EVNCPC

PRESENTATION

SHARING EXPERIENCE IN DEVELOPING SMART GRID AND STRATEGIC PLAN TO ENABLE A SYSTEM WITH HIGH PENETRATION OF RENEWABLE ENERGY

June 2022

CONTENT

EVNCPC's OVERVIEW

13 provinces, cities

Central – Highland region

Power system feature

Longitudinal shape, mostly radial power grid with low density and low demand

4,579 mil.

Customers

3,375 MW

Pmax (2021)

97.5 MW

Power generation sources (hydro, solar)

3,960 km

110kV power line

136 substations

110kV substations (100% unmanned)

30,824

Distribution substations

ACHIVEMENT OF EVNCPC'S SMART GRID PROGRAM

GUIDANCE FOR SMART GRID DEVELOPMENT

Throughout the process of implementation of smart grid, with attention, thorough guidance from the government, MoIT, EVN and EVNCPC's leaders, many decisions have been issued to create foundation for smart grid implementation:

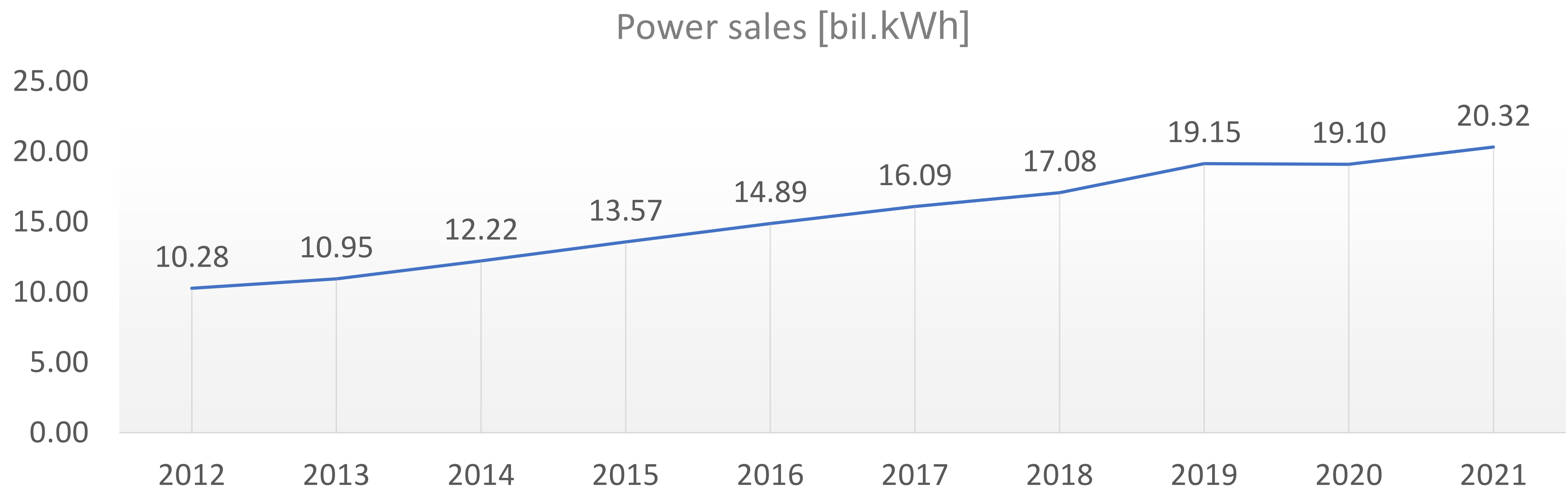
Decision 1670/QD-TTg dated 08/11/2012 issued by Prime Minister

