



# Introductory Primer on the Monitoring and Surveillance of Electric Power Markets

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## INTRODUCTION

### A. BACKGROUND AND RATIONALE

The Electric Power Industry Reform Act (EPIRA) is a major milestone in the history of energy sector policy reforms in the Philippines. The law calls for, among other things, the restructuring of the electric power industry's generation, transmission, and distribution sectors, the privatization of former monopoly-owned assets, and the unbundling of tariff rates. Equally important is the law's mandated creation of a competitive electricity market that would pave the way for more reasonably priced electricity rates and ensure electricity supply security and reliability. Along with the Philippine Department of Energy (DOE), which is the lead implementing agency of EPIRA, the Philippine Energy Regulatory Commission (ERC) plays a critical role in carrying out the intent of the law to safeguard competition, protect the consumer and investor welfare, and ensure the highest standards of technical and financial performance from all industry players.

The ERC is mainly responsible for market monitoring, a challenging assignment that calls for an intimate and profound knowledge of how the electricity market operates and the diversity of parties operating in that market. As an EPIRA-created institution, the ERC is still a relatively young institution, and is thus still in the process of putting in place its internal systems, developing regulatory policies, and strengthening its staff's technical knowledge so it will be able to fulfill its regulatory mission, as required under EPIRA. Like many other government organizations, the ERC must contend with resource constraints that hamper not only the acquisition of necessary physical facilities, but also the recruitment of exceptionally qualified staff. Currently, it is being assisted by various donor agencies in meeting its capacity-building needs. The United States Agency for International Development (USAID) is one of its main partners in staff trainings and mentoring.

The Energy Environment Training Program (EETP) has been requested by the ERC to provide technical assistance to its Market Operations Services (MOS) unit in the development of its market monitoring strategy. EETP has responded by preparing this primer on Monitoring of Electricity Markets that will introduce the MOS to basic concepts and principles of market monitoring and will equip the MOS staff with the necessary fundamental knowledge to formulate their strategic plan.

### B. PURPOSE OF THE PRIMER

In many competitive product markets in the economy, there are legal systems in place to ensure that those markets function competitively and that market abusers are punished. However, competitive wholesale electric markets are in an evolutionary state in many parts of the world. For now, for several reasons, there is a need for electric



market regulators to ensure that the electric wholesale market is functioning competitively.

First, electricity is widely recognized as an essential commodity that is imbued with “public interest.” Adequate and quality supply at fair prices is essential for the growth of the national economy and well being of the citizens. Second, electricity as a commodity is an unusual product in that, unlike other products, it cannot be stored. Supply and demand for the product must constantly be kept in balance. Third, the price elasticity of the buyers is low for electricity, providing an increased opportunity for the exercise of market power by sellers. Fourth, the market is extremely complex, given its technical nature. The skill set that is required to monitor the market is generally limited to staff involved in these industries. Finally, the competitive markets are still immature and as problems are found they need to be fixed rapidly. The electric industry regulators are in a unique position to work with the participants in the market in fashioning solutions that would fix the problems. For all these reasons, it is essential that electric regulators play a major role, at least at the inception of the competitive wholesale electric markets, in ensuring that the market is functioning competitively.

This paper provides introductory generic concepts of market power in electric wholesale markets. It is meant for staff at the ERC with a limited background in competitive electric markets. By no means does the paper cover all the complex issues surrounding market monitoring of the nascent electric competitive markets. Furthermore, each market in the world is different in how it is structured and how it operates. The market rules are different. The players are different. The underlying infrastructure, social norms, and behaviors of market participants are different. Any detailed market monitoring effort has to be tailor made to the needs and idiosyncrasies of the particular market.

By reviewing the primer, it is expected that the reader will become familiar with basic concepts of market monitoring. The reader is advised to pursue each of the topics in more depth to gain thorough understanding. Some recommended resources are noted in the References section at the end of the primer. Nothing, however, can substitute for actual field experience. It is hoped that the primer will help the reader to begin to apply the concepts discussed here to the relevant electric wholesale competitive market.

## C. PRIMER OVERVIEW

The primer consists of four parts:

**Part One** describes the evolution of the competitive wholesale market in the Philippines and provides an overview of the role of the ERC in monitoring the market.

**Part Two** offers a theoretical framework for analysis of the electric market. It defines market power, explains the implications of the exercise of market power, and



describes the types of market power and how entities can exercise it. Finally, it also provides suggestions for measuring, analyzing, and mitigating market power.

**Part Three** offers a framework for developing a market monitoring plan and provides examples of such plans in other functioning competitive electric wholesale markets in the United States of America.

**Part Four** provides illustrative exercises that are useful in analyzing the market.



# PART 1

## OVERVIEW OF THE PHILIPPINE ELECTRICITY MARKET

### SECTION 1: EVOLUTION OF THE PHILIPPINE ELECTRICITY MARKET

Up until the promulgation of Executive Order No. 215<sup>1</sup> in 1987 (E.O. 215), which made possible the entry of private investors into the power generation sector, the Philippine electricity market had been predominantly monopolistic in structure and largely government-controlled.<sup>2</sup> Government was the sole owner and operator of both the generation and transmission sectors through the National Power Corporation<sup>3</sup>, which served as the supplier of electricity to the distribution utilities (DUs). Government's stronghold of the market was also manifested in its capitalization and ownership of the majority of the DUs that retailed power to various end-users across the country's franchise areas.

Following the issuance of E.O. 215, the NPC received its power supply from its own generating assets as well as from independent power producers (IPPs). Lured by government incentives under the new BOT/BOO policy, the IPPs provided immediate supply relief during the power crisis years of the early '90s via secured power supply agreements with NPC. Despite the introduction of new players, competition in generation remained far-fetched as IPPs were unable to provide power directly to consumers due to the absence of open access on the transmission side. The BOT/BOO reforms also paved the way for some private distribution utilities like MERALCO to vertically integrate operations by co-investing in generation facilities that bolstered their strategic position in their respective markets/franchise areas. Overall, however, the increased investment activity in power generation contributed little to alleviating electrification concerns in the less viable/missionary areas.

In both of the above scenarios, the Energy Regulatory Board (the precursor organization to the ERC) possessed final authority in determining wholesale prices charged by NPC to the DUs as well as the retail electricity rates. While the regulatory environment provided relative control over market behavior, a complex mechanism of cross subsidies and government guarantees kept rates artificially lower than their true costs. As a result, there was little incentive for the market to flourish based on efficiency grounds. Also, despite the subsidies in the sector, the country continued to have one of the highest electricity rates in the ASEAN region. The high rates in turn have been found

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<sup>1</sup> E.O. No. 215 was issued on July 10, 1987, to allow private investors to participate in power generation through such schemes as cogeneration, Build-Operate-Transfer (BOT) and Build-Operate-Own (BOO).

