



Data Templates for Gathering Data for Ancillary Services

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Acronyms

The below table lists acronyms used in this document.

AGC	Automatic Generator Control
BOT	Built Operate Transfer
BST	Bulk Supply Tariff
CAN	Capacity Add-On
CFD / CfD	Contract for Difference
EPTC	Electricity Power Trading Corporation
ERAV	Electricity Regulatory Authority of Vietnam
EVN	Vietnam Electricity
GENCO	Generation Company
IPP	Independent Power Producer
LMP	Locational Marginal Price
MDMSP	Meter Data Management Service Provider
MMS	Market Management System
NLDC	National Load Dispatch Centre
NPT	National Power Transmission
PC	Power Corporation
PPA	Power Purchase Agreement
SCADA	Supervisory Control and Data Acquisition
SMHP	Strategic Multipurpose Hydropower Plant
SMO	System and Market Operator
SMP	System Marginal Price
SPPA	Special Power Purchase Agreement
VWEM	Vietnam Wholesale Electricity Market
BRP	Balancing Responsible Party
BSP	Balancing Service Provider
OTC	Over The Counter (form of trade)
PV	Photovoltaic (solar)
SMO	System and Market Operator
WP	Wind Power

1. Introduction

The purpose of this report is to suggest which data is needed to evaluate the procurement and activation of ancillary services. The meaning of evaluation in this context is that the market operator is calculating or analysing whether the correct amount of ancillary services is available. The amount should not be too little, as this is a direct threat to system security. Neither should it be too much, as this would make market operation and integration of renewable production more expensive than necessary. The report should be seen as an early step towards optimization of the markets for ancillary services. The market for ancillary services in Vietnam is under development in many aspects, and the report loosely expands on themes relating to optimizing the purchase of ancillary services through analysis of market data, and other possible uses of the data.

1.1 Schematic description of the Vietnamese market design

Vietnam's electricity market is developing at the stage of wholesale electricity market with the operating model that complies with the regulations issued by the Ministry of Industry and Trade (Circular No. 45, 2019).

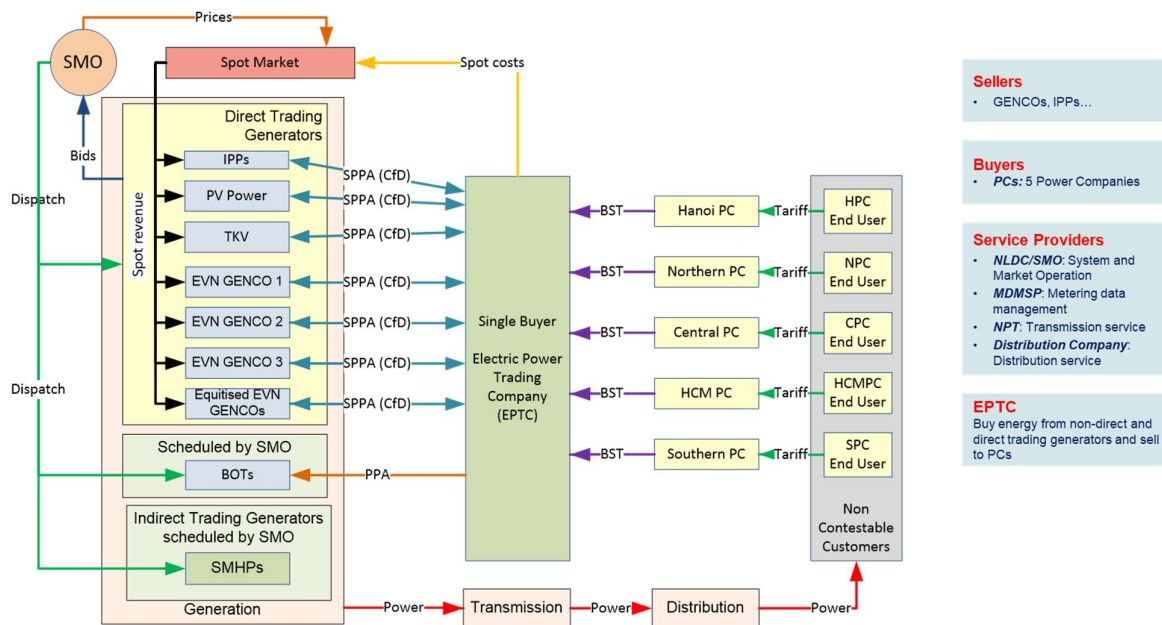


Figure 1. Schematic illustration of the Vietnamese electricity market

BOT	Built Operate Transfer
BST	Bulk Supply Tariff
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ERAV	Electricity Regulatory Authority of Vietnam
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IPP	Independent Power Producer
LMP	Locational Marginal Price
MDMS	Meter Data Management Service Provider

