Signalling scarcity

Setting a floor price during gas system outages

NZIER report to Gas Industry Company

August 2021

About NZIER

NZIER is a specialist consulting firm that uses applied economic research and analysis to provide a wide range of strategic advice.

We undertake and make freely available economic research aimed at promoting a better understanding of New Zealand's important economic challenges.

Our long-established Quarterly Survey of Business Opinion and Quarterly Predictions are available to members of NZIER.

We pride ourselves on our reputation for independence and delivering quality analysis in the right form and at the right time. We ensure quality through teamwork on individual projects, critical review at internal seminars, and peer review.

NZIER was established in 1958.

Authorship

This paper was prepared at NZIER by Mike Hensen and Peter Wilson.

It was quality approved by Laurie Kubiak.

The assistance of Andrew Knight and Grace Burtin of the Gas Industry Company and Sarah Spring is gratefully acknowledged.

Registered office: Level 13, Willeston House, 22–28 Willeston St | PO Box 3479, Wellington 6140
Auckland office: Ground Floor, 70 Shortland St, Auckland
Tel 0800 220 090 or +64 4 472 1880 | econ@nzier.org.nz | www.nzier.org.nz

Key points

The Gas industry Company (GIC) has asked NZIER for advice and a recommendation on how to set a floor price in the rules governing critical contingency events (CCEs) in the gas sector.

Floor price purpose

We understand the purpose of the 'floor price' is to provide the industry with greater certainty about what will happen in a CCE. In previous work, the GIC has suggested that the floor price should be:

- Above market prices to signal to gas suppliers and consumers that gas is scarce and encourage allocation of scarce gas to its highest value use.
- At or below the final price determined for the CCE.

The floor price should also be simple to calculate based on information that is readily available to market participants and be based on gas prices as close as possible to the time of the CCE. The floor price calculation method also needs to have the flexibility to adjust to changes in the gas market structure that will be driven by Government policy to reduce the use of gas for both electricity generation and as a source of process heat.

Requirements implied by critical contingency event regulations

We note that the GIC has proposed an amendment to the regulations that would require the expert determining the price to consider *'prices in the wholesale market for electricity, cost of loss of gas supply to affected consumers, and any other matters that the industry expert considers relevant'*[1] irrespective of whether supply is curtailed. Our advice assumes this recommendation is accepted. The purpose of setting a floor price is to increase industry certainty about the possible critical contingency price (CCP) that will be applied. It is explicitly **not** designed to be an estimate of what the CCP will be.

Floor price considerations: cost of lost gas supply and wholesale electricity prices

The cost of lost supply will vary widely across customers depending on the cost of gas as a proportion of the value of the customer revenue, whether alternative arrangements can be made to continue output without gas and what penalties the customer faces from its customers for interrupting output. In the absence of curtailment, the price paid for gas in the spot market is the best observable indicator of the value customers place on marginal gas supply.

We agree with the GIC proposal to use a volume weighted average of prices (VWAP) of trades in the emsTradepoint market as a component of the floor price.[2] The VWAP would indicate the willingness of customers to pay for gas and, therefore, the minimum cost of lost gas supply to customers.

1 'Statement of Proposal for amending the Critical Contingency Management Regulations, Gas Industry Company' page 19.

2 Op cit page 19 to 20.

We agree with the GIC's analysis that the share of gas used by electricity generation has fallen since 2011[3] due to the decommissioning of gas-fired plants. However, we note that:

- Gas use by electricity generators that are still operating in 2020 has fluctuated rather than declined. Gas use in 2020 was 35.0 PJ, near the peak over the period 2012 to 2020[4] and electricity generators are the largest consumer of gas after Methanex.[5]
- The proposed CCP regulation still requires wholesale electricity prices to be considered in setting the CCP.
- While Government has an aspirational target of 100 percent renewable electricity generation, modelling by the Climate Change Commission indicates that:
  - the structural changes in the electricity market that could enable reduced reliance on baseload thermal electricity generation will not occur until 2026 to 2028[6]
  - major structural changes in the industrial gas market will occur simultaneously with the expiry of existing Methanex gas supply contracts in 2029 (which could cause a step increase in gas prices[7]) and fuel switching for process heat.

Floor price setting while gas is used for baseload electricity generation

Based on the proposed change to the regulations and the outlook for limited change in demand and supply over the next five years and provided that Huntly Unit 5 is in operation at the time of the CCE, we recommend that the floor price setting methodology is the minimum of:

- The 7-day moving average of the VWAP (7-day VWAP) of gas in the emsTradepoint system excluding balancing trades and adjusted to remove the allowance for carbon prices.[8]
- The willingness to pay for gas of the Huntly Unit 5 plant based on the wholesale electricity price[9] when the CCE is declared and using the methodology and assumptions described in section 5.1.3 (also reported inclusive and exclusive of the allowance for carbon prices).

3 MBIE data shows the share of gas consumed for electricity generation (excluding co-generation) fell from 32 percent in 2011 to 19 percent in 2019. Gas consumed for electricity generation (excluding co-generation) fell 28 percent (from 51.3 PJ in 2011 to 37.0 PJ in 2019) while supply increased 17 percent (from 151.8 PJ in 2011 to 177.8 PJ in 2019).

4 GIC data for major users includes the following generators: Huntly, Taranaki Combined Cycle, Stratford and Junction Road. Gas use by these generators has averaged 32.1 PJ per year over 2012 to 2020 within a range of 27.5 PJ in 2015 to 37.0 PJ in 2017. Gas used by Te Rapa (co-generation) averaged 4.1 PJ per year over 2012 to 2020 within a range of 3.8 PJ in 2019 and 2020 to 4.6 PJ in 2017.

5 Methanex used 64 PJ of gas in 2020, 49.8 PJ at Motonui and 15.2 PJ at Waitara. On 24 February 2020, Methanex announced that it was mothballing the Waitara plant due to inability to obtain gas supply. This will reduce Methanex gas use to about 50 PJ per year.

6 The key changes modelled by EnergyLink for the Climate Change Commission draft advice (February 2021) that enabled reduced reliance on gas-fired baseload generation are the phased closure of the Tiwai aluminum smelter over 2024 to 2027 and the construction of geothermal generating capacity. The EnergyLink modelling for the Climate Change Commission final advice (June 2021) assumed complete closure of the Tiwai aluminum smelter in 2024 and a much faster increase in wind and geothermal electricity generation capacity.

7 For the Climate Change Commission draft advice, EnergyLink modelled increases in gas prices from $8.57 per GJ to $9.60 per GJ in 2030 (central case) or $14 per GJ (step increase). For the Climate Change Commission final advice, EnergyLink modelled gas prices as remining at $9.00 per GGJ from 2020 to 2035 or increasing at $0.20 per GJ per year from 2021 to 2030 and then remaining at $11.00 per GJ until 2035.

8 emsTradepoint gas prices include the cost of carbon calculated as the closing price of NZUs on the day and converted to a price in $ per GJ of gas using the MBIE natural gas emissions factor.

9 Up to date electricity prices for selected nodes are available at https://www.em6live.co.nz/Default.aspx. More detailed real time pricing data are available as a subscription service through https://www.ems.co.nz/services/em6/ .

We propose that the floor is set at the lower of the 7-day VWAP (excluding balancing trades and adjusted to remove the allowance for carbon prices) and the willingness to pay for gas used at the Huntly Unit 5 plant to minimise the risk that the floor could be set above the CCP.

If Huntly Unit 5 is not generating electricity at the time of the CCE, we recommend that the floor price is based on the 7-day VWAP of gas in the emsTradepoint system adjusted to remove the allowance for carbon prices.

Floor price when gas is no longer used for baseload electricity generation

Assuming the generation of electricity from gas declines as modelled (or more quickly), we suggest that the floor price setting regulations will need to be reviewed so that the floor price setting methodology only relies on the 7-day VWAP of gas in the emsTradepoint market (excluding balancing trades and adjusted to remove the allowance for carbon prices). We suggest that the trigger for this change is the cessation of baseload gas-fired generation at Huntly for the following reasons:

- The calculation of generator willingness to pay for a gas peaker plant will deliver a floor price that is about 82 percent of the willingness to pay for gas of a baseload plant.
- The uncertainty of the relevance of electricity generator willingness to pay to the CCP calculation due to the disconnect between forecast electricity and gas prices.

We note that while the cessation of baseload generation is expected to reduce gas use for electricity generation to about 35 to 40 percent of current levels by 2029, this does not imply that the share of gas demand used from electricity generators will fall by anywhere near the same amount.

Forecasts prepared for the Climate Change Commission suggest that the share of total gas demand from electricity generation will be above 20 percent in 2021, decline briefly to 11 to 12 percent in the mid-2020s and then climb back to around 20 percent by 2029. The forecast path differs between the Climate Change Commission ‘draft advice’ and ‘final advice’ depending on the assumptions made about the closure of:

- Methanex – 2029 in the draft advice and 2040 in the final advice.
- Aluminium smelter – phased closure over 2024 to 2027 in the draft advice and complete closure in 2024 in the final advice.

(A more detailed comparison of the forecasts is provided in section 6.4.2 .)

The proposed approach is the simplest option that is consistent with the regulations and the determinations of the CCP for the previous four CCE (13 July 2010, 03 Mar 2012, 24 May 2016 and 23 May 2017) while also recognising the impending structural change in the gas market driven by Government climate change policy. The simplicity is achieved at the justified expense of a more detailed consideration of the short-term variations in the demand for gas (particularly for electricity generation) and the expected duration and severity of a CCE.

Alternatives considered but discounted

We have also considered using either quarterly gas prices published by the Ministry of Business Innovation and Employment (MBIE) and our estimate of the gas price paid by Methanex. We have discounted these options primarily because they are averages over 3 months calculated with a lag and therefore unlikely to indicate the value of gas close to the time of the CCE. We also note that these options were not suggested in submissions made by stakeholders on the GIC proposal for a floor price.

Contents

Appendices

Figures

Tables

1 Introduction and scope

The Gas Industry Company (GIC) administers a range of governance arrangements for the New Zealand downstream gas industry sector.

One of those relates to what happens if there is a serious incident affecting gas supply. These arrangements are set out in the Gas Governance (Critical Contingency Management) Regulations 2008 (CCM Regulations) and associated documents.[10]

The CCM Regulations were extensively reviewed and amended after a major outage of the Maui pipeline in October 2011. Following further CCM events and other changes in the gas industry and its governance, the GIC issued a consultation paper on a range of further amendments, including to the CCM arrangements.[11] The GIC has engaged the New Zealand Institute of Economic Research (NZIER) to provide it with advice and recommendations on one aspect of the proposed changes to the CCM Regulations: the setting of a floor in the price paid to or received from certain parties after a critical contingency event (CCE).

The GIC has asked us to produce a report that could be published as a stand-alone statement of both our advice and the reasons for it if our recommendations are accepted. We have, therefore, included below some important background material, which, while it may be very familiar to experienced industry players, does result in a self-contained explanation of our results.

10 For further details, see Gas Industry Company (2020a).

11 Gas Industry Company (2020c).

2 The New Zealand gas system and critical contingencies

2.1 The New Zealand gas system

The natural gas system in New Zealand started in 1970, with the first deliveries from the onshore Kapuni field. A major expansion in the industry occurred in 1979 when the much larger offshore Maui field began delivering gas. In the early days of the development of the gas system, the Government was directly involved in owning and operating key pieces of infrastructure and being a significant buyer of gas, which was on-sold to other end-users, some of whom were also government-owned. At the same time, there was significant private sector involvement in the sector, especially in the areas of exploration, production, and transmission.[12]

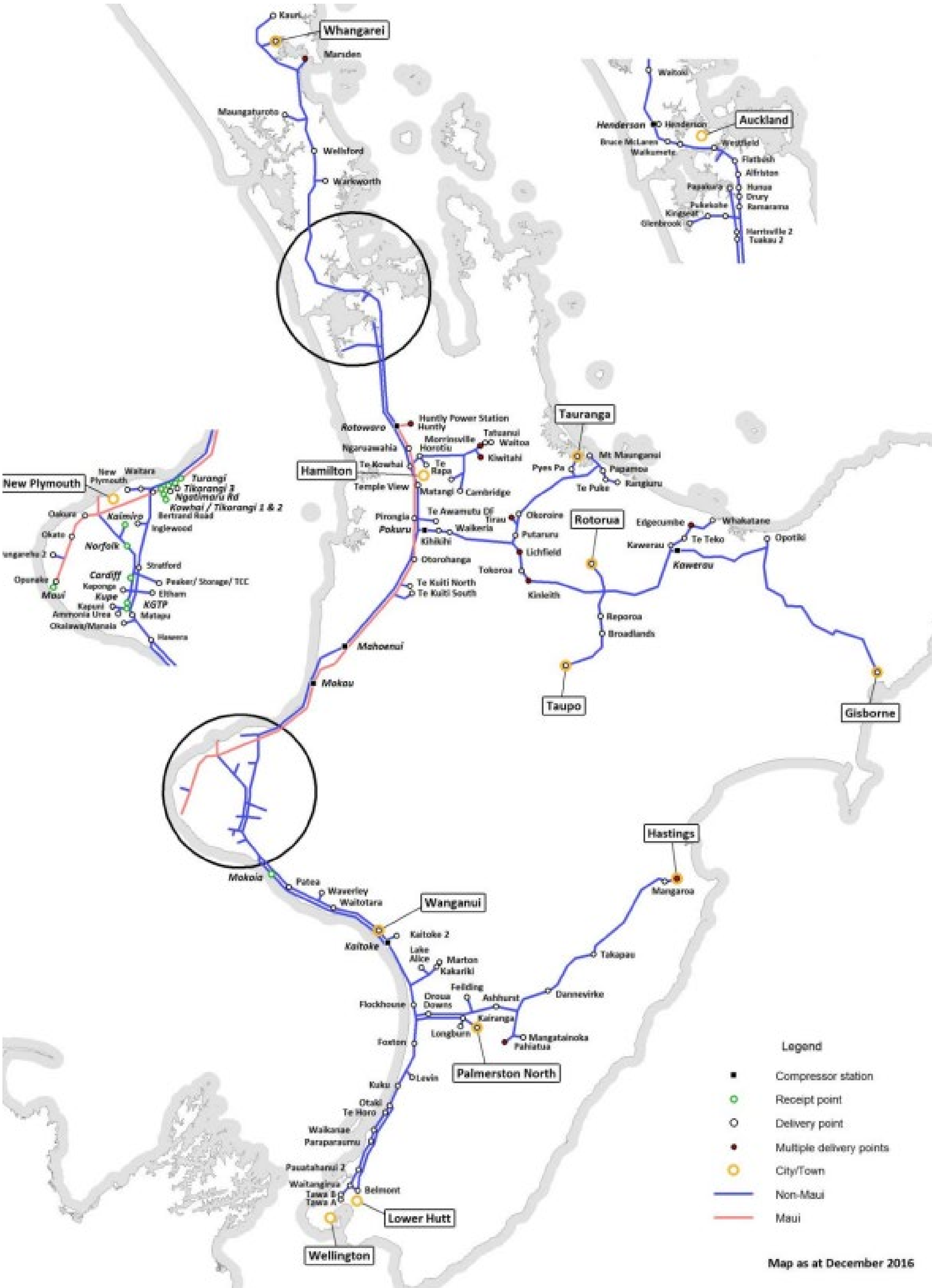
The core of the gas system is two high-pressure gas transmission systems in the North Island, currently owned and operated by First Gas Limited:

- the 309km Maui pipeline, which runs from Oaonui, in southwest Taranaki, to Huntly.
- the 2,196km system, generally radiating from the Maui pipeline and delivering gas throughout the North Island.

