Australian Energy Market Commission

RULE

CONSULTATION PAPER

VICTORIAN DECLARED WHOLESALE GAS MARKET BACKGROUND PAPER

14 MARCH 2019

INQUIRIES

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

E aemc@aemc.gov.au
T (02) 8296 7800
F (02) 8296 7899

Reference: GRC0049

CITATION

AEMC, Victorian DWGM Background Paper, 14 March 2019

ABOUT THE AEMC

The AEMC reports to the Council of Australian Governments (COAG) through the COAG Energy Council. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the COAG Energy Council.

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1 INTRODUCTION

On 5 November 2018, the Australian Energy Market Commission (the AEMC or Commission) received three rule change requests from the Victorian Minister for Energy Environment and Climate Change to amend the National Gas Rules (NGR). The request proposed changes which are:

- introducing a clean and simple wholesale gas price for the Declared Wholesale Gas Market (DWGM) in Victoria
- establishing a forward trading exchange which will make it easier for buyers and sellers to trade gas and lock in a future price in the DWGM
- improving the allocation and trading of pipeline capacity rights

The AEMC has decided to combine the first of these rule changes, relating to the simpler wholesale price, with an earlier rule change submitted by the Australian Energy Market Operator (AEMO) on behalf of EnergyAustralia which was received in November 2016. Additional information regarding each of these rule change requests can be found on the respective project pages on the AEMC website.[1]

As the rule changes are interrelated and to avoid duplication across consultation papers, this background paper has been produced to consolidate the necessary background to the DWGM that is relevant to the rule change requests, including:

- an overview of the current market arrangements and its key design features
- the findings of the Commission's 2017 *Review of the Victorian Declared Wholesale Gas Market* (the Review),[2] which provides the basis for the Victorian Government's rule change requests.

The intent is that stakeholders will be able to read this document along with the relevant consultation paper(s) to gain a sound understanding of the issues.

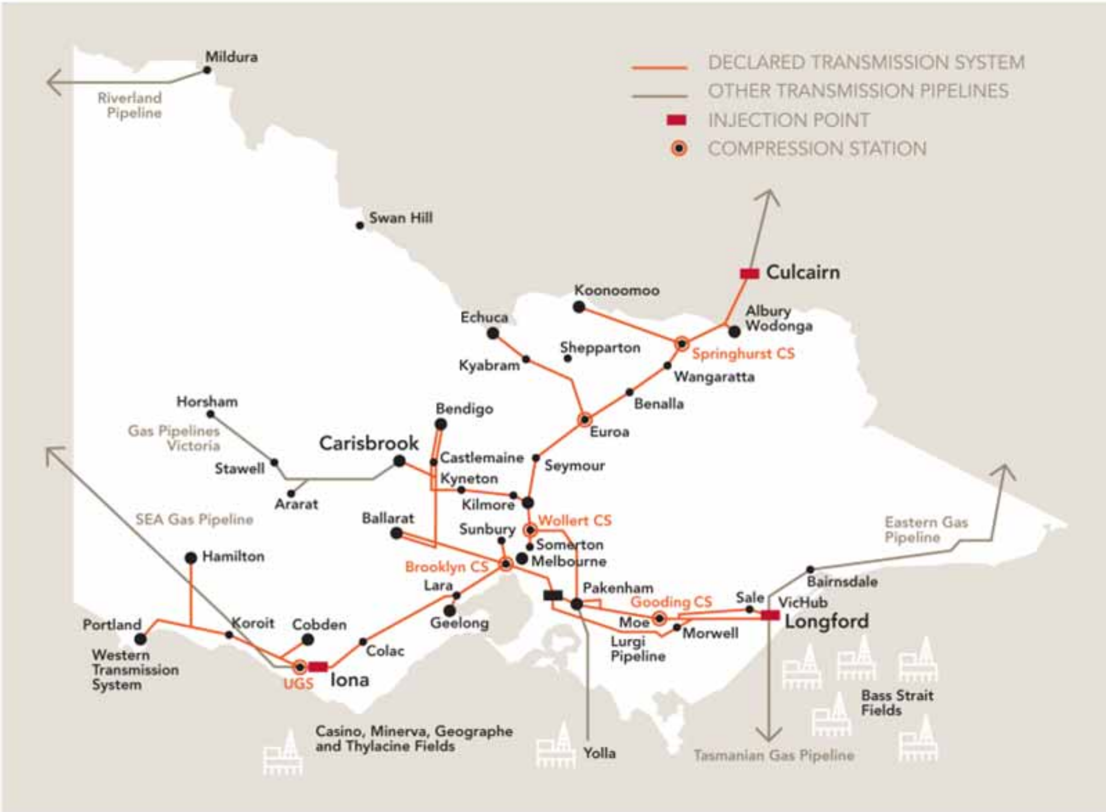
1 See AEMC Website: Project GRC0039 Application of constraints in the declared transmission system; https://www.aemc.gov.au/rule-changes/application-of-constraints-in-the-declared-transmi; Project GRC0049 DWGM simpler wholesale price at https://www.aemc.gov.au/rule-changes/dwgm-simpler-wholesale-price; Project GRC0050 DWGM forward trading market at https://www.aemc.gov.au/rule-changes/dwgm-forward-trading-market; Project GRC0051 DWGM improvement to AMDQ regime at https://www.aemc.gov.au/rule-changes/dwgm-improvement-amdq-regime.

2 AEMC 2017, *Review of the Victorian declared wholesale gas market*, Final report, 30 June 2017, Sydney

2 OVERVIEW OF THE MARKET

The Victorian Declared Wholesale Gas Market is the longest-standing facilitated wholesale gas market in Australia, and is a virtual hub operating across the Declared Transmission System (DTS) in Victoria. The DWGM facilitates the wholesale trading of gas between market participants,[3] and enables gas to be provided to approximately 1.9 million customers, with total annual demand of approximately 230 petajoules (PJ).[4] The majority of annual demand within the DWGM (approximately 125 PJ) is provided by small residential and commercial customers, with Victoria accounting for the highest residential gas usage within Australia.[5] Figure 2.1 shows a map of the DTS, points of connection to external pipelines and compressor stations that are used to move gas through the system.

Figure 2.1: Map of the DTS



Source: AEMO - *Guide to the DWGM*, p. 4.

Gas demand in the DWGM is diurnal with demand increasing in the morning and evening reflecting residential use. In addition, demand is highly seasonal across the year due largely

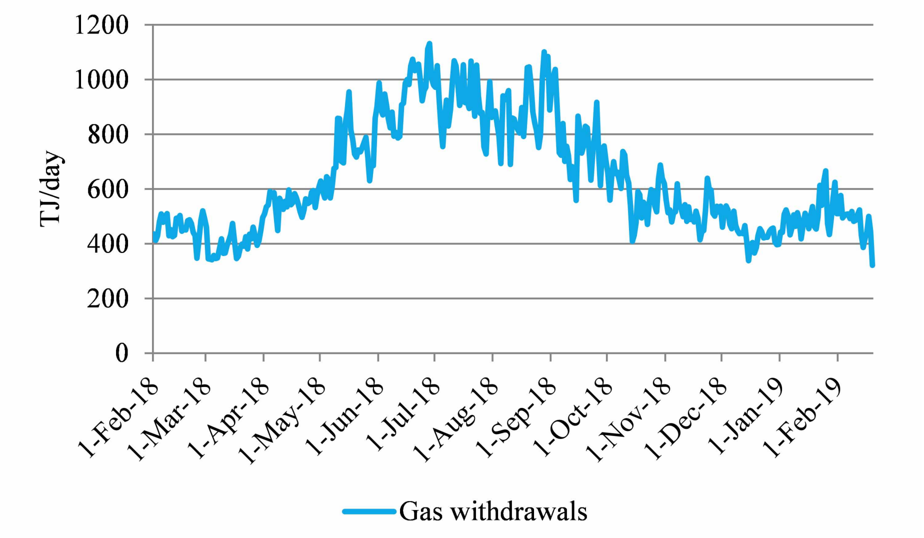
3 Market participants include storage providers, retailers, traders, market customers and distributors.

