

Auctions and Their Use in Natural Gas Markets

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I. Introduction

On July 29, 1998, the Commission issued a NOPR on Short-Term Natural Gas Transportation Services (RM98-10). The NOPR proposes lifting the price cap on short-term transportation services. As one of the measures to mitigate any remaining market power, it proposes that all short-term service must be sold through an auction. This includes all pipeline firm and interruptible transportation and all capacity release of less than one year in duration.¹ **Storage of less than one year in duration is also to be auctioned. Long-term capacity, that of more than a year in duration, does not need to be auctioned. The Commission is proposing short-term capacity auctions in order to prevent withholding of capacity and undue price discrimination.**

This paper explores several topics relating to the use of auctions in natural gas markets. It first discusses the auction proposal in the NOPR and then identifies important features of the natural gas market that are relevant to the design of auctions. Next, the paper provides some background on auctions, and their role in markets. Auctions can vary in a number of ways, and each type of auction may have different advantages and disadvantages when used in different situations. Finally, this paper also shows that auctions are not new to the gas market and discusses where they have occurred before in the natural gas and electricity industries.

II. The Commission NOPR: Background and Goals

The NOPR proposes the use of two different auction methodologies. First, is a next-day auction. A pipeline would not be allowed to establish a reserve price for its capacity, and thus would be unable to withhold capacity in the day-ahead market. A releasing shipper may, however, establish a reserve price. Second, the NOPR also proposes an auction process for capacity of more than one day, and less than one year. In auctions other than for the next day, the pipeline and releasing shippers could both establish reserve prices for their capacity.

The NOPR proposes that pipelines adhere to the following principles in designing an auction:

- ☞ All eligible shippers must be permitted to bid with no favoritism shown to pipeline affiliates or other shippers.

¹In the NOPR, the Commission proposes to define short term as less than one year, but asks for comment on using a shorter duration, such as five months, for defining short term.

- ☞ The pipeline's tariff must disclose the procedures and rules that must be applied in each auction, including the auction schedule.
- ☞ Pipelines must allocate capacity based on established criteria and parameters known in advance to all bidders. The same criteria and parameters must apply to both pipeline and released capacity.
- ☞ Shippers must be able to determine that the auction was run properly either through the posting of information sufficient to permit them to validate that the winners were selected appropriately or through the use of other mechanisms, such as an independent third party who would validate the results.

The NOPR does not propose any specific auction designs but it does discuss some example designs. It requests comments on the appropriate design. In the case of the day-ahead auction, the NOPR discusses an auction that occurs through the nominations process. Such a format could minimize the transactions costs associated with the auction and allow it to happen quickly, as would be needed in a daily auction. In such an auction, releasing shippers could submit nominations establishing the minimum or reserve price(s) at which they would be willing to sell their capacity. Shippers would not be stripped involuntarily of their capacity. Thus, shippers could either state a very high reserve price for their capacity (which they do not think the market could meet), or indicate that their nomination is to be flowed, no matter what the other bids are. This would help ensure that firm capacity will not be interrupted unnecessarily. The pipeline would determine the winning bids for its own available capacity, and that of releasing shippers, and then flow gas for the parties that placed the highest bids.

For capacity of more than one day in duration, the NOPR provides less specific options. It says that monthly auctions could be used which employ posting and bidding periods that coincide with the industry's monthly gas purchasing cycle. It notes that longer posting and bidding times might be needed for auctions of more than one month. Another possibility, not specifically given in the NOPR, is that auctions for capacity of more than one day could be on an ad-hoc basis. Pipelines could put such capacity on the market on timetables of their choosing. The pipeline and a shipper might also negotiate a deal that would be posted for bidding, as is now done in the capacity release market.

III. Selected Features of Natural Gas Markets Relevant to Auctions

To understand the characteristics necessary for any natural gas transportation auction, it is necessary to understand the workings of individual gas pipelines as well as the pipeline network. The peculiarities of how pipelines work and how gas flows on the pipelines will have important impacts on necessary design elements for any auction of pipeline capacity.

The gas pipeline system is a displacement network—meaning that the gas delivered to a receipt point by a customer is not the gas that is delivered to that customer at its delivery point.

Instead, the injection of the gas, combined with the opening or closing of appropriate valves will cause gas to flow out at the delivery point, often with little or no delay. Unlike power in the electric network, the flow of gas can be well controlled between paths.

The flow of gas may be restricted in several ways. Paths may become constrained, either all along a path or at specific points. The capacity of a path may vary slightly given system operating conditions or even temperature. Where constraints develop, other parts of the system may not be able to be used at full capacity, due to the difficulty in getting gas through the constraint. To move gas from the production area to the market area, a shipper may need to use more than one pipeline; it will need to coordinate its capacity and its deliveries and receipts across those pipelines. The shipper may desire to use one pipeline from the gathering area to a market center, another to move between two market centers, and yet another to move gas from the market center to the citygate or burnertip. It may also want to move some of the gas into or out of storage. On the other hand, the shipper may sell the gas at one of the market centers, store it there temporarily, or leave it to the buyer to arrange transportation on one of the pipelines carrying gas from that market center.

Capacity scheduling will also need to occur across pipelines. Rescheduling will be needed as shippers' needs for capacity change during the day. Shippers' requirements for capacity are likely to overlap and conflict, especially on peak. Meeting some shippers' demands is likely to render some other remaining segments of capacity worthless to other shippers. These overlapping needs will make it difficult to determine the best possible use of the pipeline system.

Pipelines often sell capacity to both affiliated and unaffiliated shippers. Affiliated shippers may include marketing affiliates as well as affiliated LDCs. Special rules govern the interaction between affiliates. Auctions can help avoid blatant favoritism. However, much care must be taken in their design to prevent opportunities for more subtle favoritism. An independent auctioneer may be needed to help prevent favoritism.

IV. Background on Auctions

An auction is one form of market institution for allocating goods and services. It is an organized market with explicit rules known to the participants for making bids and/or offers to buy and/or sell, to determine prices, and to allocate goods and services to winning bidders.

Auctions are commonly used to sell a number of items or services¹ **such as fine collectibles, stocks and bonds, agricultural commodities, timber, oil/gas/mineral leases,**

¹Our use of the phrase "items or services," term "item/service," or word "item" is meant to include anything that can be auctioned, such as goods, services, products, pipeline capacity, and commodities (e.g., natural gas). Moreover, the use of these terms does not necessarily imply that every unit being auctioned is the same or that all bidders are bidding on the same units or blocks of units. For example, if pipeline capacity for the months of November and December is

communications spectra, and estates. When bidders in an auction are bidding to buy items or services, the auction is known as a demand or demand-side auction. When bidders are bidding to determine who will supply or sell items or services, as is the case in bidding for some government contracts, the auction is known as a supply or supply-side auction. Further, some auctions, known as double auctions, have both buyers and sellers bidding within the same auction. Examples are stock exchanges and commodity futures exchanges. The discussion that follows focuses primarily on demand auctions. Auctions may be for a single item or for a number of related items. This section of the paper uses a number of words and terms that are common to the auction literature. For definitions of these words and terms, see the *Glossary of Auction Terms* being released at the same time as this paper.²

Value of Auctions

Auctions are only one of many ways that goods and services can be allocated. Two other ways are through negotiation and the use of posted prices. Why then are auctions sometimes preferred over other forms of allocating goods and services? There are four major reasons:

- Unknown Worth
- Fairness
- Limit Price Discrimination
- Efficiency.

Unknown Worth. Auctions are useful when the value of an item/service is not well known. The value may be highly uncertain either because the item or service is unique (such as with a rare antique), or because there are large and frequent fluctuations in supply, demand, and thus price (such as in gas or gas transportation).

Fairness. Properly structured auctions (e.g., ones with rules to prevent favoritism) are fair because all bidders have an equal opportunity to buy the item being sold and/or sellers have an equal opportunity to sell. Moreover, properly designed auctions are perceived to be fair when they are transparent, and thus let bidders see the processes by which the results were reached much more clearly than with private transactions. Some public sector transactions that are accomplished by auction in order to demonstrate fairness (such as selling the rights to offshore oil tracts and purchasing supplies or government securities) are done in the private sector by

posted for auction, some bidders may be interested only in November or December, while other bidders may be interested in both months.

