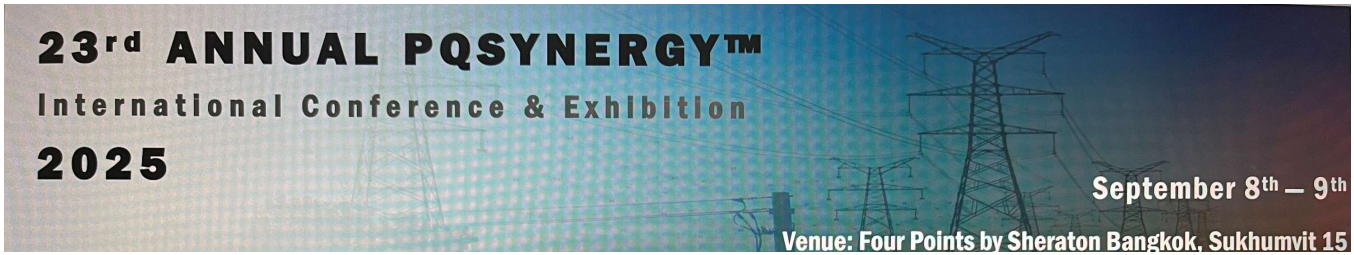
23rd Annual PQSYNERGY International Conference & Exhibition " Technology and Application of Renewable Energy in the Present Day"



- Presented by : Bancha Yathip (Energy Advisor)
- 89 Plus Energy Company Limited

Email: bancha.yat@gmail.com H/P 6689-527-3332,ID Line: Bancha2222

Reference Seminar: Technology and Renewable Energy Events

UNDP-Chula Uni. (Upskill program involved Solar Business in Thailand and ASEAN)

Department of Alternative Energy Development and Efficiency (DEDE),

Ministry of Energy

Solar Quarter (India),Energy Box (China)

Neoventure (China),ESCOM events (Indonesia),

Provincial Electricity of Authority of Thailand (PEA)

Education: Bachelor (Electrical Engineering) Patumwan Institute of Technology,

Master of Engineering (Energy Technology) King Mongkut University

of Technology Thonburi, KMUTT)

Ph.D. Candidates, Smart Energy and Environmental Management at RCSEE, RMUTR.

- Advisor| Energy and Engineering| Renewable Energy | Battery | EV | Microgrid |DERs |Grids Modernization |Infrastructure|IEC61850|Climate Change |Carbon Neutrality|

https://www.linkedin.com/in/bancha-yathip-526b9812a

Dr. Bancha Yathip
Energy Advisory

23rd PQSynergy – Technology and Application of Renewable Energy in the Present Day”

23rd PQSynergy 2025,Four Point by Sheraton

Bangkok,Sukhumvit 15

As of September 9,2025

Ministry of Energy

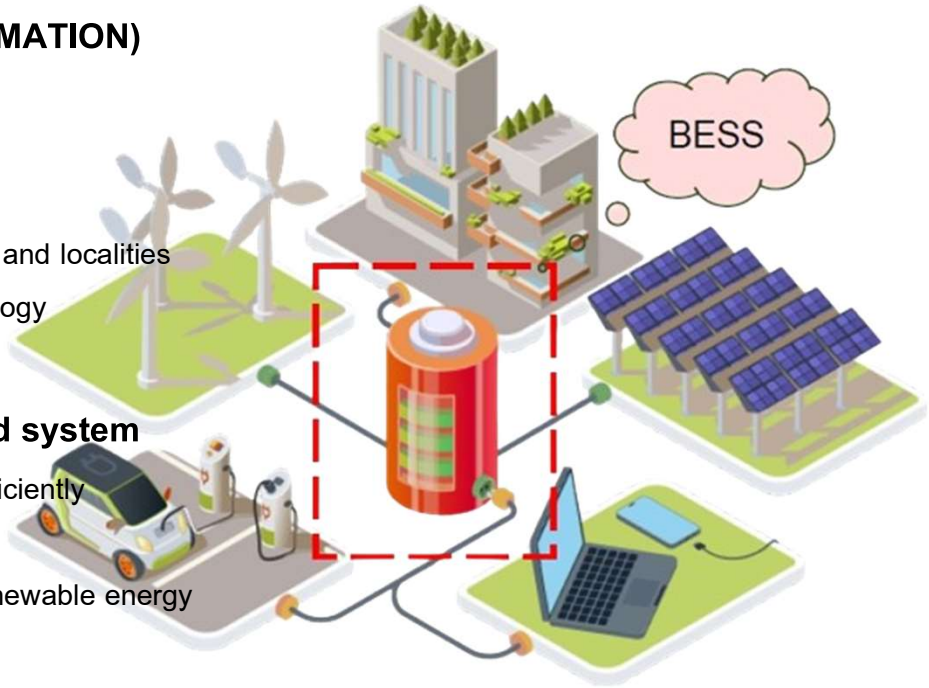
Energy Policy and Planning Office (EPPO)

Focus on developing Thailand's network system to be intelligent.

(Grid Modernization)

❖4D1E (GOING TO BE SMART GRID AND ENERGY TRANSFORMATION)

- DIGITALIZATION : Using a digital system to replace an analog system
- DECARBONIZATION :Carbon dioxide reduction
- ELECTRICFICATION : Promote the use of electric cars
- DECENTRALIZATION : Decentralization of control power according to districts and localities
- DE-REGULATION :Repeal of outdated regulations Not keeping up with technology

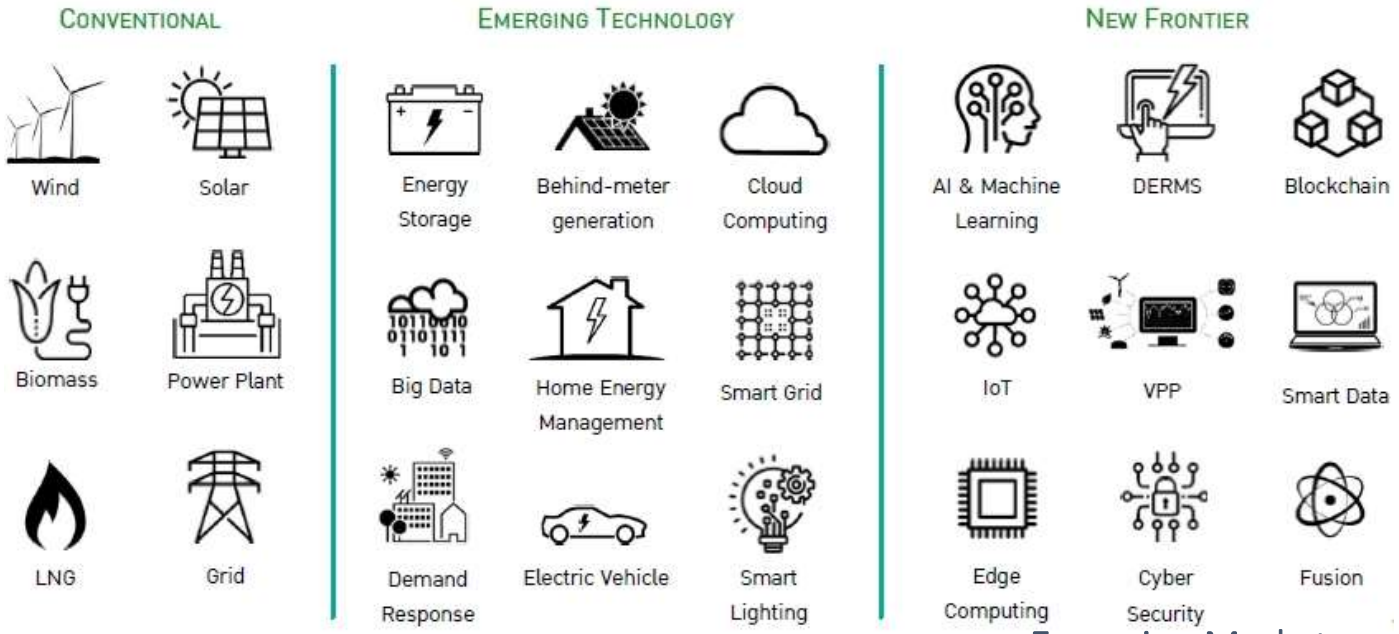


❖5 PILLARS (DRIVEN) : Five pillars driving Thailand's smart grid system

- Energy Management System (EMS) : Electrical energy management system efficiently
- Demand Respond (DR): Load Response
- Renewable Energy (RE) FORECAST : Forecasting electricity produced from renewable energy
- ENERGY STORAGE SYSTEM :
- MICROGRID & PROSUMER :Microgrid and prosumer systems, microgrid technology that can manage the electricity producer side and use electricity at the same time by relying on a small electrical network
- EV INTEGRATION : Integration of electric vehicles and the 30%@30% policy (reduce ICE engines, increase EV cars)


ระบบไฟฟ้าในอนาคต
DEMAND RESPONSE PROGRAM
DISTRIBUTION ENERGY RESOURCE MANAGEMENT
ELECTRIC VEHICLE & CHARGING
ENERGY STORAGE
SUPER GRID
MICRO GRID
SMART HOME/ SMART BUILDING
PEER TO PEER ENERGY COMMERCE

Related technology and energy transition In the near future and businesses related to solar cell systems and smart grid systems



Current system: wind power, solar cells, biomass, power plants, gas, electrical grid