<sup>2</sup> This government monopoly was established under Presidential Decree No. 40, issued on November 7, 1972, which authorized the National Power Corporation (NPC) to "own and operate as a single integrated system all generating facilities supplying electric power to the entire area embraced by any grid set up by NPC."





to have contributed to low levels of direct investment in power-intensive industries and the overall economic slack in regions where electricity supply remained unreliable.

When the EPIRA was passed in 2001, the most pressing structural defects requiring attention were the lack of real competition in the generation sector and the need to instill higher operating efficiencies among the industry players. The comprehensive reform package in the EPIRA calls for the: (1) restructuring of the industry into four distinct and independent sectors: generation, transmission, distribution, and supply; (2) introduction of competition in generation through the creation of a wholesale electricity spot market (WESM); (3) unbundling of tariffs and removal of cross-subsidies; (4) creation of a new Energy Regulatory Commission (ERC) that would instill behavioral discipline in the industry; (5) privatization of 75% of the NPC-owned generation assets; and (6) creation of a National Transmission Company (TransCo) that will eventually be privatized. These reform elements are all aimed at gearing up the Philippine electricity industry towards a market-driven environment where only the more efficient players survive, where consumer choice thrives, and where electricity rates will be determined by true production costs.

The ERC is critical in ensuring the successful transformation of the Philippine electricity market into a competitive model and inherent in fulfilling its role is the need for the Commission to set a clear set of strategies that will not only be internally beneficial in ensuring policy consistency but will also guide the regulated sectors to move in tandem with the government's intent.

## **SECTION 2: THE ROLE OF THE ERC IN MARKET MONITORING AND SURVEILLANCE**

This section enumerates the responsibilities of the ERC in market monitoring and surveillance as documented in the EPIRA and the WESM Rules. The purpose of this section is to provide the reader with a basic checklist, or reference point, for understanding the more exhaustive set of considerations in drafting the ERC's market monitoring framework.

### **1. ERC's Role as documented in EPIRA**

#### **Section 30: Wholesale Electricity Spot Market:**

- ERC shall:
  - approve the price determination methodology of the WESM
  - authorize other similar entities to become eligible members of the WESM
  - approve the market fees to be charged to all WESM members

#### **Section 43: Functions of the ERC**

- Part (k): Monitor and take measures in accordance with this Act to penalize abuse of market power, cartelization, and anticompetitive or discriminatory behavior by any electric industry participant.



- Part (s): Inspect, on its own or through duly authorized representatives, the premises, books of accounts and records of any persons or entity at any time, in the exercise of its quasi-judicial power for purpose of determining the existence of any anti-competitive behavior and/or market power abuse and any violation of rules and regulations issued by the ERC.

**Section 45: Cross Ownership, Market Power Abuse and Anti-Competitive Behavior:**

- No participant in the electricity industry or any other person may engage in any anti-competitive behavior including, but not limited to, cross-subsidization, price or market manipulation, or other unfair trade practices detrimental to the encouragement and protection of contestable markets.
- No generation company, distribution utility, or its respective subsidiary or affiliate or stockholder or official of a generation company or distribution utility, or other entity engaged in generating and supplying electricity specified by ERC within the fourth civil degree of consanguinity or affinity, shall be allowed to hold any interest, directly or indirectly, in TRANSCO or its concessionaire. Likewise, the TRANSCO, or its concessionaire or any of its stockholders or officials or any of their relatives within the fourth civil degree of consanguinity or affinity, shall not hold any interest, whether directly or indirectly, in any generation company or distribution utility. Except for *ex officio* government-appointed representatives, no person who is an officer or director of the TRANSCO or its concessionaire shall be an officer or director of any generation company, distribution utility or supplier.
- To promote true market competition and prevent harmful monopoly and market power abuse, the ERC shall enforce the following safeguards:
  - (a) No company or related group can own, operate or control more than thirty percent (30%) of the installed generating capacity of a grid and/or twenty-five percent (25%) of the national installed generating capacity. “Related group” includes a person’s business interests, including its subsidiaries, affiliates, directors or officers or any of their relatives by consanguinity or affinity, legitimate or common law, within the fourth civil degree;
  - (b) Distribution utilities may enter into bilateral power supply contracts subject to review by the ERC: *Provided* that such review shall only be required for distribution utilities whose markets have not reached household demand level. For the purpose of preventing market power abuse between associated firms engaged in generation and distribution, no distribution utility shall be allowed to source from bilateral power supply contracts more than fifty percent (50%) of its



total demand from an associated firm engaged in generation but such limitation, however, shall not prejudice contracts entered into prior to the effectivity of this Act. An associated firm with respect to another entity refers to any person which, alone or together with any other person, directly or indirectly, through one or more intermediaries, controls, is controlled by, or is under common control with, such entity; and

- (c) For the first five (5) years from the establishment of the wholesale electricity spot market, no distribution utility shall source more than ninety percent (90%) of its total demand from bilateral power supply contracts.
- For purposes of this Section, the grid basis shall consist of three (3) separate grids, namely Luzon, Visayas and Mindanao. The ERC shall have the authority to modify or amend this definition of a grid when two or more of the three separate grids become sufficiently interconnected to constitute a single grid or as conditions may otherwise permit.
- Exceptions from these limitations shall be allowed for isolated grids that are not connected to the high voltage transmission system. Except as otherwise provided for in this Section, any restriction on ownership and/or control between or within sectors of the electricity industry may be imposed by ERC only insofar as the enforcement of the provisions of this Section is concerned.
- The ERC shall, within one (1) year from the effectivity of this Act, promulgate rules and regulations to ensure and promote competition, encourage market development and customer choice and discourage/penalize abuse of market power, cartelization and any anti-competitive or discriminatory behavior, in order to further the intent of this Act and protect the public interest. Such rules and regulations shall define the following:
  - (a) the relevant markets for purposes of establishing abuse or misuse of monopoly or market position;
  - (b) areas of isolated grids; and
  - (c) the periodic reportorial requirements of electric power industry participants as may be necessary to enforce the provisions of this Section.
- The ERC shall, *motu proprio*, monitor and penalize any market power abuse or anti-competitive or discriminatory act or behavior by any participant in the electric power industry. Upon finding that a market participant has



engaged in such act or behavior, the ERC shall stop and redress the same. Such remedies shall, without limitation, include the imposition of price controls, issuance of injunctions, requirement of divestment or disgorgement of excess profits and imposition of fines and penalties pursuant to this Act.

- The ERC shall, within one (1) year from the effectivity of this Act, promulgate rules and regulations providing for a complaint procedure that, without limitation, provides the accused party with notice and an opportunity to be heard.

