Testimony of
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Joint Public Hearing of the Assembly Standing Committee on Energy and the Assembly Standing Committee on Corporations

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Albany, NY

Good morning Chairman Brodsky, Chairman Cahill, and Members of the Assembly Corporations and Energy Committees. We welcome this opportunity to examine existing wholesale energy market design and to look for ways to enhance reliability, reduce cost to consumers, and improve environmental sustainability to New York.

My name is Stephen G. Whitley. I am President and Chief Executive Officer of the New York Independent System Operator (NYISO). The New York ISO is a not-for-profit corporation that began operations in 1999, operating New York's bulk electricity system, and administering the wholesale electricity markets. The New York ISO also conducts reliability and resource planning for the state's bulk electricity system.

With me today is Dr. David Patton, President of Potomac Economics. Dr. Patton has two decades of experience in energy economics and serves as the Independent Market Advisor to the New York ISO, and for the wholesale electric markets in the Midwest, Texas, and New England. In addition to these duties, Dr. Patton serves as market advisor for the 12 states participating in the Regional Greenhouse Gas Initiative.

Today I am testifying on the efficiency of New York's market design, and the benefits it has brought to the people and businesses in New York. Dr. Patton will testify on the efficiency of uniform clearing price designed for energy markets. After our testimony, we will be glad to answer any questions you may have.

While I am a relatively recent arrival at the New York ISO, I bring with me over 38 years experience in both traditionally structured electricity markets and competitive wholesale electricity markets. During my 30-year tenure at the Tennessee Valley Authority (TVA), I served as General Manager, Electric System Operations, of the Transmission Power Supply Group, and was responsible for electric system operations and planning for the seven-state TVA service territory. Previous to my position at the New York ISO, I served as Senior Vice President and Chief Operating Officer of ISO New England (ISO-NE), a regional transmission organization (RTO) serving a six-state area, for seven years.

New York's energy needs are both diverse and complex. We have limited local fuel resources. Geographically, we serve one of the nation's largest states, with the world's largest and most complex "load pocket," New York City. We have 11,000 miles of transmission lines, more than 350 large generating units, and over 1,000 megawatts (MW) of wind generation spread out over a vast area. Our electricity demand averages about 20,000 MW, while peak demands are over 34,000 MW during the summer months. Meeting peak summer demand requires that electricity generation must come online instantaneously and without fail if we are to continue to supply this vital commodity with the reliability our citizens have a right to expect. We know that the economic costs of a large outage in our state can total $6 to $10 billion per day.

Upgrading and protecting the integrity of our electricity delivery infrastructure remains critically important, and economically efficient energy markets will play a pivotal role in helping to revitalize our state's economy. We face these challenges together as citizens, private industry, and policy makers. On behalf of the New York ISO, I look forward to assisting Governor Paterson, Legislative Leaders and Legislative Committees in achieving the State's energy, economic, and environmental goals.

New York's electricity markets opened to wholesale competition in 2000 based on the recognition that an independent organization, separate from the regulated utilities or other economic interests, would be required to operate the state's bulk transmission system and administer its new wholesale markets. Such an independent entity is key if competition is to be open and fair, avoid market manipulation, and attract needed investment. To date, experience shows that the New York ISO has been and continues to meet these market needs. The New York ISO was created to include an independent Board of Directors. In order to assure that all interests were represented, the Board was supplemented by a governance process open to market, consumer, environmental, and relevant governmental interests.

A great misconception about the state of the electric industry in New York today, is that it has been fully "deregulated." It has not. The industry has been restructured to move ownership of generation to independent companies, but the transmission and distribution systems and ancillary service systems remain tightly regulated. And, the Federal Energy Regulatory Commission (FERC) has oversight and regulatory responsibility for wholesale electricity markets, like New York's. Our bulk power and local distribution systems, wholesale consumer's rights, and the safety and adequacy of electric service at just and reasonable rates, remain the mandate of FERC, and the New York Public Service Commission (PSC). Congress has given FERC jurisdiction over interstate transmission service and the terms and conditions of wholesale power sales. This encompasses nearly everything the New York ISO does.

New York and many other states introduced competition at the wholesale level in their electric industries when many utilities found themselves with uneconomic investments resulting in stranded costs on their books. Rather than focusing on improving regulation, it was felt that competition should be introduced into the markets for electricity. At the same time, computer systems and generation technology evolved to the point where the electric energy and capacity itself could be sold on a competitive basis by suppliers who would bear the risk of their investments. Likewise, energy efficiency and demand management investments and resources could compete equally with generation resources to meet customer needs in an open market setting.

In a competitive environment, power suppliers are not paid for their energy unless their power plants generate power or provide capacity or other essential electricity services. Their plants are only chosen to generate energy if their output is competitively priced. In the event the competitive projects prove uneconomic, the investors bear the risks – not the consumers.

In our energy markets, competitive pricing is determined through a series of auctions. The system is designed to give producers the motivation to offer energy into the auctions at the lowest possible price. In New York, as in almost all other markets, that motivation is supplied by the uniform market clearing price. While the cost of fuel has driven the cost of electricity higher in recent years, the numbers here in New York show that, after adjusting for the cost of fuel, the markets have produced wholesale energy prices approximately ten percent lower than they were in the year 2000. In fact, if it had not been for the increases in the cost of fuel, competitive markets would have yielded wholesale prices for electricity, including both generating capacity and energy, 18 percent lower than in the year 2000, or over $2 billion on a current annual basis. (*See Figure 1.*)

The electricity system of this state and the nation has operated for nearly a century under a regime of regulated, geographic monopolies. We have had a little less than a decade of experience with the operation of wholesale electricity markets. However, there are strong indications that the competitive system is working and benefiting New York.

In 2008, New York's wholesale electricity markets involved more than 400 market participants and approximately $11 billion in annual transactions. The markets cleared nearly $70 billion in competitive transactions since its inception. The benefits of competitive markets in New York include attractiveness to clean and renewable sources of electricity; more efficient power plant dispatch than occurred before we started operation; improvements in the amount of power produced at existing power plants; and lower generator non-fuel operating costs. Together, these improvements created approximately $575 million in production cost savings in 2006, which contributed to lower costs to consumers.

The design of New York's markets and open access to the grid has also proven attractive to development of renewable energy resources (mostly wind) in New York. While there was no significant wind generated electricity in New York in the year 2000, before competitive markets were established, there are now more than 1,200 MW in commercial operation, as shown on the map of the New York power system we brought here today. (*See Figure 2.*) The contribution of these new wind farms is crucial. Last week wind power output reached 1,000 MW on our system for the first time, approximately five percent of the roughly 25,000 MW of total system load at the time. Our studies show that for each 1,000 MW of wind added to the system, wholesale energy costs are reduce by approximately $300 million. The market structure helps the State realize its Renewable Portfolio Standard goal. It will also help Governor Paterson's new clean energy agenda support investment and development in clean renewable energy resources in New York. The New York ISO has actively assisted the State Energy Planning Board as they craft the State Energy Plan to ensure we can meet the energy needs of our citizens.

Over 8,000 MW of additional wind and other renewable power projects are proposed for interconnection to New York's bulk electricity grid. These clean, homegrown fuels offer both significant environmental and economic benefits, as well as needed diversity to our generation fuel mix. In fact, the regions of North America served by organized wholesale electricity markets have developed 78 percent of installed wind generating capacity.

Competitive wholesale markets have also led to existing plants being run more efficiently and effectively. In New York, average plant availability increased from 87.5 percent (in the1992–1999 timeframe) to 94.4 percent (from 2001–2007). Those improvements produced the equivalent of adding 2,400 MW of generation, the equivalent capacity of four large power plants.