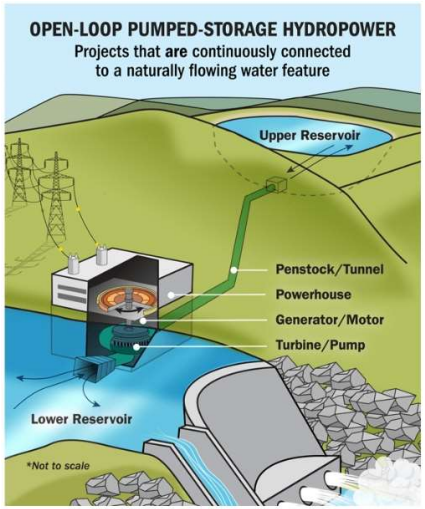
emerging system

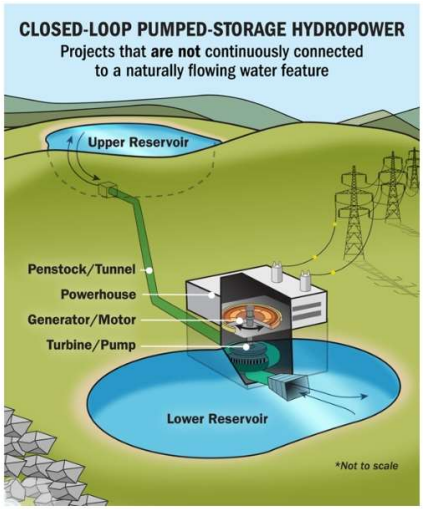
Energy storage systems (batteries), behind-the-meter electricity generation sources, cloud computing, big data, home energy management systems, smart grids, energy demand management systems, electric vehicles, smart lighting

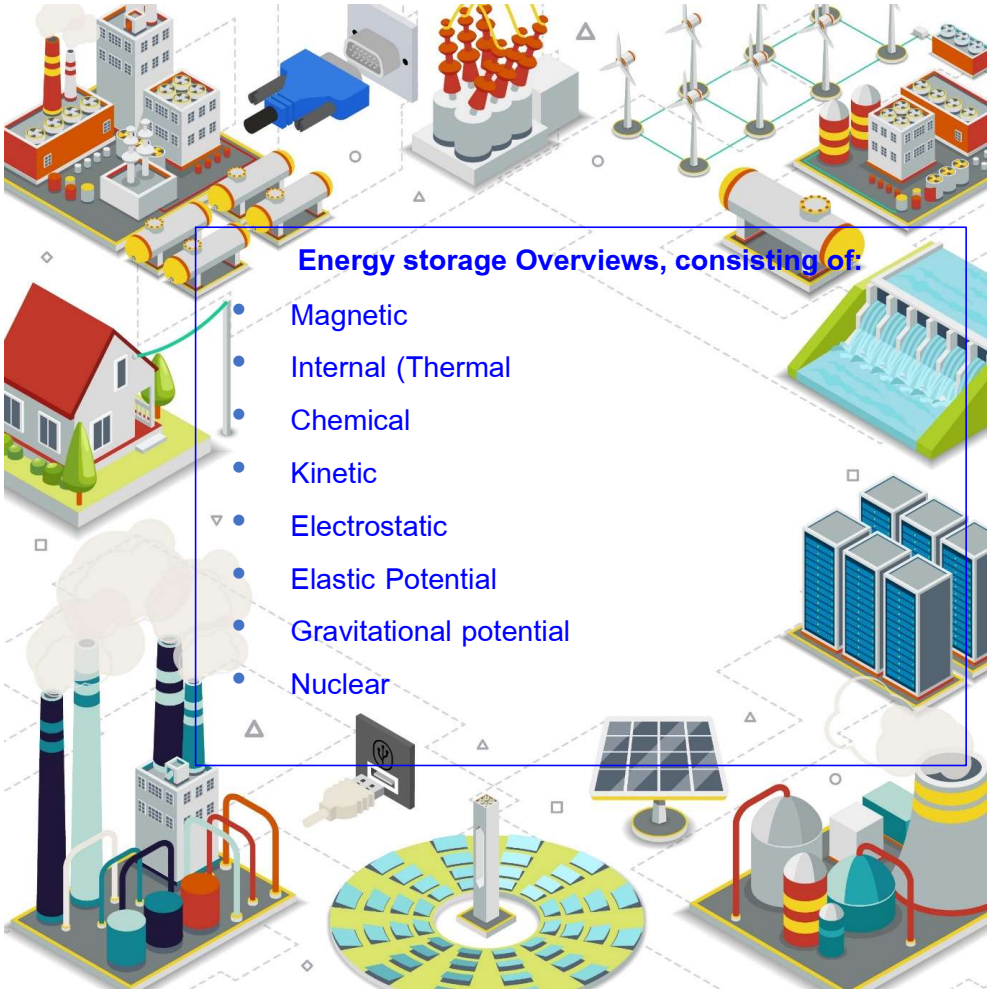
Emerging Markets

Artificial Intelligence (Artificial Intelligence), DERMS: Distributed Power Generation, Block chain, ioT, VPP: Virtual Power Plant, edge computing, cybersecurity, nuclear

Energy Storage Overview







Energy Storage technologies applied used in Thailand

1. Hybrid hydro power plant combined with BESS+Microgrid EMS (Microgrid Energy Management System)Hydro Floating Solar Hybridge
2. Energy Storage System (ESS)
3. Hydrogen Technology
4. Carbon Capture and Utilization (CCU)
5. Small Modular Reactor (SMR)

2 **Energy storage system**

- Grid Scale BESS
- โรงไฟฟ้าพลังน้ำแบบสูบกลับ

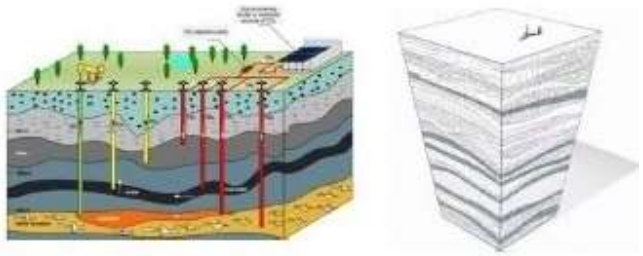
Energy Storage in Thailand

❖ Hydro Solar Floating+BESS+ Microgrid Energy Management System (EMS)

❖ Pumped Hydro +BESS

❖ Hydrogen Energy Storage Power Plant + BESS

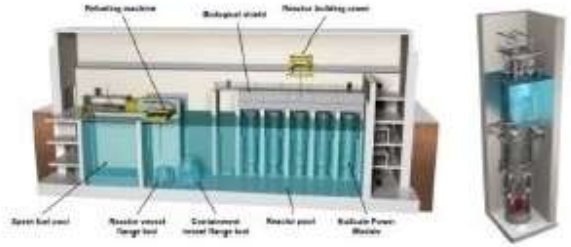
Energy Storage in Thailand



4 Carbon capture and utilization (CCS)

- เหมืองแม่เมาะ
- แหล่งก๊าซธรรมชาติน้ำพอง (Enhanced Gas Recovery)

Carbon Capture System: at Maemoh Coal Mining and Khonkhean NG



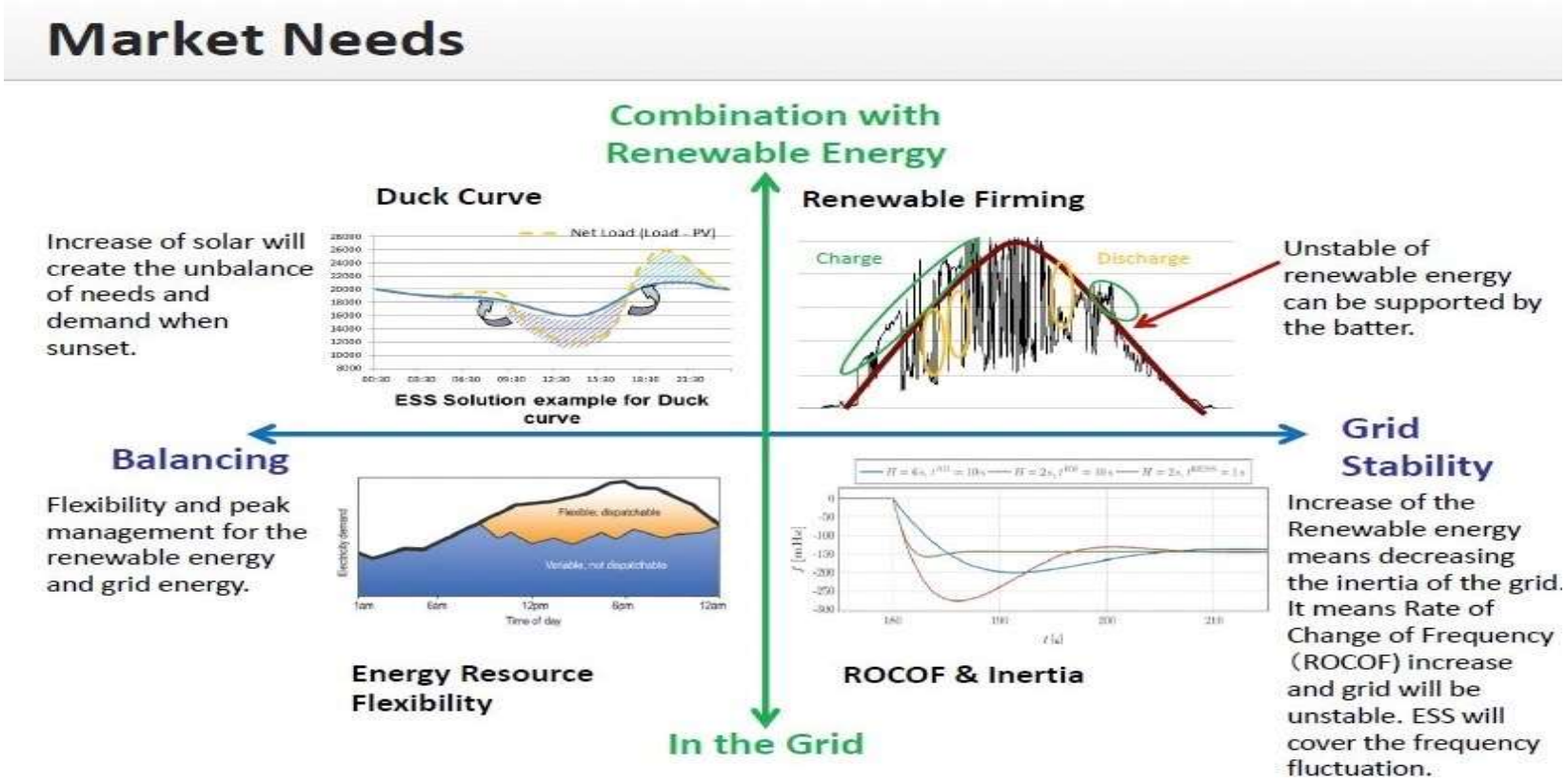
5 Small Modular Reactors (SMR)