Decision 1795/QD-EVNCPC dated 24/4/2013 issued by EVNCPC

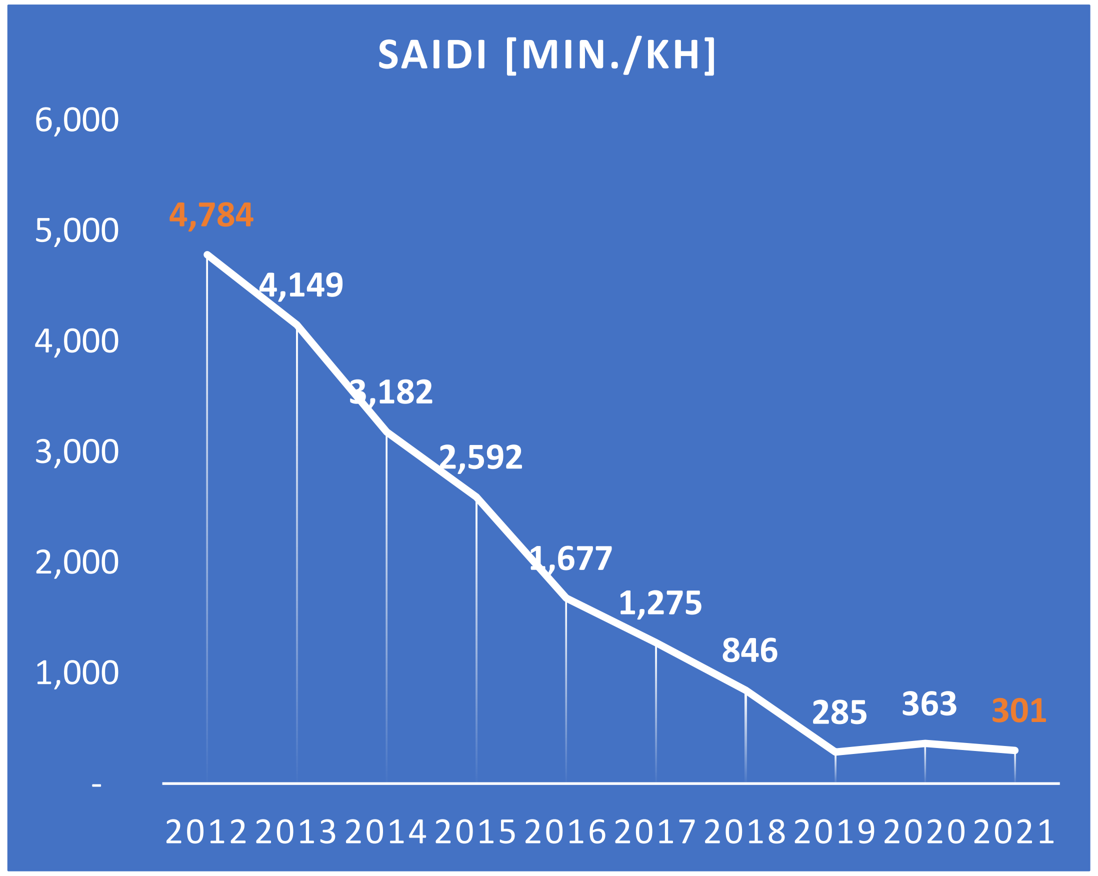
Decision 4602/QDD-BCT dated 25/11/2016 issued by MoIT

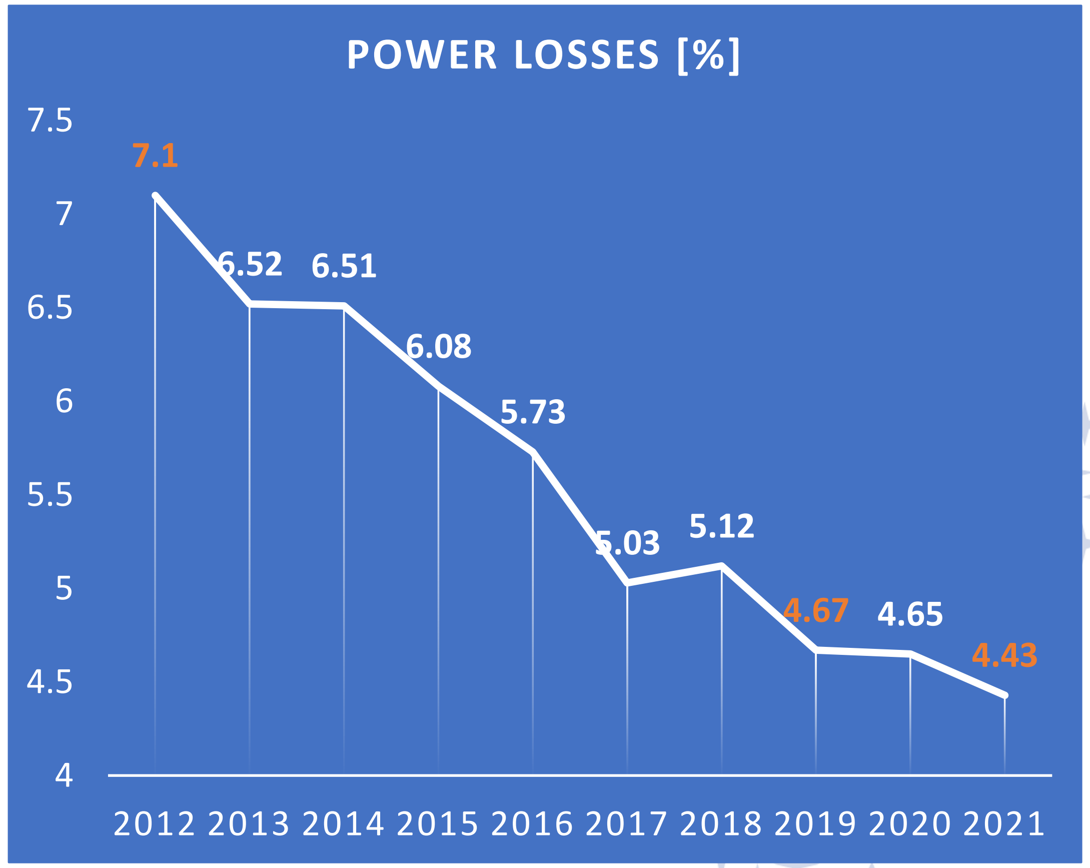
Steering Committee of Vietnam smart grid development

GENERAL RESULTS



Power sales increases from 10.28 billion kWh in 2012 to 20.33 billion kWh in 2021, equivalent to an average of 7.5% annually





2. Reliability index and power losses:

- **SAIDI:** reduce 4,483 minutes **(93.7%)** after 10 year.

