Report

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authoritative analysis

# Value added associated with gas demand

## Estimates of value added by industry for informing decisions on critical contingency management

NZIER report to Gas Industry Co.

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## Authorship

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## Purpose

This report provides estimates of value added across industries in the North Island which use gas. This information will be used to help inform the management of demand curtailment during critical contingency events.

Our estimates are summarised in the Results section below and a more complete table of data is provided at the end of this document.

Our results include estimation of the value added currently in each of the curtailment bands which determine the order in which demand is curtailed in the event of a critical contingency event.

Value added is that part of 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 GDP statistics; also known as 'contribution to GDP'.[1] It is the value which is directly at stake if a firm ceases production.

Our estimates are robust in terms of relativities across industries but they are not pin-point accurate. A number of assumptions have been made in the production of these estimates and these assumptions and other aspects of our methodology are described in the Methods section below.

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, as is clear from Figure 1, 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.

## Results

Our analysis shows that industries with large gas consumers dominate the creation of value added from the use of gas. This result reflects the dominance that large users of gas have, with a handful of industries and firms making up the vast majority of gas consumption as well as value added (see Figure 2). The top ten industries, out of a total of 48, consume 93% of gas and contribute 57% of value added.

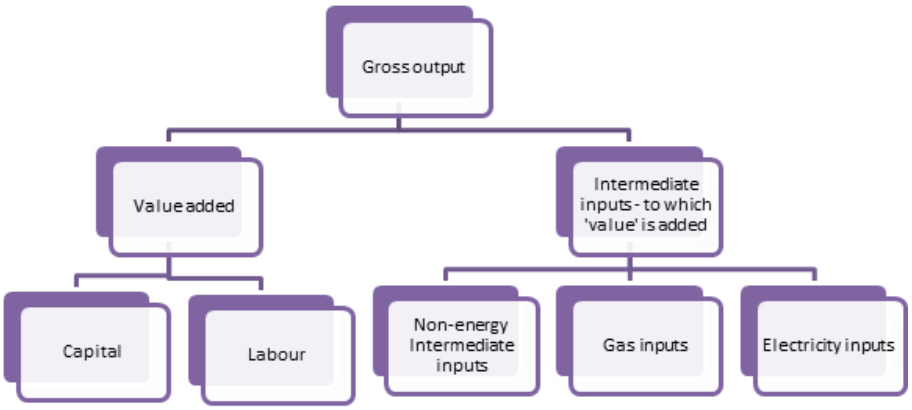
Large gas users produce considerable value added in absolute terms (see Figure 3). This reflects the fact that, in some cases, these industries generate most of their value added by adding value to gas itself – rather than using gas as a minor intermediate input or minor energy source.

There is considerable variation across industries in terms of dependence on gas. Estimated value added per GJ for an industry captures both high rates of value creation

[1] The statistics we use to obtain these figures are National Accounts and GDP (which measures value added) by industry and the 2007 New Zealand Industry Input-Output tables which track both purchases of intermediate inputs and wages and profits. The latter allows us to account for the proportion of energy and gas used by industries in relation to the value (added) which is returned to workers and owners in the form of wages and profits. Technically the measure we use is "returns to primary factors" which includes compensation of employees and operating surplus and adjustments for subsidies and taxes. Specific data sources are also mentioned in the Method section below.

and also low gas use e.g. the finance and insurance industry where overall contribution to New Zealand's GDP is enormous while gas consumption is trivial.