- ทางเลือกแหล่งผลิตพลังงานไฟฟ้าสะอาด เป็นโรงไฟฟ้าฐานที่ผลิตไฟฟ้าได้อย่างต่อเนื่อง และมีต้นทุนแข่งขันได้

Fusion Small Modular Reactors (SMR)

Energy storage in batteries and connect the system to the electricity grid, (Battery Energy Storage System: Grid Scale BESS)

The graph shows the increasing use of renewable energy from solar system and bringing batteries to work with renewable energy



Battery Energy Storage System (BESS)

Battery BESS for Energy storage consisting of:

1. Lithium Iron Phosphate : LFP
    - Safety , Decomposition temperature > 270 C
    - Deep of Discharge (DOD), Charge and Discharge, increased cycle
2. Lithium Nickel Manganese Cobalt : NMC
    - Capacity Density per areas increased
    - Quick charge and low temperatures

For using batteries to store energy in the industrial sector and power plants, LFP is commonly used for safety.
Increase the energy stability of the Grid

In the automotive or EV industry, both LFP and NMC are used,
depending on the application suitable for that model.

Technical Data for Battery Energy Storage

❖ State of health : SOH >>>

battery health Or how many % of your battery has deteriorated? For example,
when it was first used it had 100% capacity, but after 2 years of use,
it had 90% remaining, which means SOH = 90%.

* Deep of Discharge (DOD): The value of the depth of discharge (%) is easy to understand: If our car has a full tank of gas And we used it all up, that is,
used it up 100%. When we refilled it, it started up without any problems.
But if it's a battery If the battery runs out to 100% often,
it will cause the battery to deteriorate very quickly.
So we have to manage Let the battery supply only 80% of energy (20% remaining),
then we stop supplying energy (Discharge) and then we add more energy (Charge) to the battery. Slowly supply full power.

❖ Current rate : C rate >>> ability to supply current compared to capacity

C-rate	Time
5C	12 min
2C	30 min
1C	1h
0.5C or C/2	2h
0.2C or C/5	5h
0.1C or C/10	10h
0.05C or C/20	20h

Table 1: C-rate and service times when charging and discharging batteries of 1Ah (1,000mAh)

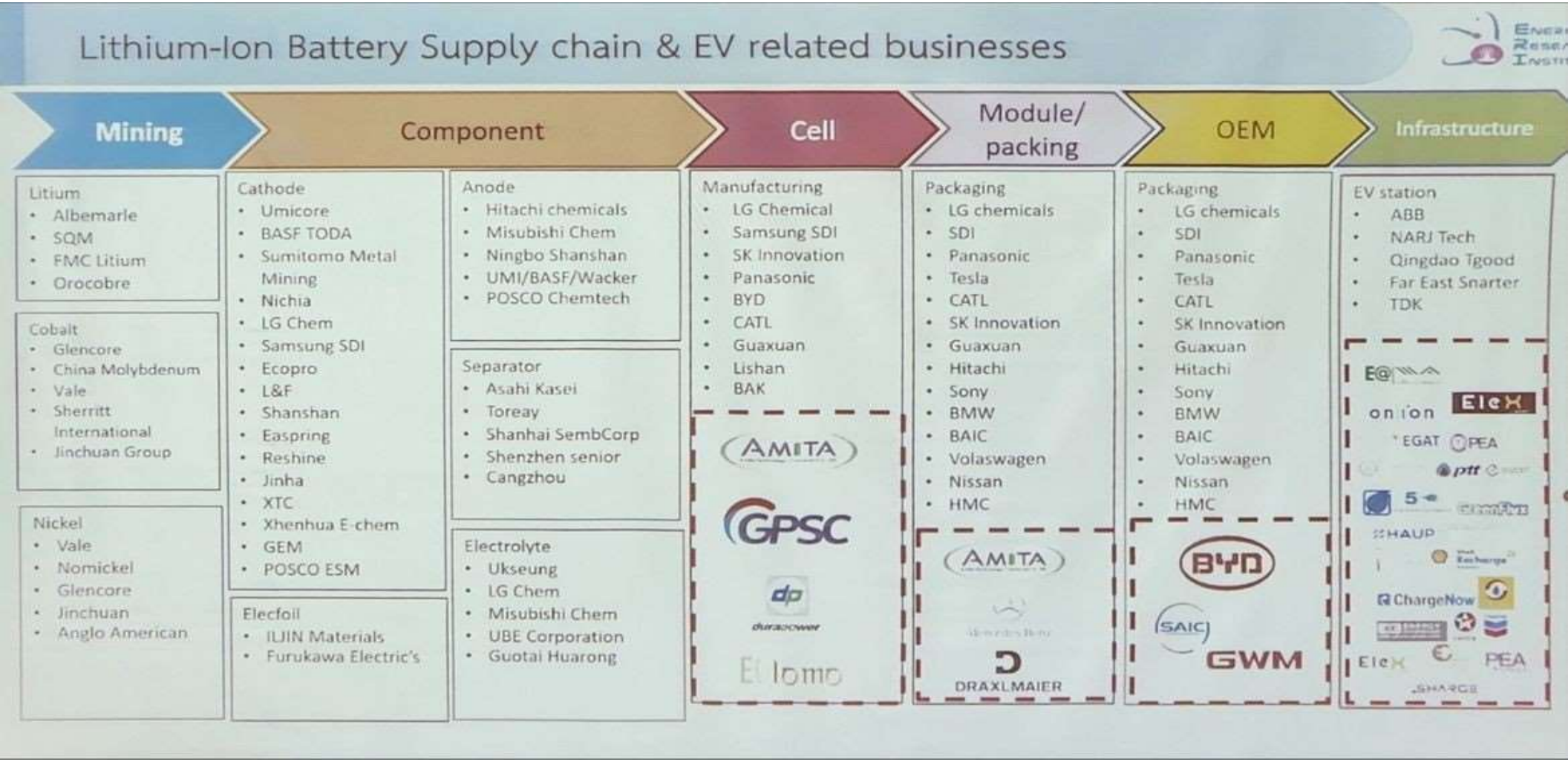
* Battery Charge Cycle >>> The number of cycles that a battery can be used before it deteriorates.

For example, Sungrow's battery can supply energy for 5,000 cycles,

which if we estimate that 1 day = 1 Cycle, it means that the battery has a lifespan of approximately 14 years (5,000 / 365 = 14)

