Demand Response in Vietnam

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Danish Energy Agency

ERAV
Electricity Regulatory Authority of Vietnam

Danish Energy Agency

Disclaimer

This report is developed under the Danish-Vietnamese Energy Partnership Programme (DEPP3) by ERAV, DEA and Energinet. It represents outcomes from the collaboration but does not necessarily represent the official position of each institution.

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Abbreviations

[AS]	Ancillary services
[BRP]	Balance Responsible Party
[DSM]	Demand Side Management
[DR]	Demand Response
[EE]	Energy Efficiency
[ERAV]	Electricity Regulatory Authority of Viet Nam
[EV]	Electric vehicle
[MOF]	Ministry of Finance
[MOIT]	Ministry of Industry and Trade
[PC]	Power Cooperation
[RE]	Renewable Energy
[ToU]	Time-of-use

Executive summary

With reference to the Development Engagement 2 – Capacity Development for Renewable Energy Integration into the Power System, under the Danish Energy Partnership Programme in Vietnam (DEPP III), this report investigated the current and potential status for Demand Response (DR) in Vietnam.

Electricity demand in Vietnam up to 2030 is expected to increase annually between 8.52% and 9.36%. Generation expansion is the main solution to meet power demand in the long-term, but it must be paired with other approaches such as DR to balance intermittent generation and limit necessary investment costs in grid protection. DR employs incentives and benefits for final consumers to provide flexibility to the electricity system, by changing their usual electricity consumption in reaction to price signals, or to specific requests that are adequately remunerated.

The Vietnamese regulatory framework supporting DR is analyzed, as well as previous DR experiences carried out as pilot programmes, highlighting the lack of clear incentives and mechanisms for remuneration of participation to DR events. In Vietnam there is no market for ancillary services, which would be an ideal environment for the exchange of flexibility, and there are no clear roles and responsibilities for the participants in DR activities.

Relevant Danish experiences are presented, giving examples of demand response applications for both implicit and explicit DR. The definition of dynamic tariffs, the smart use of air conditioners as well as the exploitation of the potential given by Electric vehicles can contribute significantly to a more leveled demand curve and bring benefits to all the stakeholders involved in electricity generation, distribution and consumption.

Final recommendations explore the benefits brought by the following actions:

1. Rollout of electric meters and development of IT infrastructure
2. Introduction of multiple-period tariff solutions
3. Creation of a market for ancillary services, allowing participation of flexibility products
4. Development of a clear regulatory framework to support DR
5. Definition of pilot projects with regard to EVs and their role in ancillary services markets

1. Introduction

Within the overarching scope of Demand Side Management (DSM)[1] encouraging final consumers to optimize their energy use, demand response (DR) employs incentives and benefits for businesses and households to provide flexibility to the electricity system, by voluntarily changing their usual electricity consumption in reaction to price signals, or to specific requests that are adequately remunerated. The benefit for the grid can be summarized in Figure 1, which shows a demand curve that adapts better to the generation profile, as it shifts from moments in which there is less power production, to times when the energy generated is greater than the forecasted demand.

1.1. Market-based DR and tariff-based DR

Based on the type of incentive to the costumer, two main options to activate DR are found. They are specifically defined as *implicit*, if they are based on a fixed tariff customers can passively react to, or *explicit*, if they are based on active participation of the customer to the market for flexibility.

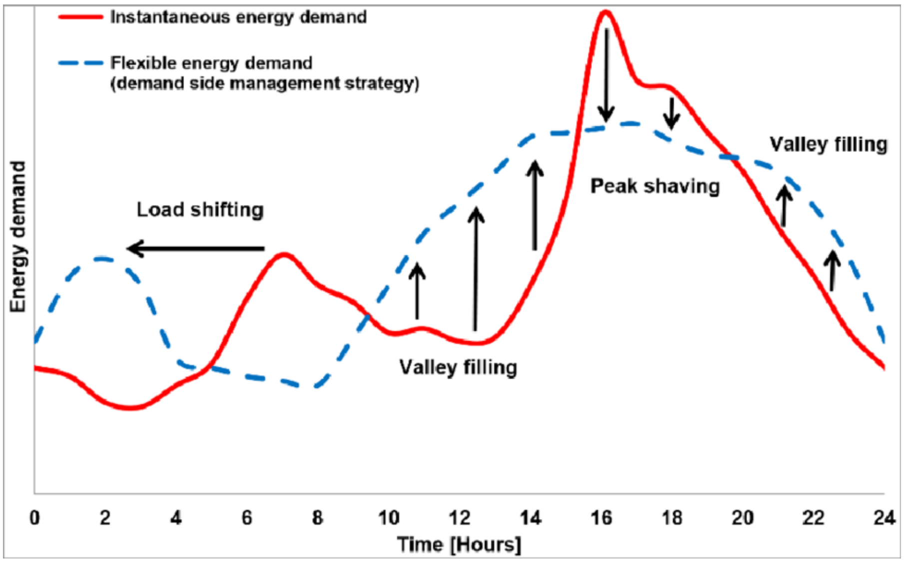

Figure 1 - Example of demand side management [1]

There are several strategies to implement DR within the system. With regard to Implicit DR, **critical peak pricing** describes a set of predetermined timeframes with different tariffs (typically higher during expected peaks), thereby incentivizing consumers to shift their demand towards cheaper timeframes, while **real time pricing** effectively connects the retail electricity price with the market, reflecting the flexible nature of both demand and supply. Both strategies require an electric meter, providing remote communication with the utility, with the same time resolution as the tariff, typically of 1h or 30m.