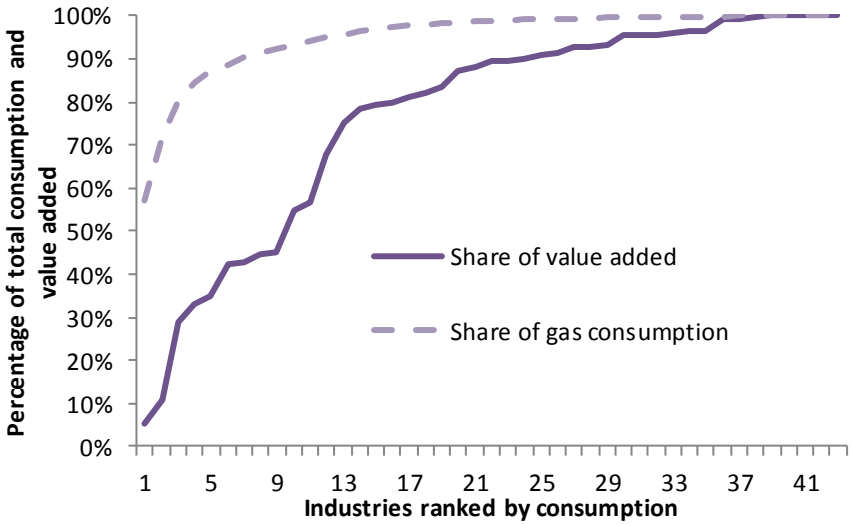
## Figure 1 Value added and inputs to production




Source: NZIER

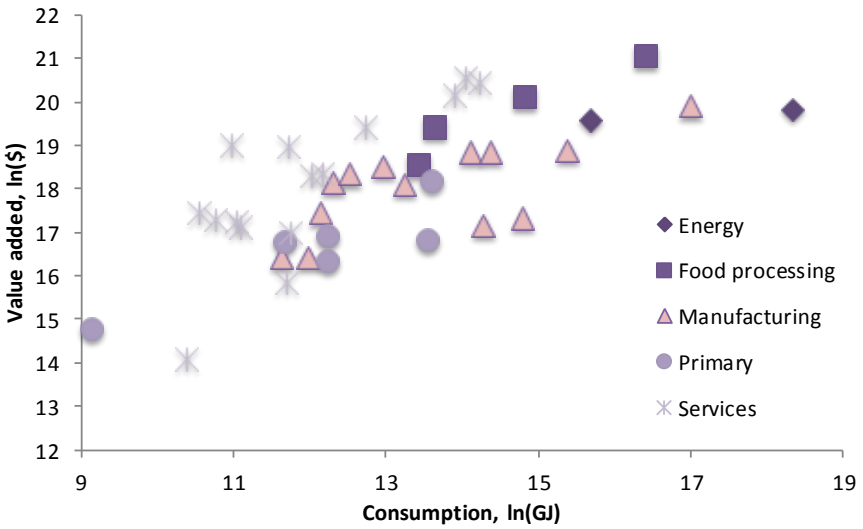
## Figure 2 Distribution of value added and gas consumption

Cumulative shares of total




Source: NZIER

## Figure 3 Consumption and total value added




Source: NZIER

From our estimates of value added it appears that the current critical contingency management (CCM) bands do a relatively good job of postponing the curtailment of demand which has high value added and relatively low demand (i.e. curtailment value).

Using a sample of data on industries by CCM band we have estimated the current value added in each CCM band. This shows that value added is distributed fairly evenly between bands 1, 3, and 5 (see Table 1).

## Table 1 Estimated value added by CCM band

2011, real 2007 dollars

| | Band 1 | Bands 2&3 | Band 4 | Band 5 | Band 6 | Domestic | Total |
|---|---|---|---|---|---|---|---|
| **ICPs** | | | | | | | |
| Count | 6 | 1,554 | 1,120 | 379 | 11,569 | 246,052 | 260,680 |
| **Demand** | | | | | | | |
| TJ | 115,200 | 21,648 | 1,974 | 11,060 | 3,467 | 5,704 | 159,052 |
| % | 72% | 14% | 1% | 7% | 2% | 4% | -- |
| Cumulative % | 72% | 86% | 87% | 94% | 96% | 100% | -- |
| **Value added** | | | | | | | |
| $millions | 2,423 | 1,741 | 580 | 2,339 | 1,019 | -- | 8,101 |
| % of total | 30% | 21% | 7% | 29% | 13% | -- | -- |
| Cumulative % | 30% | 51% | 59% | 87% | 100% | -- | -- |
| $/GJ | 21 | 80 | 294 | 211 | 294 | -- | -- |

