GPSC New Business Opportunities 2023

- Distributed Generation (PV, Micro-CHP, etc.)
- Home storage systems (<100 kWh) and Large-scale storage (>100 kWh)
- Smart appliances/home systems, prosumer services
- Engineering, Procurement and Construction: EPC and Operation and Maintenance Service
- Energy audits, energy management services
- Digital Energy
- Electric vehicles/charging network
- Other – Fuel Switching
- Decarbonize, promote the use of renewable energy and maintenance services
- Lighting, appliances, HVAC system, CHP, etc.
- System Integrator Service
- Micro grid, virtual power plants, Smart grid technology

Table of content

GPSC Business Strategy and Corporate Outlook

Goal

To become one of the top three power generation companies in Southeast Asia with more than 50% of power generation from the green portfolio.

Mission

Be a leader of the innovative power and smart power businesses of PTT Group that applies innovation for operational excellence and strives to generate value-added for stakeholders by delivering to customers reliable products with social responsibility.

GPSC's strategy in 2023 (for 2023-2030) sustains energy transition to a clean-energy innovation era, made up of S1: Strengthen and Expand the Core, S2: Scale-up Green energy, S3: S-Curve & Batteries, and S4: Shift to Customer-Centric Solutions. Business focus is on Thailand and India, Vietnam, and Taiwan (2nd Home countries). The strategy demands simultaneous development in six enablers including:

(1) partnership,
(2) financial discipline,
(3) technology & digitalization,
(4) sustainability,
(5) agile & resilient organization, and
(6) operational excellence.

These enablers would sustainably grow GPSC's business with due regard for the environment and stakeholders on its goal of being Southeast Asia's leading power producer. GPSC's Carbon Neutrality goal is by 2050 and Net Zero Emissions goal is by 2060.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf

4D+1E trends

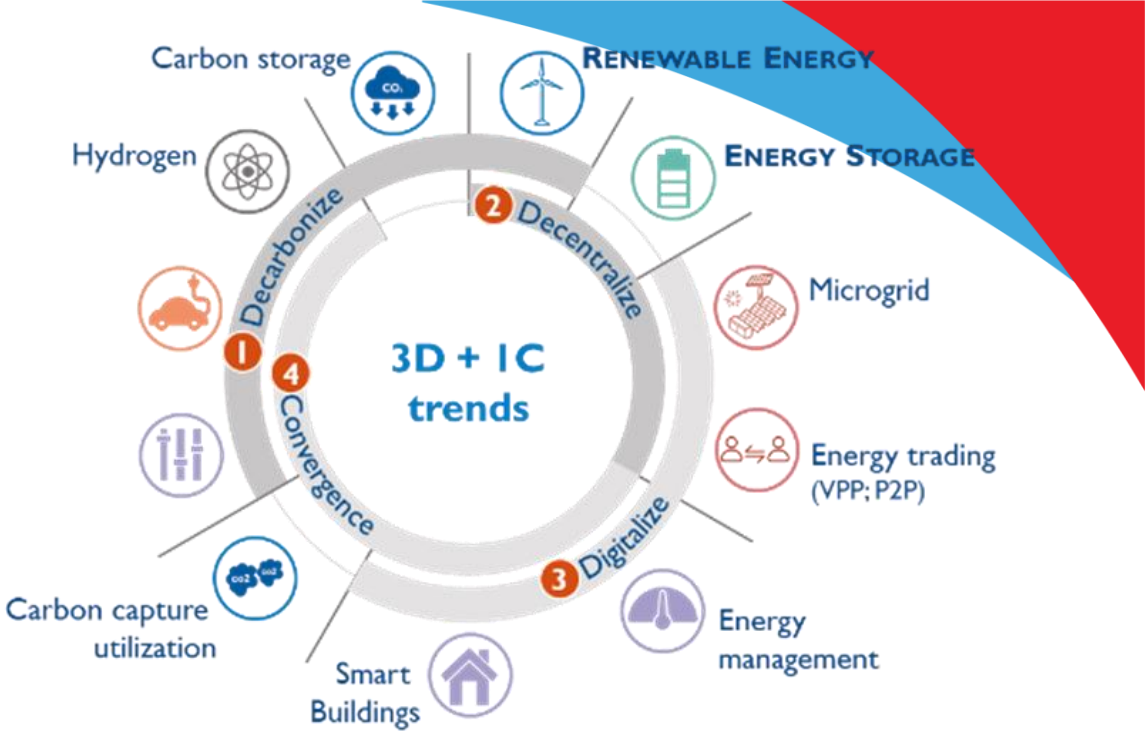
GPSC recognizes trends in technology and energy transition based on the **4D1E principle**, which consists of **Decentralization**, **Decarbonization**, **Digitalization**, **Deregulation**, and **Electrification**, as they may affect the centralized power system business and usher in a transition towards decentralized power systems.

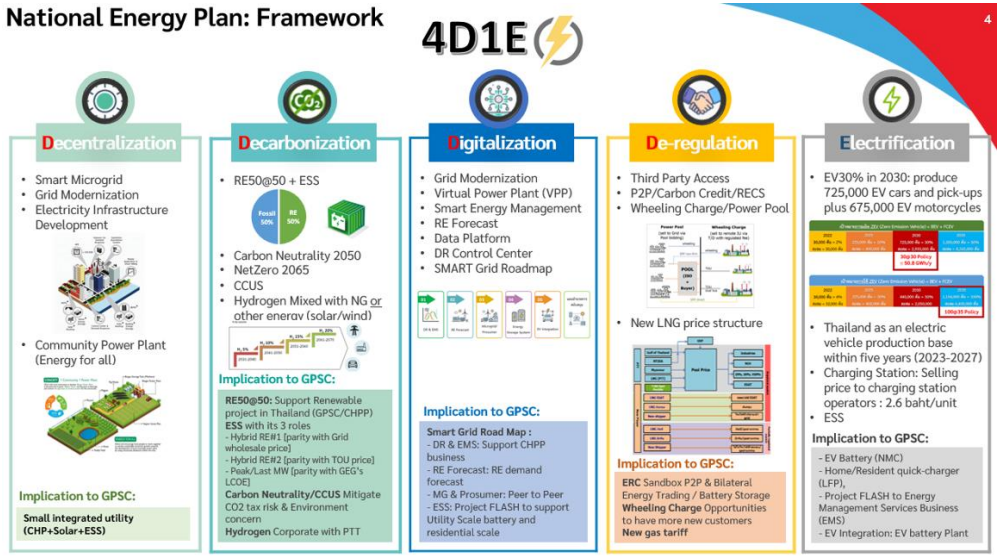
GPSC prepares and plans to change its business model by setting a higher investment budget to support this trend and generate returns from new businesses with strategies **"S3: S-curve & Batteries"** to develop innovative batteries and energy storage systems to support a wide range of industrial applications. It is the main mechanism in driving the Company's energy innovation as follows:

- Research, development, and production of batteries to commercial products called **"G-Cell batteries".**

GPSC also has a strategy of **"S4: Shifting to Customer-Centric Solution"** that focuses on the installation of small distributed generation power systems, design, development, and installation of a centralized cooling system (District Cooling), providing consultation and analyzing energy consumption, and integration of energy storage systems to increase power system's stability. It is a service that meets the needs of customers as follows:

- **Distributed generation system installation service**
- **Centralized district cooling system**
- **Energy Management services**





Source:
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model

GPSC Product & Service Offering

GPSC prepares for future changes in energy consumption patterns by introducing new technologies and integrating them with products and services. The company also looking for new business opportunities and expanding the business model to consumers that cover from upstream to downstream of energy consumption to support and adapt to changes stably and sustainably as follows:

Upstream Business

Providing services from the process of design, distribution, procurement, construction, and installation of electric power generation systems in the form of Engineering Design, Procurement and Construction (EPC) and Turn-Key projects that cover energy use both in the form of connecting to the transmission system (On-grid) and the disconnect to the transmission system (Off-grid) this include the Smart Grid system.

Downstream Business

Operation and Maintenance that covers after-sales service to customers by the company subject matter experts in the group of company such as

- Operation and maintenance of renewable energy generation systems such as solar rooftops
- Operation and Maintenance of district cooling system

Midstream Business

Distributed Generation

Distributed power generation by small consumers by providing services to customers who want to produce energy for self-use in the organization, reduce costs, be environmentally friendly. and intelligent network system (Smart Grid) implementation

Related technology

- Solar Rooftop (Photovoltaic: PV)
- Floating Solar
- Solar Farm System
- Smart Grid
- District Cooling System
- Behind-the-Meter Energy Storage System: BTM ESS

Energy Storage

Integration of energy storage and generation systems to optimize energy efficiency for both stationary and mobillity applications. Moreover, GPSC see opportunities to penetrate both the data center system, telecommunications, and electricity business market both domestic and international

Related technology

- Small energy storage system (<100 kWh)
- Large energy storage system (≥100 kWh)
- Charging Station
- System Integrator
- Lead-acid replacement battery
- Small electric vehicles such as electric tuk-tuks, electric motorcycles, and electric golf carts
- Large electric vehicles such as electric buses

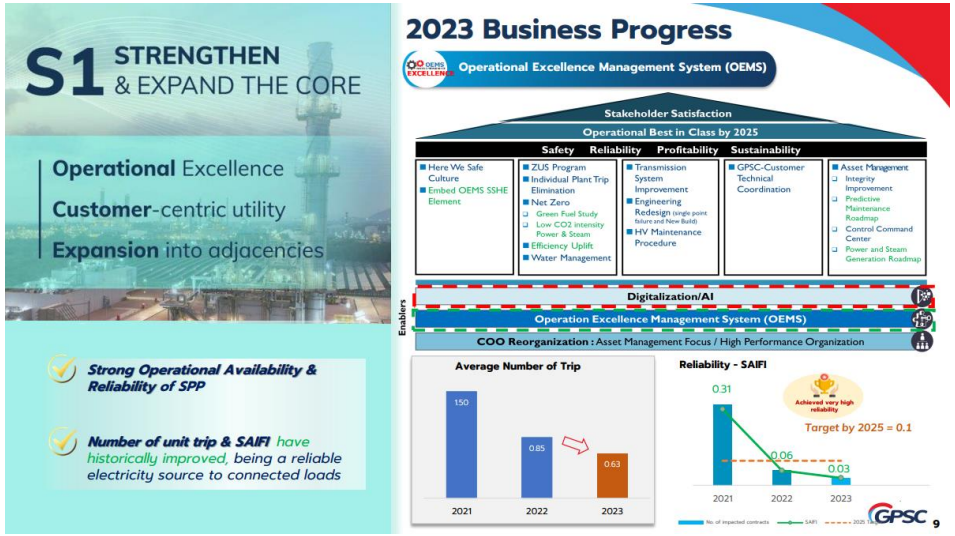
Energy Management

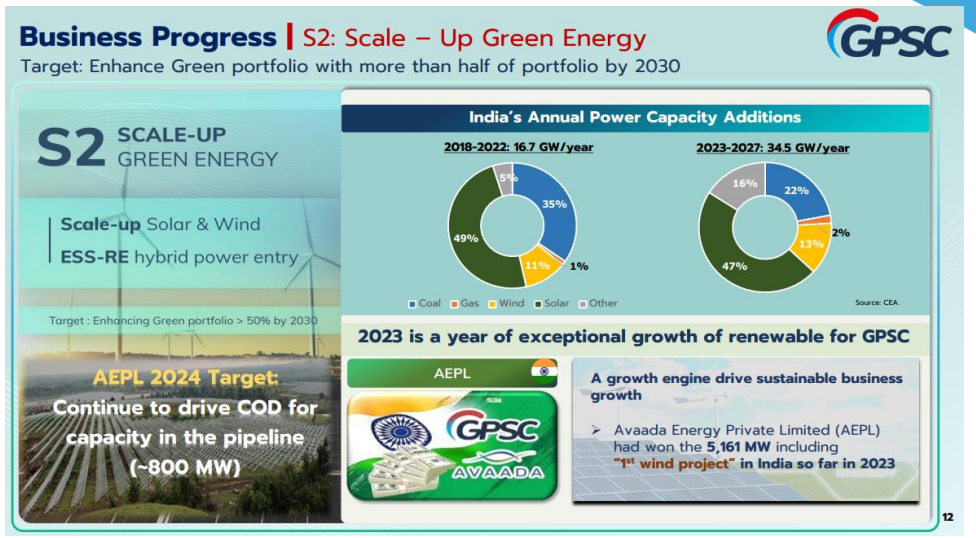
Providing inspecting services for energy systems and equipment to increase energy efficiency within the organization

- Energy Audit
- Real-Time Energy Monitoring
- Energy Efficiency Equipment Supply
- Energy Management & Solution Provider Development
- Implementation of Power Purchase Agreement (PPA) and Regulatory Certification
- Remote Management of the Power Management System

Source:
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model

2023 in Review | 4S Corporate Strategy Progress and Outlook



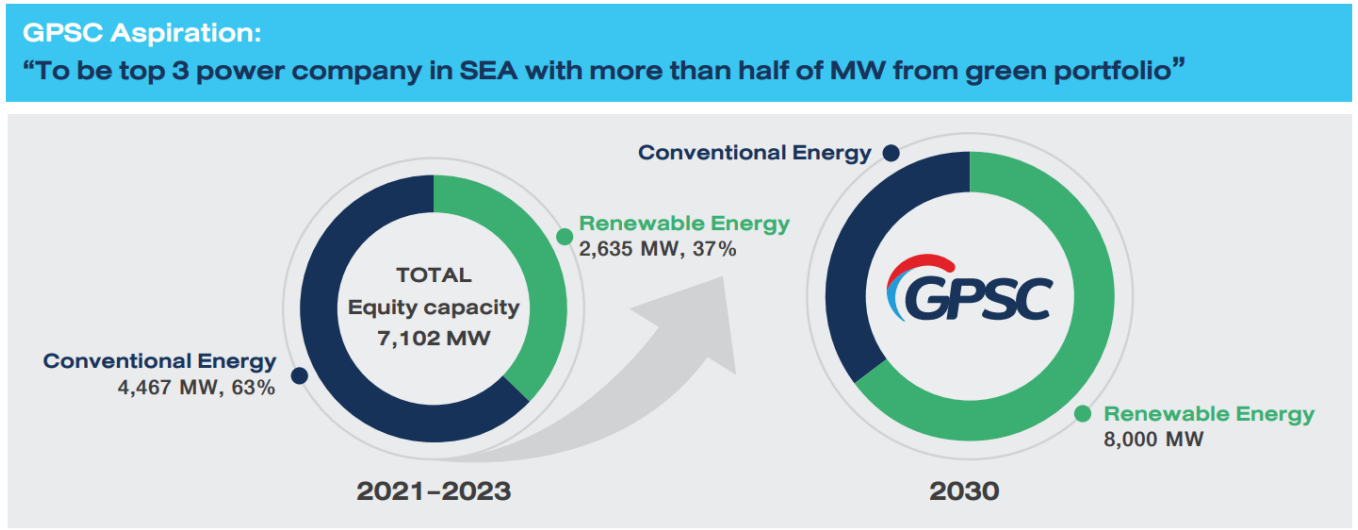


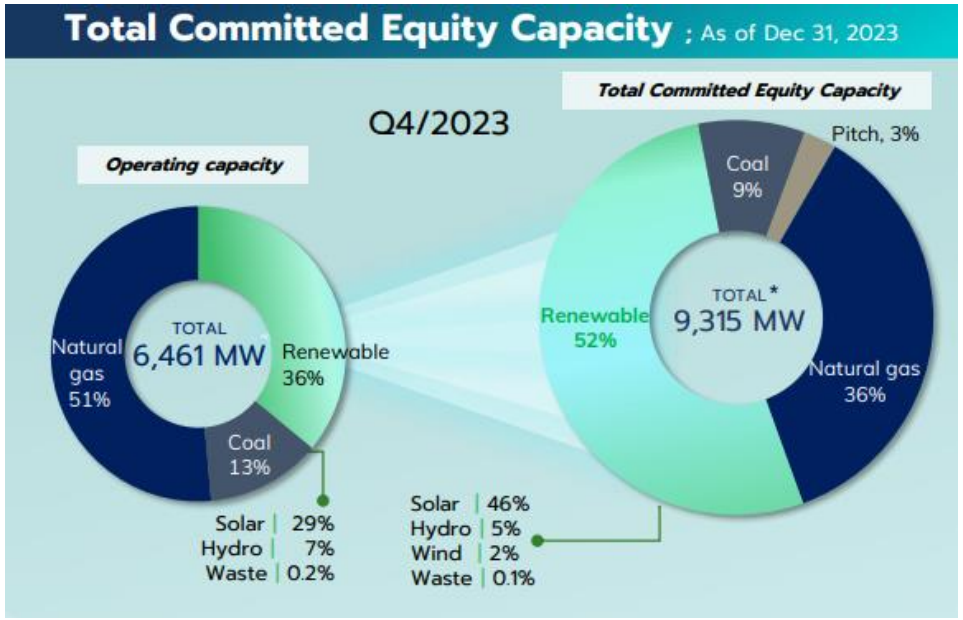
Source:
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf

Distributed Generation (PV, Micro- CHP, etc.)

Distributed Generation (PV, Micro- CHP, etc.)

GPSC Group places importance in the production of energy through renewable energy, including solar, hydro, wind and biomass energy to diversify energy production **into distributed generation or decentralization**. The company aims to increase the proportion of renewable energy production as a driving force for reducing GHG emissions and respond to a variety of customer needs by accelerating the use of clean energy and moving towards a low-carbon society. In 2030, GPSC Group set target to increase renewable energy in portfolio to be 8,000 MW.





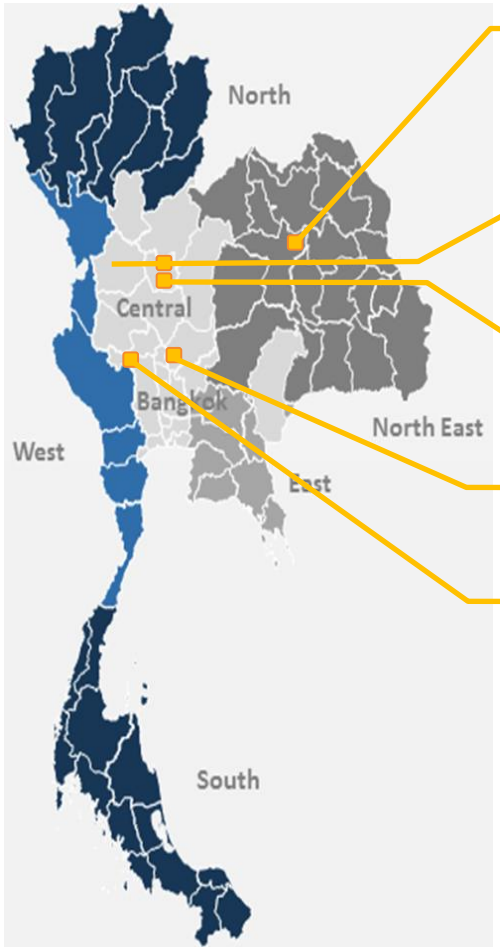
Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf

Distributed Generation (PV, Micro- CHP, etc.)

Example of the previous and future projects on GPSC Group's PV service

#	Company	Capacity (kWp)	Location
1	Michelin	867	Nong Khae
2	Continental	999	Amata City
3	Holiday Inn Phuket	428	Phuket
4	Glow IPP	637	Chonburi
5	PTT GC Glycol	1000	Mat Ta Phut
6	EECI Solar Farm	500	Rayong
7	EECI Reforestation Project	19	Rayong
8	Suez	1925	Samut Prakarn
9	Nippon Steel	500	Pluak Daeng
10	Indorama	2960	Mat Ta Phut
11	EECI Microgrid Project	170	Rayong
12	GC5	998	Mat Ta Phut

Projects operated by global renewable power company limited (GRP) (Subsidiary of GPSC Group)



Kranuan, Khon Kaen
PPsolar1 Capacity 1.2 MW
PPsolar2 Capacity 1.2 MW
PPsolar3 Capacity 1.2 MW

Saklek, Phichit
NPS1 Capacity 6 MW
WXA2 Capacity 6 MW

Taphan Hin, Phichit
WXA1 Capacity 6 MW
WXA3 Capacity 6 MW

Ban Mi, Lop Buri
NPS3 Capacity 6 MW

Dan Chang, Suphan Buri
NPS2 Capacity 6 MW

Total Installed Capacity
39.5 MWDC

Distributed Generation (PV, Micro- CHP, etc.)

