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# **Economic Analysis of LPG Costs for Households in Western Australia.**

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## **Executive Summary**

This report looks at household LPG costs in relation to household incomes. The objective is to test whether LPG has become less affordable in recent years and if this is the case whether there is any pattern across regions, household types and income groups.

Domestic LPG prices are tied to international prices via the Saudi Aramco price. The price index for LPG gases (butane/propane) has increased by 45 percent since 2000. This is well ahead of the CPI (26%) but has been matched by increases in average weekly full time earnings (43%). On average therefore LPG cost is not a significant issue. However, households whose incomes have not kept pace, including those with incomes linked to the CPI, are likely to be worse off unless they have been able to substitute away from LPG into other less expensive energy sources or economise on energy use.

Impacts on households by household type and region were analysed using a combination of data on cylinder consumption and prices from industry sources and a household survey of LPG users carried out in conjunction with this study. Disposable income data came from the Australian Bureau of Statistics Household Expenditure Survey..

Across all regions and households the average percent of weekly household disposable income going to LPG is 1.9% based on the industry cylinder usage data and estimated industry prices. The household survey yielded lower estimates for cylinder usage but similar average prices. Using the household survey, LPG consumption and price data, across all regions and household types, the average for LPG costs as percent of weekly household disposable income is 1%.

The analysis of survey results indicates that appliance choice is the major driver of cylinder usage – in particular using LPG for hot water and space heating. Household type and the whether households contained people holding a pension/health card were not significant

drivers. The evidence is that lower income households, including pensioner concession cardholders, do not significantly economise on LPG expenditure once household size is allowed for because of the commitment to gas hot water and gas heating.

If we assume no economising on energy use by low income households, then across all regions and household types, the average percent of disposable income going to LPG for households at the margin of the lowest quartile is estimated to be 3.5% using cylinder usage based on the industry data and industry prices (compared to an overall average of 1.9%). Based on the information from the household survey this 1.9% (compared to the overall average of 1%).

On the evidence it seems it is the longer term appliance choice decisions that impinge most on LPG costs and therefore, although low income households have a higher share of income going to LPG costs, a broad subsidy is likely to be inappropriate. Targeted support in the form of information and advice to assist persons who are having difficulties affording LPG to reduce their consumption and costs of LPG, especially where these are connected to particular appliance choices, might be the most appropriate initial policy.

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## **Introduction**

This report looks at LPG costs in Western Australia. The report objective is to examine how LPG costs impact on households by modelling the way that LPG costs affect families with different household incomes across the various regions in Western Australia.

As with energy use generally, households make a consumption decision about energy in two parts: appliance choice and energy use. Households choose between: gas versus solar water heaters (with electric or gas boosters), gas versus electric space heaters, gas versus electric hotplates and ovens. Once these choices are made they are locked into the associated energy source for a period. There are significant capital costs in changing appliances and typically therefore, switching energy sources will only occur at times when appliance choices are being made – replacement, relocation etc. Therefore, the short run price elasticity of demand for energy is relatively low.

Gas as LPG is available throughout Western Australia. However, most of regional Western Australia does not have reticulated natural gas so that LPG is the only form of gas available to fuel appliances.

LPG gas prices are tied to world prices which means that LPG prices are subject to greater variation over short periods of time than is typically experienced by users of reticulated natural gas.

There is a view that these circumstances could result in some households experiencing relatively higher energy costs if they are using LPG.

Some jurisdictions have included LPG in their various energy rebate schemes. For example in Victoria there is a general rebate on winter energy costs for LPG users as shown in Table 1..

It is important to know whether households committed to LPG experience greater energy costs, relative to incomes, than those with

natural gas available. This is an important input to thinking about energy policy.

This report looks at LPG costs relative to disposable income across regions and household types in Western Australia. The analysis is based on information from a variety of sources – ABS Census and Household Expenditure Survey data, data from energy use surveys by appliance type, data from discussion with industry and the Office of Energy and data from a household survey carried out by Data Analysis Australia. The household survey was carried out in parallel to the work in this report and covered households across regional Western Australia. It provided an alternative view of household LPG usage and costs and insights not available from any existing data sources.

**Table 1: LPG Rebates in Victoria**

<p>Winter Energy</p>	<p>Discount of 17.5% off mains electricity and mains gas bills issued during a six-month period between May and November.</p>	<p>CC HCC (except Child Disability, Foster Care) Gold Card (except Dependant)</p>
<p>Non Mains Winter Energy</p>	<p>A three-tiered annual rebate available to people who:</p> <ul style="list-style-type: none"> <li>• Spend \$80 or more on liquefied petroleum gas (LPG) each year; or</li> <li>• Spend \$80 or more on alternative fuel used as the main domestic energy source (diesel, petrol, heating oil)</li> </ul> <p>A \$19 rebate is available for purchases from \$80–\$119, a \$95 rebate for purchases from \$120–\$595 and a rebate of \$141 for purchases greater than \$595 (2006 amounts). Rebate amounts are adjusted annually in line with increases in the price of LPG.</p> <ul style="list-style-type: none"> <li>• Who are individually metered and billed for electricity, but who pay a caravan park or accommodation owner.</li> </ul>	<p>PCC HCC (except Child Disability, Foster Care) Gold Card (except Dependant)</p>

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## **Overview of Energy Costs**

The 2003/2004 household expenditure survey by the Australian Bureau of Statistics provides an overview of energy costs relative to household disposable income. The percent of weekly household disposable income going to domestic fuel and energy is given in Table 2. This shows that expenditure on fuel and power averages \$22.48 per week for Western Australia and varies from around \$19 per week in the Upper Great Southern to nearly \$32 in the Midlands region. The estimates for Pilbara + Kimberley have a high standard error and are not reliable based on ABS guidelines. Electricity averages \$15.38 per week and varies from just under \$12 per week in the Lower Great Southern and Upper Great Southern to \$20 in the Midlands.

The difference between overall fuel and energy costs and electricity costs is \$7 per week across Western Australia and varies from \$5.2 in the Central region to just under \$12 in the Midlands. This difference is the cost attributable to sources of energy other than electricity including gas and wood.

Overall expenditure on fuel and power is 2.5% of average weekly household disposable income. This varies from 1.7% in the Pilbara+Kimberley to 3% in the South West and Midlands.

These results are a reference point against which we can consider the modelling of LPG costs based on industry data and the results of the household survey.

