

*Electricity Market Data Transparency*

Prepared for:

Alberta Market Surveillance Administrator

Andy Baziliauskas  
Margaret Sanderson  
Adonis Yatchew

November 17, 2011

## Table of Contents

|     |   |    |
|-----|---|----|
| 1.  | Introduction and Overview.....  | 2  |
| 2.  | Data Transparency Principles .....  | 6  |
| 2.1 | Benefits of Market Data Visibility .....                                      | 8  |
| 3.  | Summary of Stakeholder Consultation Responses.....                            | 10 |
| 4.  | Data Transparency and Coordinated Behaviour .....                             | 13 |
| 4.1 | Factors Facilitating Coordinated Behaviour.....                               | 13 |
| 4.2 | The MSA’s Approach to Coordinated Behaviour .....                             | 19 |
| 5.  | The Alberta Market.....   | 20 |
| 5.1 | Background on the Alberta Market .....  | 20 |
| 5.2 | Characteristics of the Alberta Wholesale Market .....                         | 20 |
| 6.  | The Likelihood of Coordinated Behaviour in the Alberta Market .....           | 24 |
| 6.1 | Coordinated Behaviour in Electricity Markets.....                             | 24 |
| 6.2 | The Likelihood of Coordinated Behaviour in the Alberta Wholesale Market ..... | 28 |
| 6.3 | Transparency of Market Data .....   | 30 |
| 7.  | Conclusions and Recommendations.....  | 32 |

## 1. Introduction and Overview

We have been asked by the Alberta Market Surveillance Administrator (“MSA”) to assess whether data release practices in the Alberta market facilitate or contribute to the likelihood of coordinated behaviour among market participants and, if so, to offer recommendations about changes to data release policies or market rules in the Alberta market. We recognize, as do analysts and regulators in a number of electricity markets around the world, that market transparency generally improves market outcomes. Stakeholder responses to the MSA’s consultation, which we have reviewed, are consistent with the existing economic literature about the benefits of market transparency and clearly explain many of the benefits of the current level of data disclosure in the Alberta market.

Although public disclosure of market data generally improves market outcomes, as explained in our report market transparency may also increase the likelihood of coordinated behaviour among suppliers. Such behaviour can result in a variety of harms, including high prices to consumers, productive inefficiency, and dynamic inefficiency. It is important to note at the outset that market transparency does not by itself increase the risk of coordinated behaviour. It is only when other market factors are present, including one or more of high seller concentration, high barriers to entry, repeated and frequent interaction among suppliers, product homogeneity, inelastic demand, and stability of costs and demand, that market transparency can increase the likelihood of coordinated behaviour. The Alberta market has many of these characteristics, and consequently there is a risk that Alberta’s data disclosure policies, which are generous relative to other electricity markets, may increase the risk of coordinated behaviour. We note, however, that we have not conducted any empirical analyses to determine whether there is coordinated behaviour in the Alberta electricity market, although we have been asked by the MSA to assist in assessing whether observed outcomes suggest coordinated behaviour or are simply a reflection of the existing market structure. This work is ongoing and is outside the scope of this report.

In the *Offer Behaviour Enforcement Guidelines (OBEG)*, anti-competitive coordinated behaviour among competitors is described as spanning behaviours ranging from explicit collusion through tacit agreement to ‘consciously parallel’ behaviour. In our view, the MSA’s characterization of anti-competitive coordinated behaviour and its analytical framework for assessing the likelihood

of coordinated behaviour are consistent with practices established by the Canadian Competition Bureau and other antitrust enforcement agencies around the world. In this report, we use substantively the same approach to assess the effects of Alberta's data release practices on the likelihood of coordinated behaviour in the Alberta market. We do not consider the effects of data transparency on the ability of market participants to exercise unilateral market power.

### ***Overview of Findings and Recommendations***

We have identified a small subset of the data disclosed by the AESO which can potentially increase the risk of coordinated behaviour. In particular, the Historical Trading Report, the Current Supply and Demand Report, and the System Marginal Price Report disclose information that may allow market participants to infer the offers of other market participants, albeit with noise, in close to real time. Visibility of other suppliers' prices and quantities is an important factor which can facilitate coordinated behaviour, because it allows coordinating firms to signal desired price increases and to monitor deviations from a coordinated outcome. We have not found that other data disclosed in the Alberta market materially increases the risk of coordinated behaviour.

In their responses to the MSA's consultation, stakeholders indicated that market transparency provides many important benefits, including improving demand response, encouraging participation in the physical and financial markets by smaller market participants, reducing risk premiums, and increasing competitive responses (and thereby limiting unilateral exercises of market power). Other analyses also support market transparency because of improved market outcomes. In recognition of the acknowledged benefits of a transparent market, we take a cost-benefit approach to data disclosure policies. In addition to considering the costs of data disclosure in terms of facilitating or increasing the likelihood of coordinated behaviour, we consider the benefits in terms of promoting the "fair, efficient, and openly competitive" objectives of regulation and any operational benefits of data transparency.

To be clear, at issue for the purposes of this report is the visibility of each supplier's offer, generation, and capacity data to other market participants on a close to real-time basis. It is this type of visibility that can facilitate coordination that inhibits competition or, potentially results in anti-competitive market outcomes. We do not consider the effects of the visibility of market data to the MSA, system operator, or other regulators/government entities since this clearly

does not increase the risk of coordination. We also do not consider issues relating to transparency of financial market data or transparency of the retail market.

We have not conducted an empirical analysis of the costs and benefits of disclosing each type of data. This would be a substantial and costly undertaking, and would not, in any case, likely yield reliable estimates given the diffuse nature of the costs and benefits of disclosure, the lack of any 'natural experiments' in the market (e.g. discrete changes in disclosure that would allow for a 'before and after' comparisons of market outcomes), and the complex interaction between data disclosure and market rules, market structure, and the behaviour of market participants. Furthermore, even limiting attention to the effects of market transparency on competition, it is clear that disclosure of certain types of information can either increase competition (by improving demand response and increasing market participation) or limit competition by facilitating tacit collusion, or both.

We have been asked by the MSA for recommendations about changes to data release policies in the Alberta market, should we find that current policies contribute to the likelihood of coordinated behaviour. In forming our recommendations and suggestions, we looked primarily for possible changes to policies that would preserve the benefits of market transparency while reducing any risks of coordinated behaviour. Based on our analysis, we recommend that the potential effects of data disclosure policies on the risk of coordinated behaviour should be taken into account when forming policy related to the nature and timing of data disclosure. Our additional recommendations and suggestions include the following:

- Consideration should be given to possible changes to data disclosure policy that would maintain the benefits of visibility while reducing the likelihood of coordinated behaviour.
- Consideration should be given to limiting the Current Supply and Demand Report in a way that reveals only necessary outage information, without revealing generation by all units to all market participants. An alternative would be to replace the Current Supply and Demand Report with a report that more directly addresses the expressed need for outage information.

- If the AESO's two hour-ahead Pool Price forecast is not viewed by market participants as sufficiently reliable, improvements should be considered to increase the accuracy of the forecasts, thereby reducing the need for disclosure of supply data to market participants.
- Consideration should be given to delaying the disclosure of the offer data currently reported in the Historical Trading Report in order to limit the ability of suppliers to signal through their offers. Other options, short of lagging disclosure, include publishing price offers in bands (e.g. in \$10/MWh increments), rather than the actual offers themselves. Additional protections against signaling through changes in market rules should also be explored.

The remainder of this Report is structured as follows:

Section 2 discusses principles of market data transparency, including the benefits of transparency.

Section 3 summarizes stakeholder responses to the MSA's consultation.

Section 4 explains the relationship between data transparency and the likelihood of coordinated behaviour.

Section 5 provides a brief overview of the Alberta market and identifies the features of the market that are relevant for assessing the likelihood of coordinated behaviour.

Section 6 discusses concerns relating to market data transparency and coordinated behaviour in the Alberta wholesale market.

Section 7 provides our conclusions and recommendations.

## 2. Data Transparency Principles

Timely and transparent availability of market data is necessary for the functioning of an efficient and competitive electricity market in Alberta. Ideally, the data made available by the AESO to market participants would promote the fair, efficient, and openly competitive objectives of the *Electric Utilities Act*. Market participants need access to market data to interpret past events and to predict the evolution of supply and demand, transmission constraints, intertie congestion, and other variables. This, in turn, allows them to operate more effectively and to appropriately develop plans and business strategies, including investment plans. Outside parties require access to market data to assess whether entry would be profitable. Regulators and administrators need access to market data to develop and amend market rules, plan for infrastructure, monitor the market for potential abuses of market power, and many other reasons. Market transparency can also have more broadly-based benefits including promoting public confidence in the integrity of market outcomes. The MSA, along with other market monitors and regulators, recognizes the importance of information dissemination in promoting efficient outcomes. For example, one of the principles cited in the *Foundational Elements* paper refers to an 'Information Rich Environment' ("Participants operating in an information-rich environment are better placed to make rational and informed decisions that are consistent the fair, efficient, and openly competitive operation of the market").<sup>1</sup> Stakeholder responses to the MSA's consultation have also clearly articulated the many important benefits of market transparency, as discussed in Section 3.