Avaada Energy Private Limited (AEPL)

AVAADA

GPSC Hold 42.93% of shares

Contracted Capacity 6,520 MW

Project	Electricity Capacity (MW) as of 13 Jul 21	Electricity Capacity (MW) as of 17 May 23	COD
Operating	1,392 (13 projects)	3,987 (29 projects)	-
Under construction	2,352 (8 projects)	583 (4 projects)	2023–2024
Under development		1,950 (8 projects)	2023-2024
Total	**3,744**	**6,520**	

Avaada Energy Private Limited (AEPL) - India

GPSC has set a target to generate power from renewable energy sources by over 50% by 2030, primarily from solar energy. With high-potential power generation from solar and available investment opportunities in India, the company invested through the share acquisition of Avaada Energy Private Limited (AVAADA), intended to support its business target. As one of the five top solar power generation countries, the geography and climate of India are considerably suitable for solar power generation. With the extremely high solar light intensity, averaging 300 days per year of solar time (solar light on the earth's surface), the power generation capacity could reach 3.5-4.5 kWh/kWp, thus providing good returns on investment.

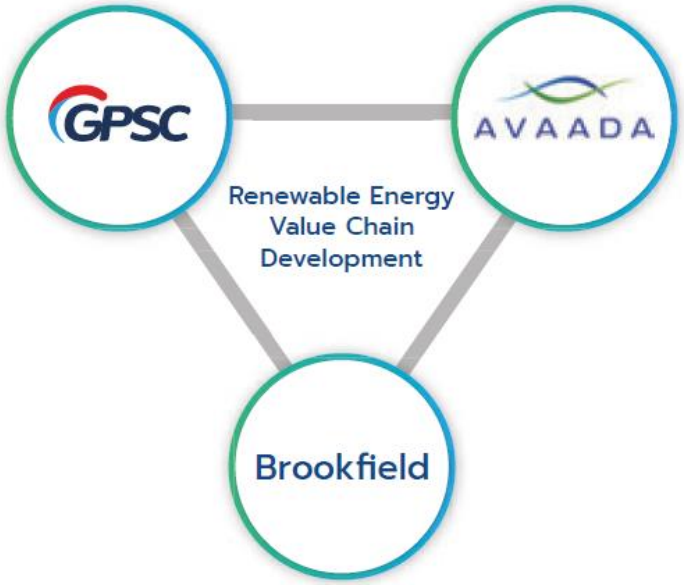
The company's current power generating capacity in India stands at 9,525 MW (up from 4,364 MW in 2022 or by more than twice). This capacity can be constantly increased under India's national energy policy to generate more than 500 gigawatts of power from renewable sources by 2030 toward the fully integrated clean energy and generation of carbon credit in the future.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf

Distributed Generation (PV, Micro- CHP, etc.)

GPSC x AEPL x BGTF

GPSC entered investment cooperation with Brookfield Global Transition Fund (BGTF), a global investment fund with sizable invested assets related to renewables and climate change, and with Avaada Group to invest in the fully integrated clean energy businesses including solar, wind, hydrogen and ESS, as well as other business development projects related to the solar power value chain.



Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf

Distributed Generation (PV, Micro- CHP, etc.)

- The construction reached 88%
- **Foundation installation completed 100% & Installation of 57-WTG completed** (as of 31 Jan 2024)
- **First power produced from 21 – WTG** (as of 31 Jan 2024)
- Under the process of cabling, test and commissioning

"Target Full Operation in 1H/2024"

Benefits for GPSC

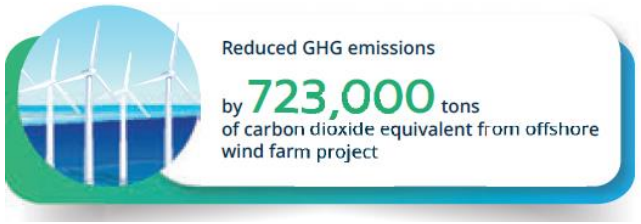
- Stable cash inflow project
- Establish partnership in Taiwan and expand into wind project with a very experienced wind developer
- PTT Group and CIP to explore future opportunity in target countries

CFXD 2024 Target:

Achieve full COD and plan to redesign cash recycling structure with more leverage

GPSC x Copenhagen Infrastructure Partners ("CIP")

GPSC engaged in joint investment with Copenhagen Infrastructure Partners ("CIP") through its wholly owned subsidiary Global Renewable Synergy Co., Ltd. (GRSC), on a 595-MW Changfang and Xidao (CFXD) offshore wind farm project, the company's first investment project on offshore wind farms with this highly experienced wind farm developer. The project demands specific sets of expertise, particularly on EPC and project development suitable for the project environmental setting while maintaining safe power generation and distribution reliability without disruption. The project EPC was 88% completed at this year-end with partial operations. The COD is scheduled for Q1/2024. The company continues cooperation with CIP and other business partners to identify future investments for renewable power generation in Thailand.



Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://gpsc.listedcompany.com/misc/presentation/20231124-gpsc-oppday-3q2023.pdf
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf

Distributed Generation (PV, Micro- CHP, etc.)

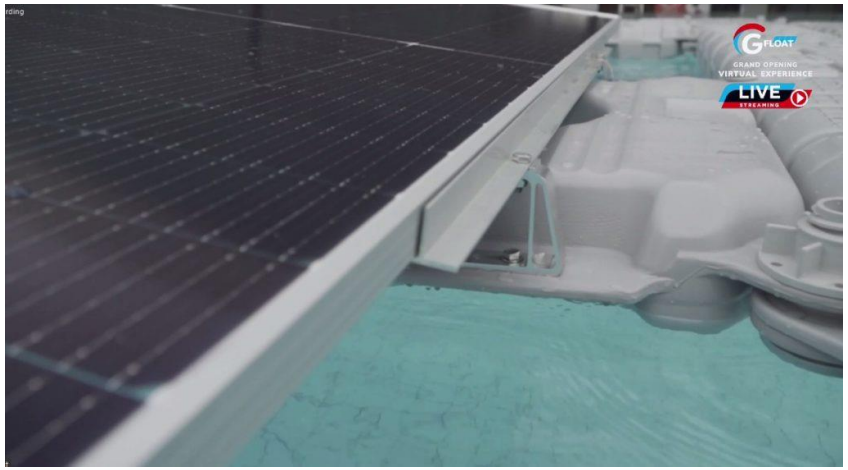
GPSC (CHPP) x OR

CHPP partnered with OR in **the designing, installing, and maintaining the solar rooftop** with the capacity of 3.88 MW (Private PPA) for 20 years contract. This project has been anticipated to sell in the commercial scale in January 2023.

Source:
บริษัท ผลิตไฟฟ้าและพลังงานร่วม จำกัด (CHPP) ร่วมพิธีเปิดศูนย์ธุรกิจไลฟ์สไตล์ ของบริษัท ปตท.น้ำมันและการค้าปลีก จำกัด (มหาชน) (OR) | Combined Heat and Power Producing Co., Ltd.

Distributed Generation (PV, Micro- CHP, etc.)

(**G - Float (Floating Solar)** – (1/5)



G- Float (Floating Solar)

GPSC, the power business innovation leader of PTT Group, cooperates with **CHPP**, a subsidiary, to launch G Float, an innovative commercial floating solar buoy product, called "**G Float**", aiming to penetrate the market of industrial customers including government and private agencies for the clean energy trend.

Mrs. Rosaya Teinwan, GPSC Executive Vice President - Business Development, revealed that G Float is ready for commercial use serving customers in industrial estate needing to install floating solar on large water surface.

The G Float is made from specialized high-density polyethylene (HDPE), product from PTTGC, with special properties are flexible, strong, durable, able to be mixed with UV protective agent and easy to be molded. These properties allow the polymer to produce the effective buoyancy with long service life time. In addition, it can be recycled to reduce GHG emission and is eco-friendly to water ecosystem due to US FDA certification.

Source:
https://www.energynewscenter.com/gpsc-%E0%B9%80%E0%B8%9B%E0%B8%B4%E0%B8%94%E0%B8%95%E0%B8%B1%E0%B8%A7%E0%B8%97%E0%B8%B8%E0%B9%88%E0%B8%99%E0%B9%82%E0%B8%8B%E0%B8%A5%E0%B8%B2%E0%B8%A3%E0%B9%8C%E0%B8%A5%E0%B8%AD%E0%B8%A2%E0%B8%99/
https://www.bangkokpost.com/business/2121631/gpscs-g-float-leads-innovation-drive

Distributed Generation (PV, Micro- CHP, etc.)

(**G - Float (Floating Solar)** – (2/5)

ENVIRONMENTAL

- UV BLENDED HIGH STRENGTH HDPE
- DRINKING WATER COMPATIBLE
- REDUCE WATER EVAPORATION
- RECYCLABLE MATERIAL

SUITABILITY

- SIMPLE INSTALLATION/DISMANTLE
- NO HEAVY TOOLS NEEDED
- OPERATING TEMP UP TO 50°C

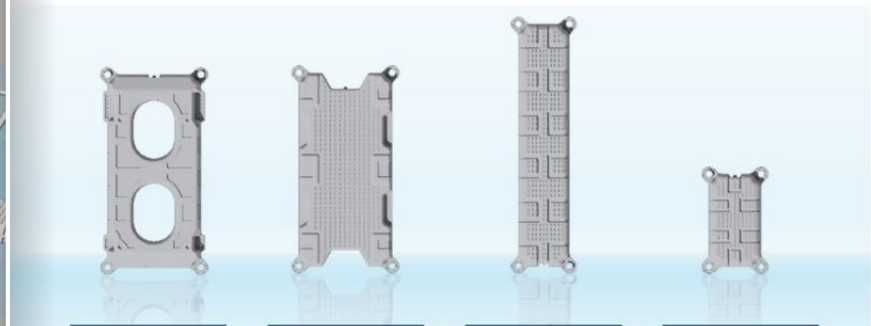
FLEXIBILITY

- LARGER MODULE COMPATIBLE
- CUSTOMIZED TILT ANGLE
- EASE OF OPERATION & MAINTENANCE

RELIABILITY

- SIMULATION AND LAB TESTED
- 25 YEARS LIFE SPAN

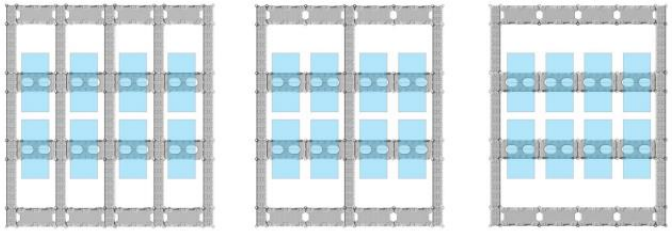
1. MAIN FLOAT
2. EQUIPMENT FLOAT
3. SHORT WALKWAY
4. LONG WALKWAY



MAIN FLOAT	EQUIPMENT FLOAT	LONG WALKWAY	SHORT WALKWAY
1500mm x 720mm x 160mm	1500mm x 720mm x 160mm	1880mm x 400mm x 160mm	720mm x 400mm x 160mm
7.50 kg	8.43 kg	7.28 kg	3.15 kg
PV SUPPORT ADJUSTABLE 5° / 10° / 15°	EQUIPMENT SUPPORT	MAINTENANCE SUPPORT	MAINTENANCE SUPPORT

INSTALLATION CONFIGURATIONS

OFFER VARIOUS INSTALLATION CONFIGURATION UP TO SPECIFIC SITE REQUIREMENT AND LIMITATION.



1-IN-A-ROW | 2-IN-A-ROW | 4-IN-A-ROW

TEST AND VERIFICATION

CFD SIMULATION TEST AND VERIFICATION FOR PONTOON COMPONENTS CAPABLE OF WITHSTANDING ENVIRONMENTAL CONDITIONS.

TESTS

WIND | WAVE & CURRENT | BUOYANCY | NATURAL FREQUENCY | UV RESISTANCE

Distributed Generation (PV, Micro- CHP, etc.)

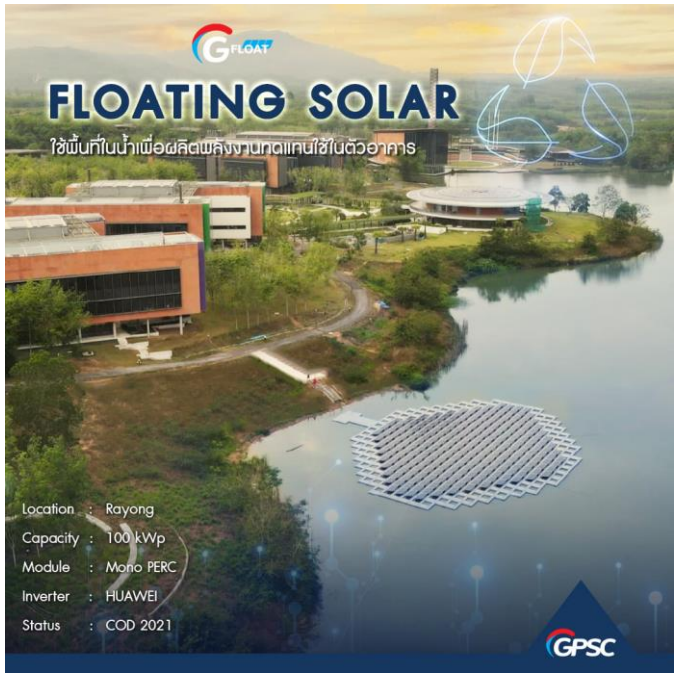
(**G - Float (Floating Solar)** – (3/5)

GPSC has assigned its subsidiary, CHPP, to collaborate with **Suranaree University of Technology (SUT)** to study and install **the 6-MW Sales of Solar Rooftop-Floating Solar Project**, integrating smart energy innovations, including BESS, Block Chain, and AI, to increase efficiency in power generation and distribution. Under this project, smart energy innovations will be integrated with the Provincial Electricity Authority's power grid for stable and reliable renewable energy solutions. **A budget of approximately 150 million baht has been allocated for the project, which will result in more than 510 million baht energy cost saving throughout the 25-year duration of the project.** The project will also serve as a smart energy learning center in the northeastern region and will be a model for a Smart Micro Grid Energy City.

Source:
https://investor.gpscgroup.com/news.html/integrate/1/id/799692#:~:text=GPSC%20has%20assigned%20its%20subsidiary,the%20form%20of%20Private%20Power
https://www.chpp.co.th/th/highlight-project/renewable-energy/82/sut-smart-university
https://www.thunkhaotoday.com : "GPSC ผนึกกำลัง ม.เทคโนโลยีสุรนารี" รุกโครงการติดตั้งโซลาร์ลอยน้ำ

Distributed Generation (PV, Micro- CHP, etc.)

(G - Float (Floating Solar) – (4/5)

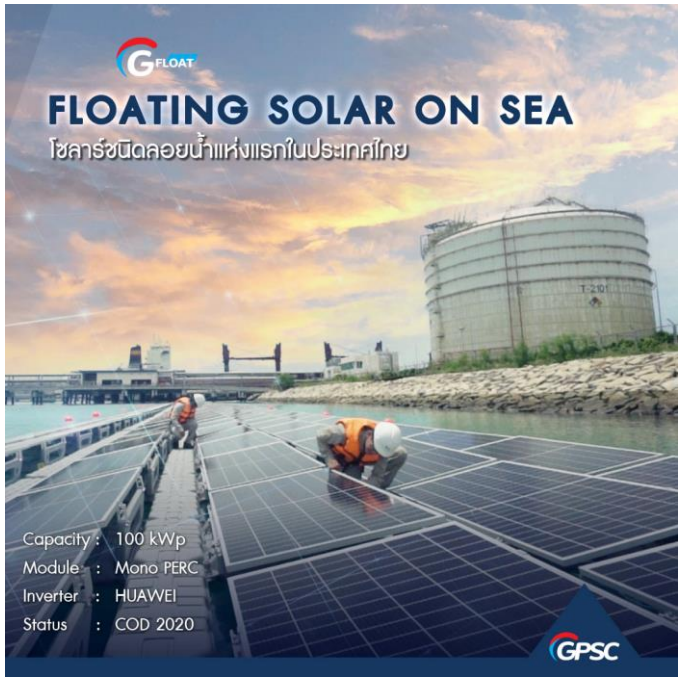


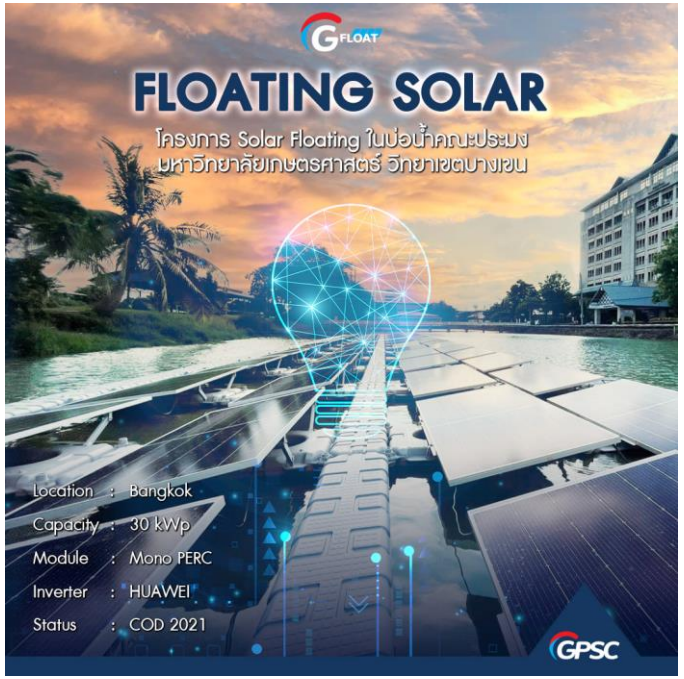
Through CHPP (GPSC Subsidiary), GPSC became a partner in the G-Float clean energy innovation development, pioneered in the New Normal model in Thailand. This **floating solar PV innovation** was ready for commercial implementation for industrial plants, customers in industrial estates, and government as well as private agencies. It was already successfully used in projects like the Smart City Project for **VISTEC** and installation of solar rooftops and floating solar PVs at Suranaree University of Technology (in progress). To elaborate, this is a combination of smart energy involving BESS, peer-to-peer energy trading, and AI for greater generating efficiency.

Source:
https://www.facebook.com/gpscthofficial/posts/244061971055861
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model
https://gpsc.listedcompany.com/misc/one-report/20220309-gpsc-one-report-2021-en.pdf

Distributed Generation (PV, Micro- CHP, etc.)

(**G - Float (Floating Solar)** – (5/5)





GPSC also cooperated with PTT Group in the installation of a **100-kW system floating solar** on sea in a marine section of PTT Tank Terminal Company Limited, in Rayong, and in the development of **solar floating** project in water pond in faculty of fisheries, Kasetsart University, Bang Khen Campus.