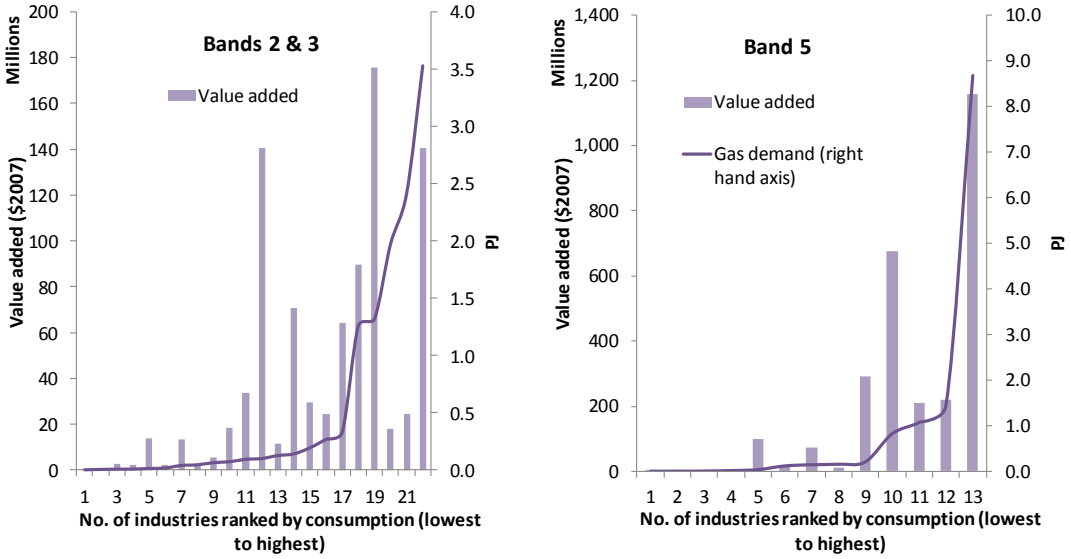
Source: NZIER, Gas Industry Co.

In these calculations bands 1a and 1b have been aggregated and bands 2 and 3 have been aggregated because there are so few consumers in each of these bands. Also, we have used a common rate of value added per GJ for bands 4 and 6 because we do not

have reliable data on industry composition for these bands. The common rate of value added per GJ is based on the remaining economy-wide value added (related to gas) which is not explained by consumption of gas in the other curtailment bands. The aggregate figures in Bands 2 through 6 in Table 1 mask a considerable amount of variation in gas demand and value added (see e.g. the distribution of consumption and value added in Figure 4).

### Figure 4 Industry distribution within Bands 2 & 3 and Band 5

Representative sample, grouped by industry




Source: NZIER, Gas Industry Co.

## Method

Our estimates are built up by:

1. **Estimating consumption** of gas by industry over time based on matching, reconciling or augmenting information from the following sources:

1.1 Ministry of Economic Development (2008, 2009, 2010, 2011) and Ministry of Business, Innovation and Employment (2012) *Energy Data File* statistics on gas consumption by industry and nature of use for 2003 to 2011;

1.2 Statistics New Zealand Energy Use Surveys (2009, 2010, and 2011) for the primary sectors in 2008, the industrial and trade sectors in 2009, and the services sectors in 2010.

1.3 Statistics New Zealand (2012) Industry Input-Output Tables for 2007 which provide use and supply of gas in terms of value in basic prices;

1.4 Gas Industry Co. data gas consumption and gate level data, and representative samples of companies by critical contingency management (CCM) band.

2. **Estimating the contribution of gas consumption to value added** in a base (2007) year:

2.1 For industries where gas is used primarily for energy purposes:

2.1.1 Estimating industry specific expenditure on stationary energy (gas and electricity) per dollar of value added using Statistics New Zealand's input-output tables (2012).