As we explain in this Report, transparency of market data can, in certain circumstances, also harm efficiency.<sup>2</sup> Most importantly, visibility to competitors of suppliers' prices or volumes can facilitate coordinated behaviour, including explicit and tacit collusion and conscious parallelism, among market participants, which can result in a variety of harms, including higher prices to consumers, productive inefficiency, and dynamic inefficiency. Antitrust enforcement agencies around the world have long recognized the economic harms that can result from collusion.

---

<sup>1</sup> *Foundational Elements Shaping the Market Surveillance Administrator's Approach to Bids and Offers*, MSA Discussion Paper, April 27, 2010, page 6.

<sup>2</sup> Legislation already prohibits the sharing of certain types of pricing and offer information between market participants. Subsection 3(1) of the *FEOC Regulation* directs that "a market participant shall not share records that are not available to the public relating to any past, current or future price and quantity offer made to the power pool or for the provision of ancillary services."

Criminal laws against price fixing are rigorously enforced and instances of explicit collusion are often punished with substantial fines and even imprisonment for the individuals involved. Tacit collusion, which unlike explicit collusion does not involve explicit agreement among competitors, is a concern primarily in the context of the civil provisions of antitrust legislation, such as mergers and abuse of dominance. For example, when investigating the competitive effects of a proposed merger, antitrust enforcement agencies will assess whether the merger would likely result in an increase in the unilateral market power of the merged entity and/or the likelihood of coordinated behaviour among remaining firms in the market. As discussed in detail in section 4.1, a key market feature facilitating coordinated behavior is market transparency. If firms can easily observe the prices and other competitive variables, such as sales volumes, of other firms in the market, then the likelihood of coordinated behaviour among firms in the market may be higher than otherwise would be the case. Market transparency is not itself a problem; rather, it is when other market factors are present, including one or more of high seller concentration, high barriers to entry, repeated and frequent interaction among suppliers, product homogeneity, inelastic demand, and stability of costs and demand, that an increased likelihood of coordinated behaviour is a concern. Section 4 explains in more detail how the presence of these market characteristics can facilitate anti-competitive coordinated behaviour.

We are well aware that market transparency can also enhance competition (as one of the primary benefits of transparency), even while also having the potential to lessen competition by facilitating coordinated behaviour. Many of the respondents to the MSA's consultation have pointed out that generous data disclosure enhances competition by encouraging participation in the physical and financial markets by smaller market participants and improving the ability for loads to curtail consumption in response to adverse pricing events. This is one of the reasons that it is difficult to trade off costs and benefits of disclosure—these costs and benefits are highly intertwined.

The term 'market data transparency' embodies a number of dimensions, including: the nature of the data (e.g. prices and quantities offered by electricity suppliers); identification of the parties to whom the data are made available (e.g. market administrators/regulators, competitors, other electricity market participants); and when the data are made available (immediately after the information is produced, or after a lag; how long should the lag be?). The tension between the



benefits and harms resulting from market data transparency is most effectively resolved by dealing with each of these dimensions separately, while recognizing that they are inter-related.

In the remainder of this section, we summarize the primary benefits of making each market participant's market data available to other market participants. We also briefly discuss data disclosure practices and policies in other markets. Section 3 summarizes stakeholder responses to the MSA's consultation. These responses clearly articulate the benefits of market transparency in the context of the Alberta market. Section 4 discusses how data disclosure can increase the likelihood of coordinated behaviour.

### 2.1 Benefits of Market Data Visibility<sup>3</sup>

When we refer to the benefits of data transparency, we are referring to *social* benefits. If an activity, behavior, or rule benefits only a subset of market participants and these benefits are less than the costs to remaining market participants, including consumers, then there is no net *social* benefit.<sup>4</sup>

At a general level, the benefits of transparency are similar across markets, but the specific benefits and their magnitudes vary across markets because they depend on each market's particular circumstances, such as its structure and rules. We therefore devote more attention in our report to the benefits of transparency for the Alberta market, as articulated in the stakeholder responses to the MSA's consultation. These responses are consistent with the benefits cited by other authorities.

#### Dimensions of Data Transparency

Market transparency can be evaluated along several dimensions. The following list covers the main ways in which data can be made more or less transparent.

---

<sup>3</sup> This section draws on Liz Hooper, Paul Twomey & David Newbery, *Transparency and Confidentiality in Competitive Electricity Markets*, June 2009.

<sup>4</sup> A discussion of welfare concepts and the distinction between private and social benefits is contained in Michael Trebilcock, Adonis Yatchew, and Andy Baziliauskas, *Overview of Cost-Benefit Analysis and its Applications in Public Policy Decisions*, prepared for the Ontario Independent Electricity System Operator, June 2007, and available online at [http://www.ieso.ca/imoweb/pubs/mear/CRA\\_Overview-of-Cost-Benefit-Analysis.pdf](http://www.ieso.ca/imoweb/pubs/mear/CRA_Overview-of-Cost-Benefit-Analysis.pdf).

- Aggregation across suppliers. Data can be aggregated across suppliers, either across all suppliers (within the entire market or within each zone), or across individual fuel types, before being disclosed to market participants. For example, PJM discloses generator operational data aggregated across the entire system, Nord Pool aggregates generator data at the zone level, and generator data is aggregated by fuel type in the UK.
- Masking of market participant identity. A market participant's data can be publicly disclosed without revealing the market participant's identity. Aggregation, as discussed above, is one way of masking identities. However, masking can be more direct: in Alberta, for example, supplier offers in the Historical Trading Report are not aggregated but the asset associated with each offer pair is not disclosed.
- Aggregation across time/timeframe. Data can be aggregated across time before being disclosed, as is the case when markets publish daily or monthly generation or outages.
- Time lag of publication. Data can be disclosed to the market with varying lags, ranging from minutes to several months. For example, supplier offers in Alberta are disclosed within minutes after the close of the hour, while in PJM, NYISO, MISO, CAISO, and ISO-NE, offer data are disclosed to the market after a lag of at least 90 days.

#### Summary of Benefits of Data Transparency

In general, disclosure of suppliers' market data in electricity markets creates (social) benefits primarily by allowing market participants to better understand how prices are formed and also to better predict how prices will evolve in the following hours, days, and months. With this information, they are likely to make more (socially) efficient operating, trading (on both the supply and demand sides), and investment decisions. This is likely to lead to lower prices, productive efficiency, and efficient entry and expansion (dynamic efficiency).

In general, market data transparency provides the following benefits to market participants:

*Risk and Uncertainty are Reduced.* Accurate and timely information about the determinants of prices allows market participants to make efficient decisions about supply, consumption, and investment. Without such information, risks increase and market participants make less

efficient decisions, potentially leading to higher production costs and missed investment opportunities (or excessive investments) or mis-timing of investment.

*Information Asymmetries are Reduced.* Market participants with a substantial share of supply or consumption have a natural information advantage over smaller market participants, simply by virtue of having visibility of their own production (or demand) and costs which comprise a larger proportion of the market. Market data transparency reduces, or even eliminates, this information asymmetry and therefore encourages greater participation in the market and improved decision making by smaller entities.

*Improved Market Monitoring.* Visibility of market data allows for monitoring of the market by regulators, academics and other analysts, and the general public. Monitoring of market outcomes by regulators, such as the MSA, can identify exercises and abuses of market power, which can lead to remedial actions. Such actions, and even the threat thereof, can increase market efficiency and promote public understanding that market outcomes are monitored and remediated. This increases the general public's confidence in the market. Visibility of market data to market analysts, academics and the general public can also facilitate monitoring and can provide important information and analyses to regulators and policymakers.

### **3. Summary of Stakeholder Consultation Responses**

The MSA received fourteen public responses (twelve of which were public) to its stakeholder consultation. Responding market participants were unanimously in favour of maintaining at least the current level of data disclosure in the Alberta market. There were a number of reasons cited for maintaining current practice. Respondents indicated that the Historical Trading Report, the Current Supply and Demand Report, and the System Marginal Price Report are useful primarily because they provide information about offers and supply that allows market participants to forecast price levels and price spikes. It is important to note that the reasons cited for transparency by stakeholders are consistent with the reasons for transparency in the existing literature. According to consultation respondents, data availability improves market outcomes in a number of ways, including by improving demand response, reducing asymmetry between larger and smaller market participants, and reducing risk premiums.

