Enhancing Potential of Hydro-Floating Solar Hybrid

Mr. Chatchai Mawong

Director - Hydro and Renewable Energy Power Plant Development Division

Electricity Generating Authority of Thailand (EGAT)

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EGAT Business

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Generation

To generate electricity by more than 52 power plants located in different parts of the country.

Installed Generating Capacity
16,037.32 MW

Transmission

To solely operate the transmission system. (Main voltage levels 500, 230 and 115 kV.)

Transmission Line Length
37,083.916 Circuit-Kilometers

Power Purchase

To purchase bulk electricity from IPPs and SPPs and from neighboring countries, i.e. Lao PDR and Malaysia.

Contract Capacity
29,443.05 MW

Affiliates

To invest in electricity generation and energy-related businesses in the following 5 affiliates.

EGAT's Investment
34,290.40 Million Baht

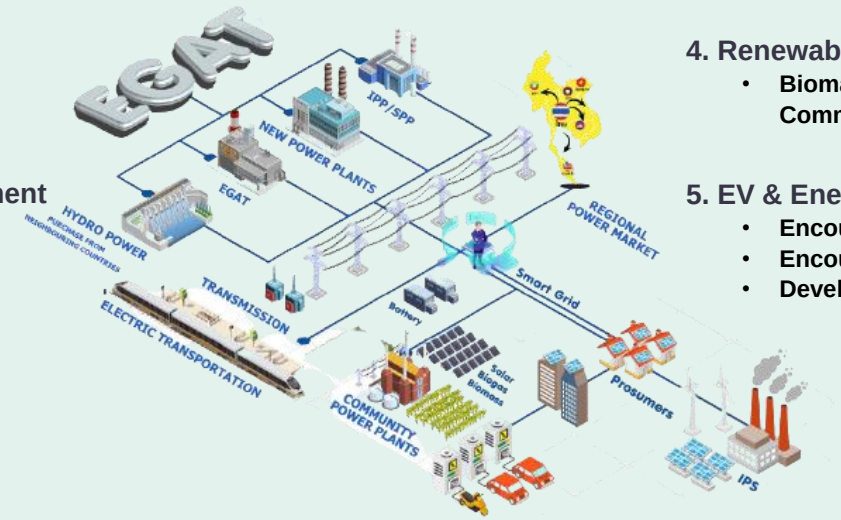
EGAT International · RATCH GROUP · EGCO GROUP · DCAP

EGAT Transformation Roadmap

1. Power System Security
- Natural Gas / Clean Coal
- Flexible Power Plants

2. Transmission System Development
- 230/500 kV
- Energy Trading
- Energy Storage

3. Smart Grid
- RE Control Center
- National Trading Platform



4. Renewable Energy
- Biomass / Biogas / Solar Community Power Plants

5. EV & Energy Storage
- Encourage-Suggest to Prosumers / IPS
- Encourage-Develop EV Charging Station
- Develop Energy Storage System: ESS

Ref. EGAT Annual Report 2020

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Thailand Power Development Plan

