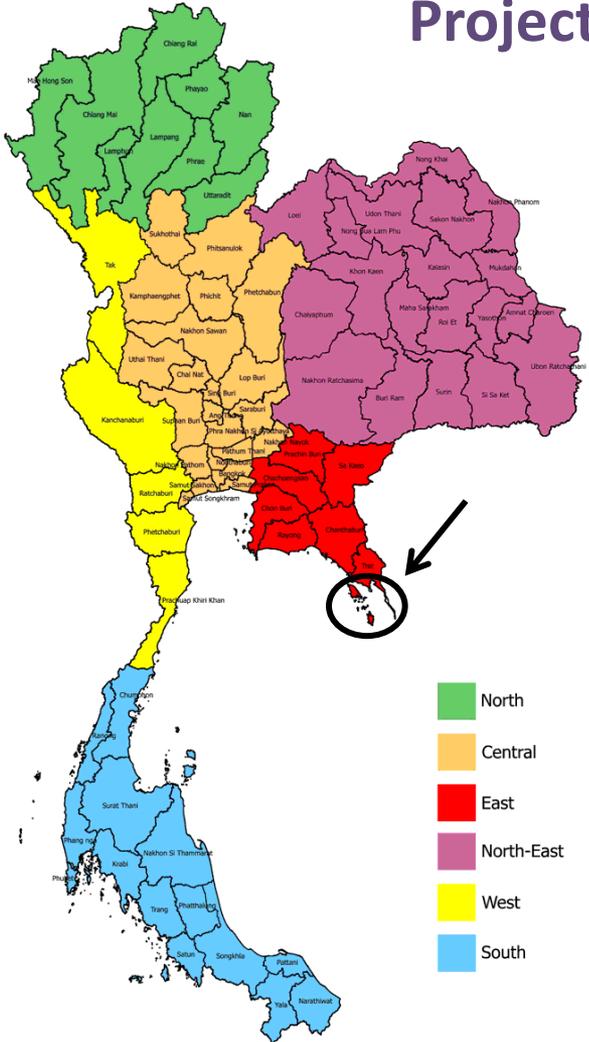


**RENEWABLE ENERGY GENERATION DEVELOPMENT PROJECT
AT KOOD ISLAND AND MAK ISLAND, TRAT PROVINCE
(MICRO GRID; REDP)**



PROJECT ON KOOD ISLAND AND MAK ISLAND

Project Area



Objective of Project :



1) To increase reliability and quality of power system.



2) To do peak shaving and reduce losses.



3) To test the energy management system for controlling the inverter of PV farm/diesel generator/battery energy storage.



4) To support the expansion of renewable energy and to implement the first smart Micro-Grid system.

