PROPOSED METHODOLOGY IN THE DETERMINATION OF AN OFFER PRICE CAP IN THE WESM

PIPPA Position Paper, 30 May 2014

NEED FOR AN OFFER PRICE CAP

In theory, under a perfectly competitive environment, the efficient price level during conditions when electricity must be shed is the value that consumers are willing to pay for supply reliability. This is the value of loss of load which is the price that consumers will be indifferent between experiencing a supply interruption and paying a very high price for supply reliability[1]. Under a perfectly competitive environment, this results to the optimal level of generation investment and level of supply interruption. Setting the price cap below the VOLL will dis-incentivize investments on new peaking generation capacity.

PRACTICE IN OTHER JURISDICTIONS

The following are the practices in other jurisdictions:

- In New Zealand, scarcity pricing arrangement is between the range of NZ$10,000 to NZ$ 20,000/MWh. The lower bound was set with reference to the costs of peaking gas-fired generator while the upper bound was based on the foregone consumption to consumers during instances of emergency load shedding.
- In Singapore, the price caps are tied to the estimate of VCR which is estimated using a macro-economic estimate as the ratio of the Singapore GDP and total electricity sales. This proxies the cost of lost production due to supply interruption.

METHODOLOGY

Similar to the above methodologies, the Offer Price Cap should be set at the level of VOLL or investment incentive needed to build required generation facility.

There are two ways to determine the Offer Price Cap: (a) demand-side method – this is the VoLL calculated as the ratio of the GDP against total electricity sales, and (b) supply-side method – the investment incentive needed for building generation facilities which is calculated as the average price of the best new entrant (BNE) peaking plant to serve the last block of energy needed by the system given a target LoLE . The latter method is easier to calculate than the former. The expected energy not served (EENS) is calculated based on the loss of load expectation (LOLE) which is the number of hours (or days) that the system may experience supply interruptions in a given year. A 1991 study recommends that the optimal level of reliability for the Luzon grid is one (1) day per year. The macro-economic method is more challenging to estimate. A macro-economic estimate places VOLL at the level of Php173.55 per kWh for the whole Philippines.

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[1]NERA REPORT

(a) Demand-side method

Table 1 below shows the estimates of the VOLL for the year 2009 to 2011. For 2011, the estimated VOLL for whole Philippines is Php 173.55/kWh.

Table 1. Estimates of Regional VoLL from 2009 to 2011*

REGION	ITEM / YEAR	2009	2010	2011
LUZON	Regional GDP ('000 Pesos)	5,828,519,226	6,557,990,226	7,061,837,093
	Electricity Sales ('000 kWh)	37,859,434	41,388,794	41,706,246
	VoLL (P/kWh)	**153.95**	**158.45**	**169.32**
VISAYAS	Regional GDP ('000 Pesos)	1,012,335,298	1,127,164,171	1,239,890,561
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MINDANAO	Regional GDP ('000 Pesos)	1,185,288,864	1,318,326,094	1,433,793,389
	Electricity Sales ('000 kWh)	6,699,295	6,840,916	7,166,977
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Philippines	Regioinal GDP ('000 Pesos)	8,026,143,388	9,003,480,491	9,735,521,043
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* GRDP source: NSCB; electricity sales source: DOE;

(b) Supply-side method

The Offer Price Caps calculated using this methodology represents the investment incentive needed by new entrants to provide energy in ensuring the reliability of supply. The measurement of reliability, in this case, is the LOLE. The Offer Price Cap will depend on the LOLE that will be targeted. The higher reliability (lower LOLE), the higher will be the Offer Price Cap calculated. Thus, there should be a careful study on the LOLE required by the system in order to determine the most appropriate Offer Price Cap.

Table 2 below shows the different Offer Price Caps calculated for a new entrant plant. If LOLE = 1 day/year is targeted, the cap level is Php 463/kWh. At a cap level of Php 62/kWh and 32/kWh, LOLE = 8 and 18 days per year, respectively.