## 2. ERC Role as documented in the Market Rules of the WESM

### Section 1.6: Market Surveillance Committee

- **1.6.1 Appointment to the Market Surveillance Committee**
  - 1.6.1.1 The *PEM Board* shall appoint persons to form a *Market Surveillance Committee* in such number and with such skills and expertise, and on such terms and conditions, as the *PEM Board* reasonably deems to be appropriate, taking into consideration the nature of the obligations and functions of the *Market Surveillance Committee*, as set out in clause 1.6.2.
  - 1.6.1.2 The members of the *Market Surveillance Committee* shall be independent of the Philippine electric power industry and the *Government*.
- **1.6.2 Responsibilities of the Market Surveillance Committee**
  - The *Market Surveillance Committee* shall from time to time as necessary and appropriate, and whenever the *PEM Board* directs:
    - (a) Monitor activities conducted by *WESM Participants* in the *spot market*;
    - (b) Prepare periodic reports, which outline:
      - (1) Activities of *WESM Participants* in the *spot market*;
      - (2) Apparent or suspected incidents of *anti-competitive behavior* by any *WESM Participant*; and
      - (3) Matters concerning the operation of the *spot market* generally, which reports shall be submitted to the *PEM Board, the DOE and ERC* upon completion;
    - (c) Assist the *PEM Board* to verify and assess:



- (1) Applications for registration of *WESM Members* under the *WESM Rules*; and
  - (2) The eligibility of *WESM Members* to be registered under the *WESM Rules*;
- (d) Assist the *PEM Board* to investigate:
    - (1) Unusual or suspicious behavior or activities of *WESM Members* in the *spot market*;
    - (2) Suspected or alleged breaches of the *WESM Rules* by *WESM Members*; and
    - (3) Suspected or alleged *anti-competitive behavior*;
  - (e) From time to time if the *Market Surveillance Committee* in its discretion deems necessary or appropriate, propose amendments to the *WESM Rules* in accordance with chapter 8 with a view to:
    - (1) Improving the efficiency and the effectiveness of the operation of the *WESM*; and
    - (2) Improving or enhancing the prospects for the achievement of the *WESM* objectives;
  - (f) Assist the *Rules Change Committee* in relation to its assessment of proposals to amend the *WESM Rules* under chapter 8.



## PART II

# THEORIES AND PRINCIPLES IN MARKET MONITORING

### SECTION 1. DEFINITION OF ELECTRICITY MARKETS

In most parts of the world electric utilities are either owned by the government or owned by private investors and regulated by the government. In some places the paradigm has changed. There, the ownership of generation assets rests with private investors and prices for electricity are not set by cost-based regulation but are determined by a competitive wholesale market.

Market is defined in Webster's dictionary as "a meeting place for trade by purchase and sale." For the purpose of the primer, market is used to define a place where buyers and sellers interact in buying and selling their goods. This interaction between buyers and sellers in the market determines the market clearing price. Buyers and sellers put in bids for how much they want to buy or sell and at what price. Typically, the price of the last winning bidder selected to meet the demand sets the market clearing price that gets paid to all winning bid sellers.

Markets exist for many products in the world and have different dimensions:<sup>4</sup>

**Spot (cash) versus Future/Forward:** in spot markets goods are exchanged on the spot and the buyer pays the seller on a cash equivalent basis. A simple example is customers buying groceries in a grocery store. In forward markets, commitments are made by buyers and sellers to exchange the product some time in the future for a given price for a given quantity. Futures markets are similar to forward markets but offer more standardized products by organized market makers. An example would be a grain producer selling his harvest well in advance to secure a fixed price for his output and a bread maker purchasing that grain well in advance to lock in an input price to make his bread. One of the most popular futures markets is New York Mercantile Exchange.

**Physical versus Financial:** In physical markets, goods are physically exchanged. An example would be a power plant (buyer) purchasing coal for its needs and coal mine owner (seller) delivering the coal to the power plant. In financial markets, it is not essential to physically trade the goods but the "value" of the goods is exchanged in monetary terms<sup>5</sup>.

**Primary versus Secondary:** Primary markets are where goods typically are traded for the first time. An example would be a corporation issuing debt or equity and raising

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<sup>4</sup> Basic introductory concepts are presented here. The reader must refer to a finance textbook for more details. There are other distinctions such as Money markets versus Capital markets, but they are beyond the scope of this primer. Only those concepts that have relevance to electric markets are presented here.

<sup>5</sup> Financial contracts typically serve risk management function for both buyers and sellers. For example, buyers and sellers can get price certainty into the future, for a given quantity, through a financial contract.



capital in the market for the first time. The proceeds from these sales go to the corporation issuing the debt and equity. A secondary market is where these debt and equity instruments are traded again and again in the market place. The proceeds of these transactions do not go to the corporation but remain between buyers and sellers of these instruments.

**Geographic Area:** The market for the product could be limited to a very local geographic area or could encompass international markets. Electric markets are relatively local whereas oil markets are global in nature.

**Organized versus Informal:** Some markets, such as the New York Mercantile Exchange (NYMEX) are well-organized with standardized products. Informal markets are where buyers and sellers engage in private bilateral transactions.

Electricity markets are a relatively new phenomenon. Markets are being set up where sellers (generators) can sell their output to buyers (utilities, direct end-use customers). While prices are determined based on supply/demand relationship and other factors, the markets are governed by a set of market rules, devised collectively by regulators and market participants. Maintaining the reliability of the complex electric system remains a high priority in this set up. Different electric markets offer different products.<sup>6</sup> A menu of electric products includes:

**Energy:** (Note that this is the focus of this primer!)

- Hourly Day-Ahead Market
- Real-Time market<sup>7</sup>

**Installed Capacity:**

- Monthly
- Six months
- Annual

**Ancillary Services:**

- Regulation
- Spinning Reserves
- Non-spinning Reserves

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<sup>6</sup> For a detailed discussion of various electric submarkets, see *Power System Economics: Designing Markets for Electricity*; by Steven Stoft, IEEE Press, Wiley InterScience Publications, 2002.

<sup>7</sup> For a discussion of locational marginal pricing, see presentation “Locational Marginal Pricing,” by Andrew Ott, July 30, 1998, available at [www.pjm.com/services/training/downloads/ferc-pres.pdf](http://www.pjm.com/services/training/downloads/ferc-pres.pdf)



## **SECTION 2. ANALYSIS OF MARKET POWER**

### **1) Definition of Market Power**

There are many definitions used to describe market power. The following definition is useful for the purpose of this primer: “Market Power is the ability of a firm or a group of firms to unduly raise prices above the competitive level, inconsistent with a competitive market outcome, in order to improve profits.”

The above definition raises several questions:

- Raise prices by how much? For how long a period of time?
- How is a competitive price level identified?
- Can the impact of actions of one entity be isolated?
- What are the consequences of transitional price spikes?
- What are the costs and benefits of intervention?
- Are the costs of intervention for a transient price increase greater than the benefits?

