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Basis and methodology for producing gas demand projections to feed into the default price-quality path (DPP) regulation of gas distribution businesses

Prepared for the Commerce Commission

27 April 2022

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1 Introduction

This note sets out the methodologies used to produce the gas demand projections in the spreadsheet file 'CPRG_Inputs_4_DPP2022_v06'. These projections are intended to feed into the Commerce Commission's Constant Price Revenue Growth (CPRG) model.

Two sets of projections have been produced:

1) Projections consistent with the gas demand projections produced by the Climate Change Commission in its central 'Demonstration Path' to transition to net-zero long-lived gases by 2050.

2) Projections based on the Gas Distribution Businesses own projections as set out in their asset management plans (AMPs)

Note: This April 2022 report is an update to our November 2021 report. The changes for this update relative to the November 2021 report solely related to the GDB-based projections, and are:

- We have used actual FY21 demand and ICP data published by the GDBs in their information disclosure. Using this actual data for FY21:
  - Moves the start year for the projections one year forward
  - Gives one year extra on which to calculate historical growth rates, which are used as an input for projecting future demand. (As described in section 3.2, later).
- We have reduced Vector projected demand by [[redacted]] from 2022 onwards to take account of the loss of a major customer due to fire.

2 Climate Change Commission (CCC) based projections

2.1 Approach used to create CPRG projections that are consistent with the Climate Change Commission's gas demand projections

2.1.1 Step 1 – Create historical actual calendar year values

The starting point was to create a series of historical 'actual' reported volumes and ICP numbers for the five gas distribution networks split between 'Residential', 'Commercial' and 'Industrial' consumer types.

We used the reported values in Schedule 8 of the gas distribution network Information Disclosures published by the Commerce Commission.

These reported values for each network area are split into tariff groups. We assigned each tariff group to be one of the three consumer types – 'Res', 'Com', 'Ind' – and summed across each type.

Two further adjustments were made to this data:

- The reported data was for each network's financial year. We used simple weighting approaches across years to convert the data to calendar year values.
- We adjusted the data for Powerco and GasNet to ensure that the reported calendar year TJ volume for all New Zealand Residential consumers exactly matched the reported Residential total in MBIE stats.

This adjustment is necessary because these two network companies do not have tariff groups that are solely for Residential consumers, but instead cover Residential and small Commercial consumers. In contrast, the other two network companies have tariffs which are solely for Residential consumers and don't need such adjustment.

The Residential and Commercial ICP numbers for Powerco and GasNet were subsequently adjusted on a pro-rata basis (scaled for the differences in average demand per consumer type).

It should be noted that there is likely to be similar issues around defining the boundary between 'Commercial' and 'Industrial'. However, we are not aware of public data that would enable such a definitive apportionment. Further, we note that historical data appears to show some year-to-year variation regarding how these consumers have been classified.

2.1.2 Step 2 – Input the historical values into ENZ, and project forward

ENZ is a Concept proprietary model which models the New Zealand emissions-emitting economy. It has various modules which address the economic and emissions outcomes of different parts of the New Zealand economy, and their various price and commodity quantity linkages.

It has been used under licence by the Climate Change Commission for producing their recommendations for New Zealand's carbon budgets.

One aspect of the Heat, Industry, and Power ('HIP') module is projections of the demand for natural gas, split by the different consumer segments and end-uses. However, such projections only considered outcomes on a national basis.

Accordingly, to produce the projections required for the Gas DPP, we added functionality to our ENZ model to enable gas network-specific projections.

ENZ models the dynamic of fuel uptake and fuel switching separately for space heating, water heating and cooking. As noted above, this is done on an average national basis. However, examination of the average gas demand per ICP for the different network areas reveals that some network areas have a lot more space heating demand than others – particularly Powerco's 'Lower' network area.

We therefore took the following approach to enable network-specific changes in demand, based on ENZ projections on national gas shares for space heating, water heating and cooking:

- Assume all consumers across the North Island have the same average per ICP GJ consumption of gas for hot water and cooking.

  This is on the grounds that we could not see any reason why there would be material geographical variation in the per consumer demand for hot water or cooking services.[1]

  We used EECA's Energy End-Use Database as the basis for determining this national average consumption of gas for hot water and cooking.
- Calculate the Residential and Commercial splits between Space Heating versus Water heating + Cooking on a per-network basis for the historical years using the above methodology.
- Project forward from these historical values pro-rated to the ENZ projections of the national change for each technology.

[1] We note there will be some increased energy requirement to heat water in cooler parts of the North Island due to lower input water temperatures. However, the proportional difference in temperature gradient for hot water is second order compared to the proportional difference for space heating. As such, we have ignored this factor.

For Industrial demand, we simply projected forward from the historical network-specific values pro-rated to the ENZ modelled national change in the demand for gas-fired process heat.