2.1.2 Estimating industry specific gas expenditure based on prices in the MED (2008) and MBIE (2012) *Energy Data Files*;

2.1.3 Using values from 2.1.1 multiplied by values from 2.1.2 to yield industry value added related to gas.

2.2 For industries where gas is used for "wholesale" energy transformation (electricity and co-generation) and non-energy purposes:

2.2.1 Using Statistics New Zealand's (2012) input-output tables to determine value added and using gas consumption data (from 1.) to calculate value added per GJ;

3. **Estimating value added over time** (2003-2006, 2008-2011) based on:

3.1 Estimated industry value added in the North Island over time by apportioning nominal GDP by industry (Statistics New Zealand National Accounts, 2012) for 2003-2009 to the North Island according to shares of employee counts by industry using Statistics New Zealand's (2012) business demography data base.

3.2 Using Statistics New Zealand constant (real) price GDP growth by industry from 2003 to 2011 to estimate growth in value added (in $2007) dollars by industry;

3.3 Dividing 3.2 by 1. to obtain a consistent time series of constant price value added per GJ by industry.

This sequence of steps was necessary to deal with a number of inconsistencies in underlying data and to try to produce results that were as granular as possible in terms of industry break down.

Inconsistencies which required reconciliation included:

- different levels of industry classification and different classification systems e.g. Value added and National Accounts data use different classifications than the MED and business demography data
- missing data in Statistics New Zealand's input-output tables which, for example, significantly underestimated gas use in the primary sector
- significant differences between MED and MBIE gas consumption by industry and results from Statistics New Zealand's energy use survey data
- MED and MBIE statistics grouping cogeneration related gas demand into a cogeneration category when a non-trivial proportion of cogeneration demand relates directly to the production of an industry and therefore its value added (the majority of energy production from cogeneration goes directly to industrial use in the case of assets owned or partly owned by firms in the dairy, steel, and pulp and paper industries).

Note that, in reconciling these issues we have had to aggregate the chemicals sector at quite a high level – such that all organic chemicals, fertiliser, pesticides, and production by Methanex is aggregated to single industry.

Note that step 2.1.1 was essential for ensuring that we did not overstate gas the share of value added which relates to gas consumption. However, introducing this step required us to assume that, at the margin, firms have optimised their energy use such that an additional dollar spent on stationary energy yields the same amount of value added regardless of whether that dollar is spent on gas or on electricity.

In general, we are happy with our method, estimates and results. There are two minor and one important exception to this:

- Minor exceptions: Significant conflicts between data sources mean that results for the cattle farming and seafood processing industries should be considered very unreliable. The seafood processing sector results are especially implausible and have been excluded from the charts in the discussion of results above. These industries are not significant sources of gas demand.
- Important exception: We have not been able to reconcile data on gas use at the Glenbrook steel mill and information on electricity dispatch from cogeneration at Glenbrook. This means that we have not apportioned any cogeneration demand to the steel sector. This is a problem in so far as steel is an important industry in terms of gas demand.

In the case of gas demand for cogeneration we have used estimates of energy dispatched to the electricity grid (converted to GJ by using plant level efficiency data) to determine the shares of cogeneration gas demand that should be allocated to the electricity industry versus other industries. This allocation is necessary for our particular purpose but would be dealt with differently for other applications (e.g. official statistics might apportion all demand to the energy firms which typically have ownership interests in these cogeneration assets). Our assumptions when making this allocation are:

- Pulp and paper industry typically generates 6% of total gas demand for cogeneration and of that 95% of the value is used by the industry
- Dairy product processing typically generates 24% of total gas demand for cogeneration and of that 70% of the value is used by the industry.

Note that our estimates are fixed within a historical context. They describe estimates of value added given actual historical gas consumption in 2007. Applying these results to e.g. future market conditions means, implicitly, assuming that gas consumers have no option but to use a fixed amount of gas in their production. For a few producers this may be reasonable (e.g. Methanex). For others, the decision to use gas will be affected by relative prices of energy and use of gas will not remain a fixed proportion of inputs to production.