4 AEMO, *2018 Gas Statement of Opportunities*, p. 15.

5 AER, State of the Energy Market 2018, p. 183.

to demand for heating. Peak demand, currently around 1100 TJ/day, occurs in winter as seen in Figure 2.2.

Figure 2.2: Daily gas withdrawals in the DWGM



Source: AEMO - *Gas Bulletin Board* data accessed at: https://www.aemo.com.au/Gas/Declared-Wholesale-Gas-Market-DWGM/Data

2.1 History of the Victorian DWGM

2.1.1 Market origination

The DWGM was established by the Victorian Government in March 1999, in order to meet the growing gas demand within the state. At its origination, the following design decisions were made:

- The ownership and operational functions of the pipeline transmission system were separated and a decision was made to operate the DTS on a market carriage basis.[6]
- The DWGM was designed as a gross pool so that buyers and sellers of gas must participate by offering gas to, and bidding gas from, the market.[7]
- An independent system operator, VENCorp (later the Australian Energy Market Operator), was given responsibility for operating the transmission system and the market. This involves balancing gas supply and demand with transportation capacity through a centrally coordinated scheduling process, and settling market participants.[8]

6 Under a market carriage framework, capacity on a pipeline system is available to all users. A shipper does not have rights in relation to being able to use capacity nor would it face penalties for exceeding a certain capacity. Rather, transmission capacity is allocated as an outcome of the commodity market. This contrasts with the contract carriage model used outside the DTS in Australia where transmission capacity is allocated through a separate market.

7 AEMO uses the term 'injection bids' for when market participants submit their offer to inject gas into the DWGM, and the term 'withdrawal bids' for when market participants submit their bids to withdraw gas from the DWGM. In this paper and throughout the rule change process the AEMC will use 'offer' to refer to injection bids and 'bid' to refer to withdrawal bids.

8 VENCorp, *Application for Authorisation of Market and System Operations Rules*, 17 May 2002, p. 22.

At the time, these design characteristics were considered to best reflect the physical characteristics of the DTS. This is because the DTS is a highly meshed network[9] with minimal pipeline storage capacity, meaning that it must be closely managed to ensure that demand is met and the integrity of the system is maintained. The same characteristics also make it difficult to determine firm transmission capacity rights amongst market participants.[10]

In the Victorian DWGM, the declared transmission system service provider (DTS SP), APA VTS Australia (Operations) Pty Limited (APA) makes the transmission pipeline available to AEMO under a contract known as the Service Envelope Agreement (SEA). AEMO manages receipt, transportation and delivery of gas. Box 1 explains the current split of institutional functions in the Victorian gas market.

BOX 1: CURRENT INSTITUTIONAL ARRANGEMENTS IN THE VICTORIAN GAS MARKET

Under the current gas market arrangements in Victoria, AEMO is responsible for the operation and security of the DTS, which is owned by APA.

APA builds and maintains the network, and makes the DTS available to AEMO to operate.

In operating the system, AEMO runs the compressors and manages flows across the DTS in accordance with the National Gas Law (NGL), National Gas Rules (NGR) and the terms in the SEA agreed with APA. Section 91 of the NGL requires that the service provider for a DTS has in place an agreement with AEMO for the control, operation, safety, security and reliability of the DTS.

The SEA determines, among other things, the transportation capacity of the DTS and the obligations of APA and AEMO in relation to the delivery of the agreed capacity. With respect to transportation capacity, AEMO and APA are required to maintain an agreed common system model that is used, among other things, to determine system capacities. This is important for a number of reasons including:

- determining the impact of planned and unplanned pipeline or plant outages on system capacity
- determining the additional pipeline capacity created by pipeline expansions/augmentations for the allocation of authorised maximum demand quantity credit certificates (AMDQ cc) by APA
- providing information to the market and regulators on potential future pipeline constraints for future investment and approval of regulated investment.

In respect of each party's obligations, the SEA requires APA to provide AEMO not only the agreed transmission system capacity, but also a range of supporting services. It also requires AEMO to observe good practice in operating the system and not operate facilities in a manner

9 The DTS has seven injection points, over 120 withdrawal points and a number of pipeline segments that can operate in a bi-directional manner depending on demand and supply conditions.

10 K Lowe Consulting, *AEMC 2014 Retail Competition Review: Retailer Interviews, Report for the AEMC*, June 2014, p. 11.

that will materially adversely affect APA's ability to comply with its obligations under the SEA.

Unlike contract carriage pipelines, shippers utilising the DTS cannot reserve firm capacity. They may, however, have an authorised maximum demand quantity (AMDQ) allocation or AMDQ cc. AMDQ was first allocated at market start and was (and has remained) commensurate with the capacity of the Longford-Melbourne pipeline at that time when it was the primary sole source of gas supply for the DWGM.

The increase in pipeline capacity resulting from an extension or expansion project is agreed between APA (as the pipeline owner) and AEMO (the system and market operator). Once agreement is reached and the new capacity becomes operational, new AMDQ cc are created.

AEMO also has a key role in operating and administering the gas market in the DWGM. As a gross pool, the current arrangements require market participants to bid their injections and withdrawals into the market, and forecast their uncontrollable withdrawals in order to access the DTS. It is AEMO's role to manage this bidding and matching process to determine the market clearing price and a schedule of gas flows for each market participant during the gas day (that is, the gas expected to be injected or withdrawn by each market participant at the various points on the system).

AEMO also manages the settlement process, which is conducted ex-post, including calculating charges associated with imbalance (caused by differences in a participant's daily gas injections and withdrawals), deviations (caused by differences between a participant's scheduled and actual behaviour), and ancillary and uplift payments (primarily generated by actions taken to manage constraints at particular locations on the system).

The Australian Energy Regulator (AER) reviews APA's access arrangement for the DTS on a five-yearly basis. Further discussion of the AER's role is covered in a subsequent section.

2.1.2 Network access and trading arrangements

Transportation of gas through the DTS occurs under an open access arrangement known as 'market carriage'. Under this arrangement the pipeline owner APA must make the transmission system available to the system operator, AEMO, to allocate pipeline capacity through the DWGM.

Access arrangements on the DWGM differ from other east coast gas pipelines. Outside Victoria, pipelines operate under a contract carriage arrangement. This means that pipeline capacity is allocated on the basis of contracts between the pipeline operator and user, i.e. it is not allocated through a central market clearing engine. These contractual rights have different terms, for example they may be firm or non-firm, and can be traded by participants bilaterally on a secondary market.

One benefit of the contract carriage arrangement is that it provides incentives for participants to invest in pipelines where additional capacity is valued. However, a draw back of this arrangement is that it does not readily enable the co-optimisation of capacity and gas allocation.

2.1.3 Investment in the DTS

While it is currently possible for participants to underwrite investments in the DTS, this tends not to happen because of the 'free rider' problem that arises as a result of the market carriage design of the DWGM. As access to the DTS is allocated on the basis of DWGM market outcomes, market participants cannot obtain exclusive access rights. The lack of such rights to use the DTS means that individual market participants have limited incentives to underwrite investment in extending or expanding the DTS. Other market participants would also benefit from a capacity expansion without having contributed to its costs, and may in some circumstances be able to displace the funding participant's usage of the capacity expansion.

Decisions on investment in the DTS generally result from the AER's review of APA's access arrangement for the DTS, which currently occurs on a five yearly basis. APA has no obligations to expand or extend the DTS to meet additional demand growth or supply requirements. It is at APA's discretion to determine which projects it proposes to the AER as part of its access arrangement process.

When proposing future capital expenditure in an access arrangement, APA will generally include information on the specific projects it plans to undertake during the period. It may draw on planning information provided by AEMO, and other commercial information or drivers, and submit this to the AER to help build a case in support of its proposed total revenue and tariffs for the upcoming period.