Since the markets began operation, with the help of the New York Power Authority (NYPA), the Long Island Power Authority (LIPA), Consolidated Edison, and other regulated companies, New York has seen the development of new generation and transmission where it is most needed: in New York City, Long Island, and the lower Hudson Valley. More than 6,000

MW of new generation has been built since the year 2000, and over 80 percent is sited where demand is greatest. This represents a $5.5 billion investment in New York generating assets. Transmission developers also have invested nearly $1 billion to deliver approximately 1,000 MW of new capacity to Long Island.

New York has also been a leader in developing demand-side management in its electricity markets. These programs effectively reduce the need for additional resources by lowering consumption during times of high demand. The total of the resources in our demand response programs have increased more than ten-fold since the year 2000, and now totals more than 2,000 MW. Demand-side resources now compete head-to-head with generation.

While a growing number of new generation resources have come into service since the start of New York's markets, a significant portion – 68 percent – of the existing generation fleet was put into service before 1980. These facilities are aging, and the costs of continued maintenance are increasing.

Replacement of these aging plants with newer technology will provide substantial environmental benefits, but will likewise require substantial new investment. To encourage these investments, it is essential that market rules maintain a level of integrity and predictability. It is also essential that the administration of the markets be independent, objective, and unbiased. Without independent administration, attracting investment will be infinitely more difficult, and ultimately more costly. Attracting investment will be more of challenge than ever, due to the national financial crisis we currently find ourselves in, and we will be competing with other regions for such investment. Disrupting the fundamental construct of our energy markets would create uncertainty and chill the climate for additional investment.

As you know, the greatest variable cost in generating electricity in fossil fuel plants is the cost of fuel. Needless to say, the costs of oil and natural gas are governed by world energy prices, beyond the control of the New York ISO or the State of New York. Despite this, the wholesale energy markets in New York have been effective to control other costs. In the second half of 2008, wholesale electricity prices in New York declined significantly as natural gas prices dropped. Natural gas prices decreased by 43 percent from June to December, and the statewide average cost of wholesale power dropped by 51 percent in that same period.

However, the recent drop in fossil fuel prices, and the decrease in demand linked to a troubled economy, must not lull us into complacency about planning for New York's energy future. Without sustained investment in diverse, non-polluting energy resources and the transmission infrastructure needed to transport these clean and renewable power supplies to high demand areas, New York's electricity consumers will continue to see power price swings tied to volatile fossil fuel prices.

Fair and competitive markets are fundamental to some of the important goals we seek to achieve, such as the investment in renewable resources, increasing our fuel diversity and independence, which leads to a cleaner environment, and the addition of jobs to our struggling economy.

The current pricing method provides greater efficiency and the ability to monitor bidding effectively, thus providing transparency and protection to consumers. It creates a marketplace that enables smaller generators, such as wind and other renewable power providers, to compete more fairly and effectively with larger traditional power producers. Now is the time for us to move forward to build more enabling infrastructure – transmission and Smart Grid enhancements – to allow greater penetration of renewables, enhance energy efficiency, increase fuel diversity, lower emissions, and lower costs to consumers. As Dr. Patton will explain, changing the market design construct to "pay-as-bid" does just the opposite. It will actually raise costs to consumers and stifle private investment.

Thank you Chairman Brodsky and Chairman Cahill for this opportunity to assist your Committees in examining the way energy markets work to determine the price of wholesale electricity in New York State. We are happy to assist you in any way.

I will now yield to Dr. Patton.

FIGURE 1

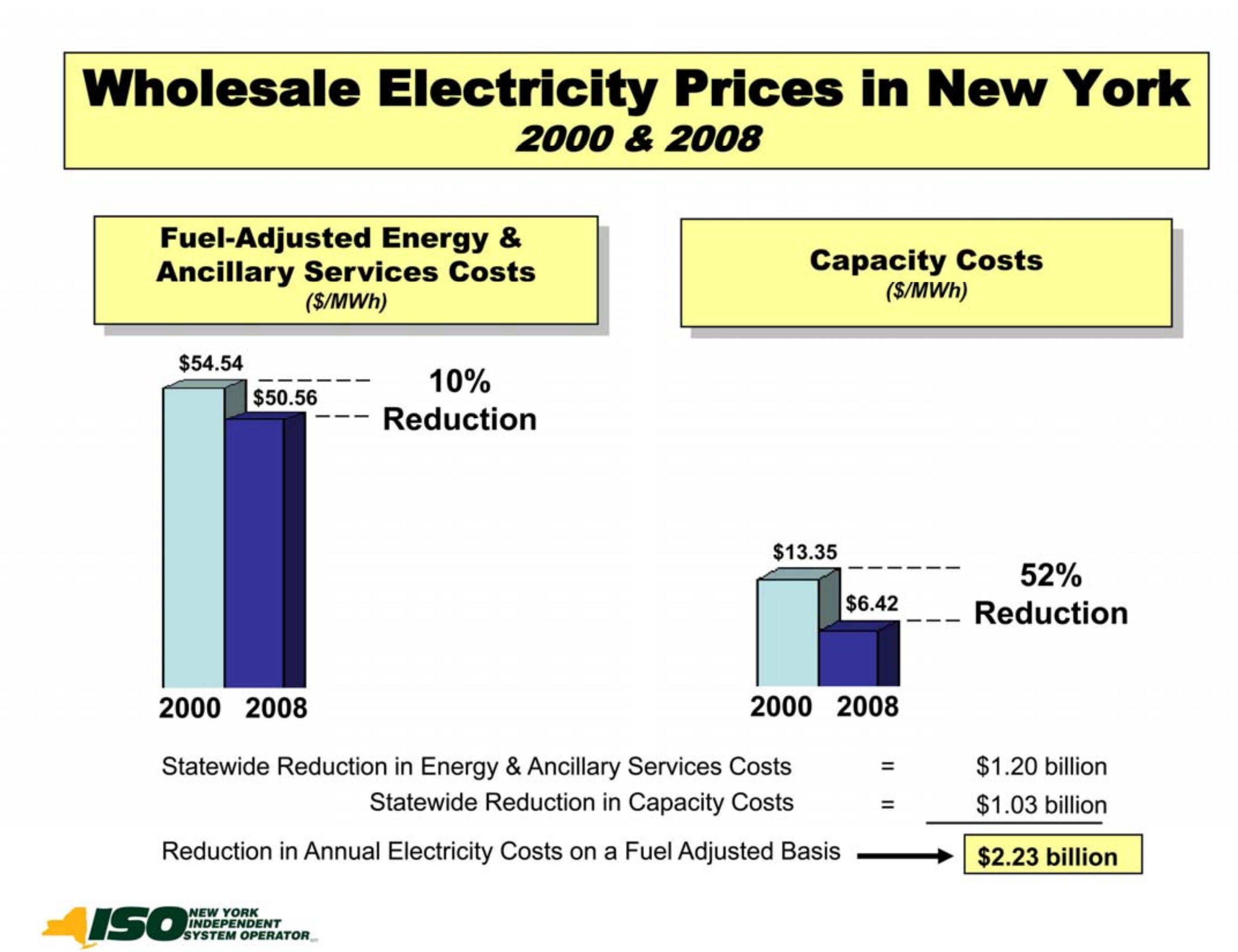
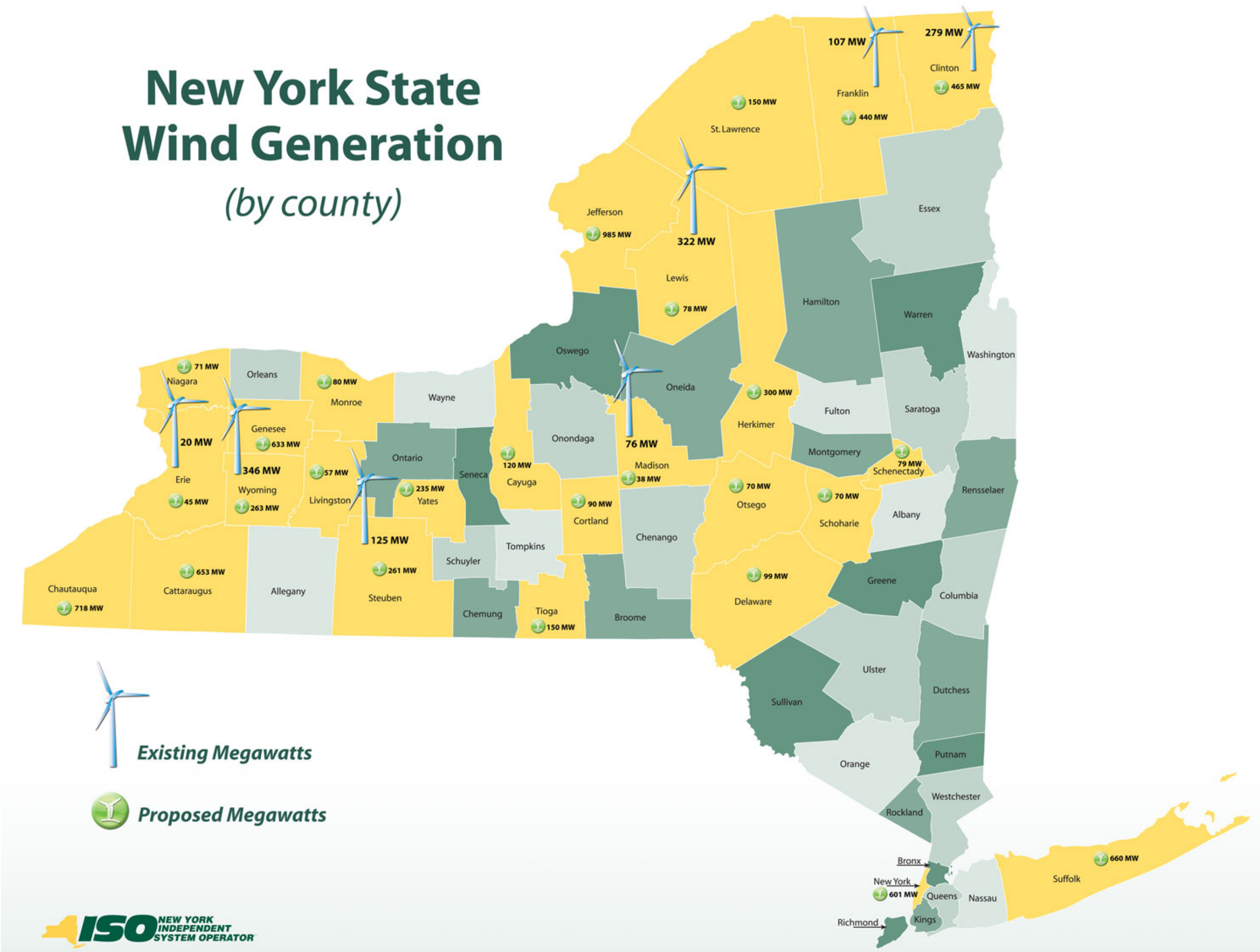


