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HỆ THỐNG AN TOÀN – THỊ TRƯỜNG MINH BẠCH

VIETNAM'S RENEWABLES REVOLUTION:

Solutions with Satellite image, Forecasting combination, and AGC

BA HOAI NGUYEN

Deputy Manager of Renewable Energy Management Department

National Power System and Market Operator Company (NSMO)

(+84) 90 2277793

hoainb@nsmo.vn

Background

Mr. Nguyen Ba Hoai has been working for the National Power System and Market Operator (NSMO, formerly EVNNLDC) for more than 10 years. He is currently the Deputy Manager (in charge) of the Renewable Energy Management Department. He received both his Bachelor's and Master's degrees in Electrical Power System from Universiti Tenaga Nasional (UNITEN), Malaysia. His responsibilities include the application of science and technology in developing tools for renewable energy operations, such as monitoring, forecasting, and management renewable energy. He also serves as the key focal point for international cooperation with other system operators around the world. Prior to this role, he gained extensive experience in the field of SCADA/EMS, particularly with AGC and state estimation.

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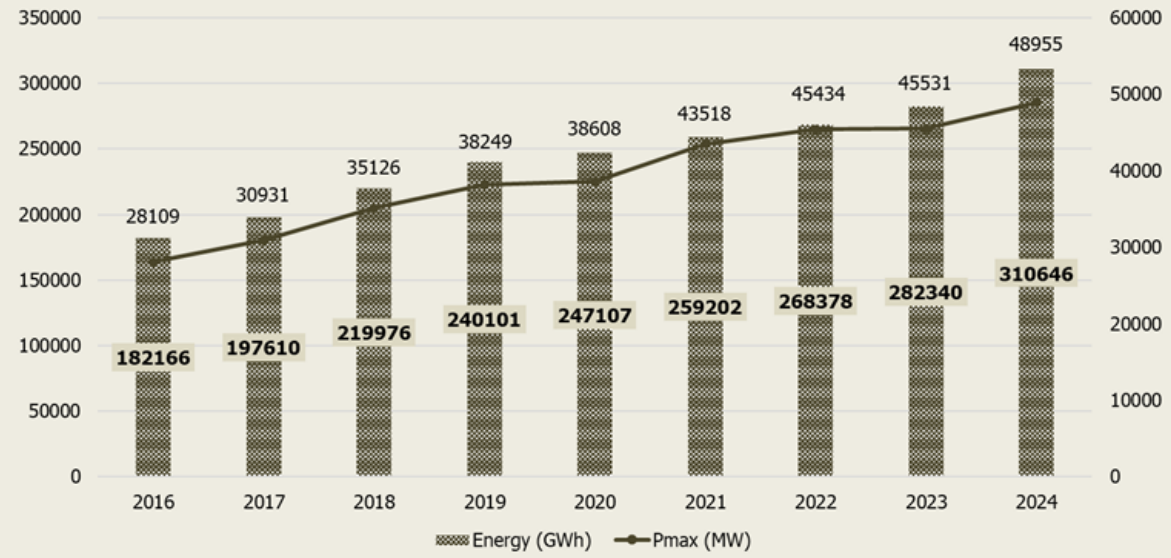
Overview of Vietnamese Power System and Renewable Energy Development