Table 2: Expenditure and Average Weekly Disposable Income by Stat Div

	Perth	South West	Lower Great Souther n	Upper Great Souther n	Midlands	South Easter n	Centra l	Pilbara and Kimberle y	Western Australia
<i>Average weekly household expenditure (\$)</i>									
0201010101 Electricity (selected dwelling)	15.27	15.12	11.49	11.48	19.92	14.07	14.88	*25.99	15.38
02 Domestic fuel and power	21.99	24.10	20.27	19.27	31.72	21.97	20.12	*27.81	22.48
<b>Total goods and services expenditure</b>	<b>893.75</b>	<b>862.71</b>	<b>766.98</b>	<b>671.83</b>	<b>905.41</b>	<b>682.40</b>	<b>602.08</b>	<b>1311.59</b>	<b>878.04</b>
<b>Average weekly household disposable income (\$)</b>	<b>902.63</b>	<b>806.57</b>	<b>733.94</b>	<b>771.49</b>	<b>1077.94</b>	<b>822.13</b>	<b>763.15</b>	<b>1658.21</b>	<b>895.96</b>
<b>Expenditure as % of Income</b>	<b>99%</b>	<b>107%</b>	<b>105%</b>	<b>87%</b>	<b>84%</b>	<b>83%</b>	<b>79%</b>	<b>79%</b>	<b>98%</b>
<b>Domestic Fuel and Power as % of:</b>									
Goods and services expenditure	2.46%	2.79%	2.64%	2.87%	3.50%	3.22%	3.34%	2.12%	2.56%
Average weekly household disposable income	2.44%	2.99%	2.76%	2.50%	2.94%	2.67%	2.64%	1.68%	2.51%
<b>Domestic Electricity as % of:</b>									
Goods and services expenditure	1.71%	1.75%	1.50%	1.71%	2.20%	2.06%	2.47%	1.98%	1.75%
Average weekly household disposable income	1.69%	1.87%	1.57%	1.49%	1.85%	1.71%	1.95%	1.57%	1.72%

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## **Regions of LPG Use**

The reticulated natural gas network in WA is largely centred on the Perth metropolitan region. Beyond this there is reticulation in Geraldton, Bunbury, Busselton, Harvey, Capel, Boyanup, Brunswick Junction, Kalgoorlie-Boulder and Esperance.

LPG reticulation is in place at Margaret River, Leinster, Albany and Rottnest Island.

Outside of these areas LPG is sold to households in standard 45Kg cylinders delivered to the household directly by local agents/distributors.

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## **LPG Pricing**

### **Pricing Components**

Typically LPG is sold in 45 KG cylinders. These may be transported as cylinders from Perth production points to regional distributors/agents who then deliver them to households or shipped in bulk to regions where the gas is put into cylinders prior to delivery.

The price of gas to a householder has several components, including mark ups:

- The raw gas cost.
- The cost of a cylinder.
- Transport and distribution cost.
- Retailing Cost.

### **Connection to Saudi Aramco prices**

The raw gas component is particularly significant because it is the component that is likely to vary in the short run. It is important to understand how the LPG gas cost can vary and why.

LPG is a tradable commodity. It is exported from Australia and also imported. In broad terms Australia exports around 1.5 million tonnes of LPG and imports around 300,000 tonnes. The imports are primarily to deal with seasonal demand in the Eastern State markets.

Western Australia is a net exporter of LPG. Two major LPG extraction facilities operate in Western Australia – the Wesfarmers’ plant at Kwinana and the North West Shelf Venture (NWSV) plant on the Burrup Peninsula, extracting LPG from gas/condensate streams. LPG is also produced as a by-product at BP’s Kwinana Refinery..

Since 1991 the price of LPG in Australia has been deregulated. Reflecting its tradable nature, the main driver of Australia LPG prices since this time has been the international LPG price level.

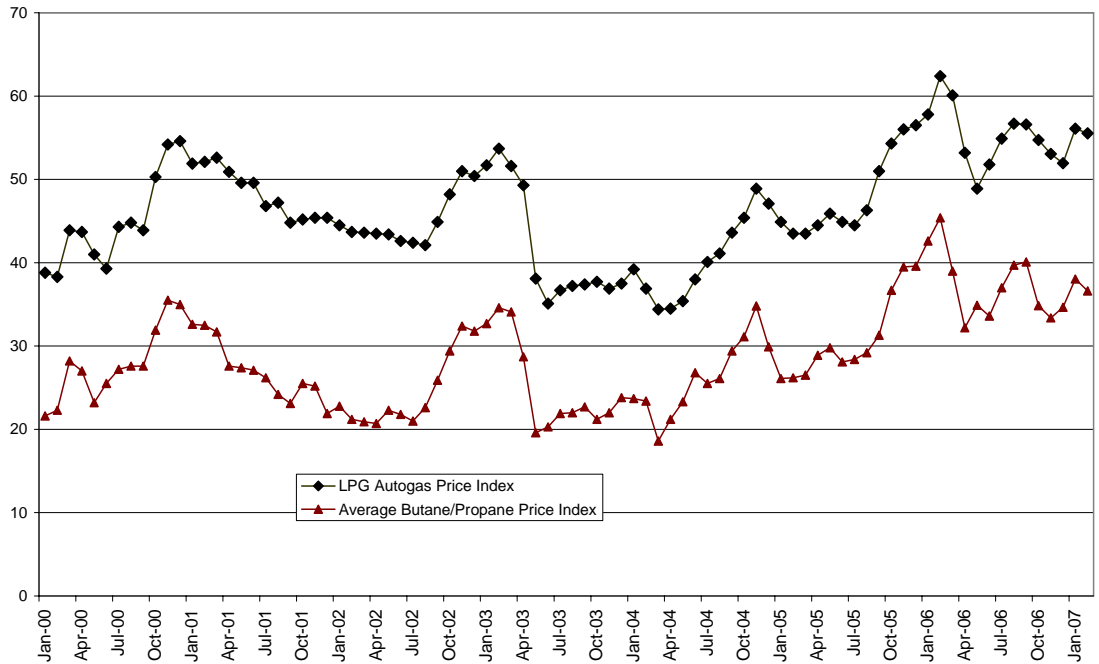
The international benchmark used to set the price for Australian LPG is the Saudi Aramco Contract Price. This is a reflection of Saudi Arabia's position as the largest exporter of LPG to the Asia/Pacific region which is where Australia producers compete in the export market for LPG.

The price set by Saudi Arabia for its largest customers becomes the reference price because it indicates the base value of Australian LPG in regional export markets. In effect this means that movements in LPG base prices in Australia reflect movements in international prices.

There is no time series for domestic LPG cylinders so it is difficult to test how closely fluctuations in LPG cylinder prices match fluctuations in international gas prices, but the nature of the relationship can be seen by looking at LPG autogas as shown in Figure 1.

LPG cylinder prices will exceed autogas prices because of transport/storage but we can expect the general trend to be as per Figure 1. We can infer trends in LPG cylinder gas prices from underlying trends in world butane and propane prices.

Figure 1: Butane and Propane Price Index Compared to LPG Autogas



### Trends in LPG compared to CPI

In recent years the trend in LPG gas prices has been upward. Figure 2 shows LPG prices as propane and butane in \$AUS for the period since Jan 2000. The solid trend line shows the trend in propane prices while the dashed line indicates the trend in propane prices that would have occurred if the prices had followed the CPI (Perth). The base gas price has increased considerably faster than the CPI over the period.

Assuming that transport and distribution costs have increased at CPI, real LPG prices to households in Western Australia should have increased over the period.

The significance of these price changes depend in part on what has happened to real incomes. This is illustrated in Figure 3. Figure 3 shows propane prices compared to average weekly full time earnings and the CPI where each has been converted to an index commencing at 100.

