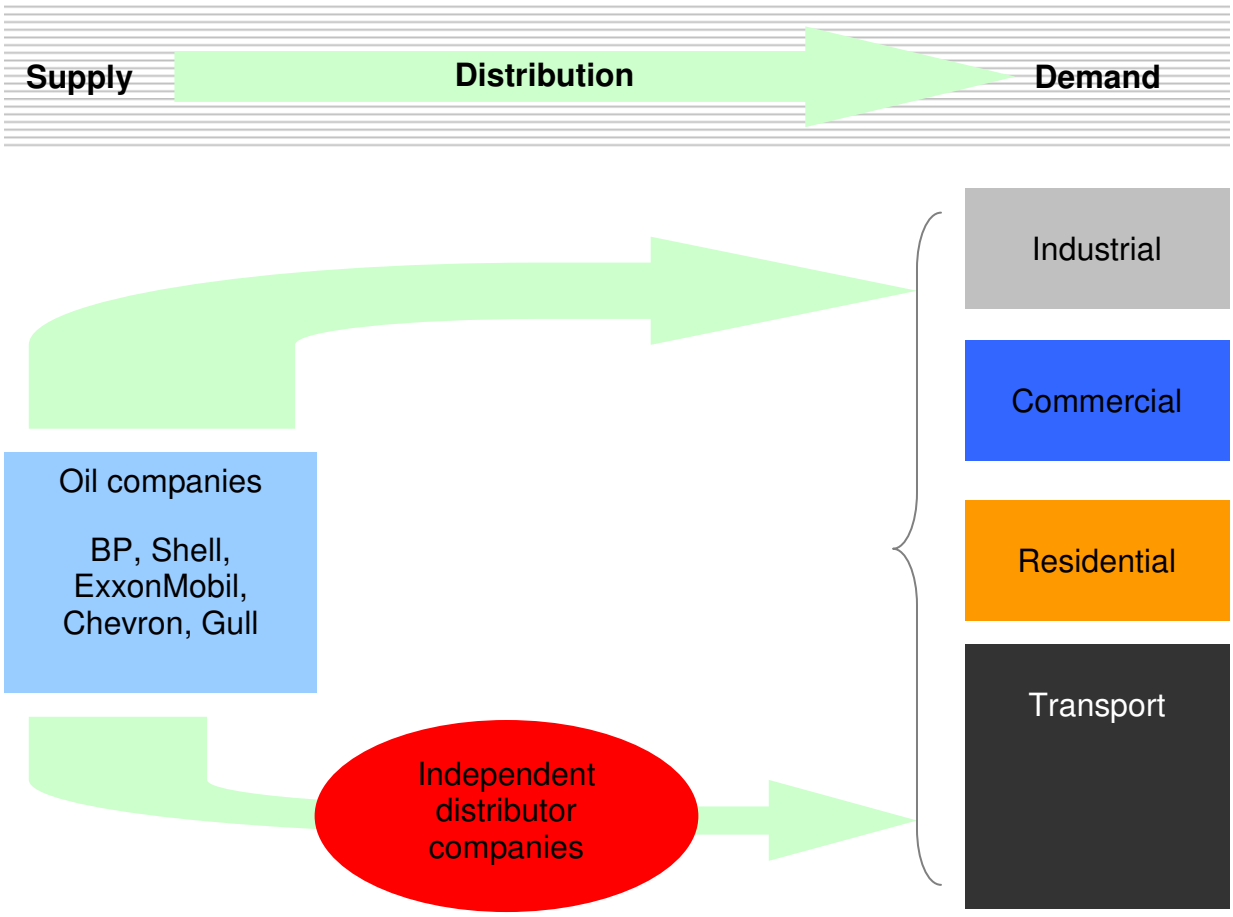
Delivering the Diesel

Liquid Fuel Deliveries in New Zealand

1990 – 2008

Principal author: Bryan J. Field, Senior Energy Analyst
Energy Information and Modelling Group
Ministry of Economic Development

February 2010



The liquid fuel supply chain in New Zealand after market deregulation in 1988

968779

Disclaimer:

1. In a nutshell…

The structure of the fuel supply chain changed after the market was deregulated in 1988 – independent distributor companies emerged to directly supply many customers that the oil companies were unwilling to

This change in structure reduced the accuracy of the government's fuel consumption statistics as data were not collected from these independent distributor companies

A new survey of these companies was designed to fill this information gap – it found that independent distributors delivered 18% of the diesel, and 3% of the petrol used in New Zealand in 2008

This information (and some clever calculations to reconstruct the deliveries back in time) was used to correct these statistics

The numbers from these corrected statistics were checked (and agree well) with the Ministry of Transport's Vehicle Fleet Model (VFM) – an independent estimate of the petrol and diesel used for transport in New Zealand based on the vehicle fleet

2. Background

The New Zealand Government is interested in where and how energy is used in New Zealand for international reporting obligations[1] and to inform energy policy development. The Ministry of Economic Development collects and publishes these statistics. For policy development and reporting obligations it is important to distinguish between fuel used for on-road transportation and fuel used off-road, and for stationary applications.

In New Zealand liquid fuel demand statistics are collected via a survey (Delivery of Petroleum Fuels by Industry (DPFI) survey) of New Zealand's oil companies, namely BP, Shell, Chevron (Caltex), ExxonMobil (Mobil) and Gull. This survey splits the oil companies' deliveries into categories[2] based on economic sectors. This survey provided a very accurate picture of New Zealand's fuel demand by sector until 1988, when the government deregulated the downstream petroleum market.

The key assumption of the way New Zealand's fuel demand statistics were collected (until now) is that fuel recorded in the "resellers[3]" category of the DPFI survey is used for on-road transport – this was a reasonable assumption when the "resellers" category included only service stations, fuel stops and marina refuelling stations. However, after deregulation in 1988, independent fuel distribution companies (companies who buy fuel in bulk from the oil companies, and deliver this fuel directly to their own customers), have played an increasingly important role in delivering fuel directly to businesses from all parts of New Zealand's economy for a variety of uses, including much off-road use – Independent distributor companies are also recorded as "resellers" in the DPFI.