Figure 1 over the page is a map of these two systems.

[12] For a more detailed history, see Gas Industry Company (2017).

Figure 1 The New Zealand gas system



Source: FirstGas

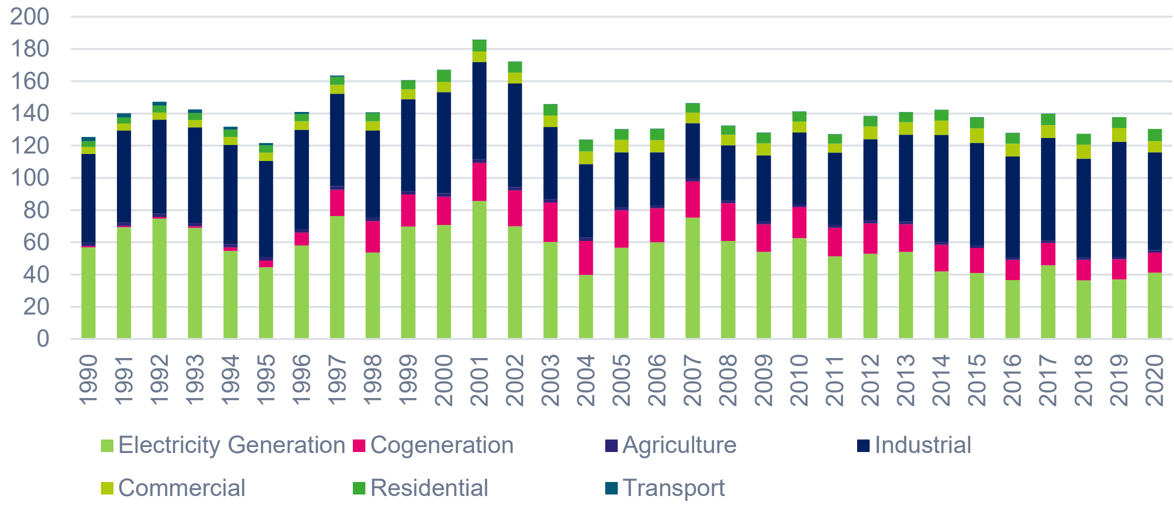
Over time, the Government removed itself from direct participation to its current role of policy development and co-regulation.[13]

2.2 Consumption data

Since about 2004, total gas consumption has been largely stable.

Figure 2 Gas consumption has been largely stable

Gross petajoules (PJ)



Source: BMIE

The Ministry of Business Innovation and Employment (MBIE) publishes gas consumption and price data for broad industry groups, and the Energy Efficiency and Conservation Authority (EECA) publishes a survey of end-users of natural gas that partially disaggregates the groups in the MBIE data. The GIC publishes data on consumption by major gas users. We have combined this data in Table 1.

13 Under Part 4A of the Gas Act, the gas industry is subject to co-regulation by the Government and the GIC.

Table 1 Major gas users' consumption

Gas use in PJ

Consumer	2012	2013	2014	2015	2016	2017	2018	2019	2020
Feedstock/heat									
Methanex Motunui	29.6	39.8	67.7	51.3	65.0	51.7	44.4	54.3	49.8
Methanex Waitara	8.1	11.9	17.1	16.5	17.1	17.4	10.8	12.5	15.2
Methanex Total[1]	**37.7**	**51.8**	**84.8**	**67.8**	**82.1**	**69.1**	**55.2**	**66.7**	**65.0**
Ballance	5.2	6.3	7.4	6.8	6.2	7.0	7.3	6.4	6.6
Sub total	**42.9**	**58.1**	**92.2**	**74.6**	**88.4**	**76.1**	**62.5**	**73.1**	**71.6**
Heat									
Glenbrook	2.0	2.0	2.0	1.9	1.8	1.8	1.9	2.2	2.0
Kinleith	2.9	2.6	2.8	2.6	2.8	3.2	2.8	2.9	2.8
Marsden Point	2.3	2.0	2.1	2.0	2.8	3.1	3.8	3.9	2.6
Fonterra (subtotal)	3.4	3.6	3.9	4.2	4.5	4.5	4.7	4.8	4.7
Sub total	**15.8**	**16.5**	**18.2**	**17.5**	**18.1**	**19.7**	**20.5**	**20.1**	**18.7**
Generation fuel									
Huntly	19.1	23.7	20.9	22.6	25.1	27.2	21.1	21.7	25.2
Junction Road[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
TCC	12.7	8.4	3.3	0.6	2.4	4.6	6.0	5.9	4.8
Te Rapa	4.0	4.1	4.3	4.4	4.3	4.6	4.0	3.8	3.8
Stratford peaker	3.6	3.6	3.2	4.1	5.3	5.2	2.1	1.8	2.6
Sub total	**16.7**	**21.1**	**22.9**	**24.1**	**25.2**	**25.4**	**24.7**	**24.0**	**25.0**
Total	**75.4**	**95.7**	**133.3**	**116.2**	**131.7**	**121.2**	**107.7**	**117.2**	**115.3**

Note:

1 Gas use at the Motonui site is between 74.8 percent and 81.3 percent of Methanex gas use.

2 Data on the gas used by the McKee electricity generation plant is not available. The major gas users' data for 'McKee/Mangahewa recorded annual consumption of 31 PJ in 2020 and 2021. However, the capacity of these plants is 109 MW, around 10 percent of the capacity of the Huntly generation plant.

Source: NZIER

Further details are in Appendix D.

Table 2 shows those users that have high daily consumption throughout the year. Note that Fonterra's usage, while high, is concentrated in the peak milk processing season.

Table 2 Major gas users – days above 15 TJ per day

Consumer	2012	2013	2014	2015	2016	2017	2018	2019	2020
Feedstock/heat									
Methanex Motunui	352	357	365	365	366	344	330	365	366
Methanex Waitara	271	332	338	347	343	354	240	253	306
Ballance	269	305	357	345	290	334	354	297	313
Heat									
Glenbrook	0	0	0	0	0	0	0	0	0
Kinleith	7	4	6	3	8	13	6	7	4
Marsden Point	0	0	0	0	0	17	30	1	0
Fonterra	106	132	109	131	143	127	137	144	145
Generation fuel									
Huntly	338	365	347	360	366	365	357	360	365
Junction Road	0	0	0	0	0	0	0	0	41
TCC	297	192	85	20	69	155	172	163	120
Te Rapa	2	3	6	12	11	8	7	3	0
Stratford peaker	102	90	83	117	179	161	50	36	56

Source: NZIER

2.3 Open access and the concept of balance

Through a long process of market development and regulatory reform, the gas transmission system now operates on an 'open access' basis, whereby parties[14] wishing to buy, sell or ship gas can use the transmission pipelines to do so in exchange for a fee and subject to a series of conditions.[15] These conditions are currently contained in two different codes: the Maui Pipeline Operating Code (MPOC) and Vector Transmission Code (VTC).[16]

One important condition is balancing, whereby, roughly, the amount drawn from the system is kept equal to the amount injected. So, for example, someone selling gas to final consumers needs to purchase gas from a field to match their sales. The actual molecules of gas injected into the system are not those that the final user will withdraw, but the system

14 In the jargon of the New Zealand gas system, there are two types of parties using the gas transmission system. "Welded parties" either inject gas directly into the system or draw gas directly from it. They are mainly gas producers, and major users like electricity generators. "Shippers" are entities that acquire gas from a third party and then on-sell it to end users, using the transmission system to transport the gas.

15 Vector introduced open access to its high-pressure pipelines in the mid-1990s while the open access commenced on the Maui pipeline in 2005.

16 FirstGas is currently in the process of replacing these separate codes with a single set of access arrangements called the Gas Transmission Access Code (GTAC).

is kept in balance. One important by-product of balancing is that the operating pressure in the system is maintained.[17]

2.4 Critical contingencies and imbalance

Critical contingencies happen if there is a shortage of gas supply relative to demand, mostly due to either an interruption at a gas production facility or damage to a transmission pipeline.

2.4.1 Gas pipeline outage history

There have been six significant outages on the New Zealand gas transmission system since it began operating, two of them caused by third party damage, one by severe flooding and two by landslips:[18]

- The rupture of the Kapuni North pipeline at Pukearuhe on the North Taranaki coast in 1977, due to a slow-moving landslip.
- The rupture of the Kapuni North pipeline near Inglewood, Taranaki, circa 1985, due to being struck by a mechanical digger.
- The rupture of the Kapuni South pipeline at Himatangi in the lower North Island in 2003, due to being struck by a bulldozer.
- The forced shutdown of the Hawke's Bay pipeline at Awapuni in 2004, when it became detached from a bridge that was swept away during severe flooding in central and lower areas of the North Island.
- The rupture of the Maui pipeline at Pukearuhe in 2011, due to a slow-moving landslip, near the 1977 Kapuni pipeline failure site.
- The planned outage of the Maui pipeline at Tongaporutu in 2018 to create a bypass so that a defect discovered in the pipe could be assessed.

The longest outages, 5–6 days, have been Hawke's Bay (2004) and Maui (2011).[19]

The two most recent events occurred after the CCM Regulations came into effect and CCEs were declared. There have also been a number of other CCEs declared due to production failures:

- Pohokura Production Station Outage, March 2012
- Pohokura Production Station Unplanned Outage, May 2016
- System Imbalance Event, May 2017.

2.4.2 Responding to an event

If this imbalance were sufficiently large and left uncorrected, then the pressure in the system could drop sufficiently to endanger the operation of the system and create risks to the health and safety of the public.

[17] The operating pressure of the system – known as 'linepack'—is both used as a threshold for establishing whether a critical contingency exists but is also itself a source of gas that can supply the system during short-term interruptions.

[18] Gas Industry Company (2020b).

[19] The duration of the 1977 Kapuni pipeline failure at Pukearuhe is not known.

The CCM Regulations set out the process to be followed to manage the gas system in these cases.[20]

Priority is given to maintaining supply to gas distribution networks supplying residential customers, as re-pressurising these networks can involve major safety issues that need to be managed carefully (essentially, each individual user would need to be disconnected from the network, the system re-pressurised, and then individual users reconnected. This could take months). To prevent this, the CCM Regulations allow the Critical Contingency Operator (CCO) (an entity appointed by the GIC to operate the CCM system[21]) to issue instructions to industrial and commercial users to stop using gas (known as 'curtailment').

When a CCE occurs, it is possible that the system can also become unbalanced if drawings exceed injections at different parts of the system. To provide an additional incentive to stop this happening, the CCM Regulations include provisions to encourage users to act in ways that help preserve the integrity of the system, even if they have contractual obligations that might work against this aim. For example, the Regulations specifically refer to avoiding shippers instructing their suppliers of gas to reduce supply during a CCE when those shippers' consumers have been curtailed.[22]

2.4.3 Contingency imbalance and the critical contingency price

A key part of the CCM Regulations is a system for paying and charging parties for imbalances that can occur during a critical contingency. The Regulations differentiate between positive and negative contingency imbalances. Positive imbalances occur when:

- A party injects more gas into the transmission system than the party has contractually agreed to inject.
- A party takes less gas than they were contractually entitled to take.
- A shipper and its customers take less gas than they were contractually entitled to take.

Similarly, negative imbalances occur when:

- A party injects less gas into the transmission system than they had contractually agreed to inject.
- A party takes more gas than they were contractually entitled to take.
- A shipper and its customers take more gas than they were contractually entitled to take.

Under the CCM Regulations:

- parties that have a positive contingency imbalance are paid a premium; and
- parties with a negative contingency imbalance are subject to a surcharge.

The amount of the premium or surcharge is the amount of the contingency imbalance times a specially determined 'critical contingency price', which is set by an industry expert after the critical contingency is over, in accordance with the CCM Regulations.

20 For a summary, see: https://www.gasindustry.co.nz/work-programmes/critical-contingency-management/current-arrangements/information-for-consumers-regarding-critical-contingency-events/document/4882.

21 The current CCO is a Taranaki-based company, Core Group. See: https://www.cco.org.nz/Home/.

22 CCM Regulation 67 (a).

To put this discussion in context, Table 3 shows the imbalances and corresponding payments and charges that resulted from the most recent CCE in 2017. Note that the imbalances and thus the changes and payments balance. This is by design.