Figure 2: Propane and Butane Prices in \$AUD

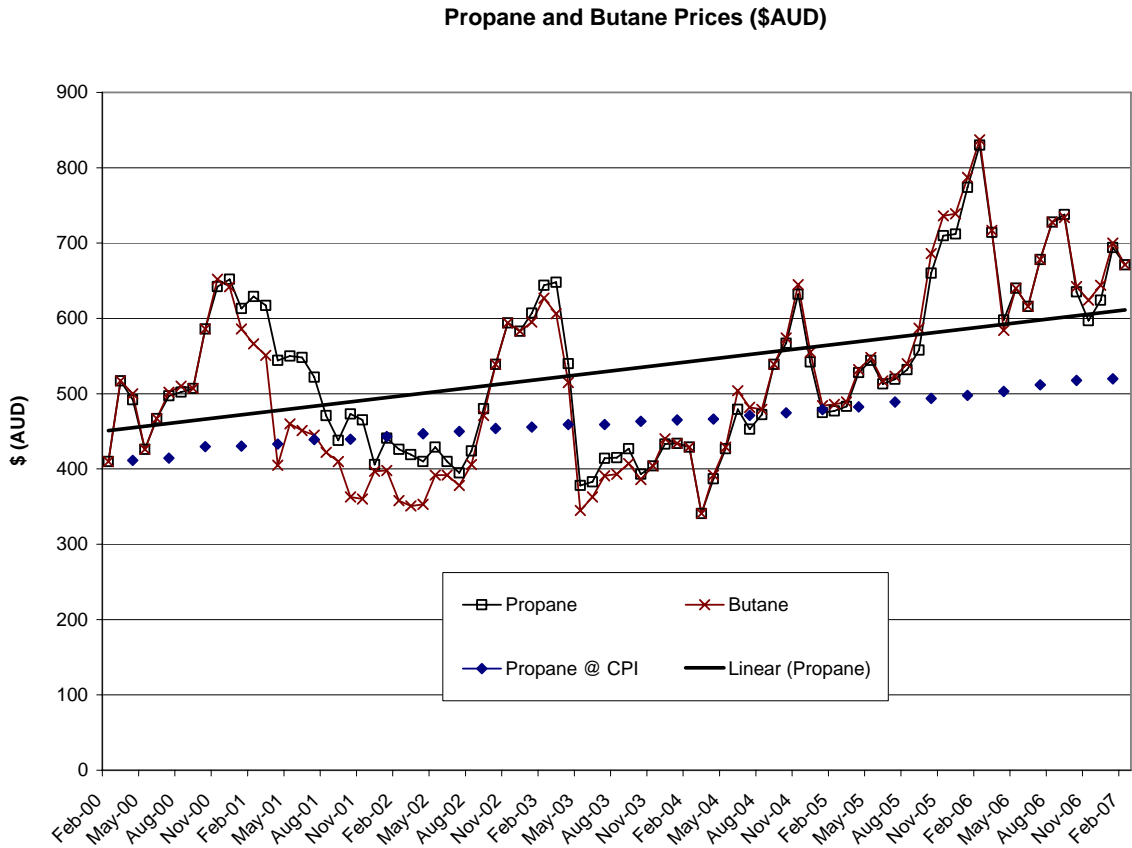
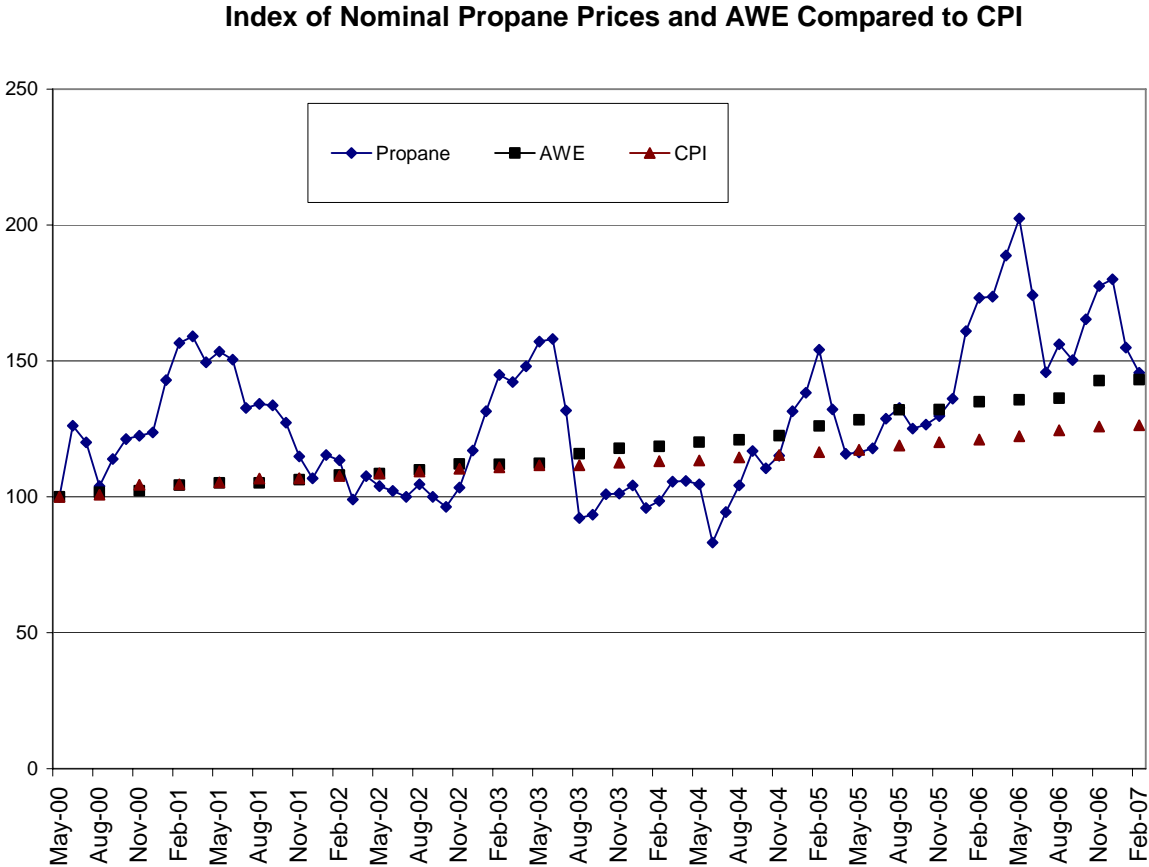


Figure 3 shows that both propane prices and average weekly earnings for full time employees have grown ahead of the CPI. Over the period, the CPI increased by 26% while average weekly earnings for full time employees increased by 43%. Propane prices in Australian dollars increased by 45%.

Base propane prices have significantly fluctuated around trend which reflects the connection to the world (Saudi Aramco) price. Therefore, on occasions the base propane price has run ahead of the CPI and on other occasions it has fallen below the general price trend. The real price has been positive for most of the period.

The upward trend in base propane prices relative to the CPI has been stronger in recent years.