The assumption that all fuel delivered to resellers is used for on-road transport has caused the fuel demand statistics collected in the DPFI to overestimate the fuel (diesel in particular, but also petrol to a lesser extent) used for on-road transport at the expense of the other categories. This effect was clearly noticed when on-road diesel transport demand from the DPFI consistently overshot the on-road transport demand figures from the Ministry of Transport's Vehicle Fleet Model (VFM) – a bottom-up calculation of the fuel (diesel and petrol) used for transport on New Zealand's roads based on the vehicle fleet.

A project to investigate the root cause of the transport demand overestimation was commissioned in 2008[4]. During this project a pilot study identified 19 independent fuel distribution companies - these companies made the final delivery of 16% of New Zealand's diesel demand, and 3% of New Zealand's petrol demand in the 2007 calendar year.

Independent distributors provide a valuable service in delivering fuel directly to customers so this fuel is more expensive than fuel purchased from a service station or fuel stop.

---

[1] To the International Energy Agency (IEA) and the United Nations Framework Convention on Climate Change (UNFCCC).

[2] These categories are: Agriculture, Fishing and Hunting, Forestry and Mining, Building and Construction, Industry and public utilities, Commercial, Residential, Commercial Transport and Resellers.

[3] A reseller is any company that buys fuel and then sells it to their own customers. These are typically service stations and truck stops, but independent distribution companies are also classed as resellers.

[4] "Liquid Fuel Use in New Zealand" prepared by Outcome Management Services (OMS) – this report is available for download from http://www.med.govt.nz/energy/liquid-fuel-demand/

Because of this extra cost, the independent distributors' customers are generally located in areas without convenient service station access, or are customers who use fuel in stationary applications (such as construction sites). This is a key factor in the business model of the independent distributors.

In 2009, the Ministry of Economic Development (MED) started a formal survey of these independent distribution companies. This survey was designed to align neatly with the Delivery of Petroleum Fuels by Industry (DPFI) survey. This survey is now complete and these data are presented in this report.

3. 2008 Annual Liquid Fuel Survey (ALFS) results

In the 2008 calendar year independent fuel distribution companies delivered 18% (519 million litres) of New Zealand's domestic diesel demand and 3% (98.9 million litres) of domestic petrol demand. These fuel deliveries were grouped together in the following categories:

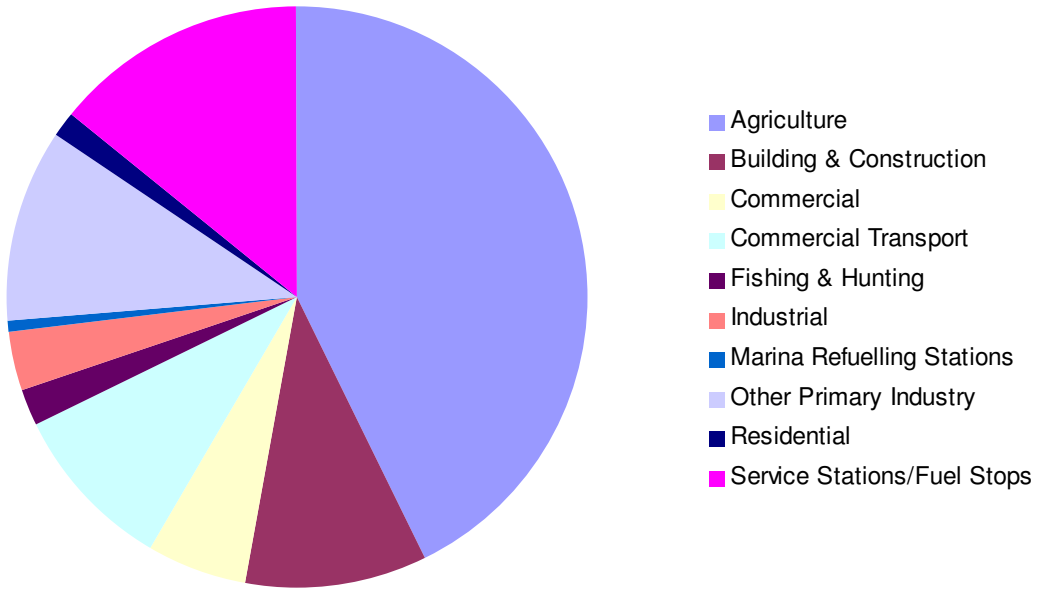
- Agriculture – includes farms, crop growers, horticulture and agricultural contracting services
- Fishing and Hunting – includes commercial fishing, aquaculture, trapping and hunting operations
- Other Primary Industry – includes forestry, logging and mining operations
- Building and Construction – includes construction companies (buildings, roads and infrastructure) and heavy and civil engineering companies
- Industrial – includes all manufacturing businesses and public utilities (electricity, gas, water, waste etc.)
- Commercial Transport – includes all commercial freight and passenger transport
- Commercial – includes all retail, wholesale, warehousing and hospitality businesses
- Residential – private households

Deliveries to service stations and fuel stops were also requested, as well as deliveries to marina refuelling stations (i.e. "boat stops").

3.1 2008 diesel deliveries

Figure 1 shows the independent distribution companies' diesel deliveries to New Zealand's economic sectors for the 2008 calendar year. Agricultural businesses (43%), forestry and mining operations (11%), building and construction businesses (10%) and service stations and fuel stops (14%) were the major recipients of these deliveries. That these deliveries relate to off-road, often remote uses aligns with the business model adopted by independent distributors.

Figure 1: 2008 independent distributor diesel deliveries by sector



3.1.1 Off-road diesel estimate

In addition to the amount of petrol and diesel each company delivered to the various sectors, the companies were asked to estimate the percentage of diesel delivered to each sector that is used off-road. Out of the 19 companies surveyed, 11 provided some data – a summary of which appears in table 1.