MMS	Market Management System
NLDC	National Load Dispatch Centre
NPT	National Power Transmission
PC	Power Corporation
PPA	Power Purchase Agreement
SCADA	Supervisory Control and Data Acquisition
SMHP	Strategic Multipurpose Hydropower Plant
SMO	System and Market Operator
SMP	System Marginal Price
SPPA	Special Power Purchase Agreement
VWEM	Vietnam Wholesale Electricity Market

In this model, there is only price offer for electricity but no bidding mechanism for ancillary services. However, according to current technical regulations, the schedule of mobilizing plants in the next day and next hour based on the offers from power plants still needs to ensure a certain amount of standby capacity for the system. Therefore, the allocation of capacity to participate in the frequency control service for market participants is made through the calculation process issued by MOIT. Inputs for these calculations as well as outputs are published by SMO on the portal for electricity market operation.

1.2 Schematic description of the Danish market design

The Danish power market is integrated into the Nordic power market. The power exchange covers the Nordic countries Norway, Sweden, Finland and Denmark. The wholesale of electricity takes place at the power exchange, although a small and decreasing part is traded bilaterally, i.e. 'Over the Counter'.

The System and Market Operator (SMO) is the central stakeholder in the markets for ancillary services. In the ancillary services markets the SMO (=TSO) is single buyer of the products. For two of the ancillary services markets in the Nordic countries, all the Nordic TSOs are buyers in combination. It is also the TSO who define and decide the amounts that has to be bought, but this is regulated in national and European laws.

A very important type of players in the European electricity markets are the 'Balancing Responsible Parties' (the BRPs).

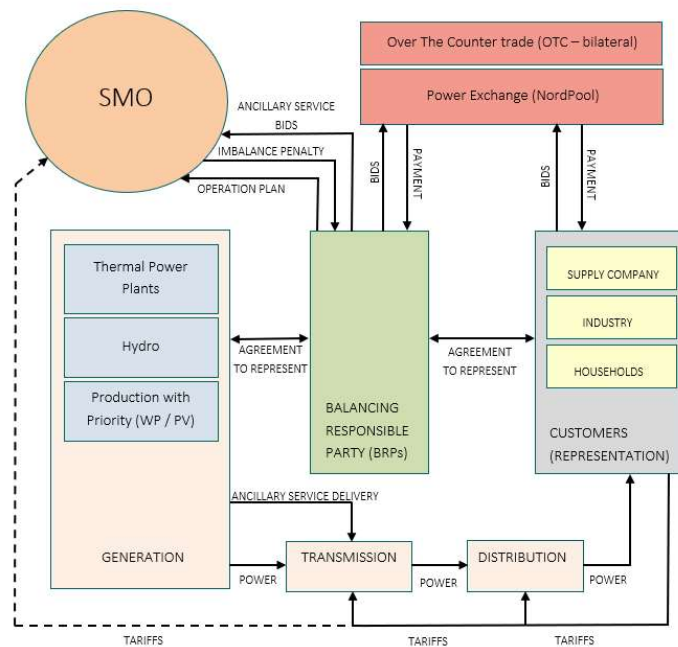


Figure 2. Schematic illustration of the Danish electricity market

BRP	Balancing Responsible Party
OTC	Over The Counter (form of trade)
PV	Photovoltaic (solar)
SMO	System and Market Operator
WP	Wind Power

To have a basis for evaluation of the current use of ancillary services in Vietnam, it is necessary to have data on different parameters on the historical capacity procurement and activation of the different ancillary services. We wish to initiate the development of such a basis for data collection regarding the procurement and activation of ancillary services.

Whenever the market, the legislation and the operation are ready for extended data gathering, this document can serve as a quick insight to the current status. Moreover, it gives some examples and recommendations.

The data gathering is mostly intended for authorities monitoring the market and market operators evaluating the use and need of ancillary services, but the data can at some later stage serve other purposes.

List of Ancillary Service in Vietnam (Circular No. 30/2019 / TT-BCT dated November 18, 2019 on amending and supplementing a number of articles of Circular No. 25/2016 / TT-BCT dated November 30, 2016 of the Minister of Industry and Trade regulating electricity system transmission).