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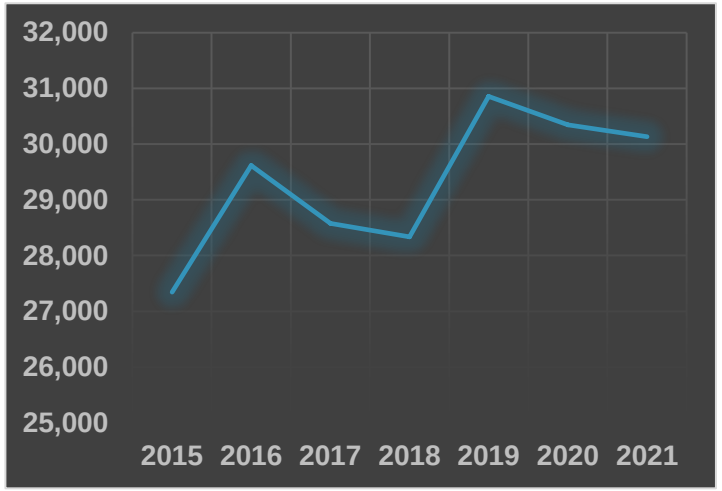
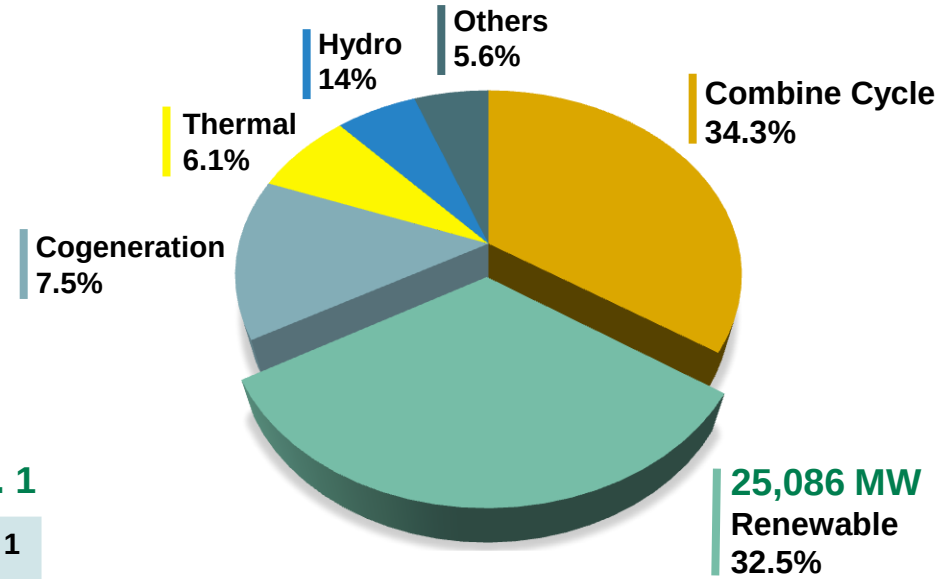
Thailand Peak Demand (2015-2021)



On April 3, 2021, 21.03 p.m., the overall peak demand of power system was 30,135.30 MW

Renewable Energy
More than 30% in 2037

Generation By Power Plant Types PDP 2018 Rev. 1



New RE capacity added in PDP 2018 Rev. 1

Renewable Energy Plan	PDP 2018 Revision 1 (2018-2037)
Biomass	2,780
Biogas	400
Solar	8,740
Wind	1,485
Waste	44
Hydro-Floating Solar (EGAT)	**2,725**
Small Hydro (EGAT)	69
Government's Policy and Community Power Plant	2,453
Total	**18,969 MW**

Total Capacity

77,211 MW

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EGAT's Potential Development