Figure 3: Propane Prices Compared to Average Weekly Earnings



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## Modelling LPG Costs

The previous section indicated the extent to which base propane and butane gases and by implication domestic LPG prices have increased relative to the CPI over recent years.

While we can infer that base propane and by implication domestic LPG prices have tended to be positive in real terms over the period this level of analysis disguises several important effects.

Over time, there are income categories that have grown more modestly than full time average weekly earnings. Those on pensions (superannuation and aged pension) tend to have their incomes indexed to the CPI, at best. Hence their experience would likely be that LPG prices have run ahead of income increases, perhaps significantly so. As pension indexation is a steady process and gas prices fluctuate this would be more significant during periods when gas prices accelerate, such as the last 2-3 years. Similarly income earners in industries/occupations where incomes have grown less than the average will have been more significantly affected by increases in LPG prices.

At any point in time the users of LPG fall into an income distribution. We would expect that LPG costs and energy costs generally, will account for a higher fraction of disposable income towards the low income end of the distribution because a certain minimum level of energy consumption appears necessary for cooking, water heating and space heating.. For these lower income groups the impact of increases in real prices is likely to be more significant than it is for higher income groups.

Regional income and gas prices do vary. Whilst price trends may be similar, some regions will have higher LPG prices reflecting transport and distribution costs, and some regions may have a higher percent of

households on low incomes. Therefore, the impact of positive real LPG prices on lower income households will likely vary across regions.

In order to understand how households are impacted we need an analysis of energy costs and LPG costs relative to disposable income across household types and regions in Western Australia.

### **Substitution Options**

There is a related dimension to positive real energy costs that affects lower income households potentially more than higher income households.

The choice of an energy source is made in conjunction with the choice of appliances. Consumers have opportunities to switch between energy sources (e.g. electricity to gas, gas to solar) at those points in time when they are acquiring/replacing appliances. At other times, once the appliance choice is made, consumers are effectively locked into the particular fuel source. For example, if switching away from LPG requires investment in alternative technologies (e.g. solar hot water, electric ovens and reverse cycle air conditioning), where a consumer has committed to gas appliances they must either bear the cost of these new appliances or bear the cost of the LPG price changes? Again this is likely to impact on low income households more because the capacity to fund appliance switching is limited or even non-existent.

Whilst the above example is in terms of LPG, the general principle applies to all consumers and all energy sources. Changing energy sources requires investment in new technology and occurs infrequently.

In view of this, there is a need to understand how energy costs affect households and whether households in any particular group or region are experiencing higher energy and gas costs relative to others to the point where they might be considered “disadvantaged”.

This is not an unusual consideration. Energy policy often provides for assistance to low income earners. Table 1 illustrated the assistance in Victoria on LPG costs. In WA we assist people north of 26<sup>th</sup> parallel with air conditioning costs. We have different allowances and pricing for water in some regions.

The modelling below looks at energy costs relative to household disposable income.

The structure of the analysis is based on:

- Estimating gas consumption (energy use) in cylinders per annum by household type.
- Estimating LPG costs by applying LPG prices to gas consumption estimates.
- Estimating household disposable income by household size.
- Comparing average consumption costs to average household income.
- Estimating the household disposable income at the low and high quartiles as a way of assessing how low income households are affected.

### **Data Limitations and Sources**

As with most studies of this type, the publicly available data is limited. Therefore reliance has been placed on a number of sources.

Energy use as gas cylinders per annum has been estimated based on:

- Studies of gas energy use by appliance type by household size and converting energy use to standard 45 kg gas cylinders for gas use appliances (hot water, cooking, space heating).
- Information from industry on typical patterns of consumption by household type by region.

- Information from the household survey on LPG usage and costs carried out by Data Analysis Australia in parallel with this study.

Price estimates used have been based on:

- Discussions with Office of Energy and gas suppliers.
- Information collected from the survey of Western Australian households on LPG usage and costs carried out by Data Analysis Australia in parallel with this study.

Household income estimates has been based on:

- ABS estimates of household disposable incomes by region in Western Australia.
- Income information collected from the survey of Western Australian households on LPG usage and costs carried out by Data Analysis Australia in parallel with this study.

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## **Model and Data**

### **Structure of the Model**

The model was developed as an excel spreadsheet with modules (worksheets) for each of the key areas. Analysis was undertaken at a range of prices and incomes. The most likely outcomes are the focus here. These are based on:

- estimates of average consumption provided by industry and cross checked with the household survey and energy use surveys from WA and SA.
- estimates of average prices based on data provided by industry and cross checked with the household survey.
- average household disposable income data provided by the ABS and cross checked with the household survey.

### **Energy Use**

The information on LPG usage (domestic gas cylinders) available from public sources is very limited. As a starting point we can consider appliance energy use and the implication for LPG use if a particular level of energy was consumed. These estimates are shown in Table 3 based on data for ovens, cook top and water heating from a South Australian appliance usage study and for space heating based on a previous Western Power study. Conversion to standard 45Kg cylinders is based on 630 Kwh per cylinder. Using this data the equivalent cylinder usage ranges from 4 to 14 per annum without space heating to 8 to 17 per annum with space heating.

**Table 3: Cylinder Use by Household Size Based on Standard Use**

Number of Persons in Household	Oven KwH pa	Cooking (Stove Top) KwH pa	Water Heating KwH pa	Number of Cylinders (LPG) (inc Space Heating)	Space Heating KwH pa	Number of Cylinders (LPG) (inc Space Heating)
One Person	268	400	1600	4	2273	8
Two Person	268	800	3600	8	2273	12
Three Person	268	1000	4400	9	2274	13
Four Person	268	1200	5200	11	2273	15
Six Person	268	1600	6400	14	2273	17

Using this data does not allow any regional variation to be introduced, nor does it allow for variation by household size in terms of usage patterns. The data represents an average or typical household. LPG using households may or may not be typical in this sense.

Far more relevant is data from surveys of consumers or industry or both regarding actual cylinder usage.

Table 4 shows data on annual cylinder use based on best guess information from industry.

**Table 4 Cylinder Use by Household Size Based on Industry Data**

Number of Persons in Household	State	Region								
	WA	Pert h	Sout h West	Upper Great Souther n	Lower Great Souther n	Midland s	Centra l	South Easter n	Pilbar a	Kimberle y
One Person	5	5	6	5	7	5	5	5	3	3
Two Person	6	7	8	7	9	6	6	6	4	4
Three Person	6	7	8	7	9	6	6	6	4	4
Four Person	8	9	10	9	11	8	8	8	4	4
Five Person	9	10	11	10	12	9	9	9	5	5
Six Person	9	10	11	10	12	9	9	9	5	5

The usage in Table 4 is lower than that implied by Table 3. This not altogether surprising. Industry data is based on actual experience selling to LPG users. It therefore reflects a variety of factors that may

explain why LPG energy usage is less than the sort of standard implied by Table 3. This includes factors such as:

- Country locations with potentially smaller homes.
- Greater use of wood fuels in space heating where this is important, as in the South West.

A survey of households was carried out by Data Analysis Australia in parallel to this study. That survey is the subject of a separate report but it did collect information directly relevant to this analysis on cylinder use, appliance choices and cylinder prices.