There is no quick text book answer for the above questions. The market monitor needs to address these questions as market power mitigation is applied in the electric markets. Monopsony power (many sellers, but only one buyer), on the other hand, is exercised by buyers to help lower the market clearing price. It must also be noted that there is a distinction between having an opportunity to exercise market power versus actually exercising it. A detailed structural analysis outline of market power is offered by the Federal Electric Regulatory Commission (FERC) and its highlights are provided in Appendix 1.

### **2) Implications of Exercising Market Power**

The exercise of market power adversely affects efficiency, fairness and confidence in markets. It distorts the competitive price and level of output.

It has an economic impact on customers in terms of potential wealth transfer from buyers to sellers. The price rise may, however, spur demand reduction from customers, depending on their price elasticity.

It is interesting to note that the generator exercising market power is potentially not the only one benefiting from the increase in market clearing price resulting from the exercise of market power. Other winning generators who have not exercised market power may also benefit from the general increase in the market price.

The increase in price may also have an impact on entry of new players into the market. Higher spot prices might lead to more new entrants in the long run that may then help to suppress the higher prices. However, in addition to attracting potential new entry, high





prices must definitely attract the attention of market monitors and regulators to review whether the high prices are due to the exercise of market power. High prices at times may signal efficient price signals, they do not necessarily imply abuse of market power; market monitor has to differentiate between the two.

Before reading the rest of the Section, it would be useful for the reader to review the characteristics of monopoly and competitive markets described in Appendix 2.

### **3) Types of Market Power**

Market Power (MP) can be described in terms of Vertical Market Power (VMP) or Horizontal Market Power (HMP). A subset of HMP is the exercise of MP in Load Pockets.

#### **Vertical Market Power**

Vertical market power is possible if one entity owns both generation assets and delivery (transmission/distribution) assets. This entity can artificially raise the price of the commodity by exploiting ownership of the delivery system.

The following are some examples of how the exploitation can happen when generation is competitive and delivery is monopoly service:

- The owner of delivery system could provide preferential pricing/service of delivery to those customers who also take its commodity.
- There could be undue cross subsidies between competitive and monopoly functions.
- The delivery company could take actions to raise the price for its commodity by not building sufficient transmission when and where necessary.

#### **Horizontal Market Power**

Horizontal market power is exercised when there is not enough generation supply to meet the demand or there is not enough diversity in owners of the generation assets. This provides room for producers to increase prices artificially. If one or few firms have majority of the market share, they could dominate and exercise market power. A dominant player could restrict output and raise prices (although sales may go down, increased prices would offset the revenue reduction to the generator).

An example of the exercise of HMP is given below:

- If unit X offered 100MW into the market and received a market clearing price of \$50/MWH, then revenues for that hour are \$5,000 [100 x \$50]
- Assume it had the ability to exercise market power. If it only offered 80MW into the market, and received \$70/MWH market clearing price [the price increase is due to X offering less into the market], then revenues for that hour are \$5,600



- Even though X produced less, it received more in revenues by withholding – this could mean an increased cost to consumers.

### **Load Pocket**

Load Pocket (LP) is a geographic area where transmission capability into the pocket is limited, hence local generation is needed to serve the load in the LP. The local generator may have market power at least in some hours of the year.

## **4) Exercise of Market Power**

The following are some methods of exercising Market Power:

**Physical withholding:** By not offering all, or only a part of the generation supply into the market, even though it is available for operation; falsely declaring that the unit is out of service; operating at a level lower than instructed by the Market Operator

**Economic withholding:** By offering all or part of the generation into the market but bidding it at a high uncompetitive level

Typically, for both the above categories of withholding, numerical or quantitative thresholds can be agreed upon to indicate unwarranted behavior<sup>8</sup>

Detecting economic versus physical withholding can be tricky. For example, an increase in the bid price of a generator from \$50 to \$55 per MWH may not appear high, whereas withholding half the output may be more dramatic. It is possible though that both actions produce the same price impact. The Market Monitor has to be vigilant in detecting Market Power.

Creating barriers to entry: By taking actions to prevent competitors from entering into the market so the existing owners can exercise market power. Causing other suppliers' price to increase: By taking actions that would cause prices of other competitors to increase

## **5) Primary Structural Defects That Lead To the Potential for Market Power**

Structural defects generally refer to core problems associated with both buyers and sellers in the market place that are not necessarily susceptible to easy quick solutions.

**Lack of Demand Response:** Lack of demand response to changing prices is a major impediment to controlling market power. Typically, customers do not see the price signals on a real time basis. Even on a monthly basis, customers are generally priced only on an aggregate load weighted average market price basis. If customers do not respond to increase in prices by decreasing consumption, generators may have an opportunity to

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<sup>8</sup> For quantitative examples, see "A Review of Monitoring Activities at U.S. Independent System Operators," by Goldman et.al.; Lawrence Berkeley National Laboratory, January 2004.



exercise market power. Good demand response would help reduce market power opportunities significantly.

**Generation is location specific and time dependent:** A specific generator may be needed for reliability purposes in a given geographic area for a certain time period that gives it a local monopoly

**High concentration of ownership:** If ownership of generation is concentrated in a few owners, it increases the potential for market power.

**Lack of sufficient forward contracting:** If sufficient amount of generation is tied up in forward contracts with loads (customers), the incentive for those generators to exercise market power decreases.

**Lack of entry from new players:** If there is a strong threat of entry from new players soon that could undercut the market share of existing generators, the incentive and the ability to exercise market power by existing generators would be lower.

## 6) Measurement of Market Power

The dimensions for measuring market dominance include the product, geography, and time. Some of the key measures that provide screening guidelines to assess market power are:

- Herfindahl-Hirshman Index (HHI)
- Lerner Index
- Residual supplier Index
- Price Elasticity of Demand

**Herfindahl-Hirshman Index** measures concentration of suppliers. It is defined as the sum of squares of market shares of all firms in a defined market. There are several rules following the HHI:

- If a firm has 100% market share, then HHI is 10,000 [ $100^2 \times 1$ ]; If there are 10 firms each with 10% market share, then HHI is 1,000 [ $10^2 \times 10$ ]; If there are 100 firms each with 1% market share, then HHI is 100 [ $1^2 \times 100$ ]
- The higher the HHI, the higher the potential to exercise market power. FERC recommends the following interpretation:
- HHI >1800 highly concentrated
- $1000 < \text{HHI} < 1800$  moderately concentrated
- HHI < 1000 unconcentrated

**Lerner Index** measures how high price is relative to the marginal cost. It is defined as  $(P - MC)/P$ , where P is price and MC is marginal cost.