Table 1: Summary of off-road percentages by sector

Economic sector	Mean	Minimum	Lower quartile	Median	Upper quartile	Maximum	Number of companies responded
Agriculture	84.2	75	76.3	85.0	90.0	97	10
Fishing & Hunting	97.0	80	99.5	100.0	100.0	100	7
Other Primary Industry	81.4	30	80.0	90.0	95.0	100	7
Building & Construction	77.5	5	82.5	92.5	95.0	100	6
Industrial	77.9	5	72.5	97.0	99.0	100	7
Domestic Transport	18.7	0	3.0	5.0	15.0	90	7
Commercial	86.3	50	83.8	97.5	100.0	100	4
Residential	99.3	98	99.0	100.0	100.0	100	3

Two conclusions can be drawn from table 1:

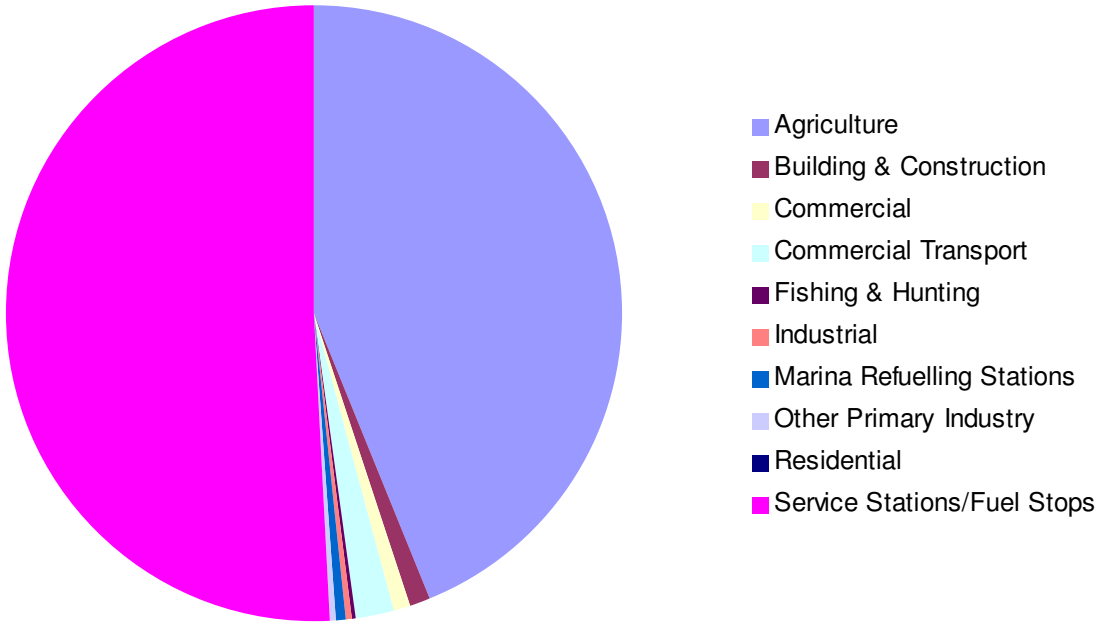
1. The independent distributors estimate a very high proportion of the fuel they deliver is used off-road, with the exception of the domestic transport category;

2. There is a large degree of uncertainty in these data, which limits their usefulness to monitoring trends.

3.2 2008 petrol deliveries

Figure 2 shows the independent distribution companies' petrol deliveries to New Zealand's economic sectors for the 2008 calendar year. Most of these petrol deliveries were made to agricultural businesses (44%) and service stations/fuel stops (51%).

Figure 2: 2008 independent distributor petrol deliveries by sector



In general, petrol is an on-road fuel and businesses that can access the service station/fuel stop networks will do so to reduce costs (direct delivered fuel is more expensive than fuel purchased from a service station). Therefore, companies whose petrol usage is mostly on the road tend to source fuel from the service station/fuel stop networks, rather than having it delivered directly. Agricultural businesses are often in locations with poor service station access, so having petrol delivered on site is desirable.

4. New Zealand's domestic demand for petrol and diesel

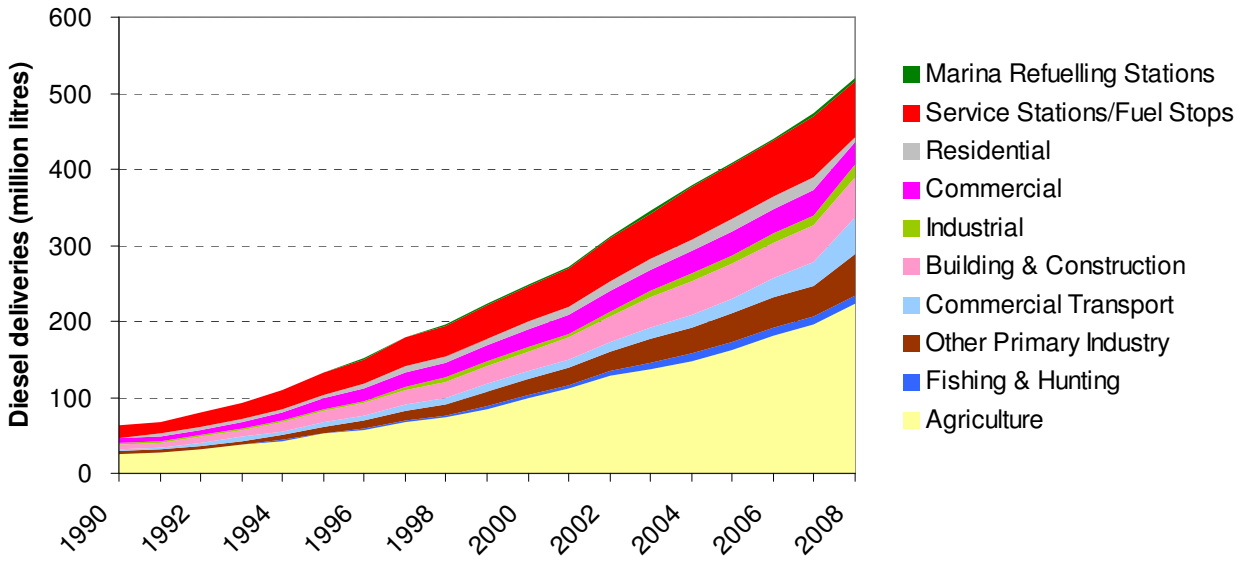
This section presents the corrected petrol and diesel demand statistics from 1990 to 2008. Appendix B is a discussion of the methodology for reconstructing the petrol and diesel demand time-series' back in time (to 1990). At the end of this chapter we compare these numbers to an independent source of New Zealand fuel demand statistics – The Ministry of Transport's Vehicle Fleet Model (VFM).