In terms of usage of LPG, Table 5 shows average LPG cylinder consumption for the last year based on survey responses. Not surprisingly these estimates are lower than the appliance based estimates but are also lower than the industry estimates. In the analysis of costs we keep both industry and survey estimates of usage in consideration.

**Table 5: Cylinder Use by Household Size Based on Survey Data**

Number of Persons in Household	State	Regions								
	WA	Pert h	Sout h West	Upper Great Southern	Lower Great Southern	Midland s	Centra l	South Eastern	Pilbara	Kimberle y
One Person	3		2	4	3	3	3	3	2	2
Two Person	3		5	4	4	3	2	4	2	2
Three Person	4		8	4	3	4	2	6	3	3
Four Person	4		6	3	7	3	4	7	3	3
Five Person	5		5	3	3	9	5	5	4	2
Six Person	4		1	12	4	3	3	6	2	2

There appears to be considerable variation in LPG usage across households and regions. The range of survey usage by household size is shown in Table 6. The table presents high/low usage data. It indicates that the top end of consumption is around 12-14 cylinders in the South West, Upper Great Southern and Lower Great Southern regions, about 10-12 cylinders per annum in the Midlands, Central and

South Eastern regions and 8-12 cylinders per annum in the Pilbara and Kimberley regions. In all regions there are households using less than one cylinder per annum (where 0= less than 1).

**Table 6: Variation in Cylinder Use by Household Size Based on Survey Data (=max/min)**

Number of Persons in Household	State	Regions								
	WA	Pert h	Sout h West	Upper Great Southern	Lower Great Southern	Midland s	Centra l	South Eastern	Pilbara	Kimberle y
One Person	12/0		8/0	12/0	12/0	6/1	9/1	12/0	5/0	7/0
Two Person	14/0		12/1	14/1	14/1	8/0	12/0	10/0	12/1	6/0
Three Person	13/0		13/1	10/1	10/1	8/1	3/2	12/2	6/0	8/0
Four Person	12/0		12/1	5/1	5/1	2/1	8/1	18/1	10/1	8/1
Five Person	12/0		12/1	8/0	8/0	12/6	10/1	12/5	10/1	2/2
Six Person	12/1		1/1	12/12	12/12	5/1	6/6	6/6	6/6	2/2

Simple regression analysis of cylinder usage sheds some light on the key drivers of usage. This analysis is shown in Table 7. The objective was to determine whether for the households in the survey there were identifiable drivers of usage.

The most significant variables are household size, the use of a gas hot water systems, and the use of gas space heating. These are the biggest positive drivers on the number of cylinders used.

Once size of household is accounted for, few family types are significant. All other things equal, household couples with children at high school and group households use fewer cylinders per annum.

Perhaps most important the income variables were not significant. Relative to the low income category (less than \$500 per week), households in the medium category (\$500 to \$1000 per week) and higher group (over \$1000 per week) did not use more cylinders. Again this is after we have accounted for household size and the use of gas for hot water and space heating.

Variables were included in the analysis to capture the presence in the household of people with pension cards, health cards or both. These were not significant indicating that households in these circumstances are still being driven by household size, hot water and gas heating in terms of their energy usage.

**Table 7: Regression Analysis Cylinder Usage**

Variable	Coefficient	SE Coefficient	T	P	Significance
Constant	0.3964	0.3619	1.10	0.274	
Hot Water	3.8398	0.2507	15.31	0.000	***
Room Heating	1.6214	0.3721	4.36	0.000	***
Pension Card 1=yes	0.4930	0.3682	-1.34	0.181	
Household Size	0.5816	0.1087	5.35	0.000	***
Income Medium	-0.0202	0.3295	-0.06	0.951	
Income High	0.4089	0.3324	1.23	0.219	
Couple Children Home, High School	-1.4226	0.4561	-3.12	0.002	***
Group Household	-2.606	1.230	-2.12	0.035	**
R-Sq = 43.2% R-Sq(adj) = 42.0%					

### **Prices**

Price data is scarce. As we have seen LPG prices should reflect world propane/butane prices. However, while publicly available price indexes exist for LPG autogas, no such data exists for domestic LPG cylinders. No LPG component exists in the CPI data breakdown.

The approach taken was to review available information, discuss prices with industry and to include price questions in the associated household survey undertaken by Data Analysis Australia.

The following tables summarise the available information. Table 8 shows the prices per cylinder based on the household survey. Table 9 shows data compiled from a variety of industry related sources and reflects our assumptions about delivery costs, markups etc.

**Table 8: Cylinder Prices Based On Household Survey**

<b>Region</b>	<b>Low Price</b>	<b>Average Price</b>	<b>High Price</b>
State	\$55.88	\$96.81	\$140.38
Perth			
South West	\$70.00	\$91.50	\$150.00
Upper Great Southern	\$55.00	\$99.00	\$126.00
Lower Great Southern	\$0.00	\$95.00	\$117.00
Midlands	\$60.00	\$92.00	\$122.00
Central	\$72.00	\$94.00	\$120.00
South Eastern	\$50.00	\$93.00	\$120.00
Pilbara	\$70.00	\$95.00	\$200.00
Kimberley	\$70.00	\$115.00	\$168.00
Pilbara+Kimberley	\$70.00	\$105.00	\$184.00

**Table 9 Cylinder Prices Based On Industry Data**

<b>Region</b>	<b>Low Price</b>	<b>Average Price</b>	<b>High Price</b>
State	\$94.74	\$101.54	\$108.35
Perth	\$84.70	\$90.75	\$96.80
South West	\$88.00	\$94.05	\$100.10
Upper Great Southern	\$88.00	\$94.05	\$100.10
Lower Great Southern	\$88.00	\$94.05	\$100.10
Midlands	\$77.00	\$83.05	\$89.10
Central	\$101.20	\$107.25	\$113.30
South Eastern	\$101.20	\$107.25	\$113.30
Pilbara	\$101.20	\$107.25	\$113.30
Kimberley	\$113.30	\$125.40	\$137.50
Pilbara+Kimberley	\$107.25	\$116.33	\$125.40

The survey data reveals considerably lower minimum, prices and higher maximum prices. It is much more comparable in terms of the average price. As with usage, we report the analysis of costs using both sets of prices.

### **Household Income**

Household income is available from the ABS via the Household Expenditure Survey. This has been supplemented with data from the household survey. The ABS data is shown in Table 10 for region and household type. The ABS household type definitions and our assessed

correlation with size of household are also given in the table. The ABS data is only available for the Pilbara and Kimberley combined. Of particular note is the drop in income for one parent families with children compared to say a couple family with dependent children. The household disposable income is almost double for the couple family in most regions. As energy costs are unlikely to double for cooking, hot water and home heating we can expect the single parent family with children to have higher energy costs as a share of disposable income.