Types of ancillary services used to adjust frequency and voltage during operation of the electricity transmission system:

- i. Secondary frequency regulation: Generating sets providing secondary frequency regulation service must be able to start providing frequency regulation capacity

- within 20 seconds after receiving the AGC signal from the electricity system operator and electricity market and provide all registered secondary frequency capacity within 10 minutes and maintain this power level for at least 15 minutes.
- ii. Quick-start: Generating sets providing quick-start reserve must be capable of increasing to the rated power within 25 minutes and maintain such rated power for a minimum of eight hours
 - iii. Voltage adjustment: Generating sets providing voltage adjustment must be capable of changing reactive power outside the band, meeting requirements of the electricity system and market operator
 - iv. Must-run operation reserves to ensure electricity system security: Generating sets providing must-run operation to ensure electricity system security must be capable of increasing to a rated power within one hour and maintaining such rated power for a minimum of eight hours (excluding the time of starting)
 - v. Black start: Generating sets providing black start must be capable of self-starting in a cold state without power supply from the national electricity system and capable of supplying electricity to transmission grids, distribution grids after successfully started.

2. Overview of current data availability

Below two tables show the current data available in Vietnam and Denmark. The tables show what data are available for analyses at the TSO. It is not about public transparency. The information in the tables is shown in a rather schematic way and may ignore other types of data that could also be relevant in this context. This level of detail is chosen to give the comparison between Vietnam and Denmark the most meaningful result.

Y: yes, data available N: no, data not available F: fixed price NR: not relevant	Demand	Bid prices	Purchased volume	Market clearing prices
Primary reserve capacity	Y	N	N	N
Secondary reserve capacity	Y	N	Y (*)	N
Tertiary reserve capacity	Y	N	N	N
Primary reserve activation	NR	N	N	N
Secondary reserve activation	NR	N	N	N
Tertiary reserve activation	NR	N	N	N

Table 1. Current data availability in Vietnam:

(*): Due to the principle of calculating and mobilizing the capacity of frequency control service issued by MOIT, the plants indirectly participating in the electricity market will be given priority, so the amount of power supplied mostly comes from these plants. Since the application so far, no direct trading plants in the market has been paid for the amount of capacity participating in frequency control services.

Y: yes, data available N: no, data not available F: fixed price NR: not relevant	Demand	Bid prices	Purchased volume	Market closure prices
Primary reserve capacity	Y	Y	Y	Y
Secondary reserve capacity	Y	Y	Y	Y
Tertiary reserve capacity	Y	Y	Y	Y
Primary reserve activation	NR	NR	NR	NR
Secondary reserve activation	NR	F	Y	(Y)
Tertiary reserve activation	NR	N	Y	Y

Table 2. Current data availability in Denmark

Note that the Vietnamese data only is available for the current operation day. So, each day has new data. It is available for each hour and is updated each hour. The available data is mainly the planned quantities and is calculated by Market Operator. In real-time operation, System Operator will decide which plants participated in controlling the frequency. If one plant existed in hourly plan of ancillary services and actually provided this service, it is paid the money following the market rule.

3. Availability to relevant stakeholders

In order to gain access to this portal, one needs to be a market participant registered with the SMO and given a password-protected account. In addition, this portal is located in a separate LAN for the electricity market so in order to access it one needs to have a separate connection infrastructure or to use a separate VPN network.