²Laurel Hyde and Michael H. Rothkopf, *Glossary of Auction Terms*, Office of Economic Policy, Federal Energy Regulatory Commission (October 1998).

other means. Presumably, these other means are used because they are more efficient and there are few or no fairness issues. Fairness may also be defined to include broader social goals.³

Limit Price Discrimination. One aspect of perceived fairness relates to the prices at which trades occur. An auction provides a way to limit price discrimination, which occurs when buyers do not face the same prices (or sellers do not receive the same per-unit revenues) and the price differences are not related to costs. Regulatory authorities may be especially interested in requiring auctions as a way to reduce or avoid price discrimination by the entities they regulate.

Efficiency. Auctions can affect efficiency by helping allocate goods and services to the highest valued consumers and production to the lowest cost suppliers. In a well-designed demand auction, items tend to be allocated to those who value them most. A well-designed supply auction tends to select the lowest cost suppliers for a specified quality. This efficiency effect can be pronounced when compared with nonmarket mechanisms for allocation. Auctions tend to work well in simple situations. In more complicated situations, negotiations may work as well or better.

Another efficiency advantage of auctions is that the public availability of market prices can help signal whether or not new production capability is needed. For example in natural gas, if prices for transmission service along a particular route are consistently above the cost of new capacity, this may indicate that new pipeline capacity should be constructed.

Other Considerations in Auction Design

In choosing a specific type of auction, several other considerations may affect the design choice. These additional considerations include market power, costs to run the auction, transactions costs, risk, and speed with which the auction can occur. The auction designer may need to choose among, or to make compromises between, some of the goals.

Market Power. When a regulatory authority requires an auction by regulated entities, one of its goals may be to limit or eliminate any exercise of market power by those entities. The NOPR proposes to limit the exercise of market power by requiring that all uncommitted capacity be sold in the daily market, and that the pipeline establish no minimum bids above its variable costs in the daily auction. This is particularly appropriate in that capacity available today cannot be stored and resold at a later date.

Costs of Running the Auction. The costs of running the auction need to be considered. Electronic auctions can sometimes be more expensive to set up, but are likely to be less expensive to run than those with human auctioneers and/or less efficient technology. Complex decision rules may also involve more development costs, but may pay off in greater efficiency.

³For example, the Federal Communications Commission considered economic efficiency, potential market power, and social goals, such as minority ownership of licenses, in structuring its auctions for spectrum licenses.

Transactions Costs of Bidders. Auctions can either raise or lower transactions costs or the costs of doing business. Where buyers and sellers have trouble finding each other, an established auction procedure may lower the parties' search costs and may be a primary reason for adopting the auction. However, some auction formats may involve more transactions costs than others, or even higher transactions costs than no auction at all. For example, auctions for a relatively low valued item that require bidders to invest a substantial amount of time in monitoring the bidding may have prohibitively high transactions costs. Also, for example, the use of posted prices by gasoline stations is much more efficient than selling each tank of gasoline by auction. When bidders participate in a number of auctions (such as acquiring capacity across several pipelines), the more similar the auction rules are across auctions, the lower will be their transactions costs of participating in those auctions. However, forcing identical auction rules and procedures across pipelines could mask important differences between pipelines.

Risk. Choices made in structuring an auction often have implications for the risks that parties bear. This risk can take several forms. It could include the risk that the bidder leaves money on the table (pays more than necessary to beat the next highest bidder), or the risk that the bid is unsuccessful. There may be the additional risk of not acquiring related items, if the items are split among multiple auctions. For example, if capacity releases were all auctioned separately and simultaneously, a bidder might end up getting either no capacity or too much capacity. Likewise, with some auctions, bidders may be exposed to the risk that they get capacity but not the gas, or vice versa. Or, a shipper may get capacity on one pipeline but not on other pipelines needed to deliver gas to or take gas away from that pipeline.⁴ **In a well-structured auction, it is important to balance costs and rewards for bearing risk among the parties. While eliminating unnecessary risk is good, it is also important to balance risk which can be eliminated from the auction against the other goals of auction design.**

Speed. In some cases, it may be important for an auction to be finished quickly. This is particularly true when the availability of or demand for the item being auctioned is short-lived or highly variable, and unpredictably so. Auctions for daily or shorter-term transportation service fall into this category. The need for a quick auction may make some forms of auctions inappropriate. This is more likely to be an issue where there are extended rounds of an auction, or when the decision rules are complex. Less complex rules may be quicker and have lower transactions costs, but otherwise lead to a less efficient outcome.

Choices in Auction Design

A number of choices must be made in designing any auction. These design choices are important because different rules and procedures can result in different incentives for buyers and

⁴One way to deal with the bidder's risk of not getting gas or upstream/downstream capacity needed for the specific capacity shippers bid on in an auction is to allow bids to be contingent on getting the needed gas supplies or upstream/downstream capacity. However, contingent bids will shift the associated risk to the pipeline.

sellers. These incentives, in turn, can influence whether or not particular desired outcomes from an auction can be achieved.

The auction literature sometimes focuses on major types of auctions, such as English, Dutch, first-price, or second-price. However trying to capture all of the rules, procedures, and characteristics of a particular auction with only a single word or phrase may be confusing or impossible because:

- Most auctions will have more than one important rule or procedure
- Different authors may be implying different rules and procedures when using the same name or term for a type of auction
- There may be more than one name for a specific rule or procedure.

As a result we use terms like "first-price" or "single round" to indicate only that a particular rule or procedure is being discussed. We also identify other terms that have been used to describe the same rule or procedure. Finally, we discuss these rules and procedures in terms of choices to be made in auction design, rather than as types of auctions.

Eight important choices in auction design include:

- 👉 How frequently should repeated auctions be held?
- 👉 How should multiple related items be sold (bought)?
 - Who may bid?
 - Do some bidders get special treatment?
 - Should bidders have multiple opportunities to submit bids?
- 👉 How should the price move during the auction?
 - What information is revealed to bidders?
 - What price(s) is/are paid by the winning bidder(s)?

How Frequently Should Repeated Auctions Be Held?

When items are available on an on-going or recurring basis, it is important to decide on auction frequency. Should items be auctioned as they come available, or held temporarily for less frequent larger sales? There are both advantages and disadvantages of frequent sales. They may cost more. However, more frequent auctions may be especially beneficial when the value, need for, or volume of the item(s) cannot be predicted well in advance, or are especially volatile. The more often the needs and values change, the greater the need for frequent auctions.

How Should Multiple Related Items Be Sold (Bought)?

Auctions are sometimes used for multiple related items or services. The items may be related in a number of ways. The items may be identical (homogeneous). They may be differentiated only slightly and be good substitutes for each other. Or, they may be complementary or useful together. Some items may be more complementary to, or more substitutable for, than others to be sold (or acquired). In an extreme case, some items/services

may be worthless without other specific items/services. Related items can be sold either sequentially or simultaneously. Each approach has its benefits.

Sequentially. With sequential auctions, each related item is offered separately. This is the least complex way to sell related items. When items are perfect or near perfect substitutes, they may sell for different prices in each of the separate auctions. As a result, the auction may not be seen to be fair. When items are less perfect substitutes or are complements, other problems may be encountered. A sequential format may not meet customers' needs when customers have a preferred combination of the items. Bidders wanting a package of items or services must acquire each separately, and will not know until the auctions are completed whether they have acquired the necessary combination of items/services to match their needs. However, in each auction, they will know for certain what they have already acquired.

Simultaneously. In simultaneous auctions, bidders bid on multiple items at once. If the items are fungible (like Treasury bills), the bids may be for any of the items. If the items are different, then bids will normally be for specific items. The auction may sell the items completely independently, or it may allow bidders some freedom to bid on combinations of items or to limit their total expenditures. When items tend to be substitutes for each other, the bidders may want to limit their total expenditures or the number of items that they win. Otherwise, they risk winning too many or too few. If the items are complements, bidders will want to be able to bid on combinations. (For example, if a bidder values each of two items at \$100, but values the pair at \$500, it will want to bid on the pair. If the items are sold independently, bidding more than \$100 for each item will be risky.) However, allowing bids on combinations complicates the auction. It may even make the problem of determining the best (i.e., revenue maximizing) set of bids mathematically difficult. The bidders need to limit total expenditures or to bid on combinations may be somewhat mitigated if the simultaneous auction is conducted in a series of progressive rounds. In such an auction, the bidders can limit their total expenditures, and they may be able to discern from the bidding something about which combinations they are likely to be able to win.