Table 3 Payments and charges after the May 2017 System Imbalance Event

Imbalances are measure in Gigajoules (GJ)

Party	Negative CC imbalance	Positive CC imbalance	Invoices	Credit notes
		Maui welded parties		
Shell Todd Oil Services Limited	0	3,489		$37,053.18
Methanex NZ Limited	-69	2,159	$732.78	$22,928.58
Todd Pohokura Limited	0	1,601		$17,002.62
Shell Exploration NZ Limited	-9,724	1,561	$103,268.88	$16,577.82
Genesis Power Limited	0	837		$8,888.94
Todd Energy Limited	0	765		$8,124.30
Greymouth Gas New Zealand Limited	0	335		3,557.70
First Gas Limited	-1	0	$10.62	
		VTC shippers		
Contact Energy Limited	0	1,384		
Genesis Power Limited	0	886		9,408.68
Greymouth Gas New Zealand Limited	-1,774	0	$18,838.59	
Mighty River Power Limited	-989	0	$10,501.85	
Nova Gas Limited	-2,688	0	$28,543.64	
Vector Gas Trading Limited	0	1,581		16,788.88
Wanganui Gas Limited	-1,372	0	14,574.57	
First Gas balancing linepack adjustment under Regulation 74(2)(c)		2,019		21,443.48
Total	**-16,617**	**16,617**	**$176,470.94**	**$176,470.94**

Source: GIC

2.5 The future

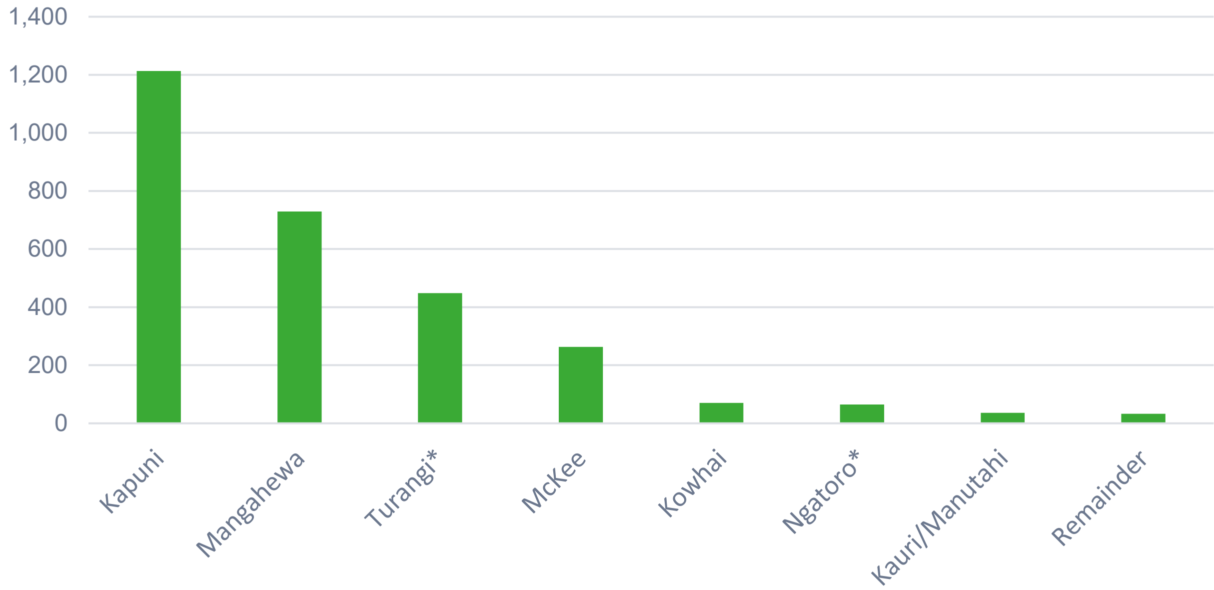
The future of gas in New Zealand will be heavily dependent on how various government policies play out. Three major policies are:

- The decision not to grant any further offshore exploration permits.
- The transition to a low carbon economy by 2050, as prescribed by the Climate Change Response (Zero Carbon) Amendment Act 2019.
- The Government's aspirational goal of 100 percent renewable electricity by 2035.

The first policy was given effect by the Crown Minerals (Petroleum) Amendment Act 2018. It is uncertain what effect this policy will have on overall gas production and thus consumption in future. It certainly does mean that the existing offshore fields, once they are exhausted, will not be replaced by other offshore fields. Existing onshore fields contain significant reserves, as shown in Figure 3.

Figure 3 New Zealand still has large onshore gas reserves

P2 ultimate recoverable reserves, in PJs, as at 1 January 2020



Notes

1 Maari includes Maari and Manaia.

2 Ngatoro includes: Ngatoro, Kaimiro, Windsor, and Goldie.

3 Turangi includes: Turangi, Ohanga, Onaero, and Urenui.

4 Remainder includes: Cheal, Radnor, Cheal E, Cooper Moki, Sidewinder, Supplejack, Surrey.

Source: MBIE

The second policy – which is in the course of being implemented – aims to see New Zealand reach net zero greenhouse gas emissions (other than for biogenic methane) by 2050, with significant reductions in biogenic methane under a separate timetable. Combustion of gas makes a modest contribution to overall GHG emissions. In 2018 (the latest figures available, natural gas combustion contributed 1,961 kilotonnes of CO_2 emissions, out of a total 8,337 kilotonnes from all energy emissions. This represented about 24% of total energy-related emissions.[23]

The third policy – which is a subset of the second – involves moving in time to 100% renewable energy. Advice to the Government from the Climate Change Commission and others is that while it is possible to cost-effectively increase the proportion of renewable generation, achieving the last few percentage points is likely to be very expensive. This is because it will mean that reasonably cost-effective short-term gas generation will not be available to meet any sudden reduction in supply (for example, due to weather conditions

[23] Ministry for the Environment (2020).

like no wind or low rainfall.) [24] This is why the Government has referred to this policy as an 'aspirational target'. That said, the Government is working on a range of policy initiatives that are designed to reach a 100% renewable electricity system by 2035.[25]

24 Interim Climate Change Committee (2019, 98).

25 See, for example New Zealand and Ministry of Business (2019).

3 Critical contingency price-setting

The purpose of setting the CCP is detailed in section 67 of the Regulations:

- Encourage suppliers to maintain supply irrespective of whether their customers are curtailed.
- Signal to suppliers and consumers that gas is scarce.
- Provide incentives particularly for retailers to make alternative arrangements to minimise the financial cost of a critical contingency.

The first two purposes are directed at the behaviour of parties during a CCE. The third, however, has a longer-term focus and is aimed at encouraging parties to plan for alternatives to curtailment during a critical contingency.

The method for setting a CCP is detailed in section 71 of the regulations and allocates a central role to wholesale electricity prices:

- If supply is curtailed to consumers in bands 0, 1 or 2, then the CCP must be based on the wholesale electricity price.
- Otherwise, the CCP should consider wholesale prices for electricity during the critical contingency period and the economic cost of the loss of gas supply to those consumers who had their gas supply curtailed.

3.1 Increasing certainty through a floor price

While the methodology for setting the CCP is set out in the current regulations, it is, by design, directed at setting a price that reflects the market situation at the time of the CCE.

Therefore, it is not possible for industry participants to forecast what the CCP might be, which reduces its effectiveness in achieving its third purpose. This is shown in Table 4, which shows the CCP set after the previous CCE.

Table 4 Past critical contingency prices have varied

Date	CCE description, duration and response	Final CCP ($/GJ)
13 Jul 2010	19:30 to 22:32 – no regulatory curtailment	15.00
03 Mar 2012	12:48 to 23:30 – regulatory curtailment of bands 0, 1a and 1b	11.10
24 May 2016	18:30 to 23:00 – no regulatory curtailment	6.66
23 May 2017	11:14 to 18:15 – no regulatory curtailment	10.62

Source: NZIER

Following comments by the industry expert after the 2017 CCE,[26] the GIC proposed two changes to the methodology contained in the CCM Regulations.

The GIC has proposed the removal of the first provision (clause 71(3)(a)), which requires the CCP to be determined using wholesale electricity prices. If this change is approved, the CCP would be determined by a combination of the wholesale electricity prices, economic cost of the loss of supply to those customers who had their supply curtailed and other factors considered by the independent expert.

The second proposal is that a price floor for contingency prices be specified in the Regulations.

The GIC stated that it considered that a volume weighted average price (VWAP) calculated from trades on a gas market over 7 days would be an appropriate floor price. It sought comments from industry.

[26] Denne (2017).

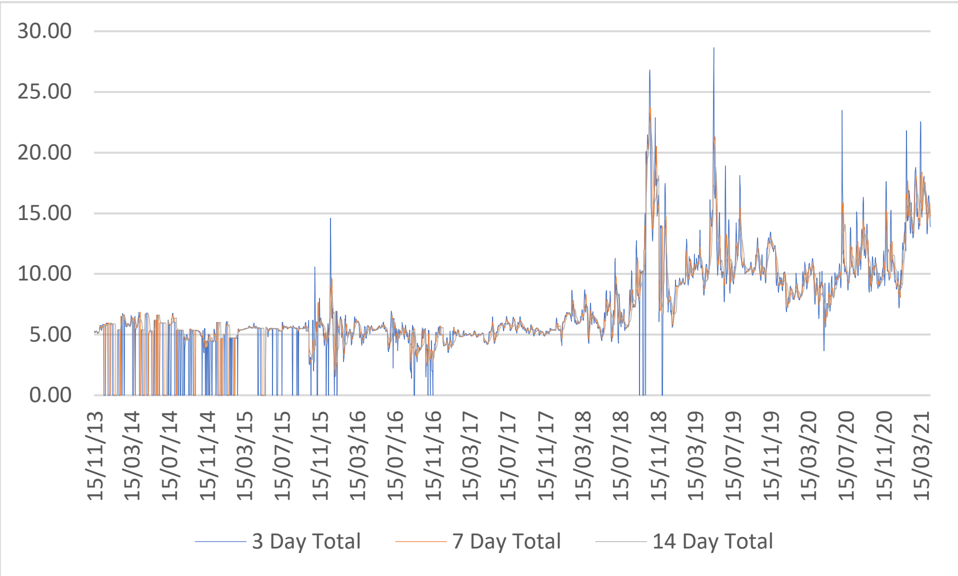
4 Submissions on floor prices

4.1 Introduction

This section reviews the comments about floor prices made by submitters, describes how these align with the concept of the opportunity cost of gas and the extent to which the suggestions made by submitters can be accommodated in a single determination process. Our key criterion for assessing the alternatives suggested in the submissions is that the objective of the floor price is to increase industry certainty about the possible CCP that will be applied but that it is explicitly **not** designed to be an estimate of what the CCP will be, and it should not be higher than the CCP.

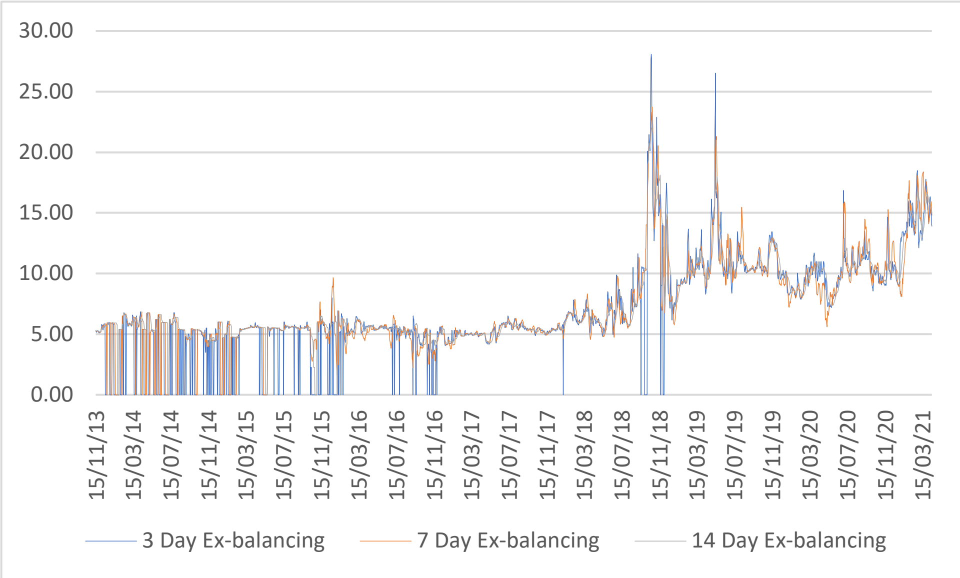
We have estimated the 3-day, 7-day and 14-day VWAP with and without balancing trades for the period 15 November 2013 to 15 April 2021. The results are shown in Figure 4 and Figure 5. These charts refer to the submissions on the use of emsTradepoint prices, which included the cost of carbon. We have included versions of Figure 4 and Figure 5, excluding the price of carbon as Figure 9 and Figure 10, and discussed the impact of this adjustment on VWAP in Appendix E.

Figure 4 VWAP including balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company

Figure 5 VWAP excluding balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company

The charts show that since the beginning of 2019:

- Trading has been frequent enough so that a non-zero VWAP could be calculated.
- The 3-day, 7-day and 14-day VWAP are volatile but generally move together.

4.2 Consensus on having a floor price – divergence on how to set the floor

All submitters that commented on the floor price proposal supported the introduction of a floor price. However, submitters had a spectrum of opinions on the appropriateness of using the 7-day VWAP as the floor price ranging from acceptance as proposed through to modification to an alternative method as follows:

- Use of the 7-day VWAP as proposed – emsTradepoint, First Gas and Methanex
- Modification of the proposed VWAP:
  - Vector suggested giving more weight to trades within a day of the critical contingency event and excluding balancing transactions.
  - Nova suggested a VWAP of the 75th percentile of prices for short term spot trades over the previous 21 days.
  - Major Gas Users Group observed that the contingency price was unlikely to fall below the 7-day VWAP but suggested the use of the higher of:
    - 7-day VWAP
    - peak gas prices over the past 12 months
    - gas prices implied by wholesale electricity prices.
- Alternative method – OMV suggested using prices from previous CCEs.

The above description of the submitters' comments is based on their answers to two separate questions about setting the floor price summarised in Table 5 and Table 6.

Table 5 Review of submissions on Q3 – calculating a floor price

Q3: Do you agree with the proposed calculation method, using VWAP for the 7 days prior to and including the critical contingency day?

Support	Alternative view
emsTradepoint (include carbon price) FirstGas Methanex	Nova: gas demand is affected by the weather, but 7-day VWAP may be misleading due to variations in the weather. OMV: does not reflect an efficient market. Use known periods of gas scarcity (previous critical contingency events and/or emsTradepoint data). Express the floor price as a premium over the 7day moving average. Vector: market and off-market trades on emsTradepoint within one day of critical contingency should be given greater weight than earlier transactions. Balancing gas transactions should be excluded from the calculation of the VWAP because of the disconnect for prices between transactions involving the system operator and those that do not.
Major Gas Users Group – qualified support – It is reasonable to assume that the contingency price shouldn't fall below the VWAP over the previous 7 days.	Major Gas Users Group: the floor price should attempt to reflect the value transfer between parties forced to forego gas it is entitled to under contract vs parties taking gas it is not entitled to.

Note:

1 emsTradepoint gas prices include the cost of carbon calculated as the closing price of NZUs on the day and converted to a price in $ per GJ of gas using the MBIE natural gas emissions factor.

Source: NZIER

Table 6 Review of submissions on Q4 – other floor price benchmarks

Q4: Are there other pricing benchmarks that should be used in setting the critical contingency price?

Submitter	Alternative view
Major Gas Users Group	The average of the 12 (or some other number) highest peak prices on in the previous 12 twelve months on the trading platform. A 'higher of' number – so the critical contingency price might be the higher of VWAP (as above), average of x highest peaks in rolling y month period, and marginal/ peak electricity wholesale price.
Nova	75th percentile of prices over the previous 21 days (adjusted for volumes, and only including short term spot trades.
OMV	A floor price could be derived using known periods of gas scarcity (either using previous critical contingency events and/or emsTradepoint data).
Vector	A VWAP that gives market trades and off-market trades transacted (excluding balancing transactions by the system operator) on emsTradepoint within a day prior to the critical contingency event being declared greater weight.