[1] DSM is a collection of technological, economic and social solutions aimed at improving the flexibility on the consumer side, which implementation involves Energy Efficiency programmes and Demand Response

Active participation to the market through DR is achievable in different ways, some more relevant for residential and small commercial consumers, others more relevant for large consumers and aggregated loads. In the case of **demand reduction bidding**, large load curtailments (>1MW) are offered by large consumers or by aggregators as additional capacity, to replace conventional generation when needed. Incentives usually consist in upfront payments for reservation, payment per MWh curtailed and penalties for failing to curtail when asked to. Another possibility is the **provision of ancillary services** (AS), accessing balancing markets and negotiating energy loads to ensure the reliability of the system through, for example, frequency control in case of generation failure or prediction errors. Operating reserves are power generators able to respond quickly to signals and compensate for under-generation. Payment schemes vary according to the amount of capacity committed.

1.2. Aggregators

Many of the strategies for DR require considerable loads to be dispatched, at times higher than what a single large customer can commit to. The role of the aggregator in demand side markets is to act as mediators between the customers, who are willing to sell their flexibility to the grid, and the relevant Balance Responsible Party (BRP), who is financially responsible for maintaining the balance between supply and demand at specific access points of the grid. A simplified market model allowing for consumers to sell their flexibility is portrayed in Figure 2.

Aggregators collect the flexibility of individual consumers and aggregate them, to bid them as one large load in the various balancing programmes for additional capacity. Initially targeting larger commercial and industrial users, the focus of aggregators is evolving together with the development of the market, and extended also to the creation of aggregated portfolios with smaller distributed loads, in some cases taking the responsibility for the installation of metering and control equipment on the customer side.

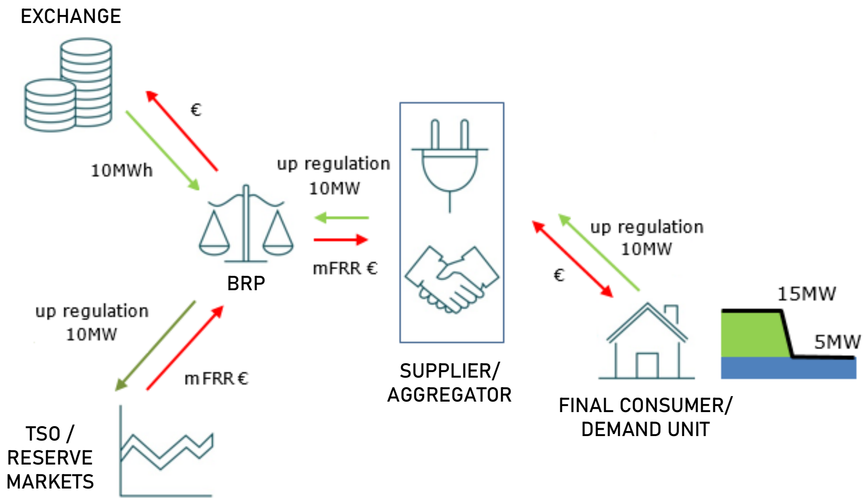

Figure 2 - Model of market for flexibility (modified from [2])

2. Status of Demand Response in Vietnam: needs, potentials, cases

Vietnam continues to experience high economic growth compared to regional and global economies. Average GDP growth rate reached 7.26% during 2001-2010, dropped to around 5.91% during 2011 - 2015 and has gradually recovered at 6.8% from 2016 to present. This economic growth goes together with an increased demand for electricity.

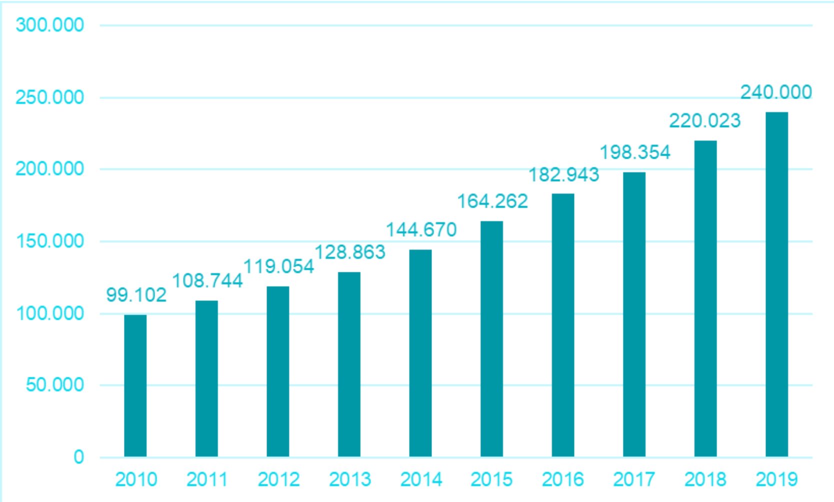

Figure 3 - Electricity demand in Vietnam in GWh (2010-2019) (Data from ERAV)

As evident from Figure 3, electricity demand in Vietnam has grown at a CAGR of 10.3% from 2010 to 2019. Treading this growth path, the forecasted electricity demand in Vietnam according to the Draft National Power Development Plan VIII is expected to increase on an average range from 8.52% to 9.36% annually till 2030. Generation expansion is the main solution to meet power demand in the long-term, but it must be paired with other approaches such as DSM to balance intermittent generation and cover demand peaks with increased flexibility, as well as to limit the necessary investment costs in grid protection.