- **Power losses** in 2019 was improved EVNCPC completed the target assigned by EVN 1 year earlier. EVNCPC.

GENERAL RESULTS

3. The roadmap to gradually reduce workforce with smart grid: When converting into unmanned substation, EVNCPC reduces nearly 50% of substation operators (around 472 staff) but still guarantees working positions for all staff, ensuring right of employees

4. EVNCPC ranks 5th among ASEAN Power Utilities in Smart-grid index: According to 2021 SGI benchmark, EVNCPC got 64.3/100 points, ranking 5th among ASEAN Power Utilities, ranking 37th globally

2021 Benchmarking Table

Utility	Country/ Market	Score	+/-	Best Practices
Enedis	FRA	96.4	17.9%	
ConEd	USA	94.6	5.4%	
TaiPower	TWN	94.6	12.5%	
UKPN	GBR	94.6	0.0%	
CitiPower	AUS	92.9	5.4%	
WPD	GBR	92.9	1.8%	
DEWA	ARE	89.3	10.7%	
PG&E	USA	87.5	-5.4%	
SDGE	USA	87.5	0.0%	
SP Energy Networks	GBR	87.5	3.6%	
e-distribuzione	ITA	85.7	1.8%	
ENWL	GBR	85.7	7.1%	
FPL	USA	85.7	7.1%	
Radius	DNK	85.7	23.2%	
SCE	USA	85.7	0.0%	
Stedin	NLD	85.7	5.4%	
ComEd	USA	83.9	3.6%	
Northern Powergrid	GBR	83.9	1.8%	
TEPCO	JPN	82.1	7.1%	
Jemena	AUS	80.4	8.9%	
LADWP	USA	80.4	1.8%	
SSEN	GBR	80.4	3.6%	
State Grid Beijing	CHN	80.4	7.1%	
Tata power-DDL	IND	80.4	5.4%	
Westnetz	DEU	80.4	0.0%	
APS	USA	78.6	1.8%	
Ausnet	AUS	78.6	5.4%	
Hydro Ottawa	CAN	78.6	3.6%	
BC Hydro	CAN	76.8	7.1%	
i-DE	ESP	76.8	1.8%	
PEPCO	USA	76.8	1.8%	
Shenzhen Power	CHN	76.8	3.6%	
BGE	USA	75.0	1.8%	
CLP	HKG	75.0	0.0%	
Guangzhou Power	CHN	75.0	5.4%	
SP Group	SGP	75.0	0.0%	
State Grid Shanghai	CHN	75.0	1.8%	
Western Power	AUS	75.0	12.5%	
Duke Energy	USA	73.2	8.9%	
Kansai	JPN	73.2	14.3%	
KEPCO	KOR	73.2	0.0%	
Toronto Hydro	CAN	73.2	1.8%	
Ausgrid	AUS	71.4	1.8%	
Chubu	JPN	71.4	3.6%	
State Grid Chongqing	CHN	71.4	7.1%	
CenterPoint Energy	USA	69.6	-5.4%	
Fluvius	BEL	69.6	1.8%	
Liander	NLD	69.6	3.6%	
PSE	USA	69.6	1.8%	
Dominion Energy	USA	67.9	5.4%	
EDP	PRT	67.9	-1.8%	
Eversource	USA	67.9	-1.8%	
EVN HCMC	VNM	67.9	16.1%	
MEA	THA	67.9	14.3%	
TNB	MYS	67.9	5.4%	
Vattenfall	SWE	67.9	1.8%	
ESB	IRL	66.1	8.9%	
State Grid Sichuan	CHN	66.1	3.6%	
EVN CPC	VNM	64.3	8.9%	
NIEN	GBR	64.3	8.9%	
HK Electric	HKG	62.5	1.8%	
Kahramaa	QAT	62.5	10.7%	
State Grid Hubei	CHN	62.5	1.8%	
State Grid Nanjing	CHN	62.5	0.0%	
State Grid Tianjin	CHN	62.5	0.0%	
Stromnetz Berlin	DEU	62.5	10.7%	
EVN Hanoi	VNM	60.7	5.4%	
Helen	FIN	60.7	0.0%	
Vector	NZL	60.7	3.6%	
Meralco	PHL	58.9	0.0%	
PEA	THA	58.9	5.4%	
State Grid Changsha	CHN	58.9	10.7%	
Eskom	ZAF	55.4	5.4%	
Wiener Netze	AUT	55.4	3.6%	
ACEA	ITA	51.8	0.0%	
CEM	MAC	51.8	0.0%	
Tata power Ltd	IND	51.8	3.6%	
Light	BRA	48.2	0.0%	
Rosseti	RUS	48.2	0.0%	
Sarawak Energy	MYS	46.4	8.9%	
Edenor	ARG	44.6	7.1%	
PLN	IDN	44.6	0.0%	
Enel Dist Sao Paulo	BRA	37.5	0.0%	
Enel Dist Chile	CHL	35.7	0.0%	
Edesur	ARG	32.1	1.8%	
City Power	ZAF	21.4	0.0%	