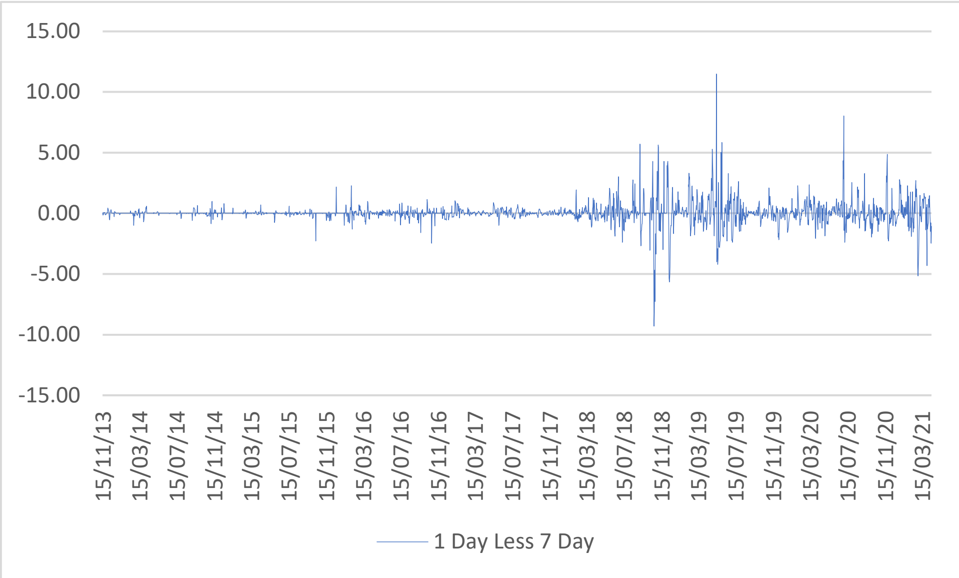
Source: NZIER

4.2.1 Vector submission

We analysed the suggestion by Vector to exclude balancing trades by calculating the difference between the:

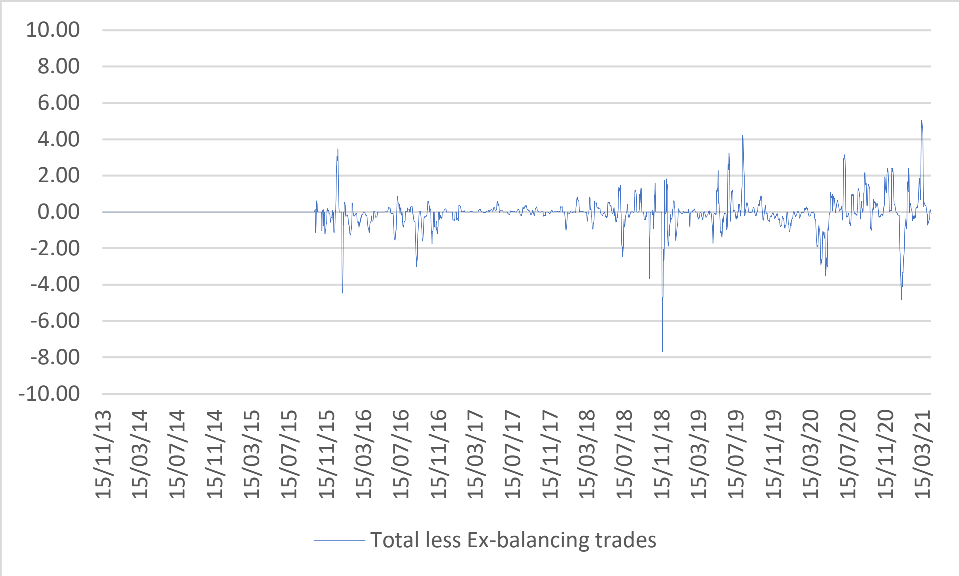
- 1-day VWAP and 7-day VWAP (excluding balancing trades for both). The average difference over the period 1 January 2019 to 15 April was $0.07 with a standard deviation of $1.22. Our estimate of the difference is shown in Figure 6.
- 7-day VWAP including and excluding balancing trades. The average difference over the period 1 January 2019 to 15 April was $0.03 with a standard deviation of $1.07. Our estimate of the difference is shown in Figure 7.

Figure 6 1-day VWAP less 7-day VWAP excluding balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company

Figure 7 7-day VWAP including less 7-day VWAP excluding balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company

The difference between the 7-day VWAP, including all trades and excluding balancing trades, is, on average, a small positive number but does not appear to have a systematic bias.

We did not model the effect of Vector's suggestion to give more weight to trades within one day of the CCE because of the lack of definition of 'more weight'. Also, we have argued in other sections of this report for the use of the 7-day VWAP in setting the floor price because it is not as exposed to calculation problems due to thin trading as the 1-day VWAP.

Conclusion on Vector submission

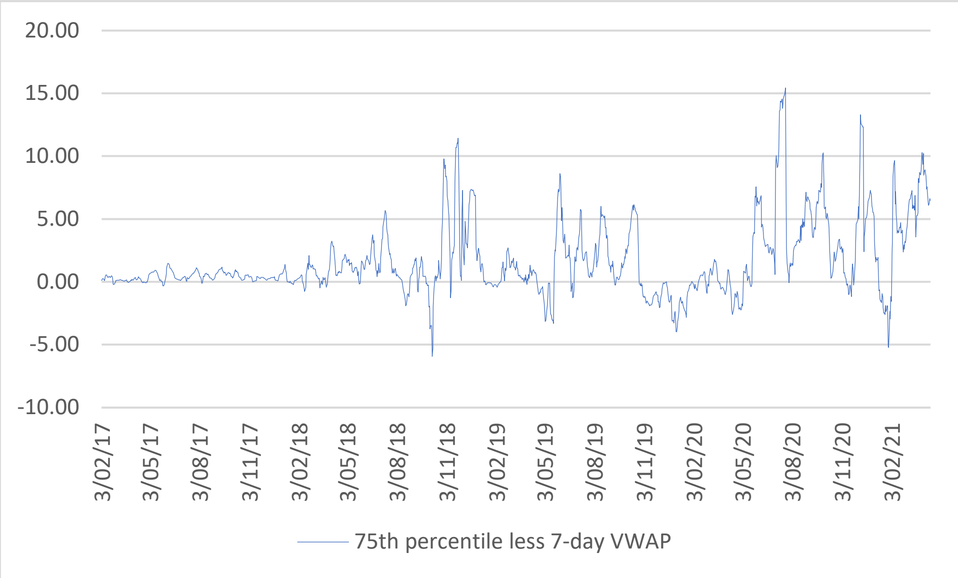
We support the Vector submission to remove balancing trades because it removes a small source of upward bias in the setting of the floor price. We do not support the Vector submission to place additional weight on trades within one day of the CCE.

4.2.2 Nova submission

We analysed the Nova suggestion by calculating the difference between the 75th percentile price of one-day trades over the relevant 21-day period[27] and the 7-day VWAP. Over the period 1 January 2019 to 15 April 2021, the 75th percentile price of one-day trades over the relevant 21-day period was on average \$2.16 above the 7-day VWAP with a standard deviation of \$3.49. The calculations required for the Nova option are much more complicated than for the 7-day VWAP and are more likely to generate a floor price that could exceed the CCP. The difference between the 75th percentile price over 21 days and the 7-day VWAP is shown in Figure 8.

[27] This is an approximation of the Nova proposal as we did not calculate the volume weighted average of the trades at the 75th percentile price. We were only able to calculate the 75th percentile for the period 3 February 2017 to 15 April 2021 due to the sparseness of spot trades before this date.

Figure 8 75th percentile (over 21 days) less 7-day VWAP



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company

Conclusion on Nova submission

We do not support the Nova suggestion to use the 75th percentile price of one-day trades over the relevant 21-day period to set the floor price as it is more likely to generate a floor price that could exceed the CCP than the 7-day VWAP.

4.2.3 Major Gas Users Group submission

The Major Gas Users Group suggestion for an average of the 12 highest emsTradepoint prices over the past 12 months is likely to produce a floor price above the 7-day VWAP and, therefore, an increased risk that the floor price would constrain the CCP determination.

Conclusion on Major Gas Users Group submission

We do not support the Major Gas Users Group suggestion to use an average of the 12 highest emsTradepoint prices over the past 12 months to set the floor price as it is more likely to generate a floor price that could exceed the CCP than the 7-day VWAP.

4.2.4 OMV submission

The OMV submission suggested the floor price could be based on previous periods of scarcity and expressed as a premium above the 7-day VWAP and implied that the floor price should be consistent with prices in *"an efficient short-term market that allocated scarce gas resources to the highest value uses".* In our view, this is the role of the CCP and not the floor price.

OMV did not suggest a value for the premium. A value for the 7-day VWAP was only available for the latest two of the four previous CCP. The CCP was about 18 percent above the 7-day VWAP in the earlier instance (24 May 2016) and 100 percent above the 7-day VWAP in the second instance (17 May 2017). In our view, these two data points do not provide enough information to suggest an average premium.

Conclusion on OMV submission

We do not support the OMV suggestion to base the floor price on previous periods of scarcity and express it as a premium above the 7-day VWAP as it is more likely to generate a floor price that could exceed the CCP than the 7-day VWAP.

4.3 Conclusion

Submitters either support using the 7-day VWAP as the floor price or an alternative calculation based on gas prices observed in the emsTradepoint market. We have reviewed submitters' suggestions for modification of the proposed floor price methodology. We support the Vector suggestion to exclude balancing trades. We do not support the suggestions for different methods of setting the floor price as we think they are more likely to result in a floor price that could exceed the CCP.

5 Potential economic cost of a gas outage

As part of our analysis, we were asked to consider the economic cost of a gas outage to consumers whose supply was curtailed and how applicable these estimates would be to setting the floor price. The economic cost of a gas outage varies with the nature of the outage but, in general, depends on the following factors:

- Size and duration of the outage in comparison to expected supply.
- Cost of alternatives to gas as a fuel.
- Loss of revenue net of the expected cost of gas as a result of the supply outage.

For industrial consumers other than electricity generators, these factors are difficult to observe and quantify after the outage is resolved, let alone at the start of the outage. Accordingly, they are at best a rough cross-check of the floor price. The following sections describe the information that is available on the value of gas to major industrial users.

5.1.1 Consumer classes by use of gas

Gas is used as feedstock for industrial processes (methanol and urea) and as a fuel for electricity generation (baseload and peak), industrial process heat (with and without cogeneration of electricity) and heating (commercial buildings and housing).

Consumers using gas as a feedstock account for the largest share of gas demand in the New Zealand market. These consumers do not have a viable short-term alternative feedstock and would need to reduce production (once any stores of gas are depleted) if their supply is curtailed. Their contracted gas price plus the gross profit per unit of gas is an estimate of the willingness to pay for gas. The demand for gas from these consumers is assumed to be evenly distributed evenly over the day.

The next largest share of gas demand is from electricity generators. The largest gas-fired electricity generator can, in the short term, partially substitute coal for gas, but the other generators must reduce their output if their supply of gas is curtailed. The demand for gas from electricity generators peaks in the early evening and has a secondary peak in the morning.

Industrial process heat consumers have limited options to substitute other fuels for gas and face a reduction in output if their supply is curtailed. For Fonterra in particular, the economic consequences of a reduction in gas supply are more severe than the loss of earnings from output alone as it will need to dump un-processed milk and compensate suppliers.

Buildings using gas for heating or steam are unlikely to have alternative options for heat. Houses using gas for heating and cooking will have partial alternatives gas for space heating but not water heating and cooking.

5.1.2 Industrials with gas feedstock

Calculating the estimated willingness to pay for gas by large industrial consumers (other than electricity generators) is not a useful approach for setting the CCP for the following reasons:

- Only highly aggregated information on the financial performance of these companies is publicly available. This makes it difficult to make a credible estimate of the average price they pay for gas.
- There is no publicly available information on the commitments these companies have to maintain supply to their customers, which would materially affect their willingness to pay for gas during short-term periods of scarcity.

The following examples of estimates of gas opportunity cost for Methanex and Ballance Agri illustrate the shortcomings of this approach and its lack of suitability to setting a floor price for gas during short periods of scarcity.

Methanex

Natural gas is the main input in the production of methanol. Methanex quarterly performance statements provide data on revenue and cost of sales. Dividing the reported cost of sales by the volume of gas consumed by Methanex provides a rough estimate of the average price paid by Methanex for gas (assuming that the cost of sales is almost all gas). Methanex's gross profit margin is a high estimate of the upper limit of the additional amount that Methanex would be prepared for gas to continue production. The results of these calculations are shown in Table 7.

Table 7 Methanex estimate of gas price tolerance

Revenue and cost in $m, gas consumed in PJ and prices in $/PJ

Category	2016	2017	2018	2019
Revenue	1,132.4	1,372.1	850.3	698.7
Cost of sales	913.3	1,110.3	626.0	542.8
Gross Profit	219.1	261.8	224.3	155.9
Gross profit/Cost of sales	24%	24%	36%	29%
Gas used (PJ)	82.1	69.1	55.2	66.7
Implied gas price ($/GJ)				
Gas is 80 percent of cost of sales	8.89	12.85	9.08	6.51
Gas is 90 percent of cost of sales	10.01	14.46	10.21	7.32
Gross profit per unit of gas ($/GJ)	2.67	3.79	4.06	2.34
Maximum opportunity cost[1]($/GJ)				
Gas is 80 percent of cost of sales	11.56	16.64	13.14	8.84
Gas is 90 percent of cost of sales	12.67	18.25	14.27	9.66

Note:

1 'Gas at 80 percent or 90 percent of cost of sales' plus 'Gross profit per unit of gas'.

Source: NZIER

Methanex gas price contracts are 'take or pay' but include a fixed component and a variable component that is linked to methanol prices.