Electricity Demand Development in Vietnam

ELECTRICITY DEMAND



310,646 GWh
Energy consumption 2024

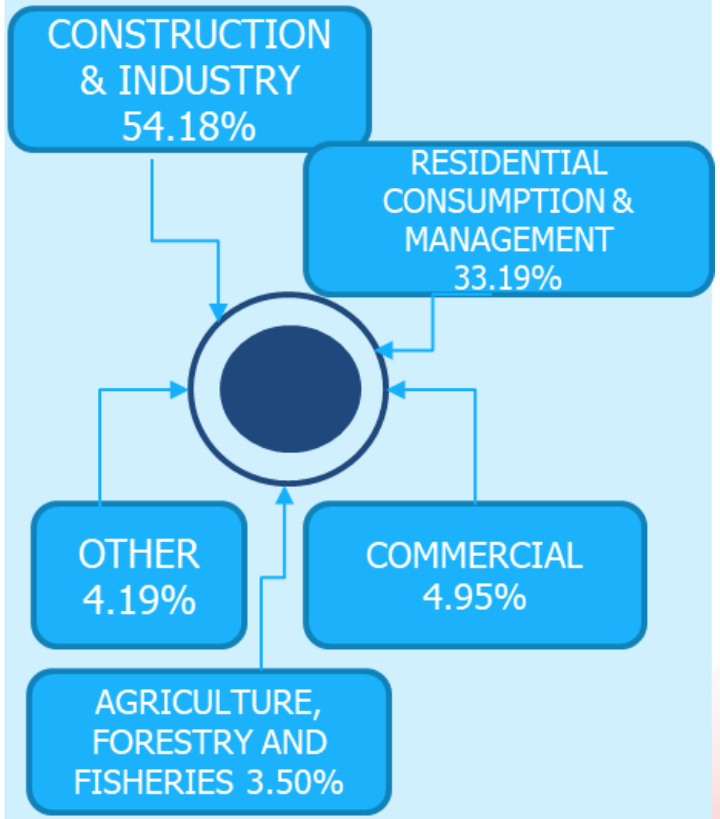
48,955 MW
Pmax 2024

AVERAGE GROWTH 2016-2024

6.4%/year Energy growth

7.3%/year Pmax growth

BY CATEGORY



Renewable Energy in Vietnam

Wind Farm:	**5,106 MW**
Solar Farm:	**8,974 MW**
Rooftop Solar:	**7,660 MW**