RESULTS OF SPECIFIC PLANS

Smart grid scheme at EVNCPC

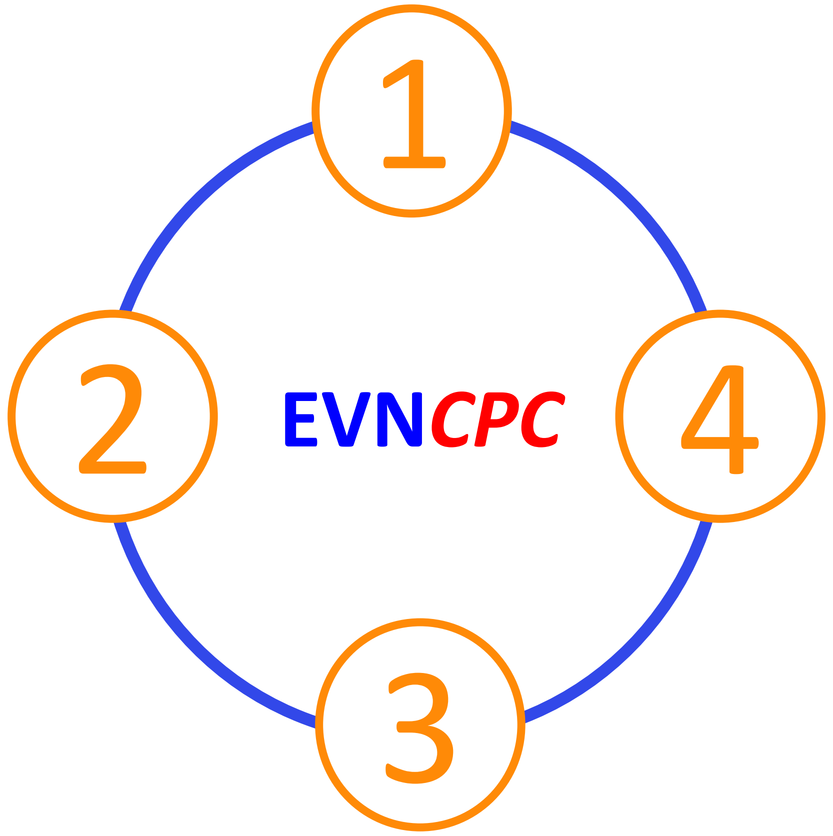
(Decision 1795/QĐ-EVNCPC dated 24/4/2013 issued by EVNCPC)

SMART GRID SCHEME AT EVNCPC

(Decision 1795/QĐ-EVNCPC dated 24/4/2013), including **04** components:

Component 1: Automate distribution power system for optimizing operation and enhancing reliability in power supply

Component 2: Modernize metering system for power trading



Component 4: Build a specialized telecommunication and IT system which is not only highly centralized, reliable, efficient but also highly secured, ready for backup operation.

Component 3: Integrate renewable energy into the distribution power system for better harnessing these sources, contributing to environmental protection and socioeconomic development

SMART GRID SCHEME AT EVNCPC

COM. 1: AUTOMATE DIST. POWER GRID

Target	Result
In 2020, converting 100% substation in to unmanned	**Completed** *(in 2019)*
In 2022, connecting 100% sectionalizing equipment	**93.4%**
To be adept in SCADA tech. at Control Center and unman. substation	**Adept**

COM. 2: MODERNIZE METERING SYS.

Target	Result
In 2013, 100% meters for power trading and boundary is electronic	**Completed** *(in 2013)*
In 2017, 100% meters at specialized substation is electronic	**Completed** *(in 2017)*
In 2022, 100% meters at distribution substations is electronic	**96.4%**

SMART GRID SCHEME AT EVNCPC

COM. 3: INTEGRATE RE

Target	Result
In 2015, conduct a pilot project for integrating RE into distribution grid	To cooperate with ICASEA, VEEAto develop grid code for RTS (in 2014).
	There are 25,032 customers/investors in RTS (3,054MWp).
	Successfully manufacturing and installing 03 EV charging stations in Da Nang city

COM. 4: BUILD TELECOM. & IT

Target	Result
In 2013, build a customer service center	**Completed** *(in 2016)*
IN 2017, build Data Center	**Completed** *(in 2015)*
Build specialized software for customer service, operation, power market…	**Built** Portal, MDMS, Site Inspection…

RESULTS OF SPECIFIC PLANS

Smart grid program in 2022

(Decision 1995/QĐ-BCĐ dated 20/8/2021)