**Residual Supplier Index** measures the concentration of pivotal players.  $RSI = (\text{Total Supply} - \text{Largest Seller's Supply}) / (\text{Total Demand})$ . If  $RSI < 1$ , it implies that the largest supplier has dominant market share and the ability to exercise market power

**Price elasticity of demand** measures the change in quantity for a given change in price.  $\text{Elasticity} = - (dQ/dP) / (Q/P)$ ; [%change in quantity/%change in price]; where d = delta/derivative/slope. If elasticity  $< 1$ , demand for electricity is inelastic, implying the likelihood that suppliers may use this as a venue for exercising market power.

## 7) Measures for Mitigating Market Power

Some of the market power mitigation measures include the following:

**Use of Bid Caps:** Under this approach the bid amount of a generator that has the ability to exercise market power is capped at a predetermined level. Bid caps could be applied to units that are must-run for reliability purpose and units that have market power potential as identified by the Market Monitor. The generator, however, still receives market clearing price. The bid cap is considered to be a proxy for competitive bids and must reflect marginal cost plus opportunity cost. The basis for generating unit-specific bid caps could be either past accepted competitive bids OR a cost formula (such as fuel + variable O&M + opportunity costs) OR /negotiation between the Market Monitor and the generator. This capped level is also commonly referred to as “Reference Level.”

]

**Use of Safety Net Caps:** This is a measure that could be applied generically to all generators on the bid or price levels. The cap level is predetermined and the goal is to ensure that the market clearing price will never exceed the cap level. The bid cap could reflect a relatively high level, reflecting value of lost load to set an upper boundary beyond which generators cannot bid. The cap sets an upper boundary on generators’ ability to exercise economic withholding. The cap would still allow prices to reflect scarcity when shortages occur.

**Automatic Mitigation Procedures (AMP):** Under this approach bids or prices could be mitigated based on preset formulas. The mitigation is automatic once the predetermined trigger levels are invoked. AMP may be necessary when there are significant infrastructure problems in the market, (e.g., sustained tight reserve conditions, loss of hydropower because of drought and major transmission line outages). The concern is that bids will be high due to withholding rather than due to scarcity. AMP may not be needed for every region within the market, but may be adopted if the Market Monitor’s analysis determines it is needed.

**Resource Adequacy Requirements:** Another approach to mitigating the exercise of market power is through the imposition of requirements on loads to procure adequate capacity well in advance, to ensure that there is adequate capacity on the system that would help mitigate market power potential. This is considered a long-term solution.



**Increased Demand Side Response:** Typically, the prices are highest at the peak load hours. There is an incentive to exercise market power in those hours as the load is very high and most of the supply is needed. If the demand could be reduced, particularly in those hours, the ability of generators to exercise market power could be reduced. Some of the competitive markets have already introduced demand side response in a market based way. For example, along with suppliers, demand side resources can bid into the market and offer how much load they will reduce at what price.

**Increased Forward Contracting:** If most or all of the generators' output is tied up in contracts with loads for a given period, then an increase in spot market prices must not provide sufficient incentive for them to attempt to exercise market power.

### **8) The Process for Mitigating Market Power**

- An initial analysis must be performed by the market monitor and a mitigation plan must be filed with the ERC. It could be updated periodically.
- Market rules must be known to the participants upfront, otherwise there is a potential to increase regulatory risk to investors in generation assets.
- An agreement is needed between the Market Operator and generators with market power stating that they must offer their supply through bilaterals or the spot market.
- All units scheduled ahead under a must-offer obligation, but not needed in real time, would be paid their startup and no-load costs.
- When market monitor identifies violation of market rules, it must work with the relevant parties to rectify the situation. Many a time the “abuser” would work very cooperatively with the market monitor for fear of being identified to the public as a violator of rules. The “shame” factor generally is a major deterrent.
- As abuses are identified and root causes understood the market monitor must take actions to fix the market rules that led to the abuse, if and where necessary.

**Over-Mitigation** Mitigation measures must be designed to minimize interference with competitive market. It is important to ensure that long term competitive prices allow the opportunity for the generators to recover their fixed costs as well as the short-term variable costs of producing power. If not, plants may be retired and new investment may not come in because investors in generation will not have a reasonable expectation of recovering their costs. If spot markets are over mitigated, there will be less of an incentive for buyers to engage in bilateral transactions as they seek lower prices in spot markets. This could lead to volatility in spot prices.



### SECTION 3. MARKET MONITORING TOOLS

#### A. Actions of the Market Monitor

1. On a routine basis, the Market Monitor must review the following:

- generator and load bidding behavior, including trends;
- economic and physical withholding actions of generators;
- actions that may adversely impact market operations;
- uneconomic overproduction by generators;
- underbidding by loads;
- audit the posted clearing prices; and
- compliance by market participants with market rules.

2. The Market Monitor must mitigate bids and prices per agreed upon rules. Conduct of the market players must be reviewed and impact of the actions of such violations of the generators must be studied.

It is possible that a market player violates rules and increases bid prices, but it may have no impact on market clearing prices. Example: Generator A bids high at \$1000/MWH although his cost is closer to \$40/MWH, the market clearing price is only \$50/MWH; the simulated market clearing price with A's cost is still \$50/MWH; hence A's actions have violated conduct but not impacted the market

If both conduct and impact are violated, mitigation may be necessary if the generator cannot satisfactorily explain the reason for its high bid. Example: Generator X bids \$500/MWH, far above its cost level of \$40/MWH; the market clearing price is \$100/MWH; the simulated market clearing price with X's cost is \$75/MWH; thus, both conduct and impact tests are violated.

3. On a periodic basis, the Market Monitor must review the following:

- Prices- hourly, daily, monthly and annual;
- Supply Demand Gap;
- Supply availability, concentration of generators;
- Input fuel prices;
- Load duration curve;
- Price duration curve;
- The drivers of price changes; and
- Market rules to see whether changes are warranted and recommend changes to improve the market place.



4. The Market Monitor must recommend steps to remove any uncompetitive actions.

## B. Analytical Market Monitoring Tools and Examples

The following are some analytical tools that the Market Monitor could use:

**Concentration Measures:** Quantifying market concentration using HHI index is a standard approach to assess individual generator market power potential. See EXAMPLE 1 at end of this section for HHI computation

**Market Behavior:** The Market Monitor needs to assess whether generators are engaging in physical withholding or economic withholding and whether loads are underbidding. The following describes some analytical tools to perform such analysis. Physical withholding could include derating a unit or not offering a unit when it is economic to do so. Economic withholding results from generators bidding at a higher price to raise the market price. Underbidding by loads happens when loads improperly bid in lower amounts of demand primarily to suppress the price.