Small Hydro:	**5,927 MW**
Biomass:	**439 MW**

Total Installed Capacity (Renewable Energy) **28,319 MW** (~34%)

Rapid capacity growth in a **short time (03 years: 2019-2021)**, **concentrated** in **specific regions**

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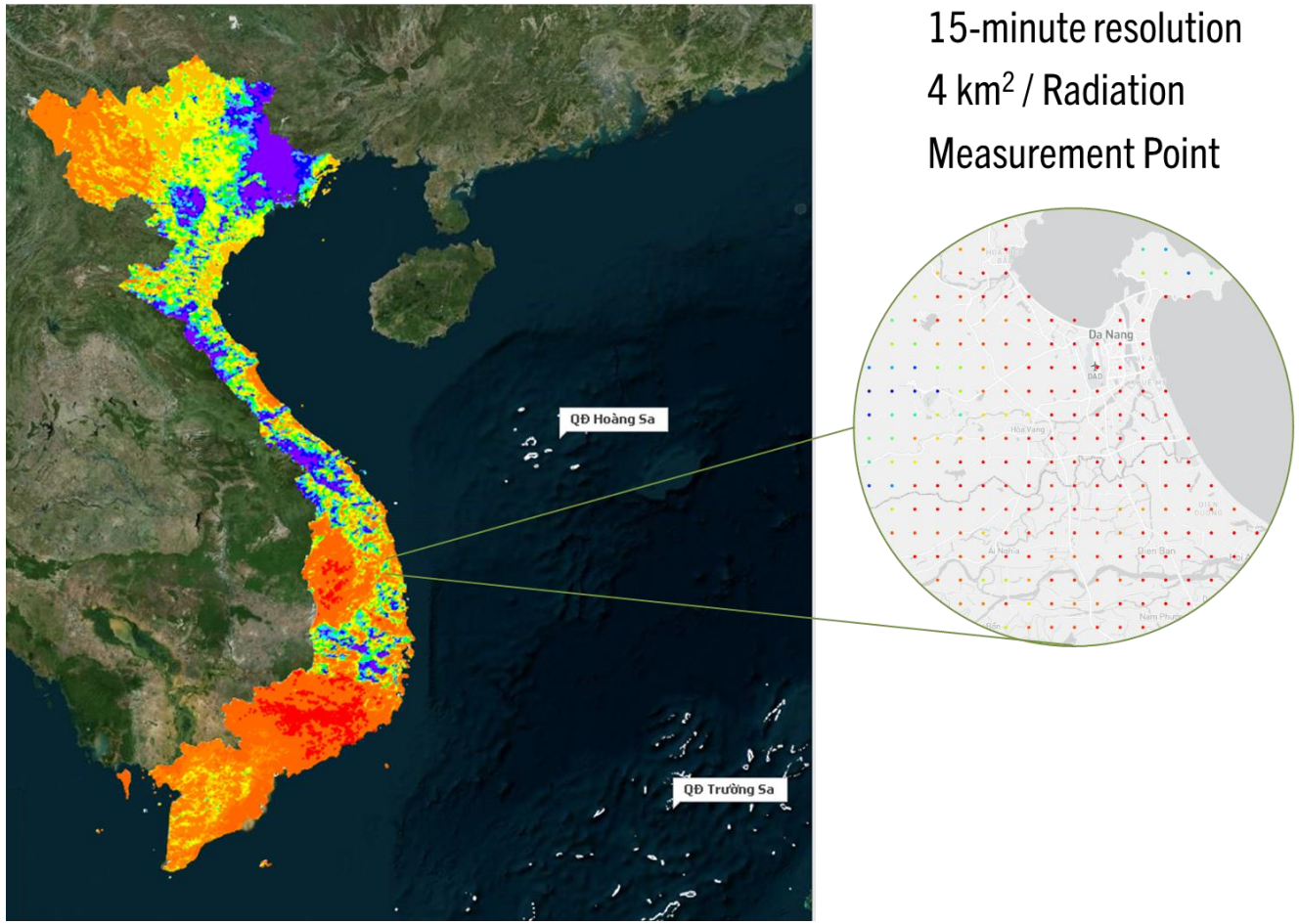
NSMO’s solutions in Renewables Operation

