Demand Side Bidding in the WESM

Part 2

MARCH 2022

This Report is prepared by the
WESM Technical Committee

Executive Summary

The control and management of demand in the Philippine electric power industry have been a long-standing policy of the government. In fact, the Department of Energy (DOE) and Energy Regulatory Commission (ERC) have issued various demand control and management policies to encourage demand side participation and energy efficiency, among others. One of the policies introduced in this regard is the submission of demand bids in the Wholesale Electricity Spot Market (WESM), allowing the demand side to participate in the trading activity. However, since the launching of WESM in 2006, the trading activities have always been confined to the supply side even when the rules and the Market Management System (MMS) already have provisions for Demand Side Bidding (DSB).

In 2021, the WESM Technical Committee (TC) conducted consultations with participants on DSB to know their level of knowledge in terms of potential benefits, risks, and challenges related to DSB and its implementation. Subsequently, the TC prepared this report to further explain the available demand side management programs and provide its initial results in its attempt to quantify the benefits of DSB based on a one-year demand and prices in the WESM. While there are more factors that need to be considered in the presented proposed methodology, the TC, based on its initial calculation, illustrates that with submission of demand bids in the WESM, there will be a potential reduction in Load Weighted Average Price (LWAP), to the benefit of the customers.

The TC believes that DSB is an important program to empower the demand side and it will benefit the industry stakeholders with the necessary support and guidance from the policy and regulatory bodies.

Hence, the TC recommends the following activities for consideration of PEMC, DOE, and/or ERC to further encourage participation and promote the active implementation of DSB in the WESM:

1. Focused consultative discussions and coordination meetings with industry players, DOE and ERC;
2. Critical review of relevant documents and formulation of DSB procedures and guidelines;
3. Formulation of implementation plan for active participation in DSB; and
4. Joint effort of DOE, ERC, and other stakeholders in support for participants' readiness.

Contents

1.0 PURPOSE OF THIS DOCUMENT

This report is a follow through to the market participant consultation conducted by the Technical Committee (TC) last March 2021 and aims to:

1. Provide additional information on DSB within the context of demand-side management in the Philippine electric power industry
2. Provide a method to estimate the potential financial benefits of DSB to the WESM
3. Provide general recommendations on the implementation of DSB in the WESM for the consideration of the PEM Board, DOE, and ERC.

2.0 BACKGROUND

The control and management of demand in the Philippine electric power industry have been a long-standing policy of the government. In fact, the DOE and ERC have issued various demand control and management policies to encourage demand side participation and energy efficiency, among others.

As indicated in the DOE's Philippine Energy Plan 2016 – 2030, initiatives on Demand-Side Management (DSM) and Demand Response (DR) for energy efficiency measures are considered as prime areas of focus to temper the country's energy requirements[1]. DSM refers to initiatives and technologies that encourage consumers to optimize their energy use[2] such as via utilization of smart energy technologies, advanced metering infrastructure (AMI), energy storage system (ESS), and other demand-reducing measures. DSM encourages load reduction or other long-term changes to consumption pattern. DR Programs, on the other hand, specifically involves short term individual actions by the consumer and encourages consumer flexibility. It refers to provisions enabling changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized[3]. Figure 1 shows an illustrative example of how the DSM program is structured which includes DR programs. Aside from DR, DSM also includes employing energy efficiency strategies, which the Department of Energy has been actively promoting with its Energy Efficiency and Conservation Roadmap[4]. DSM may also include strategic load growth which is usually tied with key technology developments such as in electric vehicles and in storage devices.

[1] Department of Energy (DOE), Philippine Energy Plan 2016-2030, 2016
[2] Energy Market Authority (EMA), 2017
[3] Federal Energy Regulatory Commission (FERC), 2020
[4] Department of Energy (DOE), Energy Efficiency & Conservation Roadmap 2017-2040, https://www.doe.gov.ph/pep/energy-efficiency-conservation-roadmap-2017-2040