Comparison table of battery types and Li-Ion battery supply chain

Credit Source: Energy Research Institute Chulalongkorn University



Benefits of the BESS battery power generation system

1 Maximize Self Consumption

2. Energy

3. Power Quality

4. Energy Arbitrage

5. Peak Shaving

6. Custom Solution

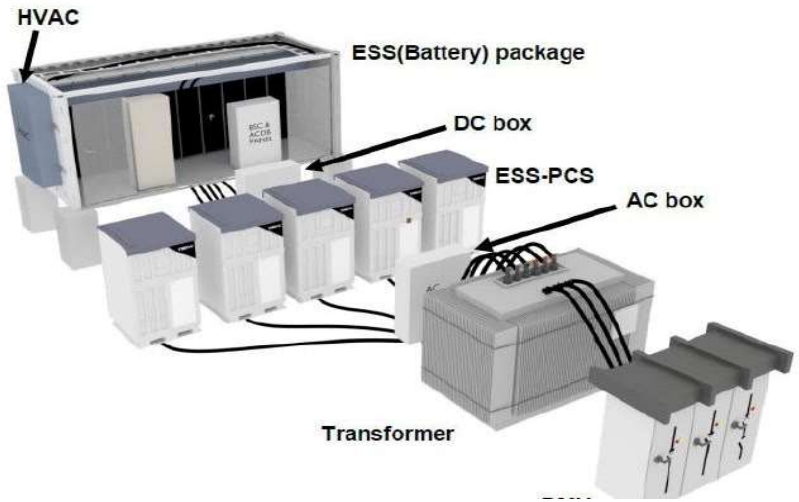
DC1500V 5.1 / 5.34MVA AC Station

Inside of container

Integrated in the factory

Main Equipment of Battery Energy Storage System, BESS

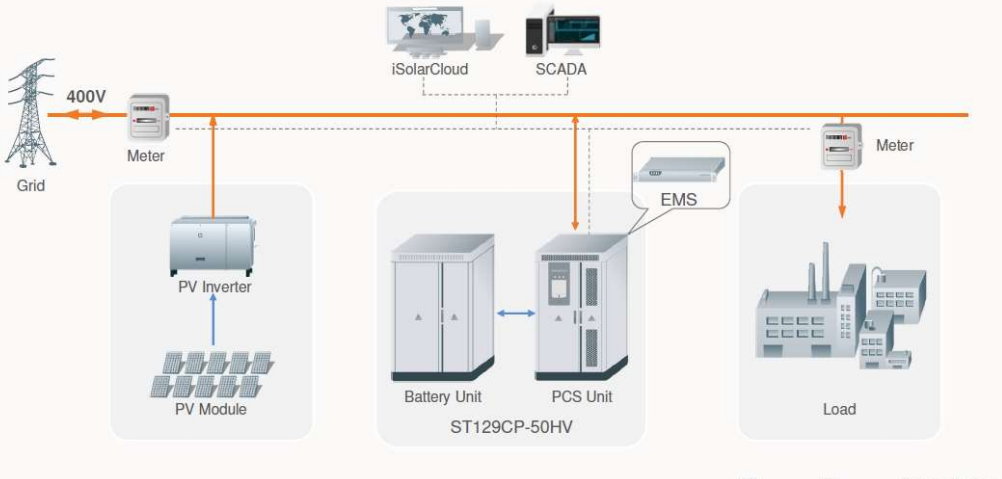
ESS System (Typical Configuration)



SUNGROW Clean power for all

Confidential

C&I ESS Solution



Solar Power Plant +BESS

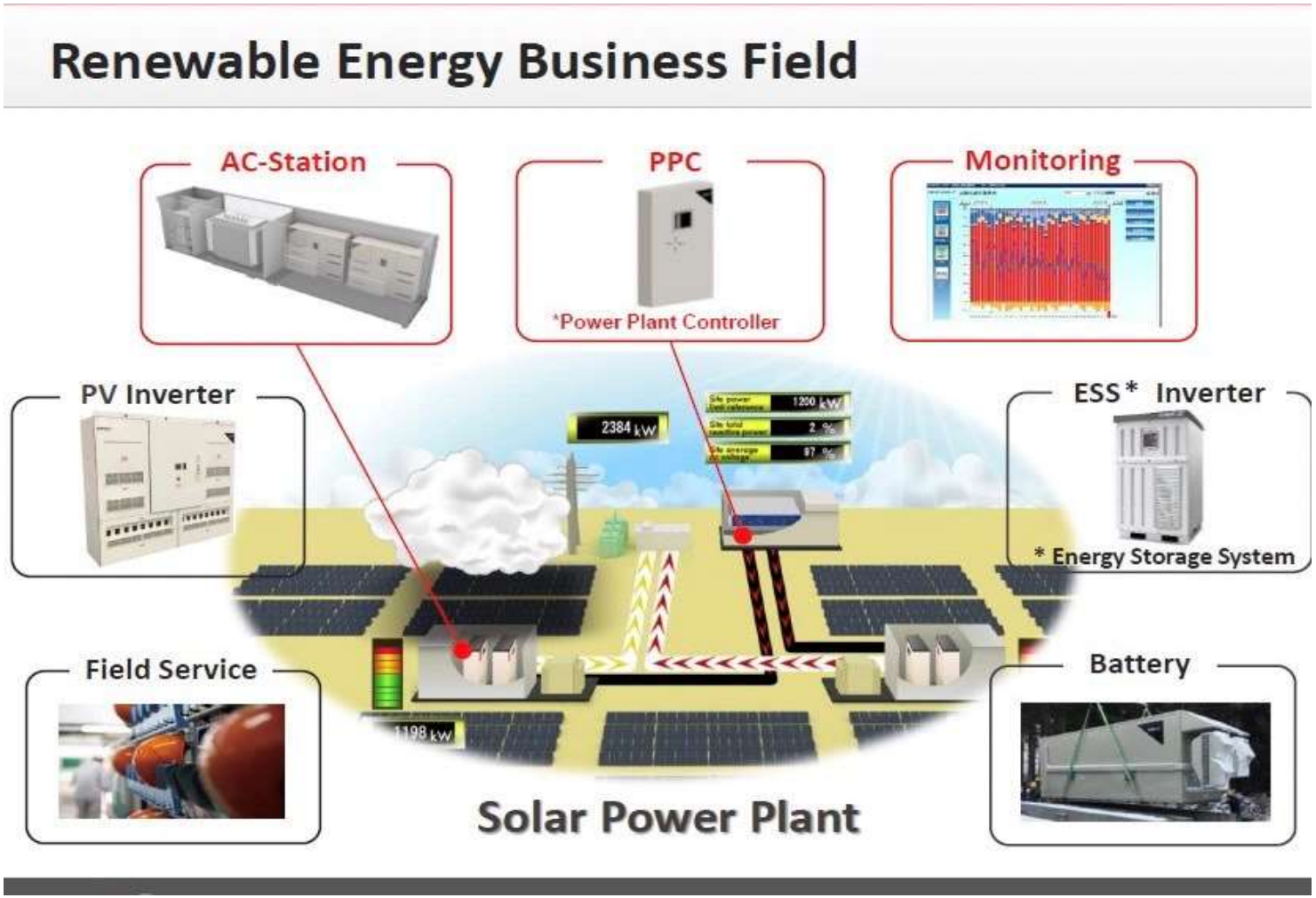
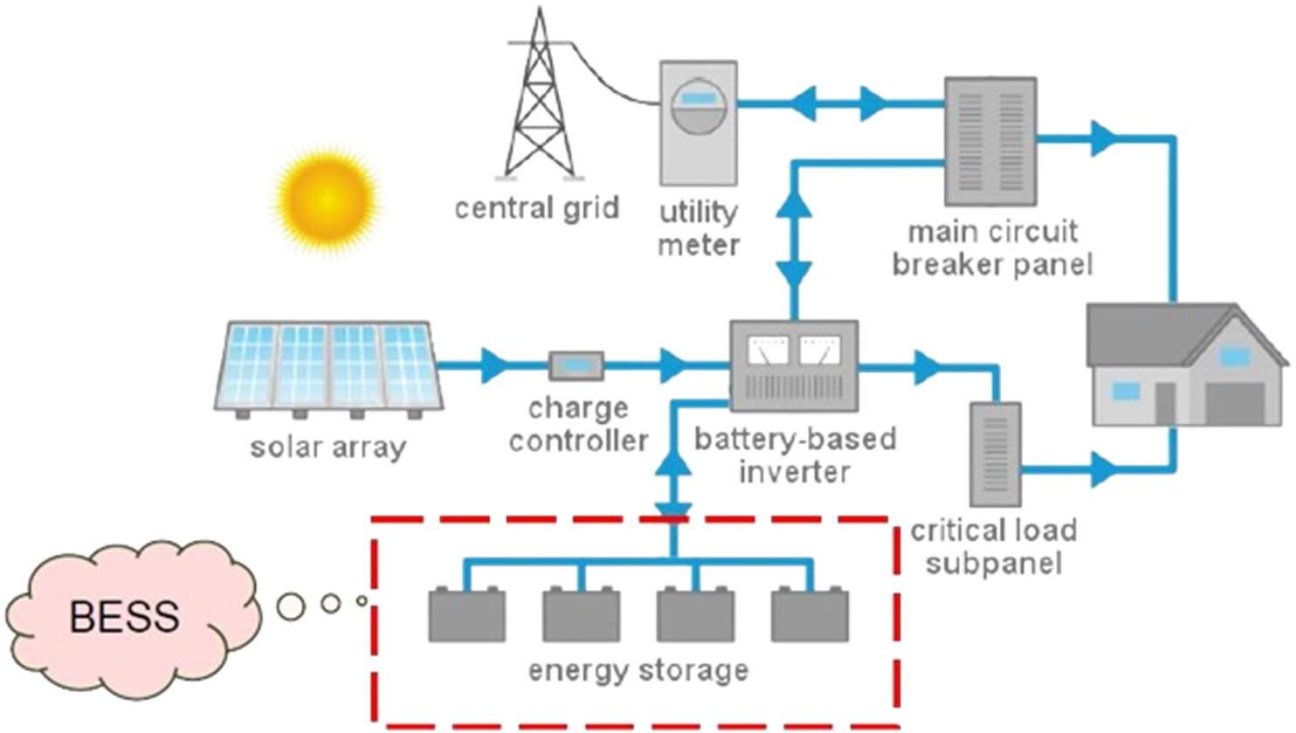


Diagram of BESS grid Connection installation at CSCS (Computer Substation Control System)