The following describes Respondents' submissions in more detail.

### **I. Data Disclosure Improves Demand Response**

Several Respondents indicated that the next hour's offer curve is often similar to the offer curve for the previous hour, and some loads use the hourly offer curve as soon as it becomes available (through the Historical Trading Report) to predict pricing for the next hour. The real time System Marginal Price and block size are also monitored to predict the load reduction that would reduce the System Marginal Price. Generator unit outputs in the Current Supply and Demand Report are used to determine whether a particular generator is returning to service or shutting down unexpectedly. In summary, the Historical Trading Report, the Current Supply and Demand Report, and the System Marginal Price Report are used to predict the shape and position of the offer curve, thus providing an opportunity for loads to profitably curtail consumption. At least one respondent suggested, correctly, that limiting the ability of loads to respond to prices would reduce the competitiveness of the market. As a matter of economic theory, this is correct—as explained in section 4, inelastic demand supports coordinated behaviour, and it also encourages the unilateral exercise of market power. Since price responsiveness implies some elasticity of demand, policies that encourage price responses, such as those that promote transparency, can mitigate unilateral and coordinated exercises of market power.

### **II. Data Disclosure Increases Physical Market Participation**

Many market participants noted that without public disclosure of certain data, smaller market participants would be at a substantial disadvantage relative to larger suppliers. The latter have access to their own offer and generation data (including outages) and therefore, absent public disclosure of each generator's data, larger suppliers would have a better perspective on the supply side of the market than smaller suppliers. This informational edge would allow larger market participants to trade in the physical and financial markets more profitably relative to smaller market participants. Some stakeholders stressed the important role that symmetric access to the outage information that can be inferred from the Current Supply and Demand Report plays in encouraging market participation. In addition, without public disclosure of key information, smaller market participants would be forced to purchase costly information from third parties, an expense that would act as a barrier to entry or to further market participation.

According to this argument, which we accept in principle, the disclosure of each market participant's data to other market participants in effect contributes to 'leveling the playing field.'

As a specific and important example, the Current Supply and Demand Report provides key information about outages. Larger suppliers, having knowledge of their own outages, will be able to better formulate an assessment of overall outage conditions within the marketplace. Smaller suppliers will be, in this sense, disadvantaged. One stakeholder indicated that "(I)f market participants do not have visibility of generation outages on units they do not own, they would be forced to wait for the short term outage report to update to understand the reason for a price spike."

One Respondent also suggested that removing certain data from public disclosure or delaying its release would allow larger market participants to exercise additional market power because they will possess a disproportionately large share of plant status information. In short, with more limited data disclosure private information would play an increased strategic role in market behaviour and development. There would be an impetus to expand in order to have a greater share of private information.

The FEOC regulation provides some protections to smaller market participants, and potentially reduces any information advantage that may be possessed by larger suppliers. This is accomplished by prohibiting (under Section 4) the use by a market participant of outage records to trade until the outage information has been made available to the public by the ISO. This prohibition, if effective, clearly reduces the information asymmetry between larger and smaller market participants. We have not conducted an analysis to determine whether the effectiveness of this prohibition or the resulting reduction in asymmetry would be limited if generation data were not disclosed (or were delayed or masked) in the Current Supply and Demand Report.

### **III. Data Disclosure Increases Liquidity**

Respondents suggested that participation in the forward market is already very limited, and more limited access to market information would cause smaller financial (and physical) market participants to exit (or forego entering) the forward trading market. The result would be that the financial market would become even less liquid. If there is asymmetry in access to data,

because smaller participants would have visibility to a smaller portion of the market compared to larger market participants (who view their own data), bid-ask spreads will increase, and this could have a negative impact on market liquidity. Asymmetric access to unit outage and offer information appears to be the primary concern for stakeholders.

#### **IV. Better Information Reduces Risk Premiums**

Stakeholders explained that the ability to accurately predict the slope of the offer curve reduces risk premiums and also increases liquidity in the financial market. Market participants currently use the offer curve from the previous hour to predict ‘gaps’ in market offer curves for future hours. This is useful because large gaps in offers lead to price volatility. Similarly, the block size in the System Marginal Price Report is a predictor of volatility. It is not sufficient for traders to have knowledge of the current price, since it is the slope of the offer curve that is useful in predicting price changes. Impairing the ability of market participants to predict price jumps will increase risk, and the market will therefore increase the risk premium.

### **4. Data Transparency and Coordinated Behaviour**

In this section of our report, we explain the economic theory of coordinated exercises of market power, as distinct from unilateral exercises of market power, and discuss the market characteristics that may increase the likelihood of such behaviour. We also briefly outline the MSA’s approach to coordinated behaviour in this section.

#### **4.1 Factors Facilitating Coordinated Behaviour**

It is important at the outset to distinguish between unilateral exercises of market power and market power exercised *via* cooperation among two or more firms in the market. Broadly speaking, a firm exercises unilateral market power when it prices above competitive levels without the cooperation of other firms in the market. A firm may be able to do so when it produces a differentiated product with no close substitutes, or when competitors have relatively high costs or limited capacity to expand output. Primarily because of the energy-only nature of the Alberta electricity market, in which market forces are relied upon almost exclusively to create incentives for investment, the MSA is generally permissive of the unilateral exercise of market power, as long as it is ‘extractive’. In its *Offer Behaviour Enforcement Guidelines*, the

MSA indicates that “market participants are free to pursue individually profit maximizing behaviour that does not impact on rivals’ conduct”,<sup>5</sup> including economic withholding. Unilateral exercises of market power are “extractive” if they involve capturing additional surplus (above production costs) that is created without affecting the behaviour of other suppliers. Economic withholding is an example of an extractive exercise of market power. An ‘extension’ of unilateral market power by a supplier involves weakening the competitive constraints imposed by a competitor, thus increasing the amount of surplus that can be extracted by the first firm. The MSA has indicated that extensions of market power are likely to be subject to investigation and potential enforcement action.

Coordinated exercises of market power occur when, as stated in the Competition Bureau’s *Merger Enforcement Guidelines*, a group of firms in a market can “profitably coordinate its behaviour because of each firm’s accommodating reactions to the conduct of others.” Simply put, coordinated exercises of market power involve explicit or implicit agreements among competitors that have the effect of increasing market prices, either directly through an agreement to increase price or indirectly through an agreement to reduce production, sales, or capacity, thereby resulting in an increase in the market price. Explicit agreements involve direct communication among firms, while tacit, or implicit, agreements are agreements that do not involve direct, explicit communications; an implicit agreement has been characterized as a “meeting of the minds without the meeting.” Another form of coordinated behaviour recognized by antitrust authorities is conscious parallelism, which does not involve either explicit or tacit agreement among firms, but which nevertheless results in a ‘softening’ of competition. For example, conscious parallelism could involve firms matching others’ offers or otherwise behaving less aggressively for fear of a response from rivals. Conscious parallelism and tacit collusion are difficult to distinguish in practice, because neither involves a direct agreement and they both lead to similar outcomes.

In our discussion of the factors facilitating coordinated behaviour, we follow closely the frameworks established by antitrust enforcement agencies. The Canadian Competition Bureau’s *Merger Enforcement Guidelines* (as well as the *Horizontal Merger Guidelines* used by the US antitrust enforcement agencies), consistent with economic theory beginning with the seminal

---

5

*Offer Behaviour Enforcement Guidelines For Alberta’s Wholesale Electricity Market*, MSA, January 14, 2011, pages 9-10.

analysis of George Stigler,<sup>6</sup> recognize that coordinated behaviour involves the sacrifice by coordinating firms of short run profits for the longer term returns that may be achieved by coordinating with competitors.

In a competitive market, each supplier sets its price to maximize its own profit, given the prices of all other firms. The resulting prices are described by economists as comprising a Nash equilibrium, which, in game theory terms, is characterized by a set of strategies where each player maximizes its own payoff, given the strategies of all other players. In a non-cooperative equilibrium a firm can still earn substantial profits, when its output is differentiated and its competitors do not provide close substitutes, or when it has a substantial cost or capacity advantage over its rivals.

Suppliers can increase their *joint* profits if they all increase their prices above price levels in a non-cooperative equilibrium. However, in doing so, each firm would be acting against its short term interest, because when all other suppliers set prices that are above the competitive (Nash equilibrium) level, each firm can increase its short term profits by undercutting its competitors. Undercutting would increase the firm's sales substantially, and the firm would earn a profit on the sales of each unit (as long as its price was above marginal cost). This is simply an illustration of the well-known 'prisoner's dilemma', in which the combined payoffs of a group of individuals is maximized if they cooperate, but self-interested behaviour prevents the group from achieving the cooperative outcome since each individual has a strong incentive to cheat on the group.