DR was first introduced by Circular 23/2017/TT-BCT [3] dated November 11, 2017 and then further institutionalized by Decision 279/QĐ-TTg [4] dated March 8, 2018, Decision 17/QD-BCT [5] dated January 28, 2019 and Decision 54/QD-DTDL [6] dated June 12, 2019. Detailed guidance in term of process, monitoring and evaluation as well as institutional arrangement have been well described in these legal documents.

Two pilot programmes for DR, which details are reported in Table 1, were carried out in Vietnam, but they were implemented on a voluntary basis with very limited incentives and payments, which made it difficult to convince customers to continue participation in the programmes. There was a need for better targeting potential DR customers, as participation from industrial customers requires much higher incentives, compensating their potential revenue losses or costs incurred in shifting production processes.

Table 1 - DR pilot projects carried out in Vietnam

Year of implementation	Details
2015	Two types of DR programmes were conducted under these pilot studies, Curtailable Load Programme (CLP) and Voluntary Emergency Demand Response Programme (VEDRP). Suitable customers are defined to be industrial and commercial customers who consume more than 1,000 MWh per year and who have electronic meters for remote data collection.
2019	EVN had instructed the National Load Dispatch Centre and Power Corporations (PC) to implement DR programmes under Circular 23. / 2017 / TT-BCT dated November 16, 2017 and Decision No. 54 / QD-DTĐL dated June 12, 2019 of the Ministry of Industry and Trade (MOIT) guiding DR implementation. NLDC and PCs had actively organized surveys, assessed DR potential, signed DR implementation agreements with customers, instructed PCs on non-commercial DR implementation process (DR agreement template, notification, verification of basic load routing, calculation of implementation results); developed demand response management software, completed, and applied at 5 PCs.

ERAV concluded that public sector customers (university, public buildings, etc.) could have presented better opportunities but were not approached in these pilot programmes. The DR incentives that were offered were not sufficient as EVNCPC allocated a limited amount of 20 million VND to the provincial PC for each MW reduction and the PC decided to pay customers only partly for their efforts to engage in DR.

2.1. Brief timeline of DR implementation in Vietnam

From 2007 to 2015, pursuant to the Minister of Industry and Trade (MOIT) Decision 2447/QD-BCN [7] dated 17/7/2007 on Approving the National Programme for Power Demand-side Management, EVN implemented DR-related initiatives including customer education and equipment audits, as well as upgrades at the customer end.

In 2015, in line with the Prime Minister's Decision 1670/QD-TTg [8] dated November 8th 2012, approving the Smart Grid Development Project in Vietnam, and with Decision 2324/QD-BCD [9] of March 19th 2014 by the Steering Committee of the Smart Grid Development Programme, EVN-HCMC rolled out a pilot DR programme in Ho Chi Minh City (HCMC) for large commercial and industrial customers.

Following the EVN-HCMC pilot and the learnings it provided, on November 2017, **Circular 23/2017/TT-BCT** [10] was issued by the MOIT on Prescribing Contents and Processes for Implementation of Load Adjustment Programmes ("Circular 23").

In 2019, following the Prime Minister's **Decision 279/2018/QD-TTg** [11] of March 8th 2018 on the National Program on DSM period 2018-2020 with a vision for 2030, all participants implemented

DR events on a voluntary basis and without any financial incentive. MOIT is officially tasked to lead national demand-side initiatives, including DR.

From the governmental decisions described above, it can be seen that DR has been carefully examined and gradually phased in since 2006. NLDC projections for long term scenarios indicate that the country will face potential supply shortages in the coming years [12], therefore Vietnam has more recently undertaken a national-scale demand response rollout to help maintain supply balance, quality and reliability of power services. Reported in Table 2, Circular 23 explores a wide range of possibilities to participate in DR, from dispatchable and incentive-based programmes, to voluntary programmes. At the time of writing, only non-commercial and voluntary DR programmes have been executed. [3]

Table 2 - DR programmes defined in Circular 23

Dispatchable Incentive-based DR Programmes
Curtailable Load Programme - CLP The CLP targets industrial and commercial customers with flexible production lines and low to high consumption, fostering efficiency and cost reduction for the marginal unit of electricity.
Emergency Demand Response Programme - EDRP Targeting industrial and commercial customers with flexible production lines able to reduce electricity demand rapidly, the EDRP is designed to ensure power system reliability. Demand response is deployed in the event that the power system is overloaded.
Non-dispatchable Time-based DR Programmes
A ***two-tiered electricity tariff programme***, comprised of a demand charge and an energy charge. Customers actively decide to adjust their demand to respond to price signals, especially within the defined peak time period, to reduce electricity billing.
Real-time peak-load electricity tariff programme, targeted at industrial and commercial customers. The tariff includes a ToU tariff and a special tariff for actual peak time periods, announced on a case-by-case by authorized operators.
Non-commercial DR Programmes
In this model, there is no financial incentive. The reward can be a “advantage” in the form of preferential treatment if load curtailment is implemented as a last resort measure to maintain integrity of the power system.
Voluntary DR Programmes
As envisaged in Circular 23, in this model, there is no financial incentive. The reward may be in the form of goodwill as the customer is seen as contributing to social good. It is unclear whether and how a corporation can incorporate such goodwill in its accounting system.