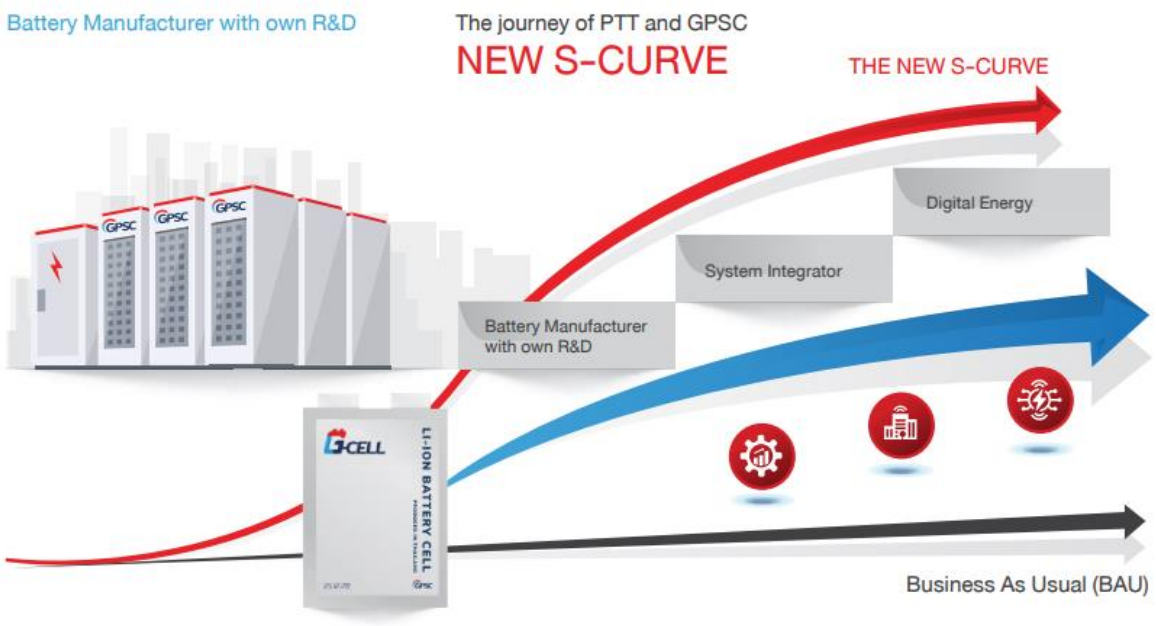
In addition, there was another project cooperated with PTTGC logistic solution about the development of **solar rooftop for time shift application** integrating with battery technology.

Source:
https://www.facebook.com/gpscthofficial/posts/244061971055861
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model
https://gpsc.listedcompany.com/misc/one-report/20220309-gpsc-one-report-2021-en.pdf

Energy storage system (<100 kWh and >100 kWh)

Energy storage system (<100 kWh and >100 kWh)

(**G Cell Battery** – (1/5)



GPSC Group has established a strategy to focus on the development of batteries and energy storage systems for both stationary and mobility type applications as one of the three “S-Curve”. The strategy aims to drive the business towards becoming a leader in energy innovation that can be applied to a wide variety of technology equipment and to meet the energy model of the future that will allow the company to rapidly grow.

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2021-en.pdf

Energy storage system (<100 kWh and >100 kWh)

(**G Cell Battery** – (2/5)

G Cell Applications

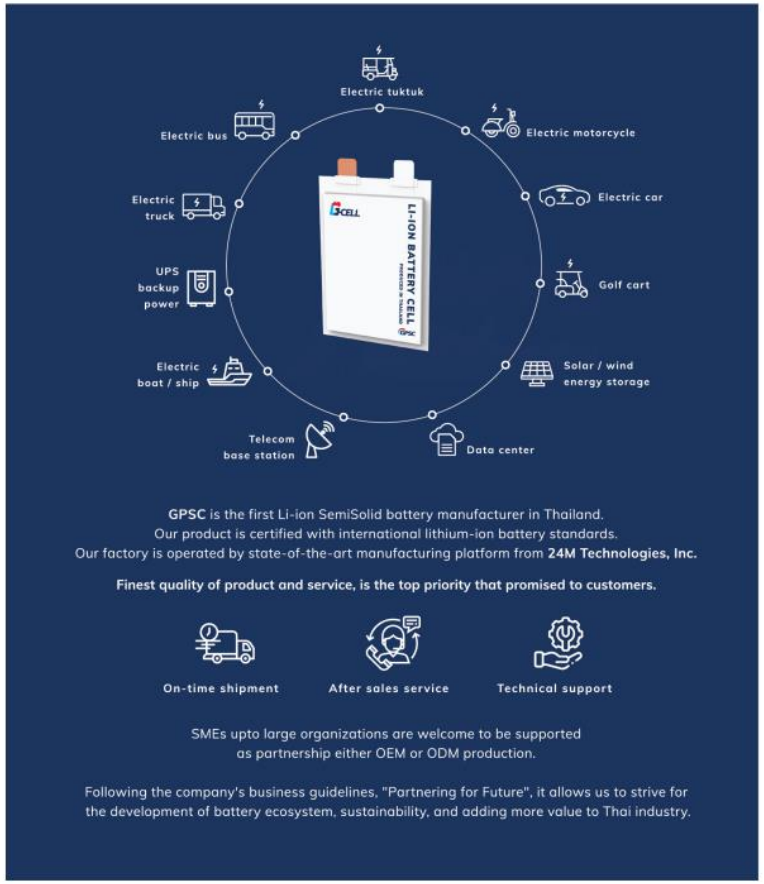
"The new S – curve" that will fill in the missing aspects of the energy system in the future. Therefore, the construction of the first semi-solid energy storage unit in Thailand with a capacity of 30 MWh per year was commenced in order to produce batteries co-invented with 24M Technologies Inc. from the United States. The factory construction was completed and was able to produce a prototype battery (First Cell) successfully at the end of last year, with plans to also expand its production capacity. **This is to support commercial products and markets with long-term growth, in order to meet the trend of switching to clean energy, electric vehicles, smart network systems (Smart Grid), smart cities, as well as the overall growing energy demand in the industrial sector,** especially in the Eastern Economic Corridor (EEC), which will continuously help to increase the competitiveness and new business opportunities for batteries and energy storage systems

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-en.pdf

Energy storage system (<100 kWh and >100 kWh)

(**G Cell Battery** – (3/5)

GPSC is the innovative energy flagship company of PTT Group. Besides, being a power & utility provider, **GPSC** is also a professional manufacturer of lithium-ion battery in Thailand.



GPSC is the first Li-ion SemiSolid battery manufacturer in Thailand.
Our product is certified with international lithium-ion battery standards.
Our factory is operated by state-of-the-art manufacturing platform from **24M Technologies, Inc.**

Finest quality of product and service, is the top priority that promised to customers.

SMEs upto large organizations are welcome to be supported as partnership either OEM or ODM production.

Following the company's business guidelines, "Partnering for Future", it allows us to strive for the development of battery ecosystem, sustainability, and adding more value to Thai industry.

The G-Cell Battery

Lithium-ion battery

G-CELL
SEMISOLID
LITHIUM ION BATTERY

SAFER

The Strength of G-CELL

G-CELL, GPSC's SemiSolid battery is designed with the strength of safety from the mechanism that protects the batteries against internal short-circuit at cell level. Its innovative process also prevents metal contamination which is the main cause of short circuit.

With the highly advanced battery manufacturing process technology from 24M, and the strength of PTT Group in energy sector that has been established in Thai society for over 40 years, it allows GPSC to develop the most reliable, environmentally friendly, and safer battery to use in this era, either of LFP and NMC products to all customers.

Energy storage system (<100 kWh and >100 kWh)

GPSC determined to expand its **battery business**, planning to increase production capacity to 1-gigawatt hour (GWH) in two years and to 10 GWH within 10 years under capital expenditure worth 30 billion baht. GPSC will produce **batteries for electric vehicles** first and then later **develop stationary batteries which are used as energy storage for renewable power**.

Source:
https://www.bangkokpost.com/business/2151523/ptt-group-to-scale-battery-production
https://www.bangkokpost.com/business/2159947/gpsc-introduces-the-first-asean-made-g-cell-battery-innovation-using-semisolid-technology

Energy storage system (<100 kWh and >100 kWh)

Technology R&D is a critical success factor for any organization. Envisioning a steady rise in demand for power and energy transition toward the Decentralized Power System, GPSC has defined the S3 (S-Curve & Battery) Strategy to cope with this rise in demand and provide more new business opportunities in response to the energy transition. These can be achieved only through the development of battery technology, a critical key to success for the decentralized power system, and businesses in the dynamic power business value chain, to maintain and enhance its capability to compete and grow sustainably.

Battery Development for Future Energy

In 2023, GPSC entered a joint venture with Gotion Singapore Pte., Ltd. (Gotion), the leader of EV batteries and ESSs in China and a subsidiary of Gotion High-tech Co., Ltd., to set up NV Gotion Co., Ltd. to manufacture battery packs and modules in Thailand to address the rising battery business. Beginning with a production capacity of 1 GWh, the company can assemble lithium-ion-phosphate, high-quality lithium-ion batteries imported from Gotion's manufacturing plant in China, for 20,000 small EVs, and grow its capability to provide more EV services to the commercial transport industry and a large-scale ESS.

Besides, GPSC invested in Anhui Axxiva New Energy Technology Co., Ltd. (AXXIVA) to expand its battery capacity to meet the steady rise in demand for EVs in China through the Next-Gen EV Battery Manufacturing Project, a fully integrated battery manufacturing project including the establishment of a cell and formation factory, a combined power station, and an R&D Building to provide technological R&D support. The project is set to commence with a 1-GWh manufacturing capacity in the 2nd quarter of 2024.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf

Energy storage system (<100 kWh and >100 kWh)

(GPSC & PTT (NUOVO PLUS) X GOTION X AXXIVA) – (1/5)

The construction of the first semi-solid energy storage unit in Thailand with a capacity of 30 MWh per year was commenced in order to produce batteries co-invented with 24M Technologies Inc. from the United States. The factory construction was completed and was able to produce a prototype battery (First Cell) successfully at the end of last year, with plans to also expand its production capacity. This is to support commercial products and markets with long-term growth, in order to meet the trend of switching to clean energy, electric vehicles, and smart network systems (Smart Grid).

In addition, **the Lithium-ion Battery Energy Storage System (BESS) with a capacity of 100-200 kWh will be installed at Suranives Dormitory and a blockchain-based smart grid will also be set up for the management of solar power generation.** Artificial Intelligence (AI) will be also included to ensure the real-time performance controlling and tracking and using those data for optimum energy production's decision-making. For example, meteorological and solar irradiance data can be used to analyze solar power generation capacity in advance to increase accuracy and efficiency in power production.

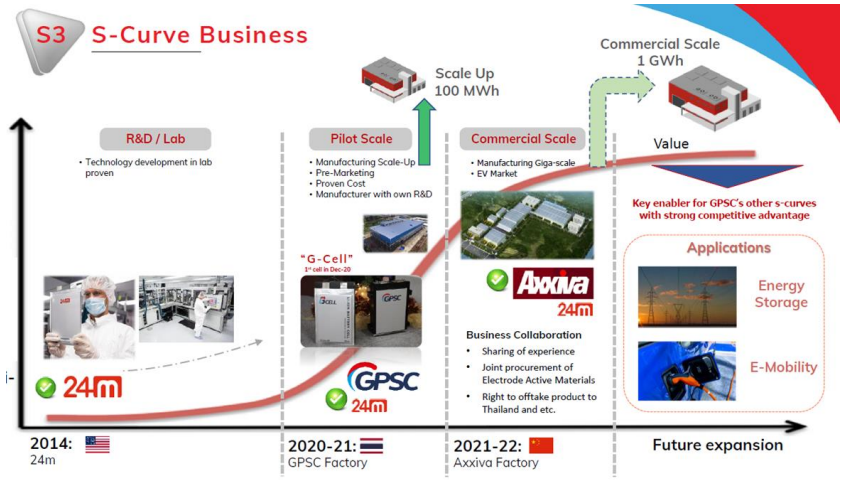
Source:
GPSC Sustainability report 2020 p.24
BESS at suranives
https://gpsc.listedcompany.com/misc/presentation/20220222-gpsc-oppday-4q2021.pdf

Energy storage system (<100 kWh and >100 kWh)

(GPSC & PTT (NUOVO PLUS) X GOTION X AXXIVA) – (2/5)

Global Power Synergy Plc (GPSC), a power generation arm of national oil and gas conglomerate PTT, is accelerating its spending on electric vehicle (EV) battery production by making a 500-million-baht investment to acquire an 11.1% equity interest in Chinese battery manufacturer Anhui Axxiva New Energy Technology Co (AXXIVA). **This can be expanded to more than 111MWh in the future.**

***Axxiva specialises** in manufacturing EV batteries, with production capacity of 1 gigawatt-hour per year. It is using technology from Boston-based 24M Technologies Inc in the US.



Bangkok Post

THAILAND WORLD BUSINESS OPINION AUTO L

BUSINESS

GPSC ups investment in EV battery production

PUBLISHED : 11 FEB 2021 AT 04:00

NEWSPAPER SECTION: BUSINESS
WRITER: YUTHANA PRAIWAN

0 0

Global Power Synergy Plc (GPSC), a power generation arm of national oil and gas conglomerate PTT, is accelerating its spending on electric vehicle (EV) battery production by making a 500-million-baht investment to acquire an 11.1% equity interest in Chinese battery manufacturer Anhui Axxiva New Energy Technology Co (AXXIVA).

Source: https://www.bangkokpost.com/business/2066303/gpsc-ups-investment-in-ev-battery-production

Energy storage system (<100 kWh and >100 kWh)

(GPSC & PTT (NUOVO PLUS) X GOTION X AXXIVA) – (3/5)

GPSC is committed to developing **battery innovations, infrastructure, and related services** to NUOVO PLUS has ensured its personnel, technology, and capital preparedness to increase investment opportunities and improve cost competitiveness through economies of scale. **The company aims to expand its production capacity to a level of gigawatt-hours (GWh) and intends to expand towards regional markets, with the goal of pushing its annual battery production capacity to 5-10 GWh by 2030**. The G-Cell battery will lend itself to a diverse range of both stationary and mobile applications in the energy industry. fully achieve the ecosystem for the production of EVs as well as utility devices and systems. In 2022, GPSC partnered with Arun Plus Co., Ltd. (ARUN PLUS), a subsidiary of PTT Public Company Limited (PTT), to establish Nuovo Plus Co., Ltd. (NUOVO PLUS) to specifically focus on battery production and development as well as **accelerate battery innovation and advancement to meet the needs of emerging markets**.

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-th.pdf
https://gpsc.listedcompany.com/misc/presentation/20221118-gpsc-oppday-3q2022.pdf

Energy storage system (<100 kWh and >100 kWh)

(GPSC & PTT (NUOVO PLUS) X GOTION X AXXIVA) – (4/5)

NUOVO PLUS was established specifically to be responsible for battery production and distribution.

A goal was set to achieve a battery production capacity by 2030.

5–10 GWh per year

NUOVO PLUS AND GOTION HI-TECH FORM "NV GOTION" TO BUILD A BATTERY PLANT WITH 2 GWH CAPACITY, AIDING THAILAND TO BE A LEADER OF BATTERY CELL BUSINESSES IN THE ASEAN MARKET.

15 DEC 2022

December 15th, 2022 - Nuovo Plus Company Limited (Nuovo Plus), a joint venture between Arun Plus Company Limited (Arun Plus) and Global Power Synergy Public Company Limited (GPSC), has reached an agreement with Gotion Singapore Pte. Ltd. (Gotion), a company in the group of Gotion High-tech Co. Ltd., to form NV Gotion Co., Ltd. (NV Gotion), a joint venture with an authorized capital almost 600 million baht 51% from Nuovo Plus and 49% from Gotion. NV Gotion plans to conduct the business of importing, assembling, and distributing battery modules, battery packs for energy storage systems, and electric vehicles (EV). An initial capacity of production will be 1 GWh/yr and expanded to 2 GWh/yr by 2025.

Dr. Buranin Rattanasombat, Chief New Business and Infrastructure Officer, PTT Public Company Limited and Chairman of the Board of Nuovo Plus Company Limited revealed that creating an ecosystem of renewable energy and electric vehicle depends primarily on the production of batteries for energy storage and electric vehicles (EV). This joint venture establishes NV Gotion company which specializes in the energy storage and EV Value Chain — upstream to downstream — in accordance with future energy business of PTT Group's strategy. NV Gotion will be capable of providing industrial sectors with one-stop service as well as international standard batteries not only in Thailand but across ASEAN by combining the knowledge of Nuovo Plus and Gotion in the fields of research and development (R&D), competitive production potential, technical service from experts. Thus, NV Gotion is going to construct a 2 GWh battery plant in the Eastern Economic Corridor (EEC). By the fourth quarter of 2023, the plant plans to develop and provide high-quality lithium-ion batteries to the market so that boosting the competitiveness through innovation and technology could ensure Thailand's Net Zero goal.

Mr. Li Zhen, Chairman of Gotion High-tech Co., Ltd. highlighted the significance of the joint venture with PTT and expectations for the future. Gotion believes that the cooperation will aid in the company's international growth and accelerate the new energy development of PTT Group. Resulting in win-win situation and laying a solid foundation for further collaboration in the future. The quality of products is the key to the joint venture's success. It is intended that both parties can leverage their respective strengths, and make their advantages complement one another. To advance product technology, enhance the functionality of products, and enhance services, thus, we must collaborate. Promoting application is the soul of the development of the joint venture. In order to help Thailand's automotive industry become more globally competitive, NV Gotion will support the Thai government to create a green economy and transform Thai automobiles. Gotion High-tech and PTT Group, with NV Gotion as the platform, will make the most of the first-class technology, high-quality products, and advanced management to support the success of electric vehicles equipped with NV Gotion batteries in Southeast Asia and beyond.

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-th.pdf
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1189/nuovo-plus-and-gotion-hi-tech-form-nv-gotion-to-build-a-battery-plant-with-2-gwh-capacity-aiding-thailand-to-be-a-leader-of-battery-cell-businesses-in-the-asean-market

Energy storage system (<100 kWh and >100 kWh)

(GPSC & PTT (NUOVO PLUS) X GOTION X AXXIVA) – (5/5)

Battery Manufacturing

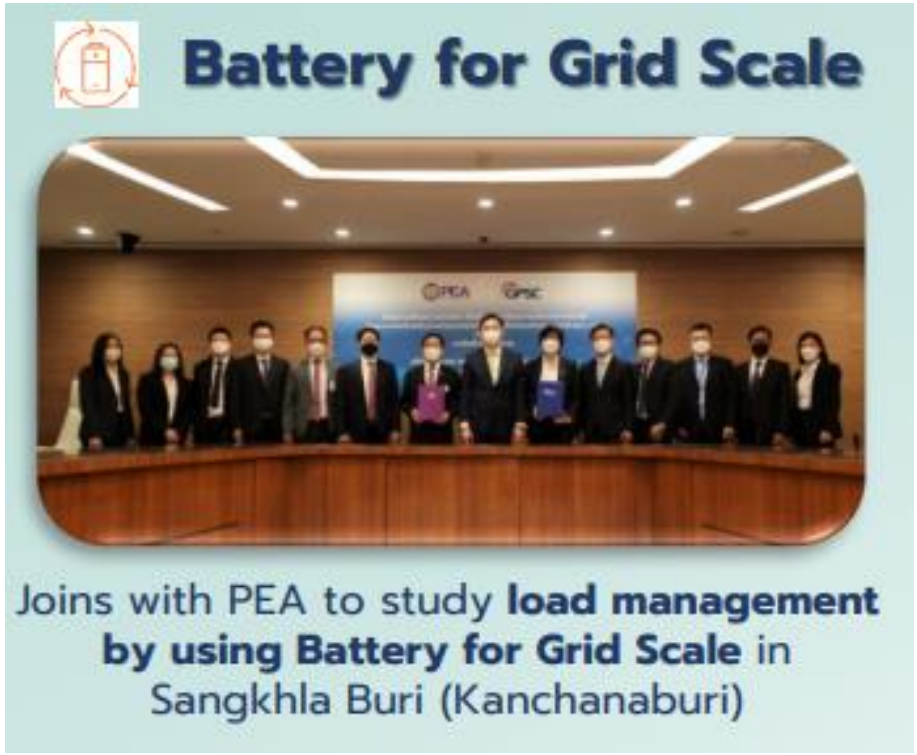
- Module and Pack Assembly
  - 1st Phase **1 GWh SOP in Q4/2023**
  - Potential expansion to **8 GWh**
- Focusing on commercial EV, ESS etc.