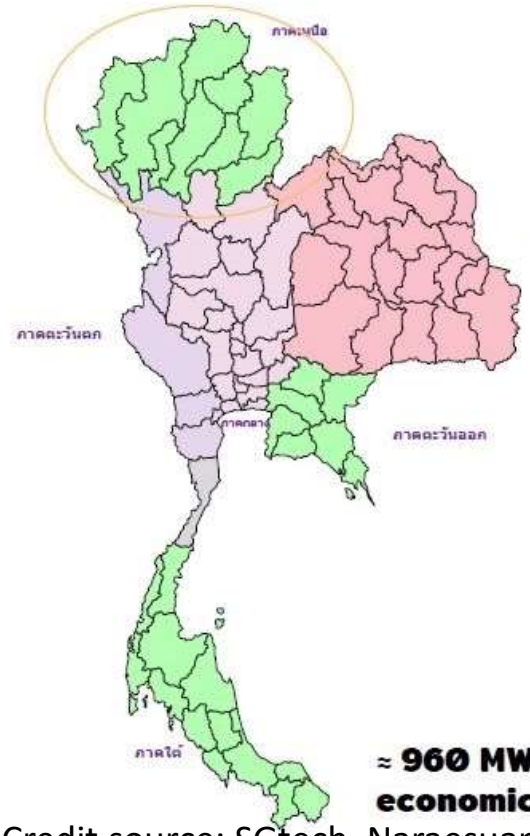


Energy Management System (EMS) at CSCS

- Battery Energy Storage System (BESS)
- Diesel Generator
- Solar Farm
- Wind Farm
- Hydro Power
- Grid 22/115KV
- CSCS (Computer Substation Control System)

SGtech
Naraesuan University

Draft Example for BESS Sizing: Northern Area



Main Applications
- Grid Deferral
- Peak Shaving
- Ancillary Service

Cost-benefit analysis

Substation	Name	Original size MW BESS	Original size MWh BESS	NPV in MTHB (Financial)	NPV in MTHB (Economic)	BESS size BESS MW	BESS size BESS MWh
UTA	UTTARADIT	10.58	30.86	43[illegible]	[illegible]49	11.00	31.00
LPA	LAMPANG 1	17.67	57.46	381.85	477.17	18.00	58.00
[illegible]	SUKHOTHAI	13.85	39.32	386.[illegible]	467.31	14.00	40.00
WGT	WANG THONG	15.19	60.03	350.24	446.33	16.00	61.00
DCA	DENCHAI	7.84	21.93	385.78	431.26	8.00	22.00
SZA	SALOKBAT	14.48	43.89	333.31	414.50	15.00	44.00
RKA	RONG KWANG	10.33	30.75	341.94	399.26	11.00	31.00
PLC	PHITSANULOK 3	18.06	69.85	129.95	242.80	19.00	70.00
LOA	LOM SAK	23.00	79.38	78.06	208.08	23.00	80.00
KKU	KHLONG KHLUNG	6.89	19.83	159.58	200.83	7.00	20.00
[illegible]IH	PHICHAI	9.00	24.00	117.80	168.49	9.00	24.00
[illegible]KA	LAN KRABU	7.24	17.62	107.78	145.79	8.00	18.00
MSA	MAE SOT 1	17.05	88.27	6.26	139.42	18.00	89.00
UAA	UTHAI THANI	26.03	84.42	(5.03)	134.63	27.00	85.00
BQA	BAN RAI	8.17	15.99	69.18	98.72	9.00	16.00
QLA	PHO THALE	11.07	31.47	(11.08)	45.98	12.00	32.00
IBA	IN BURI	9.88	25.95	(14.55)	40.34	10.00	26.00
TAA	TAK 1	12.55	54.10	(68.45)	25.75	13.00	55.00
CEA	CHOM THONG	19.13	81.63	(103.64)	24.17	20.00	82.00
WPA	WIANG PA PAO	14.94	41.19	(6[illegible]	[illegible]	15.00	42.00
QRA	PHROM PHIRAM	7.11	20.53	(34.33)	8.02	8.00	21.00
NAT	NAKHON THAI	6.17	15.74	(3[illegible]	2.19	7.00	16.00
							963.00

Grid deferral
Overload management

Peak Shaving
Energy Arbitrage

Incremental sell
Load growth support

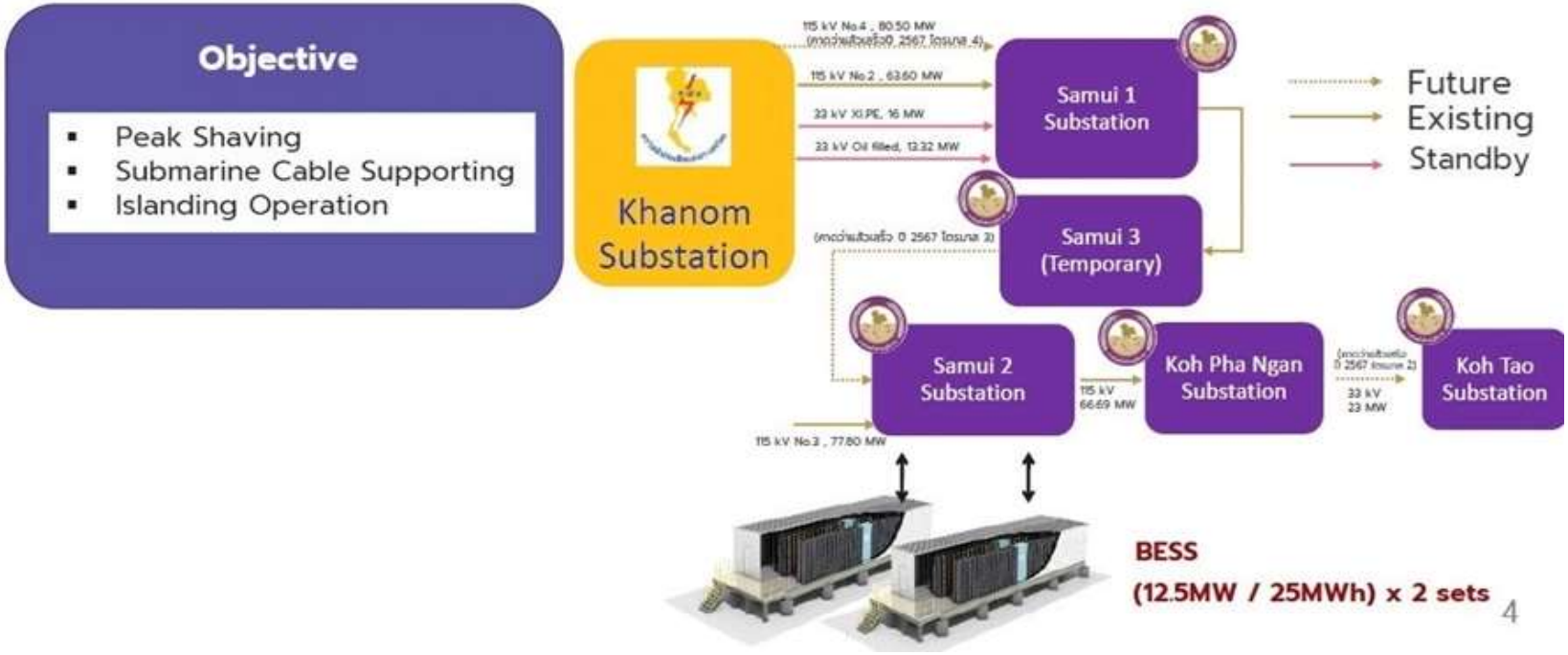
Ancillary service
Voltage support provision

Island operation
Outage power supply

Avoided outage
Outage impact reduction

≈ 960 MWh from 22 of 107 subs in the Northern region is economically feasible in the Northern region

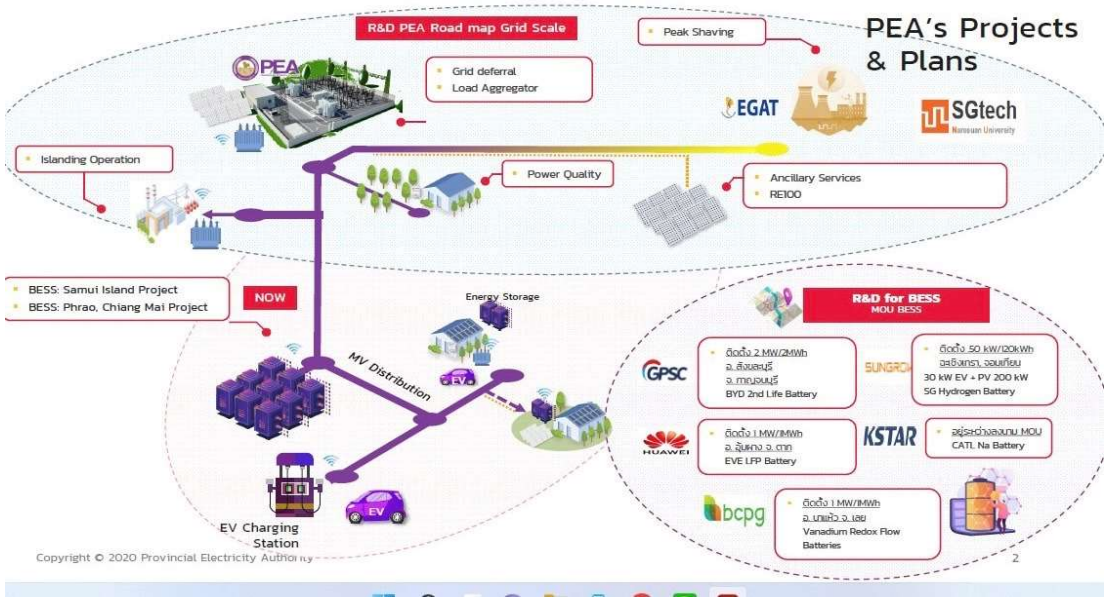
Credit source: SGtech, Naraesuan University