The AER will use the project specific information to assess (ex-ante) whether the forecast capital expenditure associated with each project is likely to be 'prudent' and meet the test for conforming capital expenditure set out in the national gas rules (NGR).[11]

Where these criteria are met and the forecast capital expenditure is approved, APA is able to collect revenues to recover the expenditure, a return on capital and depreciation to the extent the projects are expected to be operational in the coming access arrangement period. APA recovers these expenditures through reference tariffs levied on injections and withdrawals as set out in the access arrangement.

At the end of the access arrangement period, APA will prepare and propose its revised access arrangement for the forthcoming period. At this point, APA will seek to include the actual capital expenditure in the capital base.[12] The AER will assess (ex-post) the actual capital expenditure for each project and determine whether it satisfies rule 79.[13] Where it meets this test, the new asset will be included in the capital base.

The costs of all investments approved through the regulatory process are generally recovered through volumetric tariffs levied on market participants, with participants passing these costs through to end users.

11 Rule 79 of Part 9 of the NGR sets out the matters the AER must consider when determining whether capital expenditure can be rolled into the capital base.

12 Once the forecast capital expenditure is approved and the access arrangement is under way, a service provider may choose not to proceed with a planned project.

13 The rule requires that new capital expenditure would that incurred by a prudent service provider operating efficiently. See version 42 of the National Gas Rules for more information.

2.2 DWGM market design features

The DWGM is a 'gross pool' market, which means that it is compulsory for market participants wanting to inject gas to, or withdraw gas from, the DTS to trade through the DWGM.

Market participants are parties that trade directly in the DWGM and are made up of:

- retailers - who purchase gas from gas producers, offer it into the DWGM and then onsell it to consumers
- market customers - large commercial and industrial customers who elect to trade directly in the DWGM
- traders - who bid gas from, and sell gas to, gas producers and other market participants

Gas producers and storage providers may also be market participants if they choose to directly bid gas into the DWGM.

Non-market participants include the DTS SP, interconnected transmission pipeline service providers (which have pipelines connected to the DTS), distributors and end consumers (who purchase gas from a retailer).

The key features of the current DWGM market are as follows:

- AEMO schedules gas and determines the market price of gas throughout the day using offers, bids and demand forecasts (for uncontrollable withdrawals) as inputs to a market clearing engine which determines injections and withdrawals of gas at different points in the system.
- Market participants cannot reserve firm capacity in a pipeline but may hold AMDQ which provide some limited physical benefits and some market rights and benefits to holders. See chapter 4 for information on the AMDQ regime.

2.2.1 Scheduling

It is compulsory for market participants within the DTS to trade all gas through the DWGM, including for participants who already own the gas that they intend to withdraw. Approximately 80 per cent of gas bid and offered into the DWGM is bought by the same counterparty which sold it.[14]

The remainder, approximately 20 per cent, is traded between market participants and settled by AEMO. Market participants offer gas to inject to, and bid to withdraw gas from, the market.

These offers and bids are inputs to AEMO's market clearing engine which schedules injections and withdrawals of gas by minimising the total cost of supplying gas demand.

In order to be scheduled each day,[15] market participants are required to submit to AEMO:

14 Source: AEMO data analysis. For more information see AEMC, *East Coast Wholesale Gas Market and Pipeline Frameworks Review*, Stage 1 Final Report, July 2015, p. 119.

15 A gas day is 24 hours, commencing at 6 am Eastern Standard Time.

- hourly demand forecasts for non-price sensitive load ('uncontrollable withdrawals')[16]
- daily bids for price sensitive load ('controllable withdrawals') and daily offers for both price and non-price sensitive injections[17]
    - separate offers and bids must be made for each of the injections and withdrawals for each injection and withdrawal point
    - each bid can include up to ten price/quantity pairs (bid steps)
- bid constraints which reflect both the ability of the participant to respond to AEMO's changes to scheduling instructions, and the physical or contractual limitations on the participant at the specific injection and withdrawal point. These bid constraints need to be accredited by AEMO before they are applied to injection and withdrawal points in the DTS.

Based on the above information, AEMO will:

- declare a market price (using the 'pricing schedule') - the price of the marginal unit of gas that would have been scheduled absent any transmission constraints on the DTS
- subject to the pipeline system security limits, schedule each market participant's injections and withdrawals with the objective of minimising the cost of supplying demand (using the 'operating schedule').[18]

The scheduling process occurs regularly at five pre-defined times within the gas day.[19] For the first schedule of the day, at 6:00am, gas is scheduled and a market price is determined for the entirety of the upcoming gas day.

Each subsequent scheduling process then revises scheduling instructions and the market price for the *balance* of the gas day. AEMO will reschedule for the current gas day by revising or updating the schedules at intervals of 4 hours, with a larger 8 hour interval applying overnight (i.e. 10 am, 2 pm, 6 pm, and 10 pm).

The reschedules determine prices and quantities for all the remaining hours in the gas day (i.e. less than 24 hours). A reschedule can include updated demand forecasts, updated bids and offers, as well as any changes to parameters under the control of AEMO.[20]

AEMO provides a schedule a number of times each gas day to provide hourly injection schedules for each market participant, and schedules for any controllable withdrawals, using market participants' submitted bids and demand forecast as primary inputs.[21]

AEMO uses this information to produce and publish pricing and operating schedules at each scheduling time:

16 These forecasts are then automatically 'bid' into the DWGM at the market price cap.

17 See AEMO - Victorian DWGM WebExchanger User Guide v7.0, *Chapter 5* for information on how participants submit offers and bids.

18 AEMO, *Technical Guide to the Victorian Declared Wholesale Gas Market,* p. 34.

19 Ad hoc schedules may also occur but only if there are impending or imminent threats to system security requiring urgent action.

20 Market participants may update their bids and demand forecasts up to one hour prior to the time a reschedule takes effect.

21 Market participants who supply uncontrollable withdrawals must submit hourly site- and non-site specific demand forecasts to AEMO. It should be noted that market participants enter market bids for each schedule while demand forecasts are entered for each hour of the gas day.

- Pricing schedules:
  - determine the ex-ante market prices based on the bids and demand forecasts (i.e. using a 'bid stack') for all locations on the network (discussed in more detail below)
- Operating schedules:
  - determine individual market participant's scheduled hourly injections and withdrawals at each injection/withdrawal point
  - take into account physical constraints, linepack distribution, system limits on pressure and gas flows and demand and supply applicable to each node[22]
  - are optimised using a market clearing algorithm which minimises the cost of supplying the forecast gas demand within the pipeline system security limits
  - determine quantities and direct the operation of the gas system and injections into the system over the gas day.

On any given gas day, AEMO prepares and issues at least nine pricing and operating schedules:

- five standard schedules for the current gas day at four-hour intervals at 6:00 am, 10:00 am, 2:00 pm, 6:00 pm and 10:00 pm
- three gas schedules for the next gas day at 8:00 am, 4:00 pm and 12:00 am
- one schedule for two days ahead at 12:00 pm
- ad hoc schedules(s) between standard schedules on the current gas day, but only if there are impending or imminent threats to system security requiring urgent action. These ad hoc schedules do not alter the market prices but rather the operating schedule quantities only.

The 6:00 am schedule, known as the beginning-of-day (BoD) schedule, covers the 24-hour period from 6:00 am to 6:00 am the following day. Information used and issued in the BoD schedule is updated in subsequent schedules which provide for any changes in the remaining hours in the gas day.

The period between scheduling times is called the 'scheduling interval', and the period from any point in a day to the end of the gas day is referred to as the 'scheduling horizon'. The scheduled quantities are for the whole gas day but only the part of the gas day that remains (i.e. the scheduling horizon) can be changed in subsequent schedules. Each of the current day schedules overrides the existing schedule for the remainder of the gas day. For example, the 2 pm schedule will replace the 10 am schedule for the interval 2 pm to 6 am the following day.

After the scheduling process, each market participant receives the key output of the operating schedule – an individual market information bulletin board report detailing what quantity of gas and where they are committed to inject or withdraw for each hour of the gas day.

22 Linepack refers to the amount of gas that is stored in a pipeline. AEMO allows linepack to vary throughout the day but maintains an end-of-day target.