4.1 Independent distributors' deliveries 1990 – 2008

Figures 3 and 4 show the distributors' diesel and petrol deliveries by sector from 1990 – 2008. The numbers from 1990 to 2006 are calculated[5], thereafter the numbers are surveyed data. The figures below show steady growth of the petrol and diesel distribution markets consistent with our expectations (growing steadily from almost nothing in 1990 to present levels).

Diesel deliveries by the independent distributors (see figure 3) showed fairly consistent growth in all sectors. Agriculture receives the largest portion of this diesel, generally receiving about 40% of the independent distributors' diesel deliveries each year.

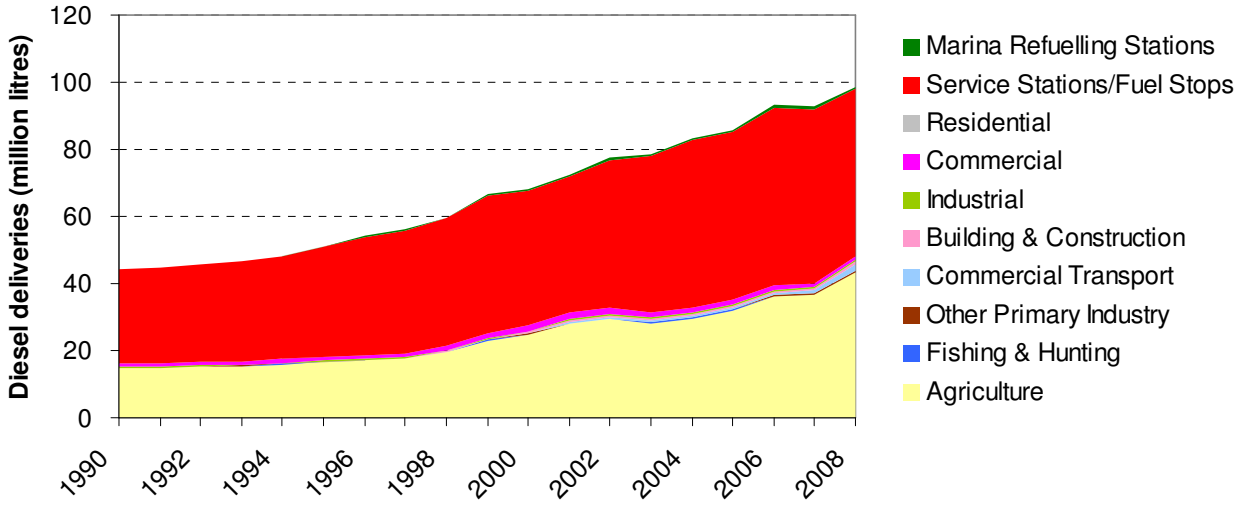
Figure 3: Independent distributors' diesel deliveries by sector 1990 – 2008



Petrol deliveries by the independent distributors are vastly dominated by deliveries to service stations and fuel stops (generally about 60%) and agriculture (generally about 35%).

[5] Calculation methodology is discussed in Appendix B.

Figure 4: Independent distributors' petrol deliveries by sector 1990 – 2008



4.2 Corrected domestic fuel demand 1990 – 2008

Figures 5 and 6 show New Zealand's annual domestic diesel and petrol demand by sector since 1990, corrected for the independent distributors' deliveries. Appendix A contains the data tables for figures 5 and 6.

These demand time-series' for diesel (figure 5) and petrol (figure 6) show an increasing trend for most sectors over the 18 years since 1990. For diesel, agricultural demand increased by nearly 160% over this time. Industrial diesel demand also increased significantly over this time, the 2008 demand was up nearly 170% on 1990. Petrol demand is vastly dominated by on-road transport, generally accounting for 96% of all demand.