FIGURE 2


New York State
Wind Generation
(by county)
Existing Megawatts
Proposed Megawatts
ISO NEW YORK INDEPENDENT SYSTEM OPERATOR
107 MW
279 MW
Clinton
465 MW
Franklin
440 MW
150 MW
St. Lawrence
322 MW
Jefferson
985 MW
Lewis
78 MW
Essex
Hamilton
Warren
Washington
Oswego
Oneida
76 MW
300 MW
Herkimer
Fulton
Saratoga
Montgomery
79 MW
Schenectady
Rensselaer
Albany
Madison
38 MW
Onondaga
Wayne
Cayuga
120 MW
Seneca
Ontario
Monroe
80 MW
Orleans
Niagara
71 MW
20 MW
Erie
45 MW
Genesee
633 MW
346 MW
Wyoming
263 MW
Livingston
57 MW
125 MW
Yates
235 MW
Cortland
90 MW
Otsego
70 MW
Schoharie
70 MW
Chenango
Tompkins
Schuyler
Chautauqua
718 MW
Cattaraugus
653 MW
Allegany
Steuben
261 MW
Chemung
Tioga
150 MW
Broome
Delaware
99 MW
Greene
Columbia
Ulster
Dutchess
Sullivan
Orange
Putnam
Rockland
Westchester
Bronx
New York
601 MW
Queens
Nassau
Kings
Richmond
Suffolk
660 MW

Testimony of David Patton, Ph.D.

Before the New York Assembly
Committees on Energy and on Corporations, Authorities & Commissions

On Issues Relating to the Design and Performance of the Wholesale Power Market in New York State

March 5, 2009

Albany, New York

I. INTRODUCTION

Chairman Brodsky, Chairman Cahill, and Members of the Corporations and Energy Committees. I appreciate the opportunity to speak with you today. I am an economist and President of Potomac Economics. I currently serve as the Independent Market Advisor for the New York Independent System Operator, and as the Independent Market Monitor for Independent System Operators in New England, the Midwest, and Texas. In these roles, I am responsible for assessing the competitive performance of the markets and monitoring the markets for abuses of market power, manipulation, or market design flaws. I have served in this capacity for the NYISO since May 1999.

I am pleased to testify today on issues related to the design of the wholesale electricity market in New York. The design of the wholesale electricity market is critically important because it coordinates the production of electricity needed to satisfy demand on an hour-to-hour basis, and because it produces the economic signals that facilitate investment in transmission and generation over the long run. Hence, modifying the design of the wholesale electricity market is non-trivial because even seemingly modest inefficiencies introduced by such changes can result in substantial costs to consumers and market distortions both in the short run and the long run.

Many elements of the wholesale electricity market design have been analyzed extensively and debated during the introduction of the competitive wholesale markets that are now operating in New York and many other areas of the country. I will be testifying today on one of the most important elements of the market design – whether to pay all suppliers a uniform market-clearing price or to pay each supplier based on the offer price it submitted. In a market with uniform clearing prices, the lowest-cost supply is selected up until the supply equals demand. In general, the highest-cost supply selected will set the uniform clearing price, which is paid to all suppliers.

The alternative approach pays each supplier based on its own offer price and has been referred to as a "pay-as-offered" design. While this approach is intuitively appealing because it seems to promise lower costs to consumers, I will explain why it has been rejected in favor of uniform clearing prices in New York and in other wholesale electricity markets in the U.S. I will discuss the economic underpinnings of the uniform–clearing-price market design and explain how it achieves economically efficient outcomes and minimizes the costs of satisfying New York's electricity needs in the short run and long run.