Facility | Process Equipment

- 1 GWh battery manufacturing plant for EV is expected to **SOP in Q2/2024**
- The facility installation, process equipment, product & material are ongoing

Source:
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf
https://gpsc.listedcompany.com/misc/presentation/20230825-gpsc-oppday-2q2023.pdf

Energy storage system (<100 kWh and >100 kWh)



The cooperation between GPSC and PEA will cover the fields of techniques, human resources, management, data analysis, summary of the project study and business collaborations, now and in the future. There will be studies and development of such energy storage system so that it contains appropriate properties that satisfy the needs of usage. Not only that, it must be safe and compliance to the power grid standards of PEA too.

The studies herein will focus on the development of infrastructure necessary for the power grid management system of Provincial Electricity Authority. Moreover, some technologies of energy storage system, e.g., SemiSolid Battery Technology, Second-life EV battery Technology, Lithium Iron Phosphate Battery Technology and other appropriate battery energy storage system technologies shall be applied in the power grid system. The other emphasis is placed on the study and the development of investment models between GPSC and PEA, as well as the affiliates of both organizations. This is to increase the potential and stability of the service of the current power grid system, to support the other forms of service businesses such as the development of distribution systems for local electricity users, to become the comprehensive electrical service providers and to increase the capacity of service provision according to the scope of this mutual project. Thereby, the working group will be established for the implementation of this project.

Source:
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf

Other – Distributed Generation

RDF product from solar panel and battery waste

GPSC has partnered with INSEE Ecocycle, a company with expertise in **transforming industrial waste into renewable fuels** and signed a memorandum of understanding (MOU) to initiate a refuse-derived fuel (RDF) power plant development project and a solar panel and battery recycling facility project in order to put solar panels and batteries into the recycling process and produce RDFs, in line with circular economy principles. The first phase of the program, lasting three years from 2022 to 2024, focuses primarily on the feasibility of the two projects, **which will then lead to the development of a joint investment scheme in the future.**

Source:
Evolving Business Model | Global Power Synergy Public Company Limited (GPSC) (gpscgroup.com)

Other – Distributed Generation

Battery Recycle Service

GPSC has joined the Memorandum of Understanding in Battery Recycling Business between PTT Public Company Limited (PTT), Global Power Synergy Public Company Limited (GPSC), Nuovo Plus Company Limited (Nuovo Plus) and Total Environmental Solution Limited (TES). This signed MOU aims to seek opportunities for the development of technology and explore the possibilities of establishing a recycling battery factory in Thailand. It is aiming to enhance the PTT Group's overall battery business in the future while also exploring the possibility of integrating recycling technologies for the benefit of clean energy-related sectors. In addition, the goal is to enhance the potential for economic development, strengthen the achievement Net Zero Emissions and foster sustainable growth for Thailand in the future.

Dead-battery recycling technology for better environment

GPSC has always given serious attention to manage dead batteries, recognizing that battery constituents can be retrieved after battery life cycles-and therefore recycling is the best option. It not only saves the cost of manufacturing, but also conserves rare natural resources. Recognizing this as a business opportunity, GPSC entered a joint venture with PTT Nuovo Plus Company and Total Environmental Solutions Company Limited (TES), the world's leading firm on electronic waste recycling, to conduct R&D on the dead-battery recycling technology, striving for fully integrated battery products and services. With supplies of dead batteries and resources, including experts, a dead-battery recycling technology feasibility study will significantly enhance clean-technology goals of PTT Group and equip GPSC with competitive advantages to better meet customers' needs quickly at lower costs. This achievement will not only bolster its capability in renewable power businesses, but also support GPSC's Net Zero Emissions target and subsequently sustainable growth for Thailand.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://gpsc.listedcompany.com/misc/presentation/20231124-gpsc-oppday-3q2023.pdf
https://www.gpscgroup.com/en/news/1298/ptt-gpsc-nuovo-plus-and-tes-team-up-to-explore-opportunities-in-battery-recycling-business-in-thailand

Smart appliances/home systems, prosumer services

Smart appliances/home systems, prosumer services

Energy Innovation Development

- MOU with SC Asset to implement the project of renewable energy and energy innovation development designated for SC Asset's development plans

In addition, GPSC has collaborated with SC Asset Corporation Public Company Limited (SC), or SC Asset, to conduct a two-year feasibility study and development project to develop electrical infrastructure and energy management systems for use in single houses, town homes, condominiums, and office buildings in real estate development projects. The outcome will serve as a prototype for electricity management for the use of clean energy and innovation-enabled efficiency maximization and will be further developed and deployed in other projects.

GPSC has intended for this collaborative study to encompass the formulation of directions, strategies, as well as technical, marketing, and price structure feasibility in order to arrive at guidelines for developing a new business model, placing emphasis on production cost reduction and the enhancement of energy efficiency and system reliability. The scope of the collaboration is as follows:

- Clean power production and the use of batteries as an ESS and a backup power system
- The application of an energy management system to facilities in future projects, such as office buildings for rent, to ensure efficient management and save energy
- Studying and developing other business models, such as electrical safety systems for use in residences and buildings
- The deployment of energy management or other relevant applications in conjunction with SC Asset's Super application to support and enhance smart home technology

7 Jul 2022, GPSC and SC ASSET commenced on the study of clean energy innovations for real-estate market.

The scopes of cooperation and development are as follows:

- ❑ Power generation from **clean energy combined with the use of batteries as energy storage** system and backup power system.
- ❑ Study and development of other business models, such as **electrical safety systems for homes and buildings.**
- ❑ Trial of **applications related to energy management system** or other relevant applications with the Super Application of SC Asset in order to support Smart Home technology.

GPSC offers service on home system by collaborating with the SC Asset Corporation Public Company Limited (SC Asset) to develop the electrical infrastructure and energy management system for applying to single houses, town homes, condominiums, and office building in the real estate development market. This can be elaborated in the detail of using clean energy and innovation-enabled efficiency maximization in a new business model between GPSC and SC Asset. Besides, the deployment of energy management is able to integrate and support **the smart home system technology** through the SC Asset's Super application.

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-th.pdf
https://gpsc.listedcompany.com/misc/presentation/20221118-gpsc-oppday-3q2022.pdf
https://gpsc.listedcompany.com/misc/presentation/20220826-gpsc-oppday-2q2022.pdf

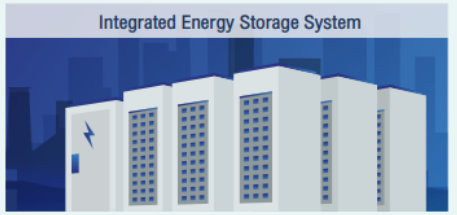
Energy Efficiency – Energy Management

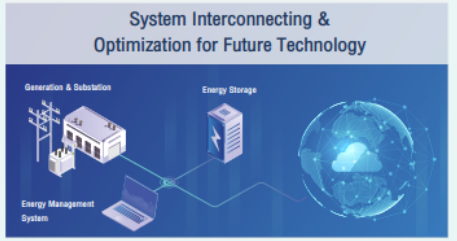
Energy Efficiency – Energy Management

GPSC responds to the energy management services by serving the state of art of the global demand with applying and integrating a highly potential innovation and technology. The focus areas for the new market opportunities of GPSC are:

- Energy audit
- Real-time energy monitoring
- Energy efficiency equipment supply
- Energy management & solution provider development
- Implementation of power purchase agreements (PPA) and regulatory certifications
- Remote management of power management system
- Integrated smart energy management services via applications
- Energy trading platform development
- Other digital technologies, such as system interconnecting and optimization for future technology

Integrated Smart Energy Management Services through ESS innovations, energy trading platforms, and digital technology





Provision of integrated smart energy management services through new technologies and innovations in order to efficiently meet the needs of energy users; consultancy services; real-time energy use analysis and inspection; remote control energy management; and ESS integration for the enhanced stability of electricity management systems.

- Installation of distributed generation systems
- Installation of district cooling systems
- Application of integrated energy storage systems
- Energy trading platforms
- Integrated smart energy management services via applications
- Analysis and consultancy on energy management optimization through the adoption of digital technologies, such as system interconnecting and optimization software

Source:
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model

Energy Management Service

Energy disruption has transformed the change in energy platforms, energy megatrends and energy consumption patterns, particularly toward clean energy. GPSC has developed a business plan to cope with such transformation and turned it into an opportunity for a new flow of revenue through a series of innovations responsive to the new energy value chain.

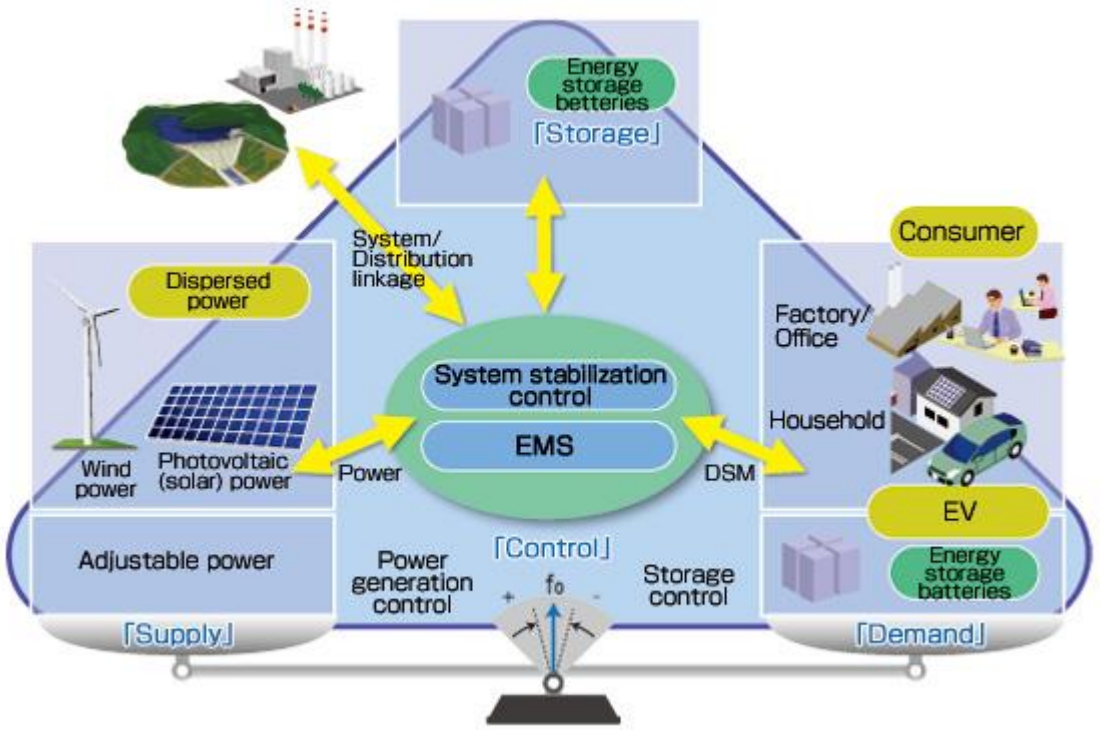
With direct expertise in energy management, **GPSC has adopted a 'Shift to Customer-Centric Solutions' (S4) Strategy, driving all energy management services under customers' demand** through modernization service patterns, such as replacement of fossil fuel-based power generators with small-scale cleaner renewable-based power generating units, providing consultation and analyses on energy efficiency to increase energy efficiency and reduce long-term energy costs, integration of the ESS and existing systems to ensure maximum system reliability. The Company also provides a solution to climate change and higher energy costs to the industrial sector with a centralized cooling control known as 'District Cooling'. Intelligent energy management is the solution to the power consumption in the future and a key to sustain customers' confidence in GPSC throughout energy disruption. Through an integration of services provided by GPSC, affiliates and subsidiaries such as Combined Heat and Power Producing Co., Ltd. (CHPP), an AI (artificial intelligence) system can provide real-time analysis and best possible recommendations for any customer to optimize its energy consumption.

Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-th.pdf
https://gpsc.listedcompany.com/misc/presentation/20221118-gpsc-oppday-3q2022.pdf

Energy Management Service

In cooperation with PTT Global Chemical Public Company Limited (PTTGC), GPSC co-developed **a 1.5MWh smart Energy Storage System (ESS),** which is the largest Li-ION ESS in Thailand to date. The ESS was placed in PTTGC Rayong Innovation Center not only to reduce the cost of electricity, but also to increase the reliability of power system. This ESS project is considered the first large scale Energy Storage in PTT Group, and as a Power Flagship of PTT Group, GPSC will continue to implement the innovative ESSs to enhance energy efficiency and energy stability for industrial users in Map Ta Put and Eastern Economic Corridor of Innovation (EECi).

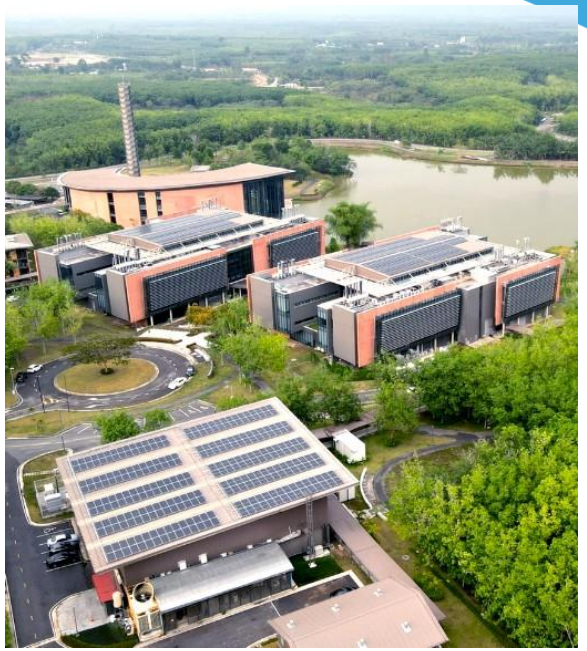
The **1.5 MWh ESS,** installed at the area of the Science & Innovation Centre of PTTGC, will allow the Gas engine to always run at rated Capacity, despite swinging electricity demand. The access electricity production then will be stored in the ESS to be used during the peak demand time at 0.25 MW for 4 non-stop hours. This will allow optimization of the gas engine and reduce PTTGC's gas cost per unit of electricity production. Moreover, the stored electricity can serve as an emergency power supply during blackouts, creating additional savings compared to buying from other sources. Overall, the ESS will save costs, while enhancing the reliability and the efficiency of power system at Rayong Innovation Center to the next level



Source:
https://investor-th.gpscgroup.com/news.rev/integrate/1/id/762740

Energy Management Service

(GPSC X VISTEC X SUT) – (1/4)



GPSC cooperates with PTT in studying intelligent energy management systems through various technologies at **Vidyasirimedhi Institute (VISTEC)** by integrating new energy technologies and innovations. This will be used in the study as a guideline for further development and practical use in the future, such as the production of electricity from stable renewable energy (Solar Rooftop and Solar Floating), Energy Storage System usage to increase efficiency, renewable energy system using Artificial Intelligence (AI) technology to analyze the production, storage, and transmission of electricity as well as the application of a network system to store online transaction accounts (Blockchain) so that each building can buy electricity directly connected to the network between computers (Peer-to-Peer: P2P), which can conduct digital transactions with Smart Contract without the need for an intermediary and showing results in real-time, etc.

Moreover, there is another successful energy solution project which is the Energy Solutions University project in **Suranaree University of Technology (SUT).** There is the 6-MW Sales of Solar Rooftop-Floating Solar Project, integrating smart energy innovations, including BESS, and other technologies like VISTEC. Under this project, smart energy innovations will be integrated with the Provincial Electricity Authority's power grid for stable and reliable renewable energy solutions. A budget of approximately 150 million baht has been allocated for the project, which will result in more than 510 million baht energy cost saving throughout the 25-year duration of the project. The project will also serve as a smart energy learning center in the northeastern region and will be a model for a **smart micro grid city**.

Source:
https://www.gpscgroup.com/en/sustainability/economic/evolving-business-model
https://www.gpscgroup.com/en/investor-relations/newsroom/set-announcements/799692/gpsc-group-suranaree-university-to-kick-off-a-6-mw-smart-solar-energy-project-served-as-a-learning-center-and-a-sustainable-rd
https://www.facebook.com/gpscthofficial/photos/a.117749663687093/284983223630402/
Renewable Energy | Combined Heat and Power Producing Co., Ltd. (chpp.co.th)

Energy Management Service

(GPSC X VISTEC X SUT) – (2/4)

GPSC GROUP JOINS HANDS WITH SUT TO KICK OFF THE SMART ENERGY PROJECT, THE MODEL LEARNING CENTER OF ENERGY MANAGEMENT FOR SUSTAINABILITY

07 SEP 2023

CHPP and Nuovo Plus, the subsidiaries of GPSC, have joined force with SUT to kick off the smart energy innovation project in higher education institutions of Thailand. The project is also expected to serve as a model learning center of energy management for sustainability focusing on the technologies of solar rooftop, floating solar, and digital platforms with an intention to optimize energy management and energy storage system to the level of Smart Grid and promote Korat to be a Smart City in the future.

The objective of this project is to promote power generation from solar energy (Solar cells) inside the university buildings in order to conduct research & development collaboration on solar energy while serving as a learning center for renewable energy technology and innovation in Thailand.

The power generation capacity of this project is 6 MW, 1.72 MW from solar rooftop and 4.28 MW from floating solar. The project also **employs the digital system coupled with the installation of battery energy storage system (BESS) in order to manage the energy consumption for maximum benefit**. It is regarded not only as the smart renewable energy project in higher education institutions of Thailand but also as **a model institute of Smart Grid** that can be further upgraded into a Smart City of Nakhon Ratchasima Province.

“Thanks to the implementation of this renewable energy project, the university is able to produce electricity from clean energy up to 8.5 million kWh per year, which is expected to save its electricity bill by 510 million baht throughout 25 years of project term, and reduce greenhouse gas emissions by 115,000 tons. Meanwhile, the installation of floating solar technology will also help reduce water evaporation in the reservoir over 30,000 cubic meters per year, increasing the efficiency of renewable energy. In addition, the project will be serving as a new learning center on solar energy for communities, playing an important role in sustainable energy conservation that is also friendly to the environment,” said Mrs. Rosaya.

The implementation of this project started in 2021 and it has been supplying electricity to the university since the beginning of 2023. The electrical system installed here is divided into 3 sections. The section 1 is the solar rooftop installed on 5 buildings with the total power capacity of about 1.66 MW, using Mono PERC Half-Cell Module, small solar cells made from silicon with high performance and long service life. The section 2 is the solar rooftop on the roof of the corridor in Building 1, with the installed capacity of 0.06 MW, using Bifacial Cells that allow the sunlight to pass through both sides for maximum efficiency. The section 3 is the floating solar system installed at Sura 1 Reservoir, with the installed capacity of 4.28 MW, using G Float pontoons by CHPP technology. The innovation is made of a special-grade polyethylene with UV stabilizers that offers excellent strength, environmental friendliness and recyclability after their service life.