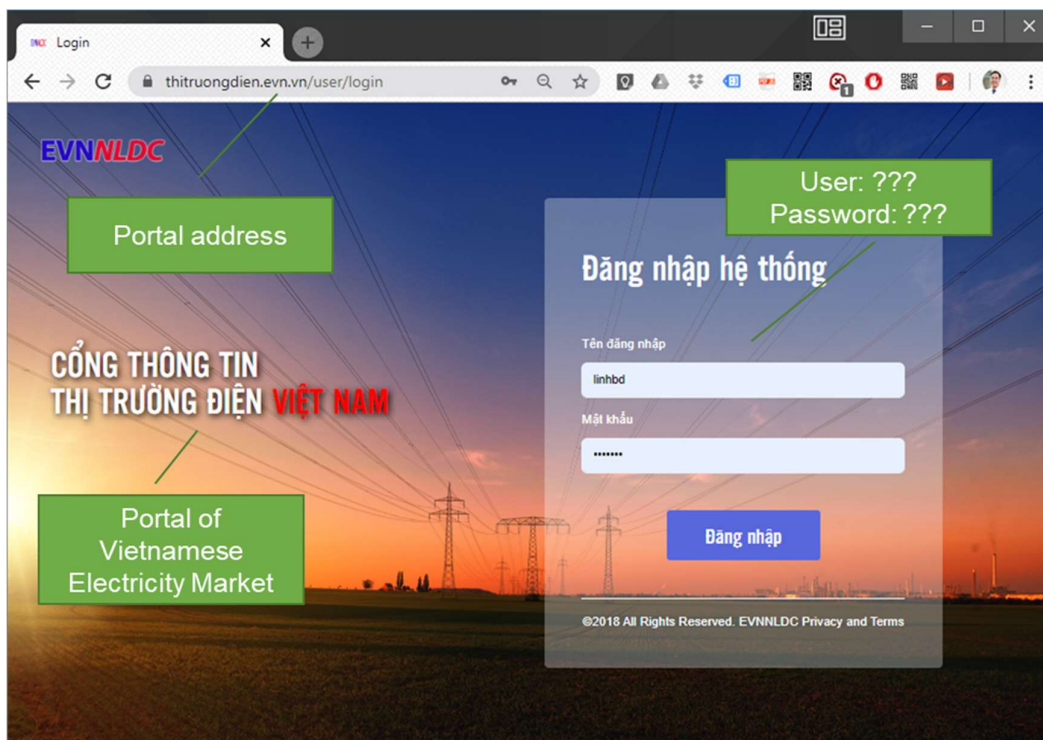


Figure 3. Interface of Login page of Portal of Vietnamese Electricity Market

Main users of the data are system & market operator (SMO) and market participants. Plants are selected independently for energy generation, and this is done the week ahead. Then day ahead, the fleet is co-optimized between energy and frequency control service. Every day, SMO calculate the allocation of capacity to participate in the frequency control service for market participants of the next day and uploading the result before 04:00 PM to the portal. Based on the list of power plants selected in the week, Market Operator is responsible for selecting the appropriate number of plants to provide frequency control service. These plants will be included in the clearing engine's constraints to ensure that the total reserved capacity of the system in each trading interval in both directions meets the reserved capacity requirement for frequency control service. This capacity requirements is then allocated according to the principles that: first capacity will be allocated for indirect market participant services providers, and then to direct market participant services providers. The principle of allocation is according to the ratio of available capacity of the plants. This picture (Figure 4) shows the day-ahead display form of frequency control service.

Direct market participants submit bids every hour and every day. Indirect market participants do not submit bids. Their available capacity is calculated by SMO (NLDC) the day before as a result of hydro-thermal optimization.

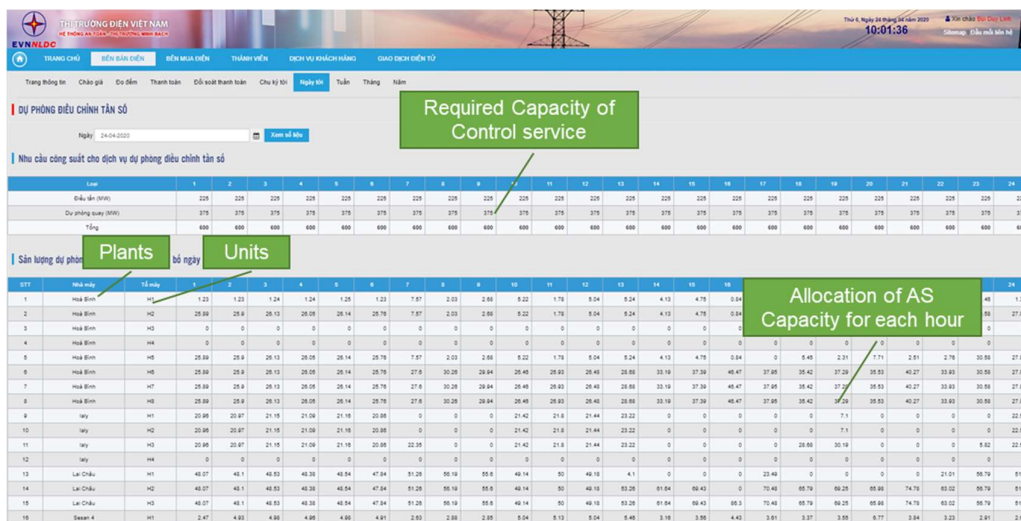


Figure 4. Day-ahead result of frequency control service

Similar to the Day ahead, for the next few hours, System Operator will provide a list of newly added services providers (if necessary and they maybe outside daily list but still inside weekly list) for Market Operator to schedule and allocate the reserve capacity for frequency control services. This picture show the hour-ahead display form of frequency control service.