**Table 10: Weekly Household Disposable Income**

<b>Region</b>	<b>Lone person household</b>	<b>Couple only</b>	<b>One parent family with dependent children</b>	<b>Couple family with dependent children</b>	<b>Group household</b>
	<b>One Person</b>	<b>Two Person</b>	<b>Three person</b>	<b>Four Person</b>	<b>Six Person</b>
State	454	928	696	1,212	934
Perth	460	957	752	1,227	976
South West	408	842	572	1,128	744
Upper Great Southern	315	649	441	870	573
Lower Great Southern	374	772	525	1,034	682
Midlands	545	1,125	764	1,506	993
Central	388	800	543	1,071	706
South Eastern	410	846	574	1,132	746
Pilbara					
Kimberley					
Pilbara+Kimberley	820	1,691	1,148	2,264	1,492

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## Results

By combining the energy usage data, the pricing data and the household income data we can estimate the impact of LPG use and expenditure on households of varying type by region.

The data is not entirely consistent coming as it does from different sources. However, by considering a range of results from different data perspectives we can get a reasonably clear picture of the way LPG costs impact on households.

Our focus is LPG costs as percent of average weekly disposable income.

### LPG Costs at Average Prices

First we consider the significance of LPG costs at average prices. This is done in Figure 4.

Using energy usage based on the SA appliance study and average prices based on combined industry data and estimation, LPG costs as a percentage of income are typically:

- Lower in the Pilbara-Kimberley.
- Highest in the Upper Great Southern and the South West.
- Less than 2% of disposable income but get into the 2.5% to 4% range for “one parent dependent children” and “group household” which we assess as household sizes of 3 and 6.

Using energy usage based on the WA industry data and average prices based on combined industry data and estimation, LPG costs as a percentage of income are typically:

- Lower in the Pilbara-Kimberley
- Highest in the Upper Great Southern and the South West and also the Lower Great Southern.

- Tend to be more evenly spread across household types.
- The cost to “one parent dependent children” and “group household” which we assess as household sizes of 3 and 6 is still higher but the gap is not as pronounced.
- Lone person households have higher costs under this model, comparable to others.

In summary, compared to energy use based on appliances, the industry data assigns greater cylinder consumption to lone person households and relatively less to larger households.

Across all regions and households the average percent of disposable income going to LPG is 2.0% based on the appliance energy usage data and industry prices and 1.9% using cylinder usage based on the industry data and industry prices.

The industry data gave a slightly higher average price (\$101 versus \$97) and higher cylinder usage generally than the survey. The detailed differences are in Table 4, Table 5, Table 8 and Table 9 above.

The household survey yielded lower estimates for cylinder usage but similar average prices. The average costs therefore tend to be even lower when based on the survey data. Using the household survey LPG consumption and price data, across all regions and household types, the average for LPG costs as percent of weekly disposable income is 1%.

### **Space Heating**

In cooler locations, an issue might arise if consumers were heating their homes with LPG. Figure 5 shows the impact of space heating on costs based on the appliance data for the South West, Upper and Lower Great Southern. Based on the estimated energy consumption in space heating, an additional 1%-2% of disposable income appears to be required. However, this result is inconsistent with the results from industry and the household survey which encompass all uses and have

lower LPG cylinder consumption than the appliance model without space heating.

### **Interpretation**

While it seems logical to build up energy costs from appliance use there are two reasons why this appears to have lead to an overstatement.

Appliance energy use data does not vary by region. Appliance energy use data makes no allowance for substitutions that consumers can make in dealing with energy costs. These include, for example, using wood where that is freely available, reducing areas of home heated and operating appliances for less time.

### **LPG Costs at High Prices**

Figure 6 shows the impact of using the maximum prices recorded, both from industry data analysis and the household surveys.

On average the use of higher price levels adds up to a half of one percent to the share of disposable income going to LPG expenditure in the case of survey data and is marginal in the case of industry based data.

Figure 4: LPG Costs Relative to Disposable Income Based on Average Prices

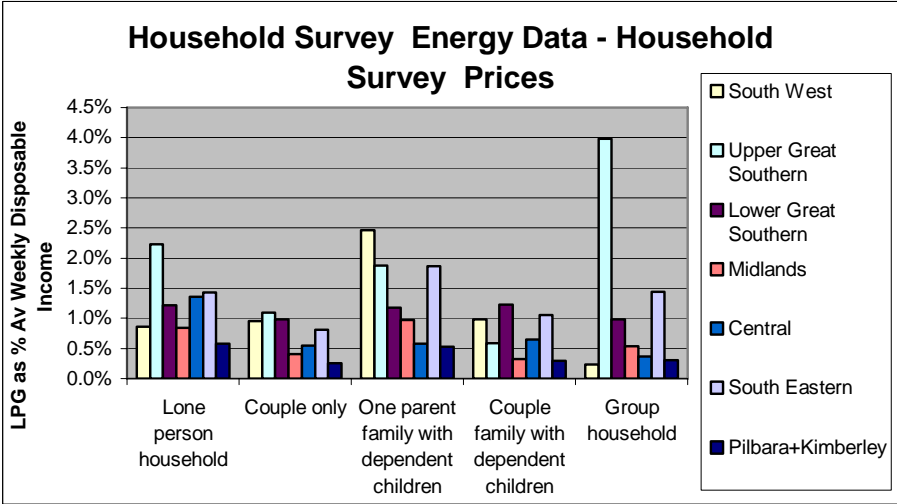
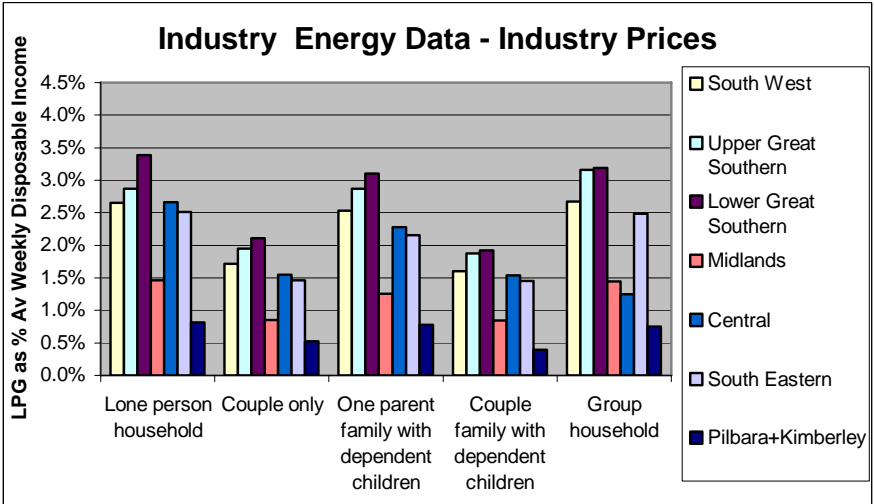
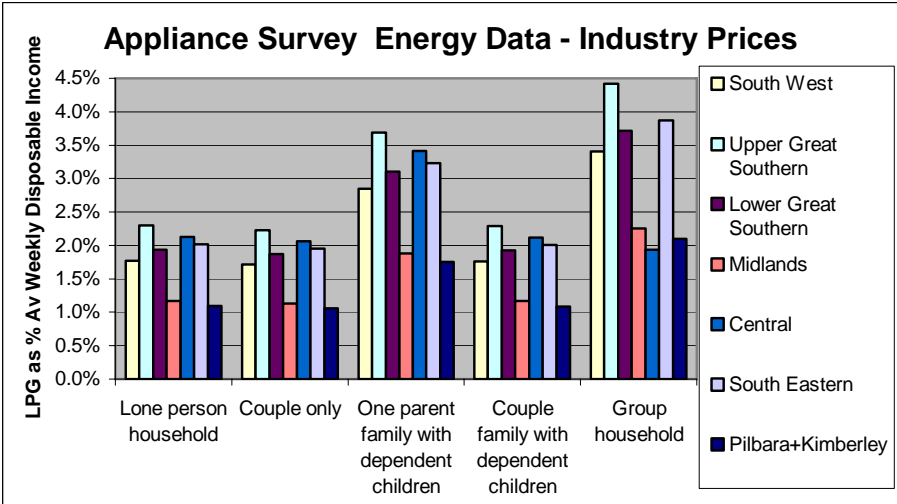