The projections for the change in ICPs were pro-rated to the change in demand for:

- Water heating, for Residential consumers, as this is the dominant use.
- Space heating, for Commercial consumers, as this is the dominant use.
- Total demand, for Industrial consumers

2.1.3 Step 3 – Convert the calendar year projections from ENZ into YE-Sep projections for the CPRG model

This last step was undertaken in the spreadsheet 'CPRG_Inputs_4_DPP2022_v01', and was achieved via simple weighting across the calendar year projections coming out of ENZ.

2.2 High-level description of ENZ's methodology for gas projections

ENZ uses the most recent historical actual values as a starting basis, and projects the future demand for gas (and other fuels) based on the following methodology:

- Project the change in demand for the underlying energy service, eg, space heating, water heating, cooking, process heat.

  This is principally driven by projections of future changes in population (for Residential and some proportion of Commercial demand) and GDP (for Industrial demand).

- Project the extent to which energy efficiency improvements will reduce the quantity of input energy needed to provide the energy service.

  These are fundamentally driven by exogenous assumptions – informed by observed historical changes in energy intensity and various stated government objectives.

  In the case of space and water heating, these are also based on a model of the change in the building stock over time, with new-builds, renovations, and building replacements separately modelled, each with their own assumptions as to their relative energy intensity.

- Project the extent to which different fuel choices meet the demand for heating.

  This is based on modelling of the relative economics to consumers of the different fuel options, given projections of (endogenously modelled) fuel prices and (exogenously projected) appliance costs and efficiencies. This modelling seeks to take account of the key different consumer situations, including new-build properties, existing appliances, and end-of-life appliances.

  Notwithstanding this detailed modelling of the economics of the different fuel options, it should be noted there is significant inherent uncertainty regarding how consumers will respond to changes in the relative prices of the fuel options. Observed consumer behaviour appears to indicate significant non-price factors driving fuel choice decisions, including: perceptions of perceived quality variations between fuels; the 'hassle factor' associated with fuel switching; and environmental sentiments. 'S-curve' type switching functionality[2] with scenario-based sensitivity factors attempts to capture this range of uncertainty.

- Project the effect of any policies which may impact on fuel choices.

[2] This s-curve functionality projects a relatively small proportion of the population will switch from fuel choice 'A' to 'B' when the economics are marginally in favour B. The proportion will steadily increase as the economics move ever more in favour of B, before the rate of switching with improvement in economics tailing off again. ie, there will be some consumers who exhibit great reluctance to switch, even in the face of apparently compelling economics.

For the Climate Change Commission's central 'Demonstration Path' projection, the key policies were:

- A prohibition on new gas connections from 2025.
- This was simply modelled by preventing the model choosing gas for the new-build consumer situations from 2025, with a linear transition to this level of new-build gas connections in the three years prior (on the grounds that a ban from a given year would be likely to also have a stifling effect on consumer's choosing gas in the years leading up to the ban).
- An assumed prohibition on all distribution-reticulated gas demand by 2050.

  This was modelled by simply projecting a linear transition from the modelled level of gas demand in 2030 to zero in 2050.

  In reality, such a transition would be unlikely to be linear, but potentially a concave, convex, or reverse-s shape. However, it is inherently difficult to predict consumer behaviour for this 'end-of-industry' dynamic to determine which pattern of transition would be likely to occur. Further, it is likely that any transition would also be determined by other yet-to-be-determined policies and practices such as how network costs would be recovered, and the subsequent extent to which phenomena such as 'death spirals' may occur. Given this uncertainty, a simple linear transition was deemed to be an appropriate first order approximation of the transition path.

It should be noted that these assumed policy interventions are a key driver of the projected demand outcomes. If the government does not follow the Climate Change Commission's recommendations about implementing such policies, it is likely that gas demand will be higher than projected, including for the DPP period out to 2029.

3 Gas distribution business (GDB) based projections

Each of the GDBs have set out projections of gas demand and ICP numbers in Schedule 12c of their asset management plans. Unfortunately, these are only on a whole-of-network basis, whereas the CPRG model requires projections on an individual consumer group basis (ie, Residential, Commercial, and Industrial). Three other factors mean that the Schedule 12c projections cannot be used 'as is' for the CPRG model

- Powerco's projections are for the combined Central + Lower networks, whereas the CPRG model requires them to be split into these individual networks
- The projections finish in 2026, whereas projections are required to 2028 for the DPP
- The CPRG model requires all projections to be YE-Sep, whereas two of the networks (Vector and GasNet) have projections on a YE-June basis

This section of the note briefly describes the methodology for translating the GDB's Schedule 12c projections into projections which can feed into the CPRG model.