For firms to achieve a market price above competitive levels, which benefits all firms, they must therefore devise a mechanism that induces each firm to act against its own short run interest to undercut the prices of other suppliers in the cooperative group. In the case of explicit or tacit collusion, they must come to an enforceable agreement (which, as discussed below, need not be explicit) about the price that each firm will charge. The agreement must be enforceable in the sense that 'cheaters' who undercut the collusive price must be punished in some way.

The most obvious way for firms to deal with the cheating problem is to enter into legally binding contracts. Since collusion is illegal, however, courts will not enforce such contracts. Firms must therefore rely on more informal methods of enforcement. In some circumstances, such as in

---

6

George J. Stigler, "A theory of oligopoly", *The Journal of Political Economy* 72:44-61 (1964).



instances of conscious parallelism, there is no agreement; instead firms recognize that cutting prices may only provide a brief competitive advantage or that it might result in further price cuts by competitors.

Economists have modeled coordinated behaviour as a repeated game, in which firms interact repeatedly in the market over time. This repeated interaction allows for a variety of enforcement mechanisms, whereby a firm that lowers its prices may be “punished” by other firms in the coordinating group who can, for example, drop their own prices in future periods. This price drop punishes the firm that initially lowers its price by reducing that firm’s future profits; thus a firm, when deciding whether undercutting the coordinating group will increase its stream of profits, trades off benefits in the form of a short term increase in profits resulting from undercutting, against the costs in the form of future profits that are lower (because of the punishment of a future price reduction by other firms) than they would have been had it not cheated in an earlier period. Economic theory shows that certain market characteristics support credible “punishment”, and when these characteristics are present in the market, firms do not have an incentive to undercut and a coordinated outcome can be stable.<sup>7</sup>

This framework, involving repeated interaction and the threat of punishment, is the basis for the analysis of the likelihood of coordinated behaviour used by economists and antitrust enforcement agencies.

In this analysis, firms in a market are more likely to coordinate (either through collusion or conscious parallelism) when they are able to: 1) recognize and reach mutually beneficial terms of trade; 2) monitor each other’s conduct and determine whether other firms have deviated from the coordinated behaviour, and; 3) credibly respond to deviations from the coordinated behaviour by other firms. The analysis of the likelihood of coordinated behaviour in a market proceeds by assessing whether the supply, demand, and other characteristics of the market support reaching and monitoring an agreement and credibly punishing those that deviate. The

---

7

Economists have shown that even though a firm that drops prices to “punish” another firm also reduces its own profits, this can still be a rational strategy in a repeated game setting.

key market characteristics are as follows.<sup>8</sup>

### *High Market Concentration and Barriers to Entry*

When there are few sellers in the market that can influence price, the transactions costs of reaching an agreement and monitoring deviations from an agreement are low, simply by virtue of the fact that, given that agreement and monitoring are costly, the associated costs are lower when there are fewer firms that are part of a coordinating group. In addition, all else equal, when there is a large number of firms in the market and each firm has a small share in a cooperative equilibrium, then there is a strong incentive for each firm to deviate from the coordinated outcome because the short term gain from doing so is a much larger share of the market than the firm would otherwise earn. When a market is highly concentrated, each firm has a relatively high share in a cooperative equilibrium so the gain from deviating, in terms of output expansion, is relatively small.

Market concentration and high barriers to entry are generally among the most important market characteristics in an analysis of coordinated behaviour, as illustrated by the fact that antitrust enforcement agencies will not consider applying theories of coordinated behaviour in a merger context unless certain market concentration thresholds are exceeded. The Canadian Competition Bureau, for instance, will not generally apply a coordinated effects (i.e. coordinated behaviour) theory to a merger unless the post-merger market share accounted for by the four largest firms in the market is at least 65%, and high barriers to entry would prevent entry into the market by a new competitor.

### *Repeated and Frequent Interaction*

Suppliers that interact with each other for only a short period of time cannot credibly threaten to “punish” deviators from a coordinated outcome, because the future horizon over which those deviating will suffer low profits as a result of punishment by other firms is too short, or even non-existent. In such cases, coordinated behaviour is not sustainable and the equilibrium outcome is non-cooperative, as in the classic prisoner’s dilemma.

---

8

This discussion draws primarily on Andy Baziliauskas and Thomas W. Ross, “Lessening of Competition in Mergers Under the Competition Act: Unilateral and Interdependence Effects”, *Canadian Business Law Journal*, 33: 373-426 (2000), and the Competition Bureau’s *Merger Enforcement Guidelines*.

A related consideration is that more frequent interaction facilitates coordinated behaviour because it allows firms to react more quickly to a deviation by another firm, and also because it shortens the horizon over which a firm earns higher profits from deviating relative to the horizon over which it earns lower profits from retaliation by others. For example, if price adjustments are infrequent, retaliation for deviating from a coordinated outcome is delayed and the horizon over which the deviating firm enjoys increased profits is longer.

#### *Product Homogeneity*

Coordination among suppliers will be more difficult, and therefore more costly, if suppliers sell differentiated products, because the firms must first find the desired relationship among prices of the various types of products and then specify the appropriate relative prices for the products. This problem is magnified if each supplier sells a large number of differentiated products. When products are homogeneous, on the other hand, it is more straightforward, and therefore less costly, to form (and monitor) coordination around a single price (for the homogeneous product) that would increase joint profits.

#### *Inelastic Demand*

The less demand for the industry's products falls as price increases—that is, when demand for the industry's product is inelastic—the more substantial are the gains from coordination, and therefore the stronger the incentive for firms to reach and maintain an agreement. If demand for the industry's product is elastic, then a concerted price increase will reduce industry sales, and the increase in joint profits will be lower, lessening the incentive to coordinate.

#### *Stable Demand and Costs*

When demand and production costs are stable over time, then the agreed-upon price does not need to be changed frequently to maintain the profitability of coordinated outcomes. If, on the other hand, demand or costs are volatile, then the joint profit maximizing price will change over time, which will require further coordination to maximize joint profitability. This in itself increases the cost of coordinating which in turn reduces the incentive to coordinate.

## *Transparency*

To monitor a coordinated outcome, firms must be able to observe or infer whether other firms have deviated by lowering prices below the coordinated level, or alternatively, by increasing output (thereby reducing the industry equilibrium price). If firms cannot make such observations or inferences, then they cannot detect deviations, and consequently the coordination will be unstable. Information about prices need not be perfect, since often firms can make inferences about other firms' prices (and therefore about whether other firms have deviated) from observations about changes in sales. Transparency of market data in the Alberta market is, of course, the main subject of our report. We discuss transparency in the context of the Alberta market in section 6.3.

In section 6 we explain that many of the features above are especially prominent in electricity markets in general and in the Alberta market in particular.

### **4.2 The MSA's Approach to Coordinated Behaviour**

The MSA's approach to anticompetitive conduct by market participants in the Alberta Power Pool is modeled explicitly on the economic and legal methodologies for assessing such conduct commonly used by antitrust authorities, including the Competition Bureau. A key component of this approach is an economic analysis of how and whether the conduct at issue harms competition. The MSA's framework is clearly articulated in the *Offer Behaviour Enforcement Guidelines*, which explains the MSA's analytical approach to assessing whether conduct by market participants is consistent with applicable regulations.<sup>9</sup>

The MSA has both an enforcement function and a monitoring function. The *Guidelines* indicate a concern with coordinated behaviour that spans the range from explicit collusion, to tacit collusion, to conscious parallelism. Explicit collusion is *per se* illegal under the *Competition Act*, and the MSA's role with respect to such behaviour involves identifying suspected collusion among Alberta market participants, referring any suspected collusion to the Competition Bureau, and collaborating with the Bureau's investigation. In cases of suspected tacit collusion, the MSA is likely to pursue enforcement action under subsection 2(h) (i) of the FEOC Regulation,

9

---

In particular, the *Fair, Efficient, and Open Competition* Regulation.

rather than referring such conduct to the Competition Bureau. The MSA will generally deal with conscious parallelism, and its associated inefficiencies, not with enforcement action but by examining possible changes to market rules or other regulations.<sup>10</sup>

## 5. The Alberta Market

### 5.1 Background on the Alberta Market

The wholesale electricity market in Alberta, known as the Power Pool, began operating in 1996. In 2000, Power Purchase Agreements, which are physical rights to the output of previously regulated generators, were auctioned, and since then the market has had essentially the same structure. The Alberta electricity market consists of a number of sub-markets, which are briefly described here for background purposes.