Figure 5: LPG Costs- Impact of Space Heating

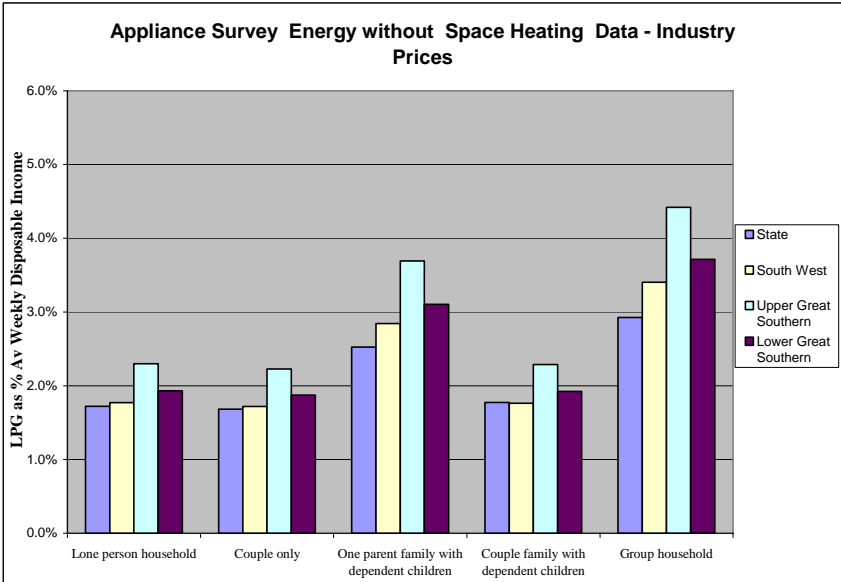
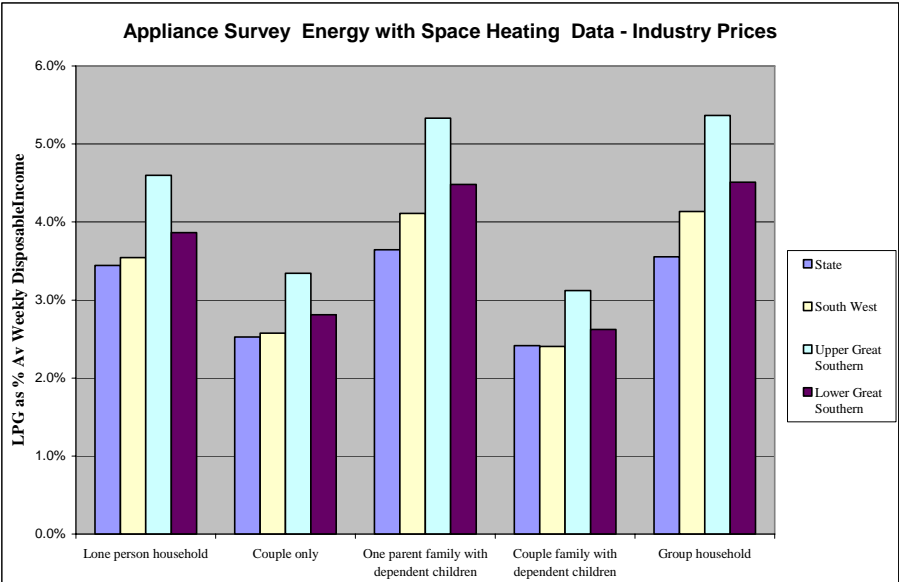
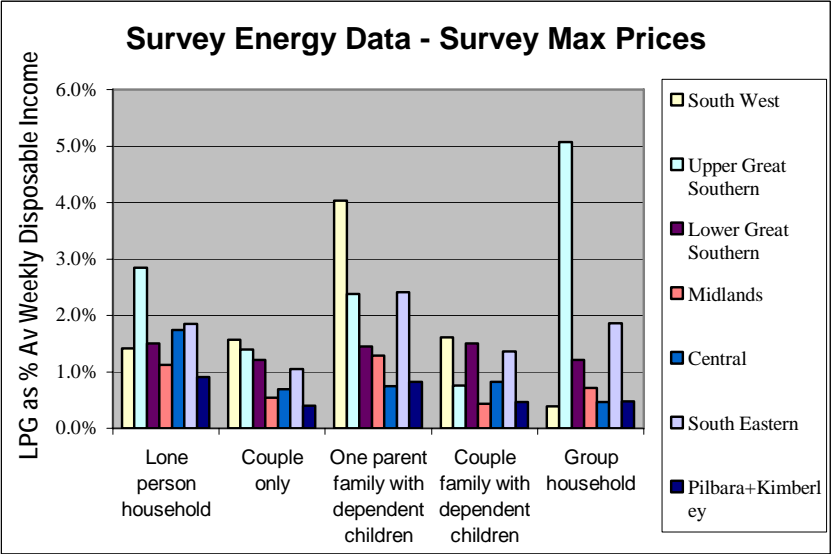
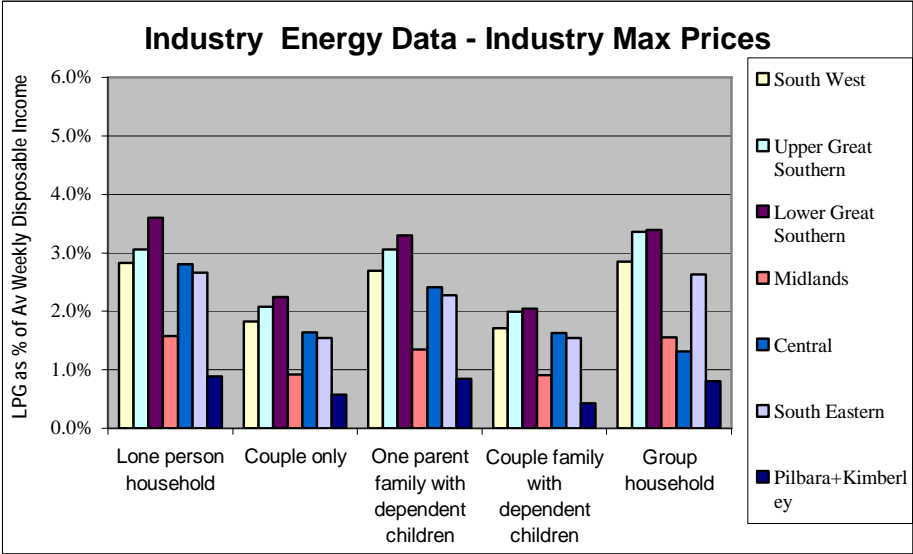


Figure 6: LPG Costs Relative to Disposable Income Based on Maximum Prices



## **Lower Income Impacts**

Although the average LPG expenditure relative to average disposable income is not particularly high, the position may change when we look at low income households.