When bidders must bid simultaneously, items may be misallocated or a bidder may win too many or too few items. The importance of these possibilities depends, in part, on the nature of the post auction market in the items auctioned. If there is an after market in which the items can be freely and easily traded, these possibilities are of much less significance than if the items cannot be traded or if the after market is slow and burdensome.

Who May Bid?

Single Sided or Double Auction. Some auctions are single sided and involve either demand bidding or supply bidding. Double auctions have bidding occurring on both the demand and the supply sides.

Bidder Qualification. It is important to determine carefully the necessary qualifications for auction participation. Sometimes, this requires a balancing of opposing concerns. If the auction is open too broadly, bidders who are financially irresponsible may affect the auction

results. They may win and then default.⁵ **Also, if quality is hard to specify completely (as, for example, in bidding for the construction of a complicated chemical plant), the bid taker may well want to limit participation to bidders in the quality of whose workmanship it has confidence.**

On the other hand, the bid-taker may be better off with a high level of participation. Controlling participation too tightly may defeat efficiency by excluding the bidder with the highest value or lowest cost. If the bidder with the second best value or cost is excluded, the price will be changed to the bid-taker's disadvantage. Furthermore, limiting participation may destroy the auction's ability to produce a result that is regarded as fair or may allow the exercise of market power by the remaining bidders.

Do Some Bidders Get Special Treatment?

Sometimes an auction gives special rights to one or more bidders. For example, one bidder may be given the right to match (or top by a given percentage) the final bid by any other bidder. Rights like these are sometimes used in manuscript auctions. In such a sale, a seller may approach a particular publisher and offer it the right to top any other bid by a certain amount, say 5 percent, in return for a large initial bid. In natural gas transportation, the right of first refusal is a "topping right." Such topping rights can be quite valuable. Thus, giving certain bidders special treatment can raise fairness issues. Special treatment can also be used to help offset the effects of past unfairness.

Should Bidders Have Multiple Opportunities to Submit Bids?

Single Round. With a single round, bidders can submit only one bid before the auction concludes. The single round format is usually associated with sealed bids (where bidders do not see the bids of others).⁶ **Otherwise, each bidder may wait until the last minute to bid and try to be the last and highest bidder. The single round format can be used with either a first-price or second-price auction format.**⁷

An advantage of the single round format is that the bids can be made and the auction concluded fairly quickly. A potential disadvantage is that the winner may not be the highest valued user. If the bidding is sealed, and bidders are uncertain of the values others place on capacity, the winning bidder may not be the bidder with the highest valuation. If the bidder with the highest valuation underbids its value in order to save money, it risks bidding less than a bidder with a lower value. If the bidding is open (where

⁵For a discussion of a case in which the winning bidder for a cable TV franchise in Oakland, California defaulted, see Oliver E. Williamson, "Franchise Bidding for Natural Monopolies—In General and With Respect to CATV," *Bell Journal of Economics*, 7(1): 73-104, 1976.

⁶See the section "What information about bids is revealed to bidders," which comes later in the paper.

⁷See the section "What price is paid by winning bidder(s)," which comes later in the paper.

bids are revealed to other bidders prior to the end of the auction), the highest valued bidder may not be the winner because it may not be the last bidder. From the point of view of the bidders, the single round (first-price) format may put a premium on the effort bidders have to make to evaluate the items being sold, since they will not get any chance to observe and react to competitors' bids. Furthermore, in deciding upon their bids they will have to gather information or make some assumptions about their competitors' likely valuations and bids.

A potential advantage of single round sealed bidding over multi-round progressive auctions is that it requires less attention from the bidder, once the auction has begun. The bidder places a bid, and waits for the auction results to be announced. With a multiple round auction, the bidder might need to expend more resources in watching the progress of the bidding. Another potential advantage is that a single round sealed bid auction may encourage bidder participation in situations in which it is known that one bidder has a higher valuation than the others for what is being sold. This advantage is the other side of the coin associated with the possibility that the bidder with the highest valuation may not win in a single round sealed bid auction. If it is known that one bidder has a higher value, other bidders may have no reason to incur any of the costs necessary to participate in a multi-round progressive auction, since there is no chance that they can win at any price at or below their valuations. This may give the high valued bidder market power in the auction. However, in a single round sealed bid auction, the very chance that the bidder with the highest value will fail to win may make participation by other bidders worthwhile. Without the participation of bidders with lower valuations, the seller may fall far short of getting the price it would get in a sealed bid auction. This could be an especially severe problem if the seller did not or could not have a reserve price.

Iterative. In an iterative round format, bidders have the opportunity to bid more than once and thereby respond to prior bids by other bidders. The term "iterative round" usually means that there are discrete multiple rounds, with each bidder being allowed to bid once in each round. Iterative bidding formats may require "activity rules" and "stopping rules" to keep the auction from dragging on.⁸ **When a short turnaround time is needed, the stopping rule may need to be severe. This severity can offset some of the advantages of allowing repeated bids.**

Continuous Bidding. Just as in an iterative round format, bidders in a continuous bidding format have the opportunity to bid more than once and thereby respond to prior bids by other bidders. However, with continuous bidding there are no discrete rounds, and bidders can bid at any time until the auction ends, usually when there is only one bidder left. Continuous bidding formats may also cause an auction to drag on. The need to keep the auction moving may cause the auctioneer to require large bid increments or to use a "fast hammer" (i.e., ending the

⁸A stopping rule is a prespecified condition under which an iterative (multiple round) auction concludes. For example, a stopping rule might specify that bidding terminates when no new bids are received in a round.

auction while one or more bidders may still be willing to bid). These actions can offset some of the advantages of allowing repeated bids.

How Should the Price Move During the Auction?

The direction of price movement within an auction is often preset. Only sealed bid, single round auctions will not have a predictable pattern of price movement. Generally, single sided auctions will be either progressive or descending in nature. In double auctions, the price movement generally may be either up or down, but will be towards a market clearing level.

Progressive. In a demand side progressive auction, the price is successively raised by an auctioneer or in some other way until only one bidder (the winning bidder) remains.⁹ **This format is also known as an ascending or ascending-price auction. An example of a progressive auction familiar to most Americans is one in which bidders have continuing opportunities to bid and the auctioneer calls out increasingly higher prices. While any demand side progressive auction may sometimes be referred to as an English auction, traditionally the method of bidding under the English format has been oral outcry. The general use of the term English auction includes progressive auctions with electronic bidding or hand signal bidding.**

Progressive auctions of single items can be efficient, as bids will rise until only the bidder valuing the capacity most remains.¹⁰ The winning bidder will need to pay only slightly more than the last bid of the next highest bidder in order to win. Thus, while bidders pay what they bid, a progressive auction is strategically equivalent to a second-price auction in which the best losing bid determines the amount the winner pays.

Descending. The auctioneer or an electronic device opens the demand auction at an initial high price and then successively lowers the price until a bid is made and the bidder thereby wins the right to the item being sold. This type of format is referred to as a descending price auction or a Dutch auction.

With a single item and descending bids, the winning bidder pays the price it bids, and since bidders see no actual bid during the auction, they may have less understanding of how other bidders value an item, as compared with the ascending-price format. Bidders will have only one opportunity to make a bid, unless the winning bidder doesn't take all of the item being sold and the auction continues after the winning bidder makes its selection. With multiple items, multiple winning bidders, and descending bids, the rules may require either that the winner pay its own bid (a first price auction) or the lowest winning bid (a variation of a second price auction).

⁹In a supply auction, the price would move progressively downward.

¹⁰In a progressive supply auction, price would fall until only the least expensive supplier remained.

A large amount of goods can sometimes be sold fairly quickly with descending bids. As a result, descending bid auctions are sometimes used for selling perishable commodities, as in the Dutch flower markets.

Since with descending bids a bidder does not have the luxury of seeing other bids, it must decide when to bid, balancing the value it places on the item/service against the price as well as the likelihood of another bidder bidding for the item at a particular price. If a bidder has poor information about the value others place on the item/service, and if bidders have different risk tolerances, the auction may not be won by the bidder with the highest valuation. Thus, from a strategic point of view, the descending price auction is like standard sealed bidding in that a bidder does not have an opportunity to react to the bids of its competitors. Once the competitive situation is observed, the auction is over.