Example: Samui Island BESS Projects,50MW/50MWh

Project Reference BESS and Case Study in Thailand EGAT-PEA-Private

- 1. Microgrid Maesarieng, Maehongsorn, BESS 3MW/1.50MWh/PEA
- 2. Microgrid Betong (BESS 4MW)/PEA
- 3. Microgrid Kho Paluay (BESS 4MW)/PEA
- 4. Microgrid Phabong (BESS 4MW)/PEA
- 5. Substation Praw, Chiengmai (BESS 4 MW)/PEA
- 6. Substation Bamnednarong (BESS 16MW)/EGAT
- 7. Substation Chaibadan (BESS 21 MW)/EGAT
- 8. Sirinthorn Dam Hydro Power (BESS 4MW)/EGAT
- 9. Ubolratana Dam Hydro Power (BESS 4 MW)
- 10. Super Energy Pcl. (BESS+PV = 136 MW)
- 11. GPSC (BESS 1 MW)/ PTT Group



BESS PRE-COMMISIONING TEST

BATTERY SUB-SYSTEM PRE COMMISSIONING TEST

1) VOLTAGE CHARGING
2) CURRENT CHECKING
3) THE SOC OF BATTERY ESTIMATE
4) BATTERY FAULT DEFECT AND ALARM ONLINE
5) BATTERY CHARGE/DISCHARGE MANAGEMENT
6) BATTERY SOH TEST

PCS TEST (POWER CONVERSION SYSTEM) PRE COMMISSIONING TEST

1) CHARGE FULL AND DISCHARGE EMPTY TEST
2) BESS CAPACITY TEST
3) MAXIMUM ACTIVE/REACTIVE POWER CAPACITY TEST
4) QUARDRANT TEST
5) ROUND-TRIP EFFICIENCY
6) NOISE TEST - FULL LOAD

OPERATION AND MAINTENANCE BATTERY ENERGY STORAGE SYSTEM (BESS)

- WARANTEE FOR 10 YEARS (BESS)
- WARANTEE FOR OPERATION AND MAINTENANCE 3 YEARS
- PREVENTIVE MAINTENANCE EVERY YEAR
- CHECK AND BALANCE CELL OF BATTERY EVERY YEAR
- REPLACE, BCU,BMS, MONITORING SYSTEM
- CHECK HAVC SYSTEM, EVERY YEAR
- CLEANING AIR GRILL AND FAN EVERY MONTH
- CHECK CABLING AND ELECTRICAL EQUIPMENT EVERY 6 MONTHS
- CHECK FIRE FIGHTING SYSTEM EVERY YEAR

Microgrid Technology

Microgrid EMS, Microgrid Controller

การไฟฟ้าส่วนภูมิภาค
PROVINCIAL ELECTRICITY AUTHORITY

GUNKUL

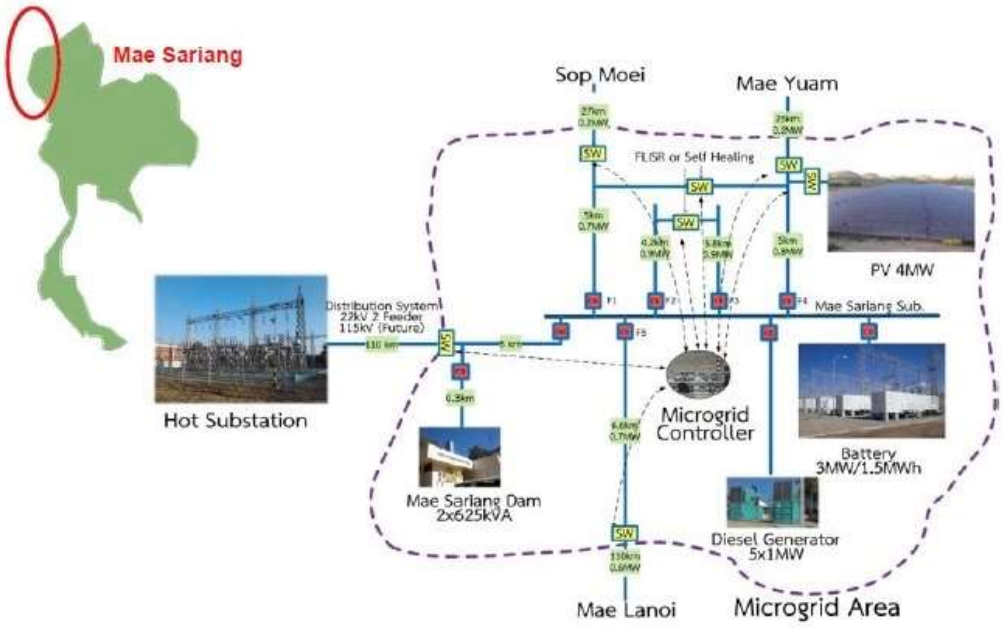
❖ Microgrid Maesarieng, Maehongsorn, Province, Thailand

- BESS 3 MW. / 1.5 MWh.
- Diesel Generator 5 MW.
- Hydro Power 1.3 MW.
- Solar Farm 4 MW.
- GRID 22 / 115 KV.

โครงการพัฒนาระบบไฟฟ้าแบบโครงข่ายไฟฟ้าขนาดเล็กมาก (Micro Grid) ที่ อ.แม่สะเรียง จ.แม่ฮ่องสอน

ระยะเวลา: 2561 - 2562
วงเงินทั้งโครงการ: 265 ล้านบาท
คู่สัญญา: บริษัท กันกุล พาวเวอร์ ดีเวลลอปเม้นท์ จำกัด
มูลค่างาน: 132.9 ล้านบาท
ระยะเวลา: 360 วัน นับถัดจากวันลงนามสัญญาและส่งมอบพื้นที่

Battery Energy Storage System	1	Unit
Microgrid Controller with BEMS	1	System
Interface System	1	System
Communication System	1	System
Load Break Switch	1	System
Diesel Modification	1	System



ทันโลก บริการดี มีคุณธรรม

Microgrid Maesarieng, Maehongsorn, Thailand

Published at Microgrid Knowledge (USA) and Solar quarter (India)

OPINION

ECONOMIC AND ENVIRONMENTAL POLICY ANALYSIS FOR

MICROGRID DEPLOYMENT IN THAILAND

THE FIRST PILOT PROJECT IN THAILAND

Microgrid Project at Mae Sariang District, Mae Hong Son Province with the Provincial Electricity Authority, Total 132.9 million baht in project management duration 450 days. The project is considered the company's renewable energy business in terms of sustainable energy management.

The important benefit of the Microgrid Project is to increase the reliability and stability of the electrical system. In case of the main power grids system failure, the micro-grid system can release itself independently. It can be utilized as the source of electricity from other sources to replace the loss of electrical energy from the main distribution system or energy storage systems. The system can determine power quality, electrical stability, and electricity reliability as well.

THAILAND'S MICROGRID PLANS TAKE SHAPE

We have a microgrid pilot project which has been operating in Thailand, marking the first success of a national microgrid policy introduced in 2018.

This got Commissioned in March and the project served the energy which was needed for some 5,000 houses or around 50,000 people in the mountainous Maehongsorn Province in northern Thailand.We developed the project called Microgrid Maesarieng. It is an 8 MW development comprising 4 MW of solar PV together with a 1.2 MW hydropower plant, 5 MW of diesel generation, and coupled with a 3 MW battery storage system. The microgrid controller and energy management system were supplied by Chinese state-owned Nari Grpor.

The Provincial Electricity Authority (PEA) is responsible for providing electric power and related services and covers the vast majority of Thailand. Under the auspices of Thailand's Microgrid Development Plan, PEA was selected to take the lead on building the Maesarieng project. PEA wants to develop the pilot project in Maesarieng because this is the area most often affected by outages in Thailand. The main problem is frequent outages where the power line fails or is broken because of flooding, landslides or some other event.

This microgrid project aims to address this reliability issue while the wider Microgrid Development Plan is designed to replace peaking generation in response to power demand growth, reduce distribution losses and overcome constraints in the development of new transmission lines, support growth in renewables, and bolster the development of smart grid technology across the PEA network.

A second microgrid project is also being constructed by us as part of PEA's network plans. Set to be developed in BeTong in southern Thailand near the Malaysian border, this 10 MW project comprises a 4 MW battery, 3 MW of solar PV and 5 MW of diesel generation capacity.

The economics here are positive as energy consumption is in high demand and BeTong recently announced an expansion of the airport, for example. Further growth is anticipated in the future with opportunities also for export into Malaysia and Singapore as well as use in Thailand

Because of the Thai government policy, there are opportunities for many microgrids to be developed in the country.