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Hybrid Projects

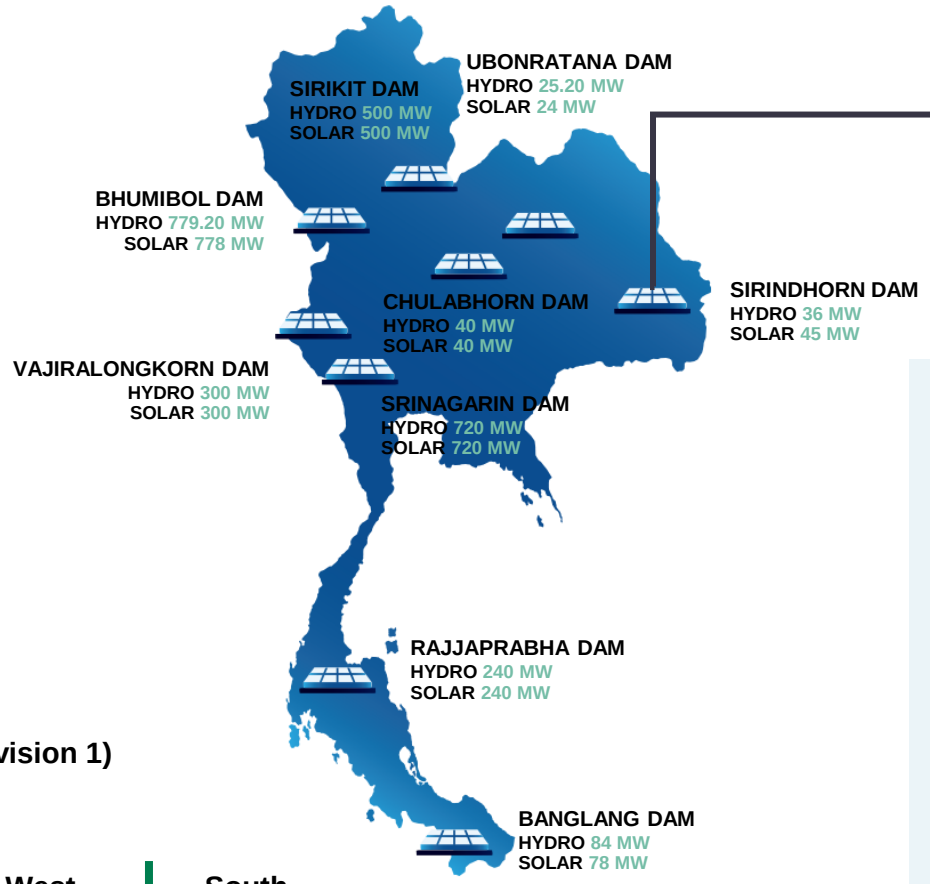
16 Projects

In 9 EGAT's Multipurpose Dams

2,725 MW

During 2018-2037 (PDP 2018 Revision 1)

North	Northeast	West	South
1,278 MW	109 MW	1,020 MW	318 MW

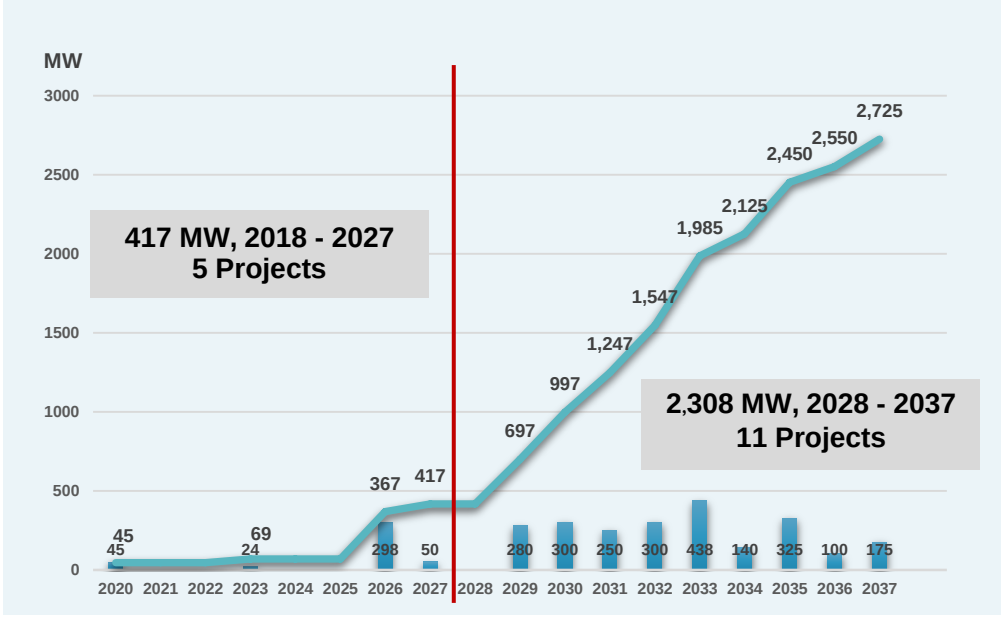


1st Pilot Project

SIRINDHORN DAM

- Hydro-Floating Solar Hybrid
- Flexible Generation by EMS
- 115 kV Substation (Existing)