3.1 Step 1 – Initial sanity check

Two checks of the data were performed:

- Within-projection consistency. ie, are there unusual movements within the 2021 to 2026 projection period
- Consistency with historical. ie:
  - are the rates of growth consistent with those observed historically? and

– is the projected 2021 number consistent with the most actual disclosed number for 2020?

The results of this sanity check are shown in Figure 1. Two sets of annualised growth rates are shown:

- For the period 2013 to 2021
- For the period 2018 to 2021

Figure 1: Comparison of GDB-projected whole-of-network annual growth rates with historical values[ ]

[redacted]

Key stand-outs from this analysis are:

- Starting 2022 values:
  - Demand
    - First Gas has a very significant jump in demand for 2022 relative to 2021. This may be due to a major new industrial consumer (or consumers) connecting in 2022, or it may be erroneous.
    - Vector's 2022 demand appears high based on most recent growth rates, but is more consistent with longer-term growth rates.
  - ICP numbers
    - These are closer to what would be expected based on historical growth rates, although all (apart from GasNet's) appear to be 1% higher than would be expected based on recent growth rates.
- Post-22 growth
  - Demand
    - First Gas' seem consistent with long-term trends, but lower than recent trends
    - Vector's has an unusual jump up in 2023, but other year's rates of growth are broadly consistent with history. It is not known whether the 2023 increase is due to expected major new industrial connection(s) in that year.
    - Powerco's seem consistent with history
    - GasNet's are low relative to history
  - ICP numbers
    - Powerco's and GasNet's are consistent with history
    - First Gas' are a bit higher than history
    - Vector's are a bit lower than history

In the absence of information which may cast light as to whether the GDB projections are accurate reflections of anticipated changes on their networks or whether some aspects may be erroneous, no adjustments have been made to the GDB projections to address any of the above.

3.2 Step 2 – Apportion whole-of-network GDB projections to individual consumer groups

This was undertaken via a multi-step process

- Firstly, the historical data from the GDB information disclosures was adjusted to ensure MBIE-consistent Residential and Commercial demand values using the process described on page 4 previously.
- Secondly, the most-recent actual year's data (for 2021) for each consumer group was projected forward at the historical rate of growth for the period 2018 to 2021. This period was chosen as
  - It is relatively recent, therefore capturing recent trends
  - 2018 is the earliest year where all networks have a consistent basis for reporting consumer data in their disclosures. 2018 was the first year for GasNet's new consumer grouping. Prior to that, 2016 was when Vector introduced new consumer groupings for the Vector and (now) First Gas.

  It was felt important to project recent trends on an individual consumer group basis, as there have been sustained variations in historical growth rates between these groups.
- Lastly, these projections were factored to ensure the whole-of-network TJ demand and ICP number values exactly matched those whole-of-network projections produced by the GDBs.

  This process also enabled Powerco's Central and Lower networks to be consistent with the whole-of-network projection produced by Powerco.

3.3 Step 3 – Project values for 2027 to 2028, and create YE-Sep values

For projecting values for 2027 and 2028, the GDB projection for 2026 was projected forward using the implied rate of growth in the GDB projection for 2025 to 2026.