2.2.2 Bidding procedure

There are three concepts of supply and demand in the DWGM which are important for understanding the operation of the market:

1. Controllable withdrawals (demand):

- Market participants can make offers to withdraw gas from the market with a defined gas quantity and price.
- This type of withdrawal can respond to the wholesale price and follow schedules and so is terms 'controllable withdrawal'.

2. Uncontrollable withdrawals (demand):

- Most of the gas demand in the DWGM is retail load that varies with temperature, seasons, day of week, weather conditions and various other external factors, for instance:
    - withdrawals include gas demand from households (for heating, cooking and hot water) which are typically winter peaking, small business and large business/industry
    - gas fired generation (GFG), which typically peaks in summer to meet high electricity demand.
- Since these withdrawals do not easily respond to the wholesale price and are not capable of following a schedule, they are termed 'uncontrollable withdrawals'.

3. Injections (supply):

- Market participants need to have contracts with producers, storage providers, or interconnecting transmission system to be able to inject.
- Similar to controllable withdrawals, market participants can make offers to inject gas to the market with a defined gas quantity and price.
- Injections are termed 'controllable' because they can respond to the wholesale price and follow schedules.

Market participants who intend to inject gas to the DTS must submit offers to the DWGM. Similarly, market participants who intend to withdraw gas from the DTS must submit bids to the DWGM.

Market participants can specify up to ten bid steps of prices and daily quantities in each offer or bid for each injection and controllable withdrawal point:

- For offers, bid steps are provided in increasing order of price with increasing cumulative quantities.
- For bids, bid steps are provided in decreasing price order with increasing cumulative quantities.

Bid prices can vary between $0/GJ and the market price cap (MPC) which is currently set at $800/GJ.

Market participants may revise price and quantity offers and bids at least nine times per day. However, the revised total offer and bid quantities must not be less that that already scheduled in any previous scheduling interval on that gas day. All offer and bid quantities, including rebids, are for the 24-hour gas day.

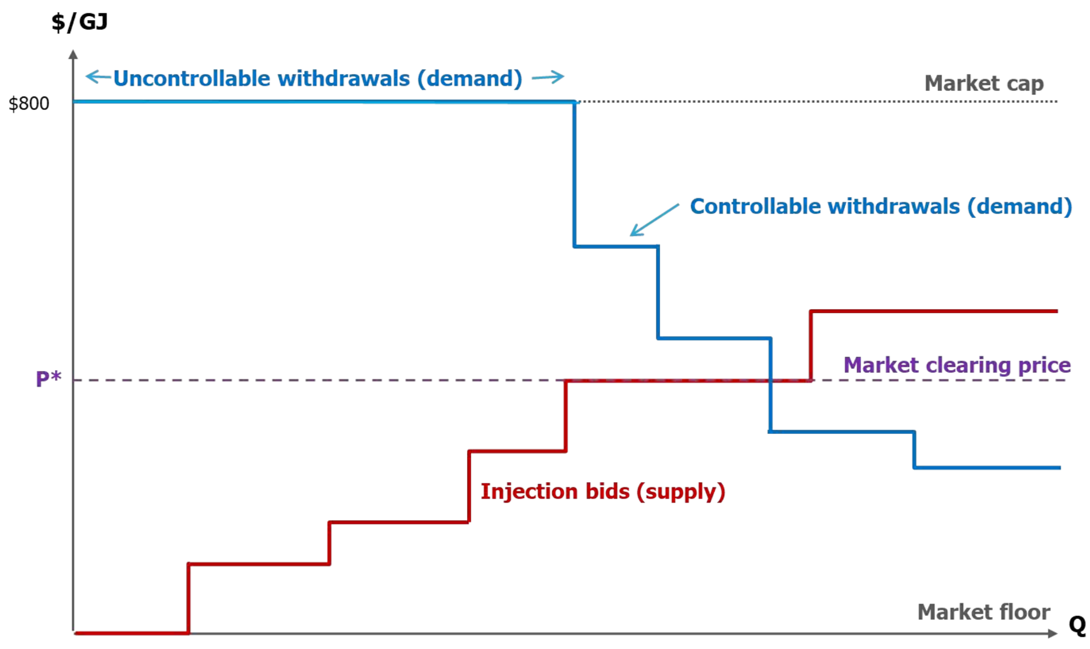
2.2.3 Determining the market price

The market price is determined in the pricing schedule as follows:

- Gas withdrawals (controlled and uncontrolled withdrawals) are met by the cheapest gas offers in the system, i.e. through a 'bid stack' process.
- Importantly, the optimisation process does not take into account transmission constraints within the DTS, i.e. the DTS's capacity is effectively assumed to be infinite.
- The market price is determined by the marginal price of the cumulative offer quantities that are required to meet the aggregate of all market participants' demand forecasts and controllable withdrawal bids, i.e. the price of the most expensive unit of gas needed to satisfy demand.

The price is set at the level at which supply and demand are equal. This is demonstrated in Figure 2.3. Demand is represented in blue, with uncontrollable withdrawals bid at the market price cap and controllable withdrawals making up the remaining curve in descending order of price. The supply curve, shown in red, represents the offer stack in order of price. The market clearing price, P*, is the price at which supply intersects demand.

Figure 2.3: Price determination in the DWGM



Source: AEMC

In determining the pricing schedule, AEMO must apply supply and demand point constraints (SDPC) to reflect contractual, physical or operating limits at injection or withdrawal points *external* to the DTS.[23]

However, in determining external demand or supply point constraints, AEMO is prohibited from taking into account operating conditions with the DTS.[24] In 2014, AEMO noticed that in practice, the pricing schedules do take into account operating conditions within the DTS when determining some supply or demand point constraints. The implications of the AEMO practice was that, in instances where injections to, or withdrawals from, the DTS are constrained, constraints are applied in both the pricing and operational schedules. This appears to have had the following effects:

- The market price is increased (for constrained injections) or decreased (for constrained withdrawals) compared to an unconstrained pricing schedule.
- The congestion pricing signals that would otherwise be provided through uplift payments are suppressed, potentially devaluing the benefits of AMDQ.
- Offers and bids that are physically infeasible due to external constraints do not impact the market (this is in accordance with market design).

AEMO has now proposed to implement a new operating practice where AEMO will apply all DTS constraints to the operating schedule only.[25]

An administrated price period may occur if the market has been suspended, a market price or pricing schedule is unable to be published by the required time or the cumulative price threshold has been reached. The cumulative price threshold (CPT) is $1,800/GJ and is calculated as the sum of the marginal clearing price over 35 consecutive scheduling intervals (7 gas days).[26] During this period, if the CPT is breached, the market price is capped at the Administered Price Cap (APT), currently $40/GJ.

2.2.4 Curtailment rights

The Victorian arrangements for curtailment of gas usage or consumption to manage emergencies and/or preserve system security have been developed by AEMO in consultation with the Victorian Government. Where curtailment is required due to a transmission constraint, the first customers to be curtailed are tariff D customers that hold no market benefit instruments or that have used in excess of their assigned market benefit instruments.[27] Discussion of these instruments is covered in chapter 4.

23 See Rule 221(3)(f) of the NGR.

24 See Rule 221(4) of the NGR.

25 See Project GRC0039 which is combined with Project GRC0049 DWGM simpler wholesale price.

26 In the *Gas Market Parameter Review 2018,* AEMO determined that the CPT for the DWGM would be lowered to $1,400/GJ. This change will come into effect from 1 July 2020.

27 These arrangements are published as the Gas Load Curtailment and Gas Rationing and Recovery Guidelines on AEMO's website. The guidelines provide classifications of gas customers, and set out the priority order under which each class of gas customer will be curtailed if curtailment is required to maintain system security. The curtailment of customers who do not hold AMDQ or AMDQ cc reflects requirements under AEMO's Access Arrangement and Rule 343 of the NGR, and is implemented by Table 0 of the Curtailment Tables.