I will also explain that while the pay-as-offered market design is superficially appealing, it would result in:

- Higher overall costs to consumers;
- Substantial inefficiencies in the operation of the system;
- Distortions in the incentives to invest in new generation and transmission assets;

- Additional costs that would harm relatively small suppliers; and
- Enhanced opportunities for suppliers to engage in market power abuses and manipulation;

II. ROLE OF THE WHOLESALE ELECTRICITY MARKET IN NEW YORK

Before discussing the rationale underlying the current market design, I believe it is important to understand the physical characteristics of electricity and how they influence the design of markets. Electricity cannot be economically stored, which requires that demand and supply be in balance at all times. Significant imbalances between supply and demand on an electrical network lead to voltage problems that will damage electrical equipment and can destabilize the transmission network. Another key characteristic of electric supply is that it relies on a physical network (with physical constraints) for delivery to consumers. For both of these reasons, one of the most critical functions of the market is to coordinate the production of electricity when and where it is needed by setting efficient prices at each location on the network. What magnifies the importance of this coordination and pricing of electricity is that electricity is a fundamental input to businesses and a necessity for consumers. Therefore, missteps in the design of the electricity market will affect economic activity and can significantly raise costs to consumers.

One could wonder how the foregoing discussion of the wholesale electricity market design relates to the average retail consumer of electricity. In this regard, the industry had taken a different path in New York than in other regions. Investor-owned utilities divested significant portions of their generation assets prior to the introduction of the competitive wholesale market. Hence, utilities serve their customers by purchasing electricity through a combination of bilateral forward contracts with suppliers that range from relatively short-term to long-term. These bilateral contracts are supplemented by daily and hourly purchases of electricity through the NYISO-administered markets. The costs of these wholesale purchases are merely one component of the ultimate retail price paid by consumers. Retail electricity rates paid by customers in New York are based on bundled, basic service rate plans under which consumers receive and pay for a "bundled" product that includes generation supply, and the associated transmission and distribution service from their local distribution utilities. The utility's costs for arranging for generation supply are passed along to retail consumers in an "Electric Supply" portion of electricity rate as approved by the NY Public Service Commission ("PSC"). This portion of the rate is adjusted periodically to recover the actual costs prudently incurred by the utility in obtaining supply for its retail customers. The utility's costs associated with paying suppliers for contracted-for supply service associated with a bundle of long-term and short-term contract costs are collected from customers in rates. To the extent that the monthly commodity rate is not sufficient to recover all of the utility's costs of supply, the utility may periodically seek a change in the commodity supply portion of the electric rate so that it fully recovers wholesale supply costs from consumers.

As described previously, only a portion of electricity provided by New York's investor owned utilities to its customers is procured in the NYISO's day-ahead and real-time energy markets. These "spot" energy markets (daily and hourly) use a "uniform clearing price" design. The next section explains what a uniform clearing price design is, and how it came to be used in pricing electricity in NYISO-administered electric energy markets.

III. THE USE OF MARKET CLEARING PRICES IN WHOLESALE ELECTRICITY MARKETS

Considerable research and analysis on all aspects of electricity market design were performed prior to introduction of the competitive wholesale markets, and continue to be performed. Virtually all leading experts in the field have agreed that a uniform clearing price method is the preferred approach for these markets. Although many markets for other commodities have used a pay-as-offered approach, these markets tend to converge to a single, uniform clearing price as the difference between buyers' bids and sellers' offers (i.e., the bid-ask spread) tends to be very small in well-functioning markets. However, this section will explain why electricity markets are different than most of these other commodity markets.

To understand why uniform clearing prices are used in wholesale electricity markets, it is helpful to start with basic economic principles that apply to electricity markets. First, the primary goal of wholesale electricity markets is to coordinate generation to produce electricity efficiently. This means using existing generating capacity (as well as demand-side resources) in a manner that minimizes overall production costs. Efficiently-produced power supports the goal of providing electricity to consumers at the lowest price.

Economic efficiency is achieved through "economic dispatch", in which generators with the lowest operating costs (or short-run marginal costs) are dispatched ahead of others with higher operating costs. What makes this task most challenging is the fact that generators at different locations create different flows over the lines in the network, each of which has a limit on how much electricity it can transfer. While in practice there are several additional operational constraints to consider in achieving least-cost dispatch, the overall task of the electricity system operator remains to dispatch generators and other resources from least costly to most costly without violating any transmission limits or other operational constraints.

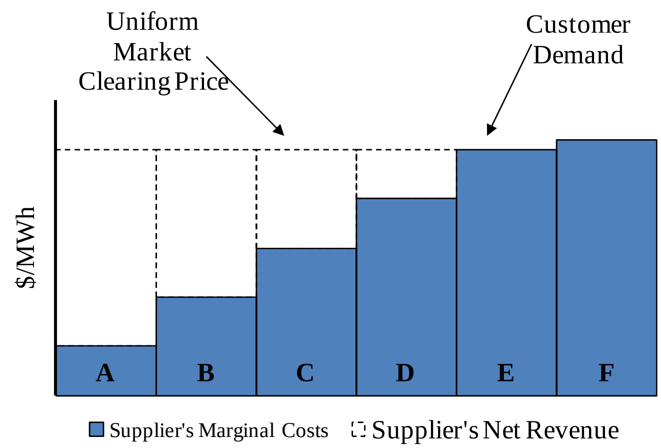
Economic dispatch is a valid and long-standing principle in the electricity industry. It is consistent with the way that power plants were operated when they were part of traditional, regulated utility systems and it guides the way that power plants are operated today in competitive wholesale electricity markets.

A. The Uniform Clearing Price Model

For markets operated by a Regional Transmission Organization ("RTO"), like NYISO, one important question is what market design can be used to obtain information about the relative costs of generation that can be used to produce an economic dispatch? In NYISO, suppliers compete for the right to be dispatched by submitting an offer into the NYISO's day-ahead and real-time markets. Ignoring possible constraints on the transmission network for the moment, the RTO determines the dispatch order by ranking the plants according to offer price (subject to reliability considerations). To be paid in the energy market, the plant has to have been selected for dispatch.

Figure 1 illustrates how NYISO uses the uniform clearing pricesystem to select and pay suppliers. As shown in the figure, NYISO first ranks the offers from the six suppliers (Suppliers A through F) according to their offer prices. The NYISO designates the least-costly resources for dispatch until there is sufficient supply from the designated resources to meet total customer demand. The market-clearing price is set by the offer price of the supplier last designated to meet total customer demand. All selected suppliers are paid the market-clearing price. Suppliers not selected do not receive any payment in this market. The result is that the system dispatches the resources in a manner that minimizes total production costs.

Figure 1: Uniform-Clearing-Price Market



For the uniform clearing pricemarket to work, suppliers must have the incentive to offer a price reflecting their marginal cost of producing electricity. Unless the supplier has market power, offering at a price higher than its marginal cost does not have a significant impact on the clearing price and thus does not increase the supplier's revenue. Experience shows that the offer price differences among suppliers with similar units are very small. In other words, a supplier raising its offer even a small amount will likely be displaced by the next-highest offer, causing it to run less and lowering its expected profits. As a result, suppliers do not have incentives to offer at prices higher than marginal costs.

Of course, a supplier offering below marginal costs may lose money in each hour it is selected when the clearing price is less than its marginal cost. As a result, the uniform clearing price system provides strong incentives for generators to submit offers equal to their marginal costs.

Not only does the uniform clearing price system provide an incentive for suppliers to offer their marginal costs and provide the system operator with the ability to operate plants according to an economic dispatch (subject to reliability constraints), but it also creates incentives for suppliers with high capital costs to participate in this market. In hours when a supplier earns a price higher than its marginal cost, (i.e., when its offer is below the clearing price) these net revenues earned above the supplier's marginal cost contribute to recovery of the generator's fixed capital and maintenance costs.[1] For example, economic new investment in baseload generation stations with low variable costs but high capital costs will only occur under a system that provides revenue that compensates the owner based on the value of the electricity to the system in each hour. This contributes to the owner's recovery of the capital costs required to finance and construct the plant. Since the uniform clearing price model satisfies this objective, it provides efficient economic incentives to invest in capital-intensive generators and other types of generators.