The seller may get more revenue than with progressive bidding, because if the buyer really wants an item (is risk averse to losing it) it may not take the chance of waiting too long to enter a bid. Thus, the bidder may bid at or near his full valuation, rather than just enough to beat the second highest bidder.

Double Sided-Towards Market Clearing Price. With a double sided auction, there may not be a pre-determined direction of price movement. Instead, for individual transactions, there are offers to sell and offers to buy. If the offers to sell are priced higher than offers to buy, these prices move towards each other until they meet and a transaction takes place. If the double auction takes place on a continuing basis, like at the New York Stock Exchange, the transaction prices will move up and down, depending on supply and demand, with each transaction defining a new market price.

What Information About Bids Is Revealed to Bidders?

Open Bid. With open bidding, bidders know what other bidders bid during the auction and sometimes know which other bidders made the bids. An open bid format is logically associated with either an iterative or continuous bid format, since the main reason for open bidding is to allow bidders to react to the bids of others.

Open bidding allows bidders to see the value others place on the item or service. This helps to avoid problems with shippers scaling back their bids to avoid overbidding associated with ignorance of the market value of the item, or of the value other bidders place upon it.¹¹ **But, this openness may facilitate the collusion of bidders, as bidders will be able to see the bids and thus see who "cheats" on any collusive bidding agreement. As a result, the collusive agreement may be more likely to succeed, because cheating is less likely to make it ineffective.**

¹¹However, bidders must be extremely careful in attempting to use such information as the seller may unfairly make use of skills to drive up the price. A skill is a party associated with the auctioneer or seller who bids only to increase the price.

Sealed Bid. With sealed bidding, bidders must bid without seeing the bids of others. A sealed bid format can be associated with either a first-price or second-price format. It can also be associated with either a single round or iterative round bidding format. Historically, an advantage of sealed over open bidding has been that the written record of the sealed bid is more appropriate for major commitments. The use of electronic bidding may eliminate this advantage.

A potential disadvantage of sealed bidding, if it is combined with a single round format, is that one or more bidders may underbid (overbid in a supply auction) because they have poor information about the value of the item being auctioned. Bidders may be uncertain about the value of the item, or bidders may not have equal information about its value. Because bidding is sealed, the bidder will not gain additional information on the value through the auction. Underbidding due to insufficient information by the highest valuing user could lead to an inefficient result if it causes that bidder to lose.

However, this potential problem with sealed bidding can be reduced somewhat if it is combined with an iterative round format. In that format, if the bidders can rule out the possibility of shills, they will at least know the amount of the highest legitimate bid in the previous round.

Even with a sealed bid auction, information may be made available after the auction has been concluded. Providing such information can be useful to bidders. It may help to show if bidding was fair. If the seller(s) and bidder(s) know information will be revealed, this may discourage favoritism by the auctioneer. Revealing bids may also provide useful information on others' valuations (or supply costs) of the items auctioned. In repeated auctions, this increased information on value may help efficiency. However, revealing the bids may also cause confidentiality concerns among bidders, making them less likely to bid their valuations.

What Price Is Paid by the Winning Bidder(s)?

First Price. In a first-price format, each winning bidder pays the price he or she has bid. A first-price auction can be used with any of the above choices. It can be associated with progressive or descending auctions, with one or multiple opportunities to bid, and with open or sealed bids.

The implications of a first-price auction become more interesting with multiple related items for sale. Such auctions may result in discriminatory pricing. Where there are multiple identical units of an item in the auction, a first-price auction may result in different bidders paying different amounts for the same item/service. In this case, the bids are sorted from high to low, and items are awarded in descending order of bid prices until the supply is exhausted.¹² **If more than one bidder wins, and the winning bidders have submitted different per-unit bids, there is price discrimination. However, this is not normal price discrimination because a bidder is not forced to pay a price different from other bidders. Rather, the**

¹²Note that auctioning related items sequentially could also result in substantial diversity in prices.

winning bidder has made his or her choice of the amount bid—and therefore the price paid. Of course, the bidder weighs the risk it takes in losing capacity with a lower bid and how comfortable it is with that risk. Such risk assessment may vary across bidders. If bidders differ in their knowledge of other bidders' valuations, those less informed may pay more.

When prices differ among substitutable, but not identical items, it is more difficult to conclude that there is price discrimination. The quality or value among the different items may differ. For example, a unit of pipeline capacity between two points in January and a unit between those same two points in July are certainly not substitutable and usually have different values. Thus, prices are likely to legitimately diverge more than for identical items.

A potential disadvantage of a first-price, sealed-bid auction for either a single unit or multiple units is that the highest valued user(s) may not always be the winning bidder(s). The highest valued bidder may bid less than its value in hopes of saving some money (not "leaving any money on the table"). However, if the bidder bids less than its value, it may bid too low, and lose the item/service to another bidder that may value the item less. In such a case, the auction would be inefficient.

Second-Price. Under a second-price format for a demand auction, the winning bidder pays a per-unit price equal to the highest rejected bid, rather than its own higher bid. If only one item is sold, the winning bidder pays a price equal to the second highest price bid (hence, the term "second-price").

This auction format is sometimes called a Vickrey auction, after William Vickrey who first suggested it. Although not used much in practice, this auction format may help avoid the possibility of an inefficient result (the highest valued bidder not winning) under a first-price format as discussed above. It provides an incentive for bidders to bid a price closer to their true valuation, since they know they won't have to pay that price if they are a winning bidder. Thus, an auction having a second-price format may help ensure that the highest valued bidders are the winners. However, if bidders do not trust the seller or fear the consequences of revealing their true value, they may bid less (perhaps substantially less) than their value.¹³ **Depending on bidder behavior, revenues collected by a seller may be higher or lower under a second-price format as compared with a first-price format.**

If multiple identical (or very similar) units are being sold and there is more than one winning bidder, all of the winning bidders may pay a uniform price equal to the highest losing bid. This is called a uniform price auction. A variant of this auction may have all

¹³Bidders may fear the seller is employing a shill to provide a higher second best bid and to drive up what the winning bidder pays. In the case of a supply auction, they may fear a shill providing a low second best bid, in order to drive down what the bidder is paid. Such information about bidders' true valuations could be of value to competitors and very damaging if it falls into the hands of those with whom the winner must negotiate. Anticipation of such disclosure can change the incentives of the bidders to bid their true values.

winning bidders paying the lowest winning bid.¹⁴ Other variants are more complicated. For example, the Vickrey-Clarke-Groves auction has bidders' payments based on others' bids, but has non-uniform pricing.¹⁵

In order to achieve the potential efficiency benefit of a second-price auction, it may be important for bids to be submitted as sealed-bids to avoid strategic manipulative bidding. Otherwise, for instance, in an open bid format with an activity rule requiring that each new bid beat the previous high bid, a bidder may be able to increase the best bid on the table by a substantial increment, and trump the highest valued bidder, while paying less than either's valuation for the item.¹⁶

Other Choices in Auction Design

In addition to the choices detailed above, other choices need to be made in designing an auction. These additional choices will also have an effect on the efficiency, and sometimes the fairness of the auction. Choices will need to be made on bid withdrawal, policies for un-honored bids, the way bids are submitted (e.g., oral, written, electronic, etc.), and criteria for determining the winning bid(s), among other things. In the case of iterative and continuous auctions, decisions will need to be made on activity and stopping rules.¹⁷ **Even seemingly innocuous choices such as the timing of bid windows and information to be announced when bidding is completed will be important. Repeated experience has shown that details can be critical.**

When affiliates of the seller may be bidding in an auction, all of these choices will need to be examined with respect to the potential for affiliate abuse. It is important to ensure that affiliates or other participants aren't favored. Capacity can be inappropriately allocated to affiliates in a number of ways including by the seller limiting the bidders, tailoring the offering to its affiliate's needs, biasing the evaluation criteria, providing information on how to win, letting the affiliate bid last after seeing other bids, and awarding capacity independent of the winning bid criteria. When auctions involve overlapping bids, favoritism may be even easier. It will also be important to ensure that affiliates cannot act as shills in the auction, driving up prices simply to increase their affiliated pipeline's revenue. An independent auctioneer may be one way to limit abuse.