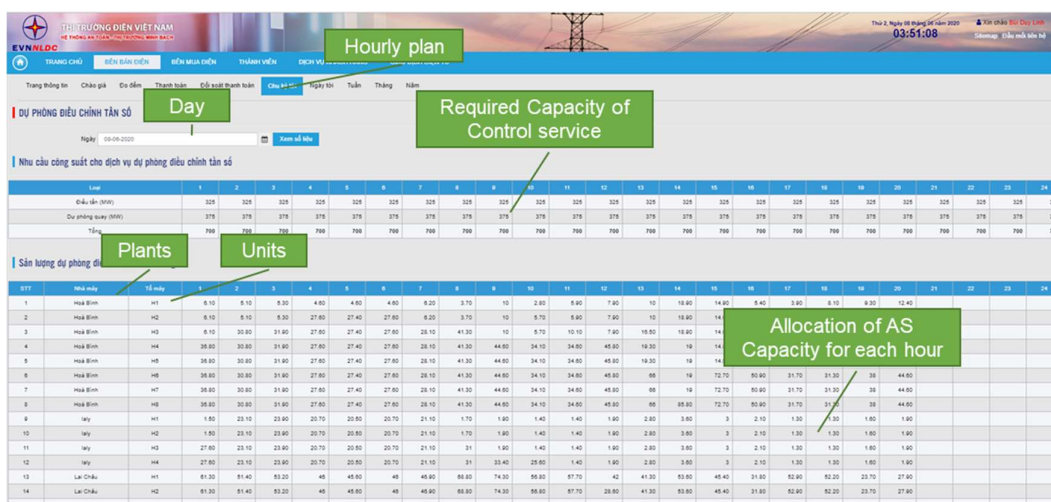


Figure 5. Interval-ahead result of frequency control service

4. What other data exist currently that is not on the data website

The historical data is stored, but is not readily available, and not at all available to the plants and others with access to the 'private' web page.

Fast start data is not on the website today but exist and could be made available. Right now, it is not that relevant because the fast start plants have yearly contracts, so these will be very static.

TT	Plant	Unit	Service	
			Fast Start	Must Run
1	Thủ Đức	GT4, GT5	✓	

		S1, S2, S3		√
2	Ninh Bình	S1, S2, S3, S4		√
3	Cần Thơ	GT1, GT2, GT3, GT4	√	
		S4		√
4	Ô Môn I	S1, S2		√
5	Bà Rịa	GT1, GT2	√	
		GT3, GT4, GT5, GT6, GT7, GT8, ST9, ST10		√

Table 3. Coming data (Decision 104/QĐ-EVN dated on 21/01/2020 issued by EVN)

For the monthly plan, EVNNLDC conducts the calculation of the reserve capacity for primary and secondary frequency regulation in the next month based on Decision No. 106 / QĐ-DTĐL dated December 14, 2018 of Electricity Regulatory Authority of Vietnam and according to the Circular No. 30/2019 / TT-BCT dated November 18, 2019 on amending and supplementing a number of articles of Circular No. 25/2016 / TT-BCT dated November 30, 2016 of the Minister of Industry and Trade regulating electricity system transmission. The calculation of the July 2020 results are as follows:

Mode	Primary frequency regulation (MW)	Secondary frequency regulation (MW)
High demand	150	700
Low demand	190	700

Table 4. July 2020 reserve calculations

EVN is also the one who approve the monthly operational plan which includes requirements for the frequency regulation.

5. What other data would it be relevant to make available

All information related to the calculation of ancillary services is publicly available on the electricity market portal but they are scattered in a number of different locations. Information on electricity market's marginal price, load forecast of next day and next hour is published as follows:

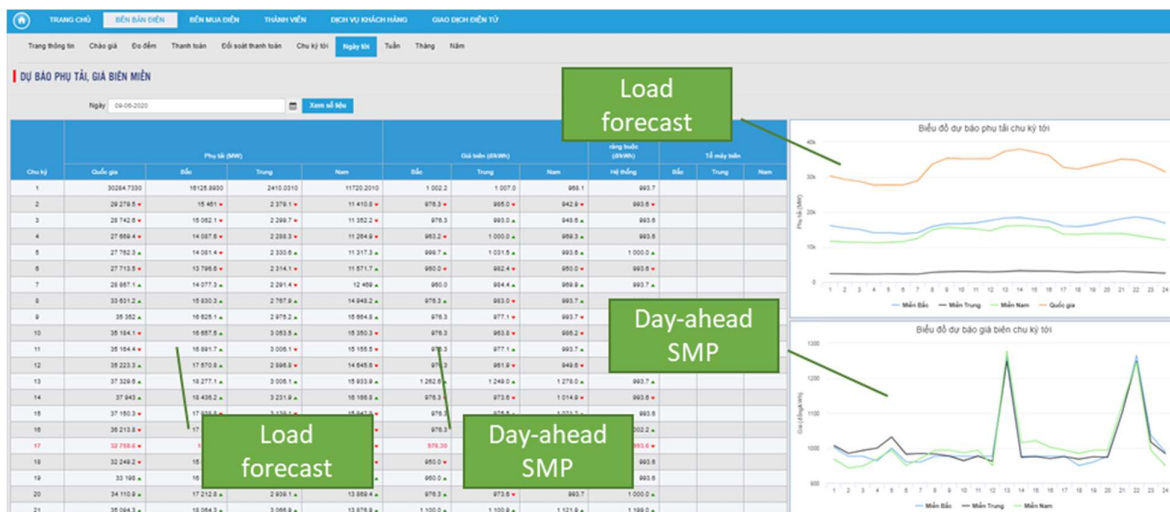


Figure 6. Public information declared by SMO to all market participant in Day-ahead plan

Details of CAN price are calculated from the annual plan and are the payment prices for secondary frequency regulation services announced to electricity market participants at the following addresses:

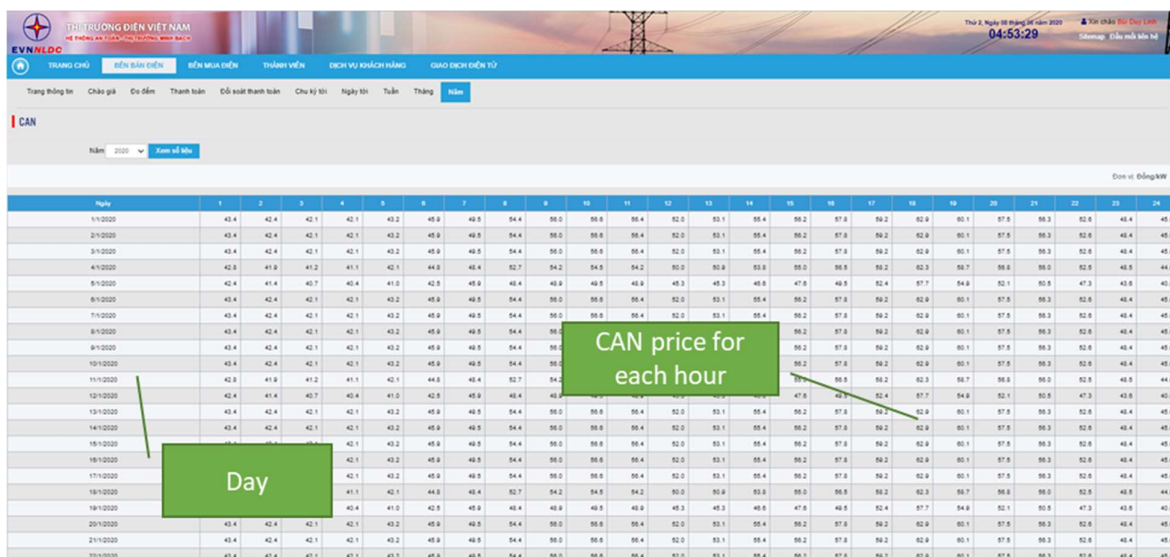


Figure 7. CAN price for every trading intervals

The maintenance and outage plan of the units approved in the month was also announced publicly on the web portal:

THỊ TRƯỜNG ĐIỆN VIỆT NAM
HỆ THỐNG AN LẬP VÀ TỰ TÌNH NGUYỆN BÁCH

THÁNG CHỦ | ĐIỂN MUA ĐIỆN | ĐIỂN MUA ĐIỆN | THÀNH VIÊN | DỊCH VỤ KHÁCH HÀNG | QUẢN LÝ ĐIỆN TỬ

Trang thông tin | Chào giá | Dự đoán | Thanh toán | Duyệt thanh toán | Chu kỳ lịch | Ngày lịch | Tuần | Tháng | Năm