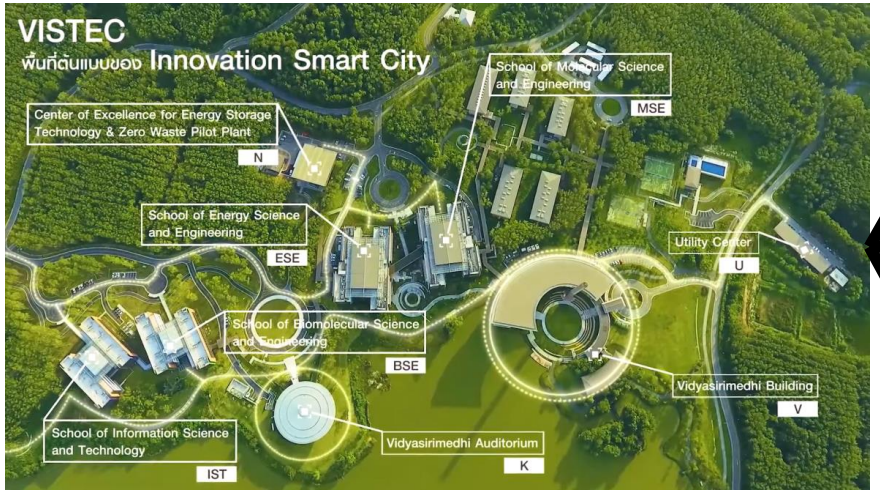
To ensure the continued availability of clean electricity, grid reliability and become a pioneer in Peer to Peer Trading with real-time trading results, the 100 kWh and 200 kWh of battery energy storage systems (BESS) have been installed along with a system of AI monitoring platform that can analyze the electricity consumption behavior in each period and align the power generation accordingly. This is all considered the development of a smart trading platform that will support an integrated energy management in an efficient manner.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1258/gpsc-group-joins-hands-with-sut-to-kick-off-the-smart-energy-project-the-model-learning-center-of-energy-management-for-sustainability

Example project of comprehensive energy management Service (1/2)

(GPSC X VISTEC X SUT) – (3/4)

- Distributed energy (solar rooftop and G float)
- Energy storage system
- Smart micro grid system



Three innovations in VISTEC

Stably Renewable Energy

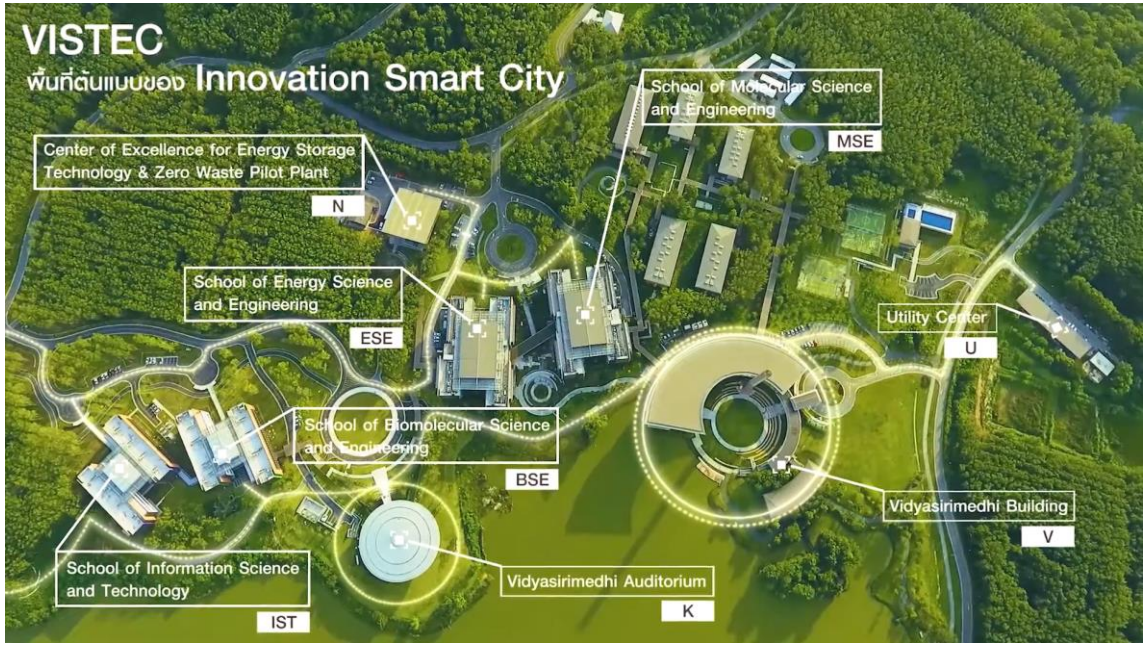
Energy Storage System

Smart Energy Management System

Source:
https://www.chpp.co.th/th/highlight-project/renewable-energy/21/vistec-ess-system-solar-system
Evolving Business Model | Global Power Synergy Public Company Limited (GPSC) (gpscgroup.com)

Example project of comprehensive energy management Service (2/2)

(GPSC X VISTEC X SUT) – (4/4)



- Distributed energy (solar rooftop and G float)
- Energy storage system
- Smart micro grid system

GPSC has partnered with PTT Public Company Limited to study and develop a smart energy management system through the use of various technologies at Vidyasirimedhi Institute of Science and Technology (VISTEC). Under this collaboration, new energy technologies and innovations are studied to create guidelines for further development and real-life applications in the future, such as reliable power production using solar rooftops and floating solar, the use of **energy storage systems (ESSs)** to optimize renewable energy systems, and the adoption of **artificial intelligence (AI)** to analyze electricity production, storage, and distribution, as well as the use of blockchain for digital peer-to-peer (P2P) on-grid power purchase between facilities through smart contracts, which will obviate intermediaries and display results in real time.

Source:
https://www.chpp.co.th/th/highlight-project/renewable-energy/21/vistec-ess-system-solar-system
Evolving Business Model | Global Power Synergy Public Company Limited (GPSC) (gpscgroup.com)

Energy Management Service

IEAT recognizes that all four of these companies possess expertise in innovation and sustainability within the energy and electricity sectors. They are committed to establishing energy and public utility security to facilitate the growth of the domestic industry and ensure the sustainable development of the country. This collaboration aims to foster integration among the five organizations involved in this cooperative effort across various aspects. These include: 1) Green Energy and Reliable Energy Systems, 2) Smart Data and Communication System, 3) Smart Energy and Microgrid Network, 4) Retail Mixed-Use Community, 5) Smart Energy Factory, 6) Integrated Operation Center, and the exploration of guidelines for establishing a utility management company, in the form of a joint venture or affiliated company under IEAT.

Under this cooperation, the entity referred to as "UMC" will assume responsibility for the management and provision of energy services, as well as the implementation of the smart utility system within the Smart Park Industrial Estate. Additionally, it will serve as a facilitator of coordination between land lessors and tenants within the Smart Park Industrial Estate, offering a one-stop service approach.

The signing of this Memorandum of Cooperation marks a significant initial step in consolidating our collaborative efforts to explore the feasibility and co-investment opportunities in smart utility projects within the Smart Park Industrial Estate. These initiatives are designed to meet the criteria for becoming a smart industrial estate, facilitating the growth of future industries such as the New S-Curve, encompassing robotics, aviation and logistics, biofuels and biochemicals, digital, and medical hub industries. Additionally, it aims to bolster the potential of existing industries within the First S-Curve, aligning with IEAT's mission to foster the development of industrial estates, oversee, and provide vital public utility systems and facilities necessary for industrial operations. He also emphasized that IEAT places recognition and emphasis on the advancement of smart utility systems.

"This commitment underscores the significance of actively developing intelligent utility systems to support emerging New S-Curve industries that are reliant on state-of-the-art technology. This initiative is aligned with the goal of elevating the status of a modern, environmentally conscious industrial city within the Eastern Special Development Zone (EEC), while working towards a low-carbon society. It also aligns with the government's BCG Economy concept and is in accordance with the Ministry of Industry's MIND policy." stated Mr. Weris.

Worawat Pittayasiri, CEO and President of Global Power Synergy Public Company Limited (GPSC), an innovative power flagship of PTT Group, emphasizes GPSC's extensive experience in managing a wide range of power plants, including those powered by conventional sources like the Map Ta Phut facility in Rayong Province, known for its robust electricity infrastructure and operational flexibility, as well as renewable energy sources such as water energy, solar power, and RDF fuel, both at home and abroad, GPSC boasts a proven track record in pioneering electric power innovations. These include cutting-edge advancements in energy storage technology and the efficient management of microgrids. GPSC stands ready to craft forward-thinking solutions by harnessing technology and an efficient digital operating system to create modern network services. These solutions are customized to meet the specific requirements of entrepreneurs within the Smart Park Industrial Estate, providing them with a competitive edge while harmonizing with the evolving global energy landscape. Our initiatives align seamlessly with the objectives of the Eastern Economic Corridor Development Project (EEC) and underscore our unwavering commitment to sustainability, as we work towards realizing a Net Zero Emissions society.

The Smart Public Utilities Project in the Smart Park Industrial Estate should provide its first services by 2024

IEAT PARTNERS WITH FOUR ENERGY INDUSTRY LEADERS TO PIONEER AN ADVANCED UTILITY SYSTEM IN THE SMART PARK INDUSTRIAL ESTATE.

18 OCT 2023

The Industrial Estate Authority of Thailand (IEAT) collaborates with four major energy companies to explore the feasibility of co-investing in collaborative ventures and establishing an affiliated utility management company under the IEAT. The primary objective is to deliver energy management services, while integrating a smart utility system into the Smart Park Industrial Estate, all in alignment with the criteria for achieving the status of a smart industrial estate.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1287/ieat-partners-with-four-energy-industry-leaders-to-pioneer-an-advanced-utility-system-in-the-smart-park-industrial-estate

Electric vehicles/ Charging network

Electric vehicles/charging network

GPSC launched **"G-Cell",** Thailand's first semi-solid battery cell, to be produced by its 1.1-billion-baht manufacturing plant. **The 30-megawatt hour battery is designed for EVs and home use**. The production facility is located on 12 rai of land in Map Ta Phut Industrial Estate in Rayong's Muang Rayong district.

Global Power Synergy Plc (GPSC), PTT's power generation arm, and PTT Oil Retail Business Plc jointly unveiled **G-Box**, a 150 kilowatt hour battery energy storage system to work in tandem with EV charging outlets at PTT stations in Bangkok's Nong Khaem district.

GPSC also acquired a 11.1% stake in China's Anhui Axxiva New Energy Technology Co (AXXIVA), a battery manufacturer. This acquisition will pave the way for GPSC to have the second battery production plant. PTT estimates its new businesses will make up 20% of its total revenue in 2030.

GPSC has planned to scale-up its battery production capacity to a gigawatt-hour level after opening the factory in the eastern province.

Source:
https://www.bangkokpost.com/business/2122923/ptt-preparing-to-debut-in-ev-assembly
https://www.bangkokpost.com/business/2246555/joint-venture-to-support-ev-production

Electric vehicles/charging network

GPSC Joined Forces With Nine Companies In The Development Of A Prototype EV Battery And A Battery Swapping Platform For Charging Stations. (1/2)

GPSC has signed an MOU with nine EV companies to develop a common battery pack using the company's Semi-Solid battery technology for electric vehicles (EV) and to develop a battery swapping platform for charging stations. The cooperation is in line with the government's policy to promote the use of electric vehicles and the global EV trends while playing a role in making Thailand an electric vehicle manufacturing hub in South East Asia.

Mr. Worawat Pitayasiri, President and Chief Executive Officer of Global Power Synergy Public Company Limited or GPSC, the innovative power flagship of PTT Group, revealed today (29 April 2021) that GPSC has signed a Memorandum of Understanding (MOU) with nine electric vehicle companies to develop a prototype common battery pack and a battery swapping system using GPSC's Semi-Solid technology or G-Cell for battery electric vehicles (BEV) such as electric motorbikes, Tuk Tuks, and cars. The technology will not only increase safety, improve heat dissipation, and reduce charging time but will also further enable battery swapping at EV charging stations in the future.

Source:
https://www.gpscgroup.com/en/news/686/gpsc-joined-forces-with-nine-companies-in-the-development-of-a-prototype-ev-battery-and-a-battery-swapping-platform-for-charging-stations

Electric vehicles/charging network

GPSC Joined Forces With Nine Companies In The Development Of A Prototype EV Battery And A Battery Swapping Platform For Charging Stations. (2/2)

The nine companies in cooperation with GPSC on the project include 1. FOMM (Asia) Company Limited, 2. I-Motor Manufacturing Company Limited, 3. Toyotron Motor Company Limited, 4. Fommunity Company Limited, 5. Asia Technology Industry Company Limited, 6. Bangkok Pay Company Limited, 7. Strongs (Thailand) Company Limited, 8. Amnuay Fire Extinguishers Company Limited and 9. Samlor Thai Company Limited.

The cooperation will be implemented in three phases. The first phase is the study on how to develop a prototype battery and a battery swapping system, including regulations and specifications, as well as the design of battery cell components for increased efficiency in heat dissipation and safety in compliance with international standards. The implementation of the first phase will result in a three-dimensional prototype battery pack, which will be used for future commercial production. The second phase of the cooperation focuses on the development of a prototype battery pack for different types of electric vehicles. The Internet of Things will be integrated into the system of the battery pack and a battery swapping station will also be set up by Fommunity Co., Ltd. and Asia Technology Industry Co., Ltd, offering a new service platform for electric vehicle users, and a test run will be conducted before being made commercially available. The third phase is a joint feasibility study on commercial sales of the common battery packs.

“The collaboration marks a success in the development of electric vehicle battery technology and helps concretely promote the electric vehicle industry as Thailand is considered a major automotive production hub in South East Asia. It is also in line with the government’s strategic plan to promote the use of electric vehicles in Thailand by switching from internal combustion engine vehicles to electric vehicles, which is a significant move toward becoming a low-carbon society and the world’s major hub for the production of electric vehicles and parts,” said Mr. Worawat.

Source:
https://www.gpscgroup.com/en/news/686/gpsc-joined-forces-with-nine-companies-in-the-development-of-a-prototype-ev-battery-and-a-battery-swapping-platform-for-charging-stations

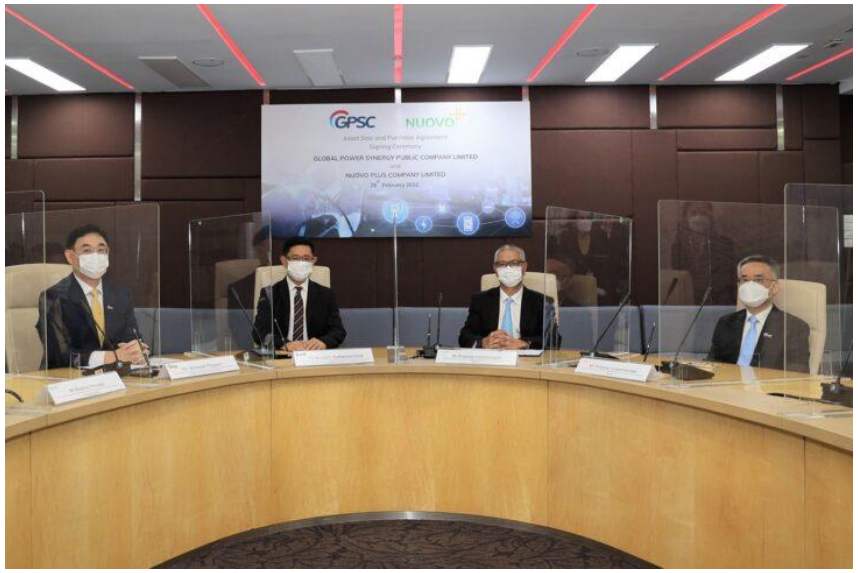
Electric vehicles/charging network

GPSC Joins Arun Plus To Embark On The Ev Battery Business As “Nuovo Plus”, Plan To Move Forward To Regional EV Market Growth Expansion. (1/2)

On 28 February 2022, Global Power Synergy Public Company Limited (GPSC) signed the agreement with NUOVO PLUS Company Limited to transfer assets involving production, education, research, and battery business development to NUOVO PLUS. The asset transfer valued at 2,428 million baht due to complete by April aims to support the growth of EV vehicle industry and energy storage system with purpose to produce 5-10 gigawatt-hour (GWh) per year in 2030.

The asset transfer is recognized as the lithium-ion battery business debut plan in preparing personnel resources, technology, capital fund, and EV Value Chain investment expansion knowhow from PTT and GPSC to NUOVO PLUS. Driven to increase competitiveness for production cost based on Economy of Scale, the plan aims to deliver the production of gigawatt-hour pack to regional markets. GPSC will proceed by transferring 24M Technologies’ SemiSolid lithium-ion battery to NUOVO PLUS for commercial production and distribution to the markets.

Mr. Worawat Pitayasiri, President and Chief Executive Officer, Global Power Synergy Public Company Limited (GPSC), the innovative power flagship of PTT Group revealed “The joint venture is established to expand battery business initially operated by GPSC and PTT Group to EV vehicle market, which is recognized as the large and fast-growing sector domestically and internationally. By combining strengths of two companies together, we are moving toward the ecosystem of EV vehicle production to support the vehicle industry development of the future. GPSC is prompted to deliver our expertise in power innovation to collaborate with PTT to drive the EV industry to support the growing EV investment and usage in Thailand in compliance with the government policy. The Energy Storage System (ESS) is the area for development in response to other related industries such as power management and renewable energy to support regional market.”



Source:
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1050/gpsc-joins-arun-plus-to-embark-on-the-ev-battery-business-as-nuovo-plus-plan-to-move-forward-to-regional-ev-market-growth-expansion

Electric vehicles/charging network

GPSC Joins Arun Plus To Embark On The Ev Battery Business As “Nuovo Plus”, Plan To Move Forward To Regional EV Market Growth Expansion. (2/2)

Dr. Buranin Rattanasombat, Senior Executive Vice President, Innovation and New Ventures Holding, PTT Public Company Limited and Chairman, NUOVO PLUS Company Limited, stated “Thailand is on verge to step forward as the vital global EV and EV parts production base in accordance to the government 30/30 policy which establishes to achieve at least 30% of ZEV production by 2030. The National policy is in line with PTT’s Powering Life with Future Energy and Beyond policy which is operated by NUOVO PLUS, the joint venture between ARUN PLUS and GPSC. The collaboration signifies the merger of innovation, marketing, and supply chain of the entire group in driving EV Value Chain development to cover in all processes from upstream, midstream, to downstream. The EV battery production is the heart of success in creating business coexistence to increase national competitiveness based on technology to lead Thailand to Zero Carbon society where economy grows with sustainability.”

Mr. Prasong Intaranongpai, Executive Vice President, Innovation and New Ventures Holding, PTT Public Company Limited and Director, NUOVO PLUS Company Limited, stated “the agreement signing between NUOVO PLUS and GPSC today indicates the significant mission transfer for PTT to move towards lithium-ion battery territory to support growth in EV industry development in Thailand and the region. GPSC has developed the preliminary battery production with SemiSolid technology and achieve in delivering the product to customers for application development. NUOVO PLUS is responsible for proceeding gigawatt-hour lithium-ion battery production for commercial purpose along with other battery technology development in pilot stage amongst PTT group. NUOVO PLUS aims to expand wider Battery Value Chain coverage into battery module and battery pack businesses as well as opening for new business alliance to build up strength and support EV battery business potential to reach the 5 - 10 gigawatt-hour goal.”

The newly launched joint venture, NUOVO PLUS, will be a manufacturer and distributor of batteries used in electric vehicles and various energy storage systems in order to achieve rapid approach to all customers which can be divided in to 2 main groups including (1) Mobility : EV, E-bike, E-tuktuk, golf cart, small EV, E-bus, E-truck, E-boat (2) Stationary: Energy Storage System (ESS), Uninterruptible Power Supply (UPS), EV Charger System at Service Stations. NUOVO PLUS is also responsible for relevant accessories procurement, providing services, and sales as well as seeking for new technology in response to EV market needs in Thailand and the region.

Source:
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1050/gpsc-joins-arun-plus-to-embark-on-the-ev-battery-business-as-nuovo-plus-plan-to-move-forward-to-regional-ev-market-growth-expansion

Electric vehicles/charging network

Chao Phraya Express Boat And GPSC Sign An MOU To Develop Thailand's First Prototype Boat Battery Packs (1/2)

On 17 December 2021 at Supatra River House, Mrs. Supapan Pichaironarongsongkram, Chairman of Chao Phraya Express Boat Company Limited, and Mrs. Rosaya Teinwan, Executive Vice President - Business Development of Global Power Synergy Public Company Limited or GPSC, signed a Memorandum of Understanding (MOU) for the development of a prototype battery pack and a drive system for electric power-driven boats at a signing ceremony presided by Mr. Phuripat Theerakulpisut, Deputy Director-General of the Marine Department. Also in attendance were Lieutenant Commander Chareonporn Chareontham, Managing Director of the Chao Phraya Express Boat Co., Ltd., Mr. Laksanapreecha Krutkuntode, Senior Vice President of New Technology of GPSC, and other distinguished guests.