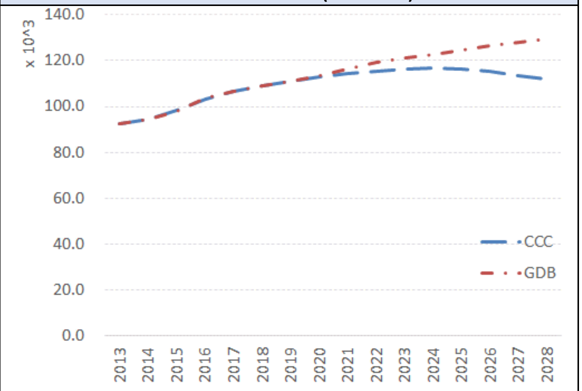
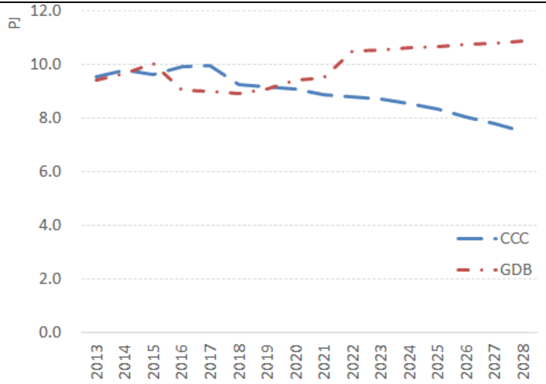
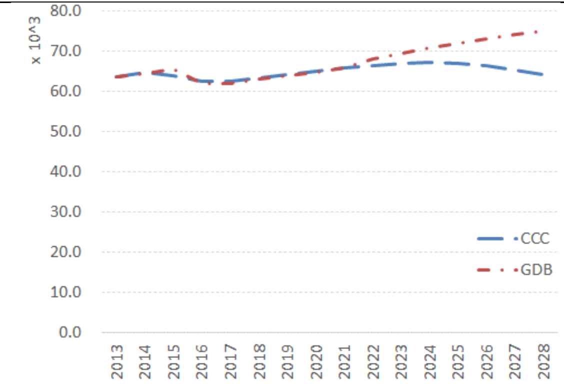
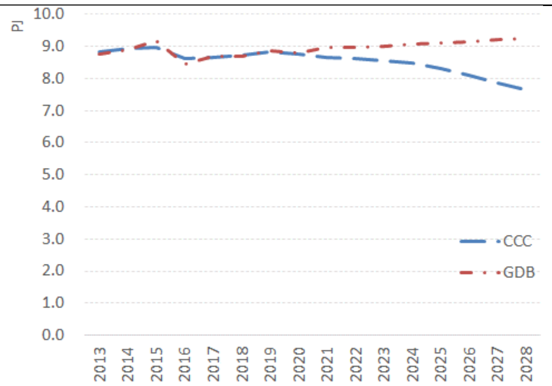
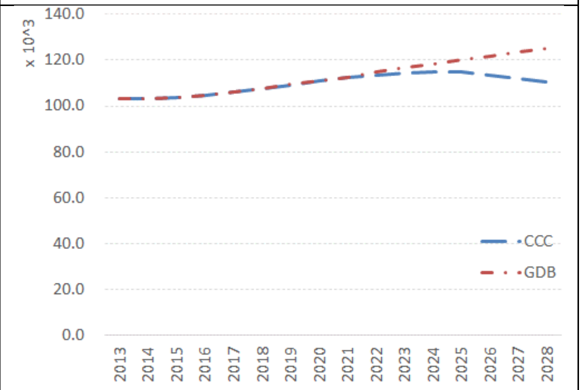
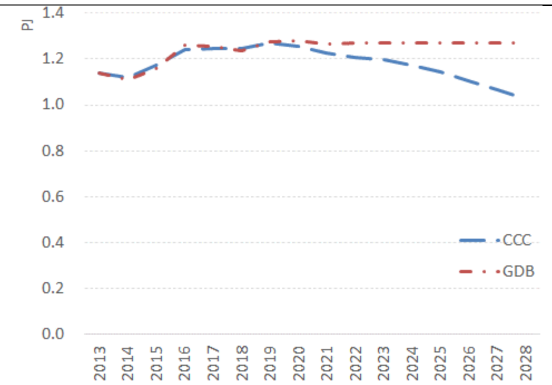
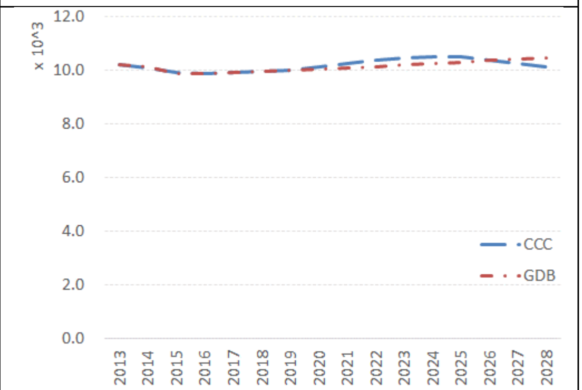
Because Vector and GasNet report on a YE-June basis, their historical disclosures and Schedule 12c projections need to be converted to a YE-September basis. This was simply achieved by applying weightings as follows:

- The YE-Sep values for year 'n' were based on the YE-June projections with a 75% weighting for year 'n' and a 25% weighting for year 'n+1'.
- This required creating a 2029 YE-June value using the process described in the previous paragraphs in order to create a YE-Sep 2028 projection.

4 Comparison and implications of CCC and GDB projections

4.1 Projection comparisons

Table 1: Comparison between CCC and GDB whole-of-network projections

	Demand (PJ)	ICP numbers (x 10^3)
Vector	[redacted]	
First Gas		
Powerco		
GasNet		

In general, the GDB projections appear to be based on 'business-as-usual' outcomes. (Although Vector's and First Gas's appear to be projecting *higher* rates of demand growth than seen recently, even though ICP growth seems more consistent.)