Table 2. Calculation of Offer Price Cap.[2]

NEW PLANT

WACC	%	15%
Remaining life	Years	30
Annual Capital Amortization	P/kW/Yr	8,028
FOM	P/kW/Yr	2,333
VOM	P/kWh	0.59
Fuel	P/kWh	7.4

Expected Dispatch Factor	Loss of Load Expectation (days/year)	Offer Price Cap
		P/kWh
0.26%	0.95	463
0.27%	1.00	440
0.70%	2.54	178
2.19%	7.99	62
2.60%	9.49	53
4.93%	17.98	32

Table 3 below shows the different Offer Price Caps calculated based on the cost of an existing plant. If LOLE = 1 day/year is targeted, the cap level is Php 419/kWh. At a cap level of Php 62/kWh and 32/kWh, LOLE = 7.20 and 16.12 days per year, respectively.

Table 3. Calculation of Offer Price Cap using the costs of an existing plant.

EXISTING PLANT

WACC	%	15%
Remaining life	Years	30
Annual Capital Amortization	P/kW/Yr	4,400
FOM	P/kW/Yr	4,960
VOM	P/kWh	0.4
Fuel	P/kWh	7.4

Expected Dispatch Factor	Loss of Load Expectation (days/year)	Average Selling Price Required
		P/kWh
0.26%	0.95	419
0.27%	1.00	398
0.63%	2.29	178
1.97%	7.20	62
2.60%	9.49	49
4.42%	16.12	32

[2] New Plant rates (WACC, CRF, FOM, VOM and Fuel) based on recent ERC Decision on a modular generator

Annex A. THEORETICAL BACKGROUND

BACKGROUND

As a pre-emptive mitigating measure, the WESM Tripartite Committee imposed an Offer Price Cap of Php 62,000/MWh (Php 62.00/kWh) upon the commencement of commercial operation of WESM on 26 June 2006.This cap was effective until the WESM Tripartite Committee lowered the cap to Php 32,000/MWh (Php 32.00/kWh) on 04 January 2014 in response to the price spikes of November – December 2013. The price cap was set based on the price cap approved for the Interim Mindanao Electricity Market (IMEM).The price cap is provisional and interim until the completion of the WESM Study.

The WESM is a gross-pool, bid-based, energy-only spot market with demand bidding provision but not currently implemented. Under energy-only spot market, the spot price of electricity is the only driver for capacity investment, there are no provisions to ensure capacity adequacy and reliability of the system.

In the 2011 market study prepared by UP National Engineering Center (UP NEC)[3], the study suggested using the 1 day per year loss-of-load expectation (LOLE) as the reliability criterion for the Luzon grid. It calculated that the LOLE for the period 2002 – 2009 are within this reliability criterion. It noted that since no generation capacity is being added to the system, the robust growth demand led to 4 days/year LOLE in 2010. The study projected the LOLE to be > 5 and 82 days per year for 2013 and 2014, respectively. PIPPA suggested to the DOE that the reliability criteria be set by the Grid Management Committee.[4]

The price spikes in 2013 only confirmed this story that no new generation capacity is being added to the system to ensure system adequacy and reliability.

Electricity markets are characterized by:

- Both supply and demand need to be balanced in real-time.
- Electricity cannot be stored (or storage is expensive commercially).
- Demand is inelastic.

Under normal market conditions, the spot price is obtained as the intersection of the supply and demand curves (Fig. A-1). This relationship is true if demand is elastic (i.e., demand is responsive to prices such that a market clearing price is always obtained), and thus the market is perfectly reliable.

If supply is scarce, the price will rise until there is enough voluntary load reduction to maintain the balance. But as supply become scarce (also inelastic because electricity cannot be stored), there is a chance that the market does not clear (Fig. A-2). In theory, when the market does not clear, the market

[3]See delMundo, the 1 day/year LOLE was used by NPC as the reliability criteria in its power development planning prior to EPIRA. Based on the PEP published by the DOE, it appears that the criteria used now in generation planning are percentage reserve.

[4]In its letter to the DOE dated April 7, 2014, PIPPA suggested that the reliability criteria and levels of operating reserves be determined and set by an independent stakeholders group or an expert panel independent of and distinct of the System Operator (specifically, the Grid Management Committee).

price is undetermined and the suppliers have unlimited market power. The price cap is, therefore, necessary to protect consumers from price spikes.