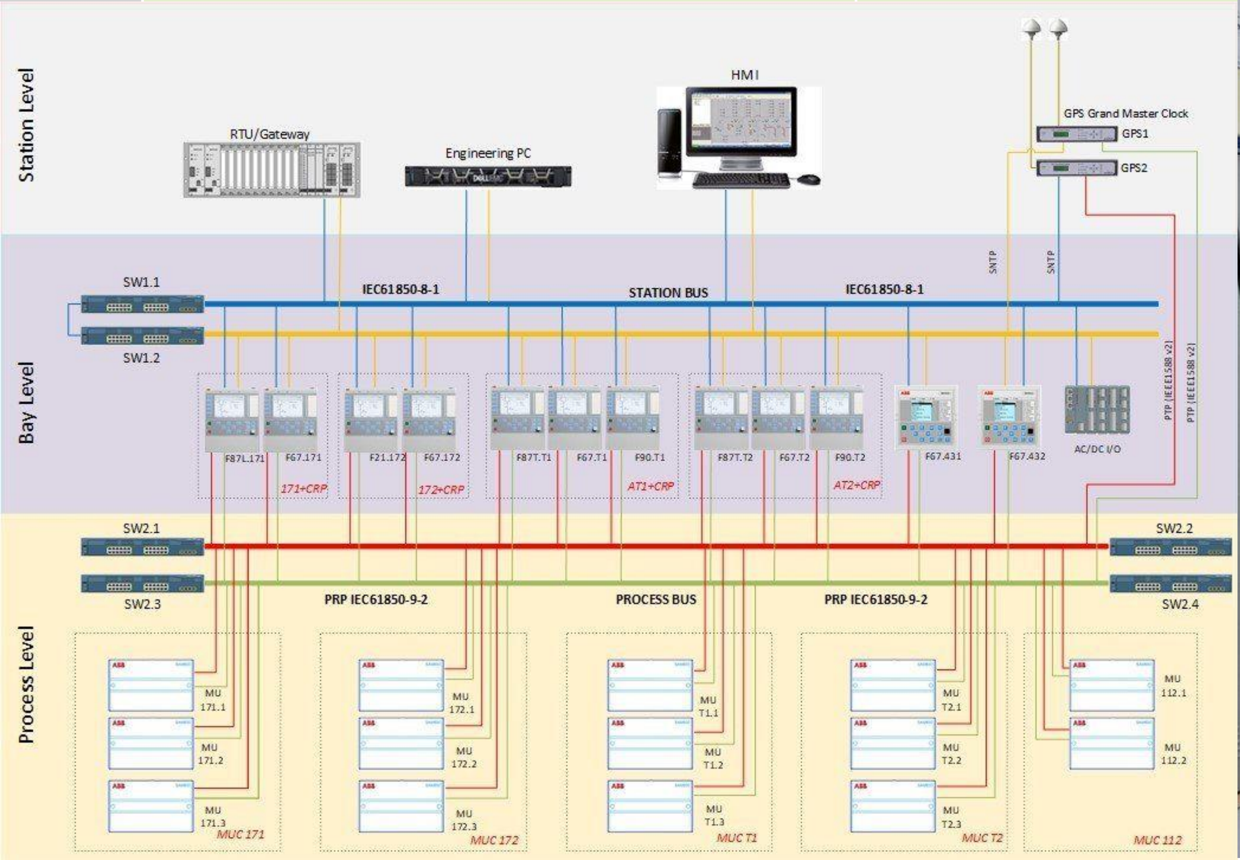
02 missions

SMART GRID PROGRAM IN 2022

No	Name of the program, project, scheme	Progress	Result
1	To harness fundamental function of DMS equipped at Power Companies: + To implement the function for power flow calculation and load forecast at Power Companies: Hue, Quang Nam, Gia Lai, Dak Lak, Quang Tri, Quang Ngai, Binh Dinh. + To implement steps for investment in applying Distribution Automation System (DAS) for all Power Companies.	To be implemented in 2021 - 2022	- At Da Nang Power Company: successfully implementing the function “Fault Location, Isolation, and Self Restoration” (FLISR) to build Distribution Automation System for 54/90 MV feeders within Da Nang city. - The other 07 Power Companies: successfully implementing 04 functions for load dispatching, including: Topology Management, Load Flow Calculation, Short-circuit Calculation, and Load Forecast. - Apart from that, in 2021, EVNCPC arranged investment capital for DAS at Power Companies, expected to be completed in 2023 for all feeders at cities and central areas.

SMART GRID PROGRAM IN 2022

NV	Name of the program, project, scheme	Progress	Result
2	To implement a pilot project of 01 110kV digital substation	To be implemented in 2021 - 2022	- To quickly access new technological trends, since 2020, EVNCPC has implemented 02 pilot projects of 110kV digital substations which are Dak Song 110kV substation in Dak Nong province (upgrade capacity with the second transformer) and My Khe 110kV substation in Quang Ngai province (newly built substation). Apart from that, Thua Thien Hue Power Company proactively research and build Phu Bai 110kV digital substation for its own. - On 20/4/2022, Phu Bai 110kV digital substation was conducted acceptance procedures and put into operation, this is the first digital substation of EVNCPC.