> *The natural gas supply contracts for our facilities in New Zealand, Trinidad, Egypt and certain contracts in Chile are take-or-pay contracts denominated in United States dollars and include base and variable price components to manage our commodity price risk exposure. The variable price component of each natural gas contract is adjusted by a formula linked to methanol prices. We believe this pricing relationship enables these facilities to be competitive throughout the methanol price cycle.*[28]

An analysis of gas prices and volumes on emsTradepoint over the calendar years 2017 to 2019 indicated that Methanex had not released supply into the market in response to tight supply conditions:

> *However, deeper analysis of wholesale gas sales information shows that Methanex sold nil gas on the emsTradepoint market throughout all of 2017. …*
>
> *On average, Huntly Power Station has the largest influence on emsTradepoint prices and the Ahuroa Gas Storage Facility has the largest influence on emsTradepoint volumes.*[29]

Ballance Agri

Ballance Agri financial statements do not provide data on the cost of sales or gross profit from urea production. However, we can infer a range of gas prices for urea from the following information:

- Urea is an internationally traded commodity. Its price has fluctuated between USD 201 and USD 265 per tonne over the past 12 months. This price range converts from about NZD 310 to about NZD 408. After allowing for freight costs, this price would be an indication of the cost of an imported substitute for locally produced urea.[30]
- Kapuni uses about 26.4 GJ of gas to produce 1 tonne of urea (based on annual gas use of 7,000 TJ divided by annual production of 265,000 tonnes of urea).
- Production cost estimates for urea[31]suggest that fixed costs of production are about USD 150 (NZD 230) per tonne in US Gulf and about USD 200 (NZD 310) per tonne in Australia.
- Based on this information, we can make the following 'high' and 'low' estimates of average gas prices for Ballance Agri:
  - Combining the international price of urea with the gas required to produce a tonne of urea suggests that if gas were the only input, then the maximum price would be prepared to pay for gas would be NZD 11.70 to NZD 15.50 per GJ

28 Methanex Corporation Annual Report 2019 page 25.

29 'The Impact of Methanex Plant Outages on the Gas Wholesale Market, Prepared for Gas Industry Co. by Contract Strategies Limited, 4 February 2020, page 8.

30 The price for urea is volatile and has traded in a range of USD 140 to USD 305 over the five-year period 2016 to 2020.

31 'AMMONIA PRODUCTION COSTS AND GAS PRICES', Duncan Seddon', page 2, available at https://www.duncanseddon.com/docs/pdf/ammonia-production-costs.pdf .

- If the estimates of fixed production cost for Australia were applied to the Kapuni urea plant, then the average price that Ballance-Agri would be prepared to pay for gas would be NZD 4.20 per GJ to NZD 7.90 per GJ.

5.1.3 Electricity generators

A thermal generators' maximum willingness to pay for gas for a short period[32] is the:

- wholesale price of electricity (P_{Wh}) less the variable cost of generation (VC_{Gen}) both expressed in \$/MWh.
- divided by generators heat rate (HR_{Gen}) – gas required to generate electricity measured in GJ/MWh.
- less other variable costs related to gas:
  - Gas transmission charges (TC_{Gen}) in \$/GJ
  - Carbon cost CC_{Gen} in \$/GJ and calculated as the current price of an NZU multiplied by the natural gas emissions factor and assuming a 100 percent surrender obligation.

The formula for calculating willingness to pay for gas (WTP) is:

$$WTP = (P_{Wh} - VC_{Gen}) / HR_{Gen} - TC_{Gen} - CC_{Gen}$$

All of the inputs required for this calculation are publicly available.

32 The formula excludes the generators 'fixed costs' and therefore yield a fuel price that is higher than the long run average price that generators would be willing to pay for gas.

Table 8 Thermal generator willingness to pay for gas

Estimated net back price of gas (less carbon costs[1]) in $/GJ at electricity prices per MWh of $100, $125 and $150

Plant name	Variable cost ($/MWh)[2]	Heat rate (GJ/MWh)[2]	Fuel Delivery Costs ($/GJ)	Wholesale electricity price ($per MWh)		
				$100 per MWh	$125 per MWh	$150 per MWh
Baseload						
Huntly unit 5 (e3p)	5.2	7.4	0.50	10.20	13.58	16.96
Huntly gas units 1, 2 & 4	9.6	10.9	0.50	5.68	7.98	10.27
Huntly unit 6 (P40)	9.7	10.5	0.50	5.97	8.35	10.72
Taranaki CC	5.2	7.4	0.44	10.26	13.64	17.02
Peaker						
Stratford	9.4	8.9	0.44	7.62	10.43	13.24
McKee	9.4	9.0	0.00	7.96	10.73	13.51
Junction Road	9.4	9.0	0.00	7.96	10.73	13.51

Notes:

1 Carbon cost is calculated at $2.11 per GJ of gas based on: MBIE natural gas emissions factor for 2018 of 0.05402 t CO_2 per GJ multiplied by the NZU price of NZD 39.05 (2 March 2021) and assuming a 100 percent surrender obligation.

2 Data for variable cost of generation and heat rate are from '2020 Thermal Generation Stack, Update Report, Prepared for The Ministry of Business, Innovation & Employment, 29 OCTOBER 2020'. Table 3-3 pages 14 -15. Data for gas transmission costs from Huntly are from ''Determination of Critical Contingency Price in respect of the critical contingency of 23rd May 2017', Tim Denne.

Source: NZIER

Other major users

The estimated average price paid by Refining New Zealand[33] for natural gas in 2019 was $10.15 per GJ.

We have not been able to find data on average prices paid for gas or gross profit margins that would inform an estimate of the short-term opportunity cost for gas of the other three major users of gas: NZ Steel at Glenbrook, Oji Fibre Solution at Kinleith or Fonterra.

NZ Steel and Oji Fibre short-term opportunity cost for gas is likely to be at or below the cost for thermal electricity generators as their gross profit is sensitive to both electricity and gas cost, and they have the capacity to reschedule production in response to high energy prices.

Fonterra's opportunity cost is considerably higher than for the other major users because Fonterra processes a perishable input – milk and does not have viable alternatives to gas at most sites that use gas.

33 'Refining New Zealand Annual Report 2019' page 73, reports natural gas recovery costs of $39.6 million for the year ended 31 December 2019. This cost divided by gas used by Refining New Zealand of 3.9 PJ. It is not clear from the report how carbon cost has been treated.

5.2 Value added associated with gas

In a previous report[34] to the GIC, NZIER estimated the value added by industries that use gas.

Value added is that part of the value from production which comes from and is returned to workers and owners. It is the sum of profits and wages calculated by Statistics New Zealand in New Zealand's National Accounts and gross domestic product (GDP) statistics, also known as 'contribution to GDP'. It is the value that is directly at stake if a firm ceases production. This estimate, therefore, provides additional information about the economic effects of curtailment. As our previous report stated, however, care is needed in interpreting this figure:

> *The numbers in this document provide a guide to the relative magnitudes of potential value at risk due to demand curtailment. They do not account for the willingness of firms to pay for uninterrupted supply or the extent to which firms can substitute to other forms of energy and as such they should not interpreted as full assessment economic value at risk. In addition, the value added we refer to is connected to gas use but, … there are a range of other inputs which can be used in production including alternative sources of energy. The estimates we have produced should not be interpreted as being value added resulting exclusively from the use of gas.* (Stephenson and Schilling 2012, 4)

This section updates those estimates for industries that are major users of gas based on the following data sets:

- Energy end use database published by the Energy Efficiency and Conservation Authority (EECA) (Table 20and Table 21).
- Contribution to GDP by industry published by Statistics New Zealand.

The following table shows the industries that account for 95 percent of non-residential gas as recorded in the energy end use database and lists their estimated gas costs and the industry contribution to GDP.

[34] Stephenson and Schilling (2012).

Table 9 Large gas users – value added and cost of gas for 2019

Industry	Value added ($m)	Estimated gas cost[1] ($m)
Petroleum, Basic Chemical and Rubber Product Manufacturing	1,441	227
Other Food Product Manufacturing	2,481	90
Dairy Product Manufacturing	3,094	46
Pulp, Paper and Converted Paper Product Manufacturing	897	27
Primary Metal and Metal Product Manufacturing	878	16
Non-Metallic Mineral Product Manufacturing	1,199	14
Accommodation and Food Services	6,836	30
Meat and Meat Product Manufacturing and Seafood	2,766	12
Health Care and Social Assistance	18,302	22
Indoor Cropping	120	18
Arts, Recreational and Other Services	9,657	17
Retail Trade – Food	3,693	10
Wood Product Manufacturing	1,604	5
Textile, Leather, Clothing and Footwear Manufacturing	672	5
Fabricated Metal Product, Transport Equipment, Machinery and Equipment Manufacturing	7,667	4

Note:

1 Gas cost is estimated as the gas consumption from the Energy end use database (EECA) multiplied by the:

a estimated gas price for Methanex for the 'Petroleum, Basic Chemical and Rubber Product Manufacturing' industry

b MBIE average industrial gas price for all manufacturing industries

c MBIE average commercial gas price for all other industries.

Source: NZIER

5.3 Conclusion

Aside from electricity generators, there is insufficient data to estimate consumer willingness and major industrial users willingness to pay for gas. The values that have been estimated for Methanex and Ballance Agri are not usable in the calculation of the floor price because they:

- Require assumptions about the value of gas used that are difficult to verify using publicly available information (unlike the estimate of electricity generator willingness to pay for gas).
- Relate to annual averages rather than periods of short-term scarcity.
- Are below the 7-day VWAP calculated for transactions listed on emsTradepoint and electricity generator willingness to pay for gas.

6 Setting a floor for the critical contingency price

6.1 Floor price purpose

The purpose in setting a floor price is to increase industry certainty about the possible CCP that will be applied. It is explicitly **not** designed to be an estimate of what the CCP will be.

As the industry expert appointed to set the CCP after the 2012 Critical Contingency observed:

> *Section 71(2) makes clear that the intent of the critical contingency price is that it mimics what a competitive short-run market price would be if the market was allocating the limited quantity of gas available during the critical contingency. Normally this would be the outcome of interactions between supply and demand, ie the volume which gas suppliers would be willing to supply at a given price and the volume which consumers would consume at that same price.* (Denne 2012, 5).

To be effective, the floor price must be:

- Able to be calculated simply and quickly enough so that it can be set at the start of the crisis without information on how long the scarcity may evolve.
- High enough to encourage large gas users (particularly those regularly consuming more than 15 TJ per day[35]) to consider altering their usage.
- Low enough so that it is at or below the CCP which will be determined by an independent expert after the event. (Based on past experience this price will be at or above the estimated willingness of thermal electricity generators to pay for gas.)

6.2 What we have considered

In suggesting a process for setting the floor price, we have considered the following factors:

- Regulations for setting the critical contingency, which emphasise the prices in the wholesale electricity market whether supply is curtailed or not.
- Economic value of gas to major users and their willingness to pay for gas. This provides an indication of the price that would be required to encourage some consumers to forego their use of gas.
- History of gas pipeline outages and the critical contingency price determinations to provide a reality check on the effectiveness of the floor price as a consistent and reliable indicator of CCP.

Looking at each of these considerations in turn:

- The CCM regulations and past CCP decisions are the main determinants of our suggested approach to setting the CCP floor. The current CCM regulations include three criteria that the industry expert needs to consider:
  - the prices in the wholesale market for electricity during the critical contingency

[35] These users are Methanex, Ballance Agri, and Genesis (Huntly plant) and Contact (Taranaki Combined Cycle plant). Fonterra also uses more than 15 TJ per day for up 145 days per year but has a much higher opportunity cost for gas than other major users because it cannot defer processing of milk and because the cost of gas is low in comparison to the economic cost of not processing milk.

- the economic cost of the loss of gas supply to those consumers who had their gas supply curtailed and
- any other matters that the industry expert considers relevant.

- The economic value of gas to major users (other than electricity generators) and their willingness to pay for it is difficult to calculate other than on an annual or quarterly average basis because of the lack of information on the amount they pay for gas and their pattern of use. For a CCE, the relevant question is the value of marginal quantities of gas that can be reallocated at short notice. Estimates of annual or quarterly average gas costs are not a good indicator of the value of gas in a CCE. The observed prices for gas in the emsTradepoint market provides a better indication of the marginal willingness to pay for major industrial users (other than electricity generators).
- The history of gas price outages provides a rough consistency check on the proposed floor price methodology, but its usefulness is limited by the following changes in the gas and electricity markets:
  - trade information from emsTradepoint was not available for two of the four CCEs, and the emsTradepoint market volumes were much higher for the second CCE than they were for the first
  - the volatility and average level of electricity prices have increased, which causes a slightly larger increase[36] in the calculated generator willingness to pay for gas.

6.3 An average price

A volume weighted average of recent gas prices provides an indication of what gas users were willing to pay before a CCE. It is aligned to the concept of opportunity costs once a scarcity occurs for the following reasons:

- The market provides a mechanism for gas users, suppliers and shippers to trade gas 'immediately' in response to changes in supply and demand.
- As it is an average, it combines the willingness to pay of users with higher and lower opportunity costs and obscures the response of individual gas users to arise in price.

Suggestions to use an average of past peak prices (Major Gas Users Group, Nova and OMV) would provide a better indication of prices in previous periods of gas scarcity, but the current scarcity may be more or less severe than previous periods of gas scarcity. Also, as the floor price is supposed to be an indicative minimum of the price that will be determined after the event relying on past peaks is likely to set the floor price at too high a level.

That said, as a floor price, as opposed to an estimate, an appropriate average of observed prices has advantages:

- It is, by definition, observable by all market participants.
- It will at least be closely correlated to the opportunity cost of gas.
- It is an easily understood metric that does signal that gas will become scarce during a critical contingency.

36 For example, if wholesale electricity prices increase from $100 per MWh to $200 per MWh (100 percent) the calculated gross willingness to pay for gas at Huntly Unit 5 increases from $12.31 per GJ to $25.82 per GJ (105 percent).

To reflect the willingness to pay for gas alone and be consistent with the CCP methodology (which excludes carbon prices), the VWAP should exclude carbon prices. The VWAP excluding carbon prices is calculated by reducing the value of gas sold each day by the cost of purchasing NZU to cover CO_2 emissions per GJ of gas and then dividing this reduced value by the volume of gas sold to calculate a VWAP excluding carbon costs. Carbon prices are readily available. The adjustment process is explained in more detail in Appendix E.

6.4 Wholesale electricity prices

6.4.1 While baseload generation continues

The regulations require the consideration of wholesale electricity prices, and gas used for electricity generation accounted for about 20 percent of net gas supply in 2019.

In practice, it is much more straightforward and less open to challenge to calculate the willingness of thermal generators to pay for gas than it is to assess the potential economic loss to industries using gas as fuel for process heat (rather than primarily as a feedstock). This is because a key driver of economic harm to users of gas process heat is their ability to defer processing until the outage is over. Those industries that can defer activity at short notice and where gas is a substantial proportion of their input costs face a much lower cost from an unplanned curtailment of gas supply than industries such as food processors, for which a large proportion of their input costs are perishable raw materials.

6.4.2 After gas-fired baseload generation is replaced by renewables

However, the current Government's aspirations for 100 percent renewable electricity generation, as well as forecasts of the increase in costs of gas as a fuel and the intentions of Genesis (the owner of Huntly power station), all suggest that the gas will cease to be used for baseload electricity generation within the next 10 years.