Figure 5: Domestic diesel demand by sector 1990 - 2008

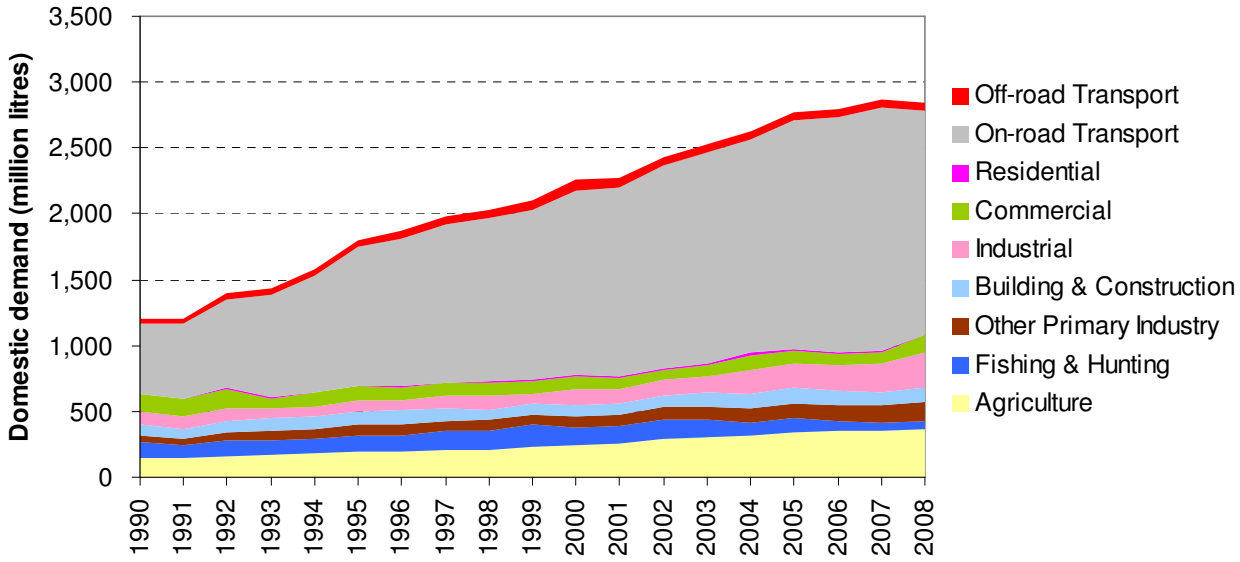
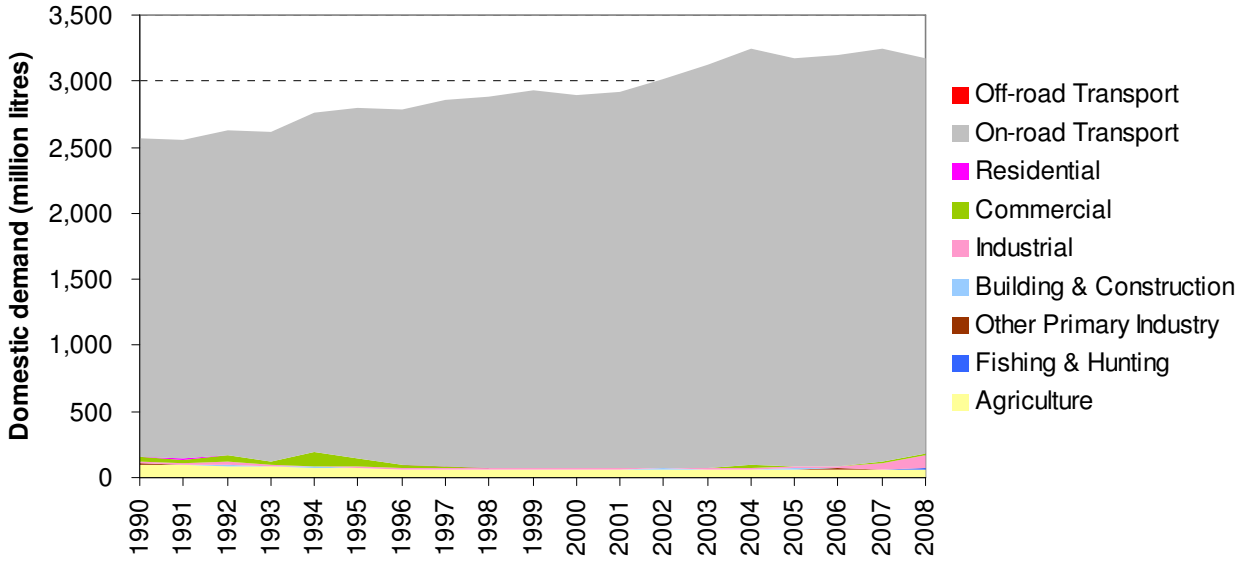


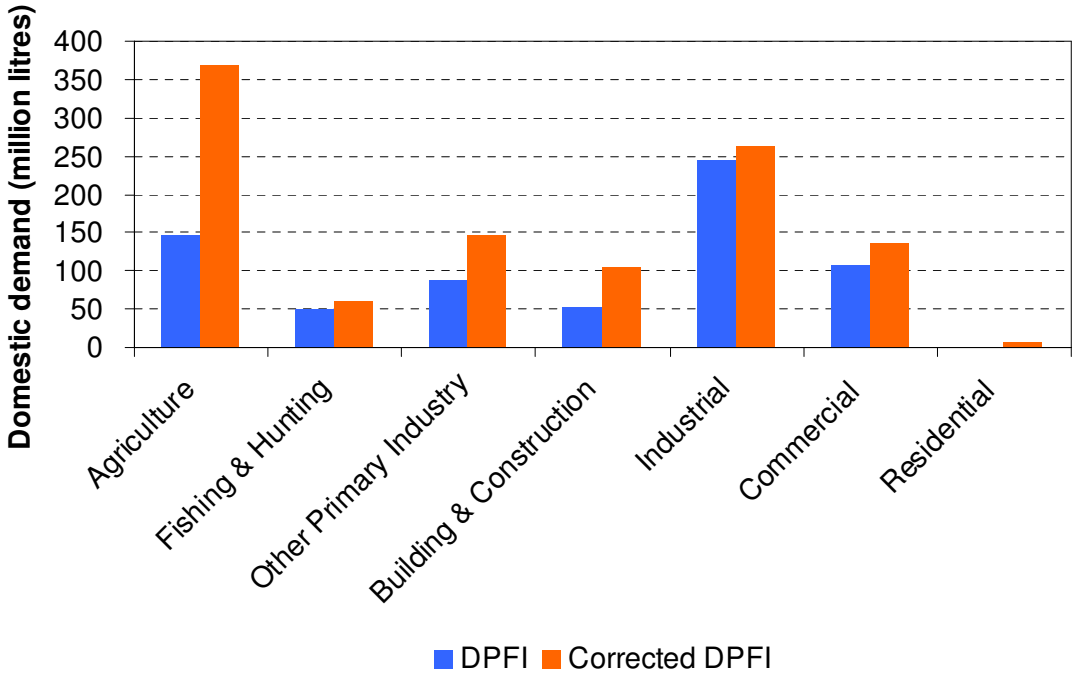
Figure 6: Domestic petrol demand by sector 1990 – 2008



In 2008, 395 million litres of diesel and 46 million litres of petrol were able to be reallocated from the DPFI "resellers" category into the appropriate sectors' demand. Figures 7 and 8 (above) show the changes to each sector's[6] demand as a result of these reallocations.