- Satellite Image
- Forecasting Combination
- AGC

Solar Rooftop - Satellite Image Data

Near-real-time Solar Irradiation Map



15-minute resolution

4 km^2 / Radiation Measurement Point

SCALE

Estimation of Rooftop PV Generation for All 110kV Substation in Whole Country

INPUT DATA

Rooftop Solar Installed Capacity

Inverter Characteristics

Satellite Irradiation Data

RESULTS

MW and Energy of Solar Rooftop in Vietnam

Solar Rooftop - Satellite Image Data

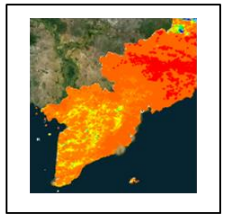
Estimation of Rooftop PV generation

Himawari-9 Satellite image

- Resolution of 10 minutes per image
- Spatial resolution of 2 - 5km
- 5 observation zones providing up to global coverage
- 16 image channels
- Real-time updates

Server Provider (Domestic)

- Receiving satellite image with ~30min delay
- Calculation of solar irradiance parameters from satellite image, applying specialized models and modules
- Assessment of atmospheric reflectivity and cloud index available



Solar irradiance data for the whole territory of Vietnam

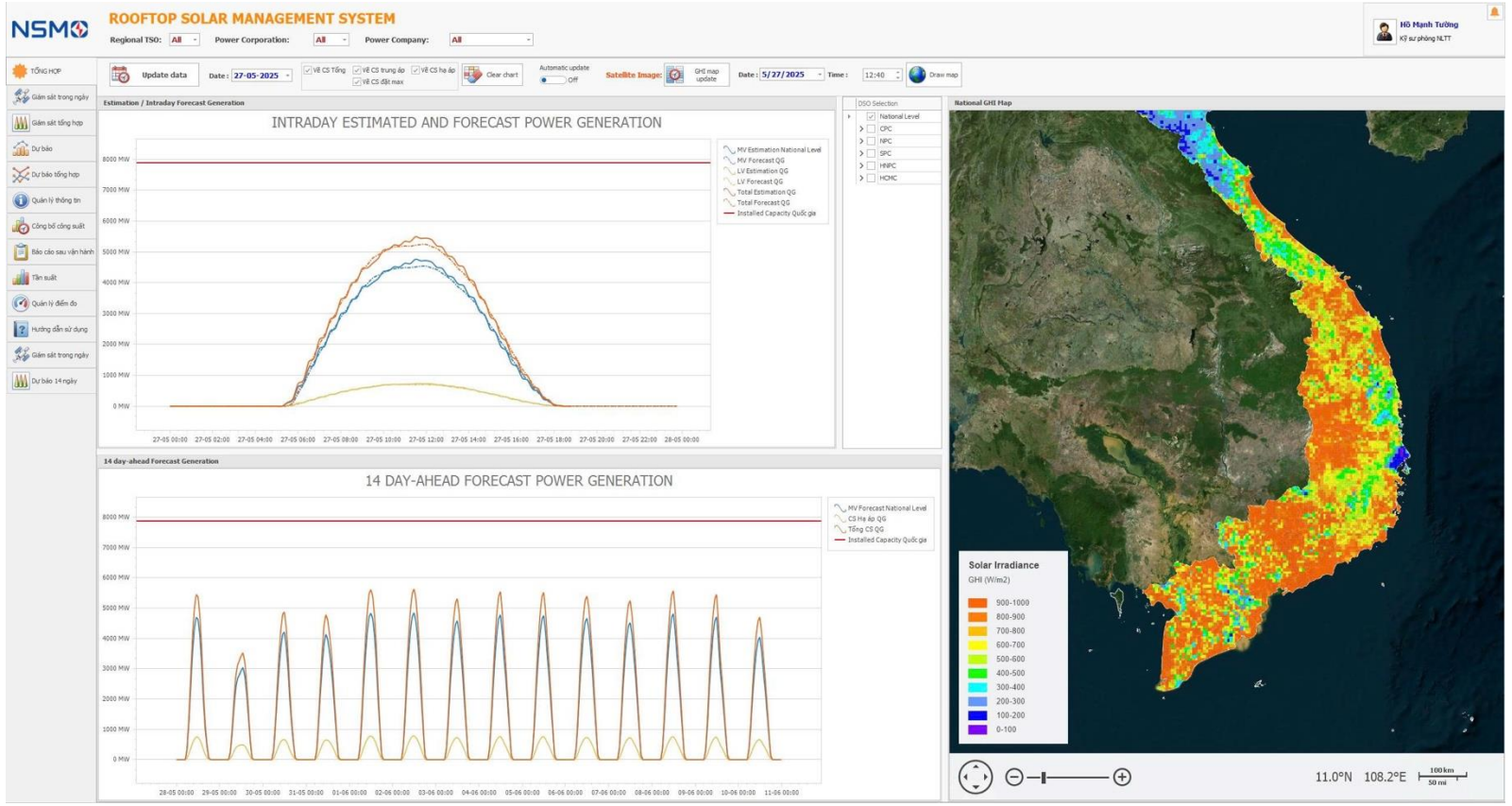
- Stored on FTP server
- Each point simulates an area of 4km2
- Standardized irradiance for each district, ward
- Delay compared to real-time: 40 - 60min