3 WHOLESALE PAYMENTS

In the course of trading gas within the DWGM on a given day, market participants may be exposed to:

- payments or charges related to selling or buying gas from other market participants at the market price
- payments or charges aimed at recovering the cost of any transmission constraints within the DTS.

3.1 Payments for gas at the market price

The market price is calculated by assuming that there are no physical limitations on the DTS. Participants offer gas into the wholesale market through a competitive bidding process. These offers are stacked in order of price and cleared against the aggregate sum of total forecast demand and controllable bids in order to determine the market price for gas within the DTS.

When trading gas within the DWGM, market participants may incur or receive imbalance payments and/or deviation payments for the gas they have bought or sold at the market price.

3.1.1 Imbalance payments

Imbalance payments are payments for the net difference between scheduled injections and withdrawals of gas by a market participant. Imbalance payments are determined on an ex-ante basis and can be positive or negative.

The daily imbalance payment for each market participant is calculated based on:

- the difference between their scheduled daily injections and withdrawals of gas at 6:00am, multiplied by the 6:00am market price
- changes to the difference between their scheduled daily injections and withdrawals of gas at each *reschedule*, multiplied by the *reschedule* market price.

In summary, if a market participant:

- withdraws and injects the same quantity of gas over the course of the day the imbalance payment will be zero
- withdraws more gas than it injects over the course of the gas day the imbalance payment will be positive (the market participant has purchased gas from the market)
- withdraws less gas than it injects over the course of the gas day the imbalance payment will be negative (the market participant has sold gas to the market).

3.1.2 Deviation payments

Deviation payments are used to settle differences between market participants' *scheduled dispatch* instruction and *actual dispatch* outcome. To be clear, this contrasts with imbalance payments, which settle on the difference between *scheduled injections* and *scheduled withdrawals*.

In contrast to imbalance payments, deviation payments are calculated on an ex-post basis. That is, they are paid at the next scheduled market price after the scheduling period in which the participant deviated from their dispatch instruction.[28] This is because variations in a market participant's actual behaviour will have physical and financial impacts on the outcomes of the next schedule.

The deviation payment is calculated as the difference between the following for each market participant, multiplied by the next scheduled market price:

- actual withdrawals less scheduled withdrawals; and
- actual injections less scheduled injections.

3.2 Payments related to transmission constraints

The presence of pipeline capacity constraints means that gas demand cannot always be met by the cheapest sources of supply. Consequently, there are a number of additional payments that market participants receive in situations where pipeline capacity constraints bind and their more expensive gas offer is required to be *constrained on*.[29] The total value of these payments is then recovered through uplift payments that are charged to the notional *causers* of the transmission constraint.

3.2.1 Ancillary payments

It is not always possible to schedule the cheapest gas to meet the required demand for a given gas day. If the system is congested, gas that is more expensive than the market price may be scheduled. Ancillary payments are compensatory payments to market participants whose more expensive gas offer is required to be *constrained on* as a result of the congestion.

Figure 3.1 provides an example of a situation where an ancillary payment will be made. In this case, there is a binding constraint on one of the pipelines that is preventing a participant from injecting their offered gas, represented as the dashed segment of the supply curve in red. The market price is set at the unconstrained optimal quantity and price indicated by the purple line, where the demand curve intersects the dashed supply curve at the market quantity Q*.

However, as some gas is *constrained off,*[30] the supply curve effectively shifts to the left by the constrained amount so that an amount of the next cheapest source of unconstrained gas that can be dispatched must be *constrained on* to satisfy the full market quantity Q*.

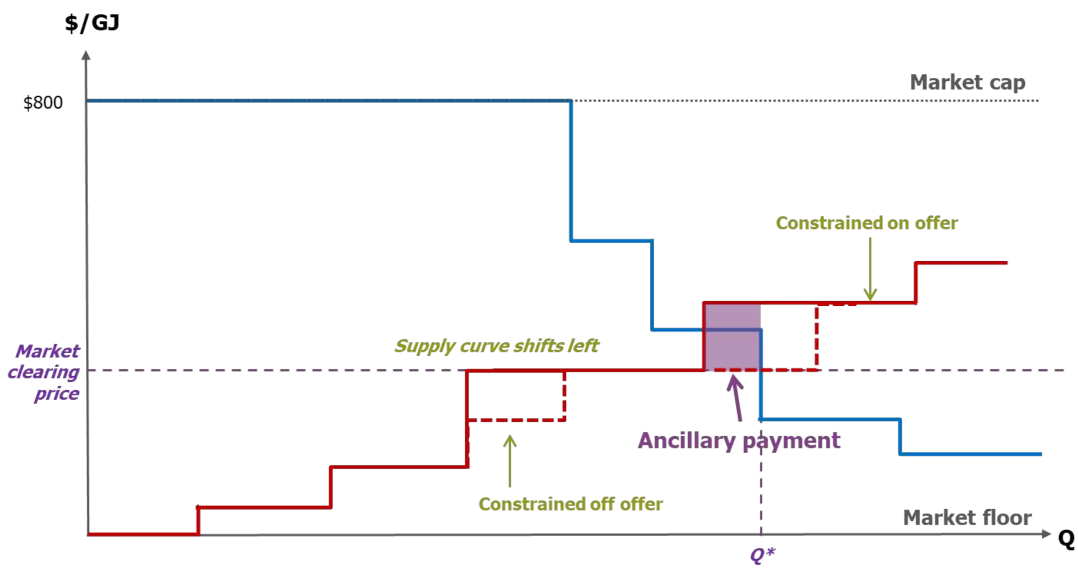
28 For example, a deviation in the 10:00 am to 2:00 pm interval is settled at the 2:00 pm scheduled market price. Deviations in the last schedule of the gas day are settled at the following 6:00 am price.

29 Gas is *constrained on* when it is scheduled to be dispatched despite being offered at a price above the market price.

30 Gas is *constrained off* when it is not scheduled to be dispatched despite being offered at a price below the market price (or bid at a price above the market price if it is a withdrawal).

The market participant whose gas has been *constrained on is* compensated by an ancillary payment (represented by the purple rectangular area in the figure) so that it receives in total (ancillary payment plus market price) its offer price for the constrained on gas. There are no ancillary payments made to market participants that are *constrained off*.

Figure 3.1: Determination of 'constrained on' ancillary payments



Source: AEMC analysis

3.2.2 Uplift payments

The total cost of ancillary payments are recovered from market participants through uplift payments. There are four categories of uplift payments:

- **Surprise uplift** - this is charged to market participants that have caused a constraint by 'surprising' the system. This can occur when the participant deviates from their scheduled injections and/or withdrawals or if they change their demand forecast in the following period. Surprise uplift occurs because gas does not flow instantaneously. For example, if demand is unexpectedly high in Melbourne it may be too late to schedule gas from a distant but cheaper injection offer. Instead, a closer but more expensive source may need to be *constrained on*.
- **Congestion uplift** - this is charged to market participants that are scheduled to withdraw or inject in excess of their allocated portion of the physical capacity of the system, as defined by their authorised maximum interval quantity (AMIQ) or uplift hedge protection, derived from AMDQ. AMDQ therefore provides financial protection against