The *Power Pool* is a spot market for bulk wholesale electricity operated by the AESO. The AESO also procures *operating reserves* via an exchange (Watt-Ex) and operates a *Dispatch Down Service* (DDS) market that compensates generators willing to voluntarily reduce supply when other generators are forced onto the market because of transmission constraints (Transmission Must Run or TMR). Electricity is traded ahead of real time on a *forward market* but this is not facilitated by the AESO.

### 5.2 Characteristics of the Alberta Wholesale Market

#### *Demand*

Because of Alberta's high industrial load, the Alberta market has a high system load factor relative to other markets (i.e. the intra-day hourly load shape is relatively flat), with a morning ramp up in the summer and morning and evening ramp-ups in the winter. Load is about 78% industrial, 18% residential, and 4% farm. Most load is passive, while a small share of total load, comprised of relatively large consumers, actively participates in the market by selling supplemental reserves to the system operator and reducing consumption when Pool prices are high (active load accounts for about 200 – 300 MW of demand). Demand is winter peaking,

---

10

In cases of conscious parallelism where firms adopt certain facilitating practices to support supra-competitive prices, the MSA may conclude that there was effectively an agreement and pursue enforcement action.

both in terms of average load and peak demand. Summer load is increasing relative to winter as the use of air conditioning in Alberta increases.

### *Supply*

As of June 2011, the Alberta system had about 13,100 MW of capacity, plus imports from Saskatchewan and BC with an average import capacity on interties of about 600 MW. The Alberta generation mix is 45% coal, 41% natural gas, 7% Hydro, 5% wind, and the remaining 2% is from other sources such as biomass.

There is substantial concentration in offer control by Alberta suppliers, with the largest six suppliers accounting for 85% and the top four accounting for 64% of offer control. The table below shows the MW controlled by the largest suppliers in the Alberta in 2011, and each supplier's share of offer control in 2010 and 2011.

#### **Market Share Offer Control (April 21, 2011)**

|                               | <b>Offer Control 2011</b> |            | <b>Offer Control 2010</b> |
|-------------------------------|---------------------------|------------|---------------------------|
|                               | <b>(MW)</b>               | <b>(%)</b> | <b>(%)</b>                |
| ATCO                          | 1392                      | 10.6       | 11.1                      |
| Balancing Pool                | 743                       | 5.7        | 6.0                       |
| Capital Power                 | 1390                      | 10.6       | 9.3                       |
| ENMAX                         | 1826                      | 13.9       | 14.6                      |
| TransAlta                     | 2088                      | 15.9       | 14.9                      |
| TransCanada                   | 2496                      | 19.0       | 20.0                      |
| Other                         | 2011                      | 15.3       | 15.9                      |
| Not Required to offer to Pool | 1169                      | 8.9        | 8.1                       |
| <b>TOTAL</b>                  | <b>13,114</b>             | <b>100</b> | <b>100</b>                |

Source: MSA, *Market Share Offer Control 2011*, June 24, 2011

The Residual Supply Index (“RSI”), which is used by the MSA to assess the ability of suppliers to influence price, also provides some useful information about price determination in the Alberta market. The RSI is based on the concept of a pivotal supplier, which is defined as a supplier who could withdraw its supply—or, more accurately because of the ‘must offer’ obligation in Alberta, price up to the offer cap of \$999.99/MWh—with the result that demand would exceed supply. If

a supplier is pivotal, it has the ability to make its offers in such a way as to set price. The RSI for a given supplier in a given hour is calculated as:<sup>11</sup>

$$\frac{\text{Total supply in the market during that hour} - \text{Supply controlled by the supplier}}{\text{Total demand}}$$

If the RSI has a value less than 1, the supplier is pivotal; when it has a value of one or more the supplier is not pivotal. As a summary measure, the MSA calculates a 'Market RSI' for each hour as the minimum RSI across all suppliers for that hour; a Market RSI for an hour that is less than 1 indicates that at least one market participant is pivotal during that hour. When the MSA calculated the Market RSI for every hour in each quarter of 2010, it found that the Market RSI was less than 1—and therefore at least one market participant was pivotal—between 89% and 95% of the hours, depending on the quarter. It also found that the minimum RSI that determined the Market RSI was that of either one of the two market participants. Furthermore, during the four quarters of 2010, the largest market participant determined the Market RSI between 71% and 92% of the time.

#### *Offers and Price Setting in the Alberta Wholesale Market*

According to AESO rules, market participants must make offers before noon for each hour of the next trading day. Suppliers can also make offers for the six days after the following day, and offers may be standing offers. The offer for each unit can consist of up to seven price-quantity pairs, and the total quantity under all offers for a given hour must be equal to the maximum capability ("MC") of the asset (i.e. there is a 'must offer' requirement). Every asset with capacity of at least 5 MW must offer all of its MC. The minimum offer is \$0/MWh and the maximum offer is \$999.99/MWh. If an asset's available capability ("AC") is less than its MC, then the controller of the asset can make a declaration to that effect if it can provide an "acceptable operational reason". An offer can be designated as flexible, which indicates that the asset is available for partial dispatch, or inflexible. A market participant can submit any price restatement (changing price and redistributing the offer quantity among blocks) up to two hours ("T-2") before real time. Imports and exports must also submit offers prior to T-2. Market participants may not change their offers after T-2. Loads are permitted to make bids into the

11

See Market Surveillance Administrator, *Quarterly Report: October – December 2010 (Q4/10)*, February 16, 2011.

market but typically do not do so; a small share of load prefers instead to reduce consumption in response to high prices.

In real time, the system operator matches load with the merit order, which is the set of price-quantity offers (reduced by declarations of AC and dispatches of reserves) for the hour arranged from lowest to highest price offers. This matching occurs at several intervals during a given hour, and at each interval a System Marginal Price is determined by matching the load at that point in time to the merit order. The System Marginal Price is the price offer of the last dispatched price-quantity pair, and the quantity dispatched corresponds to the sum of all dispatched MW. Settlement occurs at the hourly Pool price, which is the time-weighted average of interval prices during a given hour. The Alberta market is a single price market, meaning that generators in all regions of the province receive, and all loads throughout the province pay, the hourly Pool price. The Alberta market does not have regional or locational prices to deal with transmission constraints.

The merit order is typically very flat at the low end, with offers of \$0 generally accounting for up to 6,000 MW, and becomes very steep at about 8,000 MW. Price can be highly volatile, and this volatility tends to be driven by unplanned, or forced outages, rather than by changes in demand, which tends to be relatively stable, evolving in a smooth pattern over the course of the day. Normal outages for maintenance are typically scheduled for periods when demand is low, so these tend not to drive price volatility.

#### *Other Features of the Alberta Market*

A feature of the Alberta market that distinguishes it from many other markets is the emphasis on dynamic efficiency, potentially at the expense of static efficiency. This emphasis is the result of the 'energy only' nature of the Alberta market, in which market forces are relied upon to induce investment and innovation. Many other markets rely on separate capacity markets or other mechanisms to induce investment.



## 6. The Likelihood of Coordinated Behaviour in the Alberta Market

In this section, we first explain how suppliers can coordinate to increase prices in a uniform price electricity market. Then we discuss the likelihood of coordinated behaviour in the Alberta wholesale market, in light of our previous discussion of the market characteristics that support coordinated behaviour.

### 6.1 Coordinated Behaviour in Electricity Markets

There is a substantial literature on the ways that suppliers can exercise unilateral market power in electricity markets.<sup>12</sup> In general, unilateral market power can be exercised through withholding or pricing-up. *Economic withholding* occurs when a supplier deliberately reduces the output that it bids into the market even though such output could still be sold at prices above marginal cost. Withholding increases the market price because the price-setting generating unit is higher in the stack. In the Alberta ‘must offer’ market, a supplier cannot simply withhold supply, since all available capacity must be offered into the market. However, suppliers can mimic the price-increasing effects of withholding by offering units at high prices including the maximum allowed price of \$999.99/MWh. *‘Pricing-up’* occurs when a supplier bids above its marginal cost, but below the next highest offer. Withholding results in productive inefficiency when generation that is higher cost than the withheld units is dispatched (i.e. the market cost of producing the electricity to satisfy load is not minimized). Pricing-up does not result in productive inefficiency because the lowest cost units are dispatched. Both withholding and pricing-up result in prices that are higher than they would be if generators offered all units at marginal cost. As discussed above, the MSA has indicated that suppliers are free to pursue profit maximizing behaviour, including withholding and pricing-up, as long as such behaviour does not involve ‘extension’ (which is behaviour that affects the conduct of other suppliers).

Coordinated behaviour, unlike unilateral exercises of market power, involves coordination between two or more suppliers to increase prices. In uniform price electricity markets, coordination can increase market prices when two or more suppliers recognize a joint benefit from at least one of the suppliers *outside* of the dispatch increasing its offer during a given hour.