Solar Rooftop monitoring capacity

- Details to each and every 110kV substation of provincial Power Companies, for 2 levels of Medium and Low Voltage connection
- Resolution 15 minutes
- Minimum update frequency: 5 minutes

Solar Rooftop - Satellite Image Data

Rooftop solar management tool



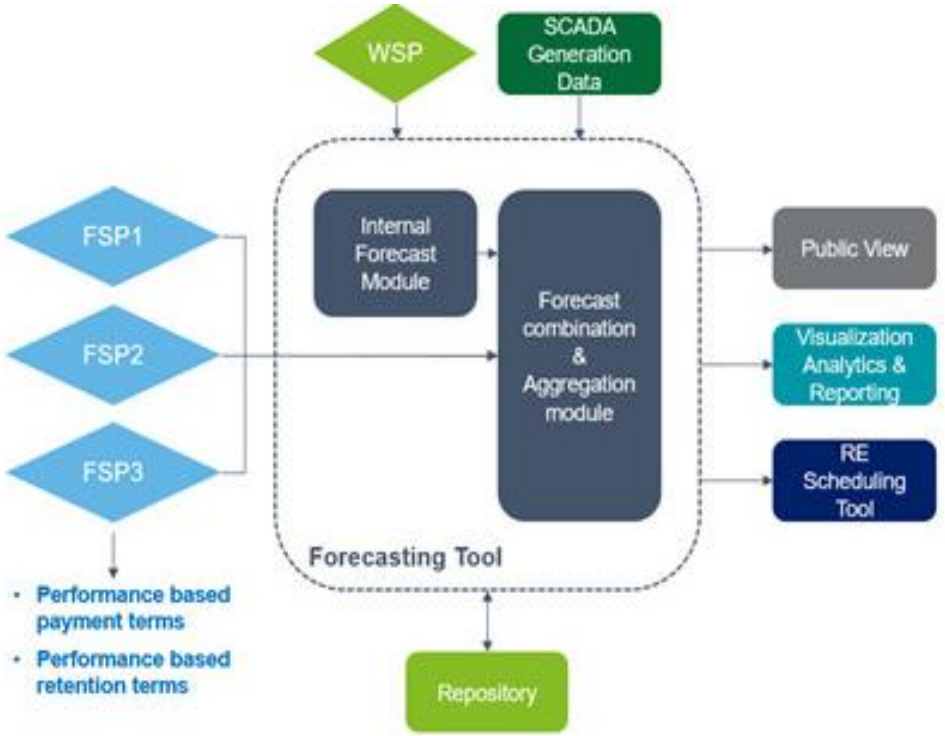
2x2km resolution irradiance

> 800 110kV Substations (for Whole Country)

40-60 minutes
Near-real-time

Forecasting Combination for Utility-scale RE Power Plants

Vietnam Forecasting Model



Forecasting Sources

- Third party supplier 1
- Third party supplier 2
- Power plants forecast
- In-house forecasting