MW of Hydro-Floating Solar Hybrid Projects (2018-2037)



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Development Guidelines

Cost

Enable Cost Reduction

- **Utilize unused space**
- **Utilize existing facilities**
- **Achieve economy of scale**

Technology

Enhance Generation Efficiency

- **Implement concept of Integrated Renewable Firm Power System (IRFPS) with smart technologies**
- Increase flexibility of RE with hybrid system + EMS
- Enhance stability of hybrid generation with technologies
- Enable security of RE in the nation with RECC + AI

Social & Environment

Value Environment and Community Concerns

- **Use eco-friendly materials**
- **Conduct real-time monitoring**
- **Improve community's quality of life with "New Landmark"**

Integrated Renewable Firm Power System (IRFPS)

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Flexibility

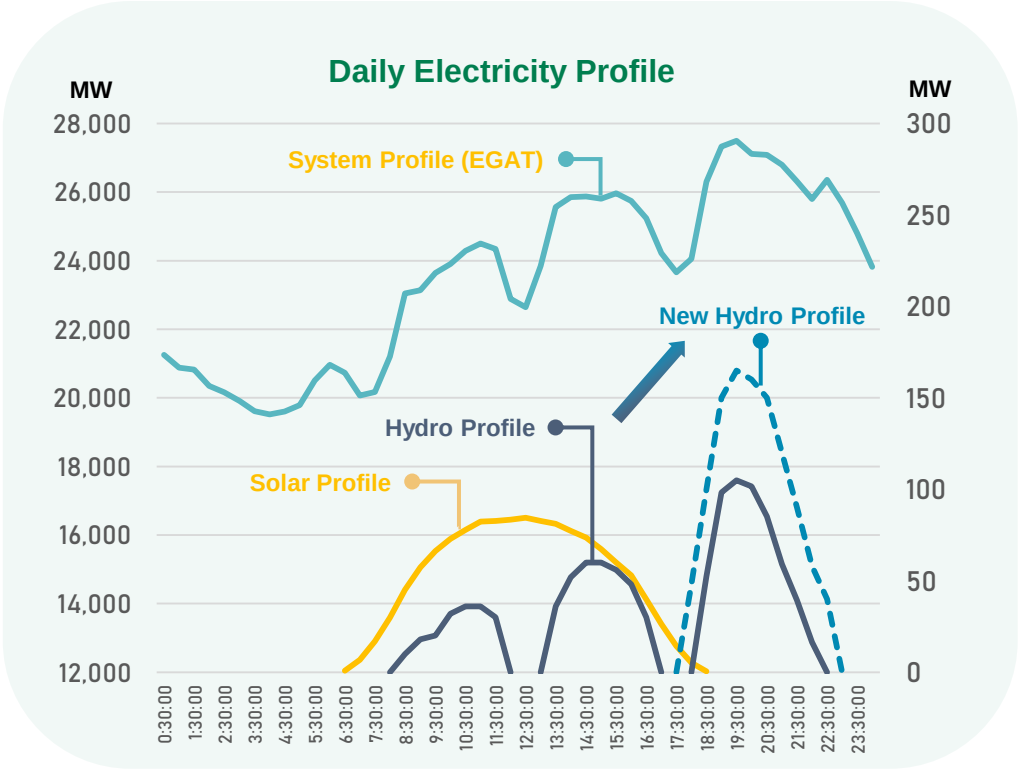
- Create hybrid power system to increase flexibility of renewable energy.