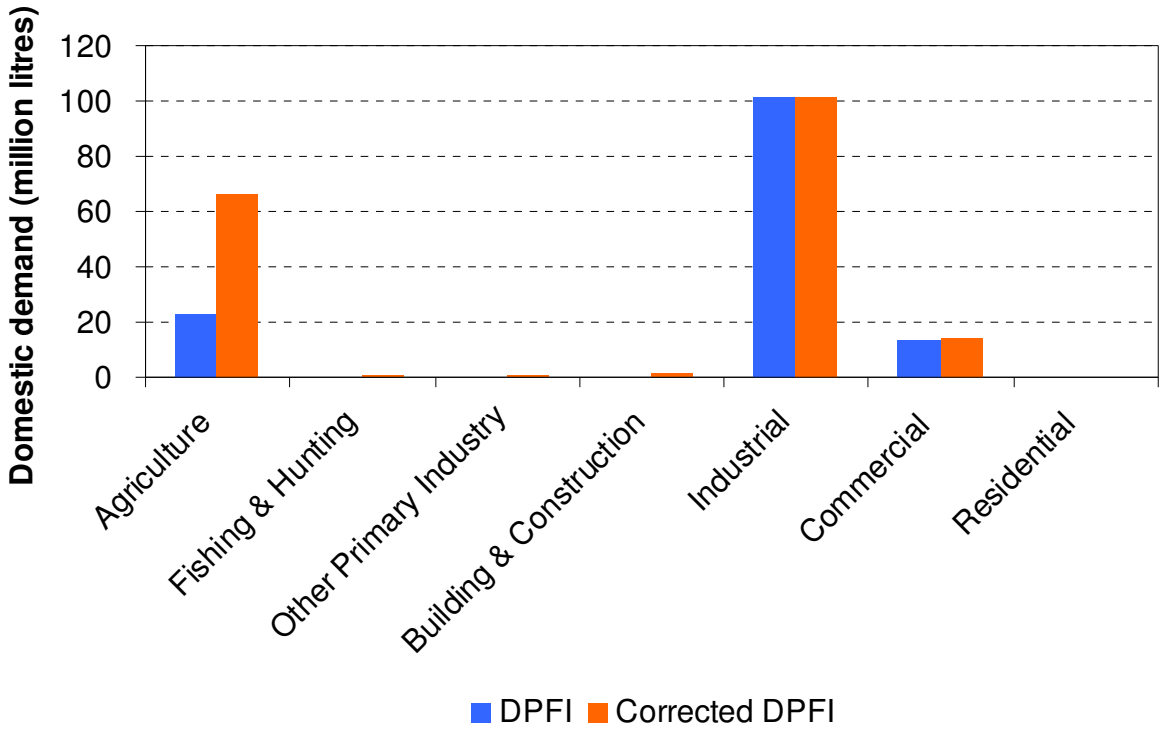
For diesel (figure 7), agriculture (up 151%), building and construction (up 98%), other primary industry (up 63%) and commercial (up 27%) all increased significantly as a result of the reallocated diesel. Nearly all of the reallocated 2008 petrol demand (see figure 8) went to agriculture, which increased by 189% as a result.

Figure 7: 2008 diesel demand by sector before and after reallocations



[6] Transport is not shown in figures 7 and 8 because the scale makes it difficult to see some of the changes.

Figure 8: 2008 petrol demand by sector before and after reallocations

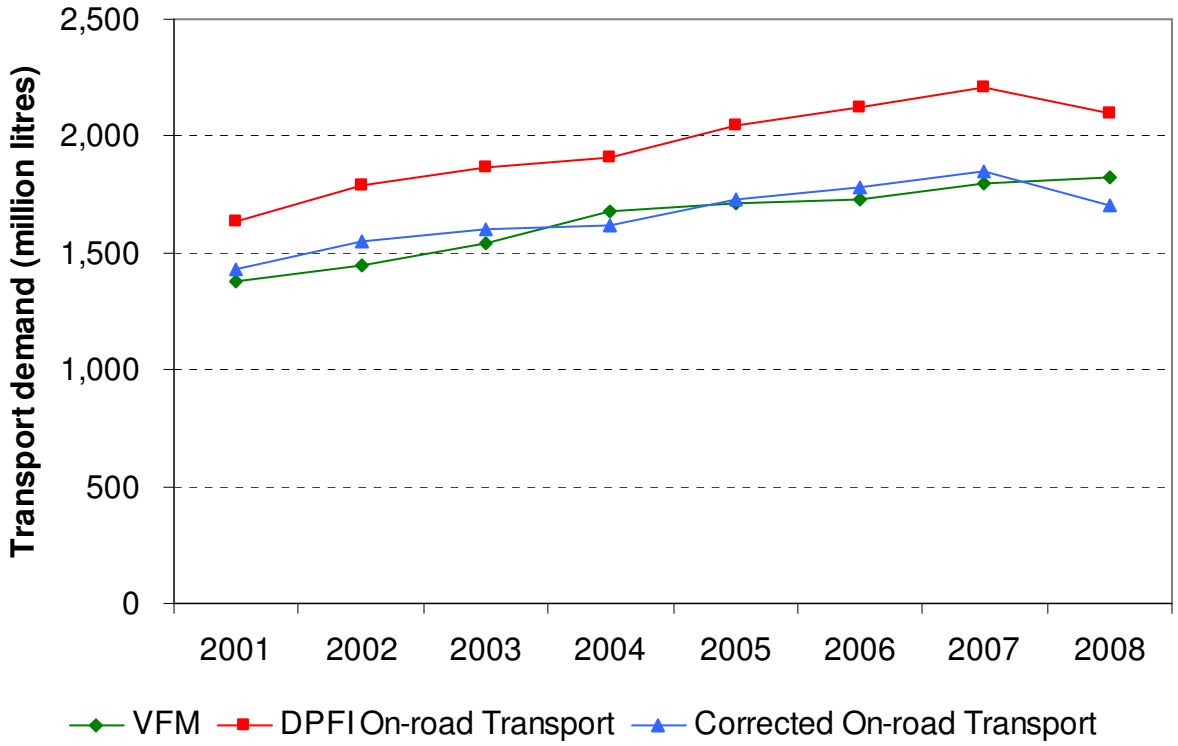


4.3 Comparison to VFM transport diesel usage

The Vehicle Fleet Model (VFM) infers transport diesel (and petrol) usage by multiplying "vehicle kilometres travelled" (VKT)[7] for each vehicle by that type of vehicle's fuel efficiency. This is an independent estimate of the diesel (and petrol) used for transport on New Zealand's public roads. The VFM comprises data since 2001, so a direct comparison can be made for the period 2001 - 2008. Figure 9 shows a comparison of VFM (green) to the on-road transport calculations from the DPFI (red), and the corrected DPFI (blue). For a fairer comparison, diesel used for rail has been excluded from the DPFI on-road transport numbers (red).