2.2. Regulation of Demand Response in Vietnam

The laws and regulations that directly relate to DR are:

- Electricity Law (28/2004/QH11 and revision 24/2012/QH13);
- Decision 2447/QD-BCN dated July 17, 2007, from MOIT on approving the national programme for power demand side management (DSM 2007–2015);
- Decision 1670/QD-TTg dated 8/11/2012 from Prime Minister approving Smart Grid Development Programme in Vietnam;
- Decree 137/2013/ND-CP dated 21/10/2013 regulating detail implementation of Electricity Law and its revision, amended few articles of that Law;
- Circular 19/2017/TT-BCT dated 29/9/2017 from MOIT, related to methodology and process for demand side study;
- **Circular 23/2017/TT-BCT dated 16/11/2017 from MOIT on Prescribing Content and Processes for Implementation of Load Adjustment Programmes**;
- Letter 6017/BCT-DTDL dated 31/7/2018 from MOIT, related to implementation of DR programme for 2018-2020, with vision to 2030;
- **Decision 279/2018/QD-TTg dated 8/3/2018 from Prime Minister, approving National programme on Demand Side Management (DSM) for 2018-2020 with vision to 2030**;
- **Decision 175/QD-BCT dated 28/01/2019 from MOIT on Approving the Implementation Plan and Roadmap for the DR Programme**, with the following specific objectives:
    - *Develop and propose policy mechanisms, financial mechanisms, incentive mechanisms for legal framework in order to implement DR programmes;*
    - *Implementation of DR programmes with an integration with DSM programmes. After 2020, DR will be implemented in a voluntary and proactive basis;*
    - *Reduction of 30% of peak load compared with DSM programmes, in detail: 90 MW in 2020, 300 MW in 2025, and 600 MW in 2030;*
    - *Improvement of national power system's load factor; implemented at each distribution substation (transformer);*
    - *Reduction of 500-220 kV transmission power loss (North – Central – South line);*
    - *Combination of DR implementation with distributed renewable energy investment by customer, especially rooftop solar PV and energy storage system (ESS)*
- **Decision 54/QD-DTDL dated 12/06/2019 of ERAV on Procedures for Implementing DR programme which includes:**
    - *The Procedure for registering for a DR programme*;
    - *The Procedure for calculating baseline loads and informing them to customers who register for demand response programmes*;
    - *The Procedure for calculating the curtailable volume of electricity and the amount of incentive money for a customer upon demand response.*

2.3. Demand Response potentials in Vietnam

DSM assessment study for Vietnam – World Bank (1997)

A “Demand-Side Management Assessment for Vietnam” study was commissioned by EVN in 1997, with World Bank assistance, to determine the potential for DSM in meeting future power requirements of the country. The DSM Assessment concluded that DSM had a potentially significant role to play in managing the growth of electricity demand in Vietnam and identified important opportunities for cost-effective electricity savings in several sectors and end-use applications. It recommended a two-phased approach for implementing DSM, which would save an estimated 680 MVA of capacity and more than 3,550 GWh/yr (about 5 million toe) by the year 2010 [13].

Energy Efficiency savings potential – ASEAN Centre for Energy (2011)

The 3rd ASEAN study forecasts final energy consumption to reach 6.384,9 PJ by 2030 under Business-As-Usual (BAU) conditions, and 5.945,3 PJ if energy efficiency initiatives are effective. There would thus be savings amounting to 6% yearly by 2030. The sector wide energy consumption savings under this study up to 2030 is shown in Table 3.

Table 3 - Final energy consumption savings by sector [14]

Sector	Final Energy Demand Savings (PJ)		% Reduction	
	2020	**2030**	**2020**	**2030**
Industry	108,9	309,8	9.7%	10.9%
Transport	0,0	0,0	0.0%	0.0%
Residential & Commercial	67,0	129,8	5.0%	7.7%
Total	**184,2**	**439,6**	**5.4%**	**6.9%**

Energy Efficiency savings potential – Vietnam Energy Outlook (2019)

The Vietnam Energy Outlook Report 2019 presents five scenarios exploring different least-cost development pathways of the Vietnamese energy system, as per Figure 4. The report shows that enhanced EE and development of RE at the highest level can deliver large and cost-effective CO_2 reductions and reduce air pollution and dependency on fuel imports. Figure 4 shows the projections for energy savings for different end-use sectors in 2030 and 2050 in PJ. [15]