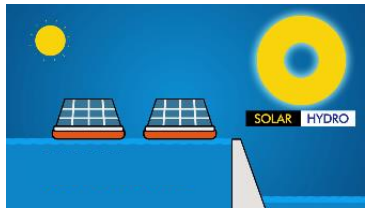
Stability

- Use smart technologies such as energy storage systems to enhance the hybrid system in providing more power and a longer supply.

Security

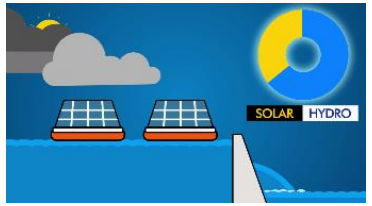
- Establish data center with AI integration to control all RE power plants across the country with one platform.





Daytime
Generate solar power in the daytime

Nighttime
Reserve hydropower in the nighttime



Anytime
Optimize energy at any time

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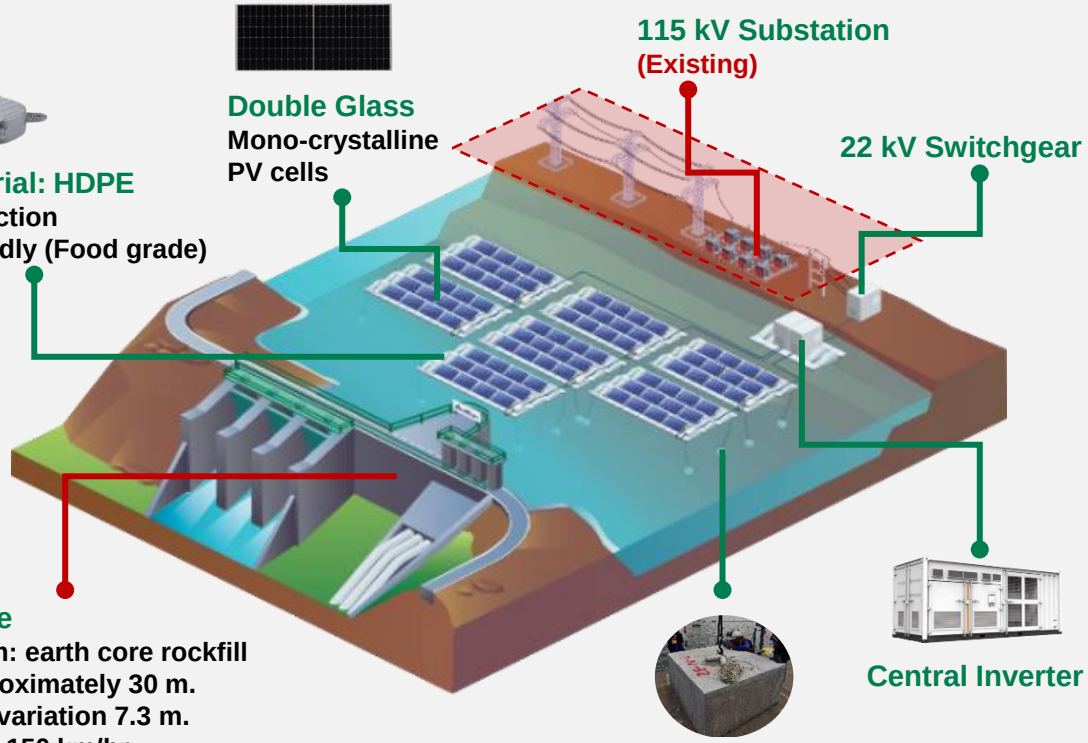
Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

Project Profile

Capacity : 58.5 MWp (45 MWac)
Location : SIRINDHORN DAM, UBON RATCHATHANI
Installed Area : 1,216,000 sq.m. (450 RAI)
% Water Surface Area : 0.27%
Grid-Connection : EGAT System
Cost : 842 MB (EPC Only)
COD : 2021

Main Equipment



Dam Profile
Type of Dam: earth core rockfill
Depth: approximately 30 m.
Water level variation 7.3 m.
Wind speed 150 km/hr.