**“Withholding Supply” Analysis:** It is important for the Market Monitor to differentiate strategic withholding from competitive conduct. In other words, it must determine whether a forced outage is legitimate or whether it is a strategic attempt to withhold. Generally, under competitive conditions, generators would want to sell the maximum output at peak periods when prices are high, to maximize profits. A generator with market power might find withholding profitable at peak periods.

- Analyze the percentage of time a participant sets the market clearing price.
- Analyze relationship between peak demands and measures of potential withholding.
- **Economic withholding:** Review relationship between capacity not available (bids far exceed base costs) and load, during peak load periods
- **Physical withholding:** Review relationship between load and capacity derating, during peak periods.
- See EXAMPLE 2 at end of section for analysis of profit potential by withholding

**Profitability of Generators:** It is important for the Market Monitor to analyze, at least in the initial years of market development, whether the profits from the markets are sufficient to entice new generation and to keep the existing generation from closing. The Market Monitor needs to analyze various revenue streams to generators, review cost elements, and determine net revenues to generators. See EXAMPLE 3 at the end of this section for a sample of profitability analysis.



### **EXAMPLE 1: Concentration Measures**

Owner	Market Share (M)	M <sup>2</sup>
A	20%	400
B	20%	400
C	20%	400
D	20%	400
E	20%	400

HHI:2000

In this scenario, all the players have equal Market Share.

Owner	Market Share (M)	M <sup>2</sup>
A	5%	25
B	10%	100
C	40%	1500
D	40%	1500
E	5%	25

HHI: 3350

In this scenario, two market players (C and D) have dominant Market Share.

### **EXAMPLE 2: Bidding Behavior and Impact on Profits**

Owner XYZ has 2 Units: Unit A: 500 MW  
Unit B: 50 MW

		A	B
Capacity	MW	500	50
MC	\$/MWH	20	40

If both are bid in, say market clearing price is \$/MWH      \$45

If Unit B is withheld, market clearing price is \$/MWH      \$60

What is the ramification of bidding Unit B to Owner XYZ?

	Net Revenues
Bid Unit B In:	\$12,750.00
Withhold Unit B:	\$20,000.00





### **EXAMPLE 3: Profitability Analysis**

Plant Size            500 MW  
 Installation Cost    \$600/KW

		<b>\$</b>	<b>Cost</b>
Total Investment		\$300,000,000	
Equity	50%	\$150,000,000	12%
Debt	50%	\$150,000,000	8%

Capacity Factor            70%  
 Annual Output            3,066,000    MWH  
 Heat Rate                 8,000        BTU/KWH

#### Annual Costs:

Labor	5,000,000
Property Tax	8,000,000
Insurance	2,000,000
<b>Total To Go Costs</b>	<b>15,000,000</b>

Tax Rate        30%

After Tax Cost of Debt        8,400,000  
 Depreciation 5%                15,000,000

Natural Gas Input Cost        \$/MMBTU    \$4.00  
 Fuel Cost                        \$/MWH        32  
 Variable O&M Cost            \$/MWH        2  
 Market Clearing Price        \$/MWH        52

Spark Spread                    \$/MWH        18

Net Revenues                    \$Million     55,188,000 (Spark Spread X Output)  
 Less To Go Costs                \$Million     40,188,000  
 Less Debt/Depreciation        \$Million     16,788,000

**Return on Equity                    12%**



## PART III

# MARKET MONITORING PLAN

### SECTION 1. ELEMENTS OF A GENERIC MARKET MONITORING PLAN (MMP)

Following are some of the elements that could be considered for incorporation in a market monitoring plan.

**Purpose of the plan:** The MMP must describe the purpose of the plan. The purposes could include the following:

- Evaluate behavior of market participants - Generators, Load, and Other participants
- Identify and mitigate anticompetitive behavior
- Punish market participants who violate rules including exercising market power
- Validate posted market prices
- Ensure transparency of market signals
- Identify opportunities for efficiency improvements - structural, operational, market rules
- Identify resource adequacy issues - whether the market yields sufficient incentives to ensure adequate resources
- Reporting to the market

**Implementation Procedures:** The MMP could include the following implementation procedures:

- Statement of rules, procedures for monitoring – the clearer the rules, the better it is for the marketplace
- Performance metrics - what metrics would be used to assess performance?
- Enforcement of rules - how would the rules be enforced?
- Mitigation Rules - how would identified market power be mitigated?
- Penalties - what are the consequences of market participants violating rules?

**Data Issues:** Data issues that must be incorporated into a MMP include:

- Definition of needed data: publicly available data, confidential data from market participants
- Obligations and Rights of market participants - what data needs to be provided to the market monitor?
- Disclosure of data and confidentiality rules



**Staffing:** The MMP must identify staffing of the function:

- Independence – the market monitor must be independent of the market participants and must have no financial or other vested interest, to avoid conflict of interest
- Internal - What must be the staffing internal to the Market Operator?
- External - Must there be an external market advisor?
- ERC oversight - What is the role of ERC in oversight?
- Funding Source for the market monitoring staff
- Roles and Responsibilities of different players - Internal monitor versus External monitor versus ERC
- Must be it solely managed by the industry itself (self policing) or involve government or a combination of both?

**Other Elements** The other elements that could be included in the MMP include:

- Dispute Resolution - Who resolves disputes among market participants and what mechanisms will be used to resolve these disputes?
- Rights and obligations of market participants
- Reporting Procedures - What are the obligations of the market monitor in preparing reports such as Annual Reports of state of the market and periodic reports on specific identified issues?



## **SECTION 2: SPECIFIC EXAMPLES OF MARKET MONITORING PLANS**

Some plan elements of the MMP for Pennsylvania Jersey Maryland (PJM RTO), New York (NYISO), and New England (NEISO) are provided below. These three were chosen because they have some of the most advanced market structures with a few years of experience behind them. Even these markets are evolving and changes are being made to improve the markets, as experience and need dictate. The MMP for a given market must be tailor made to reflect the underlying characteristics of that market. The following are major excerpts of the overall MMP for each of these markets. The reader is encouraged to review the complete plans for further details.

A detailed summary of the market monitoring organizations is provided in the report “A Review of Market Monitoring Activities at U.S. Independent System Operators.” (<http://www-library.lbl.gov/library/docs/LBNL/539/75/PDF/LBNL-53975.pdf>)

On the other hand, New Zealand Electricity Market is a self-regulated market with a disciplinary and monitoring committee created by contract, rather than by government regulation. See [www.Nzelectricity.co.nz/C2fMsc.htm](http://www.Nzelectricity.co.nz/C2fMsc.htm) for further details.