KẾ HOẠCH SỬ CHỮA THÁNG

Năm: 2020 | Tháng: 6 | Xem số liệu

Mã máy	Tên máy	Thời gian bắt đầu		Thời gian kết thúc		Công việc
		Ngày	Giờ	Ngày	Giờ	
Phụ M3 4	GT41	06/01/2020	12:01	06/04/2020	11:59	Bắt khởi động
Phụ M3 22	GT1	01/08/2020	12:01	02/08/2020	11:59	Sửa chữa
Phụ M3 22	GT1	01/08/2020	12:01	04/08/2020	11:59	Sửa chữa
Phụ M3 22	GT1	01/08/2020	12:01	04/08/2020	11:59	Bắt khởi động GT22
Phụ M3 3	GT1	01/08/2020	12:01	04/08/2020	11:59	Bắt khởi động
Huà Bình	H1	01/08/2020	12:01	04/08/2020	11:59	Đạp tu
Sông Ninh	H1	08/08/2020	12:01	13/08/2020	11:59	Đạp tu
Đà Nẵng	H4	01/08/2020	12:01	13/08/2020	11:59	Đạp tu
Hải Thuận	H1	18/08/2020	12:01	30/08/2020	11:59	Sửa chữa
Đà Nẵng	H1	08/08/2020	12:01	17/08/2020	11:59	Sửa chữa
Sông Cồn 2	H1	15/08/2020	12:01	28/08/2020	11:59	Đạp tu
Sông Ba Hạ	H2	11/08/2020	12:01	22/08/2020	11:59	Tắt tu
Bắc Bình	H2	08/08/2020	12:01	17/08/2020	11:59	Sửa chữa
Kông Nông	H2	25/08/2020	12:01	04/09/2020	11:59	Tắt tu
Huỳnh Điện	H1	20/08/2020	12:01	10/09/2020	11:59	Tắt tu
Xàman 3	H1	01/01/2020	12:01	30/08/2020	11:59	Sửa chữa
Xàman 3	H1	01/01/2020	12:01	30/08/2020	11:59	Sửa chữa
Nội Chiến 1	H1	18/08/2020	12:01	05/09/2020	11:59	Bắt khởi động
Sông Trảng 2	H2	13/08/2020	12:01	22/08/2020	11:59	Tắt tu

Figure 8. Monthly maintenance plan of generation unit

6. What are the possibilities with good data on Ancillary Services

6.1 Optimizing the purchase of ancillary services

Example: Data can reveal whether all reserves are used, or if a large portion of it is never activated. In the latter case, maybe there is basis for reducing the amount of reserves. Maybe even to some extent rely on voluntary bids for the activation market.

6.2 Study price phenomena

Example: Through mathematical / statistical analysis of bid structure and price formation, one can get an idea whether the market is well functioning and healthy, or whether undesirable traits such as monopoly or market domination occur.

6.3 Simulate possible new market designs for ancillary services

Example: When new markets are launched it is beneficial to know the market behaviour in advance and take that into account in the design. Taking data from another ancillary service with some similar features, and run simulations with that is far better than randomly generated data.

6.4 Historical documentation

Example: For the sake of analysing historical events in the grid; even technical, it is beneficial to be able to compare with events in the market and see if there is correlation between the two.

6.5 A step towards transparency

Example: Even if only for sake of curiosity, it is good to be open with data, when there is no good reason to do otherwise. Giving stakeholders access to ancillary service market data can eventually lead to other groups having use of the data. E.g. students of economy, power plant investors and bankers.

There is a systematic approach in Denmark, consisting of monthly publication of the amount purchased and the price settled for this amount. This report is public, but mostly for the use of the market operator (the TSO).

A practical example from Denmark, on the use of data.