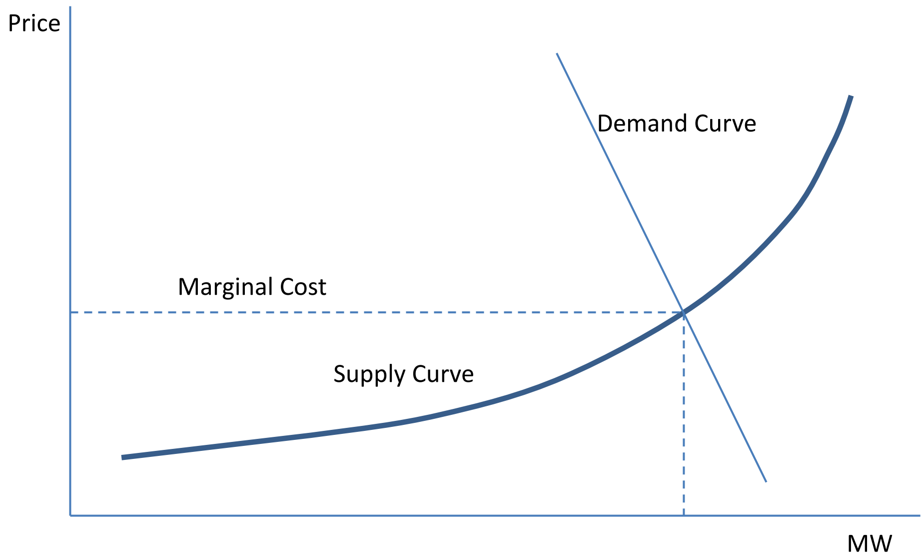

Fig. A-1.Supply and demand relationship under normal conditions.

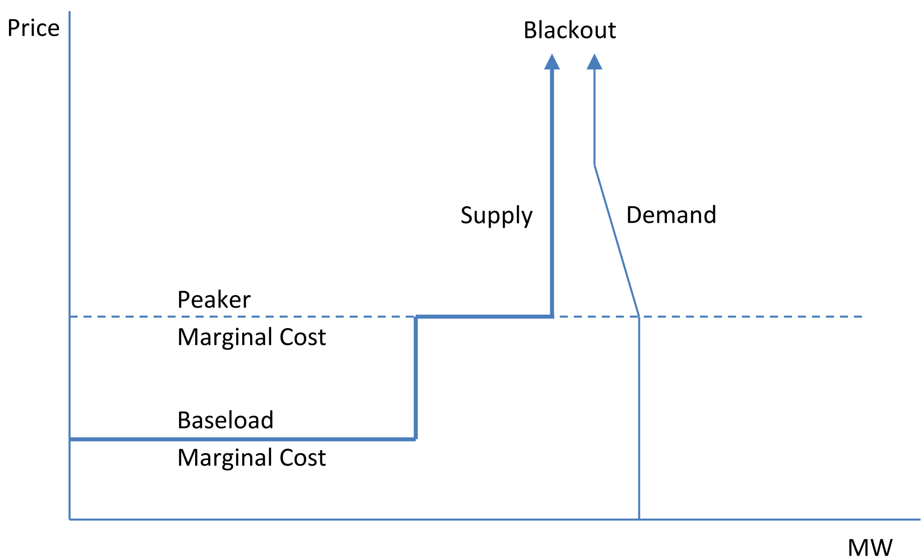

Fig. A-2.Supply and demand relationship under supply scarcity.

The price cap is set as the value of lost load (VOLL) using the demand-side approach– which is the price that the consumer is willing to pay to avoid supply interruption or the electricity price above which a consumer would rather suffer supply interruption than stay connected and pay the high electricity price or the supply side approach – which is the price that an investor will be incentivized to put up a power plant. Under a perfectly competitive market, this results in an optimal level of investment in generation capacity and optimal level of supply interruption.

Efficient pricing of electricity reliability requires maintaining the balance between the price that a customer is "willing to pay" to receive a reliable electricity and the cost of putting up the plant capacity to provide energy to ensure that reliability.

The Price Cap should be at a level reflecting the Price Equilibrium between the price a customer is "willing to pay" to receive energy during periods of scarcity (e.g., periods of high demand or emergency situation) or the cost recovery of a reliable peaking plant which will provide energy during such periods (Fig.A-3).