¹⁴If there were many bidders, a uniform price equal to the lowest winning bid might be about the same as a uniform price equal to the highest losing bid.

¹⁵For more discussion of the Vickrey-Clarke-Groves auction, see T. Groves, "Incentives in Teams," *Econometrica* (1973, 41: 617-631). See also A. Mas-Colell, M. Whinston, and J.R. Green, 1995, *Microeconomic Theory*, Oxford University Press, New York, Chapter 25.

¹⁶For example, consider a second price auction with an activity rule that requires new bids to beat the previous high bid. Bidder A values an item being auctioned at \$100, Bidder B at \$50, and Bidder C at \$25. If the bids were open and Bidder C bid first at \$25, Bidder B could immediately bid \$200 and win the capacity, while paying only \$25. Bidder A would not bid higher than B because it values the good at \$100, yet would have to pay at least \$200 to win. Thus B, a lower valued user, could win the capacity with a well-timed preemptive bid.

¹⁷Activity rules may be especially difficult to design for double auctions.

Such an independent auctioneer may allow more confidentiality of bids than would otherwise be advisable. This is likely to help market participants.¹⁸ Other rules concerning auction announcement, procedures, and post-auction revelation of bids may also be necessary to prevent affiliate favoritism.¹⁹

V. Past Use of Auctions in Natural Gas Markets

Auctions have been used in several ways in gas markets, primarily in situations where the value of the product being auctioned is either difficult to determine or quite variable over time. Auctions have been held for:

- Leases for the right to develop gas reserves on Government land
- Pipeline capacity sold by pipelines and firm capacity holders
- Gas as a commodity
- Costly contractual obligations of pipelines to purchase gas at above-market prices.

Auctions are also being used now in the electric sector.

Lease Auctions²⁰

For many years The Department of Interior has used auctions to determine which private companies will have the rights to develop and sell oil and gas resources on particular tracts of government land. The bidders bid in terms of an up-front lump sum that they will pay for this right. In addition to the lump sum that is bid, winning bidders also make royalty payments (which usually are in the range of 1/8 to 1/6 of the value of the reserves developed) and rental payments (which are \$5.00 or \$7.50 per acre per year, depending on water depth) to the Government. The exact amount for the royalty and rental payments for the tracts being auctioned are stated in the auction announcement.

The auctions have a sealed bid, first price format. They are simultaneous auctions, since more than one tract of land is auctioned at the same time and bidders have to submit their bids for all tracts of land they are interested in at the same time. Other characteristics of these lease auctions are:

¹⁸Nasdaq is looking at the Optimark Trading System which has a computer matching trades to help deal with the problem of market movement in anticipation of large party participation. See "Move Over, NYSE? Optimark System Creating a Buzz," Tom Petrino, *Los Angeles Times*, 4-12-1998, pp. D-1.

¹⁹See, for example, the NOPR's additional principles for auction design described on page 2 of this paper.

²⁰The information for this section of the paper was obtained in a phone interview on August 19, 1998, with an employee of the Minerals Management Service of the Department of Interior.

- **Bidders have to submit a deposit with their bid equal to 20 percent of the amount bid to prevent spurious bids. Losing bidders have the deposit refunded. However, bidders who decide not to execute the lease after winning it do not get a refund.**
- **All bids are made public when the winning bidder is announced.**
- **A minimum bid of \$25 per acre is required, and tracts are typically 5,000 acres.**
- **There is a reserve price (intended to represent a fair market value), the level of which is calculated after bids are submitted and, thus, unknown to bidders when they submit their bids.**

The method used to establish a reserve price varies for different types of tracts. In some cases, the market itself (as determined by bids submitted) determines or helps determine the reserve price. For some tracts considered to have little development potential, the reserve price equals the minimum bid.

Other tracts have different reserve prices to reflect whether bidders have access to the same or different information about the value of a tract. If the information is generally available (perhaps because it is issued by the Department of Interior), bidders are considered to have access to the same information. However, bidders are not considered to have access to the same information, if some bidders have significant private information not available to others (typically when one or more bidders may have more knowledge about potential reserves because they are currently developing a tract next to the tract being auctioned).

For the tracts for which bidders do not have access to the same information relating to the value of a tract, the reserve price is based on the Department of Interior's estimated value for the tract as determined by geological and engineering studies. (This value will be referred to as the "Government value" in the rest of this section.) For other tracts where bidders all have access to the same information relating to value and there are three or more bids submitted, the reserve price is considered to be met if the third highest bid is equal to 50 percent of the high bid. If the third highest bid does not equal at least 50 percent of the high bid, the reserve price is the Government value.

There can also be exceptions where a high bid below the reserve price would not be rejected. For tracts where bidders do not have access to the same information relating to value and there are three or more bids – at least one of which is 25 percent of the high bid – the high bid will be declared the winning bid if it is higher than the average of the following items: the high bid, the Government value, and all bids that are at least 25 percent of the high bid. For tracts where bidders all have access to the same information relating to value, the same process is used, except that there need be only two or more bids for the tract.

Capacity Release

Auctions are used in the natural gas industry to sell pipeline capacity through capacity release. Instituted in Order No. 636, capacity release enables a shipper with a firm contract for capacity on a pipeline (called a releasing shipper) to release part or all of that capacity to another shipper (called a replacement shipper). All capacity to be released must be posted for bidding on pipeline EBBs, with two exceptions:

- Releases offered for a term of less than one month (to permit very short-term deals to be negotiated more quickly than would be possible through the EBB bidding process)
- Prearranged deals for one month or more at the maximum rate (since bidding under current FERC regulation does not permit sales at prices above the pipeline's maximum rate).

When bidding is required, a releasing shipper may designate a pre-arranged replacement shipper who has the right to match the winning bid and get the capacity. Information about completed release transactions must be posted on the pipeline's EBB after the fact. Capacity release auctions also have the following characteristics (some of which are specified in GISB standards).

- Each release is a separate sale.
- The capacity being sold is a non-standardized product, because each release may be for different capacity amounts, durations, or receipt and delivery points.
- They follow a progressive, first-price format.
- The winning bid is the high bid, but it can't exceed the pipeline maximum rate.
- The releasing shipper may recall the capacity under conditions stated when the capacity is offered for sale.
- There are stated bid windows (during which potential replacement shippers make bids) that are uniform across all pipelines.
- During bid windows, the bidding is open (unless the releasing shipper requests otherwise) and continuous.
- The releasing shipper can state a reserve price.
- The replacement shipper can withdraw a bid before the end of the bid window.

Pipeline Sales of Capacity

A few interstate pipelines sell capacity using auction procedures approved in their tariffs. The most comprehensive such auction proposal has been filed by Natural Gas Pipeline Company of America (Natural) in Docket No. RP97-431. This proposal (reflecting a partial settlement among the parties in the case) was filed in a proceeding designed to remedy findings of affiliate abuse. The Commission required that the tariff have provisions that would ensure against affiliate preference in the auctioning and allocation of Natural's pipeline capacity in the future.

Thus, the filing was not made to respond to the Commission's NOPR on short-term transportation services, and it does not necessarily have precedential value for the NOPR. The filing is currently pending before the Commission, and the Commission has made no decision about whether to accept, reject, or modify the partial settlement.

Electronic Gas Commodity Trading

Electronic gas trading systems are PC-based real-time trading systems (using client server architecture) for natural gas transactions at numerous locations throughout North America. Two trading systems are currently active: QuickTrade operated by Enerchange and Streamline/NGX operated by Altra Energy. Both trading systems trade standardized contracts that range in term from same day and next day gas up to a period of one year.

Most trades take place through an electronic (automatic) matching procedure.²¹ **When this is the case, it is an example of a double auction, since both buyers and sellers make electronic bids to buy and offers to sell. The electronic matching procedure fills bids to buy from offers to sell that meet price, location, and duration requirements. The auction uses a first-price format, and the following price information is available to affected traders at all times:**

- **Offer price and volume**
- **Best bid price and volume**
- **Last trade price and volume**
- **Daily opening, high, and low prices**
- **Previous day's settlement prices.**

In addition to auctions for the gas commodity itself, there are also similar double auctions for gas futures contracts at the New York Mercantile Exchange (NYMEX) and the Kansas City Board of Trade (KCBOT).