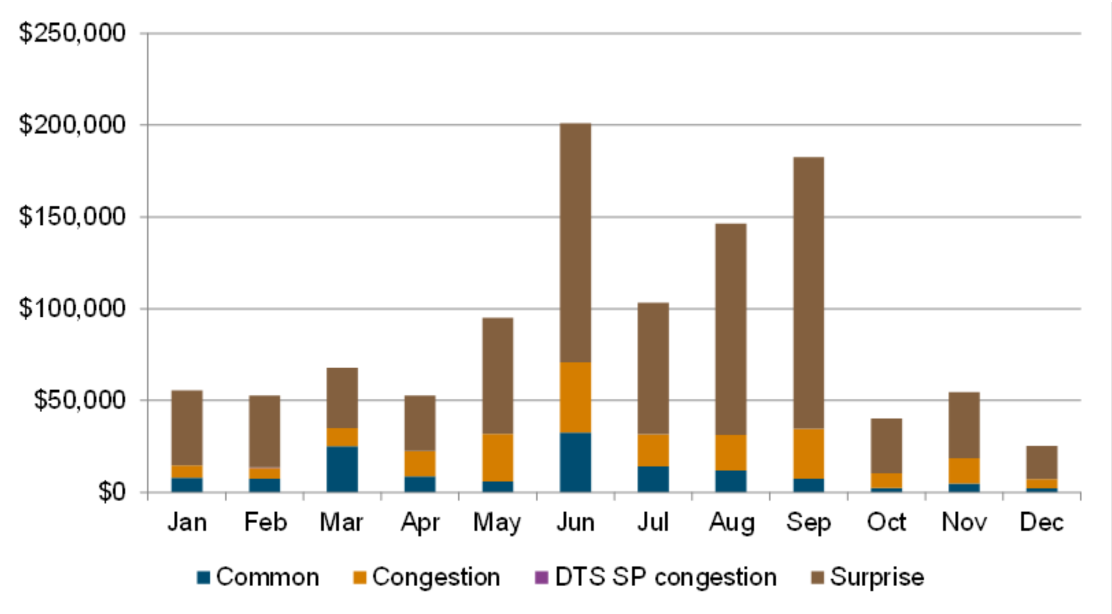
congestion uplift, but this protection is limited because it is not granted if a participant is not injecting gas.

- **DTS SP congestion uplift** - this is charged to the DTS SP in situations where it is determined that the DTS SP caused congestion by not making the necessary plant or pipeline capacity available as required under the SEA.
- **Common uplift** - this includes costs that cannot be allocated by the above means and are paid by market participants who withdraw gas on the relevant day. Common uplift is allocated to market participants in proportion to their daily withdrawals.

Uplift payments typically represent a small cost for the market as a whole, relative to the total gross amount of gas traded through the DWGM. The total value of uplift payments by type is shown in Figure 3.2. The total value of uplift payments for 2018 was around $1.08 million. This varied significantly over time with around $200,000 in June and only around $25,000 of payments in December.

More information on uplift payments is provided in the DWGM simpler wholesale price consultation paper.

Figure 3.2: Value of uplift payments by type (2018)



Source: AEMO

4 MARKET BENEFIT INSTRUMENTS (AMDQ)

There are two types of instruments that market participants use in the DWGM to gain preferable access to the DTS and to manage exposure to uplift payments. These are authorised maximum daily quantity (authorised MDQ) and authorised maximum daily quantity credit certificates (AMDQ cc). These instruments differ in respect of location on the network and time validity but are similar in respect of the rights provided to holders. Therefore, unless specifically indicated any reference to AMDQ refers collectively to both authorised MDQ and AMDQ cc.[31]

The initial allocation of authorised MDQ occurred at the commencement of the Victorian DWGM and is consistent with the capacity of the Longford to Melbourne pipeline.[32] The total authorised MDQ was set at 990 TJ/day which represented the peak capacity of the Longford to Melbourne pipeline. It was allocated in perpetuity to existing and committed new loads at the time, as follows:

- for Tariff D[33] large customer sites, typically with demand exceeding 10 TJ per year, authorised MDQ was allocated to each site equal to their existing contract maximum daily quantity with revisions approved by an independent panel
- for the New South Wales interconnect, Wimmera pipeline and Murray Valley towns approximately 18 TJ of authorised MDQ was allocated
- for Tariff V customers, the remaining balance of the 990 TJ/day was allocated as a block – that is, to all residential and small-to-medium sized commercial and industrial customers.

Most large commercial and industrial customers hold authorised MDQ allocated directly to their sites. Authorised MDQ is only valid for the withdrawal of gas made at the delivery point at which it was first allocated. Authorised MDQ is valid in perpetuity. The right may be relinquished, in which case AEMO may re-allocate the authorised MDQ.

APA (as owner of the Victorian DTS) and AEMO (as operator of the DWGM) may agree to extend or expand the capacity of the Victorian DTS through existing pipeline augmentation or new pipelines. This expansion of capacity may result in the creation of additional AMDQ cc.

AMDQ cc have been created to provide similar benefits in terms of the limited physical access rights and market rights to those arising from AMDQ issued on the Longford to Melbourne pipeline but differ in respect of location and time validity. AMDQ cc provides rights for a set term (usually the same period as APA's access arrangement period). AMDQ cc is not allocated directly to a customer or customer site but rather to a market participant (who may be an end customer but is typically a retailer).

31 Authorised MDQ and AMDQ cc are collectively known as AMDQ. Throughout this chapter, the distinction between authorised MDQ and AMDQ cc is relevant. Consequently, the consultation paper DWGM improvement to AMDQ regime will refer to authorised MDQ and AMDQ cc when referring to the specific right, and AMDQ when referring to the both authorised MDQ and AMDQ cc.

32 See AEMO's Technical guide to the Victorian DWGM, p. 29.

33 Tariff D customers are large customers with daily demand meters and are typically industrial sites.

Rights and benefits to AMDQ holders

There are two different types of right or benefit that are created by holding AMDQ:

1. Physical access rights: holders of AMDQ receive pipeline access benefits above non-AMDQ holders during periods of pipeline congestion.
2. Financial rights: market participants can use part or all of their AMDQ to partially hedge against congestion uplift payments.

Physical access rights

Holders of AMDQ have the following physical access rights:

1. Curtailment 'protection' rights – customers that do not hold AMDQ, where operationally practicable, will have their gas supply curtailed ahead of customers sites with AMDQ in the event of transmission constraints resulting in supply shortfalls.
2. Injection tie-breaking rights (also known as priority in scheduled injections) – where there are equally priced offers, participants with AMDQ are scheduled first.
3. Withdrawal tie-breaking rights (also known as priority in scheduled withdrawals) – when there are equally priced bids for controllable withdrawals, participants with AMDQ are scheduled first.

Financial rights

AMDQ is used to protect holders against congestion uplift payments that arise because of capacity limits in the DTS.[34] This protection is called 'uplift hedge'. Uplift hedge is the amount of AMDQ that a participant nominates to use as a hedge against congestion uplift payments. The nominated amount must be supported by scheduled injections from the nominated source of gas supply.

More detail on congestion uplift hedge protection is included in Chapter 2 of the consultation paper of the DWGM simpler wholesale price rule change.

Acquiring AMDQ

AMDQ can be acquired in a number of ways (these are different for authorised MDQ and AMDQ cc), including by a participant:

- entering into an agreement with existing holders of authorised MDQ to transfer an agreed quantity from one site to another or to the reference hub
- entering into an agreement with existing holders of AMDQ cc to transfer an agreed quantity at the reference hub
- applying and negotiating with the DTS service provider for AMDQ cc when they expand the capacity of the DTS or when existing AMDQ cc contracts that others hold expire
- contracting with the DTS service provider to privately expand the DTS capacity
- bidding for and purchasing spare AMDQ cc at auctions conducted by AEMO from time to time.

34 Congestion uplift payments are covered in chapter 3.

Historically, limited quantities of AMDQ have been traded between participants. More information on trading of AMDQ is provided in the consultation paper of the DWGM improvement to AMDQ regime rule change.

5 REVIEW OF THE DWGM

In September 2015, the Commission began a review of the DWGM at the request of the Victorian Government and COAG Energy Council.[35] The purpose of the review was to consider whether the market structure remained fit for purpose, including whether it:

- continued to provide appropriate signals and incentives for investment in pipeline capacity
- allowed market participants to effectively manage price and volume risk
- facilitated the efficient trade of gas to and from adjacent markets
- facilitated upstream and downstream competition.

The final report, published in June 2017, concluded that the DWGM was not likely to meet the above objectives.[36] The report also concluded that features of the market could be inhibiting the development of a liquid eastern Australian gas market.

5.1 Context of the review

At the time of its establishment, the DWGM had only very limited inter-connectivity with other sources of gas supply and demand. That permitted the market to operate relatively autonomously. However, since then the construction of an interconnected network of transmission pipelines has linked the DWGM to markets across eastern Australia.