12

---

See for example Paul Twomey, Richard Green, Karsten Neuhoff and David Newbery, “A Review of the Monitoring of Market Power”, *Cambridge Working Papers in Economics CWPE 0504*.

Furthermore, for coordination to effectively increase prices, the coordinating supplier that is outside of the dispatch must offer the lowest price outside of the dispatch. If a coordinating supplier with the lowest price outside of the dispatch increases its offer, this increase allows the suppliers in the dispatch to increase their price-setting offers, and thereby increase their profits. In a uniform price electricity market, therefore, tacit coordination expands the scope for exercising unilateral market power.

A simple example illustrates the point (more complex examples that account for actual features of the market are provided below). Suppose there are four suppliers, A, B, C, and D, each with one 100 MW unit available to offer into the market. The marginal costs of these four units are assumed to be  $MC_A = \$0/\text{MWh}$ ,  $MC_B = \$10/\text{MWh}$ ,  $MC_C = \$15/\text{MWh}$ , and  $MC_D = \$20/\text{MWh}$ , where the subscript 'i' in each term  $MC_i$  indexes the supplier. Further suppose that the load in a given hour is 200 MW (and demand is perfectly inelastic).

If each supplier offers its unit at marginal cost, the supply stack is (in order from lowest to highest price offers)  $[A = \{100 \text{ MW at } \$0/\text{MWh}\}, B = \{100 \text{ MW at } \$10/\text{MWh}\}, C = \{100 \text{ MW at } \$15/\text{MWh}\}, D = \{100 \text{ MW at } \$20/\text{MWh}\}]$ . The market price is  $\$10/\text{MWh}$  because the demand curve intersects the supply stack at 200 MW, and the price-setting unit at 200 MW is offered at  $\$10/\text{MWh}$ .

Each of the two lowest-cost suppliers, A and B can, however, exercise unilateral market power by pricing-up to just below the lowest offer outside the dispatch, which is C's offer of  $\$15/\text{MWh}$ . For example, if B offers  $\$14.99/\text{MWh}$ , which is just below C's offer of  $\$15/\text{MWh}$ , while all other units are offered at marginal cost, the supply stack becomes  $[A = \{100 \text{ MW at } \$0/\text{MWh}\}, B = \{100 \text{ MW at } \$14.99/\text{MWh}\}, C = \{100 \text{ MW at } \$15/\text{MWh}\}, D = \{100 \text{ MW at } \$20/\text{MWh}\}]$ , and with a load of 200 MW, the market price is  $\$14.99/\text{MWh}$ . If, on the other hand, A offers  $\$14.99/\text{MWh}$  and all other suppliers offer their units at marginal cost, the supply stack is  $[B = \{100 \text{ MW at } \$10/\text{MWh}\}, A = \{100 \text{ MW at } \$14.99/\text{MWh}\}, C = \{100 \text{ MW at } \$15/\text{MWh}\}, D = \{100 \text{ MW at } \$20/\text{MWh}\}]$ , and again the market price is  $\$14.99/\text{MWh}$ .

Thus, either A and B, acting unilaterally, can increase the market price to  $\$14.99/\text{MWh}$  by pricing up to the next lowest price in the offer stack, which is C's offer of  $\$15/\text{MWh}$ . The important point to note here is that the two suppliers in the dispatch, A and B, cannot further increase profits by coordinating their offers. The best that A and B can do with an agreement is

to increase their price up to C's offer of \$15/MWh, but as shown above, either A or B can increase the market price to \$14.99/MWh unilaterally. Thus, A and B derive no benefit from colluding.<sup>13</sup>

Either A or B can, however, increase its profits above the levels it can earn through the exercise of unilateral market power by colluding with C. To see this, suppose that B and C agree that C will increase its offer to \$20/MWh from \$15/MWh. Then B can increase its offer to \$19.99/MWh while still being included in the dispatch, and the offer stack, assuming again that A and D bid their marginal costs, becomes [A = {100 MW at \$0/MWh}, B = {100 MW at \$19.99/MWh}, C = {100 MW at \$20/MWh}, D = {100 MW at \$20/MWh}]. At a load of 200 MW, the market price is \$19.99/MWh, which is higher than the \$14.99/MWh price that B can achieve unilaterally. An analogous agreement between A and C can similarly increase the market price.<sup>14</sup>

A drawback to this simple model is that, absent a side payment from A or B to C, C has no incentive to participate in this scheme. Whether or not it participates in a collusive agreement with A or B, C is outside the dispatch and therefore earns a zero profit. In a more complicated and realistic model, however, C may have an incentive to join the collusive agreement. The real

---

<sup>13</sup> This is a very simple example, but the logic extends to more complex cases. It also extends to economic withholding, which can be profitable when a supplier offers multiple units and increases the market price received by its dispatched lower-cost units by withholding higher cost units.

<sup>14</sup> There is a way that 'quasi-collusion' among suppliers in the dispatch (A and B in this example) may increase prices. Assume the same costs for each unit as above, but instead of a demand of 200 MW, assume that demand is 180 MW. Then A and B can each profitably increase the market price by exercising unilateral market power. If A increase its offer to just under \$15/MWh while B's offer price is its marginal cost of \$10/MWh (and C and D also offer at their marginal costs), then the market price is just under \$15/MWh and A's dispatch is 80 MW (since it is higher in the supply stack than B), and its profit is just under  $(\$15 - \$0) \times 80 \text{ MW} = \$1,200$ . Assuming all other units are bid at marginal cost, this offer yields a higher profit for A than if it bid its marginal cost of \$0, in which case the market price is \$10/MWh, 100 MW of A's unit is dispatched, and A's profit is  $(\$10 - \$0) \times 100 \text{ MW} = \$1,000$ . Similarly, if A, C, and D bid their marginal costs, then B can increase its profit (relative to bidding at marginal cost) by bidding just under \$15/MWh, in which case 80 MW of its unit is dispatched and B's profit is just under  $(\$15 - \$10) \times 80 \text{ MW} = \$400$ . If B bids its marginal cost of \$10/MWh, the market price is \$10/MWh and B's profit is zero. In this example, both A and B have a unilateral incentive to price up to \$15/MWh, but each benefits more if the other exercises unilateral market power. If A offers just under \$15/MWh and B bids its marginal cost, B's dispatch is 100 MW, and since the market price is just under \$15/MWh, B's profit is just under  $(\$15 - \$10) \times 100 \text{ MW} = \$500$ ; if, on the other hand, B's offer is just above A's offer, then B's dispatch is 80 MW and its profit is just under \$400. Thus, B can increase its profit by unilaterally exercising market power, but its profit is even higher if A increases its offer. A similar logic holds for A. Both A and B therefore have an incentive not to exercise unilateral market power, in the expectation that the other one will (since each of A and B receive higher profits if the other increases its offer). This describes a 'free-rider' problem that may result, in some circumstances, in neither A nor B increasing its offer above marginal cost in the expectation (and hope) that the other will. An agreement between A and B whereby each 'unilaterally' exercises market power, could solve this free-rider problem. Note that the observed outcome of such an agreement would be exactly the same as the outcome in which each ignores the free-rider problem.

world market has two features absent from this simple model, namely that the interaction between firms is repeated every hour, and demand is variable and uncertain.

Variation in demand can provide for inter-period paybacks. Since firms submit offers every hour, many opportunities are provided for A and/or B to switch places with C; for some hours, C can increase its offer and remain out of the dispatch, providing an opportunity for A and B to increase their own offers, while in a separate set of hours, A or B can return the favour to C by increasing their own bids to \$20/MWh, which provides the opportunity for C to bid just under the offers of A and/or B while moving into the dispatch and earning a profit that it would not earn without the cooperation of A or B. We note that this type of behaviour further complicates detection of cooperative behaviour.

The examples above sidestep the question of how A or B come to an agreement with C. One possibility is that they explicitly agree, *via* perhaps a verbal agreement, that C will increase its offer above its marginal cost (or whatever its offer would be if it were acting unilaterally). As discussed above, such an agreement, as it involves explicit communication between competitors, would likely be investigated under the (criminal) price-fixing provisions of the *Competition Act*.

Another possibility is that A, B, and C would learn, over many repeated interactions in the hourly market, to learn to behave cooperatively. That is, they would each independently recognize that cooperation would be mutually beneficial, and through trial and error they would arrive at a stable cooperative equilibrium in which they all earn a higher profit than they would if they acted as if their actions were not accommodated by the behaviour of the other suppliers. This type of coordinated behaviour can be facilitated by 'signaling', where one of the suppliers submits an offer during a given hour that its collusive partners understand to be the offer that they are to submit in the next offer period. Collusive signaling strategies can be very complex, and it is impossible to precisely define how signaling would work in the abstract. One possibility is that a supplier makes a particular offer that has a certain set of digits after the decimal. For example, in the offer \$400.23/MWh, the final two digits '.23' would indicate that the offer is a signal to other suppliers in the coordinating group to submit offers of about \$400 during the next period. Signaling could also take various other forms, perhaps relying on a certain understood (by the cooperating firms) pattern of offers, or some other means.