Forecast resolution: **30** min → **15** min

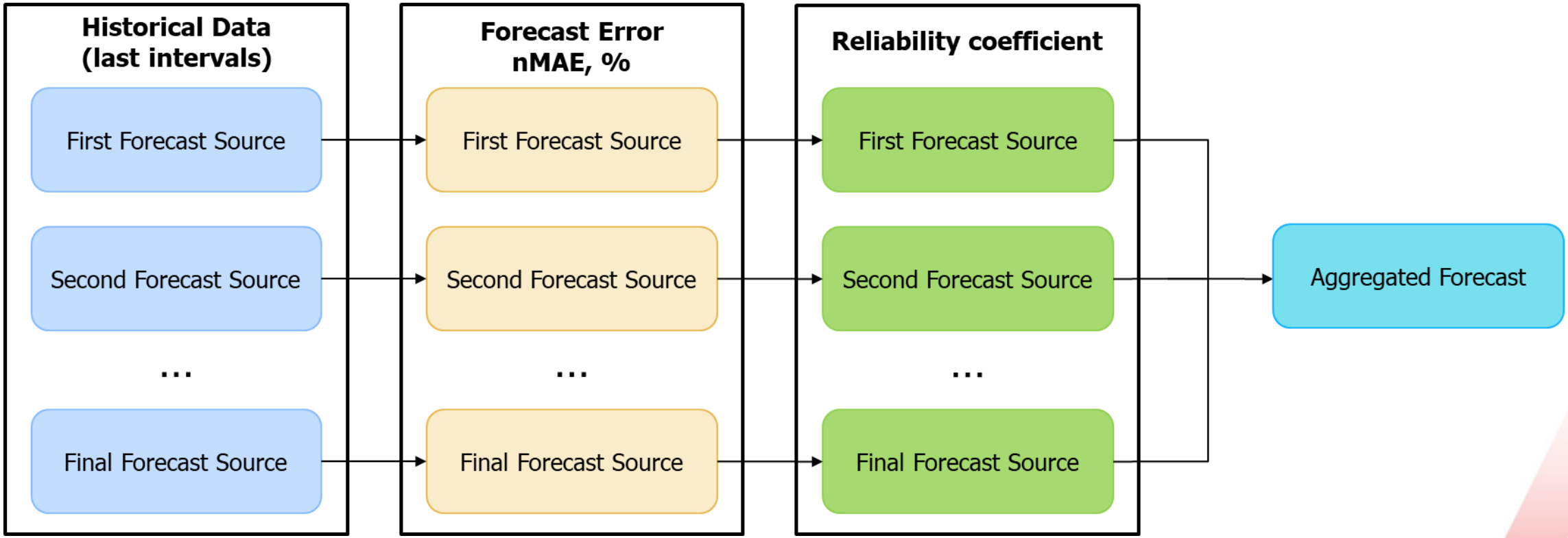
Forecasting Combination for Utility-scale RE Power Plants

Forecasting combination algorithm

Real-time running

Tool for RE Operator

Accuracy Improvement



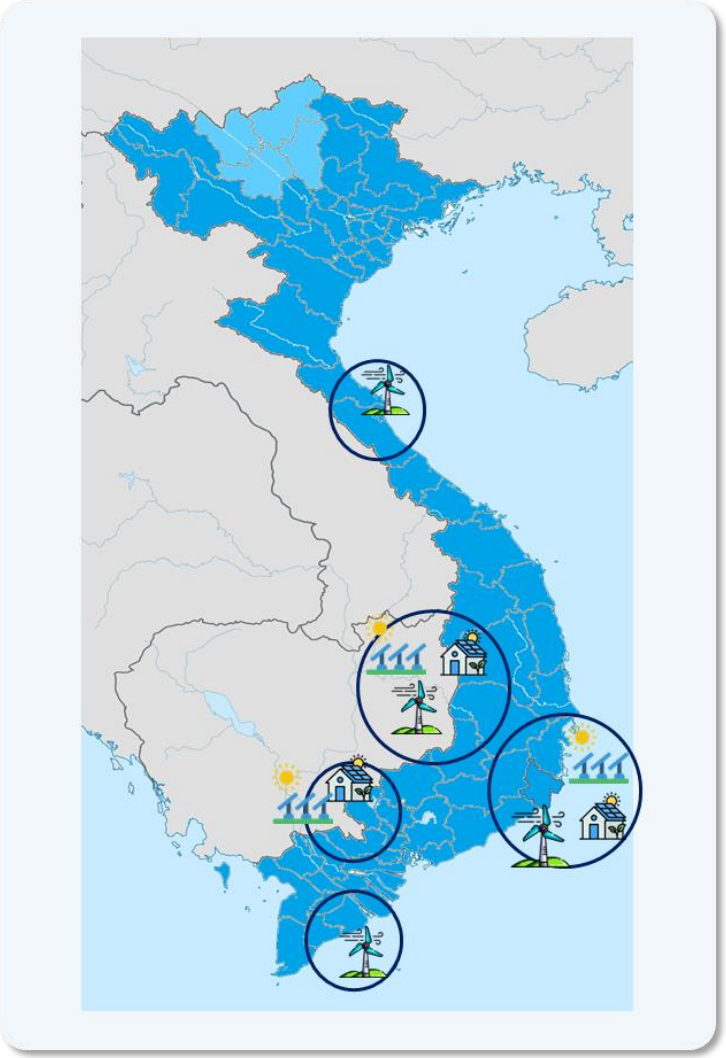
$$nMAE = \sum_{i=1}^{n} \frac{|F_i - A_i|}{P_{installed\_capacity}}$$