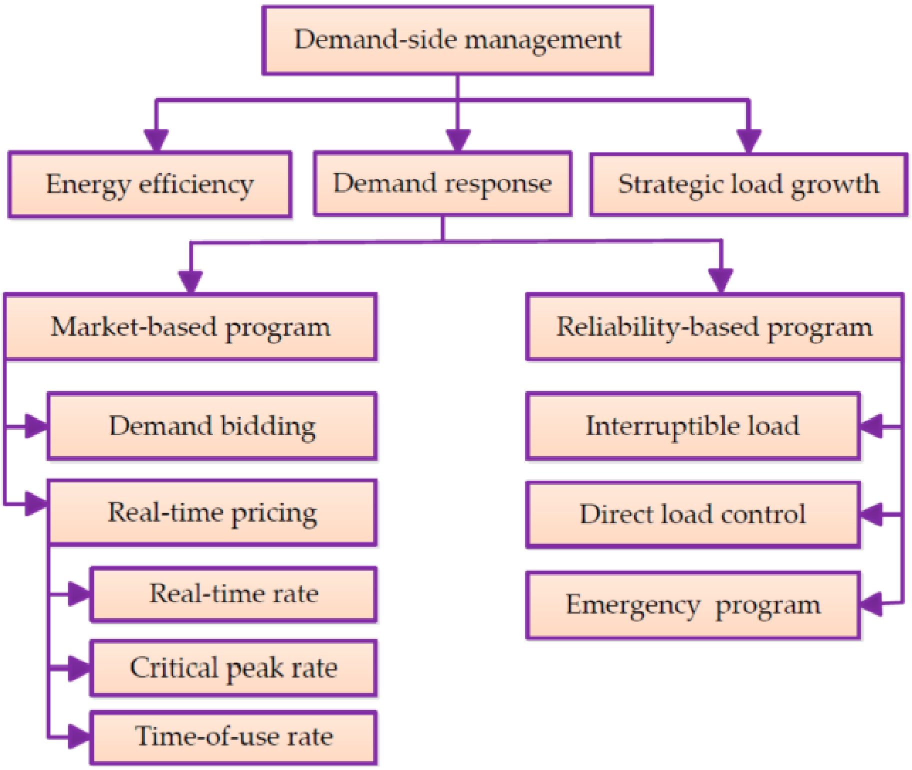


Figure 1. Illustrative example of DSM Program Structure[5]

Provided below are the existing demand control and management policies and programs in the Philippines and how it may relate to the future implementation of DSB in the WESM:

2.1 Demand Control Program

The Philippine Grid Code (PGC) introduces the concept of demand control which is defined as the reduction in demand for the control of the frequency when the Grid is in an emergency state. Demand control includes automatic load dropping (ALD), manual load dropping (MLD), demand reduction on instruction by the System Operator (SO), and Voluntary Demand Management. These demand control programs can be classified into two categories which are mandatory load curtailment and voluntary demand management.

i. Mandatory Load Curtailment

Mandatory Load Curtailment applies to alert and emergency conditions which are based on technical considerations. This includes the following processes:

- Automatic Load Dropping or ALD is practiced by the SO by establishing the level of demand required for Under-Frequency Load Shedding (UFLS) and Under-Voltage Load Shedding (UVLS) in order to limit the consequences of significant incidents or a major loss of generation in the grid.

[5] Jabir, Hussein & Teh, Jiashen & Ishak, Dahaman & Abunima, Hamza. (2018). Impacts of Demand-Side Management on Electrical Power Systems: A Review. Energies. 11. 10.3390/en11051050

- Manual Load Dropping or MLD requires the involvement of the User by making arrangement that will enable it to disconnect its Customer immediately following the issuance by the System Operator of an instruction to implement MLD. MLD involves manual and deliberate removal of pre-selected loads during abnormal system conditions to maintain system integrity.

ii. Voluntary Demand Management

Voluntary demand management can be done by market participants during normal and alert conditions and involves financial considerations. The PGC provides the guidelines on voluntary demand management which can be classified as – Demand Disconnection initiated by a User, Customer Demand Management, and Voluntary Load Curtailment. These voluntary demand management programs require direct coordination with the SO.

Customer Demand Management is defined in the PGC as the reduction in the Supply of Electricity to a consumer of electricity or the Disconnection of a Customer in a manner agreed upon for commercial purposes, between a Customer and its Generation Company, Distribution Utility, Supplier or System Operator, while Voluntary Load Curtailment (VLC) is defined as the agreed self-reduction of Demand by identified industrial and commercial End-Users to assist in Frequency Control when generation deficiency exists. VLC is also known as Interruptible Load Program (ILP).

Table 1 summarizes the various demand control programs based on the definitions provided in the PGC.