**PJM Market Monitoring Plan**  
**PJM Interconnection, LLC; FERC Electric Tariff; Fifth Revised Volume No. 1**  
**(Highlights from Attachment M)<sup>9</sup>**

I. Objective

- Monitor and report on issues relating to the operation of the PJM Market including market power
- Evaluate the operation to detect design flaws
- Evaluate enforcement mechanisms
- Ensure independence and objectivity in monitoring

II. Definitions

III. Monitored Activities

- Compliance with rules, standards, and procedures set forth in tariff, operating agreement, primers etc.
- Actual or potential design flaws
- Potential of any market participant to exercise market power

IV. Corrective Actions

- Report to Commission immediately if a significant problem is identified; engage market participants informally in corrective actions; and if issue is not resolved, bring it to the appropriate authority including PJM Board
- Confidentiality provision

V. Market Monitoring Unit

- Establishment
- Adequate staffing to carry out functions
- Composition
- Qualified full-time staff and use of consultants as appropriate
- Accountability and Responsibilities - Accountable to PJM Board

VI. Specific Monitoring Functions

- Primary information sources:
  - Data gathered in normal course of business plus publicly available data
  - Information requests
  - Right to request market participants for data if needed to investigate

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<sup>9</sup> The complete document can be found at [www.pjm.com/markets/market-monitor/downloads/mmplan.pdf](http://www.pjm.com/markets/market-monitor/downloads/mmplan.pdf)



- Addressing market participants' complaints
  - Any market participant can bring a complaint to the market monitor on a confidential basis and ask for an investigation.
  - Market monitor and the Board will investigate if they see merit in the complaint
  
- Collection and availability of information
  - Market monitor has to collect necessary data
  - Make data available to the public as appropriate including disclosing what data is being collected
  - Confidentiality of data, where necessary, is extremely important for integrity of the market
  
- Evaluation of information
  
- Refine data collected based on experience
  
- Market monitoring indices
  - Summary PJM statistics
  - System prices and loads
  - Congestion by hour, zone
  - Volumes of bids, bilateral transactions, imports/exports
  - Comparative prices with other regions
  - Locational prices and loads
  - Offers and dispatch
  - Available capacity
  - Market Structure
  - Concentration ratios by hour, by zone
  - Price-cost margins
  - Unit specific, company specific data
  - Capacity market

## VII. Reports

- Reports to PJM Board
  - State of competition, efficiency of the markets, recommendations for improvement
  
- Reports to Government agencies
  - Information provided to the Board plus other information requested by government agencies
  
- Public Reports
  - Detailed annual public report

## VIII. Annual Audit of Market Monitor's Performance



**New York ISO Market Monitoring Plan**  
**New York Independent System Operator, Inc; FERC Electric Tariff; Original Volume**  
**No 2 (Highlights from Attachment H)<sup>10</sup>**

I. Purpose and Objectives

- Means for the ISO to mitigate the market effects of any conduct that would substantially distort competitive outcomes
- Monitor the market for abuse of market power

II. Conduct Warranting Mitigation

- Conduct significantly inconsistent with competitive conduct
- Conduct that would result in material change in prices:
  - Physical withholding of an electric facility
  - Economic withholding
  - Uneconomic production

III. Criteria for Imposing Mitigation Measures

- Conduct Threshold for identifying
  - Physical withholding
  - Economic withholding
  - Uneconomic production
- Reference Levels
- Material Price impact  
Market impact threshold
- Consultation with market participants

IV. Mitigation Measures

- Default bid : designed to cause a market party to bid as if it faced workable competition
- Sanctions
- Penalty amounts

V. Other Mitigation Measures

VI. Dispute Resolution

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<sup>10</sup> The complete document is at [www.nyiso.com/services/documents/filings/pdf/services\\_tariff/att\\_h.pdf](http://www.nyiso.com/services/documents/filings/pdf/services_tariff/att_h.pdf)



**New England Market Monitoring Plan**  
**New England Power Pool; FERC Electric Rate Schedule No.6**  
**(Highlights from Appendix A)<sup>11</sup>**

I. Purpose and Objectives

- Mitigate market effects of conduct that would substantially distort market outcomes
- Monitor abuse of market power
- Modify congestion area threshold as appropriate

II. Mitigation Principles

- Conduct subject to mitigation
- Conditions for the imposition of mitigation measures
- Categories of conduct that may warrant mitigation
  - Physical withholding by a participant
  - Economic withholding and uneconomic production
  - Anti-competitive increment offers and decrement bids
  - Other conduct
- Other Monitoring objectives
- Duration of mitigation measures

III. Consultation Requirements

- Notice and opportunity to respond
- Consideration of information
- Advance consultation by participant
- Participant access to its reference levels

IV. Physical Withholding

- Identification of conduct inconsistent with competition
- Thresholds for identifying physical withholding
- Hourly Market impact if not mitigated
- Imposition of mitigation measures

V. Economic Withholding and Uneconomic Production

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<sup>11</sup> The complete document is at [http://www.iso-ne.com/market\\_rules\\_and\\_procedures/MRP\\_17\\_Market\\_Monitoring\\_Reporting\\_and\\_Market\\_Power\\_Mitigation/MRP-17-in-effect.pdf](http://www.iso-ne.com/market_rules_and_procedures/MRP_17_Market_Monitoring_Reporting_and_Market_Power_Mitigation/MRP-17-in-effect.pdf)





- Definition of Pivotal Supplier
- Thresholds for identifying economic withholding
- Threshold for identifying uneconomic production
- Hourly market impact if not mitigated
- Market impact thresholds
- Calculation of Resource Reference Levels
- Mitigation measures

VI. Reliability Must-Run Agreements

- Mitigation agreements
- Cost of service agreements
- Filing with the Commission

VII. Mitigation of Demand Bids

VIII. Mitigation of Increment Offers and Decrement Bids

IX. Mitigation of Installed Capacity Resources

X. Alternate Dispute Resolution Review of ISO Mitigation Actions

- Actions subject to review
- Standard for review

XI. Reporting

- Data collection and retention
- Periodic reporting to public, regulators
- Annual reviews
- Other communication with government agencies
- Other information available from ISO on request by regulators



## PART IV

### QUANTITATIVE EXERCISES IN MARKET ANALYSIS

#### 1. MARKET POWER POTENTIAL

Market Power Potential Assessment Exercise

Generator	Capacity (MW)	Cost (\$/MWH)
A	50	50
B	150	70
C	200	75
D	300	40
E	400	25
F	500	30
Peak Load	1000	
Annual Number of Hours	8760	> 5000
Load Level (MW)	500	> 800 > 1000 > 10

Question:

Assess Market Power of Each of the Generators Under Each of the Following Scenarios

Scenario 1:

All the Generators are Available

Scenario 2:

Assume Generators A and F are out for Peak Period Months



## Market Power Potential Assessment Exercise Solution

Generator	Capacity (MW)	Cost (\$/MWH)	MKT Share (M) %	M <sup>2</sup>
A	50	50	3	10
B	150	70	9	88
C	200	75	13	156
D	300	40	19	352
E	400	25	25	625
F	500	30	31	977
<b>Total</b>	<b>1600</b>		<b>100 HH</b>	<b>2207</b>
			<b>RSI</b>	<b>1.1</b>

### Scenario 1: All the Generators are Available

While no individual generator has a dominant market share, the HHI and RSI warrant close attention. Collusion between two generators together (e.g. E and F) could lead to exercise of market power, particularly in peak hours.