## 6.2 The Likelihood of Coordinated Behaviour in the Alberta Wholesale Market

Section 4 explained the theory of coordinated behaviour and outlined the market characteristics that economic theory predicts would lead to an increase in the likelihood of coordinated behaviour, and section 6.1 explained how coordinated behaviour can be implemented in a uniform price electricity market in Alberta. In this section, we provide our analysis of the likelihood of coordinated behaviour in the Alberta market in light of economic theory and the market characteristics and offer rules for the Alberta wholesale market.

### **Alberta Market Characteristics**

In section 4.1, we listed the market characteristics that antitrust enforcement agencies and analysts look for when assessing whether a market is susceptible to coordination. It is important to note that it is not necessary for all of these characteristics listed in section 4.1 to be present to conclude that a market is at risk of coordinated behaviour. Nor is there economic theory indicating which characteristics must be present and to what degree. However, antitrust enforcement agencies generally view high seller concentration (and high barriers to entry), repeated interaction among suppliers, and market transparency as being necessary conditions for a finding that a market is at a material risk of coordinated behaviour. Market transparency is discussed separately in section 6.3.

#### *High Market Concentration*

Based on simple measures of concentration, the Alberta market is highly concentrated, with six firms accounting for about 85% of supply offer control, and four firms accounting for about 64% of offer control. The four firm offer control concentration ratio (of 64%) is just under the 65% threshold that the Competition Bureau applies to filter mergers that may increase the risk of coordinated behaviour. A more relevant measure of concentration for the purposes of assessing the likelihood of coordinated behaviour is concentration in price-setting capacity. There are limited data in relation to concentration in price-setting capacity; however, the Market RSI—the minimum Residual Supply Index (RSI), an indicator of whether there is a pivotal supplier during a given hour—indicates that at least one market participant was pivotal in 89% to 95% of hours in 2010. As pivotal supplier status is likely to be positively correlated with price setting capacity, high Market RSI's are consistent with high concentration in price-setting

capacity. We have not, however, conducted a detailed analysis of concentration in price-setting capacity. Based on the simple measures of concentration noted above, we believe that the Alberta wholesale market may be sufficiently concentrated to warrant concern about the ability of suppliers to engage in coordinated behaviour.

#### *Repeated and Frequent Interaction*

Suppliers in the Alberta wholesale market interact repeatedly and frequently, and the identities of market participants, and the assets that they control, are stable over time. Market participants submit bids for each hour of every day, 24 hours a day, 7 days a week. Thus there are many opportunities for suppliers to punish deviators from a coordinated outcome. Furthermore, the time horizon over which a 'deviation' results in higher profits for the firm is short (as discussed above, deviating from a coordinated outcome in a uniform price electricity market generally involves a reduction in offer price by a supplier that should be outside the stack in the coordinated outcome), since suppliers can restate their price offers up to two hours before real time; this means that, assuming that deviations can be observed (this is discussed in more detail below), firms can begin punishing deviators from an agreement after two hours, and therefore (again assuming detection) the cheating firm may only enjoy higher profits for two hours. When deciding whether to deviate from the coordinated outcome, a supplier will trade off the higher profits from deviation, which it may earn for a short period, against the lower profits over a potentially much larger number of hours during the "punishment" phase. It is our opinion that interaction among suppliers in the Alberta electricity market is repeated and is sufficiently frequent to support coordinated behaviour.

#### *Product Homogeneity*

The product sold in wholesale electricity markets is virtually perfectly homogeneous, and therefore there are no additional costs that suppliers must incur to agree on multiple products, as suppliers in a differentiated product market would.

#### *Stable Demand and Costs*

As in all electricity markets, prices in the Alberta market vary substantially over time because of shifts in demand and supply from interval to interval. In the Alberta market, we expect

additional price instability over time with the increase in the share of wind power in total Alberta generation. As discussed in section 4.1, cost and demand instability tend to undermine coordination by increasing the costs of reaching agreement on price or quantity—essentially, when the market is unstable, coordinating firms may have to ‘re-contract’ whenever market conditions change, which increases transactions costs. Demand and cost instability in the Alberta market may tend to undermine the profitability of coordination to some extent, but given the potentially high profits available from successful coordination, it is our opinion that the level of market instability in Alberta does not eliminate the risk of coordination.

### **Unilateral Market Power Considerations**

An additional factor to consider when assessing whether market conditions are conducive to coordinated behaviour is the scope for the exercise of unilateral market power. As a matter of economics, acquiescence to the exercise of *unilateral* market power by the regulator reduces the incentives for collusive behaviour and the exercise of *coordinated* market power. The reason for this is that as unilateral exercises of market power move prices higher, the return to coordinated behaviour is reduced. Thus, notwithstanding our finding that the Alberta wholesale market displays certain conditions which make it susceptible to coordinated behaviour, since unilateral exercises of market power (as opposed to extensions of unilateral market power) are not discouraged by the MSA,<sup>15</sup> the scope for incremental exercises of market power through coordination is likely reduced.

### **6.3 Transparency of Market Data**

The analysis in the previous section suggests that many of the factors that are normally considered to be indicative of a potential for coordinated behaviour—repeated and frequent interaction, high market concentration, and stable demand and costs—are present in the Alberta wholesale market. In this section we consider whether the market is sufficiently transparent to support the successful detection of deviations from coordinated outcomes.

Successful monitoring of a coordinated outcome in Alberta’s electricity market—which must precede a response to deviations from that outcome --requires that there be visibility of the

15

---

See the MSA’s *Offer Behaviour Enforcement Guidelines* at Section 2.2.1.

prices and offers of members of the coordinated agreement to other members. The data disclosed by the AESO provides substantial and timely information in this regard. The Historical Trading Report, which is published within minutes following the end of the hour, includes all offer pairs (price and MW). The identities of the assets associated with each offer pair are not made available immediately. However, given the richness of the data available to market participants it is likely that interested parties can predict identities of bidders reasonably accurately on an ongoing basis.<sup>16</sup> Furthermore, the disclosure of offer data after the end of the hour potentially allows suppliers to signal desired offers in future hours. Given the T-2 rule in the Alberta market, a supplier could potentially submit an offer for hour T--which other suppliers observe shortly after the close of the hour (T+1) -- that acts as a signal for other suppliers to restate their offers for hour T+3 to the desired level. The Current Supply and Demand Report discloses Total Net Generation by asset for each interval, and is published in close to real time (approximately a minute lag). The richness of the data available in this report provides market participants the ability to see which units are running in close to real time. Units that are not running are either unavailable or not dispatched for energy. By examining the variations in unit generation as System Marginal Price changes market participants can gain an understanding of where units have and have not offered in the merit order. The System Marginal Price Report, which includes the system marginal price and the price-setting block size for the previous interval, is also published in close to real time. While providing much less detail than the Historical Trading Report, the price-setting offer pair (price and MW) may also help infer which participant or which asset is on the margin.

Thus, market participants may be able to infer, with some precision, the offer price for many of the relevant assets—in particular, for the assets at the higher end of the offer stack, which are the ones that would most likely be involved in a coordinated outcome. Perhaps more importantly, in light of the theory of coordination in uniform electricity markets discussed above, market participants can identify which assets were dispatched. Recall that effective collusion in an electricity market involves an out-of-dispatch asset increasing its offer, to provide an umbrella for in-dispatch assets to increase their offers. Since the amount of dispatched generation for each asset is visible to all market participants shortly after the end of an interval,

16

---

All offer pairs (price and MW) and the asset associated with each offer pair are publicly disclosed 60 days after real time in the Merit Order Snapshot.



each member of a coordinating group can observe almost immediately whether a supplier increased its offer price and remained out of the dispatch, or deviated from the coordinated outcome by lowering its offer, thereby entering the dispatch.

The considerations above suggest that monitoring of coordinated behaviour by market participants in the Alberta wholesale market is relatively easy, given the richness and timeliness of the data on offers and dispatch that is made available. The easy and prompt (although possibly imperfect) detection of deviations from a coordinated outcome discourages deviations. Since suppliers can change their offer prices until T-2, a non-deviating firm would have to wait only two hours from the time of detection before responding with lower offers. Furthermore, the visibility of offer prices after the end of the hour allows for some ability for suppliers to signal the willingness to participate in desired coordinated outcomes for future hours.