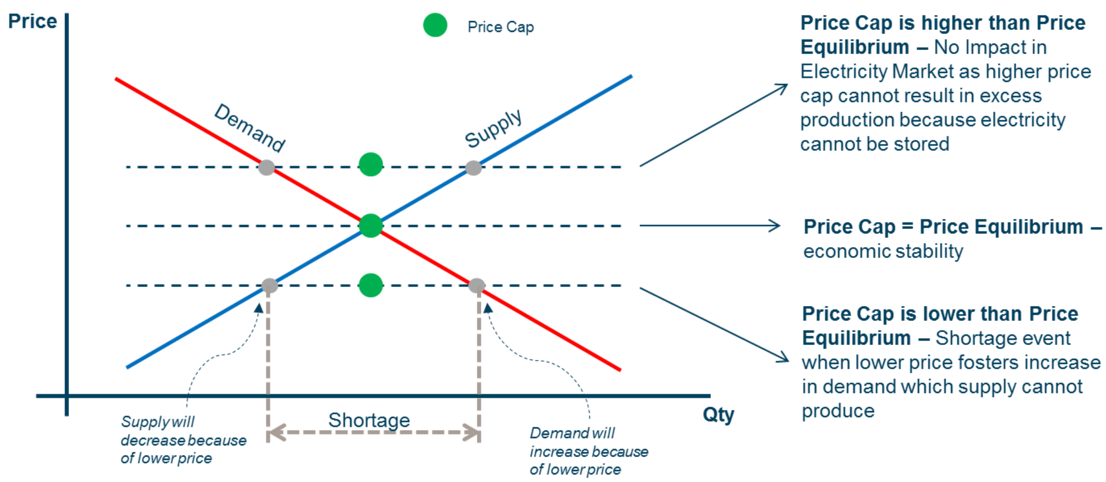

Fig. A-3.Price cap equilibrium.

No impact is expected to the market when the price cap exceeds the price equilibrium as power markets cannot generate surpluses which can be stored (the generation always matches load demand). However, when the Price Cap is below the Price Equilibrium, a situation of shortages would soon arise as demand will increase (because of the lower price) well above the point which producers will be able supply or have the incentives to invest on new peaking capacity.

Thus, by adjusting the level of the price cap, the market can influence the incentives for peaking capacity.

There are at least two established methods in determining the Offer Price Cap: (a) demand-side approach; (b) supply-side approach.

DEMAND SIDE APPROACH- VALUE OF LOST LOAD (VOLL)

The Demand-side approach equates the VoLL to the economic implication to the consumer of supply reliability and calculated by estimating the value that consumers place on receiving reliable electricity supply. Estimating VOLL is a challenging undertaking and is country/region specific. Studies suggest that VOLL depends on a number of factors such as the affected customer class (residential, commercial, and industrial), regional economic conditions and demographic, time and duration of the outage, frequency, season, and other specific traits. This is normally done through customer survey which is a long and tedious process. A reasonable macroeconomic estimate may be established by dividing the country's gross domestic product (GDP) by its total electricity consumption assuming that the entire GDP is driven mainly by electricity. Below is a comparison of VOLL in other countries. To date, there is no study made on the value of VOLL despite the requirement of WESM rules in setting the price cap based on VOLL. Based on the study made by del Mundo(1991)[5], the optimal level of system reliability in the Luzon grid is 1 day per year (i.e., the extent of brownouts/blackouts due to generation outages should not exceed 1 day per year only. Table A-1 shows a macro-economic estimate of VOLL in the Philippines and Table A-2 shows the VOLL in other countries.

Table A-1.Macro-economic estimate of VOLL in the Philippines.

REGION	ITEM / YEAR	2009	2010	2011
LUZON	Regional GDP ('000 Pesos)	5,828,519,226	6,557,990,226	7,061,837,093
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Table A-2.Macro-economic estimate of VOLL in the other countries.

Figure 1. Summary of VOLLs by jurisdiction

Region/Market	Methodology	System-wide VOLL	Residential	Non-Residential		Applicability to ERCOT
				Large C/I	*Small C/I*	
US - Southwest	Analysis of past survey results		$0	$8,774	$35,417	High
US - MISO	Analysis of past survey results/ Macroeconomic analysis		$1,735	$29,299	$42,256	Moderate
				Commercial	*Industrial*	
Austria	Survey		$1,544			Low
New Zealand	Survey	$41,269	$11,341	$77,687	$30,874	Low
Australia - Victoria	Survey	$44,438	$4,142	$28,622	$10,457	Moderate
Australia	Analysis of past survey results	$45,708				Low
Republic of Ireland (2010)	Macroeconomic analysis	$9,538	$17,976	$10,272	$3,302	Low
Republic of Ireland (2007)	Macroeconomic analysis	$16,265				Low
US - Northeast	Macroeconomic analysis	$9,283-$13,925				Low