[7] VKT is sourced from odometer readings taken at Warrant of Fitness checks.

Figure 9: Comparison of road transport diesel demand to the VFM



The above figure shows that the on-road transport data from the DPFI (commercial transport + resellers) clearly overestimates on-road transport by an average of 20% each year. The corrected on-road transport (blue) values, however, are much closer to the demand suggested by the VFM (green). The average deviation of the two series' is about 4% over the 8 years. This level of agreement is certainly within the uncertainty bounds of the VFM (estimated to be around 5 to 10%).

Appendix A: Petrol and diesel demand – data tables

Table A1: New Zealand's domestic demand for diesel by sector 1990 – 2008 (million litres)

Year	Agriculture	Fishing & Hunting	Other Primary Industry	Building & Construction	Industrial	Commercial	Residential	On-road Transport	Rail Transport	Domestic Demand
1990	143.47	126.48	48.04	82.52	97.95	128.24	3.93	540.58	29.56	**1,200.77**
1991	146.83	94.76	46.99	77.72	93.94	135.64	4.35	566.89	38.54	**1,205.67**
1992	154.71	118.77	68.59	82.69	101.93	146.81	6.68	670.48	48.16	**1,398.80**
1993	169.24	109.65	76.79	90.09	71.66	82.60	7.36	772.53	51.34	**1,431.27**
1994	180.77	113.36	71.64	99.58	73.85	99.88	7.75	882.92	53.82	**1,583.58**
1995	189.84	121.08	87.27	103.84	81.03	105.05	7.91	1,050.06	57.79	**1,803.87**
1996	197.09	120.97	84.74	101.58	83.87	95.03	7.81	1,118.37	56.86	**1,866.31**
1997	212.02	136.42	79.34	92.60	101.50	91.48	9.06	1,201.47	59.71	**1,983.60**
1998	210.28	148.00	74.31	82.97	98.65	103.55	10.38	1,238.72	57.63	**2,024.49**
1999	232.34	164.48	75.47	83.72	73.37	100.44	11.63	1,289.42	66.37	**2,097.25**
2000	240.09	141.55	85.30	81.61	118.17	101.00	10.98	1,391.08	91.48	**2,261.27**
2001	259.60	125.04	92.23	82.43	114.17	81.04	11.40	1,430.96	72.31	**2,269.17**
2002	293.20	140.68	100.48	91.14	116.26	73.37	12.32	1,548.16	60.39	**2,436.00**
2003	303.82	127.64	109.34	102.25	120.81	86.63	13.50	1,604.61	63.14	**2,531.73**
2004	314.34	99.62	107.65	111.62	177.56	117.78	14.79	1,619.25	65.09	**2,627.69**
2005	338.66	113.07	111.78	117.94	178.07	102.42	15.98	1,730.08	57.23	**2,765.24**
2006	347.65	81.57	119.83	110.54	190.47	84.79	15.94	1,782.57	58.77	**2,792.12**
2007	346.79	70.92	128.85	92.92	225.69	83.58	16.68	1,847.08	59.84	**2,872.34**
2008	369.60	60.18	145.46	105.67	262.75	135.89	7.42	1,701.11	58.00	**2,846.08**

Table A2: New Zealand's domestic demand for petrol by sector 1990 – 2008 (million litres)

Year	Agriculture	Fishing & Hunting	Other Primary Industry	Building & Construction	Industrial	Commercial	Residential	On-road Transport	Domestic Demand
1990	100.19	0.84	2.21	6.81	15.91	30.69	0.33	2,411.08	**2,568.07**
1991	92.75	0.68	2.25	5.06	12.66	25.85	0.32	2,418.14	**2,557.72**
1992	85.40	0.72	1.73	3.55	33.30	43.07	1.55	2,461.11	**2,630.42**
1993	80.33	0.62	1.70	2.86	9.93	23.82	1.42	2,491.40	**2,612.09**
1994	76.07	0.53	1.45	2.35	7.06	104.81	0.98	2,573.18	**2,766.43**
1995	72.02	0.45	2.14	1.97	5.63	58.60	0.66	2,660.21	**2,801.68**
1996	62.47	0.40	0.90	1.58	11.78	17.63	0.29	2,685.34	**2,780.38**
1997	60.48	0.43	0.79	2.24	5.84	19.26	0.15	2,764.50	**2,853.69**
1998	60.87	0.51	0.59	1.23	3.86	9.44	0.33	2,808.10	**2,884.92**
1999	61.63	0.82	0.56	1.13	3.15	5.25	0.75	2,854.01	**2,927.30**
2000	60.35	0.92	0.68	1.02	4.41	4.20	0.35	2,827.91	**2,899.84**
2001	61.26	0.92	0.60	1.20	3.80	5.21	0.11	2,845.31	**2,918.41**
2002	63.51	1.47	0.52	1.12	3.85	5.05	0.11	2,940.96	**3,016.59**
2003	61.72	1.75	0.47	1.10	3.89	4.22	0.10	3,046.62	**3,119.86**
2004	62.58	1.18	0.49	1.14	10.87	14.79	0.07	3,156.81	**3,247.92**
2005	64.03	1.12	0.47	1.08	13.03	4.94	0.07	3,084.45	**3,169.20**
2006	65.36	1.01	0.51	0.90	13.64	3.84	0.06	3,109.95	**3,195.27**
2007	62.46	0.80	0.45	0.83	49.84	10.77	0.06	3,126.30	**3,251.52**
2008	66.12	0.57	0.43	1.23	101.55	14.33	0.09	2,984.92	**3,169.22**

Appendix B: Reconstructing fuel deliveries back to 1990

To avoid discontinuities in the petrol and diesel demand time-series', each economic sector's petrol and diesel deliveries from the independent distributors were reconstructed – these are presented in section 4.1. Where available, actual delivery volumes were collected from the distributor companies, where numbers were not available they were estimated. The calculation method that was employed to estimate the deliveries makes several key assumptions that will be discussed later in this appendix.