## 7. Conclusions and Recommendations

The analysis in section 6 indicates that electricity market characteristics in general, and certain features of the Alberta market in particular, create conditions for the possibility of coordinated behaviour. These include high supplier concentration and barriers to entry, repeated and frequent interaction, inelastic demand, product homogeneity, and stable demand and costs. Furthermore, the market appears to be highly transparent in that market participants' offer and generation data are visible or inferable with some precision by others. Taken together, these findings suggest that the Alberta wholesale electricity market may be susceptible to coordinated behaviour. However, we stress that our findings to date indicate only that market conditions in the Alberta market, along with the AESO's data release policies, provide opportunities for suppliers in the Alberta market to engage in coordinated behaviour. We have not conducted any analyses to determine whether Alberta market participants have actually engaged in such behaviour, nor have we considered any evidence relating to the existence, prevalence, or effects of coordinated behaviour in the Alberta market. We note, however, that the MSA has asked Charles River Associates for assistance in identifying coordinated behaviour.

As discussed in Section 3, stakeholders who responded to the MSA's consultation were unanimous in supporting at least the current level of data disclosure in the Alberta market. Some went further to suggest that additional data should be disclosed to improve market

outcomes. Stakeholders made compelling submissions about the importance of the offer data in the Historical Trading Report, the unit generation data in the Current Supply and Demand Report, and the System Marginal Price and price-setting block size in the System Marginal Price Report, for forecasting prices in future hours. The cited benefits of the disclosure of this data included increased market participation, improved load response, and increased liquidity in related financial markets. Stakeholder responses were consistent with the benefits of market transparency cited in the existing literature.

Ideally, an empirical analysis would estimate the costs (mainly in terms of an increased likelihood of coordination), and the benefits (as identified by Respondents and other analysis) of each type of data, and these estimates would be compared to determine if costs exceed the benefits. We have not conducted such an analysis, nor have stakeholders provided empirical analyses; as explained above, this type of empirical analyses would be unlikely to provide reliable estimates of costs and benefits. Our approach in forming recommendations and suggestions to the MSA is to identify possible changes to data disclosure policies in the Alberta market that would preserve benefits while minimizing risks of coordinated behaviour.

With this background, we offer the following set of recommendations. As additional background to our analysis, we note that energy-only markets, such as Alberta's, generally have stronger data disclosure requirements than two-part markets (i.e. those with capacity markets), since energy-only markets rely to a greater degree on rival reactions to ensure competitive discipline. This appears to be true of Nord Pool, the UK, ERCOT, New Zealand, and Australia.<sup>17</sup> We also note that the Alberta market is more transparent than many other energy-only markets. For example

- Australia, ERCOT, and Nord Pool disclose unit-level or aggregated generation data with at least a one-day lag. New Zealand and Ontario disclose unit generation data with a one-hour lag.
- Australia discloses supply offers with IDs, but with a one-day lag, New Zealand discloses offers with IDs with a two-week lag, while ERCOT has a two week lag for

17

---

See José A. Garcia, James D. Reitzes, "International Perspectives on Electricity Market Monitoring and Market Power Mitigation", *Review of Network Economics* Vol.6, Issue 3 – September 2007.

data aggregated by zone. Most other markets have much more substantial lags, such as thirty or sixty days, and some mask offer IDs even after disclosing data with a substantial lag.

Our recommendations are as follows.

1. Data disclosure policy should include, as a decision criterion, the effect that any changes in the nature and timing of data disclosure are likely to have on coordinated behaviour in the market. Coordinated behaviour, to the extent that it occurs, increases prices to consumers and distorts the price signal to market participants and potential entrants, and is therefore inconsistent with fair, efficient and open competition. We suggest that particular attention be paid to coordinated behaviour when considering disclosure policy with respect to data that increases visibility of offer and generation data.
2. Changes to data disclosure policy that would maintain the benefits of visibility while reducing the likelihood of coordinated behaviour may be available and should be considered.
3. According to stakeholders, one of the primary benefits of the publication of the Current Supply and Demand Report is that it provides important information about unit outages. Outage information facilitates forecasting of price levels in future hours, which allows loads to more effectively curtail consumption. In addition to benefitting loads, this increases competition by making it more difficult to exercise unilateral market power and by reducing the benefits to coordinated behaviour (thus reducing its likelihood). Public disclosure of unit generation data also reduces informational asymmetry, which decreases the advantages of larger market participants who observe their own outages. If this information is not publicly disclosed, larger market participants could profitably trade or otherwise act in the physical and financial markets with a substantial advantage over other participants. This perceived disadvantage could discourage market participation and entry.

However, the data in the Current Supply and Demand Report includes much more than outage information. We recommend that consideration be given to limiting this report in a way that reveals only some outage information, without revealing generation by all

units to all market participants, which, as discussed above, facilitates monitoring of deviations from collusive agreements. Alternatively, the Current Supply and Demand Report could be replaced with another report that contains only outage information—which would perhaps be more useful than the outage information that can be inferred from the Current Supply and Demand Report—without containing data on generation by all units.

4. The AESO publishes a two hour-ahead Pool Price forecast, which may be at least a partial substitute for the forecasts that market participants can make on their own using the reports discussed herein. If market participants do not view the forecast as sufficiently reliable, improving the accuracy of the forecast may diminish the necessity of disclosing data in the other reports (in effect, the AESO would itself combine the reports so it would not be necessary for market participants to have access to the underlying data).
5. To the extent that the offer curves disclosed in the Historical Trading Report are reliable predictors of offer curves in future hours, this report can allow market participants to make more accurate forecasts of price levels and price spikes in the hours following. We believe that there is a material risk, however, that suppliers can also use the disclosure of offer curve information to signal other suppliers to restate their offers to higher coordinated levels. Even though offers are disclosed after the end of the hour without asset IDs, it is relatively easy for a supplier to identify itself to others through its offers. For example, a supplier could simply use an understood combination of digits to identify a particular offer as its own to other suppliers, and possibly use some other identifying feature of its offer to signal that other suppliers should restate their offers to a certain level for a particular hour. Signaling can also be much more complex, possibly involving sequences of offers and complicated combinations of digits.

One way to reduce the likelihood of signaling through offers is to delay the disclosure of offer data. Most other electricity markets disclose offer data with a lag of at least one day. As noted above, Australia discloses offers with a one-day lag (albeit with asset IDs), New Zealand discloses offers (with unit IDs) with a two-week lag, ERCOT has a two week lag for data aggregated by zone, and markets in the U.S. under FERC jurisdiction do not

disclose offer data for at least thirty days. We recommend the consideration of a similar delay in the disclosure of offer data in the Alberta market. To the extent that the offer data currently disclosed after the hour cannot be used to reliably forecast offers for future hours, the benefits to the market of delaying disclosure may outweigh the costs. Furthermore, offer data is partially a supplement to the unit generation data in the Current Supply and Demand Report, in that they both provide information about outages, which facilitates price forecasting. The incremental benefit to the market of disclosing offer data, given the availability of unit generation data (or a substitute for the Current Supply and Demand Report that is limited to outage information only), may be small enough that market outcomes may be improved by delaying the disclosure of offer data.

The ability of market participants to signal through their offers may also be reduced by publishing price offers in bands, rather than publishing the actual offers. For example, the AESO could disclose only that a given price offer falls within a band with a width of, say, \$10 or \$100. Thus, an offer of \$726.23/MWh would be disclosed in the Historical Trading Report as an offer that falls in a \$720/MWh - \$730/MWh band or within a \$700/MWh - \$800/MWh band. We have not conducted an analysis of what the appropriate width of the band would be, but we suggest that a properly chosen band width could reduce the opportunity for signaling while maintaining the ability of market participants to use offer data to forecast offers in future hours.

We would also recommend that additional protections against signaling be explored. In Australia's market, suppliers can submit ten price-quantity offers for the trading day for each unit. Quantity can be redistributed among the price offers right up to the dispatch hour, but suppliers cannot change prices. Adopting a similar rule in the Alberta market would increase the costs of, and therefore discourage, signaling. Signaling in Alberta is effectively costless under current bidding rules, but with a bidding rule similar to Australia's, the costs of signaling would increase because a supplier would be committed to a set of prices that is potentially non-optimal in future hours.

In concluding, we offer some additional suggestions for consideration. We note that to the extent that coordinated behaviour may be occurring and is incrementally profitable for

market participants in the Alberta market, even if data release became more limited in scope or was delayed, suppliers could seek other means of signaling and coordinating. Thus, at a minimum, delaying the public release of market participants' data would have to be coupled with penalties or impediments to private sharing of data by market participants. Other as yet unknown avenues to coordinated behaviour would also have to be identified and blocked. Finally, we suggest that a clear statement of remedies of last resort, such as forced divestiture in the event of repeated and harmful conduct, should be provided by the regulator.