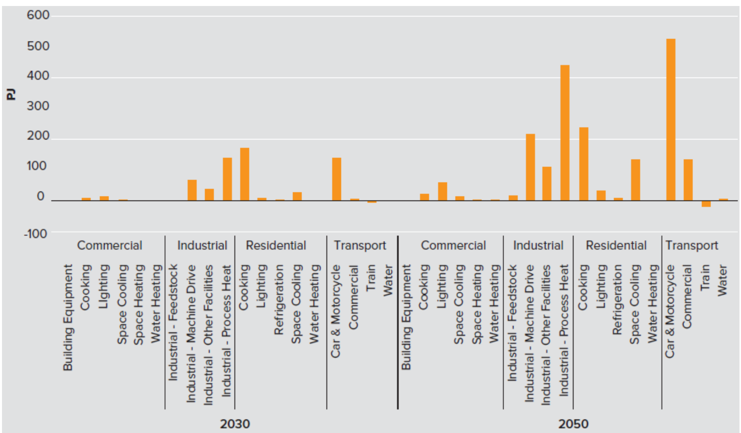

Figure 4 - Energy savings from VEOR2019

Penetration of Electric vehicles in the Vietnamese market

The pledge for carbon neutrality in 2050 expressed by the Vietnamese Prime Minister at the COP 26 clears the way for the development of less polluting solutions across multiple sectors. This includes the transportation sector, which will likely see a sensitive growth in the demand for electric vehicles (EVs). As per Bloomberg, the global electric automobile market is expected to reach more than 90 million vehicles by 2030, with Hanoi alone expected to have 11 million electric motorbikes by 2025.[16] Vinfast, domestic car manufacturer part of VinGroup, already sold 50,000 e-motorbikes in 2019 and is anticipating an increasing demand in EVs, expecting to build 30,000-50,000 charging stations and to sell 20,000 electric cars as well as 1,500 buses by 2022. [17]

According to preliminary results for the Vietnam Energy Outlook Report 2021, the share of EVs in the system could undergo a remarkable development, with assumptions for at least 30% of individual vehicles being electric by 2030. Preliminary results for the Paris Agreement scenario indicate a continuous trend up to 2050, with a share of 75% of all cars being electric and a total of 141,534 GWh battery capacity potentially connected to the grid. Policies by the government, such as Decree 10/2022/ND-CP, promote the consumption of electric vehicles in the local market and could prove essential for the future development of the sector. With effect from 01/03/2022, the tax on various types of battery-run EVs will indeed be reduced by 3-12 percentage points from the current levels of 5-15%, while the first registration fee will be set to 0% for 3 years. [18]

When not in use, EVs connected to the grid can function as a dispatchable electricity load increasing the flexibility of the system. As seen from international experiences, the significant capacity resulting from the aggregation of charging vehicles can be managed according to the preferences of the users on one side and the needs of the system on the other.

If flexibility is not achieved, EVs can impose large challenges for the distribution grid and potentially expensive grid reinforcements. In Figure 5 the distribution of time when vehicles arrive home is used to calculate the expected aggregated charging load, which is forecasted to have very high values and will pose consistent threats to the grid if not managed properly.

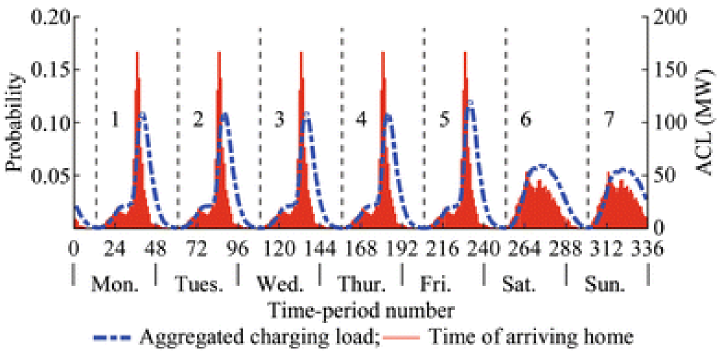

Figure 5 – Aggregated charging load and distribution of time when vehicles arrive home in the week [19]

2.4. Barriers hampering roll-out of DR in Vietnam

Implementation guidance for DR events is ready from the technical and institutional standpoint, however financial supporting mechanisms are still missing. After years of pilot implementation, all PCs have faced challenges in encouraging customers to participate in DR events due to lack of financial incentives, as benefits for participants are not significant nor clear. Without financial incentives, the level of participation of customers has decreased over time.

Direct compensation for customers participating in DR events has been applied during a pilot programme in Ho Chi Min City (EVN-HCMC) in 2015 from the Science and Technology Fund. However, this mechanism is mainly appropriate for short-term, pilot-type implementation. As a matter of fact, DR is not recognized as an ancillary service in Vietnam like in other international power markets, so expenses associated with the implementation of DR are not eligible to be accounted as business expenses and PCs are not able to pay direct compensation to customers, nor deduct their power bills as bonus. [20] [21]

With regard to the regulatory treatment of DR-related costs, MOIT proposed to consider expenses to compensate DR programmes as reasonable costs and to include them into "production and business costs", but MOF noted that direct expenses are only those that relate to business activities such as electricity generation, transmission, or distribution. MOIT argued the role of DR as flexible availability of supply and the possibility to consider DR-related "negative generation" costs as a direct expense as "positive generation" costs are. MOF noted however that they will not make that call and have referred MOIT to other government institutions.

MOF suggested that the MOIT coordinates with the Commission for the Management of State Capital at enterprises to clarify the legal basis and propose the necessary amendments to the financial management mechanism of EVN[2]. A Time of Use (ToU) mechanism has been reflected in the existing tariff structure. For years, the ToU mechanism has contributed to shifting demand toward off-peak hours. However, the difference between the time differentiated tariffs is not significant enough to attract DR implementation. Additionally, as the power system evolves, the definition of peak hours needs to be more dynamic in order to increase the efficiency of the ToU mechanism.

It is essential that all the above-mentioned barriers would be resolved in the future. Recommendations for policy improvement will be the starting point for policy makers in MOIT to initiate intervention in the power sector and establish effective mechanism for DR implementation.