BANCHA YATHIP

ASSISTANT PROJECT DIRECTOR, GUNKUL ENGINEERING PUBLIC COMPANY LIMITED

INSIGHTS

ECONOMIC AND ENVIRONMENTAL POLICY ANALYSIS FOR

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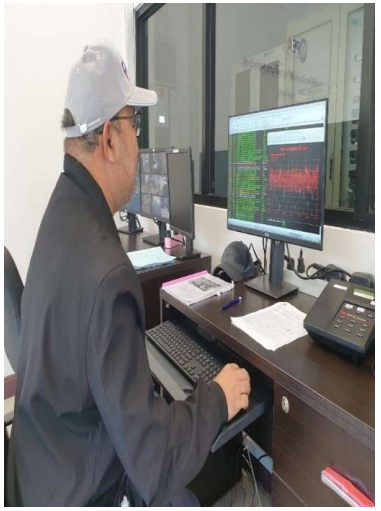
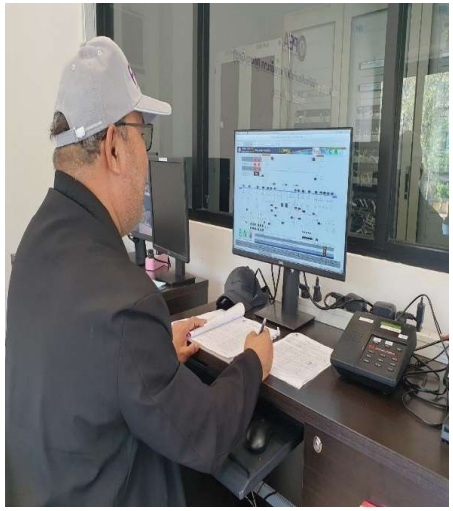
BANCHA YATHIP

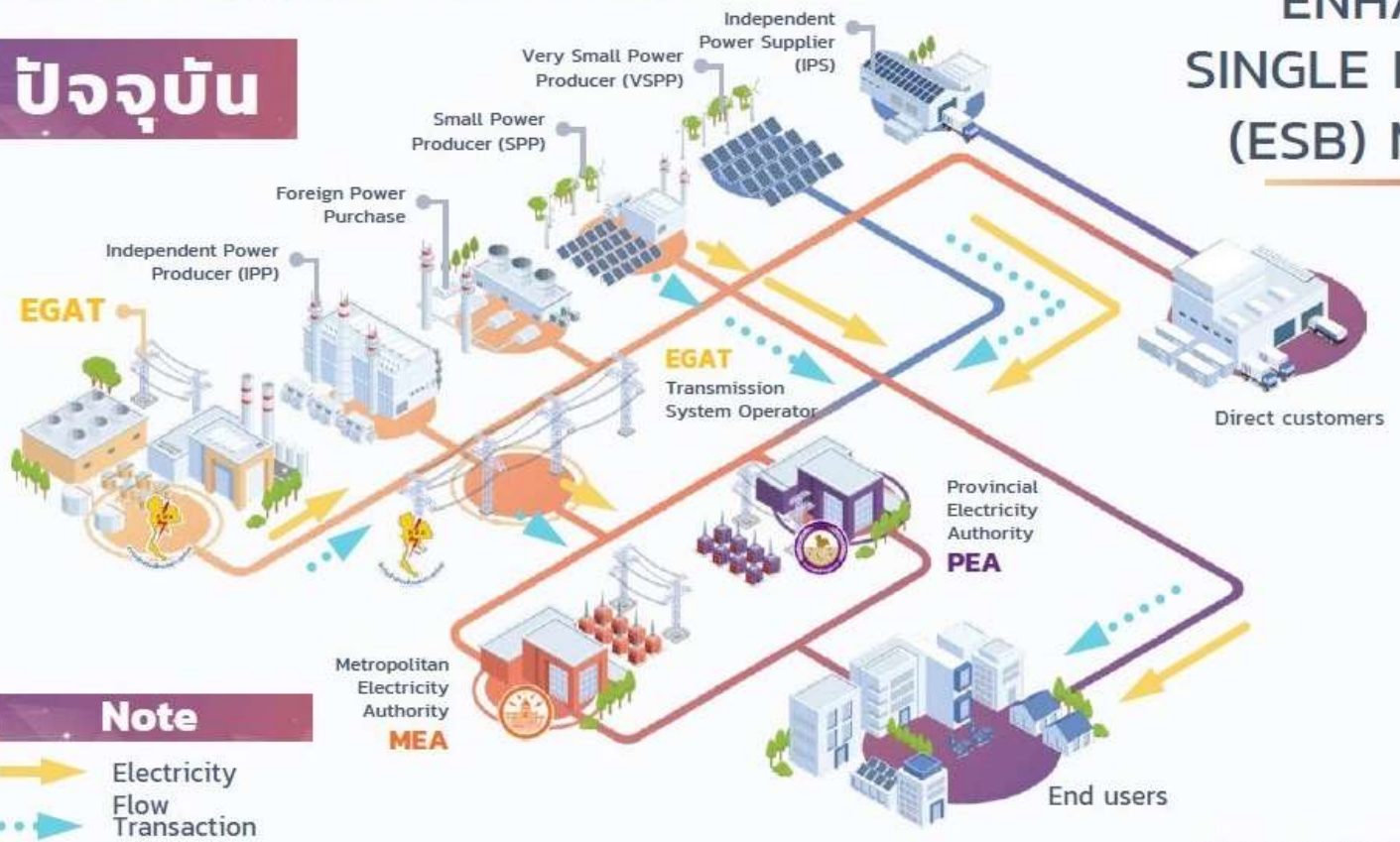
ASSISTANT PROJECT DIRECTOR, GUNKUL ENGINEERING PUBLIC COMPANY LIMITED





อุตสาหกรรมไฟฟ้าไทย

ปัจจุบัน



Source : NETP Project 2019

อุตสาหกรรมไฟฟ้าไทย

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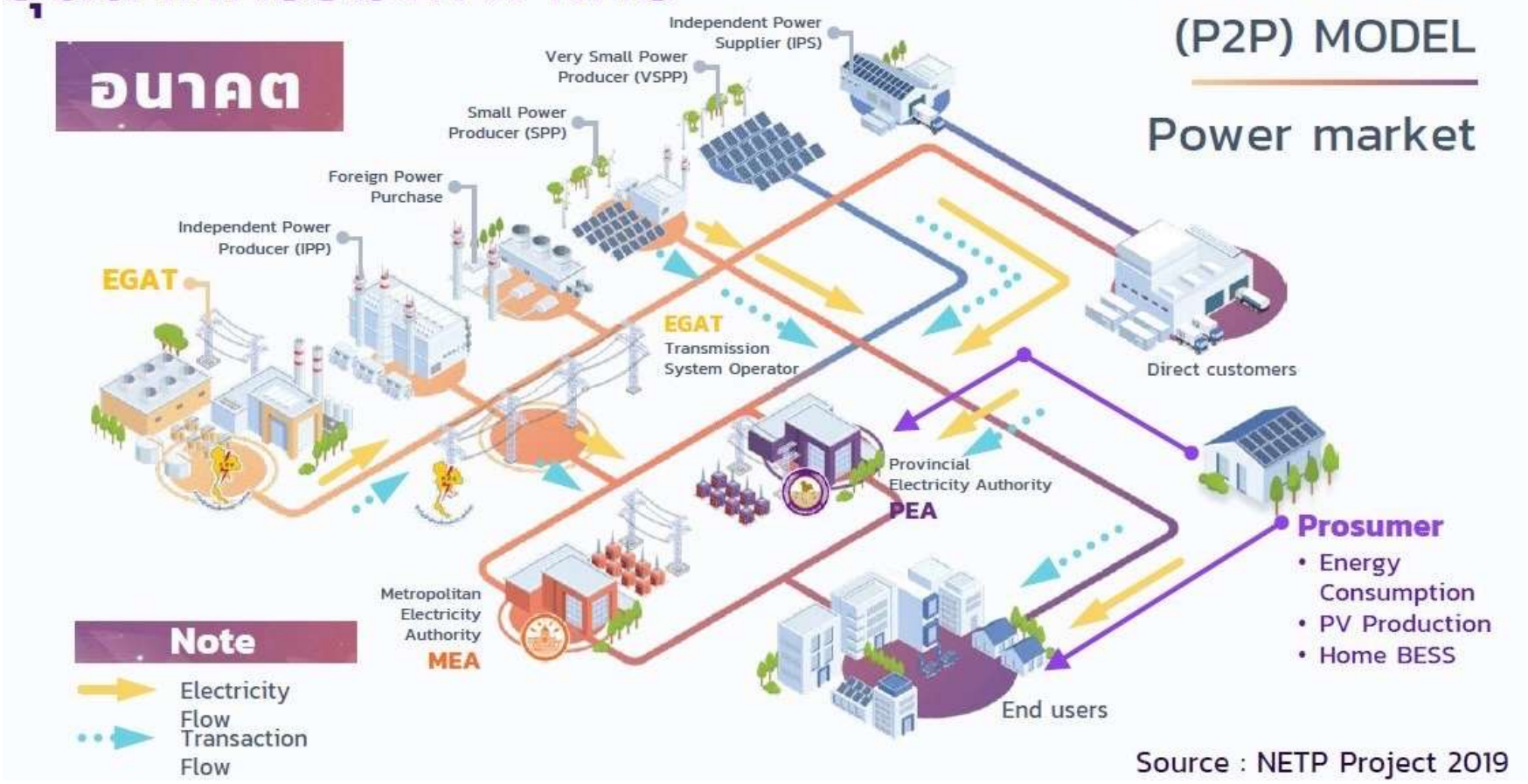
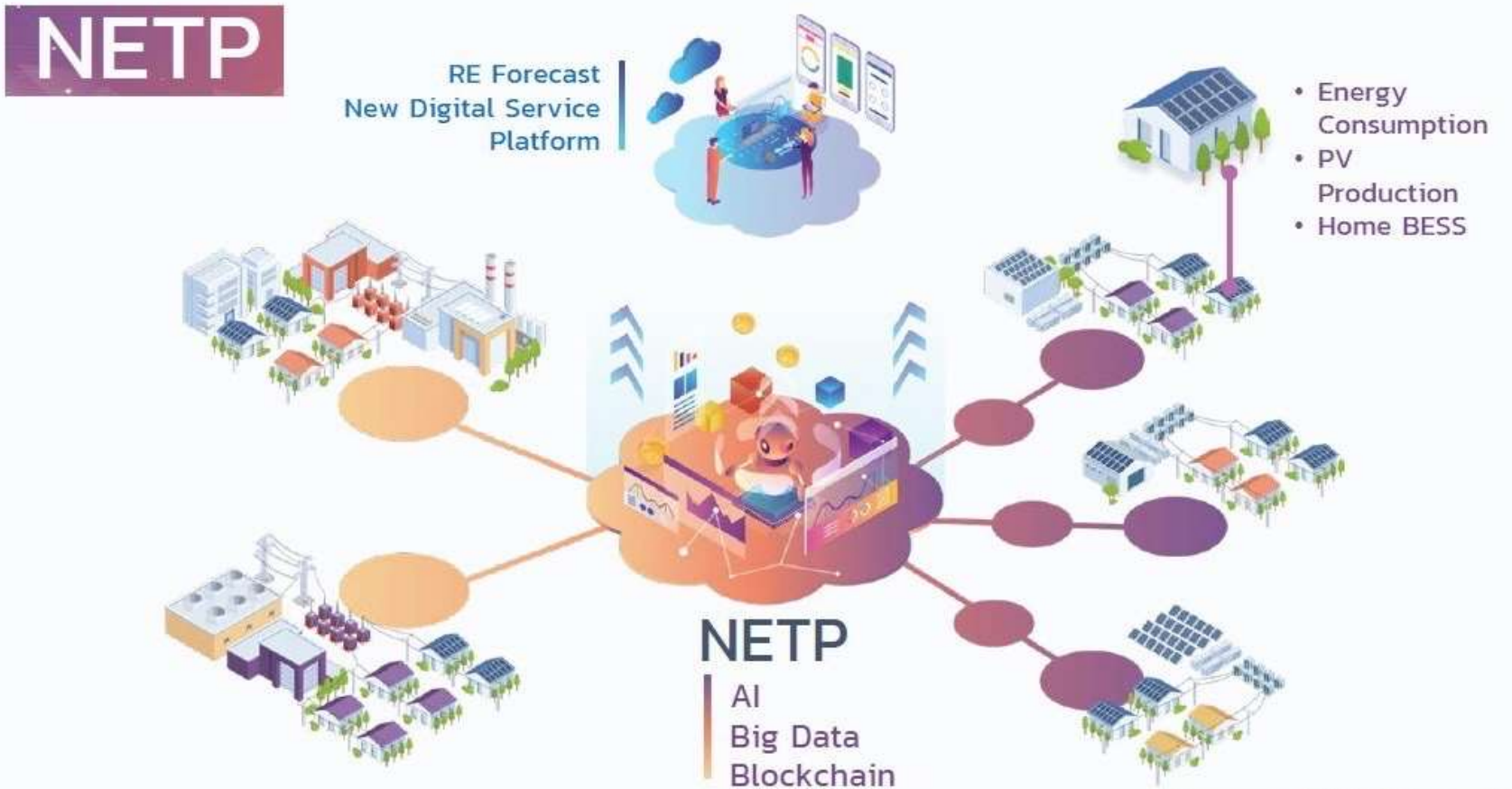