In contrast, the CCC projections are based on outcomes considered necessary to meet the government's target of achieving net-zero emissions by 2050. As set out in section 2 previously, the CCC has identified that this will require:

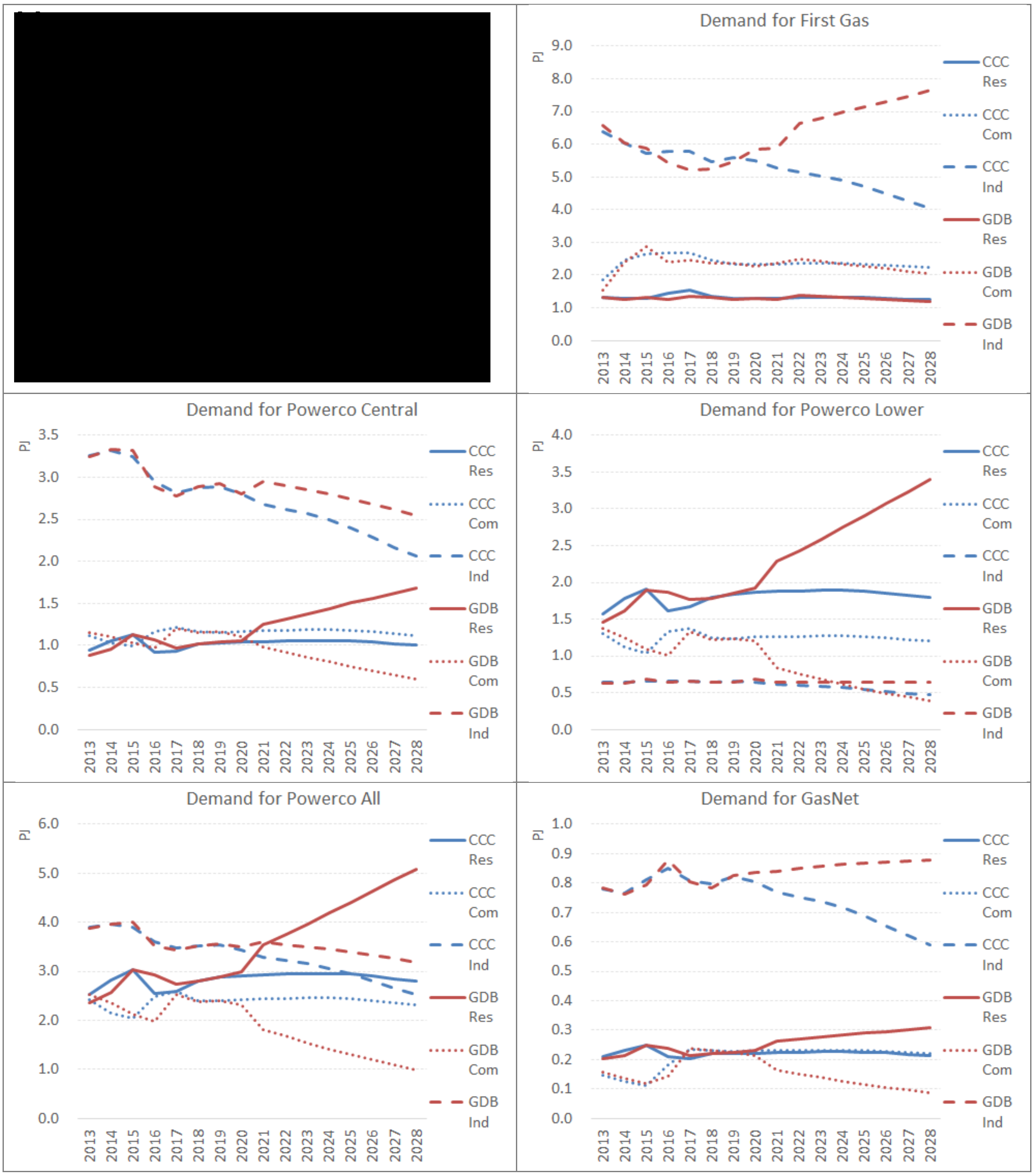
- moving to <u>zero</u> distribution-reticulated gas consumption by 2050, and
- significant policy interventions to achieve this outcome, in particular the banning of new gas connections from 2025.

Overall, this results in the GDB projections being substantially higher by 2028 than the CCC projections.

Table 2 below compares the CCC and GDB-based projections on an individual consumer group basis.

The apportionment of whole-of-network GDB projections to individual consumer groups will inevitably introduce greater margins of error as it relies on developing a standard mechanistic approach based on historical trends, without knowing whether this is also the approach that the network companies have used to project the different consumer segments.

Table 2: Comparison of CCC and GDB-based projections split by consumer groups



4.2 Policy implications

As highlighted in Table 3 below, there is a significant difference between the GDB and CCC projections. Thus, by 2028

- Total NZ distribution-reticulated gas demand is projected to be 29% greater under the GDB projections compared to the CCC projections.
- Total ICP numbers are projected to be 14% greater under the GDB projections compared to the CCC projections

Table 3: Comparison between CCC and GDB-based projections on a whole-of-NZ basis

	Total across all consumer segments	Consumer-segment breakdown

Analysis by Concept for the CCC indicates that the transition away from fossil gas will be beneficial for New Zealand[3], and consistent with New Zealand's commitment to achieving net-zero long-lived gases by 2050.