While gas will continue to be used to meet peak load requirements, forecasts completed for the Climate Change Commission suggest two different outlooks for the use of gas in electricity generation depending on the assumption about the timing of the closure of Methanex and the aluminium smelter at Tiwai Point.

Forecasts prepared for the Climate Change Commission[37] draft advice suggest that total gas demand in 2029 will be less than 40 percent of 2020 levels primarily due to the closure of Methanex. According to these forecasts:

- Gas demand from electricity generators in 2029 will be about 35 percent of demand in 2020.
- The share of total gas demand from electricity generation will be 22 percent in 2021, decline to 11 percent by 2026 and then recover to 23 percent in 2029 and remain around this level until 2035.

[37] Output from ENZ model, 10 February 2021 - '2021-Draft-Advice-Scenarios-dataset-v2.xlsx', 'Our Path to 2035' worksheet, rows 210 to 219, Concept Consulting' available at https://www.climatecommission.govt.nz/get-involved/sharing-our-thinking/data-and-modelling/

Forecasts prepared for the Climate Change Commission[38] final advice suggest that total gas demand in 2029 will be around 60 percent of 2020 levels primarily due to reduced demand from Methanex. According to these forecasts:

- Gas demand from electricity generators in 2029 will be about 40 percent of demand in 2020.
- The share of total gas demand from electricity generation will be 23 percent in 2021, decline to 1 percent by 2025 and then recover to 19 percent in 2029, increase to 24 percent in 2030 and reach 27 percent by 2035.

6.5 Minimum of willingness to pay and 7-day VWAP (ex-carbon prices)

As noted at the beginning of this section, the purpose of the floor price is to increase industry certainty about the possible CCP that will be applied but increase industry certainty about the possible CCP that will be applied. It is explicitly **not** designed to be an estimate of what the CCP will be and to be effective, so it must be at or below the CCP, which will be determined by an independent expert after the event.

Wholesale electricity prices may decline or rise over the course of the CCE due to factors unrelated to the gas market.[39] Electricity prices vary widely during the day depending on whether demand is at peak, shoulder or off-peak levels, which can, in turn, affect the calculation of generator willingness to pay by a factor of two or three. To lower the risk of the floor exceeding the CCP, we suggest that the floor is based on the minimum of the willingness to pay calculated based on wholesale electricity prices and the 7-day VWAP (excluding balancing transactions and carbon prices).

6.6 Alternatives considered but discounted

We have also considered using either quarterly gas prices published by MBIE and our estimate of the gas price paid by Methanex (see section 5.1.2). We have discounted these options primarily because they are averages over 3 months. They are also calculated with a lag and, therefore unlikely to indicate the value of gas close to the time of the CCE. Quarterly MBIE gas price data is usually published three to four months after the end of the quarter. Methanex statements required to calculate the quarterly average are published 4 weeks after the end of the quarter. (An additional objection to the use of the estimated Methanex price is the need to assume a percentage of the cost of sales that applies to gas purchases in the absence of any independently verifiable of this percentage.)

We also note that these alternatives were not suggested in submissions made by stakeholders on the GIC proposal for a floor price.

38 Output from ENZ model, 9 June 2021 - 'Scenarios-dataset-2021-final-advice.xlsx', 'Demonstration Path' worksheet, rows 244 to 247, Concept Consulting' available at https://www.climatecommission.govt.nz/our-work/advice-to-government-topic/inaia-tonu-nei-a-low-emissions-future-for-aotearoa/modelling/

39 The CCE on 24 May 2016 is an example of this situation. The wholesale electricity price fell from $75.48 per MWh at the start of the CCE to $60 per MWh within half an hour (one trading period) and remained in a range of $53.10 per MWh to $58.79 per MWh for the rest of the CCE.

6.7 Conclusion

In our view:

- A key determinant of the desirable price floor is that it is a floor, not an estimate of the CCP and therefore, the risk that the floor could exceed the CCP should be made as low as possible.
- The cost of a gas outage to consumers is not observable at the beginning of a CCE.
- Recent prices (excluding balancing transactions and the cost of carbon) paid by consumers in the emsTradepoint market provide the best observable indication of the value of marginal quantities of gas to those consumers.
- The regulations require the consideration of both wholesale electricity prices and the cost of a gas outage. Therefore, the electricity generator willingness to pay for gas needs to be considered in setting the floor along with recent prices.

We suggest that the proposed approach that best satisfies these requirements and is consistent with the common themes of stakeholder submissions analysed in section 4 is:

- While the Huntly Unit 5 is in operation, the minimum of:
  - The 7-day VWAP of gas in the emsTradepoint system excluding balancing trades and adjusted to remove the allowance for carbon prices[40] (as long as there were trades within the last 7 days)
  - The willingness to pay for gas of the Huntly Unit 5 plant based on the wholesale electricity price[41] at the time the CCE is declared and using the methodology and assumptions described in section 5.1.3.
- Otherwise, the 7-day (VWAP) of gas in the emsTradepoint system excluding balancing trades and adjusted to remove the allowance for carbon prices.[42]

[40] emsTradepoint gas prices include the cost of carbon calculated as the closing price of NZUs on the day and converted to a price in $ per GJ of gas using the MBIE natural gas emissions factor. This element will need to be deducted.

[41] Up to date electricity prices for selected nodes are available at https://www.em6live.co.nz/Default.aspx. More detailed real time pricing data are available as a subscription service through https://www.ems.co.nz/services/em6/

[42] If there were no trades within the last 7 days, the floor should be based on the most recent 7-day VWAP within the past month.

7 Comparison of floor price to past outages

This section compares our proposed approach (see section 6.7) for setting the floor price to critical contingency events that occurred on:

- 13 July 2010 – the CCM gas price was based on the price paid in the balancing gas market.
- 03 March 2012 – the CCM gas price was based on the willingness of combined cycle gas turbine (CCGT) plants at Huntly and Otahuhu B[43] but set above the price other thermal generators would be willing to pay.[44]
- 24 May 2016 – Netback of gas price for Huntly e3P (baseload generator) but above the
  - willingness to pay of the highest cost thermal generators (McKee and Stratford peakers) operating during the CC event
  - highest price paid in the gas market of $5.85/GJ.[45]
- 23 May 2017 – Netback of gas price for Huntly e3P (baseload generator) but above the willingness to pay of the highest cost thermal generators (McKee and Stratford peakers) and prices paid in the gas market.[46]

The proposed floor price was less than the final CCM price but above gas market prices for two of the four CC events.

43 Otahuhu B has been decommissioned.

44 Denne (2012, 9).

45 Op cit page 5.

46 Op cit page 8.

Table 10 Comparison of floor price to past outages

Contingency floor price actually set and the proposed floor price – the minimum of the 7-day VWAP (excluding carbon prices) and the estimated willingness to pay for gas based on Huntly Unit 5

Date	CCM description duration and response	Final CCM price ($/GJ)	Proposed CCM floor price calculation[1]			
			CCM Floor ($/GJ)	Generator netback ($/GJ)	Wholesale price[2] ($/MWh)	7-day VWAP ($/GJ)[2]
13 Jul 2010	19:30 to 22:32 – no regulatory curtailment	15.00	11.64	11.64	95.05	N/A
03 Mar 2012	12:48 to 23:30 – regulatory curtailment of bands 0, 1a and 1b	11.10	9.02	9.02	75.63	N/A
24 May 2016	18:30 to 23:00 – no regulatory curtailment	6.66	5.58	8.62[3]	75.48	5.58
23 May 2017	11:14 to 18:15 – no regulatory curtailment	10.62	5.25	7.82[3]	71.72	5.25

Notes:

1 The CCM floor price calculation is the minimum of the:

- a Generator netback as explained in section 5.1.3 with the relevant NZU surrender obligation.
- b 7-day VWAP exclusive of the price carbon as explained in Appendix E (if the VWAP was available).

2 Wholesale electricity price at node HLY2201 for the trading period at the beginning of the CCM.

3 Net of the cost of CO_2 emissions of $0.38 per GJ in 2016 and $0.67 per GJ in 2017.

Source: NZIER

8 Conclusion and recommendations

8.1 Discussion

In our view, the key determinant of the desirable price floor is that it is a floor, not an estimate of the CCP.

What the GIC is proposing is to reduce, not eliminate, uncertainty by signalling that users can plan on the basis that while the CCP will still be determined based on the industry expert's view of the three relevant factors, it will never be lower than a knowable floor.

Likely future developments in the gas industry suggest that electricity generator willingness to pay for gas (estimated from the wholesale price of electricity less the variable costs of a gas-fired electricity generator) may become a less useful indicator floor price, especially if the Government's 100% renewable generation target is met. While it has advantages in being readily observed, it will become less indicative of the economic cost of the loss of gas supply to those consumers who have supply curtailed.

This takes us back to the GIC's original proposal of using a weighted average of observed prices of gas as a **floor**. Given that a critical contingency, by definition, means that supply is constrained compared to demand, it will always be the case that the declaration of a critical contingency will lead to prices increasing: less supply, with demand in place, will, according to fundamental economic principles, lead to higher prices. The practical difficulty, of course, is that this price increase is not observable in real-time. Hence the need for an industry expert to set a CCP *ex-post*.

8.2 Recommendation

Based on the proposed change to the regulations and the outlook for limited change in demand and supply over the next five years and provided that Huntly Unit 5 is in operation at the time of the CCE, we recommend that the floor price setting methodology is the minimum of:

- The 7-day moving average of the volume weighted average prices (7-day VWAP) of gas in the emsTradepoint system (excluding balancing trades) adjusted to remove the allowance for carbon prices[47]
- The willingness to pay for gas of the Huntly Unit 5 plant based on the wholesale electricity price[48] when the CCE is declared and using the methodology and assumptions described in section 5.1.3.

We propose that the floor is set at the lower of the 7-day VWAP (excluding carbon prices and balancing trades) and the willingness to pay for gas of the Huntly Unit 5 plant to minimise the risk that the floor could be set above the CCP.

If Huntly Unit 5 is not generating electricity at the time of the CCE, we recommend that the floor price is based on the 7-day VWAP of gas in the emsTradepoint system (excluding balancing trades) adjusted to remove the allowance for carbon prices.

[47] emsTradepoint gas prices include the cost of carbon calculated as the closing price of NZUs on the day and converted to a price in $ per GJ of gas using the MBIE natural gas emissions factor. This element will need to be deducted.

[48] Up to date electricity prices for selected nodes are available at https://www.em6live.co.nz/Default.aspx. More detailed real time pricing data are available as a subscription service through https://www.ems.co.nz/services/em6/

The proposed approach is the simplest option that is consistent with the regulations and the determinations of the CCP for the previous four CCEs.

The simplicity is achieved at the justified expense of a more detailed consideration of the short-term variations in the demand for gas (particularly for electricity generation) and the expected duration and severity of the CCE.

References

Denne, Tim. 2012. 'Determination of Critical Contingency Price: 2012'. Wellington: Covec.

———. 2017. 'Determination of Critical Contingency Price'. Auckland: Covec Limited.

Gas Industry Company. 2017. *The New Zealand Gas Story*. Sixth. Wellington: Gas Industry Company. https://www.gasindustry.co.nz/about-the-industry/nz-gas-story/document/5806.

———. 2020a. 'Critical Contingency Management: Overview'. 2020. https://www.gasindustry.co.nz/overview.

———. 2020b. 'Gas Industry – Facts at a Glance'. Gas Industry Company. https://www.gasindustry.co.nz/about-the-industry/nz-gas-story/document/6540.

———. 2020c. 'Statement of Proposal for Amending the Critical Contingency Management Regulations'. Wellington: Gas Industry Company. https://www.gasindustry.co.nz/work-programmes/critical-contingency-management/consultation-statement-of-proposal-for-amending-ccm-regulations/document/6966.

Interim Climate Change Committee. 2019. 'Accelerated Electrification'. Wellington: Interim Climate Change Commission. https://www.iccc.mfe.govt.nz/assets/PDF_Library/daed426432/FINAL-ICCC-Electricity-report.pdf.

Ministry for the Environment. 2020. 'New Zealand's Greenhouse Gas Inventory 1990-2018'. April 2020. https://www.mfe.govt.nz/publications/climate-change/new-zealands-greenhouse-gas-inventory-1990-2018.

New Zealand, and Innovation & Employment Ministry of Business. 2019. *Discussion Document, Accelerating Renewable Energy and Energy Efficiency.* https://www.mbie.govt.nz/dmsdocument/10349-discussion-document-accelerating-renewable-energy-and-energy-efficiency.

Stephenson, John, and Chris Schilling. 2012. 'Value Added Associated with Gas Demand'. Wellington: New Zealand Institute of Economic Research. https://www.gasindustry.co.nz/publications/document/2735.

Appendix A Regulations[49]

A.1 Section 67 – Purpose of critical contingency price

Critical contingency price for contingency imbalances

67 Purpose of applying critical contingency price to contingency imbalances.

The purpose of regulations 68 to 71 is to determine a critical contingency price to be applied to the contingency imbalances sustained by interconnected parties and shippers during a critical contingency to—

(a) avoid shippers instructing their suppliers of gas to reduce supply during a critical contingency when those shippers' consumers have been curtailed; and

(b) signal to suppliers and consumers of gas that it is a scarce and valuable product during a critical contingency; and

(c) provide incentives before a critical contingency, particularly for retailers who supply gas to consumers who are unlikely to be curtailed, to make alternative arrangements to minimise the financial consequences of a critical contingency.

A.2 Section 71 – Setting the critical contingency price

71Determining critical contingency price

(1) The industry expert must determine the critical contingency price in dollars per gigajoule of gas.

(2) The industry expert must seek to set the critical contingency price at a level that reflects the price that would be established by an efficient short-term market that allocated scarce gas resources to the highest value uses during the critical contingency.

(3) If—

(a) only consumers in curtailment bands 0 and 1, or 0, 1, and 2, were curtailed during the critical contingency, the industry expert must base his or her determination on the prices in the wholesale market for electricity during the critical contingency except where that would be contrary to subclause (2); and

(b) any other circumstances apply, the industry expert must take into account the following matters:

(i) the prices in the wholesale market for electricity during the critical contingency; and

(ii) the economic cost of the loss of gas supply to those consumers who had their gas supply curtailed; and

(iii) any other matters that the industry expert considers relevant to achieving subclause (2).

[49] See Gas Governance (Critical Contingency Management) Regulations 2008 at https://www.legislation.govt.nz/regulation/public/2008/0426/latest/DLM1683495.html

Appendix B Gas price data

B.1 Introduction

This section includes additional data on the estimates of prices paid by major purchasers of gas as well as indications from major suppliers of the values they attach to the gas they sell to different market segments. These are both compared to the MBIE datasets on gas prices, which seem to be estimated from surveys of retail prices.