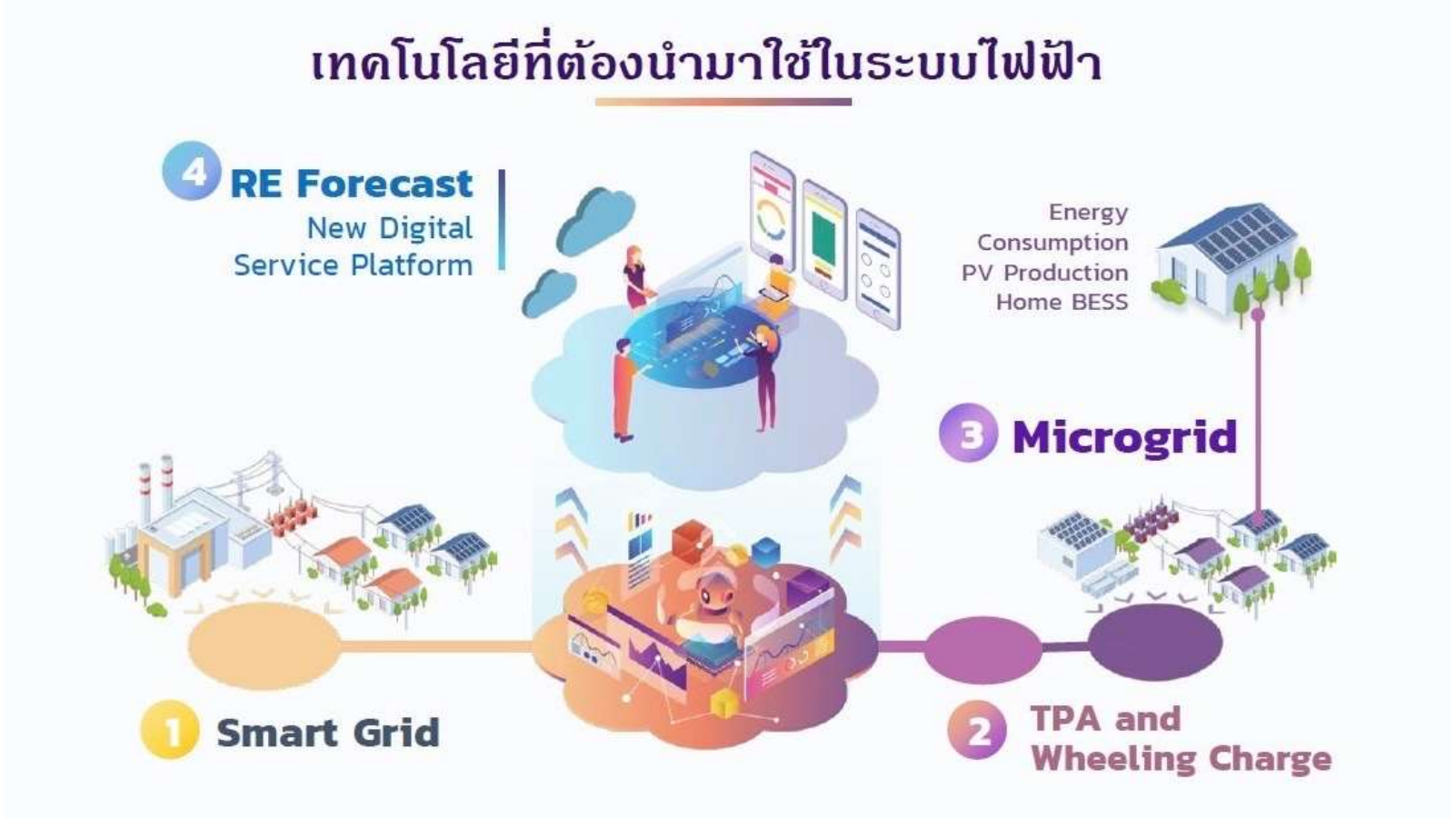
Source : NETP Project 2019

แพลตฟอร์มซื้อขายไฟฟ้าแห่งชาติ

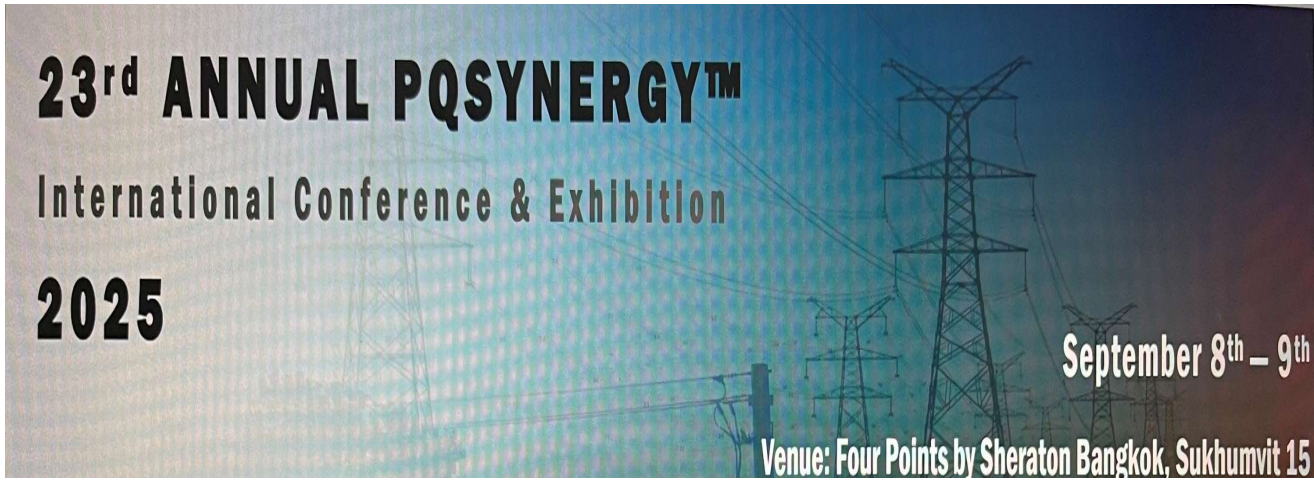


Source : NETP Project

เทคโนโลยี ที่ใช้ในการทำให้ระบบไฟฟ้าเป็นระบบสมาร์ทกริด



THANK YOU



bancha

Bancha Yathip
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