Table 1. Various demand control programs based on the PGC's definition

Demand Control Program			
Mandatory Load Curtailment			**Voluntary Demand Management**
Automatic Load Dropping		**Manual Load Dropping**	
Under-Frequency Load Shedding	Under-Voltage Load Shedding	Manual and deliberate removal of pre-selected loads during abnormal system conditions to maintain system integrity	Demand Disconnection initiated by a User Customer Demand Management Interruptible Load Program

<u>2.2 Interruptible Load Program (ILP) Mechanism</u>

ILP is also referred to in the PGC as Voluntary Load Curtailment. The Energy Regulatory Commission (ERC) issued a resolution, ERC Resolution No. 5 Series of 2015, which provides the rules to establish a process for the interruptible load program administration by the National Grid Corporation of the Philippines (NGCP) and Distribution Utilities (DUs). The DU with Participating Customers (PC) shall administer the ILP in their respective franchise areas while NGCP shall be responsible in implementing the ILP de-loading protocol and compensation to Directly Connected Customers (DCC), Philippine Economic Zone Authority (PEZA) Economic Zones, DUs without any PC, and DUs with PCs who agreed to be under the NGCP-administered ILP.

The implementation of the ILP shall be revenue neutral for either NGCP or the DUs implementing the same, as well as the Retail Electricity Supplier (RES) which has an ILP Agreement with the DU and a Contestable Customer (CC).[6]

2.3 Demand-Side Bidding (DSB) for WESM Implementation

Part of the short to medium-term plan[7] of the DOE is to work on the implementation of demand-side bidding in the WESM which is a demand response mechanism that enables consumers to actively participate in electricity trading, by bidding or pricing their energy demand block to match the generators' offers[8]. The integration of customer's bid price to the market optimization model aims to promote higher level of competition and provide more accurate price signals. Currently, the WESM Rules[9] allows customer with dispatchable load to submit a standing demand bid on a voluntary basis.

Table 2 shows the comparison between the interruptible load for ILP and dispatchable load used for DSB.

Table 2. Comparison of Interruptible Load and Dispatchable Load[10]

Salient Points	Interruptible Load	Dispatchable Load
Definitions in WESM Rules	A load that a Customer is able to interrupt at very short notice in response to: (a) a frequency deviation; or (b) a request of the System operator in order to meet applicable ancillary service requirements, subject to the requirements of the Grid Code and Distribution Code.	A load which is able to respond to dispatch instructions and so may be treated as a **'Scheduled Load'** in the dispatch process.
Purpose of the Program	Address power imminent shortage through customer participation	Mitigate high spot market prices when supply is scarce through Demand Bidding and boost supply of capacity for ancillary service requirements or reserve market
Financial Considerations	Loads reduced under ILP are compensated for incremental cost of self-generation	Reduction in energy trading amount in WESM settlement and compensation as ancillary service provider under Ancillary Services Cost Recovery Mechanism (ASCRM) or reserve market
Participation	Customers with self-generation facilities which could operate to reduce their demand from the DU or Grid	Customers in the WESM whose load could be dispatched (by any means) according to schedule and monitored for SO compliance
Scheduling	Day ahead when "Red" (or "Yellow") alert is declared by SO	Real-time dispatch through Demand Bid for energy market and real-time

[6] ERC Resolution No. 5 Series of 2015
[7] Department of Energy (DOE), Philippine Energy Plan 2016-2030, 2016
[8] Green, R. Hull, L., A Practical Guide to Demand-Side Bidding, International Energy Agency Demand-Side Management Programme, 2003
[9] Section 3.5.6.1, WESM Rules, November 2020
[10] WESM Rules, 2021; Philippine Grid Code, 2016

Salient Points	Interruptible Load	Dispatchable Load
		dispatch through Capacity Offer for reserve market
Dispatch Commitment	ILP Customers participate on a voluntary (as available) basis without firm commitment or penalties for non-compliance to dispatch schedule or instruction	Customers operating with dispatchable loads are treated like generating resources under the WESM Rules and Ancillary Services Procurement Plan (ASPP)/ASCRM may apply when operating as reserve provider

It can be observed that DSB is a demand response that differs from other existing options as it uses real-time market prices to trigger reduction in demand instead of system security or emergency conditions. Although DSB is already embedded in the WESM, it requires the infrastructure and support of the SO and NSPs as well as participating DUs and Customers. This is where bulk of the preparations are necessary in the implementation of a DSB program. Also, awareness activities need to be undertaken for the market participants to be fully aware of their responsibilities when they participate in DSB as well as the commercial aspects which may result from their participation.