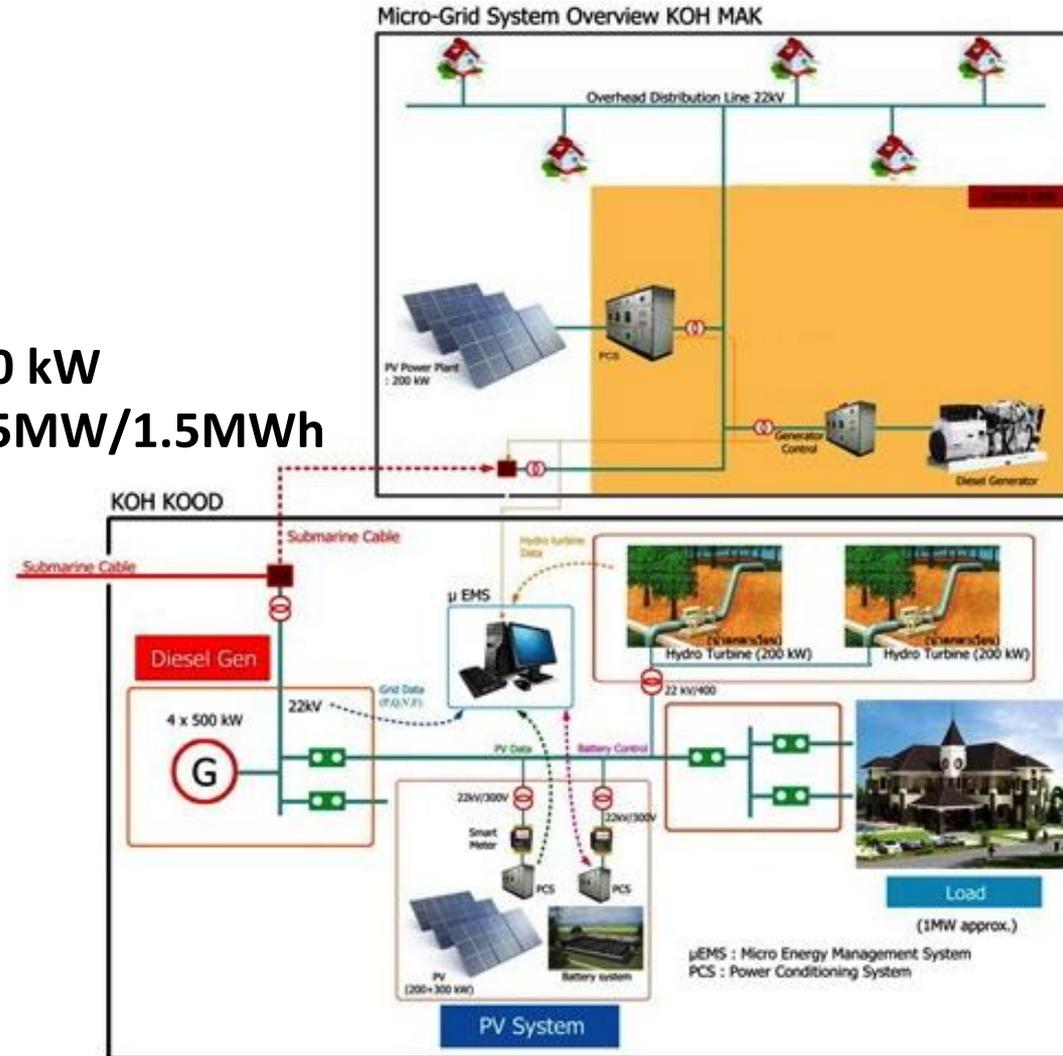
Scope of Work

KOOD ISLAND

- Install PV Plant 200 kW
- Construct Hydro Power Plant 400 kW
- Install Battery Energy Storage 1.5MW/1.5MWh
- Install Micro Grid Controller

MAK ISLAND

- Install PV Plant 200 kW





Draft Revision PEA Smart Grid Roadmap

PEA Smart Grid Roadmap

Revision Aligned with National Policy

A Road to PEA Smart Grid

Vision of Our Energy Future

-  Business Operations Focus
-  National Policy Alignment
-  Strong Benefits Realization
-  Actionable Roadmap



Country Roll-Out



Smart Grid Pilot Project



Align Roadmap to TH
Nation Regulatory/ Policy

Strengthen Smart
Grid Roadmap based on
proven implementation



Smart Grid
Demonstration Program

PEA Smart Grid Roadmap Revision

- PEA would like to revise the current roadmap to achieve the following:

PEA Smart Grid Roadmap Revision Aligned with National Policy



Business Operations Focus



Shifting from the technology focus, PEA would like to plan and prepare business operations for supporting smart grid initiatives and ensure the new operations are designed to match with PEA and our customers.



National Policy Alignment



PEA would like to ensure the designed PEA smart grid capabilities are in line with the country's smart grid direction and regulator's policy.



Benefits Realization



PEA requires a smart grid roadmap with a clear economic justification and benefit realization to PEA, customers, and society in order to support the government approvals for investment actions.



Actionable Roadmap



PEA would like to establish the smart grid roadmap that is actionable, achievable, and practical to PEA, customers, and Thailand. The business operations and technology should be designed and leveraged the proven and successful cases from leading utilities.