UPCOMING PLAN FOR SMART GRID

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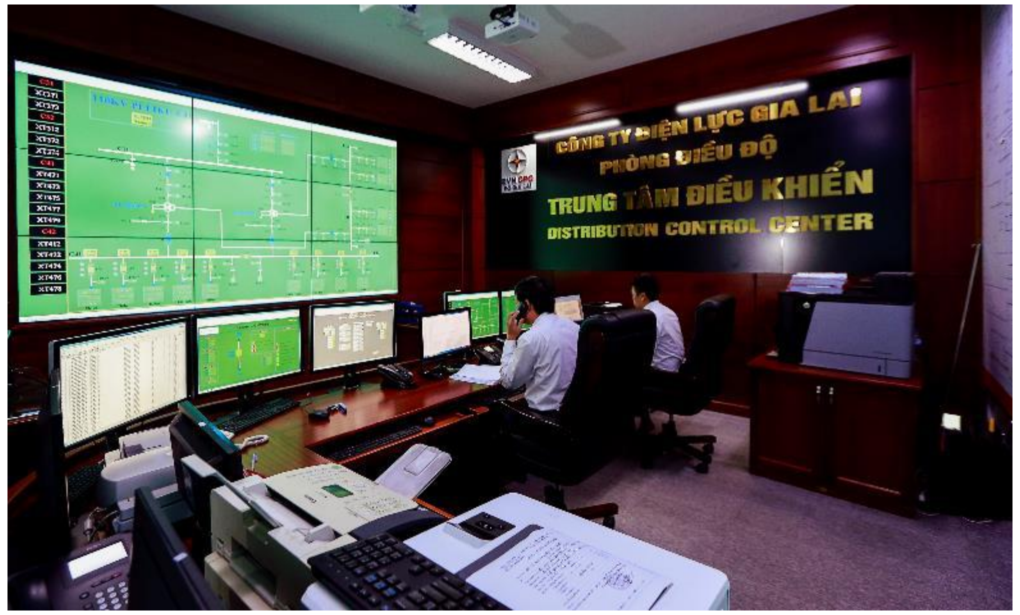
01. To efficiently harness the SCADA/DMS system



a. The SCADA/DMS at Control Centers of Power Companies:

- To equip all DMS functions for all Power Companies and put these DMS functions into operation in order to enhance the efficiency in load dispatching, power operational work.
- To invest in upgrading SCADA/DMS at Control Centers (both hardware and software), not only ensuring safe, continuous, reliable operation but also meeting requirements for backup, IT security.

b. The Supervisory Center at EVNCPC’s headquarter:

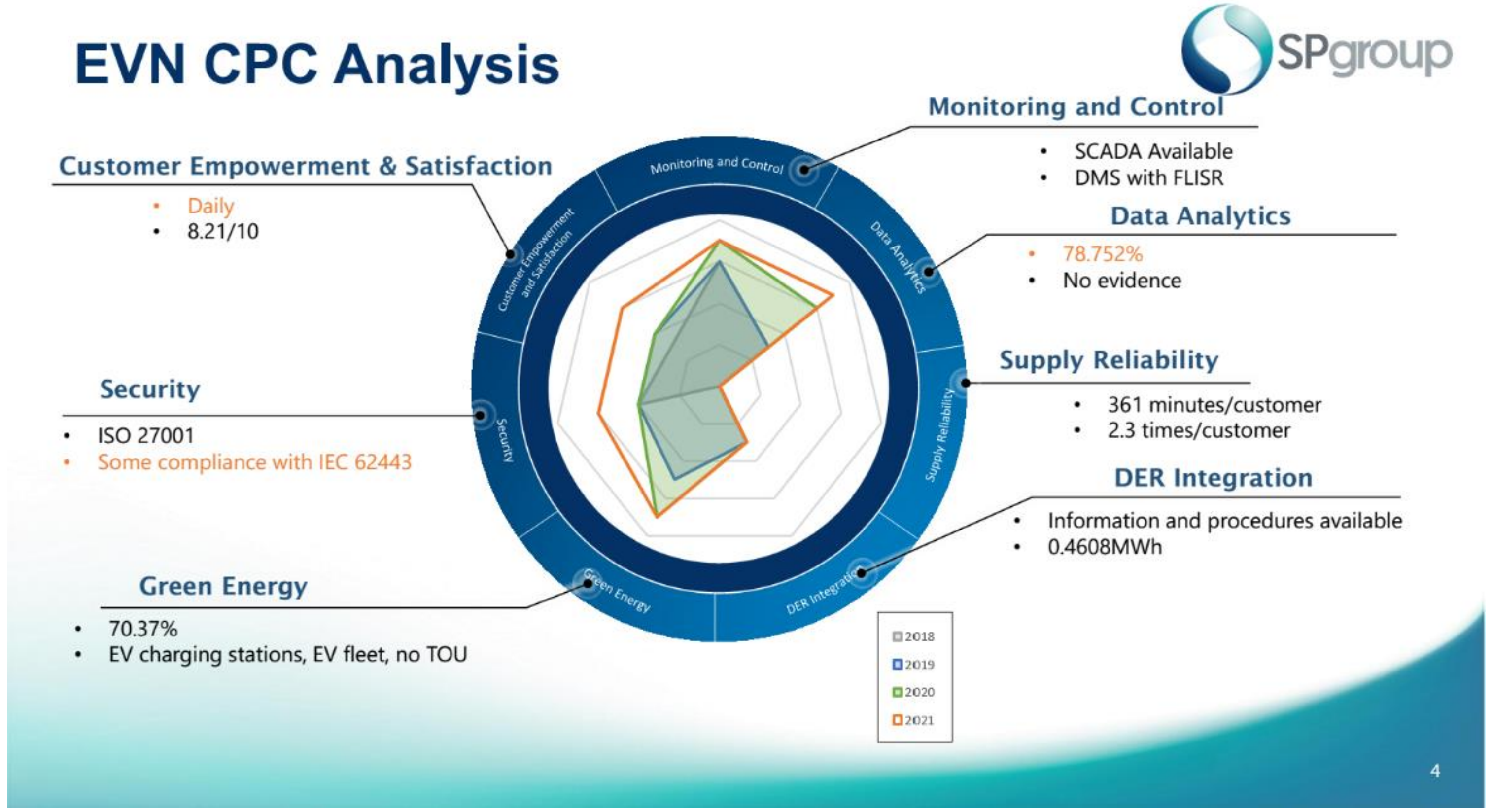
- To complete and summarize all forms of operational reports for managing and monitoring operation of all Power Companies.
- To automatically send SMS message or E-Office message to operators/Leaders when there is fault in the power system.
- To share database of SCDA system at Supervisory Center for calculating reliability index..