Mr. Phuripat Theerakulpisut, Deputy Director-General of the Marine Department said that the Marine Department under the Ministry of Transportation has been working with the private sector on several EV development projects, including electric power technology for boats and piers. The partnership between Chao Phraya Express Boat and GPSC certainly provides a solution for fuel efficiency and emission reduction and could expand to other projects under the transportation system development plan, which focuses on increased reliance on electric energy to ease road traffic and reduce pollution levels, in line with the country's development plan. The cooperation will also help promote the use of electric boats for water transportation in a concrete manner.

Source:
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1014/chao-phraya-express-boat-and-gpsc-sign-an-mou-to-develop-thailands-first-prototype-boat-battery-packs

Electric vehicles/charging network

Chao Phraya Express Boat And GPSC Sign An MOU To Develop Thailand's First Prototype Boat Battery Packs (2/2)

Mrs. Supapan Pichaironarongsongkram, Chairman of the Chao Phraya Express Boat Company Limited, an operator of Chao Phraya express boat service, said that for the past 50 years, the Supatra Group's Chao Phraya Express Boat Company Limited has been continuously promoting fuel efficiency to reduce air pollution and conserve the environment. The development of electric boats and the transition to using more electric power-driven boats are naturally our main goals. The partnership with GPSC marks a significant step for the company in its electric boat endeavor, in which GPSC-developed lithium-ion battery will play an important role. The high-quality Thailand-made battery will be used with the company's Water Limousine fleet, which is currently in the design phase. Subsequently, the initiative will be extended to the company and Supatra Group's other types of electric passenger boats as well to enhance the prospects of related businesses.

Mrs. Rosaya Teinwan, Executive Vice President - Business Development of Global Power Synergy Public Company Limited or GPSC, the innovative power flagship of PTT Group, said that the partnership marks crucial progress in the commitment to reducing air and noise pollution to maintain environmental friendliness in and along the Chao Phraya River and riverside communities. Towards this goal, electric power-driven boats will be developed under the cooperation with Chao Phraya Express Boat, a highly-experienced water transportation service provider, with a focus on devising an electric power system that is commercially suitable for water transportation in the Chao Phraya River and other waterways in the country.

The shared vision has resulted in the collaboration on "the development of a prototype battery pack and a drive system for electric power-driven boats" between GPSC and Chao Phraya Express Boat. The highly safe and eco-friendly G-Cell lithium-ion battery will be used to power Supatra Group's passenger boats, starting with the Water Limousine fleet before expanding the commercial cooperation to other boat types.

With GPSC and 24M's SemiSolid lithium-ion battery cell manufacturing technology, internationally recognized by such world-class organizations as Volkswagen, Kyocera, AXXIVA, and Freyr, the partnership is certain to become another major milestone in the energy storage system innovation developed by Thais. The partnership will not only support the country's energy policy to tackle environmental problems but will also enhance energy efficiency in a wide range of settings from the industrial, transportation, and public and private sectors to buildings and offices.

Source:
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1014/chao-phraya-express-boat-and-gpsc-sign-an-mou-to-develop-thailands-first-prototype-boat-battery-packs

Electric vehicles/charging network

Technology R&D is a critical success factor for any organization. Envisioning a steady rise in demand for power and energy transition toward the Decentralized Power System, GPSC has defined the S3 (S-Curve & Battery) Strategy to cope with this rise in demand and provide more new business opportunities in response to the energy transition. These can be achieved only through the development of battery technology, a critical key to success for the decentralized power system, and businesses in the dynamic power business value chain, to maintain and enhance its capability to compete and grow sustainably.

Integrated Battery Innovation Development

At present, battery holds the key to success for renewable energy development, as it efficiently provides storage capacity for energy generated from renewables. With additional development, battery energy storage can be expanded into a large ESS that addresses related industries, including energy management and renewable energy. Battery also holds the key to the growth of EVs, a transport mode purely using batteries. Under the national 30@30 policy, initiated to support the Zero Emission Vehicle (ZEV) with a target of 30% share of EVs in the total vehicles manufactured in 2030, Thailand would become a global hub for EV assemblies and parts. In the future, the battery business is extremely promising. As an energy service provider and battery technology developer, GPSC has continuously viewed and invested in the entire battery value chain to achieve its target of becoming a fully integrated battery power provider, aligning with the national goals and policy on the automotive industry, energy storage, universal energy transition, and taking PTT Group to the helm of the EV industry before moving eventually into a low-carbon society.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf

Other – Fuel Switching

GPSC x Meranti

GPSC JOINS HANDS WITH MERANTI TO STUDY THE CLEAN ENERGY FOR THE GREEN STEEL PROJECT, FOCUSING ON GREEN HYDROGEN WITH AN INTENTION TO REDUCE CO2 EMISSION

14 JUN 2023

GPSC and Meranti signed a Memorandum of Understanding (MOU) to conduct the joint study and the development of clean energy designated particularly for the steel project, with an expectation of 150 MW of electricity, focusing particularly on solar power, wind power, and hydrogen. The objectives of this project are to enhance the efficiency of high-quality steel production, reduce carbon dioxide to emphasize the environmentally friendly production processes, support national steel and its downstream industries for GDP growth, and study the possibility of the establishment of a long-term energy joint venture with aiming to be the first green steel projects in South East Asia.

GPSC began its investigation of green hydrogen in 2023 by launching a joint-venture project with Meranti Steel Co., Ltd., a leading steel manufacturer of Singapore, in using green hydrogen for steel production. The project scope included a feasibility study on using clean energy and energy management to produce steel that is environmentally friendly while reducing GHG emissions from conventional processes. Meranti plans to invest in a steel factory in Thailand as the first green steel manufacturing plant in Southeast Asia using clean energy, including **solar, wind, and green hydrogen with an expectation to use approximately 150 MW of electricity**. This project has commenced operations in the second half of 2027 with a capacity of 2 million tons per year in Map Ta Phut, Rayong Province.

With state-of-the-art steel manufacturing technology, Meranti can reduce GHG emissions by up to 3 million tons of carbon dioxide per year versus conventional technology and processes. This milestone project bears a conceptual design of GHG reduction truly integrated from the beginning and set to significantly enhance the national achievement on GHG reduction.

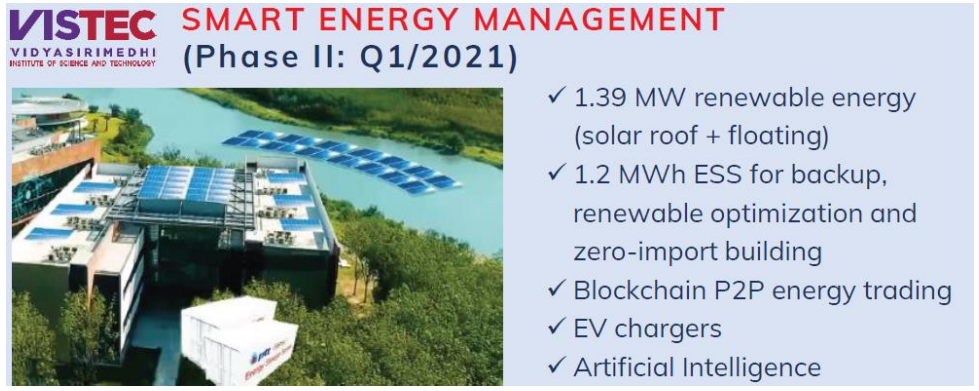
Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1229/gpsc-joins-hands-with-meranti-to-study-the-clean-energy-for-the-green-steel-project-focusing-on-green-hydrogen-with-an-intention-to-reduce-co2-emission

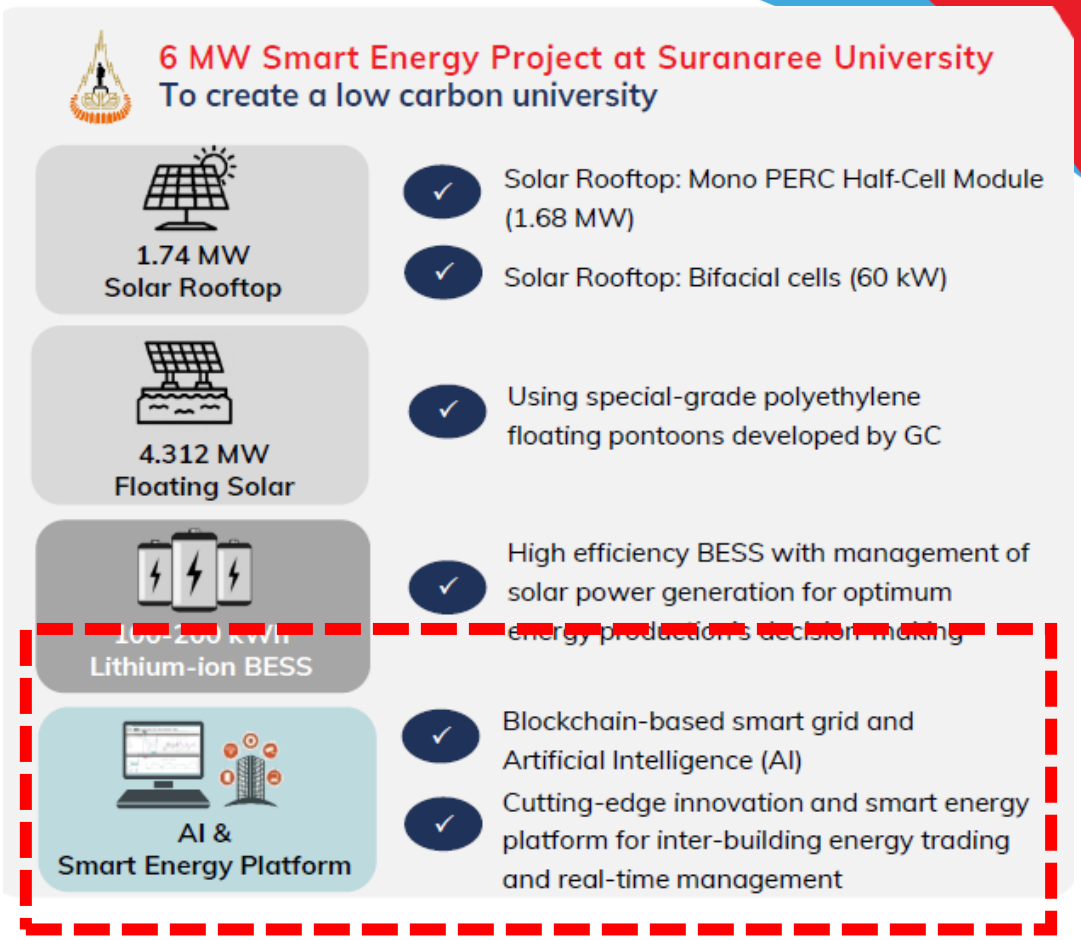
Micro-grids, virtual power plants

Smart grid technology

Executive vice-president Rosaya Teinwan said her firm will not only focus on power generation and steam-related businesses, but will also develop other key facilities for **energy storage systems and smart grids.**

the Lithium-ion Battery Energy Storage System (BESS) with a capacity of 100-200 kWh will be installed at Suranives Dormitory and a blockchain-based smart grid will also be set up for the management of solar power generation. Artificial Intelligence (AI) will be also included to ensure the real-time performance controlling and tracking and using those data for optimum energy production's decision-making. For example, meteorological and solar irradiance data can be used to analyze solar power generation capacity in advance to increase accuracy and efficiency in power production.





Source:
the collaboration with university
https://investor-th.gpscgroup.com/news.rev/integrate/1/id/762740
https://investor.gpscgroup.com/news.html/integrate/1/id/799692

Smart grid technology

- GPSC signed a Memorandum of Understanding (MOU) with Electrify (a Singapore energy company pioneering, Electrify.SG, Singapore's first retail electricity marketplace and Synergy for country-wide peer-to-peer (P2P) energy trading. Electrify.SG transacted more than 60GWh of electricity, helping over 500 commercial and industrial companies in Singapore save a combined S$1.5 million.)
- This collaboration focuses on deploying Electrify's patent-pending **peer-to-peer (P2P)** Synergy platform in various sites around Thailand where **Electrify solution** by Combined Heat and Power Producing Co. Ltd. (CHPP) (subsidiary of GPSC). **Other potential business models include, but not limited to, the use of smart grid technology, distributed energy resources (DERs), energy storage systems (ESS).**
- Electrify's patent-pending P2P software (Synergy) will be integrated **with GPSC's smart energy offering of rooftop solar, floating solar, energy storage systems and energy management systems as a complete solution for new energy business models**. This partnership combines Electrify's drive to achieve mass adoption of renewables through Synergy by working with national utility companies and GPSC's commitment to new frameworks to support the growth of renewable energy in Thailand. Synergy will also be configurated as a supporting learning tool for practising students to explore new energy modules such as management and development of DERs, variable energy market conditions and energy trading concepts.
- In this collaborative **will integrate the Synergy platform with GPSC's smart energy** framework, GPSC will lead in the overall project management, including the installation of smart energy solution components and IoT devices. Concurrently Electrify will be responsible for developing and deploying Synergy and academic knowledge transfer to relevant parties for academic collaboration and use case extension through decentralised energy in future potential projects.

Source:
https://electrify.asia/2021/05/18/electrify-mou-gpsc-peer-to-peer-energy-trading-platform/

Micro-grids, virtual power plants, Smart-Grid

GPSC Group - Suranaree University To Kick Off A 6-MW Smart Solar Energy Project, Served as a Learning Center and a Sustainable R&D (1/3)

GPSC has assigned its subsidiary, CHPP, to collaborate with Suranaree University of Technology in the 6-MW Sales of Solar Rooftop-Floating Solar Project, integrating smart energy innovations, including BESS, Block Chain, and AI, to increase efficiency in power generation and distribution in the form of Private Power Purchase Agreement (PPPA). Under this project, smart energy innovations will be integrated with the Provincial Electricity Authority's power grid for stable and reliable renewable energy solutions. A budget of approximately 150 million baht has been allocated for the project, which will result in more than 510 million baht energy cost saving throughout the 25-year duration of the project. The project will also serve as a smart energy learning center in the northeastern region and will be a model for a smart micro-grid city.

Mr. Chawalit Tippawanich, President and Chief Executive Officer of Global Power Synergy Public Company Limited or GPSC, the innovative power flagship of PTT Group, revealed that a MOU signing ceremony was held today (28 September 2020) for the cooperation of the Solar Energy Research and Development Project between Suranaree University of Technology and Combined Heat and Power Producing Co., Ltd. or CHPP, a wholly-owned subsidiary of GPSC, to produce a total of approximately 6 MW of solar power to create a "low carbon university' for Suranaree University which can help for the university's utility bills saving through PPPA. The project will also serve as a learning center on smart energy innovations in the northeastern region catering to staff, university students, and the general public. A budget of about 150 million baht has been allocated for the project, which is expected to be ready for commercial operation in 2022.

The project's installations are divided into three parts which are (1) installation of Mono PERC Half-Cell Module rooftop solar panels with a capacity of 1.68 MW on the roof of the Suranaree Technology Building # 8 of Suranaree University (2) installation of rooftop solar panels with a capacity of 60 kW on the roof of Administration building's walkway, using Bifacial cells instead of regular roof tiles and (3) installation of solar floating with a total capacity of about 4.312 MW in Sura 1 Reservoir, using special-grade polyethylene floating pontoons, with the UV stabilizer to make it last longer, environmentally-friendly, and recyclable. This technology is developed by PTT Global Chemical Public Company Limited (GC), a subsidiary of PTT. The Data Engineering Process will be incorporated to ensure the highest efficiency of the energy management systems.

Smart Energy Campus

Suranaree University of Technology

A collaboration with Suranaree University of Technology to develop a Smart Micro-Grid Energy City model through the use of various technologies, from energy production from renewable energy to energy storage and distribution as well as power trading between private organizations (private PPAs).

Source:
https://www.gpscgroup.com/th/investor-relations/newsroom/press-releases/799692/gpsc-group-suranaree-university-to-kick-off-a-6-mw-smart-solar-energy-project-served-as-a-learning-center-and-a-sustainable-rd
Evolving Business Model | Global Power Synergy Public Company Limited (GPSC) (gpscgroup.com)

Micro-grids, virtual power plants, Smart-Grid

GPSC Group - Suranaree University To Kick Off A 6-MW Smart Solar Energy Project, Served as a Learning Center and a Sustainable R&D (2/3)

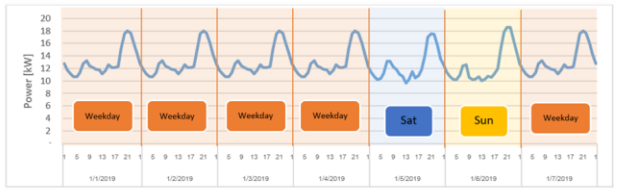
Project Offer

- **Solar System** — Solar Rooftop = 1.7 MWp; Solar Floating = 6.3 MWp
- **Energy Storage System** — BESS = 100 kW/200 kWh
- **Block Chain System** — Smart Energy Platform (SEP)
- **Artificial Intelligence : AI** — Innovation Smart City

Energy Storage System

จากการสำรวจพื้นที่พบว่ากลุ่มของอาคารที่เหมาะสมสำหรับการติดตั้งเซลล์ผลิตไฟฟ้าพลังงานแสงอาทิตย์เพื่อทำ Zero Import ช่วง Peak คือ กลุ่มอาคารที่พักนักศึกษาที่มีการใช้พลังงานไฟฟ้าในช่วงเวลา 18:00 - 22:00 น. ซึ่งเป็นช่วงเวลาที่ไม่มีการผลิตไฟฟ้าจากพลังงานแสงอาทิตย์

พฤติกรรมการใช้ไฟฟ้ารายสัปดาห์ที่ถูกจำลองจากข้อมูลปริมาณการใช้ไฟฟ้าของอาคารหอพัก



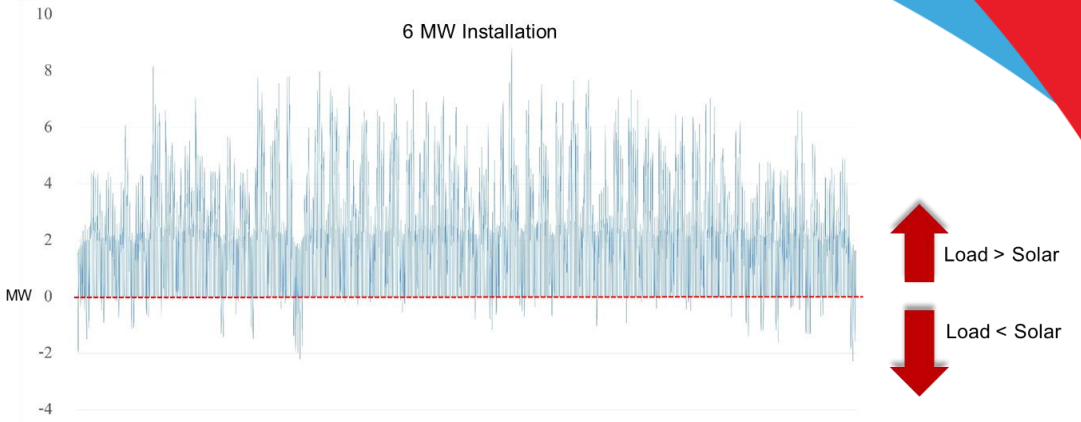
เป้าหมายของการทำ Zero Import ช่วง Peak ที่ 98% พบว่าขนาดของระบบผลิตไฟฟ้าพลังงานแสงอาทิตย์และระบบกักเก็บพลังงาน จะมีค่าดังนี้

Location	อาคารสุรนิเวศ 5
PV Size (kWp)	150 kWp
BESS Size (kW/ kWh)	100 kW/ 200 kWh