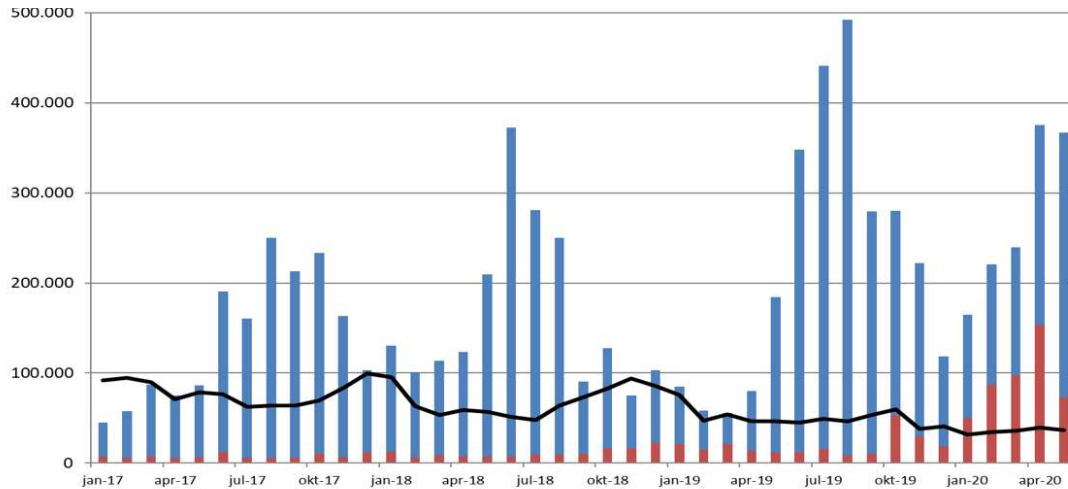


Figure 9. Ancillary Service capacity prices

Legend: (•) German prices – symmetrical (•) Danish prices up-regulation (•) Danish prices down-regulation

The graphics above shows prices for primary reserves (frequency regulation) in two different neighboring markets (western Denmark and Germany). Prices on the Y-axis is Danish currency (DKK) per MW per month. The German prices are shown with the black line. For Germany the up-regulation and down-regulation is shown in one value because the German market for primary reserves is symmetrical. Danish prices are split in blue for up-regulation and red for down-regulation. The graph covers monthly values over almost 3.5 years.

Several interesting pieces of information can be extracted from the graph just by a glance:

- Up-regulation is almost invariably more expensive than down-regulation
- Down-regulation in Denmark has become remarkably more expensive the last 6-8 months
- Danish prices have some seasonality with a wide peak during summer
- German prices have weaker seasonality with an inconspicuous peak late autumn to early winter
- Danish prices have an increasing trend in average over the 3.5 years
- German prices have a decreasing trend in average over the 3.5 years
- German prices are remarkably lower than Danish prices

Apart from these obvious observations, yet another number of interesting things can be extracted if the data are analyzed more thoroughly. More data gives more possibilities, for instance if higher data resolution is available, if it can be categorized further or if it can be compared to other data sets.

Which conclusions can be drawn by professionals having access to such data, and the possibility to analyze them? Some examples could be:

- Market operator and market regulator can tell from the rather smooth seasonality that it is probably a well-functioning market without a dominant market player. The main cause of the seasonality is the need for district heating in the cold months, making ancillary services a cheap by-product to some extent.

- Potential investors can see that Denmark is more profitable than Germany but will have to live with much larger fluctuations. Off course costs in Denmark have to be taken into account.

System operator, being the buyer of the product, can see rising prices in Denmark, and start to consider actions to counter the development. One could be to merge the Danish market with the German market.

7. Conclusion and outlook

It is a prerequisite, or at least a great advantage to have historical data about ancillary services available, when the markets are developed. Each step in the development should make the markets more effective and supporting of an optimized transfer of goods. Even if markets are not in a development stage, it is relevant to follow it and evaluate it.

It will indeed be relevant to look at extending the amount of different data available to stakeholders in the market. Especially when co-optimized markets are implemented, and preferably simultaneously.

We do not include in this deliverable a precise template to gather data in, nor do we pick an exact list of data that should be gathered first in Vietnam. The right first steps will depend on parallel development of other factors in the electricity markets and the transmission grid. The table 1 could be a good inspiration for a start.

From table 1, the most informative values can be picked for a first data gathering and exposure on the web page, and even a roadmap for stepwise exposure of all values can be created for use after the end of this output.

8. References

#	Description
1.	Here some useful sources of information regarding Ancillary Services data: https://thitruong.dien.evn.vn/user/login
2.	The Nordic Power Exchange: https://www.nordpoolgroup.com/
3.	The Nordic Power Exchange specific page about manual reserves: https://www.nordpoolgroup.com/Market-data1/Regulating-Power1/
4.	Energinet's Energy Data Service: https://www.energidataservice.dk/
5.	Energinet's Energy Data Services specific page about Ancillary Services: https://www.energidataservice.dk/collections/ancillaryservices
6.	The European Transparency Platform https://transparency.entsoe.eu/