As such, the CCC-based projections of declining demand are more consistent with least-cost outcomes for New Zealand than the GDB-based projections which project growing demand.

However, under current policy settings – particularly a current lack of a ban on new gas connections from 2025 (a key underpinning of the CCC projections) – it is more likely that outcomes closer to the GDB projections will occur.

Ironically, GDBs should prefer the DPP price cap to be set using the CCC-based demand projections. This is because, under a weighted average price cap (WAPC) form of control, GDBs will benefit if gas demand turns out to be higher than the forecast demand used to set the price cap. Conversely, consumers should enjoy lower prices during the control period if the GDB demand forecasts are used.

However, this points to a deeper incompatibility between the current WAPC form of control and New Zealand's broader decarbonisation objectives:

- The best long-term outcomes for New Zealand consumers would be a progressive switching *away* from gas.
- However, under WAPC control, GDBs are incentivised to grow gas demand – as evidenced by the current ongoing campaigns encouraging consumers to *choose* gas. This WAPC-driven profit

[3] For example, see Figure 8.3 in the Commission's final advice: "*Ināia tonu nei: a low emissions future for Aotearoa*"

incentive on GDBs may also cause them to lobby against the introduction of policy measures such as the CCC-recommended ban on new gas connections from 2025;

This points to some tricky choices for which gas demand forecast to use:

- In the short-term consumers will enjoy lower prices if the GDB demand forecasts are used
- However, if using the GDB forecasts creates a stronger incentive on GDBs to promote increased gas demand, it is likely that the long-term economic costs will be greater than if the CCC-based forecasts are used

Further, there is a particular challenge to choosing a demand forecast in that outcomes will be heavily dependent on future government policy decisions. In particular, whether or not the CCC-recommended ban on gas connections from 2025 occurs. This creates an unmanageable risk for GDBs if the GDB-based demand forecasts are used, but the ban on fossil gas connections is subsequently implemented in policy.

5 Treatment of 'green' gas

The above modelling based on the Climate Change Commission projections assumes that there will be no emergence of 'green' gas options which would allow consumers to continue to take energy services through delivery of reticulated gas, and still enable New Zealand to transition to net-zero long-lived greenhouse gases by 2050.

If, within the next few years, reticulated hydrogen or biomethane are considered to be sufficiently feasible options such that the government decides not to implement the Climate Change Commission's recommendations about implementing a ban on new connections from 2025, the above CCC-based projections would need to be revised.

That said, although it is not the subject of this engagement, significant modelling we have done in this area indicates to us that reticulated hydrogen and/or biomethane is fundamentally uneconomic relative to switching to direct electric or (in the case of some process heat) biomass heating options.

For the relatively small number of use cases where these options are very expensive, our provisional evaluation is that bio-LPG is a far more cost-effective option than continuing to fund the considerable costs of maintaining a pipeline network.