These efficient investment incentives allow the uniform clearing price market to achieve two other important outcomes over the long run. First, these incentives support the introduction of new generating technologies, such as renewables and demand-response resources. By paying suppliers the marginal value of electricity to the system, the full value of the services provided by the new technologies will be captured by the supplier.

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1 In the traditional model of utility regulation, these fixed costs were recovered in the base rates of the utility, with rates designed to collect money from ratepayers to cover investment costs, return on investment, labor, and so forth. Sometimes the fixed rate included fuel costs, too, but in many cases the utility's fuel costs were covered in a fuel-adjustment clause, which fully recovered prudently-incurred expenditures on fuel. In the RTO energy market, the revenues are designed to contribute toward paying these other costs, since there is no equivalent "base rate" collected by the generators.

Second, these investment incentives help govern the overall investment necessary to maintain an efficient level of generating capacity. If the system becomes over-built, the uniform price levels will fall and investment will slow until the surplus is eliminated. The opposite occurs when the system is under-built.

B. Transmission Congestion

An essential facet of the electricity system is that electricity is not generated and consumed at the same location.[2] Generating plants and customers are connected through a network of transmission and distribution lines. Transmission complicates the market by introducing constraints and associated congestion costs. Limitations in the transmission network in the short run constrain the movement of electricity over the network and, thereby, impose a higher marginal cost in certain locations. In the simplest case, electricity will flow over a single transmission line from a low-cost location to a high-cost location. Assuming this line has an operating limit such that not all of the electricity that can be generated in the low-cost region can be used, some of the low-cost plants would be dispatched down and some of the high-cost plants would be dispatched up. In this case, a portion of the demand would be met by higher-cost plants, even though the lower-cost plants are not fully dispatched. Absent the constraint, the high-cost plants would generally not run. The prices in the two locations differ because of the transmission congestion. This difference in these locational prices is necessary to provide the generators the incentive to produce the amount of electricity necessary at

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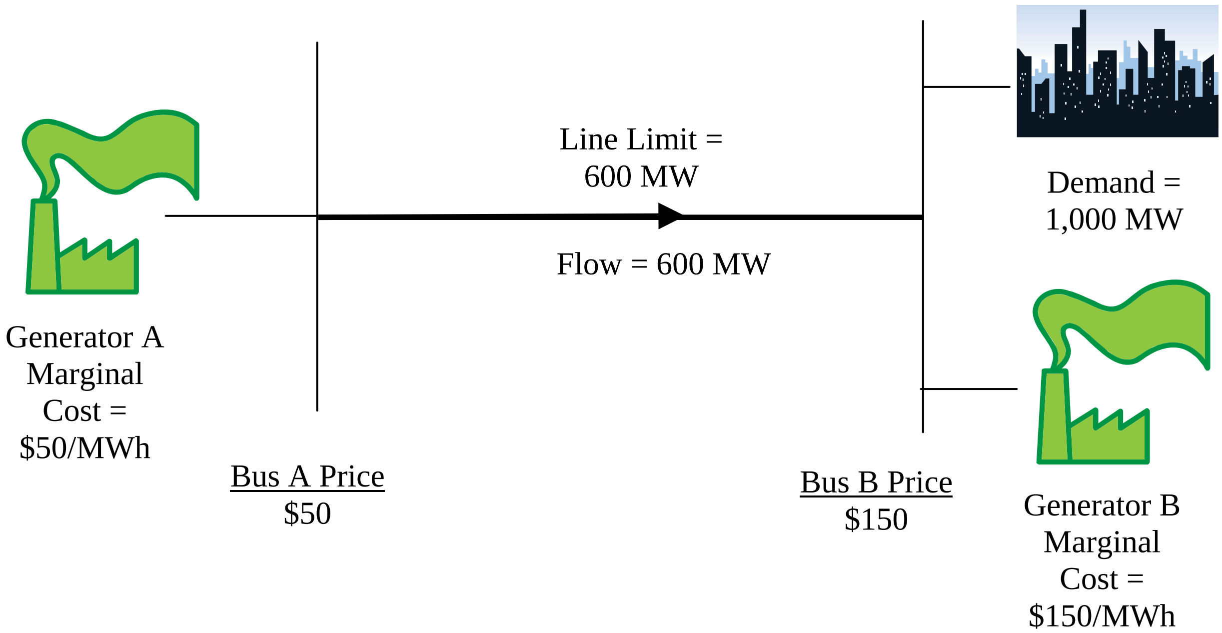
2 "Competitive Electricity Market Design: A Wholesale Primer", William W. Hogan, December 17, 1998.

each location to satisfy demand while not overloading any transmission lines. Consider the illustration below that is an example of this simple one-line network.[3]



The illustration shows a constrained scenario, which the market will reflect by producing a different clearing price for each location. The economic dispatch will still arrive at the least-cost solution to meet demand given the additional system constraint (i.e., the transmission line limit of 600MW). The economic dispatch in this case is 600MW from generator A at $50/MWh and 400MW from Generator B at $150/MWh. Higher-cost Generator B produces 400 MW because only 600 MW can be delivered to the customers over the transmission line from lower-cost Generator A. The uniform-price mechanism still provides incentives for generators to offer at marginal cost. The economic dispatch process would produce the prices shown at each location, which is based on the combined effects of the generation offers and transmission congestion. In terms of the supply and demand at each location, all market participants would see a

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[3] In the illustration, a "bus" is a physical part of the transmission network that connects high-voltage conductors to other elements of the network, like generators and lower-voltage load centers.

single price that reflects the marginal value of electricity at the location. The transmission price is the difference between the prices at the two locations.

With efficient pricing and economic dispatch, suppliers will have the incentive to produce in a manner that ensures the reliable supply of electricity to the State's consumers at the lowest possible cost. Perhaps more importantly, these locational prices provide efficient price signals and incentives for new investment in the long run. By building new generation and transmission when and where it is needed, as indicated by the locational clearing prices, the long-run costs to consumers will be reduced.

IV. UNIFORM CLEARING PRICE MARKET DESIGN VERSUS PAY-AS-OFFERED DESIGN

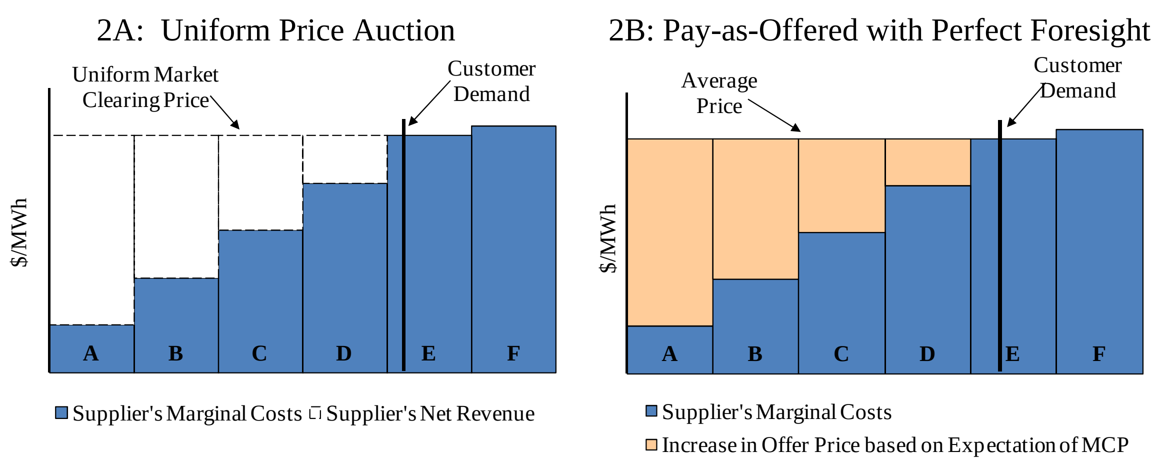
Some observers have argued that it would be appropriate to adopt a pay-as-offered auction in wholesale electricity markets as an alternative to today's uniform clearing pricedesign. In a pay-as-offered auction, suppliers offer a price at which they are willing to produce electricity. Similar to the uniform clearing price approach, the lowest-priced offers are selected that would satisfy the demand for electricity. In contrast to the uniform clearing price approach, selected suppliers are paid their offer prices, rather than a price reflecting the offer of the last supplier needed to satisfy the demand.