3.0 ESTIMATING FINANCIAL BENEFITS OF DEMAND-SIDE BIDDING IN THE WESM

The discussions on the general benefits of demand response, including DSB, in other market jurisdictions, were presented in the consultation paper of the TC in March 2021[11]. In this published TC paper, a report from US-DOE was cited wherein demand response provides financial benefits to the trading participants and the market, as well as improve system reliability and market performance.

This section describes a method of *estimating* the potential financial benefits of demand-side bidding in the WESM through sampling of historical demand and prices in the WESM.

3.1 Historical Demand and Price Data

In this method, the historical hourly demand and Load Weighted Average Prices (LWAP)[12] of Luzon-Visayas grids from 26 June 2020 to 25 June 2021 were used as sample data, with Figure 2 showing the scatter plot between LWAP and demand. As expected, prices increase with increasing demand. The resulting correlation between system demand and WESM prices was calculated at 51.4 %. It is noted that the correlation between demand and price may vary widely at different periods because of the other variables affecting demand and supply such as trading participants' behavior. Hence, predicting the pricing outcome in the WESM has always been a difficult challenge, particularly, in quantifying the financial benefits of DSB in the WESM.

[11] WESM Technical Committee, Consultation Paper on Demand Side Bidding, March 2021

[12] Load Weighted Average Price (LWAP) was used to estimate the effect of DSB in the total trading amount (TTA). In the WESM, TTA is generally calculated as the sum of Ex-Ante Amount and Ex-post Amount (see relevant documents such as WESM Rules, Billing and Settlement Manual, and WESM Participant Handbook for details).