This transformation has been accelerated in recent years by the commencement of liquefied natural gas (LNG) exports from Queensland, linking the wider eastern Australian market to markets overseas. LNG exports drove a substantial increase in overall gas demand across eastern Australia, from 709 petajoules (PJ) in 2014 to 1,851 PJ in 2017.[37]

The increase in demand and linkage to international markets has put upward pressure on domestic gas prices. The average daily price in the DWGM was $9.42 per gigajoule (GJ) in the third quarter of 2018, double that of three years before.[38] The market price was also subject to increasing volatility during this time.

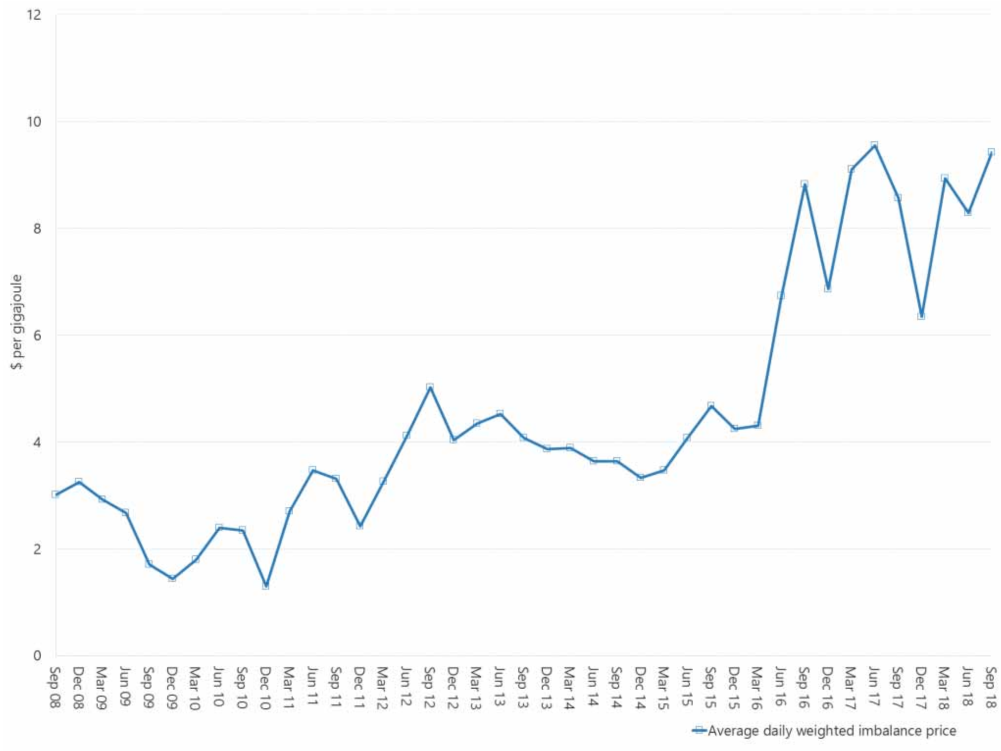
35 COAG Energy Council and Victorian Government, *Review of the Victorian Declared Wholesale Gas Market*, Terms of Reference, 4 March 2015.

36 AEMC 2017, *Review of the Victorian declared wholesale gas market*, Final report, 30 June 2017.

37 AEMO, *2018 Gas Statement of Opportunities*, p. 15.

38 AER, Victorian gas market average daily weighted prices by quarter, accessed 7 February 2019. Available at: https://www.aer.gov.au/wholesale-markets/wholesale-statistics/victorian-gas-market-average-daily-weighted-prices-by-quarter.

Figure 5.1: DWGM average daily weighted prices by quarter



Source: AER, Victorian gas market average daily weighted prices by quarter, accessed 7 February 2019. Available at: https://www.aer.gov.au/wholesale-markets/wholesale-statistics/victorian-gas-market-average-daily-weighted-prices-by-quarter

Note: The average daily prices are imbalance weighted prices that use (forecast) imbalance volumes and prices for the five schedules each day.

It was in this context that the DWGM review occurred. The evolution of the wider eastern Australian gas market meant that new approaches to managing price risk were becoming increasingly important to market participants. This evolution was largely unforeseen at the time the DWGM was developed, and it is these factors that led to a renewed focus on market development to promote efficient outcomes for consumers.

5.1.1 COAG Energy Council's Vision

In recognition of the trends described above, in December 2014 the COAG Energy Council formulated a Vision for Australia's future gas market.[39] The Vision aimed to achieve a liquid wholesale gas market through transparency in pricing, market driven investment and effective trading between hubs.

39 COAG Energy Council, *Australian Gas Market Vision*, December 2014, p. 1.

In February 2015, COAG Energy Council tasked the AEMC to identify a roadmap to achieve the Vision for the east coast of Australia.[40] The review was to consider the role and objectives of the existing markets on the east coast in light of the changing market dynamics and to set out a roadmap for their continued development. The recommendations of the AEMC's *East Coast Wholesale Gas Market and Pipeline Frameworks Review* were considered and agreed to by the COAG Energy Council in August 2016.

5.1.2 Review timeline

In March 2015, COAG Energy Council and the Victorian Government tasked the AEMC to undertake a specific, more detailed review of the Victorian DWGM.[41] This followed the recommendations of Peter Reith in Victoria's Gas Market Taskforce in October 2013.

The review commenced on 10 September 2015 with publication of a discussion paper, and was finalised in June 2017. During this time, the Commission consulted extensively with stakeholders, including convening a technical working group composed of experts from market participants, industry and consumer groups.

Review publications included two discussion papers, two draft reports, an assessment of alternative designs and a final report.[42]

5.2 Findings

In its final report, the Commission concluded that the DWGM was encumbered with a number of issues that arose as a result of its market design.[43] These issues included that:

- market participants had limited options for managing spot price risk within the market
- the market had opaque longer-term pricing which could be inhibiting investment in physical gas supply and gas consuming-facilities
- there is little incentive for market participants to underwrite investment in the DTS due to the 'free rider' problem inherent in the market design
- the disjointed nature of market arrangements across eastern Australia was inhibiting trading across the east coast, as well as increasing complexity and transaction costs for market participants.

These issues are detailed in sections 1.2.1 to 1.2.4 below.

5.2.1 Limited risk management options

The review concluded that there were insufficient physical or financial risk management options available to market participants within the DWGM.

40 COAG Energy Council, *East Coast Wholesale Gas Market and Pipeline Frameworks Review*, Terms of Reference, 20 February 2015, p. 1.

41 COAG Energy Council and Victorian Government, *Review of the Victorian Declared Wholesale Gas Market*, Terms of Reference, 4 March 2015.

42 See AEMC Website: Project GPR0002 Review of the Victorian Declared Wholesale Gas Market at https://www.aemc.gov.au/markets-reviews-advice/review-of-the-victorian-declared-wholesale-gas-mar

43 AEMC 2017, *Review of the Victorian declared wholesale gas market*, Final report, 30 June 2017.

The DWGM operates as both a commodity and capacity spot market. Access to the network is allocated dynamically and implicitly to market participants on the basis of bids and offers made for gas on or near the trading day in question. There is no way as part of the DWGM market arrangements to buy or sell gas ahead of the gas day in order to hedge spot price risk.

In addition, at the time of the review, financial risk management products had not yet emerged as a means by which market participants could hedge their price risk. The review concluded that this was because the DWGM pricing mechanism was overly complex in nature.

The main method available to market participants to manage their spot price risk is physical and external to the market. That is, market participants could choose to enter into long-term gas supply agreements (GSAs) with producers, or conduct bilateral secondary trades of gas with other market participants. Market participants then had to offer the gas they procured outside of the DWGM into the market to meet their own gas withdrawal requirements, in order to limit any price exposure.

The review considered that there were a number of limitations with this risk management approach; namely:

- GSAs appeared increasingly insufficient at the time as a tool for market participants to manage their exposure to the DWGM market price. This was because the GSAs that were being offered by producers had more restrictive and expensive load factor flexibility than historically.
- The approach only hedges market participants against the market price. The participants may also be exposed to uplift and deviation charges.
- Bilateral trades were not well-suited to satisfy short-term imbalances in a market participants' individual supply or demand, as they generally involve high search and transaction costs.