Reverse Auctions

In a reverse auction, the winning bidder is paid for taking something that is burdensome or costly, instead of paying to get something of value. It is a procedure whereby one party puts up for bid a burdensome or costly item. Other parties offer bids on how much they have to be paid to take the item. The party willing to accept the lowest payment wins, similar to what happens in a standard supply auction. The Commission has approved the use of reverse auctions

²¹Both electronic trading systems also have a procedure that allows for direct negotiation and discretionary matching by traders.

in several proceedings for determining the amount of GSR costs that can be recovered from shippers.²²

For a pipeline, a reverse auction involves determining through bidding how much the pipeline must pay another party to assume the pipeline's obligation to pay (often at above-market prices) for gas supplies, transmission capacity, or storage capacity under contract to the pipeline. The winning bidder gets the rights to the gas or capacity, as well as a payment from the pipeline. Subject to Commission approval, the pipeline is then allowed to recover from customers the payment made to the winning bidder.

Laboratory Experiments on Natural Gas Capacity Auctions

In the late 1980's, the Commission sponsored two sets of laboratory experiments testing the potential use of auctions in the allocation of natural gas transportation capacity. Laboratory experiments can help to create empirical evidence on how markets would react under different sets of circumstances.²³

In these laboratory experiments, experimenters create a decision making environment within the laboratory with an essential structure similar to the gas market. Experiments are usually run following these steps: subjects are recruited and are given the rules of the market, multiple periods of the market are run, and then the subjects are paid their rewards in cash at the end of the experiment. The experimenters use their control over the subject's cash awards to induce appropriate incentives on the subjects, and then to see what people would do in the markets they have created. In the Commission-sponsored experiments, some subjects were given incentives like producers, some like pipelines, and some like buyers.

Among other things, the experiments found that a double auction appeared to be relatively efficient right away, but that some market power might still be exercised. The experiments also concluded that integrated markets where transportation and commodity auctions were combined performed best. These markets were the most efficient, showing the fewest market power problems. They also most easily handled the interdependencies between different transportation services and the natural gas itself. By contrast, when gas

²²Gas supply realignment (GSR) costs are costs that result from pipelines having to reform or terminate altogether certain gas supply contracts with producers (and sometimes associated transmission contracts or storage contracts) no longer needed by the pipeline as a result of Order No. 636.

²³For more information on these experiments, see the Commission's Office of Economic Policy's Technical Reports 88-1 (*A Policy Context For FERC-Sponsored Laboratory Experiments Concerning Market-Based Regulation of Natural Gas Transportation*) by Dan Alger, 88-2 (*Research On Pricing In A Gas Transportation Network*) by Charles R. Plott, and 88-3 (*An Experimental Examination of Competition and "Smart" Markets On Natural Gas Pipeline Networks*) by Kevin McCabe, Steven Rassenti, and Vernon L. Smith.

purchases were made before arrangements for transportation, the markets worked less well. Both prices and efficiency were volatile when gas was bought first. Thus, it appears that the market may function more efficiently with simultaneous gas and transportation purchases.

Electric Sector Auctions

Electric markets are providing examples of auctions as well. Auctions are being conducted in California and the PJM pool. Auctions are also planned in other pools. Some of the details of these auctions can shed light on potential auctions for gas transportation capacity.

California. In 1998, California implemented (with FERC's approval) procedures under which electric energy, ancillary services (generation capacity for backup energy), and congested transmission capacity in California are auctioned. Industry participants are allowed to either participate in the energy auction or to execute bilateral deals. The auctions are double sided, with bids for demand and supply. The final price is the highest supply bid taken (including offers to back off of demand). Bids are sealed, with one round each for the energy and ancillary auctions, and two rounds for the transmission congestion auction. Bids may be a quantity at a single price, or bidders may submit a number of prices and associated quantities.

California's auction for the energy is structured primarily as a day-ahead auction by a power exchange or PX, with bidders allowed to submit different quantities for each hour. This auction is accompanied by hour-ahead auctions for energy, to allow for divergences from the day-ahead bid. Such changes may be necessary due to unexpected changes in weather or generating capabilities. The ISO also conducts a real-time auction in which supplemental energy supply and demand bids are received. Bidders indicate the prices at which they are willing to change their generation or purchases in real time. The ISO uses these bids to balance total generation and load in real time, in response to parties being out of balance. Prices are established in the real-time market every five minutes.

After preliminary hourly day-ahead prices for energy are established by the PX, an independent system operator (ISO) holds an auction for congested transmission capacity. Parties participating in the PX auction, as well as those with bilateral deals bid for the transmission they need in order to meet their commitments. Transmission is broken into paths between 24 different points. There could be a different price on each path. Owners of the transmission are paid these prices. However, where there is no congestion on a path, the price will be zero. The transmission prices are then factored back into the energy auction to calculate energy prices at each of the 24 points. The utilities whose transmission is controlled by the ISO collect an access charge (primarily from loads in their service area) to cover their embedded costs of their transmission system. Revenues from transmission prices are credited against these access charges.

Problems have surfaced with the California ISO's ancillary services market. Its interrelationships with the other ISO-administered markets, as well as the PX and other energy

markets appear to have contributed to market power problems in the ancillary services markets. The Market Surveillance Committee of the ISO and the Market Monitoring Committee of the California Power Exchange independently concluded that the ISO's ancillary services markets do not yet operate in a manner consistent with workable competition. The reports identify a number of underlying factors contributing to the inefficient operation of the ancillary service markets, and propose solutions. Reports by both committees conclude that the ISO should retain the authority to impose a "damage control" price cap and to exercise that authority until the ancillary service markets are demonstrably competitive. The ISO proposes to improve the ancillary services market through a collaborative and deliberative process.²⁴ **The experiences in this market suggest that it may be useful to develop procedures to reexamine and perhaps modify any auction process, if problems in its design become apparent.**

PJM. The PJM pool runs as an ISO. It has a day-ahead auction for energy. Bids can be either to supply or take energy, although most demand is simply estimated rather than bid into the pool. However, supply bidders are only allowed to bid their FERC-approved costs. There are approximately 1,700 nodes in the system, each of which could potentially have a different energy price, depending on transmission congestion. However, in any given hour there may be little or no congestion and only a single non-zero price may be reported. Embedded costs of transmission are recovered through access charges on customers receiving firm service. There is also an auction for certain ancillary services in which bidders may bid start-up costs in addition to running costs.

VI. Conclusion

The Commission's proposal for auctioning of all short-term capacity is simply a new chapter in the use of auctions in the natural gas industry. If the Commission proceeds with a final rule requiring auctions for short-term capacity, determining the appropriate auction design will involve a number of choices. Numerous types of auctions with varying effects could be considered. For example, some are more incentive-compatible (i.e., it is in the interest of bidders to bid closer to their valuations); some are more efficient, some can be run more quickly, some are more demonstrably fair, and some will involve lower transactions costs or risk. Finding the right balance among possibly competing objectives will be a challenge.

²⁴Docket No. ER98-2977-000, Comments of the California Independent Operator Corporation on Reports Regarding Ancillary Services Market Operation (September 1998).