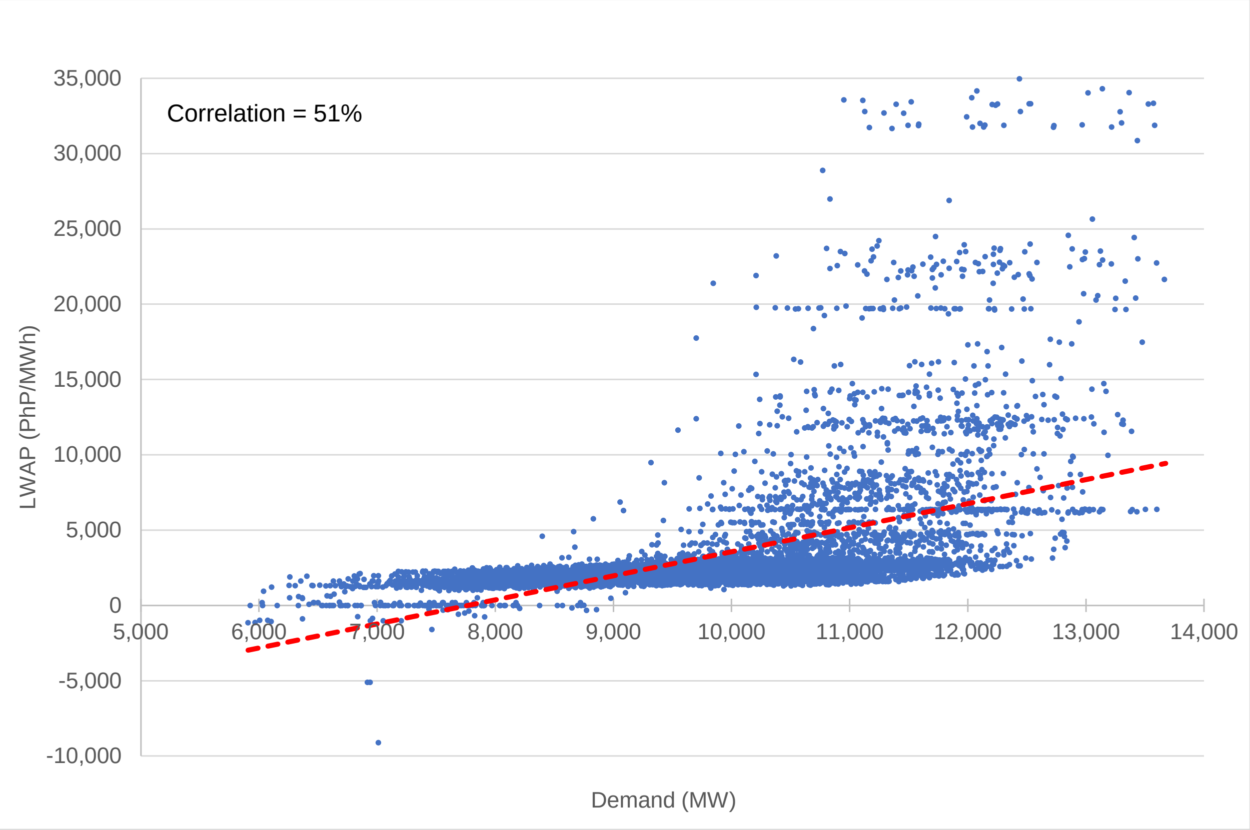


Figure 2. LWAP vs Demand scatter plot (26 June 2020 to 25 June 2021)

3.2 Load and Price Duration Curves

The only certainty in the WESM is that higher demand results to higher energy prices. This price and demand relationship can be loosely applied to the concept of duration curves which determines the length of time each data exceed a certain value. Figure 3 shows the Load Duration Curve (LDC) and the Price Duration Curve (PDC) for the sampled data.

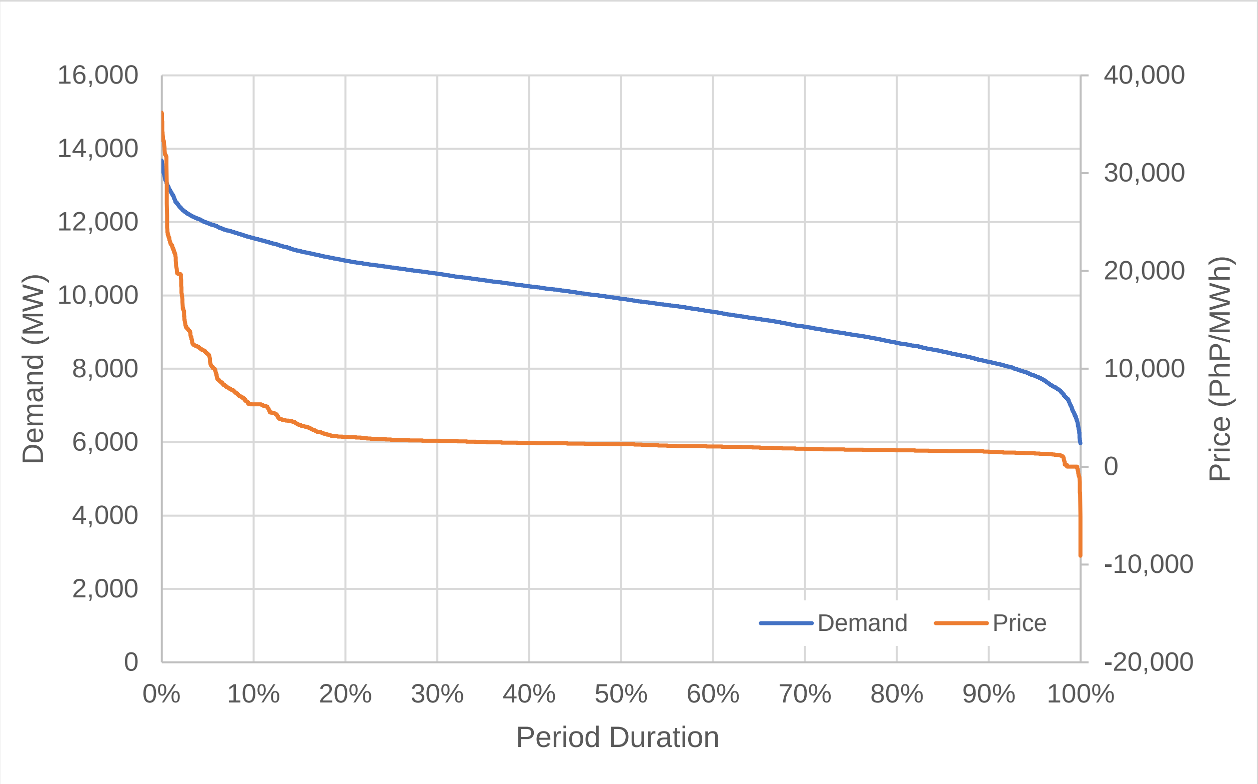
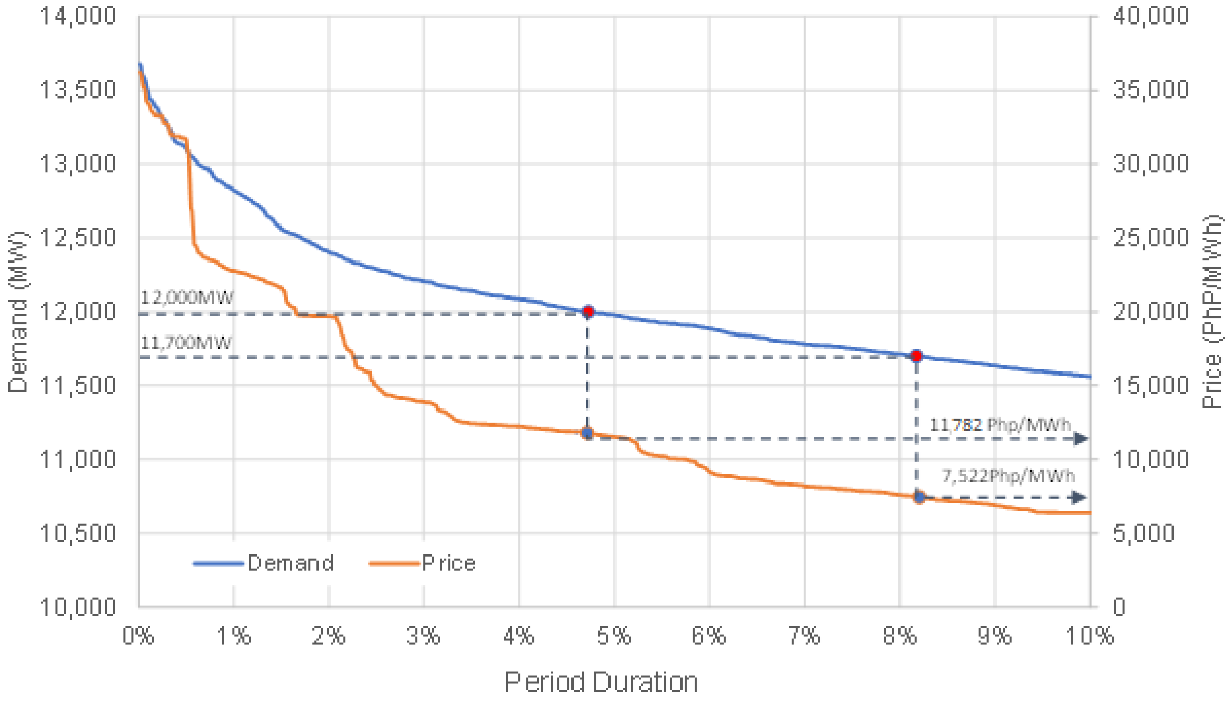