- โดยเลือก อาคารสุรนิเวศ 5 ซึ่งมี Average Power อยู่ที่ 16.6 kW และ Peak Load อยู่ 25.97 kW
- อาคารมีขนาดพื้นที่หลังคาและโครงสร้างที่สามารถรองรับการติดตั้งระบบผลิตไฟฟ้าพลังงานแสงอาทิตย์ขนาด 150 kWp
- การเลือกกำหนดที่ตั้งระบบผลิตไฟฟ้าพลังงานแสงอาทิตย์และระบบกักเก็บพลังงานโดยติดตั้งให้อยู่ภายในอาคารเดียวกันเพื่อเป็นประโยชน์ในการศึกษาทดลองการทำ Zero Import ในช่วง Peak

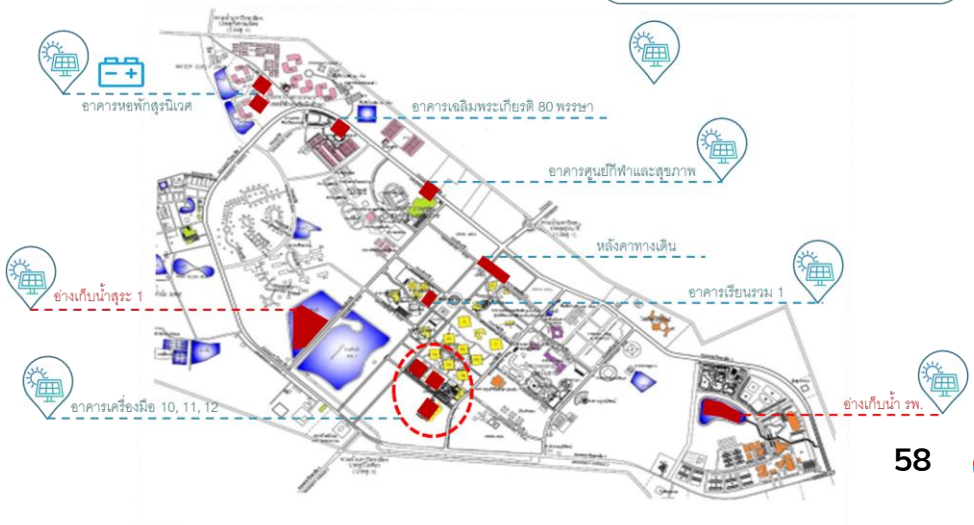
Load Analysis

กราฟแสดงผลต่างระหว่างปริมาณไฟฟ้าที่ใช้งานของ SUT กับปริมาณไฟฟ้าที่ผลิตได้จาก Solar system ปี 2562



ปริมาณไฟฟ้าที่ผลิตได้จาก Solar system สูงกว่า ปริมาณไฟฟ้าที่ใช้งานของ SUT ส่งผลให้ต้องลดกำลังการผลิตลงประมาณ 2.42%

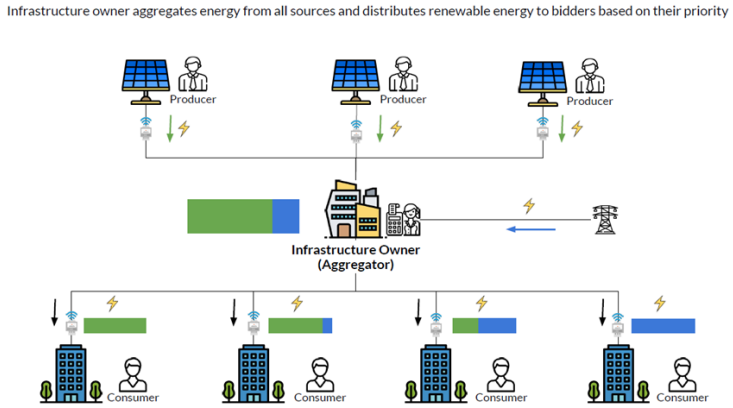
Solar rooftop ขนาดกำลังการติดตั้งรวม 1.7 MWp
Solar Floating ขนาดกำลังการติดตั้งรวม 6.3 MWp
ติดตั้งรวมทั้งสิ้น 8 MWp



Micro-grids, virtual power plants, Smart-Grid

GPSC Group - Suranaree University To Kick Off A 6-MW Smart Solar Energy Project, Served as a Learning Center and a Sustainable R&D (3/3)

Smart Energy Platform



1 Trading Renewable Energy

ระบบซื้อขายไฟฟ้าที่ผลิตได้จากแหล่งพลังงานทดแทน ผ่านแอพพลิเคชั่นที่ใช้งานง่าย

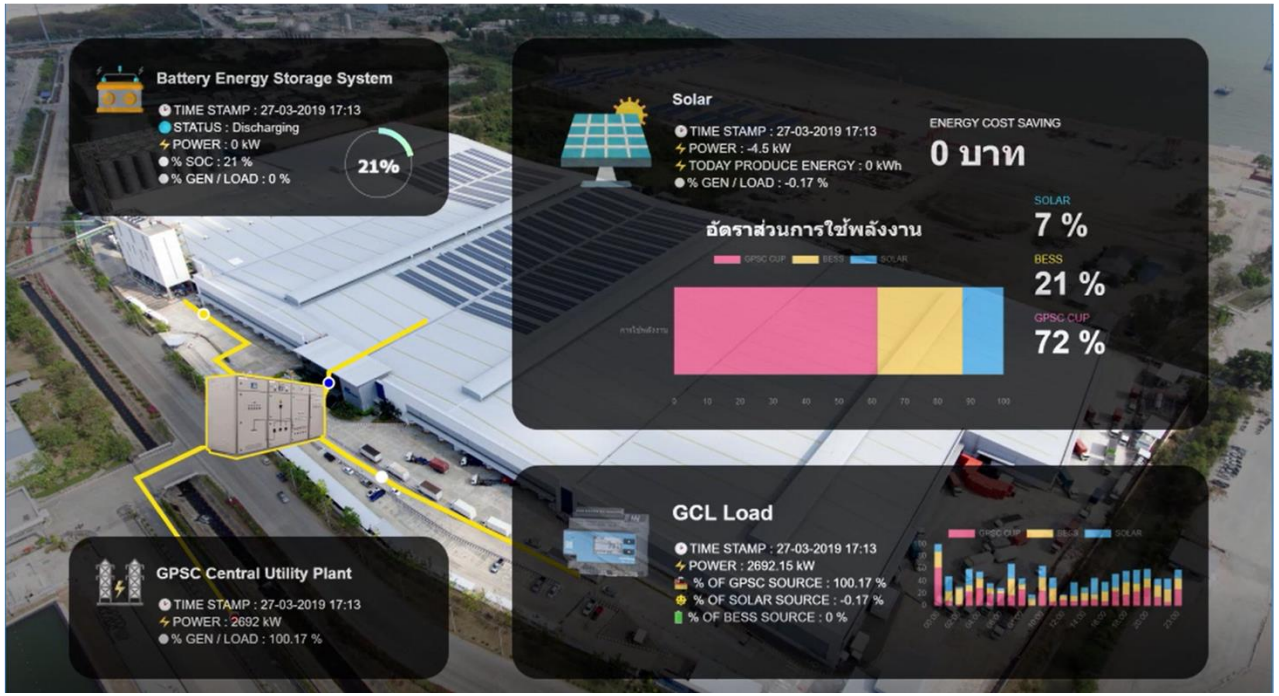
2 Monitoring Energy Trading Transaction

ระบบตรวจสอบและติดตามผลที่สามารถประเมินอัตราการใช้ไฟฟ้าและอัตราการผลิตไฟฟ้าจากแหล่งพลังงานทดแทนแบบ Real Time

3 Trackable and Traceable

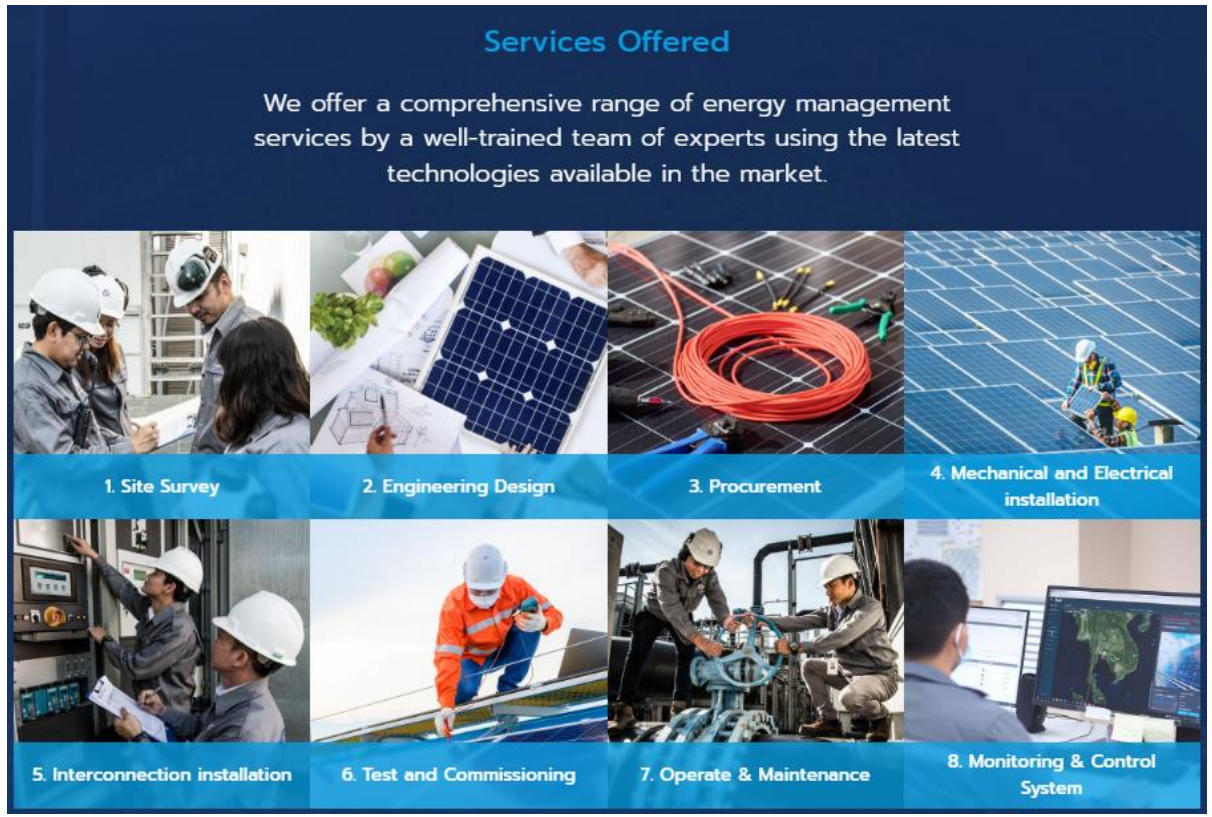
ระบบการซื้อขายไฟฟ้าและระบบตรวจสอบการซื้อขาย ซึ่งเป็นระบบที่ตรวจสอบป้องกันและยืนยังคำสั่งซื้อการซื้อขายที่มีประสิทธิภาพสูง

Artificial Intelligence : AI



Engineering, Procurement and Construction (EPC)

Engineering, Procurement and Construction (EPC)



Highlight Projects

- Smart grid, micro-grid projects
  - Projects at VISTEC and Suranaree university
- Digital energy
  - P2P trading,
  - Smart energy
  - ESS project at Suranaree university and VISTEC
  - Project with Electrify
- System integrator
  - Projects at VISTEC, Suranaree university and hospital

Beside the EPC services, CHPP also provide two more services to be a one-stop service renewable energy provider, as follows:

- Operate and maintenance
  - operate and maintain the solar farms through our well-trained teams of experts
- Monitoring and control system
  - real-time monitor using a smart platform

Source: https://www.chpp.co.th/en/home

Engineering, Procurement and Construction (EPC)

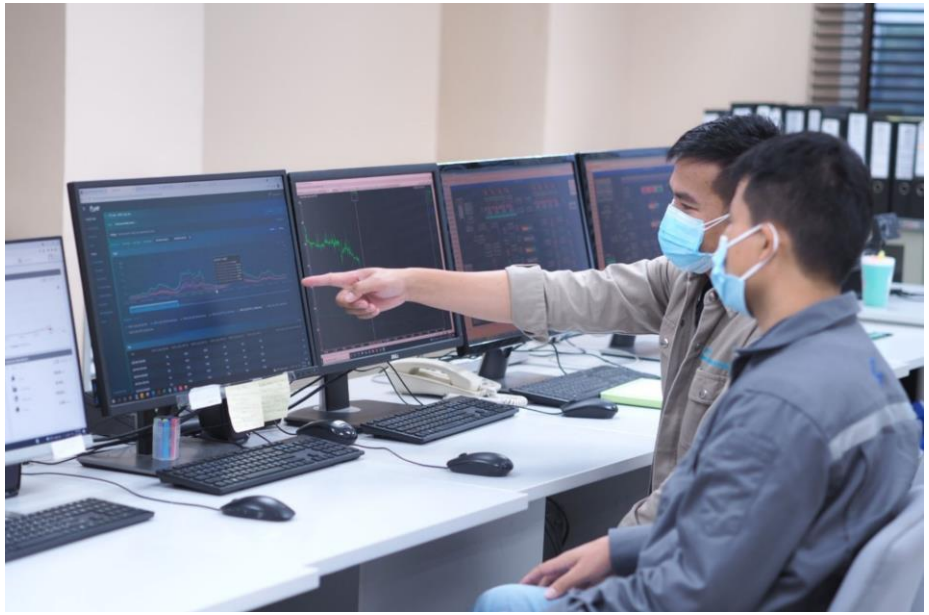
The example of EPC project for the installation of energy project which includes:

- PV Module installation
- Mounting Structure
- Inverter
- Optimizer
- Battery
- Backup Box
- Power Sensor
- Raceway and Walkway

Operation and Maintenance Service

CHPP's (GPSC Subsidiary) services include operating and maintaining a solar farm after it has been built. We oversee the power generation operation and maintain the system's efficiency under an operational and maintenance contract. A solar farm is a long-term investment with a variable payback period based on generation and consumption. Regular maintenance is required to ensure a positive return on investment. The following are included:

- Plant Monitoring
- Solar panel cleaning
- System maintenance
- Periodic system reviews
- Preventive maintenance
- Regular maintenance
- Spare parts
- Licensing



Source:
https://www.chpp.co.th/en/products-services/operation-and-maintenance

Lighting, appliances, HVAC system, CHP, etc.

Chilled water for HVAC system

CHPP is a very small power producer (VSPP). It distributes power to MEA by entering into a 5-year non-firm power purchase agreement on 23 April 2009, subjecting to be automatically renewed every 5 years unless the agreement is terminated. The surplus generated power is used in the production of conditioned air, which is distributed to Bangkok Government Complex. The company has entered into a conditioned air sale and purchase agreement with DAD. The term of the agreement is 30 years and will be ending in 2038.

5
MEGAWATTS
of electricity

12,000
REFRIGERATION TONS
of chilled water

CHPP is a very small power producer (VSPP). It distributes power to MEA by entering into a 5-year non-firm power purchase agreement on 23 April 2009, subjecting to be automatically renewed every 5 years unless the agreement is terminated. The surplus generated power is used in the production of conditioned air, which is distributed to Bangkok Government Complex. The company has entered into a conditioned air sale and purchase agreement with DAD. The term of the agreement is 30 years and will be ending in 2038.

By product from power generation process, Chilled water, can be used for Heating, Ventilation, and Air-conditioning (HVAC) system. CHPP can provide 12,000 refrigeration tons of chilled water from power generation process of 5 megawatts of electricity for that utilization.

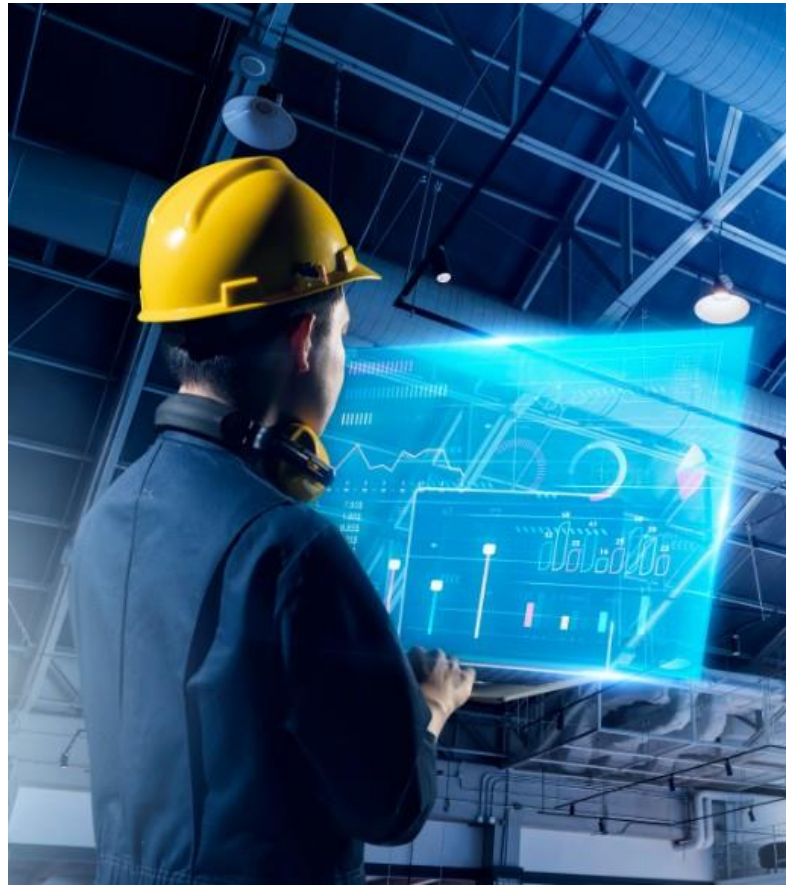
Source: https://www.gpscgroup.com/en/business/project/17/combined-heat-and-power-producing-co-ltd

Digital Energy Service

Digital Energy Service

GPSC Group initiates digital energy service by planning to integrate digital and technology as an intelligent energy management for customers who demands smart energy platform.

The service integrates advanced energy technology such as energy storage system/battery, Artificial Intelligence and blockchain to efficiently reduce energy cost, reduce environmental impact through renewable energy, and increase energy security.



Technology Artificial Intelligence (AI)

AI-assisted forecast for electricity generation, storage, and distribution enables us to better cope with each building's fluctuating demand throughout the day. This AI also predicts each building's electricity surplus and stores it in the energy storage system or to be used when there is no electricity from solar energy. If each building consumes less electricity than anticipated during the day, the surplus will be sold to other buildings through a smart contract that relies on blockchain technology. This peer-2-peer (P2P) trading eliminates an intermediary and promotes a balance between energy use and storage. Data is shown in real-time, allowing customer (i.e. VISTEC, ERC Sandbox Phase 2) to manage its green energy efficiently.

Source:
https://www.chpp.co.th/en/products-services/renewable-energy

Digital Energy Service

GPSC SIGNS MOU WITH PTT DIGITAL TO EXPLORE THE DEVELOPMENT OF AN ENERGY PLATFORM TO PRODUCE CLEAN ENERGY AND THAT WILL SUPPORT ENERGY TRADING IN THE FUTURE, ENHANCING SUSTAINABLE, CLEAN ENERGY MANAGEMENT.

26 JUL 2023

Energy Platform for Developing Clean Energy through Smart Innovations

Committed to energy business leadership that advocates clean energy and future power trading business models to elevate sustainable clean-energy business management practices, GPSC joined hands with PTT Digital (PTT Group's ICT service provider) in conducting energy platform R&D. Known as GAIA Platform, this technology enables operators to manage and plan energy trading on a real-time basis. The platform can also precisely forecast consumers' application and energy demand through machine learning and AI for maximum efficiency in energy management and planning.

GPSC also applies the platform to support supply & demand planning within the corporation to enable itself to efficiently plan capacity and distribution that are consistent with goals and prevailing power demand. The platform aids in planning and computing areal costs of power plants to enable the most cost-effective generation and distribution. In place is a project example (a solar farm) whose internal management was aided by the platform; this is because project locations do affect costs, which in turn is a function of consumers' distances (from grids).