Glossary of Auction Terms

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Glossary of Auction Terms

activity rules

Rules which bidders must follow to remain active bidders in an auction. They are designed to keep the auction progressing, and to decrease inappropriate bidding. For example, in a **simultaneous progressive auction**, bidders who currently are not high bidders may be required to beat the previous high bid by a given percentage in order to maintain their right to bid.

affiliate/ affiliated bidder

A bidder that has a financial tie through ownership structure to the party soliciting bids (generally seller, or buyer with an auction to supply) or to the auctioneer.

affiliated values

An auction is said to involve affiliated values when bidders, upon learning that a competitor values an item more highly, will raise their own valuation of that item. See **independent private values/valuation** and **common value/valuation**.

after market

The arrangements for further trading of items sold in an auction.

ascending (bid or price) auction

An auction in which the bidders can see or hear the bids of others, and react to those bids. Such an auction can be conducted in several modes including oral outcry, electronic or written posting of bids. When a bidder hears or sees a bid higher than his/her own (lower in the case of a supply auction), the bidder has an opportunity to improve upon the bid to win the item. See **progressive auction**.

ask

The offer of a seller in an auction (where the seller is competing with other sellers via submission of bids), it is sometimes just called a **bid**.

auction

A structured method of selling or buying items/services with formal rules in which potential buyers and/or sellers make **offers**.

auction procedures

Rules established for management of the auction. This includes rules for when bids can be placed, information to be provided in the bid, information to be provided to bidders, how the **best bid or combination of bids** will be determined, etc.

auctioneer

The party conducting the auction.

best bid or best combination of bids

The bid or combination of bids that best meets the criteria for the **winning bid(s)** established by the **auction procedures**. Those criteria may be highest value, highest net present value, or involve other things, such as ensuring that winners meet diversity requirements, for example, that small businesses account for at least a given percentage of the accepted bidders.

bid

The **offer** of a buyer of a price or prices at which it is willing to take (provide) the item(s)/service(s) being sold. It may also refer to the offer of a seller to supply item(s) or service(s).

bid increment

The minimum amount by which a new bid in a **progressive auction** must improve the previous best bid. A large bid increment makes the auction go faster but risks more lost revenue and a larger misallocation of the item being sold. For example, with two bidders respectively valuing an item at \$53 and \$57, a bid increment of \$10 could result in the item being sold to the lower valuing bidder at \$50. A bid increment of \$5 would likely result in an efficient allocation and a sale price of either \$50 or \$55.

bid window

The period of time during which bids and/or asks may be placed. There may be a single bid window, or when an auction has **multiple rounds**, a bid window for each round.

bid withdrawal

A bidder's removal of its bid from consideration in the auction. Depending on the auction rules, bid withdrawal may be allowed if bidding has not ceased, or in some cases a winning bid may even be withdrawn after bidding has stopped. Bid withdrawal may be associated with a financial penalty, or with a prohibition from participation in the remainder of the auction.

bid-ask spread

The difference in price between the best (highest) offer to buy and the best (lowest) offer to sell.

bidders

Those submitting offers to buy or sell.

bid-taker

Auctioneer or party soliciting the bids (seller or, in case of a supply side auction, buyer).

bid-taker cheating

When the bid-taker violates the auction rules in order to take advantage of a bidder(s). The potential for such cheating is a greater concern in auctions in which the price a bidder pays is determined by the bids of others, as the bid-taker has an incentive to fabricate a bid that will raise the payments it receives.

binding bid

A bid which may not be withdrawn (see **bid withdrawal**).

collusion

When two or more bidders act cooperatively to coordinate their actions rather than compete in the auction. The collusion may include only a few parties participating in the auction or it may include all bidders. Collusion may consist of explicit agreements about which bidder will be allowed to win a particular auction (or what it should bid). It may also consist of a tacit or implicit understanding that restraint will be exercised in bidding. Groups of collusive bidders are sometimes known as **rings**.

combinational or combinatorial bids

When bidders are allowed, within a **simultaneous auction**, to place a single bid on a self-selected package of items/services, as opposed to bidding on each item independently. Also known as **package bids**.

common value/valuation

The situation in which an item being auctioned is known to have the same (but usually an unknown) value to each bidder. The bidders, however, may well have different estimates of its value. An example would be a offshore oil tract. See **affiliated values** and **independent values/valuations**.

constrained auction

A **multiple unit auction** in which all bids cannot be fulfilled simultaneously.

contingent bid

A bid which may be withdrawn under specified circumstances or contingencies. For example, a shipper might want to place a bid for transmission capacity that is contingent on getting upstream or downstream capacity on another system.

demand or demand side auction

An auction in which the bidders are bidding to acquire the item or service. See **supply auction** and **double auction**.

descending bid auction

An auction in which the auctioneer announces successively lower prices, for example a **Dutch auction**. However, the term could also apply to a **low-bid-wins progressive supply auction**.

discriminatory auction

A **multiple unit auction** in which homogenous (undifferentiated) units are sold at different prices to different bidders, according to the bids they made. For contrast, see **uniform auction**.

discriminatory pricing

Auction pricing in which homogenous units are sold at different prices to different bidders, according to the bids they made.

double auction

An auction in which buyers and sellers both submit offers. In this auction, the bids of buyers and of sellers are ranked to generate supply and demand curves. In a continuous double auction many individual transactions are carried on at one time, and trading does not stop as each sale is concluded. Examples of continuous double auctions are the New York Stock Exchange and the regulated futures exchanges. See **single sided auction**.

Dutch auction

An auction in which the auctioneer announces successively lower prices, sometimes using a mechanical or electronic device to do so, until a bidder claims the auctioned item/service at the current price. When there are multiple similar units for sale, the successful bidder may take as much as it wants at the unit price of its winning bid. If any units remain in the current lot, the auctioneer resumes the descending auction for the remaining units. This continues until all units are sold, or the reserve price is reached. In some financial circles, the term "Dutch auction" has a different meaning. There it means a **uniform price auction**.

electronic auction

An auction in which the auction may be announced, bids are submitted, and auction results are given, electronically. For example, bids may be submitted over the Internet. Best bids may also be determined electronically, and perhaps automatically.

English auction

Traditionally, a **progressive single-sided** auction that is oral outcry. When a bidder hears a bid higher than his/her own, the bidder has an opportunity to improve upon the bid to win the item. Under this auction format, a bidder would generally be willing to bid up to its valuation of the item, but no more.

fast hammer

The practice of an auctioneer in an **English auction** of ending the auction while one or more bidders may still be willing to bid. This may involve bidder favoritism, but usually is just an effort by the auctioneer to get bidders to speed up the bidding for subsequent items.

first-price

In a first-price auction, the bidder pays what he/she has bid. In a multiple unit auction, this may result in different bidders paying different prices, i.e. **discriminatory pricing**. In a first price auction, to avoid **leaving money on the table**, buyers may lower their bids to less than their actual value. Likewise, sellers may raise their **asks**.

flexible bid

A bid for which the bidder expresses willingness to modify some parameter of the bid, should it be necessary to allow for a higher **best bid combination**. For example, a bidder may be willing to take fewer units than it originally bid for. Contrast this to an **inflexible bid**.

high bid

The current highest bid, which must be topped for another party to win the auction. In the case of an auction with **inflexible bids** and **lumpiness**, this may be a group of bids which generate a combined best current bid. However, each of the bids within this group may not be higher per-unit bids currently outbid. This is because of **overlapping bidding** with other of the bids in the high bid group.

high-bid-wins auction

An auction in which the highest bid or bids win--normally an auction in which the **bid-taker** is selling.

incentive compatible

An auction is incentive compatible if each bidder finds it in his/her interest to bid his/her valuation honestly.

independent auctioneer

An auctioneer that is not affiliated with any of the parties participating in the auction, including the bidders and the party for which it is running the auction (the party soliciting bids). Such an auctioneer may be needed when there is a concern that the party taking bids may inappropriately favor one of the bidders or pass it information on other bidders.

independent private value/valuation

An auction is said to involve independent private values when bidders cannot learn anything about the value to themselves of an item/service being sold from other bidders' valuations of it. See **common value/valuation** and **affiliated values**.

independent verifier

A party, not affiliated with any of the parties associated with the auction, whose job is to assure that the auction was conducted according to the stated auction procedures, and that the appropriate winners were chosen. Auction complexity, participation in the auction of parties affiliated with the seller or auctioneer, and/or a policy of keeping bids secret may create the need for an independent verifier.

inflexible bid

A bid for which the bidder expresses an unwillingness to modify some parameter of the bid, should it be necessary to allow for a higher **best bid combination**. Contrast this to a **flexible bid**.

iterative auction

An auction in which bidders are given the opportunity to respond to prior bids. This term is usually used when there are discrete **multiple rounds** of bidding as opposed to continuous **open** (first definition) bid submission.