Figure 3. Demand and Price Duration Curves of Sampled Data

The LDC and PDC allows graphical estimation of prices based on prospective demand with and without DSB participation for any given duration. The prospective benefit of DSB can thus be computed while recognizing weak demand and price correlation in this dataset. An expanded view of the LDC and PDC (i.e., 10% duration) is shown in Figure 4 to illustrate the worked example.



,

Figure 4. Demand (in MW) and Price (in PHP/WMh) Duration Curves for highest 10% of Sampled Data

3.3 Estimating Financial Benefit Using LDC and PDC

A high demand condition, say 12,000 MW, is when demand bids would most likely be submitted. This occurs within the 10% duration of the sampled period. The LDC indicates a duration of 413 hours or 4.71%[13] of the 8,760-hour period. For this duration, the indicative price is about Php11,782/MWh. Assuming a bilateral contract level of 85%, about 10,200 MW will not be exposed to this market price. The trading amount without DSB can be calculated as follows:

$$\begin{aligned} Amount_0 &= (Demand_0 - BCQ) \times Price_0 \\ &= (12{,}000MW - 10{,}200MW) \times Php11{,}782/MWh \\ &= Php21{,}207{,}600/h \end{aligned}$$

Assuming that DSB is active with a demand bid of 300 MW for a price of Php10,000/MWh. A reduction of 300 MW will result to 11,700 MW of system demand and an indicative price of Php7,522/MWh in the PDC. Using a similar formula, the trading amount can be calculated as follows:

$$\begin{aligned} Amount_{DSB} &= (Demand_{DSB} - BCQ) \times Price_{DSB} \\ &= (11{,}700MW - 10{,}200MW) \times Php7{,}522/MWh \\ &= Php11{,}283{,}000/h \end{aligned}$$