This approach is superficially attractive. If each supplier were paid its offer price, then it would seem that total payments to suppliers would be lower than in a uniform clearing price system. Unfortunately, this is not the case. Economic theory and research show that pay-as-offered approaches generally lead to less efficient outcomes and higher costs. I will explain why this is the case by identifying the major problems associated with the pay-as-offered approach.

A. Suppliers' Offers will Change

The first flawed assumption made by proponents of the pay-as-offered system is that suppliers' offers will not change from marginal-cost-based offers in a uniform clearing price system. In reality, however, suppliers' offers in a pay-as-offered system would be expected to differ dramatically from those under a uniform clearing price system. Figure 2 illustrates how suppliers behave under the two alternative market designs. Panel 2A of the figure shows the uniform clearing price system where suppliers submit offers at their marginal cost levels. Panel 2B of the figure illustrates the change in offer behavior that would occur under a pay-as-offered system.

Figure 2: Offers and Prices in Alternative Market Designs



In the pay-as-offered market, Supplier A knows that a winning offer is only paid its offer amount, so there is no longer the incentive to offer supply at its marginal cost. Instead, Supplier A would submit an offer equal to the expected marginal value of electricity (i.e., equal to the most expensive resource needed to satisfy the demand) in order to maximize its revenues. Offering at its marginal cost would substantially reduce its revenue. In this example, we initially assume that suppliers in the pay-as-offered auction have perfect foresight regarding of the marginal value of electricity.[4] Hence, each of the suppliers will submit offers at the same price as the uniform clearing price. Both Panels of Figure 2 show that with perfect foresight, the overall payments to the suppliers will be the same as under a uniform clearing price system. This equivalence is achieved because the revenue-maximizing offers by generators in this example result in the same overall price levels and payments as in the uniform clearing price system.

At first glance, an observer may argue that payments in the uniform clearing price market are too high because they exceed the suppliers' marginal costs, particularly for baseload resources with low operating costs. However, this compensation is needed by suppliers to recover their fixed capital and maintenance cost. In a pay-as-offered model, not only would it be economically irrational for a supplier to offer at or close to its marginal cost, but any supplier that did so would never recoup its fixed capital and maintenance costs.

Therefore, if there were no uncertainty about the value of electricity in a particular hour, the two market designs would produce the same dispatch and the same cost to consumers. Unfortunately, variations in weather and other system conditions introduce substantial uncertainty that affects the performance of pay-as-offered markets. The effects of this price uncertainty are discussed in the following subsection.

B. Suppliers will Make Mistakes

In the previous subsection, I explained that if suppliers have perfect foresight regarding the marginal value of electricity, uniform clearing price and pay-as-offered

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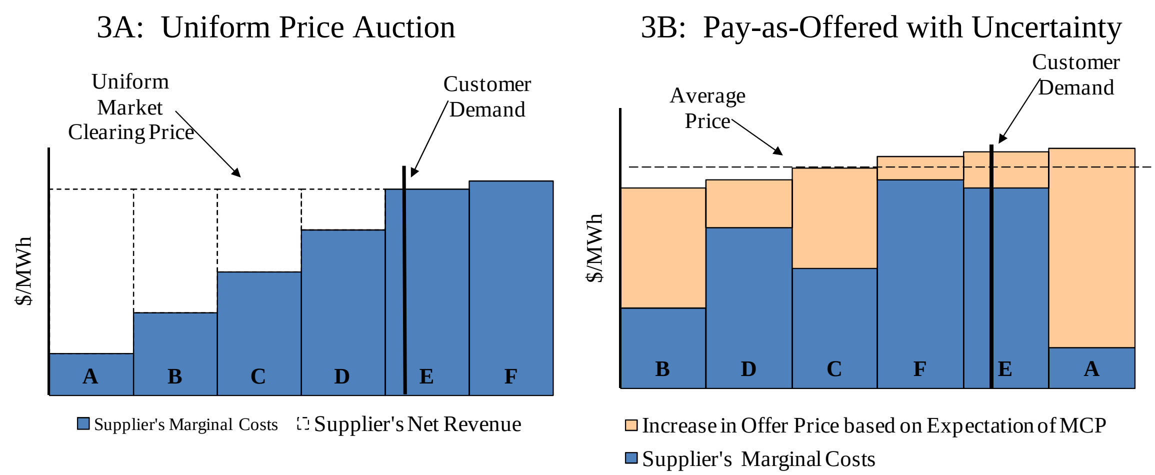
4 The marginal value of electricity is the cost of producing the last MW to meet demand. This is synonymous with the "Market Clearing Price" in a uniform clearing price system.

markets result in identical costs. In reality, suppliers do not have perfect knowledge of the expected marginal value of electricity, a fact that produces significantly different outcomes between pay-as-offered and uniform clearing price systems. In contrast to Figure 2, the more realistic scenario is represented in Figure 3 and compares a uniform clearing price auction with a pay-as-offered auction where market participants <u>do not</u> have perfect foresight of the marginal value of electricity.

Figure 3: Offers and Prices in Alternate Market Designs



Panel 3A of the figure remains unchanged from the prior Figure - suppliers continue to submit offers at their marginal cost levels and receive the uniform clearing price. However, Panel 3B is markedly different from Panel 2B from Figure 2 where suppliers are assumed to have perfect foresight. In this case, suppliers make mistakes in formulating their offer prices due to the uncertainty regarding the expected marginal value of electricity. In this example, the mistakes made by Suppliers A and F significantly change the dispatch and raise overall costs to consumers. Supplier A (the lowest-cost resource) overestimates the expected marginal value of electricity and is not selected to produce, while Supplier F (the highest-cost resource) underestimates the expected marginal value of electricity and is dispatched. These mistakes by suppliers result in two important consequences. First, they result in an inefficient dispatch that raises the total production costs and lowers suppliers' profits. Second, they result in higher average costs to consumers.[5]

These conclusions have been supported by extensive economic research comparing pay-as-offered markets to uniform clearing price auctions. One example of this research is the economic experiments conducted by professors at Cornell University, which compared uniform clearing price and pay-as-offered auctions.[6] The Cornell experiments showed that suppliers change their offers dramatically when the market is changed from a uniform clearing price to a pay-as-offered structure. Further, they showed that when uncertainty in market conditions is introduced, suppliers make mistakes that result in higher overall costs to consumers. Furthermore, these mistakes change the ranking of offers that result in a less efficient dispatch of resources.

Another study of this issue was performed by Nobel Laureate Vernon Smith.[7] Like the Cornell study, this study was based on economic experiments comparing uniform clearing price markets to pay-as-offered markets, which they refer to as a discriminatory price auction (DPA). Vernon Smith, *et al.*, summarized their findings in the following manner:

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5 When poor market design results in market inefficiencies and incurrence of costs, these are referred to as deadweight losses. Deadweight losses hurt all market participants – they lead to higher costs to consumers and lower payments to suppliers.