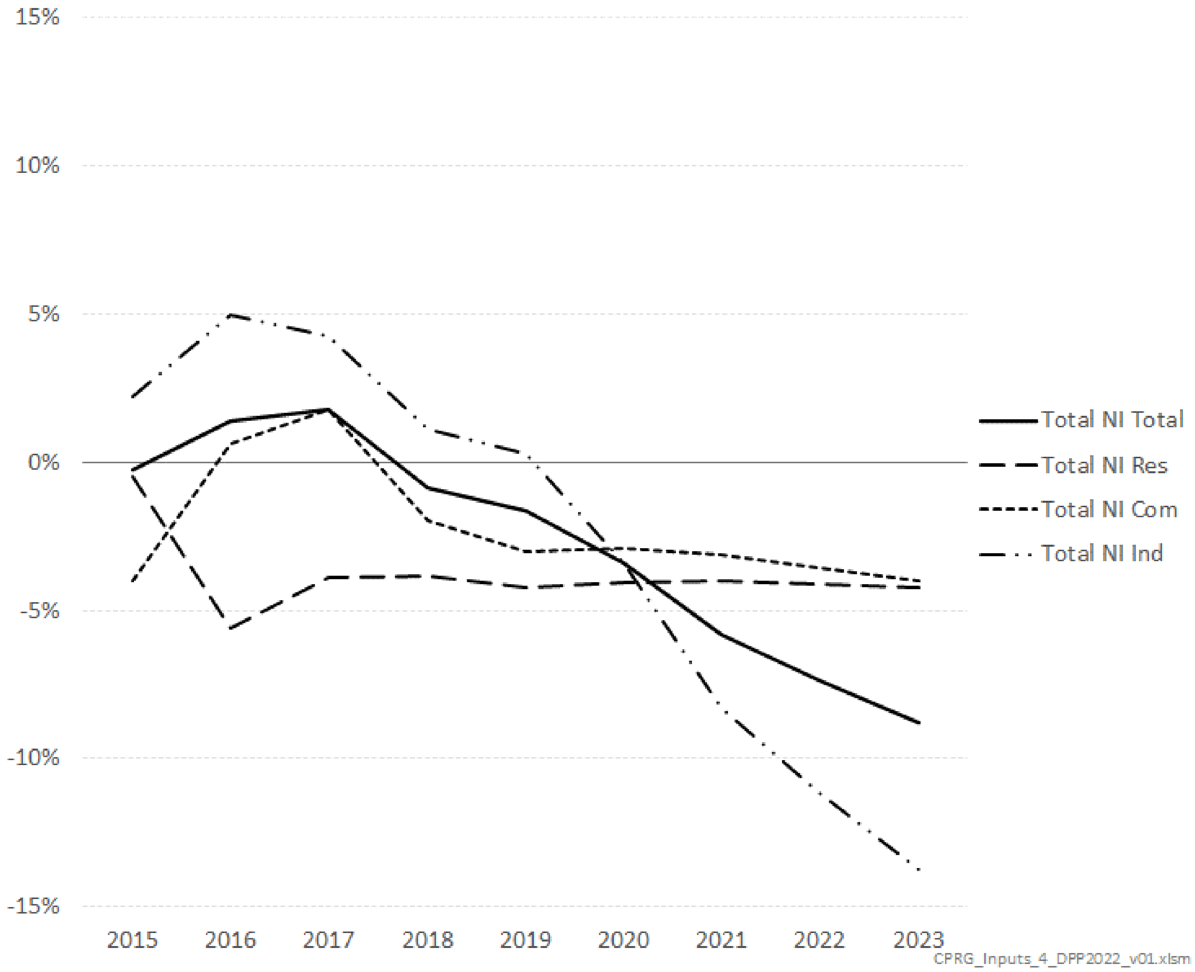
6 Comparison with original projections

It is always interesting, and sometimes even useful, to compare past projections with subsequent actual outturns.

The following graphs show the percentage difference between the CCC-based gas demand projections within the 'CPRG_Inputs_4_DPP2022_v02' workbook (of which the values up to 2019 are actuals) and the projections that were undertaken in 2016 and which fed into the 2017 DPP.

Figure 2 shows this comparison for total North Island gas demand across all five network areas.

Figure 2: Percentage difference between current gas demand projections (up to 2019 being actuals) and 2016 projections for total NZ gas demand (FY-end Sep)



This shows that overall gas demand estimated in 2016 was an underestimate compared to actuals in 2016 and 2017, but an overestimate compared to actual 2018 and 2019 demand. It also shows that the current projections for the years 2020+ are materially lower than was originally projected in 2016.

It also shows that there is considerable variation between consumer types as to whether the 2016 projections were an over- or under-estimate compared to the actuals up to 2019. Generally, the 2016 projections over-estimated residential demand but under-estimated industrial demand.

The fact that the CCC-based projections for 2020+ are systematically lower than the projections for the same period that were made in 2016 is to be expected, as these current projections have been made in an environment where there are expectations of progressive decarbonisation-driven switching away from reticulated gas.

Figure 3 shows the same type of information as for Figure 2, but also includes the lines for the five different gas network areas. Appendix A provides a separate graph for each network area.

Figure 3: Percentage difference between current gas demand projections (up to 2019 being actuals) and 2016 projections for individual network areas (FY-end Sep)

[redacted]

This shows there is much greater variation between the 2016 projections and actual outcomes when looking at an individual network area basis. There does not appear to be a systematic geographic bias towards whether the 2016 projections were consistently higher or lower, nor any other systematic factor driving this observed variation between predictions and outcomes.

All that we believe can be concluded from the above analysis is that there is significant inherent uncertainty over predictions.

Such uncertainty is compounded if there is inconsistent reporting of outcomes. In this, we note that there has been some historical movements in the relative demands of residential and commercial consumers as reported by MBIE that appear inconsistent – potentially due to the boundary between 'commercial' and 'industrial' being interpreted differential by different retailers (who provide the data to MBIE) who have won and lost different consumers over time.

We also note that PowerCo and GasNet not having dedicated Residential consumer tariff groups will give rise to similar issues, as there has been need for judgements to be made as to the proportions of reported demand for their 'Residential / Small Commercial' tariff group that is comprised of residential consumers. Given this, there could be merit in requiring network companies to have separate residential-only tariffs as it would aid reporting and subsequent policy decision making regarding this most important (from a distribution network revenue perspective) of consumer groups.