The gross benefit of activating DSB was determined by subtracting the calculated trading amount when DSB is activated from the calculated trading amount without DSB then multiplying it to the duration period and a coincidence factor. The correlation between price and demand was used as a factor to

[13] This can also be expressed in terms of percentile.

compensate for the non-coincidence of the LDC and PDC. The gross benefit amounting to MPhP 2,090,502 was calculated using the formula[14] below:

$$
\begin{aligned}
Benefit_{gross} &= (Amount_0 - Amount_{DSB}) \times Duration \times Coincidence\ Factor \\
&= (21.208MPhp/h - 11.283Php/h) \times 413h \times 51\% \\
&= MPhp2{,}090.502
\end{aligned}
$$

The estimated benefit of Php2 billion is termed as gross since there are no cost considered in the DSB activation such as the cost of interruption or generation replacement for the 300 MW load that participated in the DSB, among others. Assuming the cost is a compensation for the customer with DSB, this can be calculated as follows:

$$
\begin{aligned}
Cost_{DSB} &= Demand_{DSB} \times Price_{bid} \times Duration \\
&= 300MW \times Php10{,}000/MWh \times 413h \\
&= MPhp1{,}239.000
\end{aligned}
$$

Therefore, the net benefit can be computed as follows:

$$
\begin{aligned}
Benefit_{net} &= Benefit_{gross} - Cost_{DSB} \\
&= MPhp2{,}090.502 - MPhp1{,}239.000 \\
&= MPhp851.502
\end{aligned}
$$

3.4 Impact to Market Participants

The cost to compensate the DSB participants is still subject to policy or regulatory decision since it impacts the rest of the market customers in the WESM. To demonstrate the impact, assume the following policies were adopted:

1. The DSB customer shall be compensated for removing its load base on its offer price. This assumes that the offer price is the cost of interruption or power replacement for the affected DSB customer.

2. The customers in the WESM who benefited from the DSB-related price reduction shall share in the compensation cost. This shall exclude the demands of customer already covered by bilateral contract since they are not exposed to the market spot prices.

To quantify the cost impact to the benefitting customers,

$$
\begin{aligned}
Cost_{Share} &= Cost_{DSB}/(Demand_{DSB} - BCQ) \\
Cost_{Share} &= MPhp1{,}239.000/(11{,}700MW - 10{,}200MW) \\
&= MPhp0.826/MW
\end{aligned}
$$

The average impact of this to the customer buying price over the given duration is as follows:

$$
\begin{aligned}
Price_{Impact} &= Cost_{Share}/Duration \\
Price_{Impact} &= Php826{,}000/413h \\
&= Php2{,}000/MWh
\end{aligned}
$$

This implies that the price of buying energy for the benefitted customers, which includes non-participants to DSB, which was supposed to be reduced from Php11,782/MWh to Php7,522/MWh will have to be increased by Php2,000/MWh to Php9,522/MWh to cover DSB compensation cost.

[14] Correlation was used as the coincidence factor noting that the TC does not have available data on this.

As earlier mentioned, compensating DSB participation is still a policy or regulatory issue since it impacts the buying price of electricity which will ultimately affect consumers. The above calculation is only for demonstration.

3.5 Further Studies Required

The previous section presented a methodology to estimate the financial benefit of DSB in the WESM based on historical data of demand and price. The worked example provided a fair illustration of the concepts involved but it is by no means complete and comprehensive.

The methodology can be extended to perform sensitivity analysis for different market conditions, among others, use of sampled data for different periods, submission of multiple demand bids and lower system demands.

It is also important to note that this methodology only assumes the market outcome based on historical data to estimate the financial advantage of DSB over a defined period. It cannot predict the outcome of the market prices with the implementation of DSB. Other methodologies, if available, can be used for this purpose.

Also, the cost of the DSB that was estimated in the worked examples only applies to the load interruption or generation replacement cost of the DSB participant. This does not consider the infrastructure and other implementation costs for DSB participation and the preparation cost for MO, SO, NSP, and other service providers in the WESM.

As earlier mentioned, there are other advantages of DSB such as improvement in system reliability and market performance which should be studied. Although not covered by this report, these are equally important considerations in pursuing the implementation of DSB.

4.0 IMPLEMENTING DSB IN THE WESM

As part of the TC's 2021 work plan and in compliance with the ERC directive[15], the TC conducted a consultation to gather information from various stakeholders on their interest and preparedness for the possible implementation of DSB in the WESM, and likewise, published the report[16] in June 2021.