Mooring System
- **Bottom mooring with deadweight concrete**
- **Stainless steel rope**

Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

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Mooring System

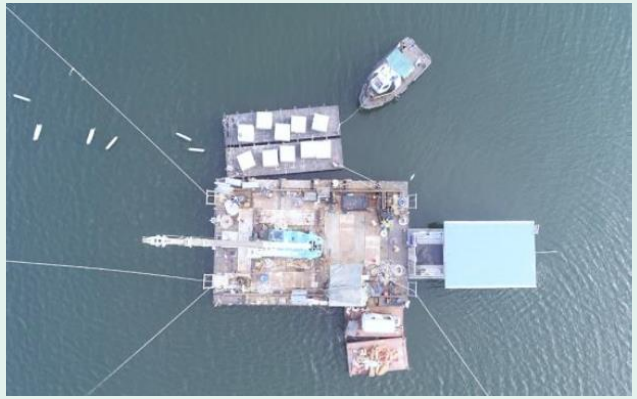
1 Pouring cement into a mold to form a deadweight concrete

2 Moving deadweight concrete to the storage area

3 Loading deadweight concrete onto the transport barge

4 Using a crane to lift the deadweight concrete to the main barge

5 Using the anchor winch to adjust the position of the main barge



6 Setting the location for dropping deadweight concrete with RTK-GPS

Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

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PV Floating system

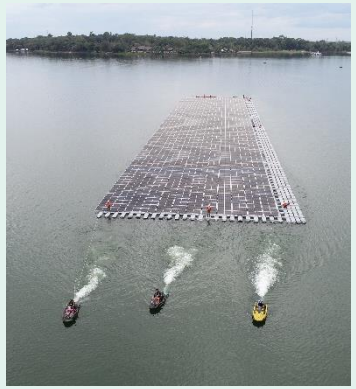
1 **Preparing an assembly platform**

2 **Assembling floats and PV Modules on the platform**

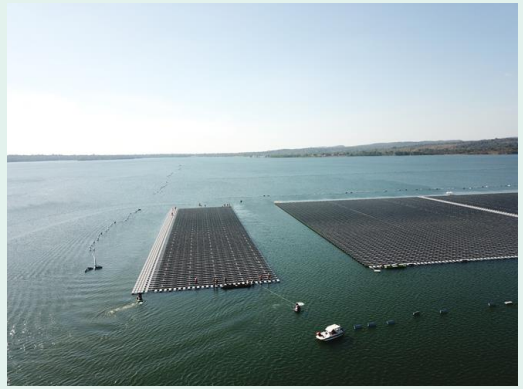
Process

- Square Array Assembly
- Floating Body Splicing
- Rod Connection
- PV Module Installation
- Installation of Cable Floating Plate, Anchoring Truss, Cable Bracket, Combiner Box Bracket

3 **Moving the PV floating array to the installation area**



4 **Connecting the PV floating arrays together and securing to the mooring system**



Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

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Test and Commissioning

Test Item (Individual)

Onshore	Offshore
1. Auxiliary Transformer 50 kVA	1. PV Transformer
2. Main Equipment (SWGR)	2. Aux Transformer 5 kVA
3. Auxiliary System	3. RMU
4. Metering Equipment	4. PV Panel I-V Curve
5. Relay and Protection	5. PV Ground System
6. 22kV AC Cable (Power Cable Outgoing Feeder)	6. PV Cable (Solar Cable)
7. Function Test for SWGR	7. Fiber Optic Cable
8. Grounding System	8. DC Cable
9. Wet Test for Aux System	9. AC Cable on Floater Boat
10. AC Withstand SWGR 22 kV	10. Inverter
11. RTU & SCADA Simulate Test	11. Cable Link Box
	12. Fiber Optic Cable
	13. 22 kV Underwater Cable

1st Energization

- Commissioning
- 1st Synchronization
- Functional Test
- Performance Test

COD

Main Equipment (SWGR)