UPCOMING PLAN FOR SMART GRID

02. To make the grid smarter

- To improve smart-grid index to rank higher in SPGroup SGI benchmark.
- To build Distribution Automation System at 13/13 Power Companies to reduce outage duration per customers and improve reliability in power supply. It is expected to be completed in 2022 for Quang Binh, Phu Yen, Kon Tum, Dak Nong and Khanh Hoa Power Companies and in 2023 for the other Power Companies.
- To analyze and evaluate 110kV digital substations in order to establish proper model of digital substation.

Apart from that, EVNCPC will continue to conduct missions annually assigned by the Steering Committee of Vietnam Smart grid development.



EXPERIENCE IN DEVELOPING SMART GRID IN EVNCPC

EXPERIENCE IN DEVELOPING SMART GRID IN EVNCPC

The roadmap strategy:

- To break down steps and create an annual plan
- Based on current staff capability and power system condition.

01

2013

Conduct research and model for integrated control system at laboratory scope; then conduct a pilot project in Hoi An 110kV substation (Quang Nam province)

02

2016

Implement the plan for converter 110kV conventional substations into 110kV unmanned substations

03

06/2018

Completing equipment of SCADA system for 13 PCs

04

11/2019

To complete converting 100% 110kV substation into unmanned ones

EXPERIENCE IN DEVELOPING SMART GRID IN EVNCPC

Workforce:

- Being adept in technology plays an important role in building smart grid
- In bidding document must specify detailed requirements for training an tech. transfer
- Assign key staff for the position

Technology:

- To use the 3rd party software in order to avoid technology deoendence.
- The equipment for investment, procurement must have good quality, high reliability
- SCADA/DMS software: only procure necessary functions.
- Promote study and application of new technology: DAS, SRFI, digital substations

Legal frame:

- It is encouraged to issue regulations, standards based on guidance from EVN, MoIT as orientation for smart grid development

STRATEGIC PLAN TO ENABLE A SYSTEM WITH HIGH PENETRATION OF RENEWABLE ENERGY

CURRENT SITUATION

In 2020-2021, with high penetration of RE into the power grid, EVNCPC faces many challenges in load dispatch and grid operation, specifically: grid operation mode is less flexible; power flow fluctuates largely upon RE generation capacity; it is more difficult to properly calculate, coordinate protective relays in order to meet frequent fluctuations in power flow. Therefore, in the upcoming time, EVNCPC will focus on studying and finding solutions for managing, monitoring, controlling and forecasting DERs, especially rooftop solar systems (RTS).

MANAGEMENT WORK OF DERs

EVNCPC built the software **dmtmn.cpc.vn** for managing and monitoring customer information, including:

(i) detailed information of customers with rooftop solar system (installation date, grid-connection date, signing PPA date, reports, pictures…);