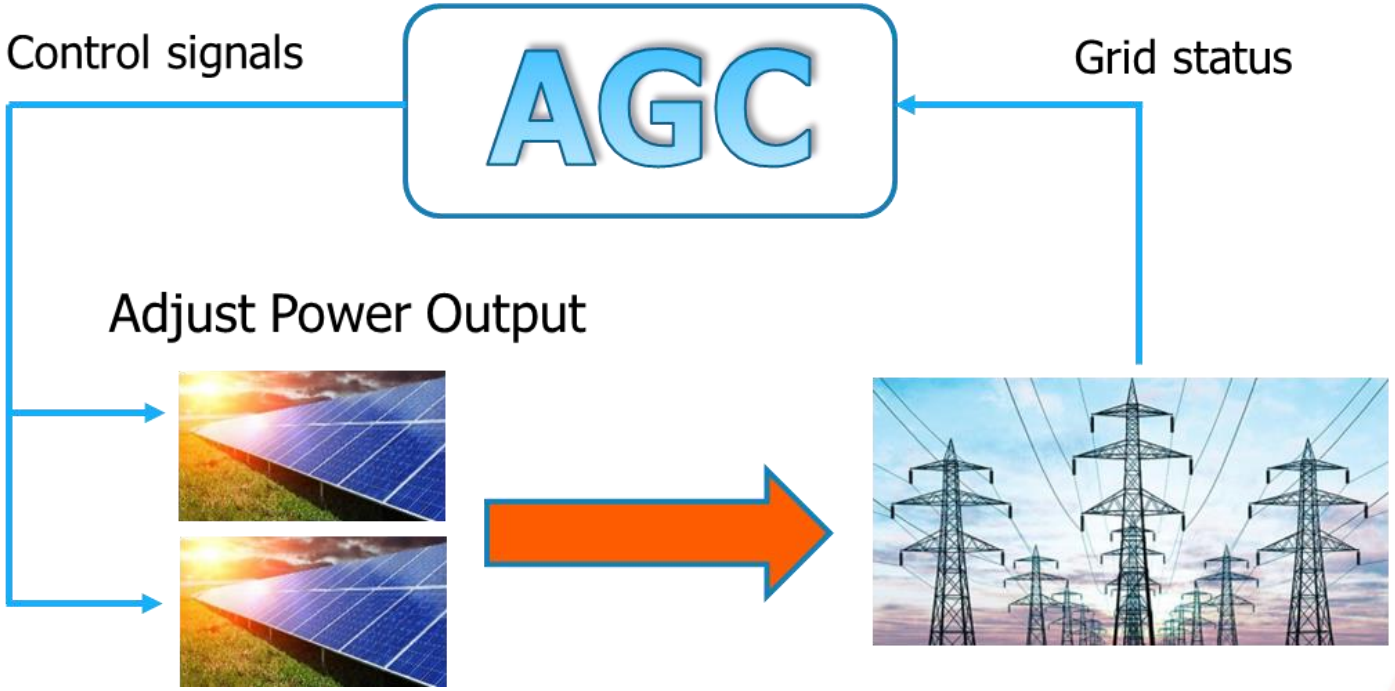
F_i: Forecast values

A_i: Actual values

Grid Overload – Automatic Generation Control

Online control RE plant





Grid Overload – Automatic Generation Control

Online control RE plant

L10	276NP2-276TNam	To Bus	232.2	59.9	19.2	163.3	153.1	944.1	ON
			230.6	-59.4	-22.2	153.1			
L11	172PNinh-178HSa	From...	114.7	3.9	4.9	33.0	33.0	666.3	ON
			114.3	-3.6	-4.4	26.0			
L12	172CLam-172BDC	To Bus	113.1	-1.5	1.8	0.0	15.2	494.7	ON
			112.7	1.3	-2.8	16.6			
L13	272DTrong-276DL	From...	231.5	127.4	-11.8	314.6	314.6	489.9	OFF
			0.0	0.0	0.0	0.0			
L14	172DNai-175TC2	From...	114.7	-32.8	-3.6	168.2	168.2	445.0	OFF
			116.1	33.1	0.4	168.0			
L15	171TC1-174TC220	From...	116.7	-23.1	5.0	114.3	114.3	536.4	ON
			115.3	22.9	-4.3	119.0			
L16	171HBRE-171DHon	From...	117.8	12.3	0.0	60.0	60.0	494.7	ON
			117.2	-12.3	-0.9	66.4			
L17	172TNguy-175Krb	From...	116.2	15.6	-3.4	80.8	80.8	460.4	ON
			116.0	-15.6	2.3	80.9			

Unit No.	Alarm	TYPE	Area	Name	Group	Mc CB
75		TD_0_xa	NamMT	CH1-SONGHINH_H2	0	
29		DMTroi	NamMT	CP1-AMIKHANHH...	L06	
82		DMTroi	NamMT	CP1-BINHNGUYEN	L07	
116		DMTroi	NamMT	CP1-BMT (A3)	L08	
31		DMTroi	NamMT	CP1-CAMLAMVN	L09	
83		DMTroi	NamMT	CP1-CATHIEP	L10	
84		DMTroi	NamMT	CP1-CUJUT	L11	
160		DMTroi	NamMT	CP1-DAMTRAO	L12	
6		DMTroi	NamMT	CP1-DLMIENTRUNG	L13	
148		DMTroi	BacMT	CP1-DOHWALETH...	L21	
57		DMTroi	NamMT	CP1-EUROPLAST...	L19	
85		DMTroi	NamMT	CP1-FUJIWARA	L03	

Online control

Calculate every 4s, send control signal every 8s

Overload areas

Covers 220/110kV network & inter-area 500kV AC lines

NSMO Innovation

NSMO inhouse algorithms: the power ceiling and sequential line

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Operational challenges and solutions under study

Distributed Energy Resource Management System (DERMS)