### Scenario 2: Assume Generators A and F are out for Peak Period Months

Once A and F are taken out the available supply dwindles to 1050 MW, perilously close to the peak load. The HHI and RSI change to 2834 and .65 respectively. Any on supplier can easily withhold even a fraction of his output and exercise market power, particularly during peak periods.



## 2. BIDDING BEHAVIOR AND IMPACT ON PROFITS

### Bidding Behavior and Impact on Profits

Owner XYZ has 2 Units: Unit A: 500 MW  
Unit B: 50 MW

		<b>A</b>	<b>B</b>
Capacity	MW	500	50
MC	\$/MWH	20	40

If both are bid in, say market clearing price is \$MWH \$45  
If Unit B is withheld, market clearing price is \$MWH \$60

What is the ramification of bidding Unit B to Owner XYZ?

	<b>Net Revenues</b>
Bid Unit B In:	\$12,750.00
Withhold Unit B:	\$20,000.00

Question:

What is the breakeven market clearing price that would affect the decision not to bid in Unit B?

**BIDDING BEHAVIOR AND IMPACT ON PROFITS EXERCISE - SOLUTION**

Breakeven market clearing price =  $\$X/\text{MWH}$

Profit per hour from unit A =  $(X-20)*500$

Profit per hour from unit B =  $(X-40)*50$

If Unit B is bid in, net revenues are \$12,750

The breakeven price has to produce at least this level of net revenues.

If unit B is not bid in, at the breakeven level:

$$(X-20)*500 = 12,750$$

$$X = \$45.50$$

If the market clearing price is below \$45.50, unit B needs to operate to increase revenues.

Say, unit B was not bid in, and the market clearing price was only \$45.25

Then the net revenues would be  $(45.25-20)*500 = \$12,625$

This level is lower than \$12,750 resulting from both units bidding in and running.



### 3. PROFITABILITY ANALYSIS - EXERCISE

Plant Size            500 MW  
 Installation Cost    \$600/KW

		<b>\$Million</b>	<b>Cost</b>
Total Investment		\$300,000,000	
Equity	50%	\$150,000,000	12%
Debt	50%	\$150,000,000	8%

Before Tax Cost of Debt    8%

Capacity Factor            70%  
 Heat Rate                    8,000            BTU/KWH

#### Annual Costs:

Labor	5,000,000
Property Tax	8,000,000
Insurance	2,000,000
<b>Total To Go Costs</b>	<b>15,000,000</b>

Annual Depreciation        5%

Natural Gas Input Cost    \$/MMBTU    \$3.50  
 Variable O&M Cost        \$/MWH        2

#### Questions:

- 1) What should be the market clearing price to achieve a required return of 15% on equity?
- 2) If the market clearing price is \$40/MWH, how many hours does the unit have to run to cover its "To Go" costs? How many hours to also cover debt service?
- 3) Below what market clearing price would it make sense for the unit to be mothballed?



## PROFITABILITY ANALYSIS EXERCISE - SOLUTION

### 1) Market Clearing Price needed to achieve an after-tax return of equity of 15%:

Fuel cost per unit output using heat rate and gas cost assumptions = \$28/MWH

Total variable cost = fuel cost + variable O&M = \$30/MWH

To Go Costs = \$15M

Depreciation = (\$300M\*5%) = \$15M

After-tax cost of debt = (\$150M\*8%\*0.7) = \$8.4M

Pre-tax cost of equity = (\$150M\*15%)/0.7 = \$32.1M

Total Annual Cost = \$70.5M

Total Output = 500MW\*60%CF\*8760 = 2,628,000 MWH

Say market clearing price = \$X/MWH

$$2,628,000*(X-30) = \$70.5M$$

$$X = \$56.83/MWH$$

### 2) Number of hours needed to run to cover “to go” costs at \$40/MWH price

Revenues net of variable costs = 40-30 = \$10/MWH

Number of hours needed to run = X

$$\$10*500MW*X = \$15M$$

$$X = 3000 \text{ hours}$$

### 3) Market price below which the unit will not even recover “to go” costs

Say Market price = \$X/MWH

$$(X-30)*500*0.6*8760 = \$15M$$

$$X = \$35.71/MWh$$



## **Appendix 1: Structural Analysis Framework for Market Power:** **(Federal Energy Regulatory Commission's proposed Rule)**

### Analyze:

- Market concentration by type of generation
- Conditions for entry of new supply
- Demand Response
- Transmission constraints and load pockets that give sellers the ability and incentive to exercise market power

### Specify Behavioral Rules:

- Physical withholding: generators may not falsely declare that a facility is out of service; must comply with must-offer obligations
- Economic withholding: generators may not submit high bids that are not consistent with caps
- Availability Reporting
- Factual Accuracy of data submitted
- Cooperation with Market Monitor

### Data Requirements

- Market statistics (e.g., market clearing prices)
- System conditions (e.g., transfer capability, planned and forced outages)
- Other prices (e.g., input fuel prices)
- Load and Available Supply
- Generator bidding patterns
- Generator specific data (costs and operating parameters)
- Confidentiality of data

### Reporting Requirements

Market monitor must submit periodic, public reports and at least an annual report containing:

- General description of the market operations
- Analysis of market structure and participant behavior
- Evaluation of effectiveness of mitigation measures
- Overall assessment of market efficiency
- Evaluation of barriers to entry for generation, transmission and demand response
- Recommended changes to market design or mitigation to improve performance





## Enforcement

- Market monitor must have authority to investigate behavior of market participants
- Set of predetermined penalties to be applied for conduct violation
- Bring to Commission attention matters as necessary

### **Appendix 2: Characteristics of Monopoly Market**

- 1) Single seller, no competitors
- 2) Seller can set price and service terms
- 3) Seller will set prices that yield largest profits
- 4) Customers have no choice
- 5) Typically, industry's technological characteristics lead to a natural monopoly
- 6) Seller extracts monopoly rents, if unchecked
- 7) Production, Consumption levels inefficient

### **Appendix 3: Characteristics of Competitive Market**

- 1) Many sellers, many buyers
- 2) Prices are decided in the market place
- 3) No single buyer or seller can influence the price by his actions
- 4) Sellers are price takers
- 5) Buyers and sellers possess perfect information
- 6) Substitutes are easily available
- 7) Free entry and exit from the market
- 8) Economic efficiency maximized



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