## Table 2 Industry value added and value added per GJ

Average 2003-2011, 2007 dollars

| Industry | $/GJ | Value added | % of total |
|---|---|---|---|
| Horticulture and fruit growing | 92.25 | 67,801,480 | 0.9% |
| Sheep, beef cattle and grain farming | 162.09 | 19,592,850 | 0.3% |
| Dairy cattle farming | 162.61 | 198,131 | 0.0% |
| Poultry, deer and other livestock farming | 47.89 | 91,241 | 0.0% |
| Fishing and aquaculture | 28.46 | 19,953,085 | 0.3% |
| Agriculture, forestry and fishing support services | 111.58 | 20,863,266 | 0.3% |
| Forestry and logging | 517.95 | 2,322,325 | 0.0% |
| Coal mining, other mining and quarrying, and services to mining | 807.39 | 15,030,460 | 0.2% |
| Oil and gas extraction | 60.64 | 367,955,279 | 4.9% |
| Dairy products | 97.61 | 1,214,138,984 | 16.1% |
| Meat and meat product manufacturing | 159.74 | 105,872,669 | 1.4% |
| Seafood processing | 138.68 | 115,613,074 | 1.5% |
| Fruit, oil, cereal and other food product manufacturing | 201.27 | 533,418,763 | 7.1% |
| Beverage and tobacco product manufacturing | 351.39 | 293,570,703 | 3.9% |
| Textile and leather manufacturing | 145.93 | 67,488,318 | 0.9% |
| Clothing, knitted products and footwear manufacturing | 470.65 | 109,556,773 | 1.4% |
| Log sawmilling and timber dressing, and other wood products | 79.36 | 141,975,404 | 1.9% |
| Paper and paper products | 34.25 | 156,820,782 | 2.1% |
| Printing, publishing and recorded media | 108.88 | 13,181,674 | 0.2% |
| Petroleum and coal product manufacturing | 39.90 | 30,830,154 | 0.4% |
| Basic chemicals and fertiliser manufacturing | 12.42 | 402,459,058 | 5.3% |
| Inorganic industrial chemicals, other chemical products, rubber and plastic products | 108.93 | 38,666,607 | 0.5% |
| Non-metallic mineral product manufacturing | 124.40 | 140,330,243 | 1.9% |
| Primary metal and metal product manufacturing | 10.01 | 28,186,594 | 0.4% |
| Fabricated metal product manufacturing | 326.69 | 76,954,734 | 1.0% |
| Transport equipment manufacturing | 354.81 | 2,048,710 | 0.0% |
| Other furniture and machinery manufacturing | 354.40 | 91,896,011 | 1.2% |
| Water supply, sewerage and drainage services | 70.79 | 13,566,838 | 0.2% |
| Construction | 346.73 | 22,025,737 | 0.3% |
| Wholesaling | 384.99 | 89,808,081 | 1.2% |
| Retailing | 387.16 | 29,119,660 | 0.4% |
| Food and beverage and accommodation | 396.88 | 530,504,487 | 7.0% |
| Road Transport | 259.29 | 1,359,258 | 0.0% |
| Other transport | 65.51 | 7,238,868 | 0.1% |
| Other transport services, postal and storage | 531.21 | 88,217,013 | 1.2% |
| Information and communications | 682.67 | 32,800,086 | 0.4% |
| Finance and insurance | 2,958.14 | 176,862,012 | 2.3% |
| Real estate and rental services | 374.76 | 25,620,083 | 0.3% |
| Professional scientific and technical services | 1,291.35 | 166,005,696 | 2.2% |

| | | | |
|---|---|---|---|
| Administrative and support services | 883.64 | 34,400,439 | 0.5% |
| Government (including foreign), administration and defence | 815.84 | 262,629,307 | 3.5% |
| Education, cultural, recreational, personal and other services | 366.57 | 756,832,451 | 10.0% |
| Health and community services | 627.85 | 838,946,099 | 11.1% |
| Electricity generation | 5.53 | 403,726,730 | 5.3% |

**Source: NZIER**