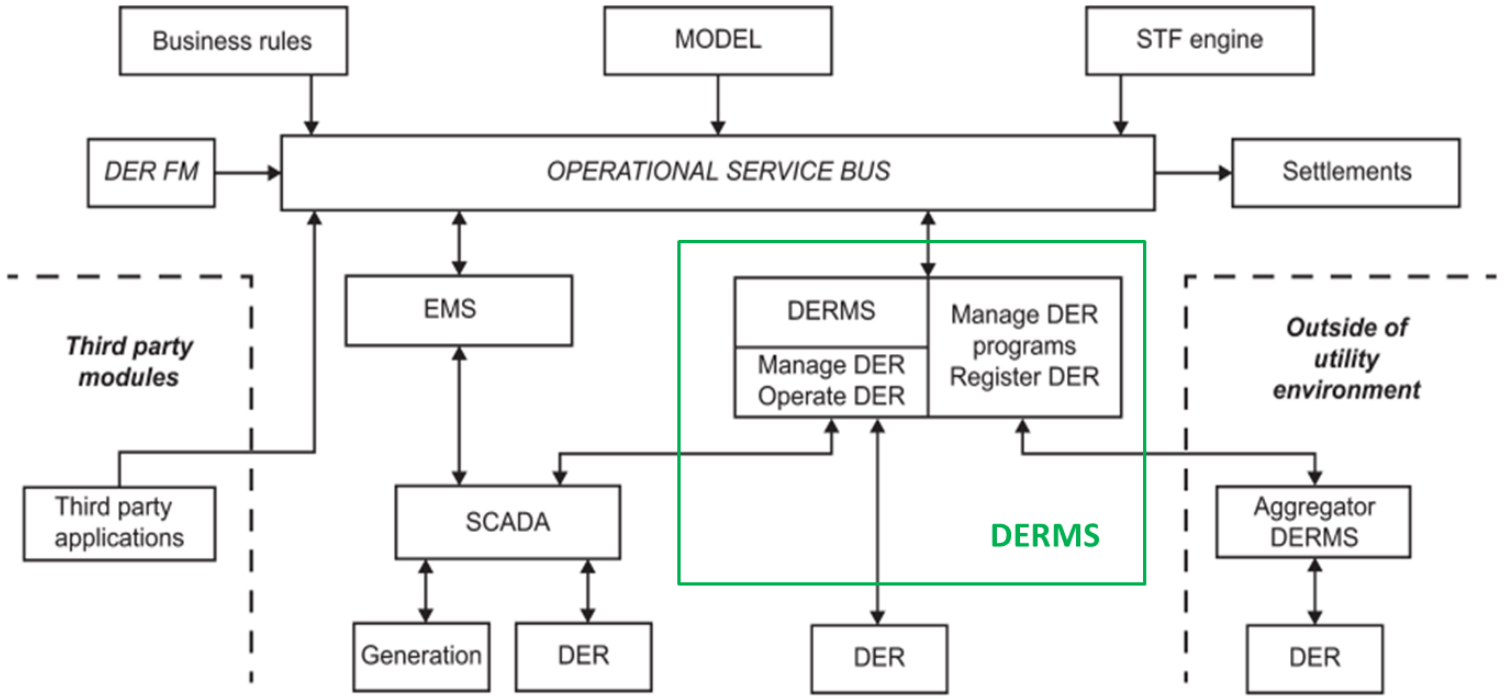
OBJECTIVES

DERs include

- Rooftop
- Small Hydro
- BESS
- EV

FUNCTIONS

- Data collection: telemeter, data logger, SCADA/EMS
- Utilizing existing data to produce reliable data
- Monitoring and forecasting power generation
- Automatic connect to TSO/DSO



Source: IEEE Guide for Distributed Energy Resources Management Systems (DERMS) Functional Specification," 2021.

Upcoming Event: G-PST Workshop on DERMS & AI Applications

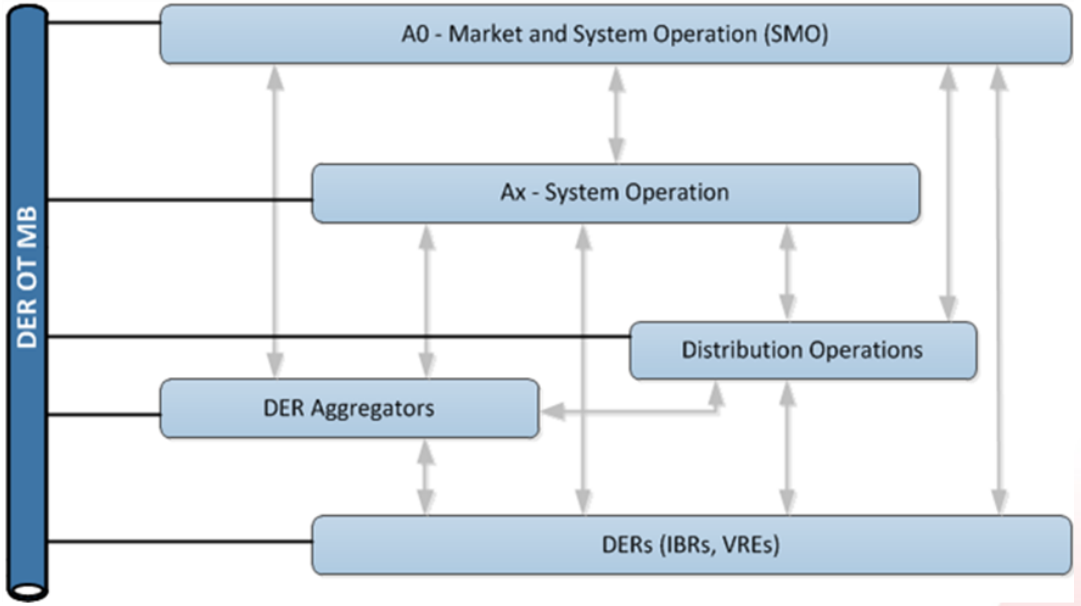
October, 2025 Hanoi, Vietnam

Enterprise Service Bus (ESB) – Message Bus

OTMB/ESB Architecture from Oracle

Source: https://www.oracle.com/ie/a/ocom/docs/industries/utilities/utilities-integrate-operational-tech.pdf

Proposed model for Vietnamese TSO- DSO Coordination



Thank you!