[2] As per current mechanisms, NLDC will calculate the needed capacity for single DR events, then EVN will give quotas for each PCs. PCs will work with customers to encourage their participation in DR events.

3. Danish experiences

3.1. Flexibility in district heating

Denmark developed since the 1970s an extended network for district heating, serving the vast majority of the country. The heat to warm the water in the network is historically provided by waste heat from power plants, but recent years have seen the introduction of more and more electric boilers and large heat pumps in the system, which guarantee additional flexibility in the management and consumption of resources. The graph in Figure 6 depicts the weekly operation of a local district energy plant in central Denmark, showing production of energy units, electricity prices and total heat demand for each hour. It can be noticed how large electric boilers (orange in figure) are operated at times of low electricity prices (off-peak) to heat up water that will be stored for later use, thereby limiting the need for dedicated CHP plant heat production and offering flexibility to the grid. [22]

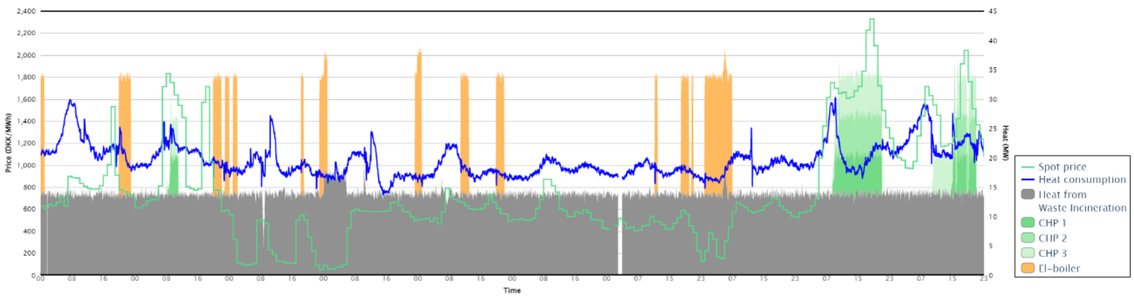

Figure 6 - Svendborg District Heating, 25/10/2021-03/11/2021

3.2. Parker project (2016-2019)

Building on the findings of a previous project (Nikola – Intelligent Electric Vehicle Integration, 2013-2016), the Parker project was a Danish project partnering with Nissan, Mitsubishi and NUUVE, among others. It focused on Vehicle-Grid Integration (VGI) with the aim to demonstrate that contemporary electrical vehicles could participate in advanced smart grid services including the use of Vehicle-To-Grid (V2G). With a small fleet of 10 EVs connected to an existing commercial hub, the project tested different services providing support to the power grid both locally and system-wide, and demonstrated scalability in different directions (different services, brands, battery sizes, number of cars). It established a commercial V2G hub that provided frequency services for 13,000 hours for a single car, with average annual revenue of €1,860/car and final recommendations for a full electrification of the transport sector. [23]

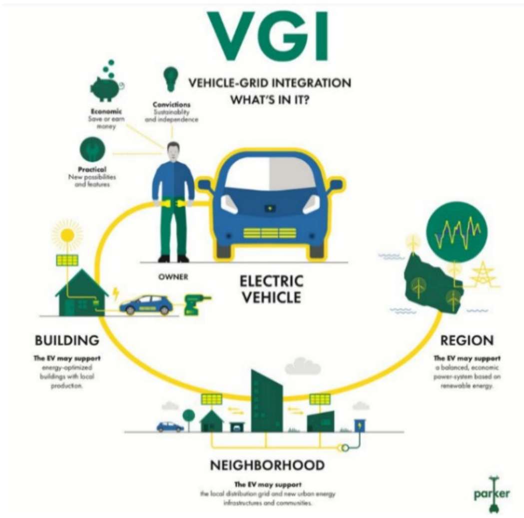

Figure 7 - Vehicle Grid Integration model

3.3. EcoGrid 2.0 (2016-2019)

Power plants have historically regulated the production of electricity to follow demand, but the transition to variable renewable energy resources creates a challenge when renewable energy production is low and demand is high. The project EcoGrid 2.0 attempted to regulate electricity to follow production, harnessing demand-side flexibility by managing the charging of EVs and heating in houses. The project demonstrated an electricity market with small-scale flexible power consumption in private households, with technology available in Denmark today. 1,000 heat pumps[3] and electric radiators were remotely controlled on the Danish island of Bornholm, in an attempt to optimize the power consumption in line with the amount of power available in the system at any given time. Over one hour, consumption could be increased by 559kW or decreased by 300kW. High quality forecasts for baselines (to predict consumption) were generated through machine learning over historical data. Analyzing comfort levels and requirements from homeowners to allow for third-party remote control of power consumption, the project also developed the link between households and the electricity market by introducing aggregators as a new stakeholder in the market. It was found that private households are willing to let others manage their heating to provide flexibility, but confidence in those managing the consumption plays a key role, and this process is partly relationship-driven. At the same time, when an aggregator manages and pools flexible consumption it requires specialised expertise, large amounts of data and new tools, as the amount of flexibility each household can deliver must be estimated at any given time. Moreover, the project concluded that for a successful participation of households to DR, technical complexities must be removed and simple user interfaces must be employed. Flexibility must be introduced in a simple way and built on existing habits. [24]

Figure 8 - Illustration of EcoGrid 2.0 project on the island of Bornholm

3.4. Smart meters and tariffs

Until 2016, a consumer in Denmark who selected a new supplier would receive two electricity bills, one from the distribution company (grid tariff and taxes), and one from the supplier. Today, the system has been simplified for the consumers, and only one bill is sent. The supplier also includes grid tariffs and taxes, as seen in Figure 9a, and the supplier is thus the only contact point for the consumer.