Aux Transformer 5 kVA

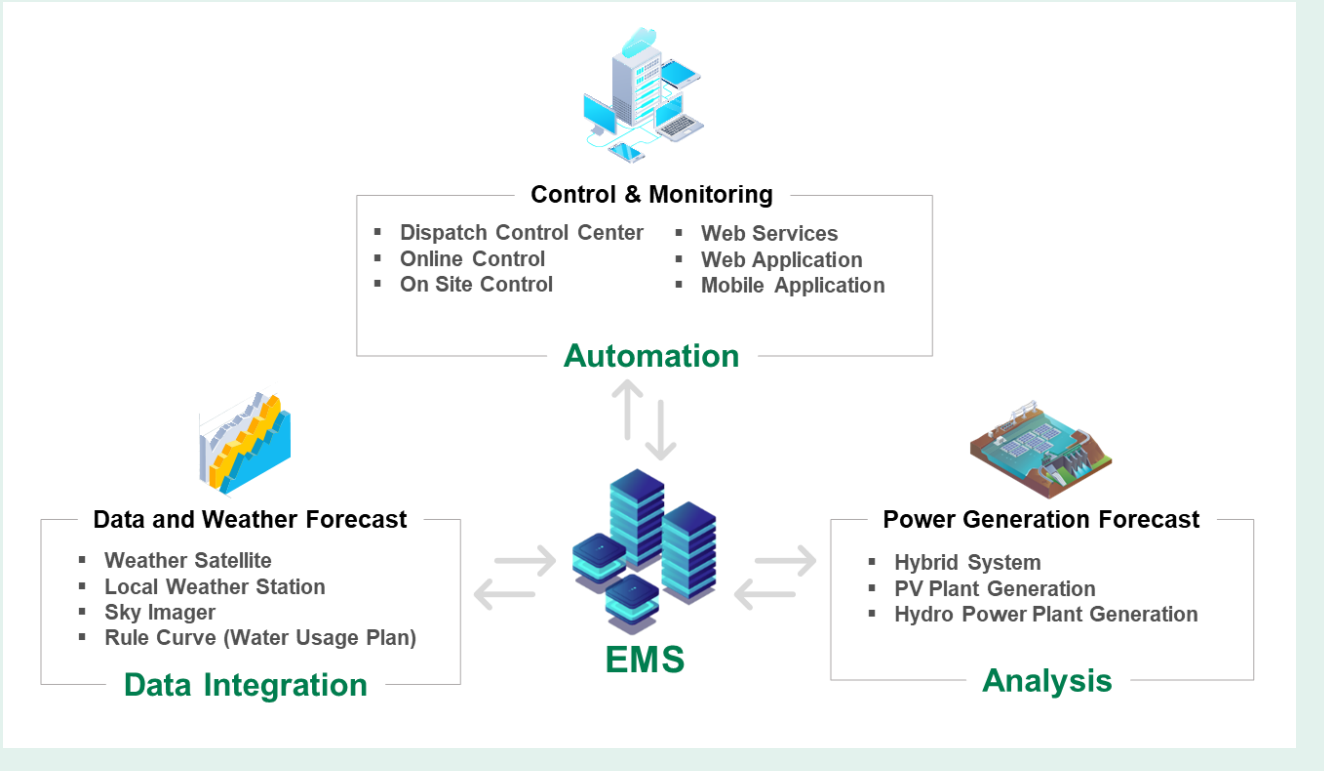
Inverter

Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

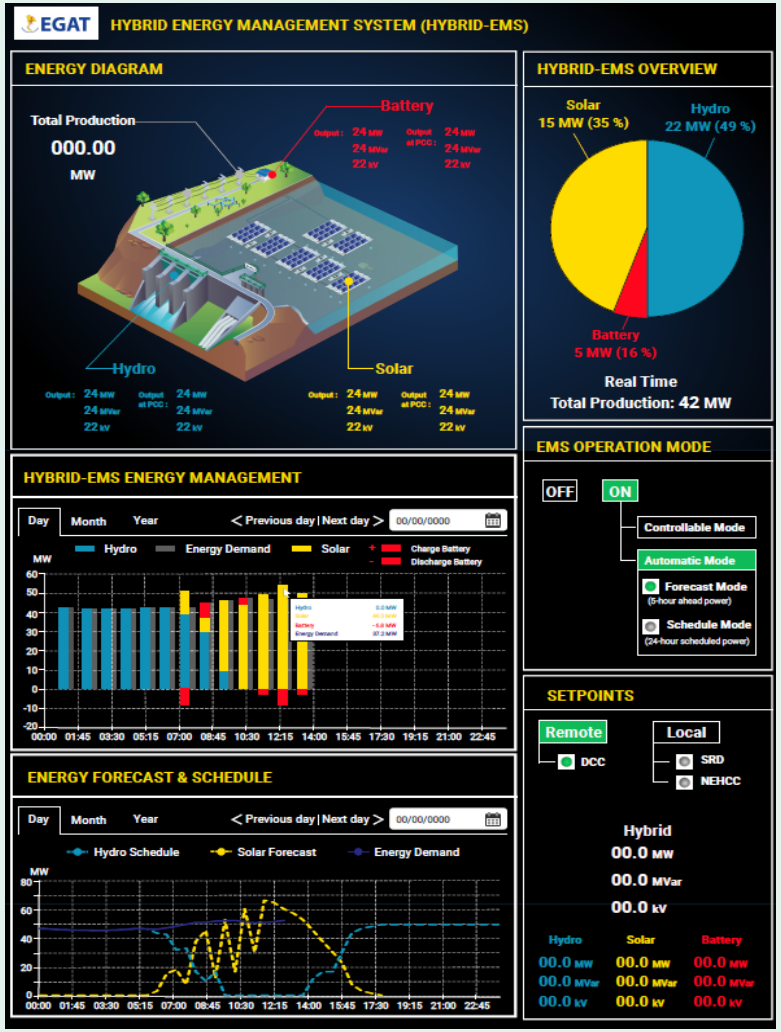
Energy Management System (EMS)

Energy Management System (EMS) is the smart technology integrated with weather forecast information to control, monitor and optimize the performance of hybrid generation.

Concept



Hybrid EMS Dashboard



Pilot Project: Hydro-Floating Solar Hybrid at Sirindhorn Dam