**All values in 2012 US dollars/MWh*

http://www.ercot.com/content/gridinfo/resource/2014/mktanalysis/ERCOT_ValueofLostLoad_LiteratureReviewandMacroeconomic.pdf

[5]See del Mundo,Rowaldo," Development of Data and Models for Optimizing Power Supply Reliability in the Philippines", University of the Philippines, 1991

SUPPLY SIDE APPROACH- INVESTMENT INCENTIVE

The Supply-side approach equates the investment incentive to the full cost recovery of capital costs (inclusive of reasonable margin) and pass through operating, maintenance and fuel costs in putting up and operating the best new entrant peaking generation capacity to avoid outages and ensure the desired level of reliability of the system/market. The desired level of system reliability is measured in term of Loss of Load Probability (LOLP) or Loss of Load Expectancy (LOLE). The Energy Not Served (ENS) is the expected energy (in kWh) that will not be supplied as a result of the level of LOLP. A UP National Engineering Center study made in 2011 suggests that the optimal LOLE level for the Luzon grid is 1 day per year. The investment incentive is then calculated as the average cost of Best New Entrant peaking plant to supply the ENS.

Below is the illustration presented by Mike Thomas of Lantau Group re: the price cap of Php 32/kWh.

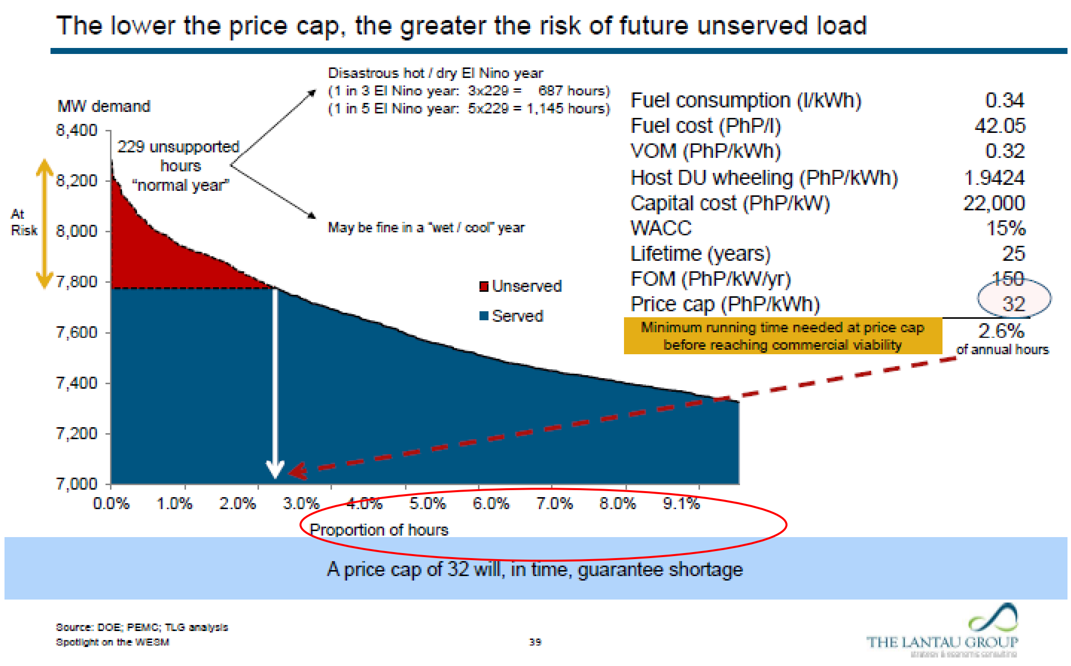

Fig.A- 4.Resulting Unsupported Hours from the Price cap at Php 32/kWh.[6]

Using the same load duration curve as Figure 4 above, the additional capacities needed to decrease the unsupported hours (power interruptions) is presented in Figure 5 as blocks of energy. The last power plant needed to be built will have the least amount of dispatch. The price cap in this case should have the capability to support this particular power plant.