The result of the survey[17] shows that majority of the respondents claimed basic to no knowledge on DSB. Also, while the DSB feature is already integrated in the New Market Management System (NMMS) and has been in place in the current MMS since 2006, no DSB participation has been reported based on the available data from the Independent Electricity Market Operator of the Philippines (IEMOP). Non-participation in DSB may be attributed to the lack of trainings and information drives or with the lack of policies and rules that will encourage or incentivize the customers to participate in DSB.

[15] ERC Case No. 2017-042 RC, December 2020, page 245

[16] WESM Technical Committee, Demand-Side Bidding in the WESM, June 2021

[17] Ibid.

In view of the foregoing, the TC summarizes its recommendations as follows:

4.1 Consultation, Information, Training and Education

Trainings and education for participants and stakeholders have always been the vehicle for gaining support, preparing participants, and ensuring the success of this undertaking in the WESM. Conduct of such activities will raise awareness and equip the participants with healthy understanding of the DSB to encourage industry-wide discussions on DSB in the WESM.

Furthermore, any major undertaking in the WESM starts with consultation and information dissemination among stakeholders as an initial step. Consultations usually happen at different levels (e.g., policy, planning, implementation, and operational levels) possibly with overlapping agenda and timing.

4.2 Policies and Resolutions

Since there are still lacking policies and rules that will promote the participation in DSB, the DOE and ERC should formulate a more comprehensive demand response program using DSM as an umbrella policy (similar to Figure 1 above) to include programs that are already familiar to the power industry players such as ILP, MLD, VLC, and others. The policy should also recognize the relevance of demand control (interruptible loads) in reserve ancillary services and the reserve market.

In addition, a critical review of relevant documents (e.g., DOE and ERC issuances, WESM Rules and Manuals) is necessary to ensure clarity and consistency in the implementation of DSB.

4.3 Rules and Procedures

Equally important is the WESM Rules, the PGC, and PDC to ensure that provisions relevant to DSB implementation are consistent and complementary. Any inconsistencies should be harmonized prior to program implementation.

4.4 Infrastructures and Systems

Part of the TC's recommendations in the June 2021 report is to ensure that the systems of Network Service Providers (NSP) are ready. DSB is a feature of the WESM that necessitates the installation of control and monitoring infrastructures for its implementation. The DSB program alone may not justify the establishment of these infrastructures and system.

With this, relevant demand control program should be developed by network service providers and direct-connected bulk customers to support or compliment the DSB program. DSB will not work without their support to these WESM customers.

5.0 CONCLUSION AND RECOMMENDATIONS

Since the launching of WESM in 2006, the trading activities have always been confined to the supply side even when the rules and the MMS already have provisions for DSB. Last year saw a renewed interest in this subject with the DOE planning to issue DSB rules in the WESM and the completion of the participant consultation by PEMC/TC.

In preparation for any potential development on DSB implementation, the TC recommends the following courses of action be considered by PEMC:

1. Critical review of relevant documents
   - Relevant ERC Orders and Resolutions
   - Relevant DOE Policy Directions
   - WESM Rules and Relevant Procedures
   - Philippine Grid Code
   - Philippine Distribution Code

2. Focused consultative discussions and coordination meetings
   - PEMB, ERC, and DOE
   - WESM Governance Committees
   - MO, SO, and MSP
   - Distribution Utilities
   - Direct Connected Customers

3. Formulation of DSB procedures and guidelines
   - Study manuals from other market jurisdiction
   - Rough draft of DSB procedures and guidelines
   - Revision of conflicting Rule Provisions
   - Revision of conflicting guidelines and procedures
   - Subject draft to critical internal review
   - RCC and PEMB Approvals
   - Consultative Workshops
   - ERC and DOE Approvals

4. Formulation of implementation plans for active participation in DSB
   - IEMOP Preparations
   - SO/MSP Preparations
   - DU Preparations
   - DC Customer Preparations

5. Support for participants' DSB readiness
   - IEMOP Declaration
   - SO/MSP Declaration
   - Participant Declaration
   - PEMB Clearance
   - ERC/DOE Clearance
   - DSB Trial Operation

Submitted by:

TECHNICAL COMMITTEE

[signed]
JORDAN REL C. ORILLAZA
Chairperson

[signed] MARIO R. PANGILINAN Member	[signed] ERMELINDO R. BUGAOISAN, JR. Member