6 "Testing the Performance of Uniform Price and Discriminative Auction", T.D. Mount, W.D. Schulze, R.J. Thomas, R.D. Zimmerman, 16th July, 2001. (Also includes independent experimental results from Thomas Overbye at the University of Illinois.)

7 "Discriminatory Price Auction in Electricity Markets: Low Volatility at the Expense of High Price Levels", S. J. Rassenti, V. L. Smith, B. J. Wilson, Journal of Regulatory Economics, 2003.

> Using the experimental method, we compare the DPA with a uniform price auction (UPA), strictly controlling for unilateral market power. We find that a DPA indeed substantially reduces price volatility. However, in no market power design prices in a DPA converge to the high prices of a uniform price auction with structural market power. That is, the DPA in a no market power environment is as anti-competitive as a DPA with structurally introduced market power.

In other words, this study found that in a competitive electricity market, changing the market design from a uniform clearing price structure to a pay-as-offered structure raises prices by approximately the same amount as introducing market power to the market. This is powerful evidence that is fully consistent with the economic theory described above. We estimate that the price increases found in this study would cost the consumers of New York billions of dollars.

C. Pay-as-Offered Markets do not Mitigate Market Power

A popular argument for the shift to a pay-as-offered market design is based on the misconception that the uniform clearing price markets are susceptible to market power abuses and gaming by large suppliers. This argument is premised on participants having the incentive to withhold supplies in order to increase the uniform clearing prices. Advocates of pay-as-offered markets fail to realize that a participant with the same degree of market power could implement precisely the same strategy in the pay-as-offered market by raising its offers on all of its units, which will generate the same profits for the supplier as in the uniform clearing price markets. Therefore, pay-as-offered markets do not provide any advantage in terms of mitigating market power. Any exercise of market power available to a supplier in a uniform clearing price system is equally available to the same supplier in a pay-as-offered system.

However, the pay-as-offered system does have one substantial disadvantage in monitoring and mitigating market power. Monitoring for and mitigating abuses of market power and market manipulation would be difficult or impossible in a pay-as-offered market. Under the uniform clearing price system, since competing suppliers should (and do) rationally offer at marginal cost, we can easily detect withholding and have the authority to cap suppliers' offers when they attempt to raise prices. This has been proven highly effective, even in congested areas like New York City. Under a pay-as-offered market, competitive suppliers have the incentive to raise their offer prices above marginal cost. This makes it is very difficult to differentiate between mistakes made by a supplier in forecasting the marginal value of electricity and instances of deliberate withholding designed to raise prices.

D. Pay-as-Offered Markets are Discriminatory

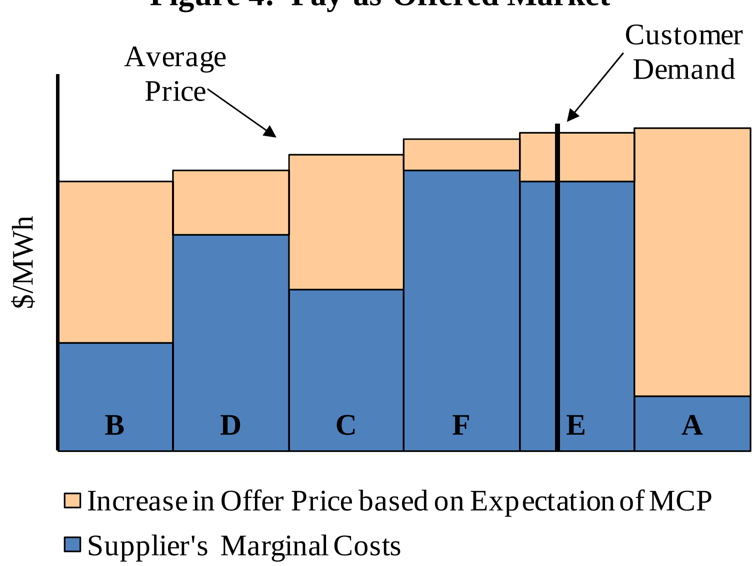
Another disadvantage of moving to a pay-as-offered system is the high cost imposed on all market participants for forecasting market prices. These costs are particularly onerous to small suppliers. Under the uniform market-clearing price system, sellers have the incentive to offer at their marginal costs, which is information that is readily available to them. Hence, participating in this type of market imposes a relatively small cost on suppliers. A pay-as-offered system, however, would introduce substantial analytical challenges related to formulating offer prices in the face of substantial demand and price uncertainties. A generator's profitability would be based in part on its ability to successfully forecast uncertain market conditions.

The added burden of the costs to support such forecasting and analysis creates a significant problem that imposes differential relative burdens on small and large firms, a fact discussed in a 2001 Blue Ribbon Panel Report performed for the California market.[8] The costs per unit of gathering the necessary information and developing the modeling capability to make accurate forecasts of the real-time market prices are much lower for large firms with many generating units. A small firm would have to undertake similar efforts as a large firm, which would translate to much higher costs per unit of output for small firms and make it more difficult for small firms to compete with their larger counterparts. Hence, pay-as-offered markets discriminate in favor of large suppliers and against smaller suppliers.

E. Pay-as-Offered Markets Would Distort Investment

Pay-as-offered markets would also distort investment by discouraging investment in large baseload resources. Mistakes in formulating offer prices are much greater for generators with low variable costs. This is easy to see in Figure 4 shown below.

Figure 4: Pay-as-Offered Market



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[8] "Pricing in the California Power Exchange Electricity Market: Should California Switch from Uniform Pricing to Pay-as-Offer Pricing?", A study commissioned by the California Power Exchange, A.E. Kahn, P. Cramton, R. Porter, R. D. Tabors, January 23, 2001.

Supplier A with low variable costs loses a substantial amount of net revenue as a result of not being selected to produce electricity due to an incorrect forecast of market conditions. Supplier E with higher variable costs also produces less due to its mistake, but losses far less net revenue. Because the costs of mistakes in setting offer prices by owners of low-variable-cost baseload units are higher than for other technologies, a pay-as-offered market reduces the incentive to invest in these capital intensive resources in favor of resources with higher variable costs. This shift in investment will ultimately increase electricity costs to consumers in the long run.

F. Network Congestion Exacerbates Issues with Pay-as-Offered Markets

The adverse implications of pay-as-offered markets discussed above are exacerbated when network congestion is considered. The issues addressed so far have ignored the transmission network, implicitly assuming just one location for supply and demand of electricity. In reality, the electrical network is vastly more complicated. I have shown that uniform clearing prices that vary by location provide generators with efficient incentives to produce efficiently when and where electricity is needed. These locational prices are efficient because they are based on offers submitted that correspond to each unit's marginal costs. Hence, the costs of re-dispatching generation to manage the flow on a line are accurately reflected in the locational clearing prices. Because suppliers in a pay-as-offered market do not have the incentive to submit offers at their marginal cost, there is no efficient means to redispatch generation to manage congestion in a least-cost manner. For example, when generation at a location needs to be reduced to manage the flow on a line in the network, operators in a pay-as-offered market do not know which units are the most expensive and if they rely on offers, they may dispatch down a low-cost baseload unit rather than units with higher variable costs. These dispatch inefficiencies would translate to lower profits for generators and higher costs to consumers.