The GAIA platform is an enterprise software platform developed by PTT Digital to address the issues related to supply chain management by helping firms manage and trade energy in real-time. It also **provides consumer behavior analysis and accurate energy demand forecasting using AI & machine learning – helping firms achieve the highest levels of efficiency through power management and planning**. In addition, GAIA reduces costs, in terms of both time and money, and increases business confidence. GPSC believes digitalizing operations management through the GAIA platform will increase power management efficiency, facilitate smoother and more resilient operations, and increase its competitiveness in the marketplace. Importantly, the platform gives us the ability to introduce future improvements to our renewable energy offerings which will help develop the market.

The partnership between GPSC and PTT Digital will explore how GPSC generates and distributes solar energy by using the GAIA platform. GAIA will also aid GPSC in operations management through supply and demand planning, enabling the power supply to be managed based on total distribution capacity, set limits, or end-user demand. Additionally, GAIA will help 'right-size' solar farms by aligning costs with farm size – ensuring efficient returns on investment. Further, location plays a key role in determining solar farm investment costs – especially the distance to end-users or the grid, and must be carefully managed to ensure efficient energy production and distribution.

Source:
https://www.gpscgroup.com/storage/download/sd-report/20240409-gpsc-sd2023-en.pdf
https://www.gpscgroup.com/en/investor-relations/news/press-releases/1245/gpsc-signs-mou-with-ptt-digital-to-explore-the-development-of-an-energy-platform-to-produce-clean-energy-and-that-will-support-energy-trading-in-the-future-enhancing-sustainable-clean-energy-management
https://gpsc.listedcompany.com/misc/presentation/20230825-gpsc-oppday-2q2023.pdf

System Integrator Service

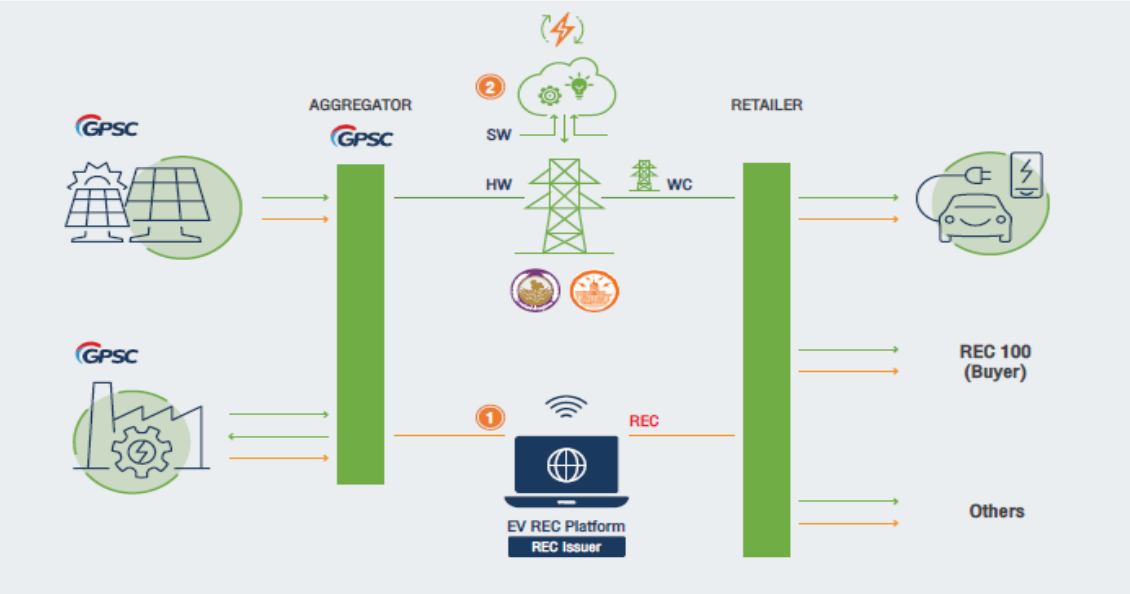
System Integrator Service

System Integrator

Developing the potential of the System Integrator to enable GPSC Group and/or its affiliates to provide a complete range of customer services from project studies, system development and installation of energy storage system for customers.

GPSC Group place importance on system integrator which is a crucial element in the smart energy platform as it interconnects energy component and maximize energy management throughout the system to the next level. The application of system integrator will enable a smoothly energy utilization and enhance energy management efficiency. The system integrator has already been implemented at various sites such as Vidyasirimedhi Institute of Science and Technology (VISTEC) and Suranaree University of Technology.

Decarbonize, promote the use of renewable energy and maintenance services

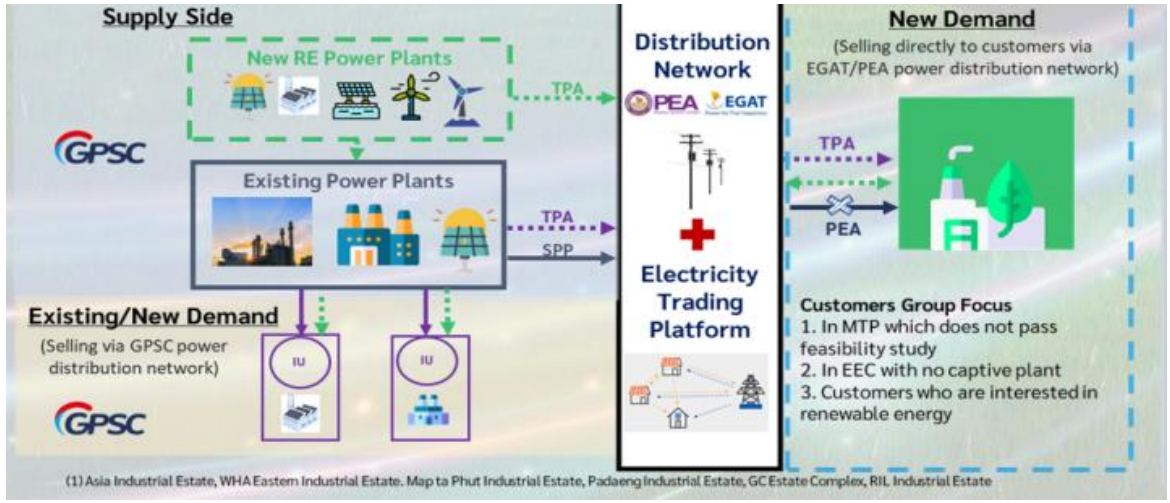


Business Drivers

The rising trend of electricity utilization, particularly from renewable energy sources, has led to a shift in consumer behavior from being a mere consumer to a "prosumer" who both produces and consumes energy. This aligns with the concept of small decentralized power generation (decentralization) and the integration of digital platforms in energy management (digitalization), both of which serve as important drivers that can increase market opportunities and generate new income in order to elevate energy innovation and accommodate future energy consumption patterns.

Three projects were conducted to study energy management innovations as part of **the ERC Sandbox** Phase 2 for future business expansion.

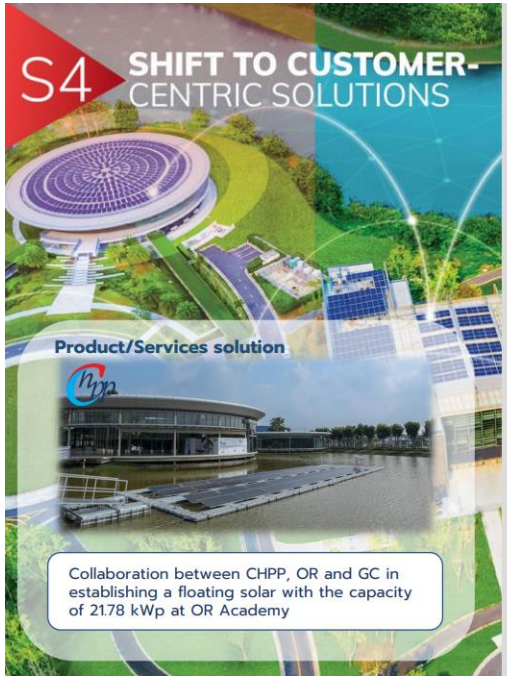
GPSC collaborated with suppliers and partners to study and develop **a new smart energy** consumption business model.

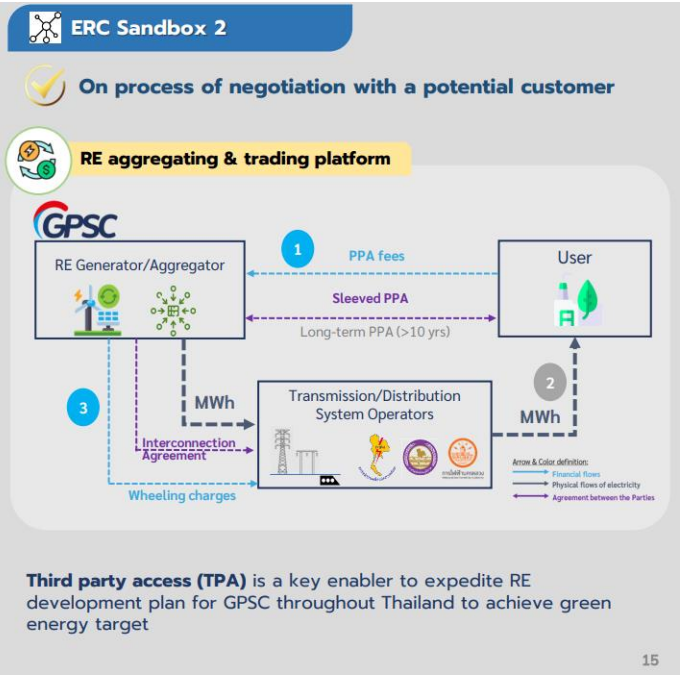


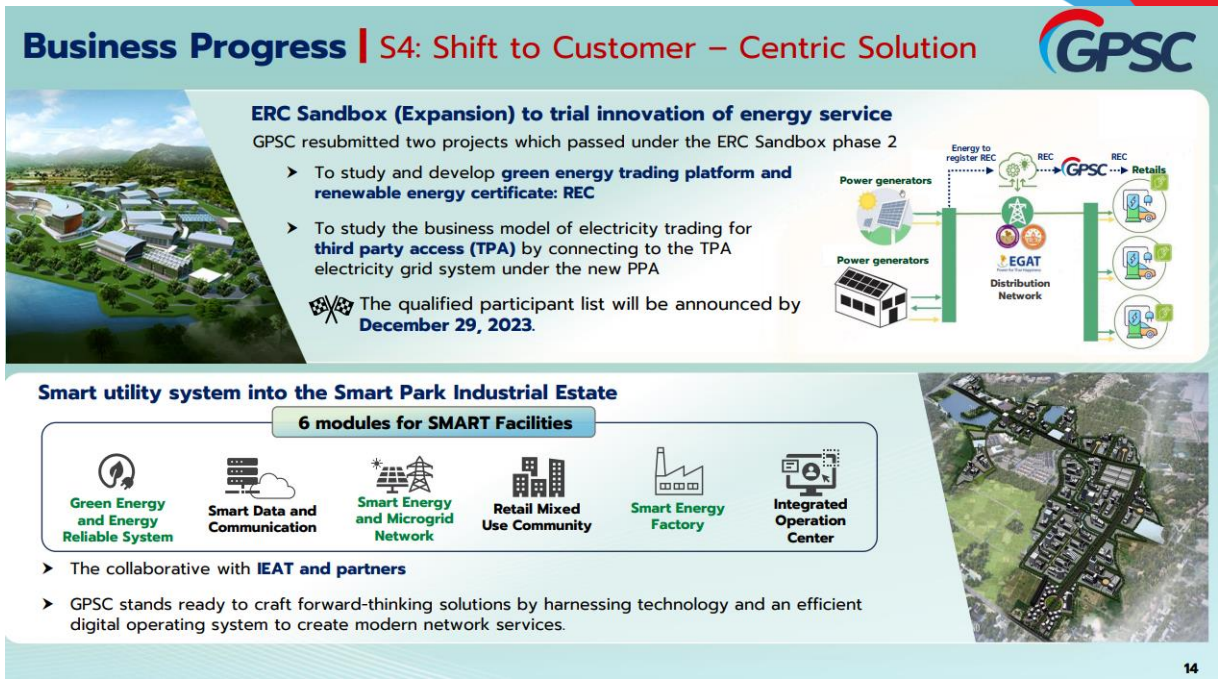
In response to changes in energy consumption trends and innovations, GPSC is committed to developing new electric business models, elevate energy innovations of the future to offer more alternatives to power users, as well as enhance efficiency and reduce production costs through **energy management** collaboration with various organizations with the goal of meeting evolving needs and contributing to the GHG reduction targets of energy users. GPSC has conducted a feasibility study on the use of new forms of energy as part of the ERC Sandbox Phase 2, in which **energy service innovations and technologies** are tested, in collaboration with its suppliers and business partners in order to study and develop new energy business models, products, devices, and services with the goal of applying them in practice.

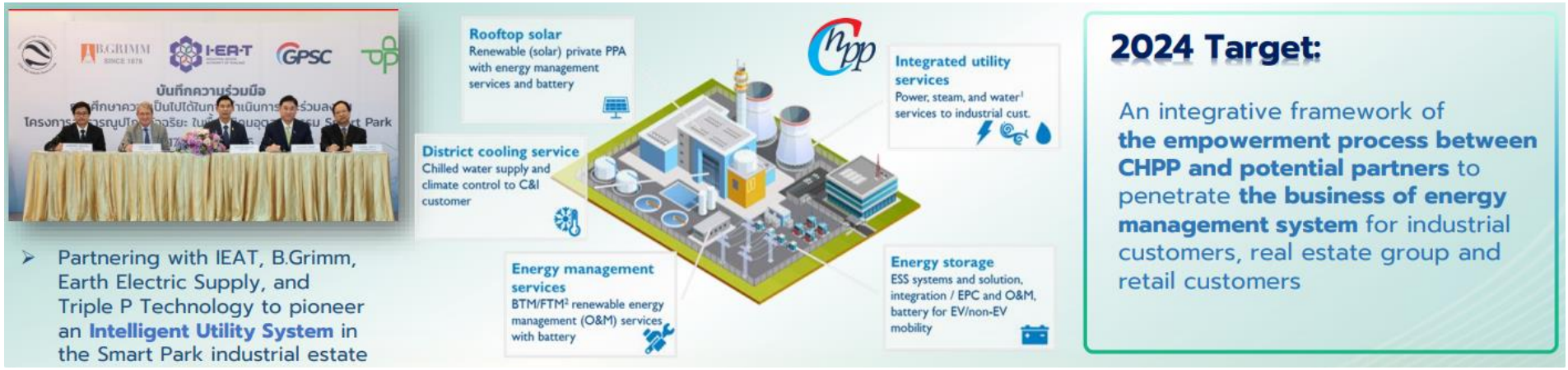
Source:
https://www.gpscgroup.com/storage/download/sd-report/gpsc-sd2022-en.pdf
https://gpsc.listedcompany.com/misc/presentation/20230221-gpsc-am4q2022.pdf

Decarbonize, promote the use of renewable energy and maintenance services









Source:
https://gpsc.listedcompany.com/misc/presentation/20230825-gpsc-oppday-2q2023.pdf
https://gpsc.listedcompany.com/misc/presentation/20231124-gpsc-oppday-3q2023.pdf
https://gpsc.listedcompany.com/misc/presentation/20240229-gpsc-oppday-4q2023.pdf

Decarbonize, promote the use of renewable energy and maintenance services

Decarbonize, promote the use of renewable energy and maintenance services

GPSC Group provides service to decarbonize and promote the use of Renewable energy sources for customers that shift energy usage patterns towards more environmentally friendly products, such as solar, wind, water or biomass, which are all able to reduce the carbon footprint caused by fossil fuels. In addition, GPSC Group provides maintenance service for solar energy power plants through Global Renewable Power Co., Ltd. (GRP) where GRP has invested by 100% in 4 companies; Global Renewable Power Operating Co., Ltd. N.P.S. Star Group Co., Ltd., World Exchange Asia Co., Ltd. and P.P. Solar Co., Ltd., which operate the solar farm management and maintenance business (Operation and Maintenance), together with 9 solar farm projects, with the total production capacity of 39.5 MW, located in 4 provinces; Lopburi, Suphanburi, Pichit and Khonkaen. Currently, the electricity generated is distributed into PEA's system over a 25-year PPA. The PPA can be classified into an adder-type, at the rate of 8 Baht per unit (for the first 10 years of the agreement) for 3.6 MW, and the feed-in tariff (FiT)-type at the rate of 5.66 Baht per unit for 35.9 MW. All of the power plants have commenced commercial operations since 2014-2015.

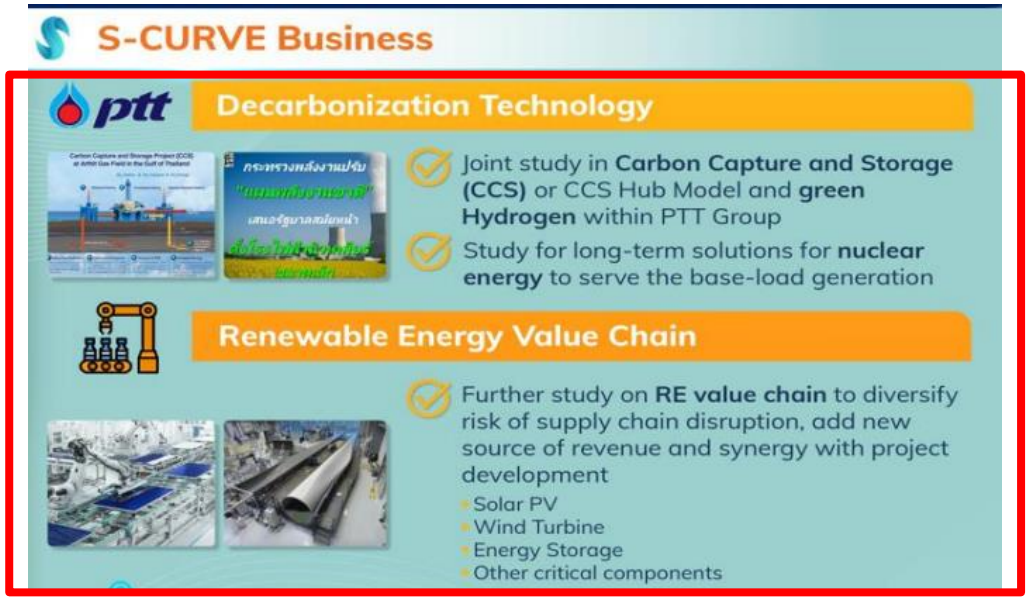
Source:
GPSC Annual Report 2020, page 53

Developing the CCS technology and clean energy toward Decarbonization and large commercial scale

2 Jun 22, PTT Group Study CCS Hub Model Technology Prototyping for Net Zero Goals To drive GPSC's Net Zero GHG Emission Target

- The cooperation is an important step for GPSC to jointly study the application of Carbon Dioxide Capture and Storage Technology (CCS), which is one of the technologies to reduce greenhouse gas emissions.
- This development will be able to be used in a large commercial scale to drive the organization and Thailand to achieve concrete goals of Carbon Neutrality and Net Zero Emission.

As of current, both PTT Group and GPSC are actively driving the adoption of emerging technologies such as CCUS, green hydrogen, and nuclear energy to facilitate the transition of the energy sector towards decarbonization on a large scale. This includes collaboration with industries such as Meranti to supply green hydrogen for steel production, showcasing a commitment to green and sustainable energy solutions.



Source:
https://gpsc.listedcompany.com/misc/presentation/20230221-gpsc-am4q2022.pdf
https://gpsc.listedcompany.com/misc/presentation/20220809-gpsc-performance-result-2q2022.pdf
https://gpsc.listedcompany.com/misc/presentation/20230825-gpsc-oppday-2q2023.pdf

THANK YOU