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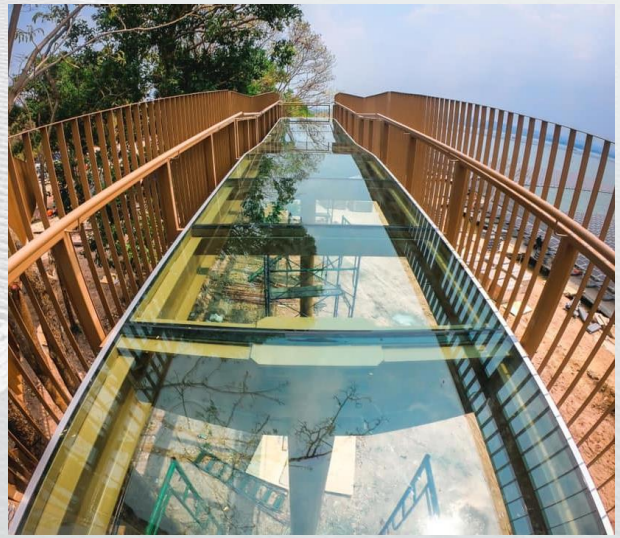
Benefits

- More firm green energy
- Improve quality of community's life
- Stimulate local economy with new landmark
- Reduce CO2 (0.546 tons/1,000 kWh)
- Reduce water evaporation (10,222 m3/yr./MW)



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Thank You

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