5.2.2 Opaque longer-term pricing

Market outcomes are in part a function of the quality of information available to market participants.

An effective gas market is one that can deliver to participants meaningful, market-based reference prices for gas that reflect underlying supply and demand conditions. Such prices can provide signals to drive the efficient use of gas in the short-term, while promoting efficient levels of investment in physical gas supply and gas consuming-facilities in the long-term.

The review found that, while the DWGM spot price reflects immediate conditions, it is not representative of supply and demand over the longer term. Long term trades struck outside of the DWGM are negotiated bilaterally, with the terms and price kept confidential. In addition, a liquid financial derivatives market that provided information to market participants on pricing had not yet emerged.[44] This meant that the gas price might not be sending sufficient long term signals to participants regarding the efficient level of consumption, supply and investment needed in the transmission system.

5.2.3 Limited market-driven investment in the declared transmission system

The review concluded that there is limited incentive for market participants to underwrite investment in the DTS due to the 'free rider' problem inherent in the market design.

Access to the DTS is allocated on the basis of DWGM market outcomes and influenced by non-firm capacity rights held by market participants. Because market participants do not have firm access rights, they have limited incentive to underwrite investment in the system when it is needed.

Consequently, the review concluded that investment decisions in the DTS are generally the result of a regulatory process, as part of the AER's review of APA's DTS Access Arrangement. The regulator and APA are unlikely to have the same information or incentives to make efficient decisions compared to market participants, because the risk of those decisions are in large part borne by consumers.

5.2.4 Barriers to trading between markets

There are currently three different facilitated market designs in operation in eastern Australia, with six different pricing points. The review considered that it was likely that the disjointed nature of these market arrangements was inhibiting trading across the east coast, as well as increasing complexity and transaction costs. These factors may also be deterring participants in one market from entering another.

5.3 Recommendations

In its draft final report, the Commission recommended significant changes to the Victorian gas market design. The reform package that was developed is referred to as the 'target model'.[45] See Box 2 for a summary of the target model.

BOX 2: THE TARGET MODEL

The target model would unbundle the three roles currently undertaken through the DWGM:

- gas commodity trading
- balancing responsibility and
- pipeline capacity allocation.

Commodity trading

44 There has been emerging signs of increased liquidity in the intervening period. See AEMC, *Forward Trading Market*, Consultation paper, 14 March 2019 for more information.

45 AEMC, *Review of the Victorian declared wholesale gas market*, draft final report, 14 October 2016.

Under the target model, trading would occur on a voluntary, continuous basis. Participants could trade bilaterally or through a trading exchange, for a variety of products of different lengths. Like the DWGM, the southern hub would be a virtual hub that covers the entire declared transmission system. Bids and offers could be matched at any location.

These arrangements were considered to provide the following benefits:

- **Improved risk management:** Participants would have greater flexibility to trade physical products, either bilaterally, or through a low cost, anonymous trading exchange. This may enable them to better manage price and volume risks. Liquid physical trading may also facilitate the development of financial derivatives, which would further risk management.
- **Transparent and meaningful reference prices:** Prices on the southern hub exchange and the reporting of bilateral trades, including any liquid financial derivatives market that might also emerge, would provide market participants with transparent and meaningful reference prices. This would be used across the supply chain to inform investment decisions.
- **Improved trading between hub locations:** The southern hub trading exchange would be the same as the Northern Hub exchange to support low cost, anonymous and transparent trading for participants. Having similar characteristics across the eastern gas market should lower transaction costs and complexity for traders operating across both hubs, encouraging greater participation and trade across the wider east coast market.

Balancing responsibility

Under the target model, each market participant would have financial incentives to balance its supply and demand position under a mandatory, continuous balancing mechanism. Participants would do this by trading either bilaterally or through the exchange and as such create greater liquidity and contribute to the benefits noted above. However, the system operator would remain responsible for ensuring system security and would take action where market participants are not collectively sufficiently in balance.

Continuous balancing means that market participants would not be required to exactly balance their positions at any particular point in time. However, if AEMO, as system operator, was required to buy or sell gas to maintain system security, the participants responsible for the imbalance would be allocated a portion of those costs, hence providing incentives not to cause system-wide imbalances.

Pipeline capacity allocation

Under the target model, the existing market carriage model for allocating capacity in the declared transmission system, and associated limited pipeline transportation rights, would be replaced with a system of entry and exit rights. These rights would enable participants to be confident that their nominated injections and withdrawals would be achieved. Entry and exit rights would be made available through a variety of channels, including secondary trading.

Unbundling capacity allocation from gas trading would allow for physical rights providing exclusive use of pipeline capacity. Participants could obtain additional entry and exit rights by committing to fund capacity expansions, so improving their incentives to underwrite investments.

The target model represented a significant change to the current market. Designing, testing and implementing the target model was likely to take several years and involve significant costs and risks. The Commission considered that this was at odds with the need to reform the DWGM in the shorter term.

Consequently, in its final review report, the Commission recommended a staged approach to reforms. This staged approach included a number of incremental reforms that could be implemented in the short-term and would go towards alleviating the issues identified in section 5.2. Furthermore, the incremental reforms were consistent with longer-term progression towards the target model, as well as with broader arrangements in eastern Australian gas markets.

The incremental reforms included:

1. **providing a cleaner wholesale market price** by including the costs currently intended to be recovered by common and congestion uplift in the market price, while retaining separate pricing of temporal constraints
2. **establishing a forward trading exchange over the DTS** while retaining the existing daily DWGM
3. **improving pipeline capacity allocation and introducing capacity rights trading** by:
    a. introducing separate, tradable entry AMDQ rights and exit AMDQ rights
    b. introducing an exchange to improve secondary trading of AMDQ rights (permanent transfer) and benefits (temporary transfer)
    c. making AMDQ available for a range of different tenures.

As a next step, the Commission recommended that the Victorian Government submit rule change requests to the AEMC on each of the three incremental reforms. This process would allow consideration of the most effective way to implement the recommendations through a consultative process.

On 5 November 2018, the AEMC received three rule change requests from the Victorian Minister for Energy Environment and Climate Change to amend the National Gas Rules (NGR).[46] The rule change requests proposed changes related to the review findings detailed above. Additional information regarding these rule change requests can be found on the respective project pages on the AEMC website.

46 See AEMC Website: Project GRC0049 DWGM simpler wholesale price at https://www.aemc.gov.au/rule-changes/dwgm-simpler-wholesale-price; Project GRC0050 DWM forward trading market at https://www.aemc.gov.au/rule-changes/dwgm-forward-trading-market; Project GRC0051 DWGM Improvement to AMDQ regime at https://www.aemc.gov.au/rule-changes/dwgm-improvement-amdq-regime

ABBREVIATIONS

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMDQ	Used to collectively refer to authorised maximum daily quantity and AMDQ cc
AMDQ cc	Authorised maximum daily quantity credit certificates
APA	APA VTS Australia (Operations) Pty Ltd
APT	Administered price threshold
BoD	Beginning of day
COAG	Council of Australian Governments
Commission	See AEMC
CPT	Cumulative price threshold
DFPC	Directional flow point constraint
DTS	Declared Transmission System
DTS SP	Declared Transmission System Service Provider
DWGM	Declared Wholesale Gas Market
GFG	Gas fired generation
GJ	Gigajoule
GSA	Gas supply agreement
LNG	Liquefied natural gas
MDQ	Maximum daily quantity
MPC	Market price cap
NEL	National Electricity Law
NEO	National Electricity Objective
NERL	National Energy Retail Law
NERO	National Energy Retail Objective
NGL	National Gas Law
NGO	National Gas Objective
PJ	Petajoule
SEA	Service Envelope Agreement
the Review	Australian Energy Market Commission's 2017 Review of the Victorian Declared Wholesale Gas Market
TJ	Terajoule