[3] A heat pump is essentially a reverse air-conditioner, using the refrigeration cycle to warm the interior of a building or to heat domestic hot water

Since the end of 2020, all consumers are connected to an electronic meter with remote reading and hourly settlement. This made it possible for customers to buy electricity via innovative contract types, among which ToUs or spot prices with hourly prices. As an example of technologies that can benefit from hourly prices, heat pumps are available today with a connection to the internet and the ability to gather spot prices. The consumer can indicate on a scale from 1 to 5 (separately for space heating and hot water) how sensitively heat generation should be adjusted to prices, providing the adjustable balance between the preference and satisfaction of the user and the needs of the grid. EVs can also be charged in a similar way. While flat DSO tariffs have been prevailing since 2003, the use of ToU tariffs is now spreading. For households, ToU tariffs have two steps (see Figure 9b below). The peak period is defined as between 17:00 and 20:00 during the months from October to March. For companies, a three step ToU is used. [25]

The clear advantage of a wide distribution of smart meters consists in the simplicity in billing and the transparent communication of the tariffs in every monthly bill, while ToUs did not impose on consumers a firm commitment, offering instead the freedom to decide when and how to react to price signals. The challenge is finding an optimal difference between time intervals and price levels, such that a higher responsiveness could benefit the whole power system, as well the consumers themselves.

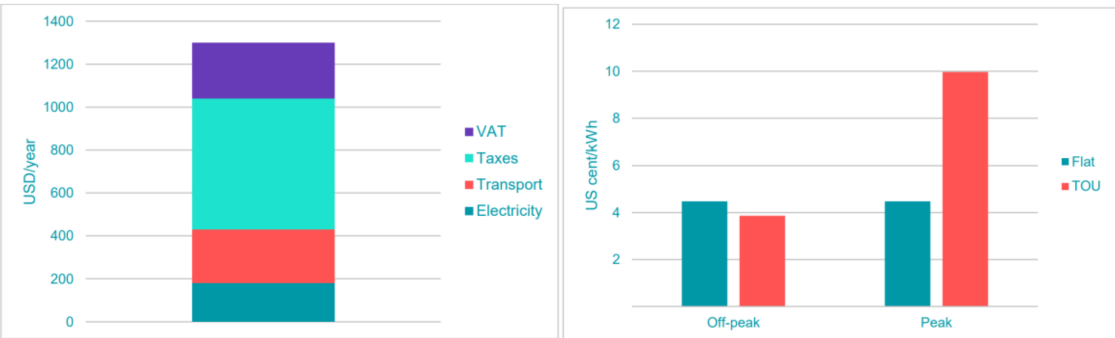

Figure 9 – a) Typical composition of electricity bill for a Danish household and b) Comparison between DSO tariffs (flat and ToU) for electricity in Copenhagen

3.5. True Energy (2018)

Established as a start-up in 2018 and bought by Landis+Gyr in April 2021, True Energy is a technology company that allows for automated and intelligent charging of a personal vehicle, monitoring the hourly price for electricity and choosing optimal periods when electricity is cheapest and produced by renewable energy sources, instead of thermal power plants. By participation in the market for FCR, True energy combines this service with smart grid integrated flexibility services and provides EV owners with an easy way to save money while lowering the CO2 emissions of the energy system. [27] The success of the company has been due to the proven economic savings due to charging flexibility and by the simplicity of the user interface, represented by a smartphone app, which contributed to the active participation of consumers.

3.6. Local flexibility in Lolland (2019-present)

As the transmission network does not expand quickly enough to cover the needs of extended renewable energy generation, the Danish TSO and DSO started a project as a joint collaboration to regulate local production and consumption, by means of dynamic tariff design and differentiated network products. While investments in the network allow for expansion and more interconnected possibilities, the focus of the project is on a transition option in the short term, specifically market solutions for trading local flexibility and procedures that can be readily implemented with currently available technology. Regulating the ramping up or down is achieved by activating/deactivating several smaller units individually, with an appropriate delay in between, achieving a ramping of 15 minutes and a limit of 3MW for on/off regulation. With the electrification of the heating and transport sector with heat pumps and EVs, the capacity of the distribution network will be challenged and trade with local flexibility can represent one of the solutions. Activation and control of flexibility, however, becomes more complex the lower the specific voltage level. Today there is no market where distribution companies can trade flexibility, therefore a new market platform must be implemented to allow it in the future or changes have to be made to the existing platforms in order to handle bids also from the distribution companies. The related costs, together with the uncertainty of commercial liquidity, will prompt distribution companies to look also at other measures that can promote flexibility in the network and move consumption away from bottleneck situations. Such solution can be for example a network connection with limited network access, where consumers receive a discount when the distribution company interrupts their connection, time variable tariffs to shift consumption away from peaks, and specific reinforcements to the network, if the system capacity is challenged on a daily basis. [26]