REVISION PEA Smart Grid – 9 Focused Areas and Key Elements

1. Sustainable Generation

Renewable energy management



2. Power Grid Operation

Micro Grid & DG/ES integration

Distribution Management (SCADA/EMS/DMS/OMS/DA/Transformer)



3. Empower Energy Customers

Advanced Metering Infrastructure

Customer Appliances (HAN/IHD/HEMS)

Demand response

Meter-to-Cash Process

4. Integrated Technology Platform

Data Management

IT Architecture



5. Data Analytics to Support Decision

Grid Operation Analytics

Asset Analytics

Customer Analytics

6. Enabling Electric Vehicle

Electric Vehicle (EV)

EV Charging Station

Grid impacts

7. Energy Efficiency & Green Buildings

Energy Efficiency Approaches

Green Building Technologies

Building Energy Management Systems (BEMS)

8. Smart Grid Standard Development

SG Standards Alignment



9. Smart Grid Comm.& Security

Last Mile Network

Meter Back Haul Network

Network Operation Centers

Cyber Security

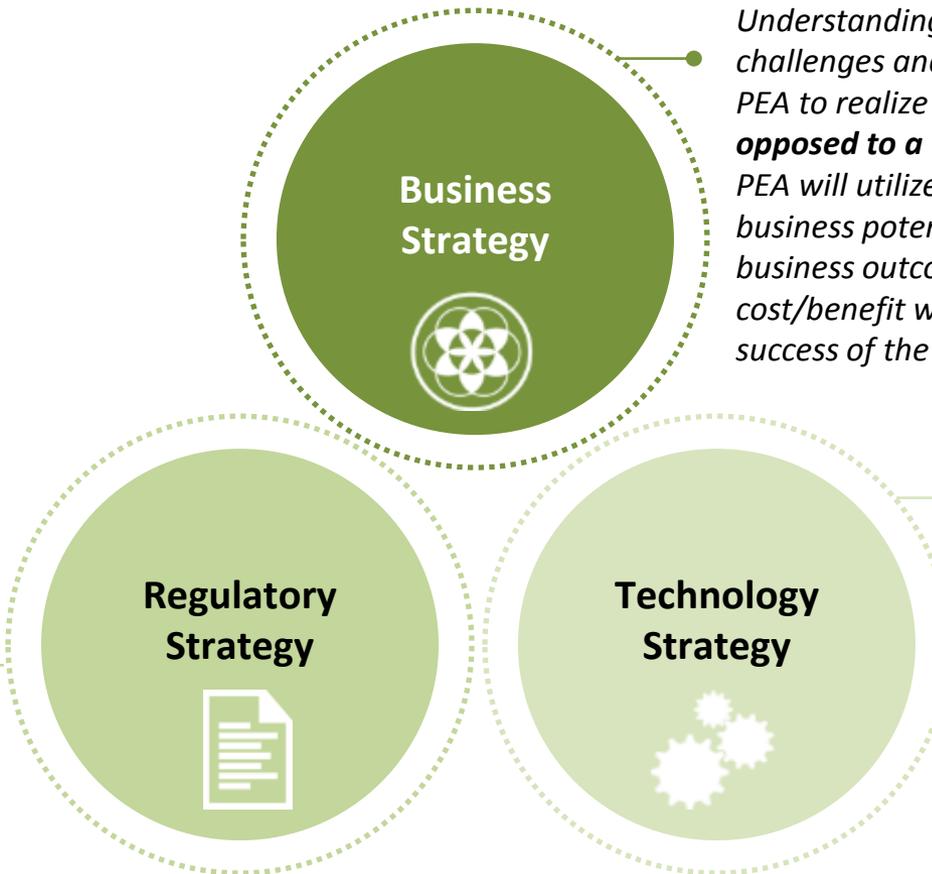
The 3 Strategies

Grid Operations

Customer Operations

IT Operations

Regulation is a meaningful step toward smart grid's development. In order to achieve smart grid's vision, it is necessary to have appropriate regulatory model to ensure benefits to both operators and consumers



Understanding smart grid's drivers, business challenges and PEA's objectives will enable PEA to realize its business capabilities. As **opposed to a technology-driven approach**, PEA will utilize its technology to achieve its business potentials. A strong focus on business outcomes, operational impacts, and cost/benefit would be critical to the overall success of the project.

Once business capabilities are realized, the project would present and recommend scalable solutions and proven technologies while respecting the existing investments PEA has already made.



THANK YOU