G. The Uniform-Clearing-Price Market Design has Produced Good Results

The current market design has produced good results, in part due to the efficient market design employed in New York. These results are in sharp contrast to markets implemented in California, where there were significant design flaws that caused markets to perform very poorly for extended periods and are now being replaced by markets very similar to New York's markets.[9]

Our many analyses as the Independent Market Advisor for the New York ISO have generally shown the markets to be both competitive and efficient, characteristics that should lead to lower costs for New York's consumers. These benefits are corroborated by a study performed in 2007 that estimates several economic benefits from the operation of NYISO markets.[10] These benefits include: more efficient power plant dispatch than occurred previously under the New York Power Pool (estimated annual savings growing to $225 million in 2006);[11] improvements in the amount of power produced at existing nuclear plants (estimated annual savings rising to $254 million a year in 2006);[12] improved output at fossil-fuel power plants, due to less down time

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9 California's markets lacked a day-ahead component to coordinate the commitment of generation, they managed network congestion on an overly simplified zonal basis, and they included price-caps and scheduling rules that led to inefficient import and export scheduling.

10 "A Cost-Benefit Analysis of the New York Independent System Operator: The Initial Years", Susan F. Tierney, Edward Kahn, Boston, Massachusetts, March 2007.

11 These changes resulted from improved dispatch through centralized unit commitment and dispatch.

12 This resulted from an estimated 11 percent average annual increase in output from nuclear units.

(estimated savings growing to $66 million in 2005);[13] and lower non-fuel operating costs (estimated savings growing to $30 million in 2006).

These benefits are increasing as the markets evolve and improve over time. Since the initial wholesale markets were implemented eight years ago, many changes have been made to the markets to improve their efficiency and to lower overall costs. In fact, in addition to monitoring the market to identify any potential market power abuses or manipulation, one of our primary functions is to continually seek improvements to the market's design or operation.

Notwithstanding these improvements, wholesale electricity prices have risen by almost 90 percent over the past eight years. These price increases suggest to some that the markets may not be operating properly. However, that suggestion is not correct. Because such a dominant portion of a generator's marginal production cost is related to fuel costs, changes in fuel prices translate directly to changes in electricity prices. Figure 5 shows the trends in fuel input prices over the past eight years.

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[13] This is based on an estimate of 5.5 percent average annual increase in availability from fossil-fuel units over 2001-2005.

Figure 5: Generator Fuel Prices: 2000 to 2008

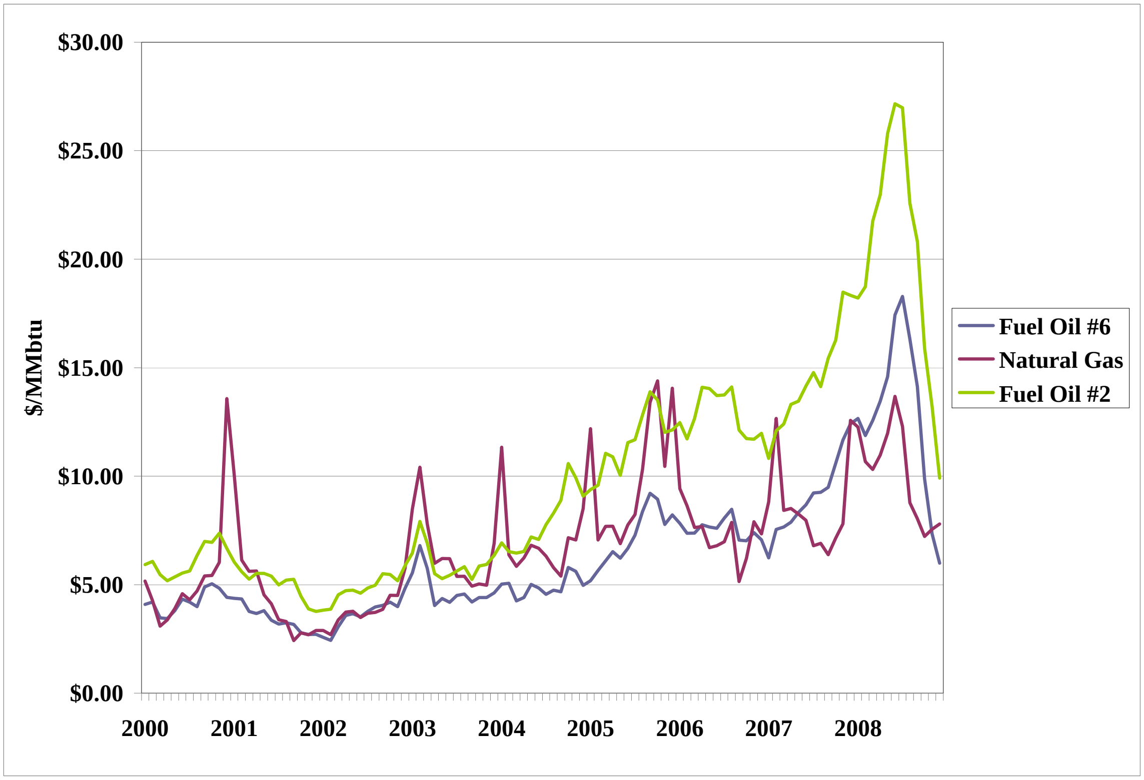

Figure 5 above shows the increasing trend in both natural gas and fuel oil prices from 2000 to 2008. Natural gas prices, the most widely used fuel by generators that set the market prices in New York, increased by more than 90 percent over this timeframe. This increase in fuel prices has driven the slightly smaller increase in electricity prices over the same timeframe. Fortunately, fuel prices have fallen substantially in recent months, which should translate to lower wholesale electricity prices in 2009.

Because the increase in electricity prices is driven by input costs, similar increases would have resulted under a pay-as-offered market structure or any other reasonable market structure. The increase in electricity prices, while unfortunate, cannot be attributed to the uniform clearing price design or to market power. In fact, as discussed above, switching to a pay-as-offered market at this point would simply raise electricity costs further to New York's consumers.

V. CONCLUSIONS

Even if one accepts the economic rationale that supports a uniform clearing price system over a pay-as-offered system, one may still wonder why a baseload unit under the uniform clearing price system is paid $100 per MWh in a particular hour when its variable cost is only $30 per MWh. There are three good reasons why this is the case.

First, the *net revenue* from this payment is needed for the supplier to recover its fixed operating, maintenance and capital costs. Without this payment, many of the generators could not recover their fixed costs through the market and private investment in new generation would likely cease.

Second, because the baseload supplier would not rationally offer at its marginal costs ($30 in this example), the only way to avoid a higher payment would be to abandon the market and regulate the suppliers' offer prices. Re-regulating the wholesale market would cause New York to lose the hundreds of millions in benefits the market is producing today. Additionally, it would require that all future investment be made subject to cost-of-service regulation. The move to competitive markets was motivated, in part, by the desire to rely on private investment where the investor is at risk for unprofitable investments, not the ratepayer. This transition has largely been successful and returning to a regime that relies on regulated investment would not likely benefit New York's consumers.

Third, to the extent that these payments generate any significant economic rents for a particular generating unit over and above the fixed costs of the unit, these rents were paid for by the suppliers when they bought the divested generating units. In fact, there is evidence that suppliers substantially over-paid when they purchased the generating assets to the benefit of the integrated utilities and consumers. Attempting at this point to reclaim these rents via regulation raises serious equity and legal issues. Additionally, economic rents provide a signal to investors to enter the market with additional capacity to capture the rents. Hence, this entry will lower prices and should ensure any excess profits are transitory.

In summary, I strongly encourage the Committee to re-consider its proposal to prohibit the use of uniform clearing prices in the current wholesale electricity markets. There is substantial evidence that this would raise costs to New York's consumers in both the short run and even more in the long run, as well as lead to substantial problems managing electricity flows on the network efficiently. I am unaware of any credible countervailing evidence suggesting that such of change could potentially generate savings for New York's consumers.