B.2 Methanex

The following table shows revenue and cost of sales data obtained from Methanex New Zealand Annual Reports[50] and uses methanol production data from Methanex 'fourth quarter' reports.[51]

The annual reports do not explain what is included in the cost of sales and do not provide information on the paid for gas. However, the annual reports from 2016 and earlier provide more detail than those in later years about what is and is not included in the cost of sales. In particular:

- Wages included in the cost of sales in 2016 accounted for less than 4 percent of the cost of sales.
- Other expenses from normal activities such as distribution and administration were not included in the cost of sales.
- Depreciation and rental payments were not included in the cost of sales.
- No indication that Methanex NZ was purchasing methanol for on-sale.

This information rules out the inclusion of several potential non-gas costs in the cost of sale and provides supporting evidence that the main component of the cost sales Is payment for gas.

Estimates of the price paid by Methanex for gas in Table 11 are defensible despite the fact that they are well above the MBIE estimates of the wholesale price of gas and the price of energy attributed to gas by Genesis and Contact.[52] However, as noted in section 5.1.2, these estimates are not suitable as estimates of the floor price.

50 The reports used were for the years ended 31 December: 2010 (pages 17-18), 2012 (pages 17-18), 2014 (pages 17-18) 2016 (pages 19-20), 2017 (page 6), 2018 (page 5) and 2019 (page 5). These reports are available from the NZ Companies Office.

51 The reports used were for the quarters ended 31 December: 2010 (page 2), 2012 (page 3), 2014 (page 3) 2016 (page 2), 2018 (page 5) and 2019 (page 4). These reports are available at https://www.methanex.com/investor-relations/financial-reports.

52 Genesis Energy and Contact are the main suppliers of gas for which we can obtain financial accounts.

Table 11 Methanex estimate of gas price tolerance

Revenue and cost in $m, gas consumed in PJ and prices in $/PJ

Category	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Revenue	621.4	711.9	818.0	1,193.8	1,501.2	1,220.6	1,132.4	1,372.1	850.3	698.7
Cost of sales	498.0	574.9	649.0	904.7	1,116.9	1,024.3	913.3	1,110.3	626.0	542.8
Gross Profit	123.4	137.0	168.9	289.1	384.3	196.3	219.1	261.8	224.3	155.9
Gross profit/Cost of sales	25%	24%	26%	32%	34%	19%	24%	24%	36%	29%
Gas used (PJ)	28.3	28.3	37.7	51.8	84.8	67.8	82.1	69.1	55.2	66.7
Implied gas price ($/GJ)										
Gas is 80 percent of cost of sales	14.09	16.27	13.76	13.98	10.54	12.09	8.89	12.85	9.08	6.51
Gas is 90 percent of cost of sales	15.85	18.30	15.48	15.73	11.85	13.60	10.01	14.46	10.21	7.32
Gross profit per unit of gas ($/GJ)	4.37	4.85	4.48	5.58	4.53	2.90	2.67	3.79	4.06	2.34
Maximum opportunity cost[1] ($/GJ)										
Gas is 80 percent of cost of sales	18.46	21.12	18.24	19.56	15.07	14.99	11.56	16.64	13.14	8.84
Gas is 90 percent of cost of sales	20.22	23.15	19.96	21.31	16.38	16.50	12.67	18.25	14.27	9.66

Note:

1 ‘Gas at 80 percent or 90 percent of cost of sales’ plus ‘Gross profit per unit of gas’.

2 Estimated for 2010 and 2011 based on gas to methanol conversion rate of 34TJ per tonne of methanol in 2012. Over the period 2014 to 2019, Methanex’s volume of gas input per tonne of methanol varied between 34.4 and 38.9 TJ of gas per tonne of methanol.

Source: NZIER

B.3 Gas suppliers

Genesis Energy[53] and Contact both operate gas-fired thermal generation and supply gas to commercial and residential customers. Their annual reports provide the following indications of the value of gas to generate electricity and commercial and residential users.

53 Genesis operates the Huntly (baseload) generation plant and accounts for about 65 percent of the gas used for electricity generation. Contact owns the Taranaki Combined Cycle (baseload), Stratford (peaker) generation plant and the Te Rapa cogeneration plant which is supplies the Fonterra plant with steam and electricity. Todd Generation Taranaki owns the McKee, and Junction Road generation plants.

Table 12 Genesis Energy gas values

Revenue and cost in $m, gas consumed in PJ and prices in $/PJ

Category	Q3 FY18	Q4 FY18	Q1 FY19	Q2 FY19	Q3 FY19	Q4 FY19	Q1 FY20	Q2 FY20	Q3 FY20	Q4 FY20	Q1 FY21	Q2 FY21
Gas Netback ($/GJ)	8.89	8.10	8.70	8.80	10.10	9.21	9.40	9.80	10.60	10.60	10.50	10.50
VWAP[1] ($/GJ)												
Residential	53.18	31.13	25.80	34.30	57.40	32.15	27.20	36.30	51.40	32.80	28.60	37.60
SME	18.76	15.35	14.40	16.80	19.20	15.50	14.56	16.30	17.60	17.30	15.40	17.00
C&I	9.59	9.91	10.00	10.90	10.80	10.27	10.41	11.10	10.90	10.80	10.50	12.20
Gas Sales (PJ)												
Residential	0.3	0.7	1.1	0.6	0.3	0.7	1.0	0.6	0.3	0.7	1.1	0.6
SME	0.2	0.4	0.5	0.4	0.3	0.5	0.6	0.4	0.3	0.3	0.5	0.4
C&I	0.8	1.0	1.0	0.9	0.8	1.1	1.1	0.8	0.8	0.9	1.2	0.7
Total	**1.4**	**2.1**	**2.7**	**1.8**	**1.4**	**2.3**	**2.7**	**1.8**	**1.4**	**2.0**	**2.8**	**1.6**
Internal electricity generation (PJ)												
Gas used	6.7	5.7	5.3	3.4	5.9	5.7	5.5	4.6	6.5	8.0	5.7	5.0
Coal used	1.7	3.3	1.2	5.7	5.7	3.3	4.2	3.5	4.5	3.1	6.3	4.1
Weighted average cost												
Gas burn cost ($/GJ)	8.43	8.80	8.26	8.44	9.12	8.80	9.10	9.70	9.20	8.55	9.00	9.00
Coal burn cost ($/GJ)	5.38	6.83	5.61	5.91	6.63	6.83	7.10	7.10	6.58	6.30	6.10	6.00
Fuel Cost - Thermal ($/MWh)	69.66	76.82	68.54	68.65	78.13	76.82	81.44	79.33	81.88	71.72	78.95	81.33
Fuel Cost - Portfolio ($/MWh)	42.89	47.23	30.03	38.30	56.76	47.23	47.79	44.97	60.59	52.74	49.25	48.48

Note:

1 'Volume weighted average price

Source: NZIER

Table 13 Contact gas price data

	FY17	FY18	FY19	FY20	FY21 (f)
Gas used (PJ)					
Residential	1.6	1.6	1.6	1.6	
SME	0.9	1.3	1.5	1.4	
Tariff ($/GJ)					
Residential	32.00	31.60	31.50	33.10	32.00
SME	17.50	15.50	15.10	15.50	17.50
Gas values ($/GJ)					
Gas costs	5.80	5.60	5.90	7.90	5.80
Carbon costs	0.30	0.70	1.00	1.40	0.30
Total energy cost	6.10	6.30	6.90	9.30	6.10
Thermal plant fuel cost ($/MWh)[1]	59.00	62.00	76.00	77.00	81.00

Notes:

1 Includes cost of carbon.

Source: NZIER

Appendix C Submissions on floor price setting

C.1 Submitters

This section summarises the views in submissions on questions 3 and 4 of the Gas Industry Council Statement of Proposal for amending CCM Regulations from:

- emsTradepoint (question 3 only).
- First Gas.
- Fonterra.
- Major Gas Users Group on behalf of: Ballance Agri-Nutrients Ltd, Fonterra Co-operative Group, New Zealand Steel Ltd, Oji Fibre Solutions (NZ) Ltd and Refining NZ
- Nova Energy.
- OMV.
- Vector.

Transpower and Haast Energy trading made submissions on the amendment but did not submit on questions 3 and 4.

These submissions need to be assessed on the extent to which they are likely to set a floor price that meets the objectives of the regulations and is below the CCP that is likely to be determined by the industry expert. This suggests the floor price should be:

- above market prices immediately before the critical contingency event (to signal scarcity of supply).
- influenced by the price generators are willing to pay for gas based on current wholesale electricity prices (because this price is likely to be similar to or lower than the estimated willingness to pay of other major gas users).

Table 14**,** Table 15 and Table 16 include submitters comments on question 3 about the calculation of the floor price and Table 17 and Table 18 include submitter comments on question 4 other benchmarks for calculating the floor price.

Table 14 Submissions on Question 3 emsTradepoint, FirstGas and Fonterra

Q3: Do you agree with adding a floor price to the calculation of the contingency price? Do you agree with the proposed calculation method, using VWAP for the 7 days prior to and including the critical contingency day?

Submitter	Submission
emsTradepoint	Overall, we support the use of emsTradepoint's Volume Weighted Average Price (VWAP) as a floor price in a critical contingency event, but we think that the price calculation method needs to consider the following factors. 1 The graphs included in the consultation document differentiate between market and off-market trades. It is unclear .... If the differentiation is deliberate, explaining why would be helpful. 2 … emsTradepoint suggests this carbon component element of the gas price is considered if the emsTradepoint price is used for calculating a floor price in a CCM event. 3 … We therefore suggest that in a Critical Contingency event the relevant price is published on the emsTradepoint public website, the regulator's website, or the Critical Contingency Operator website so it is available industry-wide for that day. 4 As highlighted in the consultation document, volume going through emsTradepoint can often be 'peaky'. There may be days where no volume is traded through emsTradepoint. emsTradepoint agrees the floor price should use the average VWAP of seven days leading to and including the event. This would account for either a lack of volume, or anomalous prices. From a price perspective, it has been observed that the emsTradepoint VWAP may not be fully representative of market conditions, this is predominantly due to the fact the Gas System Operator (SO) uses the spot market to buy and sell for pipeline balancing purposes. In this case the SO is often a price taker, pushing prices up or down depending on if they are a net seller or net buyer. emsTradepoint notes that these peaks and troughs in prices are beneficial in setting a floor price. The market still captures the value of scarcity. The contingency price floor therefore needs to be reflective of that scarcity.
First Gas	Yes. It feels sensible to have a floor price to ensure that the CC price should always reflect the scarcity of gas and incentivise the correct behaviour from gas users. Such a mechanism would have been an appropriate safety net when circumstances like the May 2016 critical contingency event presented themselves. Yes, 7-days feels like the right balance to strike for the reasons set out in the GIC's paper.
Fonterra	No additional comment. (See Major Gas Users Group submission).

Source: NZIER

Table 15 Submissions on Question 3 – Major Gas Users Group, Methanex

Q3: Do you agree with adding a floor price to the calculation of the contingency price? Do you agree with the proposed calculation method, using VWAP for the 7 days prior to and including the critical contingency day?

Submitter	Submission
Major Gas Users Group	We agree with setting a floor price if the current methodology of independent post-event valuation continues (see our alternative suggestion in response to Q4). The floor price should attempt to reflect the value transfer between parties forced to forego gas it is entitled to under contract vs parties taking gas it is not entitled to. The trading market should be a reasonable reflection of the marginal value of gas under various demand/ supply conditions, although not necessarily for tight supply conditions. However, it is reasonable to assume that the contingency price shouldn't fall below the VWAP over the previous 7 days.
Methanex	Methanex supports use of a price floor based on gas market VWAP and the use of a 7-day rolling average represents a reasonable compromise between a price which reflects current conditions without at same time being too volatile or relying on a price where market depth or trading activity may have been insufficient. Methanex generally supports strengthening incentives for participants to follow curtailment instructions. However, it is also critical that curtailment instructions are as far as practicable, provide consumers with a reasonable opportunity to shed load in a safe, efficient and orderly manner to minimise exposure to "no-fault" imbalance penalties. In a number of respects, the proposals made in Section 5 and 6 if the SOP run counter to this. In this regard, Methanex Is particularly concerned with proposed changes to curtailment band definitions and curtailment orders that increase the prospect of inadvertent and uncontrollable contingency imbalances being incurred by consumers.
Nova	Nova agrees with adding a floor price. The 7-day VWAP may not be a good indicator of the value of gas on the day of an outage. Given gas demand is related to the weather, a critical contingency could easily occur on a cold snap following a week of warm weather, in which case prices on the previous week would be misleading.

Source: NZIER

Table 16 Submissions on Question 3 – OMV and Vector

Q3: Do you agree with adding a floor price to the calculation of the contingency price? Do you agree with the proposed calculation method, using VWAP for the 7 days prior to and including the critical contingency day?

Submitter	Submission
OMV	We also support the proposed introduction of a floor price to ensure that the Critical Contingency Price remains broadly predictable. However, we do not think that a pricing mechanism for the floor price that refers to recent historic pricing prior to a Critical Contingency Event I s consistent with the objective of having a price that reflects the scarcity of gas during the Critical Contingency Event. Almost by definition, the minimum pricing during the event must be some margin above the pricing immediately prior to the event. Yes, a floor price would reduce the pricing uncertainty during a critical contingency event. However, an average of the pricing in the (7) days immediately prior to an event would not price the gas that is available during an event consistent with "an efficient short-term market that allocated scarce gas resources to the highest value uses" and therefore would not be a suitable floor price. Alternatively, a floor price could be derived using known periods of gas scarcity (either using previous critical contingency events and/or emsTradepoint data). This floor price could be expressed as a premium for gas that is available during an event above the 7-day volume-weighted emsTradepoint average price and could be calculated conservatively such that it acted as an effective minimum.
Vector	Yes, we agree with adding a floor price to the calculation of the critical contingency price. This should provide certainty to those parties who can deliver more gas into the system when needed. We would favour market trades and off-market trades transacted on emsTradepoint (i.e. within a day prior to the critical contingency event being declared) to be given greater weight in the calculation of a floor price. Those transactions on emsTradepoint are more relevant than those that have occurred over the prior week. We would caution against the inclusion of balancing gas transactions in the calculation of VWAP. This may result in a materially higher floor price that exceeds the value of gas to any other buyer. This is because there appears to be a disconnect for prices at certain times between transactions involving the system operator and those that do not.

Source: NZIER

Table 17 Submissions on Question 4 – FirstGas, Fonterra, Major Gas Users Group, Methanex and Nova Energy

Q4: Are there other pricing benchmarks that should be used in setting the critical contingency price?