Back-calculation methodology

The methodology that was used to project the independent distributor companies' fuel deliveries back in time is very simple. It focuses on using each company's percentages of petrol and diesel delivered to the sectors from the recently surveyed data and applies these to the total deliveries of petrol and diesel for the previous years (back to 1990). The advantage of this approach was that, where possible, actual numbers were used – the estimated numbers just filled the gaps.

The methodology is as follows:

1. Starting with the 2007 data from the pilot study, each company's total annual deliveries of petrol and diesel were reconstructed back in time. Several companies were able to provide total annual deliveries of petrol and diesel for several previous years, where these were not available the 2007 total deliveries for these companies were scaled by the year on year growth of the "resellers" category of the DPFI[8]. These deliveries were calculated back to 1990, or to when the company was formed (if this was after 1990).

2. Each company's total annual petrol and diesel deliveries were allocated to sectors based on the percentage splits from the 2007 or 2008 surveyed data (whichever was deemed to be more accurate).

3. The petrol and diesel deliveries across all companies were then summed to find the independent distributors' annual deliveries by sector, back to 1990.

Discussion of assumptions

Because of fairly sparse information about fuel deliveries from previous years, several assumptions had to be made in the design of this methodology. The validity of these will be discussed here.

The fuel distribution market is stable over time

Really, there are two linked assumptions here:

1. Each company's deliveries grow smoothly at the average rate

2. Each company's percentage of fuel delivered to each sector is constant over time

[8] The independent distributor companies are coded as "resellers" by the oil companies in the DPFI; hence growth in deliveries by the independent distributors is concentrated in this category.

Assumption 1 and 2 both affect the final allocations to each sector.

Assumption 1 is valid – since we are mostly interested in the market growing as a whole, fluctuations in individual companies' sales will even out over all companies. Additionally, companies covering 76% of 2007 petrol delivery market share, and 58% of 2007 diesel delivery market share provided at least one previous year of data.

Assumption 2, however, is a slightly more risky assumption. Over the 16 years that we have poor information for, the individual companies' customer bases may have changed significantly. Unfortunately, there is very little information available to enhance these data, so there is a certain degree of "blind faith" involved here. One company was able to provide four previous years of actual delivery data – the variance in the proportions of petrol and diesel delivered to each sector was less than 1% over these years. Thankfully, in this case, the proof of the pudding is in the eating – the reconstructed on-road transport time-series compares very well with the VFM annual estimate of fuel used for on-road transport, an independent check of the numbers (see section 4.3).

Growth of the fuel distribution market is concentrated in DPFI Resellers

Using the year on year growth of the DPFI resellers to build each company's total sales back in time assumes that the growth of the resellers is mostly driven by growth of the independent distributors. This is a fairly good assumption because the antithesis of this is that the growth in the resellers was driven by growth of sales through service stations and truck stops. This is unlikely to be the case because the number of service stations/truck stops has drastically reduced since 1990.

Direct delivered fuel is used solely off-road

With the obvious exception of fuel delivered directly to commercial transport businesses, we assume that direct delivered diesel is not used for driving on public roads.

Before we start discussing this assumption, it is timely to clarify some definitions. These data are collected and reported on the basis of the International Energy Agency's (IEA) Energy Statistics Manual, which defines transport as:

> *"…fuel used in any vehicle for transportation on public roads."*

Therefore, of the fuel delivered to any particular sector of the economy, the fuel used on the road is classed as transport, and the fuel used off the road is included in that sector's energy use.

Using these definitions, the on-road components of the sectors' diesel use should be allocated to transport. While this is true, the surveyed off-road percentages (presented in table 1) are so high[9] that this added complexity adds very little value to the final numbers. This assumption will be reviewed each year, but for the purposes of the reconstructed time-series', it is better to keep it simple.

[9] Median reported sector off-road percentages in the 2008 survey data are all above 85%, with the exception of commercial transport (5%).

Appendix C: Acknowledgements

A special thank you extends to the following companies who provided data which helped in the preparation of this report.

Company	Website
Allied Petroleum	http://www.alliedpetroleum.co.nz/
Aratuna Freighters	http://sites.yellow.co.nz/site/aratunafreighters/
BSP Services	N/A
Bushetts Fuel	N/A
CRT Fuels	http://www.crtfuel.co.nz/
Direct Fuels	http://www.directfuels.co.nz/
Kauriland Petroleum	http://www.kauriland.co.nz/Fuels.html
McFall Fuel	http://www.mcfallfuel.co.nz/
McKeown Petroleum	http://www.mckeown.co.nz/mphome.htm
Minifuels	http://www.minitankers.co.nz/
Nelson Petroleum	N/A
RD Petroleum	http://www.rdpetroleum.co.nz/
Rural Fuel	http://www.ruralfuel.co.nz/
Southern Heating Fuels	http://www.shf.co.nz/
SouthFuels/NorthFuels	http://www.southfuels.co.nz/
	http://www.northfuels.co.nz/
United Petroleum	http://www.toll.co.nz/Toll-United.html
VJ Distributors	http://www.vjdist.co.nz/
Waitomo Petroleum	http://www.wpl.co.nz/
Wealleans Petroleum	http://www.groundspread.co.nz/petroleum/

Thanks also to BP, Shell, ExxonMobil, Chevron, Gull and Kiwirail.