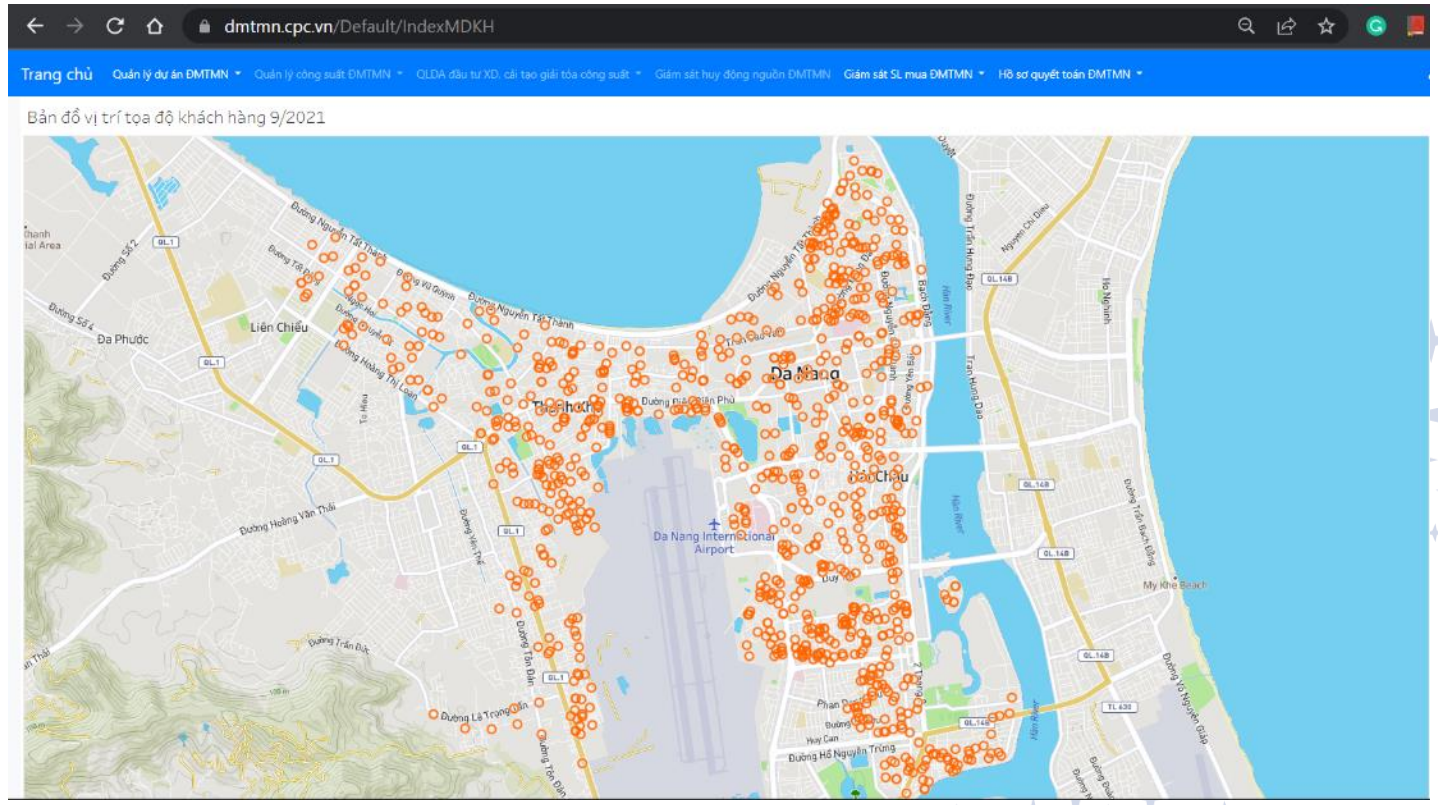
(ii) (statistic form of rooftop solar systems for each Power Company, for each 110kV substation, each MV feeder, each range of RTS….;

(iii) the function for alerting abnormal electricity generation as compared to installed capacity;

(iv) display distribution of RTS in map;

(v) to supervise investment projects for releasing RE capacity;

(vi) to monitor trading electricity of RTS and mobilization plan.



MONITORING AND CONTROLLING DERs

- To implement the solution for controlling and monitoring RTS at Quang Nam Power Company. The solution connects to 07 RTS from 01/7/2021.

However, the implementation faces many challenges due to

- Lack of regulations on cooperation and mobilization of RTS;
- Currently RE is still used conventional PPA template and relevant regulation, there is no regulation on controlling inverters of RTS, on collecting operational data of inverters in real-time, on connecting to Control Center for grid operators to conduct load dispatch, especially during unfavorable conditions…
- it's just based on willingness of RTS investors..

FORECASTING WORK

- **Short-term Forecast Tool for RTS developed by NLDC.** All EVNCPC' subsidiaries are well-trained with the Tool and receive daily solar radiation information provided and forecasted by NLDC via portal SMOV.VN.

- **RTS Management System** from 01/6/2022. Currently, the System enables forecast function (for the next 14 days), monitoring electricity generation of RTS (almost in real-time).

- **Virtual Power Plant**: with the above-mentioned challenges in operating power system with high penetration of RE, studies and investment in VPP is necessary in foreseeable future. Currently, EVNCPC is cooperating with GIZ _ German consultant to implement a VPP in Central and Highland region. The project will play an important role in energy digitalization transformation in EVNCPC in particular and in EVN in general, as well as pave the legal way for managing, regulating DERs in upcoming time

EVNCPC

Thắp sáng niềm tin

THANK YOU

FOR YOUR ATTENTION !