[6] Source:Ppresentation slides from Mr. Mike Thomas of the Lantau Group

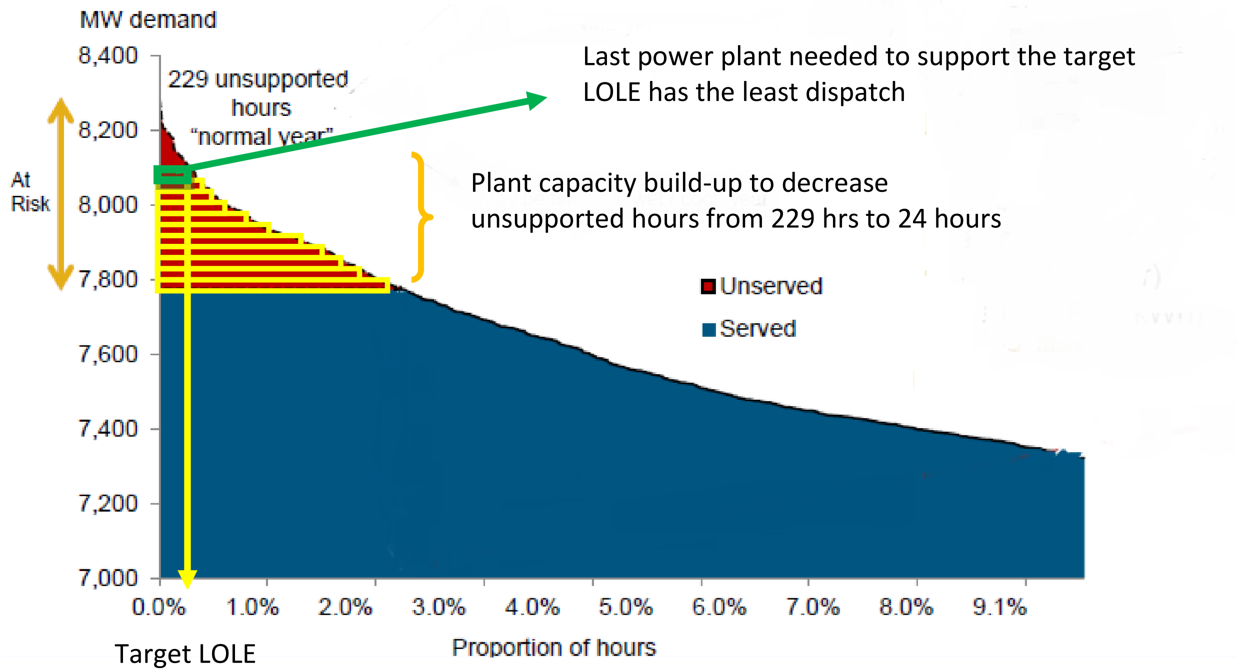

Fig. A-5.Blocks of energy needed to decrease unsupported hours in a year

EFFECT OF DEMAND BIDDING

Demand bidding gives the value of reliability from the perspective of the user who pays the cost who also has the ability to respond to the price. It enables users to signal their price for electricity and respond to supply offers – a situation that suggests price caps is no longer needed.

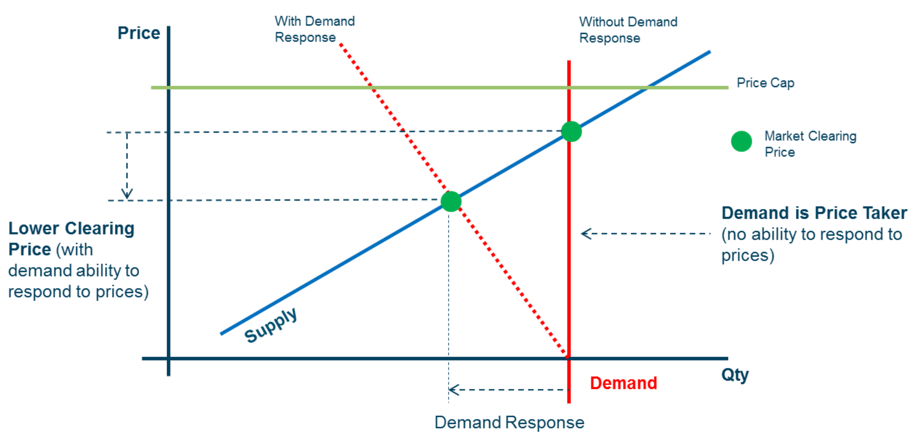

Fig. 5.Effect of demand bidding.