Japanese auction

A variant of the English auction in which each bidder can observe at every price whether each other bidder is still participating in the auction or has irrevocably dropped out. It is primarily a theoretical construct useful for analyzing the limiting case of maximum information transfer during an auction, and is not generally observed in practice.

leaving money on the table

Money is "left on the table" when a buyer in a first-price auction (or other discriminatory auction) bids more (or a supplier bids less) than it needs to win the auction. A bidder need only top the next best bid by a small increment to win. However, when a buyer lacks knowledge of the amount of the next best bid, it will normally bid less than its valuation of the item, balancing its chance of winning against the size of its net gain if it does win.

low-bid-wins auction

An auction in which the lowest bid or bids win--normally an auction in which the **bid-taker** is buying.

lumpy/lumpiness

Lumpiness is said to exist when bids in a **multiple unit auction** that are not **proratable** with respect to any of a number of parameters, making determination of the best combination of bids difficult. The parameters in question could include such things as number of units, time, points of use..... With lumpiness, the **best combination of bids** may leave some of the item or service unsold. See **overlapping bids**.

market clearing price

The price at which the quantity demanded equals the quantity supplied. There is no excess supply or excess demand at this price.

minimum bid

The smallest bid allowed; it is the price under which the auctioneer is unwilling to accept bids. This minimum bid may or may not be the same as the **reserve price**. If best bid is higher than the minimum bid but lower than the reserve price the item(s)/service(s) will not be sold.

money left on the table

See **leaving money on the table**.

multiple round auction

An auction with a sequence of **bid windows**, in which the bids in a later round can improve upon high bids from the previous round. Each bidder is allowed a single bid per item per round.

multiple unit auction

An auction in which more than one item or unit of service is being sold. Such units are usually related in some way. They may be identical, complementary or substitutable for each other.

non-discriminatory auction

A **uniform price auction**.

offer

A submission to the auctioneer of prices and quantities at which a buyer or seller is willing to trade.

open auction

There are three different possible meanings. First, and most important, an open auction is one in which bids are revealed in time for competitors to react. Second, open auction may mean a **public auction**. Third it may mean an auction which is still in process.

oral auction

Traditionally this has been an auction which is conducted with all parties present (or represented), with an auctioneer soliciting bids, and calling out resulting bids. However,

today, an oral auction could be easily substituted for by an **electronic auction**, with bids posted, rather than orally provided.

overlapping bids

Bids in a **multiple unit auction** that conflict with each other in part, so that each cannot be accepted in full. For example, a bid for a system's capacity for the months of March and April overlaps a bid for that capacity in April and May. An overlap can involve such things as number of units, time, points of use, etc. With overlapping bids, the **best combination of bids** that can be completely accepted simultaneously may leave some items unsold. See **lumpy/lumpiness** and **constrained auction**.

package bids

See **combinational or combinatorial bids**.

private auction

An auction in which buyers and/or sellers participate by invitation only. See **public auction**.

progressive auction

An auction in which the bidders can see or hear the bids of others, and react to those bids. Such an auction can be conducted in several modes including oral outcry, electronic or written posting of bids. When a bidder hears or sees a bid higher than his/her own (lower in the case of a supply auction), the bidder has an opportunity to improve upon the bid to win the item.

proratable bid/proratability

A bid in an auction with multiple (identical) units that is also a bid at the same price for fewer of those units.

public auction

An auction which is open to all qualified parties, not just parties who have been invited to participate. See **private auction**.

qualification

Parties may be required to qualify, such as by meeting certain creditworthiness criteria, before being allowed to participate in an auction.

RFP (Request for Proposal) process

A solicitation of bids from suppliers where the bids may differ in many ways and there is no complete preannounced (and usually no predetermined) way of comparing bids.

reserve price

The lowest price at which the auctioneer is willing to sell an item. This may be higher than an announced **minimum bid**.

ring

A group of actively colluding bidders. See **collusion**.

risk averse

A party who prefers a certain amount of money rather than an uncertain amount with the same expected value is risk averse. For contrast, see **risk seeker** and **risk neutral**.

risk neutral

A party who is indifferent between a certain amount of money rather than an uncertain amount with the same expected value is risk neutral. For contrast, see **risk averse** and **risk seeker**.

risk seeker

A party (such as a gambler) who prefers an uncertain amount of money with a given expected value to that amount of expected value is a risk seeker. For contrast, see **risk averse** and **risk neutral**.

second-price auction

In a second-price auction, the winning buyers pay the bid of the highest losing bidder. In a variant with slightly different results, winners pay the lowest winning bid. A second price auction is more likely to cause bidders to bid their true valuations because their own bid does not affect what they pay (unless they are the last winning bidder and that price is used). When bidders bid their valuations, the auction will be more efficient. In a supply auction, suppliers are paid the lowest losing ask.

sealed bid

An auction structure in which bidders cannot see the bids of others before they bid. This process can be used in a single round auction or in multiple rounds, with the results of a round being announced before the next round commences. Bids may or may not be announced at the end of a sealed bid auction.

sequential

An auction structure under which related items (such as coins, stamps, or parcels of real estate) are auctioned separately, one following another. This is as opposed to a **simultaneous** auction.

shill

A party associated or affiliated with the auctioneer or seller that bids in attempt not to acquire the item, but in an attempt to raise the price of the item being sold. The shill may do so in a surreptitious manner. For example, a shill may bid on an item to either force another bidder to bid closer to its valuation, or to imply that the unknown common value

is higher than the existing bid. Shills could also try to lower the price for the buyer or auctioneer in an auction to supply.

signaling

Communication between bidders via their bids in an attempt to influence competitive behavior. Bidders may signal in a number of ways, and for different purposes. For example, bidders may put trailing digits on their bids to tell other bidders to stay away from certain units offered or to communicate **ring** information. A bidder might also escalate a bid quickly to tell other bidders to stay away.

simultaneous auction

A **multiple unit** auction that allows bidding on related items at one time. A simultaneous auction should allow bidders more back-up strategies, but is more difficult to administer than a **sequential auction**.

single round auction

An auction which concludes after each bidder has placed one bid for an item/service. Such an auction is normally a **sealed bid** auction.

single sided auction

A demand or a supply auction. An auction in which there are bidders to acquire or bidders to supply an item/service, but not both types of bidders. See **double auction**.

stopping rule(s)

Prespecified conditions under which an **iterative** or **multiple round** auction concludes. For example, an auction might conclude when the value of the best bid combination fails to increase.

supply or supply side auction

An auction where the bidders are bidding to supply. See **demand auction** and **double auction**.

topping rights

The right to make the last bid in the auction. The exercise of such a right may require a specific fixed or percentage increase over the best previous bid.

transaction costs

The costs of executing a trade. These include costs of finding a deal, of preparing an offer, and of participating in a trade.

transparent

An auction is transparent when participants can see how allocation occurs via the auction, and the auction processes are clear and easily understood. Transparent prices are public prices that can be reacted to in a timely way.

uniform price auction

A **multiple unit auction** in which homogenous (undifferentiated) units are sold at the same price to different bidders. For example, it could be a second price auction with all bidders paying the highest losing bid. For contrast, see **discriminatory auction**.

unit price auction

An auction in which prices bid are prices per unit.

Vickrey auction

A **sealed bid second-price auction**. Traditionally in this auction for a single item, what the bidder bids does not affect what the bidder pays, so long as his bid is higher than the next highest bid. It was designed in an attempt to give bidders the incentive to bid their value for the item, making for an efficient auction.

Vickrey-Clarke-Groves auction

A generalization of the Vickrey auction to multiple item sales in which a bidder may want more than one item. A bidder pays the amount of its accepted bids but is then reimbursed for the extra total revenue beyond that which could have been achieved by the auction, had the bidder not participated. The effect of this reimbursement is that a bidder's payment is determined completely by the bids of others.

waiver

A relief or partial relief from the requirements of an auction rule. In the FCC spectrum auctions, bidders were entitled to waivers from the requirements of the activity rules in a limited number of rounds.

winner's curse

In an auction with an unknown common value or with uncertain affiliated values, bidders must make estimates of the unknown value of the item being auctioned. There is a tendency for the bidder making the most optimistic estimate to win the auction. In such a situation, on average, the winning bidder will find it has overestimated the value of what it wins. The term "winner's curse" applies to this overestimate. If the winning bidder has made an adequate allowance in its bidding strategy for this value shortfall, winning the auction will still be desirable, and, at least on average, profitable. The term "winner's curse" is also used, less precisely, to denote an actual loss suffered by a winning bidder who has not made adequate allowance for this potential value shortfall.

withdrawable bid

A bid which is not a **binding bid**. A withdrawable bid might be withdrawn under any circumstances, or could be a **contingent bid**.