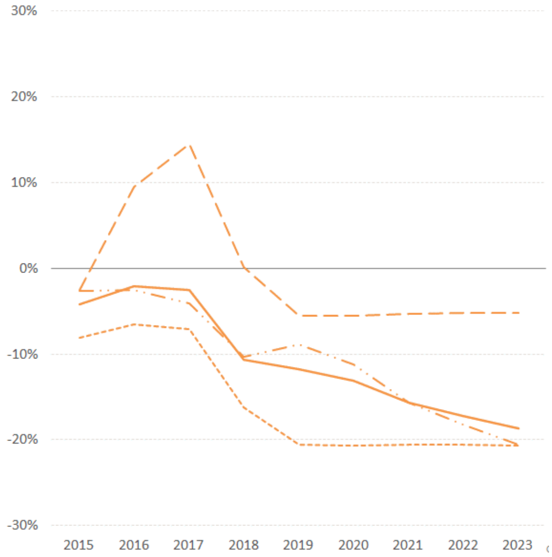
Overall, the above analysis points to there being considerable uncertainty with regards to gas demand projections, and this uncertainty should be taken into account when considering the form of price control. Further, our view is that this uncertainty is likely to grow significantly due to decarbonisation. This is due to uncertainty over future policy decisions, and uncertainty over the extent to which 'green' sentiments may increasingly drive consumer decisions.

Appendix A. Individual network comparison with original projections

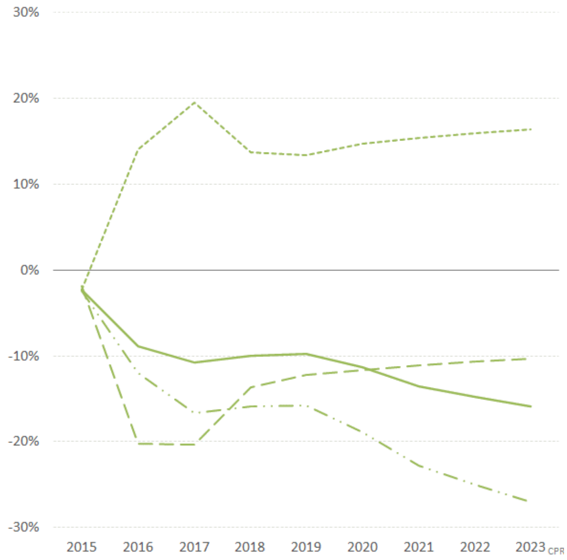
Auckland

[redacted]

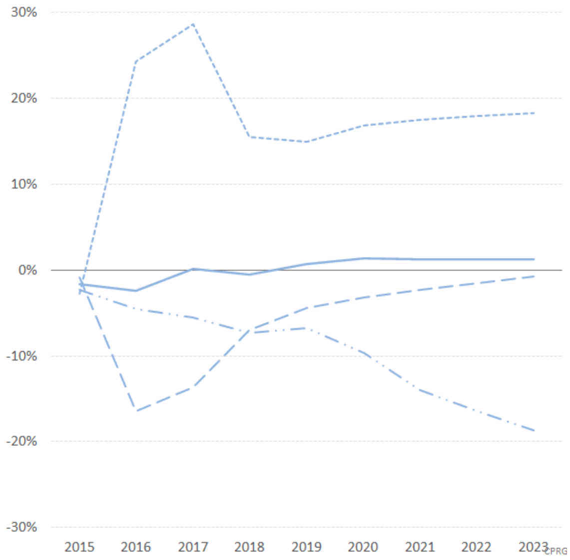
Non-Auckland



Central

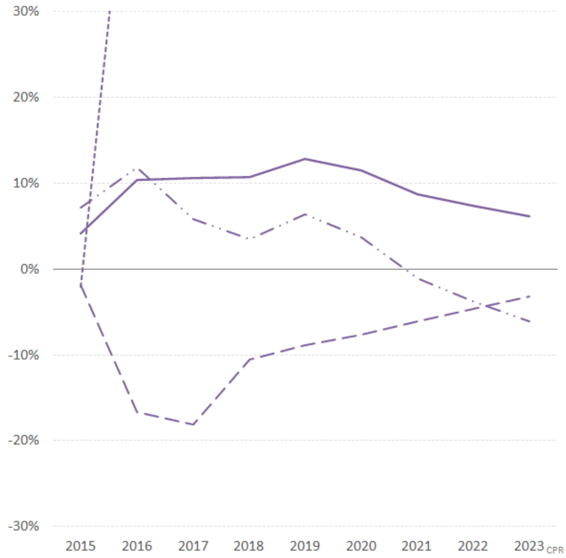


Lower



Key: Total Res Com Ind

GasNet



Note: GasNet Commercial line reaches 107% by 2017, then slowly rises to 116% by 2023.

Key: Total Res Com Ind