3.7. Flexibility in shopping malls (2020)

In the context of a green transition and conversion of the electricity system towards more interconnection and more variable renewable energy generation, a collaboration between Siemens and the Danish TSO, Energinet, demonstrated how cooling and ventilation systems could aid the stability of the grid. The investigation focused on a shopping mall in Ballerup, Denmark, which was effectively modeled as a virtual power plant, with the possibility of choosing when to turn on/off appliances in order to deliver frequency regulation (FCR). The results were very optimistic, although it would require several shopping malls to merge their flexibility, in order to play an active role in the market. Siemens has identified a potential of 10MW for the region in the short term, and up to 100MW in the long term, connecting the energy management system of buildings to the AS market. It is believed that the transition of shopping malls to virtual power plants will have only limited costs, with a payback period of 3 to 4 years. [28]

4. Recommendations

After consideration of the information gathered on the status and potential for DR in Vietnam, and with reference to Danish experiences in the development of options for demand side flexibility, it can be concluded that at present Vietnam faces considerable barriers to the participation of consumers to the exchange of flexibility products.

Vietnam does not have a regulatory structure in place to enable participation of demand side resources in the markets, and the process of defining the role of independent aggregators and DR service providers have not yet commenced. At the time of writing, there appear to be a lack of a defined party to offer the service, a lack of a way to measure or pay for the service and no markets in which consumers or aggregators can sell demand side flexibility.

Therefore, these following recommendations are proposed:

1. **Rollout of electric meters and development of IT infrastructure**

Detailed remote monitoring of energy consumption is essential for the participation of consumers to participate in DR activities, offering the possibility to create adequate baselines for demand over historical data or to quantify the individual consumption over specific time periods, in the case of time differentiated tariffs. The consumers will benefit from more information and control over their use of energy, gaining financially by adjusting to price signals. It is recommended that Vietnam ensures a standardized rollout of electric meters that can be read remotely, at least hourly resolution, as it represents one of the first steps to establish a DR infrastructure. Data-driven DR entails the exchange of information among several actors in the system at a fast pace. A high level of digitalization and interconnectivity is an essential element for the success of DR and it is recommended to ensure the development of appropriate IT platforms for communication and control, to foster and aid the development of flexibility resource exchange in the country.

2. **Introduction of multiple-period tariff solutions**

The objective is to introduce framework conditions that will avoid or lower congestion of the grid during peak-load hours. Higher congestion will require considerable investments in the future to reinforce the grid, resulting in higher costs for the customers. However, electricity consumption is not evenly distributed over the year and over the day. If the electricity consumption can be levelled out, reinforcements can in turn be avoided, which will mean less costs for the consumers. This can be achieved in the short term by introducing time-of-use tariffs to convey clear price signals to customers, who will react by changing their consumption patterns when possible. Before the development of more dynamic tariff solutions, it is recommended to design, communicate and introduce a cost reflective tariff that will separate the price for electricity generation from the cost of maintenance of the grid, and allocate charges for the defined time periods that are different enough to provide sufficient incentives for the consumers to adapt their demand.

3. Creation of a market for AS, allowing participation of flexibility products

With the goal to safeguard security of supply and efficiency of the electricity market in mind, a review of the current market design should foresee the inclusion of dispatchable flexibility resources. The flexibility market should initially be built upon the existing need for ancillary services, namely frequency regulation, subsequently extending the participation of flexibility products to capacity markets. It is therefore recommended to introduce a balancing market, ensuring easy access to flexible demand units willing to participate in the bidding mechanisms. To achieve it, focus shall be put on several elements that could otherwise present barriers to the participation of flexible consumers.

- A simplified process of prequalification should be defined for flexibility resources in balancing mechanism.
- There should be no minimum bid size to access the market, in order to engage consumers or aggregators with a lower flexibility portfolio.
- Short time steps (eg. 15 minutes) should be envisioned, to allow demand units to participate to the flexibility market with a limited time commitment.
- The gate-closure time of the market should be close to real-time of electricity dispatch.
- Asymmetrical bids should be allowed, allowing consumers to participate only in down- or up-regulation, as that would favor VRE power generators.

4. Development of a clear regulatory framework to support DR

Roles and responsibilities in the market for each actor must be clearly defined. To allow aggregation providers to enter the market in a safe and scalable manner, it is critical that relationships between retailers, BRPs and aggregators are clear, fair and allow for fair competition. Standardized frameworks and processes should be put in place to enable the smooth functioning of the market and at the same time protect the customer-aggregator relationship.

Clear and fair rules shall be also defined to calculate the volumes traded and its compensation. Proper baseline methodologies should be applied, to calculate as accurately as possible "business as usual" consumption and to account for curtailment measures during a DR event. Price formulas should then reflect the loss of revenue by the retailer, who previously bought energy that is not going to be consumed because of DR participation.

5. Definition of pilot projects with regard to EVs and their role in AS markets

As mentioned in chapter 2.3, several sources indicate a remarkable growth in the demand for EVs in the coming year. A large fleet of vehicles connected to the grid can represent a valuable resource, if their flexibility potential is properly tapped. As the demand for EVs will grow, lacking infrastructure will hinder their penetration, therefore a planned extension of the infrastructure for servicing EVs, such as electric charging stations and service stations, should be ensured. In particular, charging stations should be designed allowing for future integration in the market for flexibility. Pilot projects investigating how vehicles at charging stations can help the stability of the grid are recommended.

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