Submitter	Submission
FirstGas	No. We consider that there are now sufficient pricing parameters to guide the industry expert in setting the critical contingency price, while providing a degree of flexibility to deal with the potentially unique circumstances associated with each critical contingency event.
Fonterra	No additional comment. (See Major Gas Users Group submission)
Major Gas Users Group	The preferred benchmark should be the actual marginal price of the gas reflecting its scarcity as per regulation 71(2). A benchmark that might better reflect that value could be to use the information embedded in historical peak traded gas prices. For example, using the average of the 12 (or some other number) highest peak prices on in the previous 12 twelve months on the trading platform. For the two events noted in the SOP (23 May 2017, 24 May 2016), the respective numbers would have been \$7.42/GJ (\$10.62/ GJ)4 and \$12.35/ GJ (\$6.66/ GJ). While this may not be the "right price" when compared to the actual calculated prices the concept of using historical peak prices to value scarcity can be experimented with different combinations of weighting or combination of peak prices, or ratios between peak and average prices. This alternative benchmark could also be included as part of a "higher of" number – so the critical contingency price might be the higher of VWAP (as above), Average of x highest peaks in rolling y month period, and marginal/ peak electricity wholesale price. An advantage of this concept is that the contingency price would be known in advance of the CC event, i.e. calculated daily and posted on say First Gas or CCO website and thereby act as a further incentive for parties to follow the curtailment instructions. It could also incentivise voluntary curtailment from bands not called for to assist a more rapid recovery. We also considered whether there is merit in using a "reserve price" in the same way that the electricity market uses reserve price. While there are practical differences in the concept to consider, the analogy of a reserve market where gas producers are offering available capacity e.g. through Ahuroa Gas Storage or swing capacity in production facilities might offer (some) replacement gas into the market at a time when it is needed. The concept might require some modification of the use of the trading platform products.
Methanex	No
Nova	Nova believes it more appropriate to base the floor price on the 75th percentile of prices over the previous 21 days (adjusted for volumes, and only including short term spot trades, rather than longer term strips.) This would even out the influences of weather, and better reflect the circumstances of constrained supply

Source: NZIER

Table 18 Submissions on Question 4 – OMV and Vector

Q4: Are there other pricing benchmarks that should be used in setting the critical contingency price?

Submitter	Submission
OMV	Depending on the liquidity and activity it may be the case that the emsTradepoint market is appropriate for setting the critical contingency price. The current regulations do not prevent the expert from considering emsTradepoint data under 71(3)(b)(iii) the expert may consider "any other matters that the industry expert considers relevant to achieving subclause (2).
Vector	No, we consider the proposed benchmarks to be sufficient in informing the setting of the critical contingency price.

Source: NZIER

Appendix D Gas consumption data

This section includes tables of gas consumption data from MBIE, major gas users and the EECA energy end use survey all stated in PJ per calendar year.

Table 19 Gas consumption[54]

PJ per calendar year

Consumer	2011	2012	2013	2014	2015	2016	2017	2018	2019
Energy Transformation	**78.6**	**80.4**	**78.2**	**65.9**	**63.3**	**55.1**	**66.2**	**57.0**	**56.9**
Electricity Generation	51.3	53.0	54.1	42.0	41.0	36.6	45.7	36.4	37.0
Cogeneration	17.8	18.9	17.1	16.5	15.4	12.6	13.9	12.8	12.6
Other Transformation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Production losses and own use	8.6	7.8	6.1	6.6	6.1	5.4	5.9	7.2	6.5
Transmission and distribution losses	0.9	0.9	0.9	0.8	0.8	0.6	0.7	0.7	0.8
Non-Energy Use	**24.4**	**31.7**	**39.6**	**59.2**	**50.2**	**58.2**	**53.3**	**45.1**	**50.8**
Consumption	**58.0**	**66.5**	**69.5**	**83.5**	**81.1**	**78.6**	**77.9**	**74.3**	**84.6**
Agriculture/ Forestry/ Fishing	1.7	1.6	1.5	1.6	1.6	1.3	1.4	1.4	1.3
Industrial	45.0	50.7	54.0	66.4	63.5	62.8	61.6	57.6	67.9
Food Processing	15.2	16.6	14.2	15.8	17.0	14.1	17.2	18.3	21.7
Wood, Pulp, Paper, and Printing	5.0	5.5	3.9	4.0	3.8	3.5	4.7	4.8	4.7
Chemicals	18.9	22.7	28.2	40.0	37.1	39.7	33.4	28.2	34.8
Basic Metals	2.9	3.1	4.5	3.0	2.4	2.4	2.6	2.5	2.8
Other	2.9	2.9	3.2	3.6	3.1	3.0	3.7	3.7	3.8
Commercial	5.7	7.9	7.8	8.9	9.0	8.1	8.1	8.6	8.5
Residential	5.6	6.3	6.2	6.6	6.9	6.4	6.8	6.8	6.8

Source: NZIER Natural Gas data tables, Produced by Markets Team Ministry of Business, Innovation & Employment, energyinfo@mbie.govt.nz,

[54] Transport is not included in the table as the value for the reported years is 0.0 PJ.

Table 20 Energy end use database – selected agriculture and industrial sectors

PJ per calendar year

Sector	ANZSIC Code	2017	2018	2019
Indoor Cropping	A0111, A0114, A0122	1.3	1.2	1.2
Forestry and Logging	A03	0.0	0.0	0.0
Mining	B	0.1	0.2	0.2
Industrial	B-E	0.6	0.4	0.2
Meat and Meat Product Manufacturing and Seafood	C111-C112	1.4	1.5	1.7
Dairy Product Manufacturing	C113	5.3	5.7	6.7
Other Food Product Manufacturing	C114-C119, C12	10.5	11.2	13.3
Textile, Leather, Clothing and Footwear Manufacturing	C13	0.5	0.5	0.7
Wood Product Manufacturing	C14	0.7	0.8	0.7
Pulp, Paper and Converted Paper Product Manufacturing	C15	3.9	3.9	3.9
Printing	C16	0.1	0.1	0.1
Petroleum, Basic Chemical and Rubber Product Manufacturing	C17-C19	33.4	28.2	34.8
Non-Metallic Mineral Product Manufacturing	C20	2.2	2.2	2.1
Primary Metal and Metal Product Manufacturing	C21	2.2	2.2	2.4
Fabricated Metal Product, Transport Equipment, Machinery and Equipment Manufacturing	C22-C24	0.5	0.5	0.5
Construction	E	0.5	0.5	0.5

Source: NZIER (from Energy End Use Database 2017 to 2019 available at https://tools.eeca.govt.nz/energy-end-use-database/)

Table 21 Energy end use database – selected commercial sectors and the residential sector

PJ per calendar year

Sector	ANZSIC Code	2017	2018	2019
Wholesale and Retail Trade - Non Food	F33, F34, F35, F37, F38, G39, G40, G42, G43	0.6	0.6	0.6
Wholesale Trade – Food	F36	0.0	0.0	0.0
Retail Trade – Food	G41	0.6	0.7	0.7
Accommodation and Food Services	H	2.0	2.1	2.1
Transport, Postal and Warehousing	I46-I51	0.0	0.0	0.0
Transport, Postal and Warehousing (Commercial - Non-Transport)	I52, I53	0.3	0.3	0.3
Information Media and Telecommunications	J	0.0	0.0	0.0
Financing, Insurance, Real Estate and Business Services	K, L, M, N72	0.6	0.6	0.6
Central Government Administration	O751	0.3	0.3	0.3
Local Government Administration	O753	0.4	0.4	0.3
Defence	O76	0.2	0.2	0.2
Education and Training: Pre-School, Primary and Secondary	P80	0.4	0.4	0.4
Education and Training: Tertiary Education and Other Education	P81-P82	0.3	0.3	0.3
Health Care and Social Assistance	Q	1.5	1.5	1.5
Arts, Recreational and Other Services	R, S	1.0	1.1	1.2
Residential	Z001	6.8	6.8	6.8

Source: NZIER (from Energy End Use Database 2017 to 2019 available at https://tools.eeca.govt.nz/energy-end-use-database/)

Appendix E Carbon price adjustment

E.1 VWAP calculation

The VWAP for one day is calculated by dividing the sum of daily value[55] of each gas trade by the sum of the daily volumes traded.

E.2 Adjustment for carbon prices

Gas prices provided by emsTradepoint include carbon prices. However, the CCP determinations exclude the carbon price. Therefore, the floor price estimate based on the 7-day VWAP will need to use VWAP that are adjusted for the price of NZU to ensure the floor price methodology is consistent with the CCP methodology.

The carbon price in $ per GJ of gas = NZU Spot Price * Surrender Obligation * Emission Factor where:

- NZU spot prices are available from emsTradepoint, or Jarden Commtrade (available at www.commtrade.co.nz/) or Carbon Forest Services (available at www.carbonforestservices.co.nz).
- The surrender obligation is one NZU per tonne of CO_2.[56]
- The emission factor is 0.05402 tonnes of CO_2per GJ of gas.[57]

E.3 Historical VWAP adjusted for carbon prices

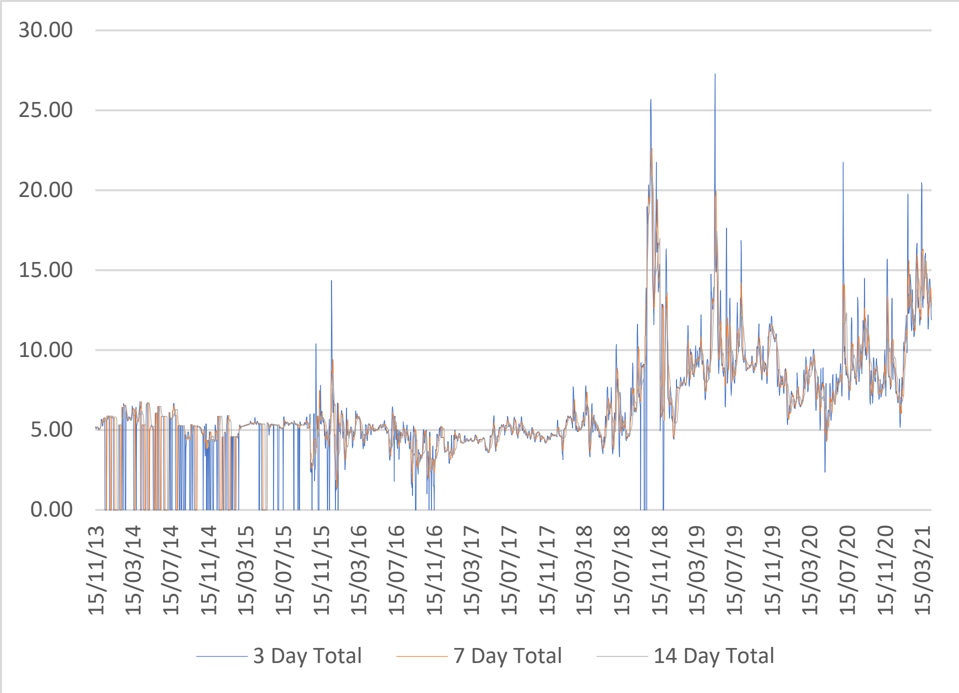
Carbon prices are much less volatile than the gas prices quoted on emsTradepoint. Therefore, the adjustment of the VWAP to exclude carbon costs does not materially alter the shape of the comparison of the 3-, 7- and 14-day VWAP. Figure 9 and Figure 10 below show the 3-, 7- and 14-day VWAP excluding carbon costs, including and excluding balancing transactions, respectively.

[55] 'Unit price' multiplied by 'Quantity' from emsTradepoint data.

[56] Prior to 1 January 2017 non-forestry ETS participants only had to surrender 0.5 NZU per tonne of CO_2e (1 NZU for every 2 tonnes of CO_2e). This increased to 0.67 NZU per tonne of CO_2e (1 NZU for every 1.5 tonnes of CO_2e) from 1 January 2018 and then to 1 NZU per tonne of tonne of CO_2e from 1 January 2019.

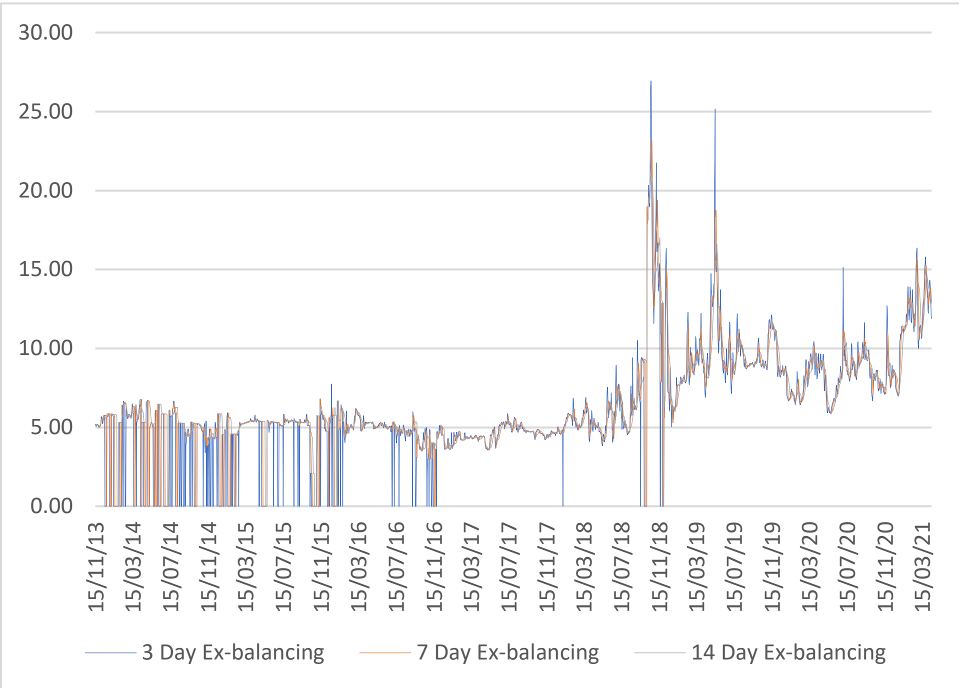
[57] Emission factors for calendar years are available from www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/energy-statistics-and-modelling/energy-statistics/new-zealand-energy-sector-greenhouse-gas-emissions/ . The last published factor was for 2018. We have used this factor for our adjustment for 2018 to 2021.

Figure 9 VWAP excluding carbon cost and including balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company and carbon prices

Figure 10 VWAP excluding carbon cost and excluding balancing transactions



Source: NZIER analysis of emsTradepoint data provided by Gas Industry Company and carbon prices