PRICE CAP IN OTHER JURISDICTIONS

Table 2.1 Considerations taken into account in setting the market price cap(s)		
Jurisdiction	Price Cap (per MWh)	Considerations
New Zealand	NA	During limited supply emergencies, scarcity pricing is triggered, which involves a market price range of NZ$10,000/MWh to NZ$20,000/MWh (AU$8,850/MWh to AU$17,690/MWh). The lower bound was set with reference to the costs of a peaking gas-fired generator. The upper bound was set with reference to the value of forgone consumption to consumers during emergency load shed. (**from PhP363,340/MWh to PhP726,740/MWh**)
ERCOT (Texas, USA)	US$5,000 increasing to US$9,000 in 2015 (AU$5,320 to AU$9,570) (**PhP218,415 to PhP392,900**)	Increases in the market price cap have been in response to concerns about a slowing of generation investment and have been designed to increase the revenues available for the marginal generating unit. The market price cap has also been set to limit the scope for generators to exercise market power given stakeholder concern.
Singapore	S$4,500 (AU$4,240) (**PhP174,075**)	A recent proposal to double the VCR was rejected because of concerns that: it would provide an inadequate incentive for investment in peaking plants; there is no need to incentivise investment in base load plants; it may raise risks of generators exercising market power; and consumers may become more vulnerable to extreme price spikes in the spot market because of high market concentration and low demand response.
Alberta, Canada	CA$1,000 (AU$1,060) (**PhP43,519**)	A number of market characteristics (high industrial load, flat load profile and large degree of interconnectedness) mean that the relatively low price cap is considered to be sufficient to encourage new investment. Further, the price cap has been maintained in part to limit generator opportunities to exercise market power.
Great Britain	NA	Estimated VCR is intended to be used to procure capacity as part of the proposed capacity market and for setting network reliability standards. VCR may also be used to price involuntary consumer disconnections that may arise from the balancing market (not currently priced).
MISO Midcontinent Independent System Operator Figure 7.2 MISO geographical reliability market 	US$3,500 (AU$3,720) (**PhP152,726**)	The scope for both supply-side and demand-side entities to bid into energy and capacity markets means there is less of a need for a market price cap to incentivise generation investment.
PJM (Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.)	US$1,800, increasing to US$2,700 in 2015 (AU$1,910 to AU$2,870) (**PhP78,416 to PhP117,829**)	Increase in the market price cap is to accommodate demand side bidding. The ability of both supply-side and demand-side entities to bid into the capacity market means there is less of a need for a market price cap to incentivise generation investment.
The Netherlands	€3,000 day-ahead auction and strips market (AU$4,330) (**PhP177,770**) €99,999.90- intraday market (AU$144,333) (**PhP5,925,652**)	Price caps have not been set with reference to an estimate of the VCR. Rather, they have been set in collaboration with market parties and exchanges in interconnected countries with the intention of harmonising across the markets. The Netherlands has a binding forward market that places significant risk on participants that price imbalance energy at very high levels, which reduces the importance of price caps.

Source: NERA Economic Consulting, **"Review of Alternative Approaches to Setting a Wholesale Electricity Market Price Cap, A Report for the AEMC"),** 14 October 2013

REFERENCES

Cramton, Peter et al, Capacity Market Fundamentals, 26 May 2013

Del Mundo, Rowaldo," Development of Data and Models for Optimizing Power Supply Reliability in the Philippines", University of the Philippines, 1991

Del Mundo, Rowaldo and Espos, Edna,Philippine Electric Power Industry Market and Policy Assessment and Analysis of International Markets, UP - National Engineering Center, May 2011

Del Mundo, State of Competition in Electric Power Industry: Power Supply Security and Power Rates, Presentation to PCCI Power Forum, Dusit Hotel, Makati, 22 May2014

GDP regional data, published by the National Statistical Coordination Board

Mike Thomas (The Lantau Group), Spotlight on the WESM, Presentation to the American Chamber of Commerce (Philippines), 26 March 2014

Power Statistics, published by the Department of Energy

Vries, L.J., The Instability of Competitive Energy –Only Electricity Markets, Research Symposium European Electricity Markets, The Hague, September 2003

http://www.ercot.com/content/gridinfo/resource/2014/mktanalysis/ERCOT_ValueofLostLoad_LiteratureReviewandMacroeconomic.pdf

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