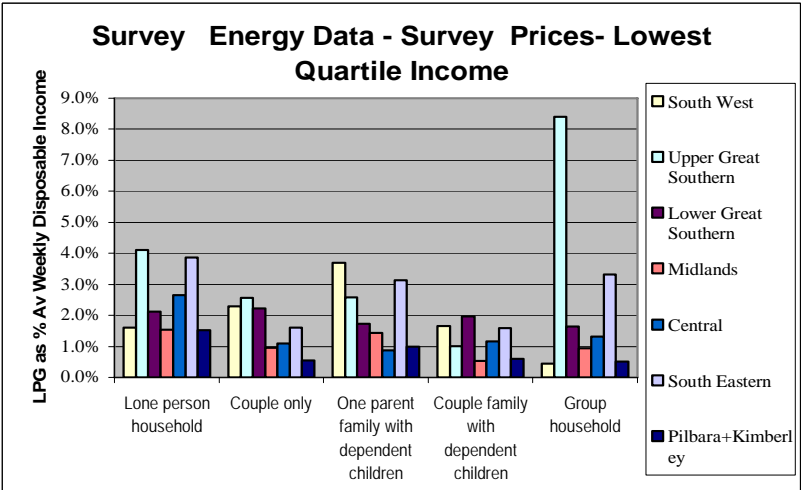
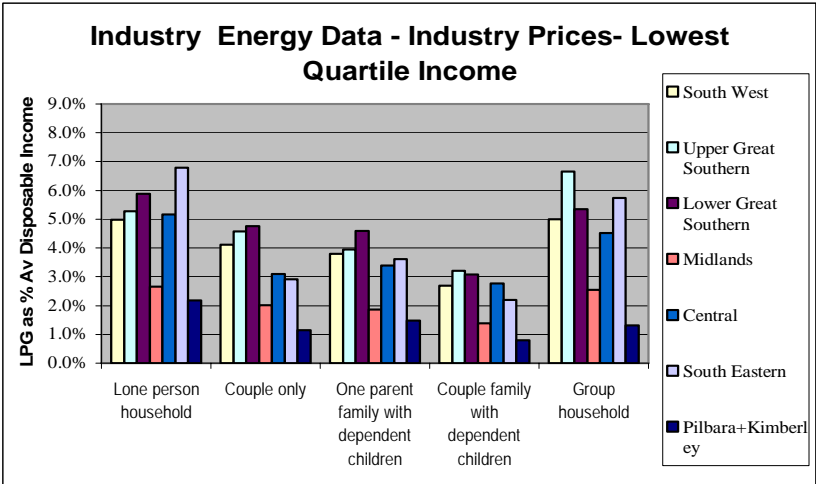
Figure 7 shows the possible consequences for low income households.

It is based on assuming the same usage figures and prices for each region and household type/size but incomes at the lower end of the income distribution. For this purpose an estimate has been made of the income level that marks the lowest quartile as a definition of low income.

Using this approach, for both the industry based and survey based data, the share of disposable income going to LPG expenditure increases by 1% to 2% on average.

Based on the industry derived data, a significant number of household type/region categories are now have LPG costs above 4% of household disposable income. Based on the survey data, LPG costs hover around 2.0% to 3% of household disposable income.

Figure 7: LPG Costs Relative to Disposable Income Based on Average Prices and Lowest Quartile Estimates



**Interpretation-Is this an issue for particular households?**

Although the above analysis suggests that cost can rise significantly relative to income, two issues need to be considered further. Do lower income households economise on cylinder use relative to others thereby offsetting some of the effect? Do particular types of households tend to be affected more or less by these effects?

The simple regression results presented in Table 7 can assist the analysis.

Table 7 showed that cylinder usage across the households in the survey was primarily driven by household size, the use of gas hot water systems, and the use of gas space heating.

Income was not significant in the model. Relative to the low income category (less than \$500 per week), households in the medium category (\$500 to \$1000 per week) and higher group (over \$1000 per week) did not use more cylinders. Again this is after we have accounted for household size and the use of gas for hot water and space heating.

Perhaps most important for the issue of low income households, variables included to capture the presence in the household of people with pension cards and health cards were not significant indicating that households in these circumstances are still being driven primarily by household size, hot water and gas heating in terms of their energy usage.

For the purposes of this study we would expect the sign of the “pension card” variable to be negative. This would indicate that pension card holders tend to use fewer cylinders than others, all other things equal. This would be consistent with anecdotal evidence that pensioners make adjustments in their lifestyles to economise on gas use. However, in Table 7, the “pension card” variable is not significant at conventional test levels, indicating that we cannot reject the hypothesis that being a pension card holder has no impact on cylinder usage.

Once size of household is accounted for, few family types are significant. All other things equal, household couples with children at high school and group households use fewer cylinders per annum.

Cylinder usage translates into cost and hence the costs are driven primarily by household size and the use of gas hot water and space heating systems.

If pension card holders and other low income earning households do not use fewer cylinders and incur lower LPG costs, all other things equal, this is consistent with them experiencing higher costs relative to incomes compared to the rest of the population.

The survey results are consistent with the analysis based on energy usage and household disposable incomes from the previous sections.

The issues here can be considered in a little more detail if we look at differences between groups in terms of cylinder use and cost.

When we look at cylinder use, we find that the mean number of cylinders used per annum is:

- not significantly different if the household has a pension card, a health card, both cards or neither.
- Not significantly different whether the household has weekly income less than \$500, between \$500 and \$1000 or above \$1000.

These results are illustrated in Figure 8 and Figure 9 which show the mean number of cylinders used across health card groups and income groups, along with the associated 95% confidence intervals. The hypothesis that the mean number of cylinders is no different across health card groups and between card holders and non card holders cannot be rejected. Similarly the hypothesis that the mean number of cylinders used is not different between income groups cannot be rejected. Virtually identical results arise if we replace annual cylinder numbers with annual cost in the analysis.

This confirms the points made previously that low income earners, both card holders and others are not adjusting usage and cost in any significant way. Rather the use of LPG is driven by family size and house configuration (gas water heating and space heating).

This means that for any given household type, costs are going to be a higher proportion of income for low income households because they have not or cannot adjust their gas use in the short term.

An important implication of these results is that it is the interaction between family size and the configuration of the household's energy appliances that is most relevant in explaining costs and there is no obvious measure that allows households bearing the highest costs relative to disposable income to be identified for policy purposes.

**Figure 8: Mean # of Cylinders per Annum by pension/health Card**

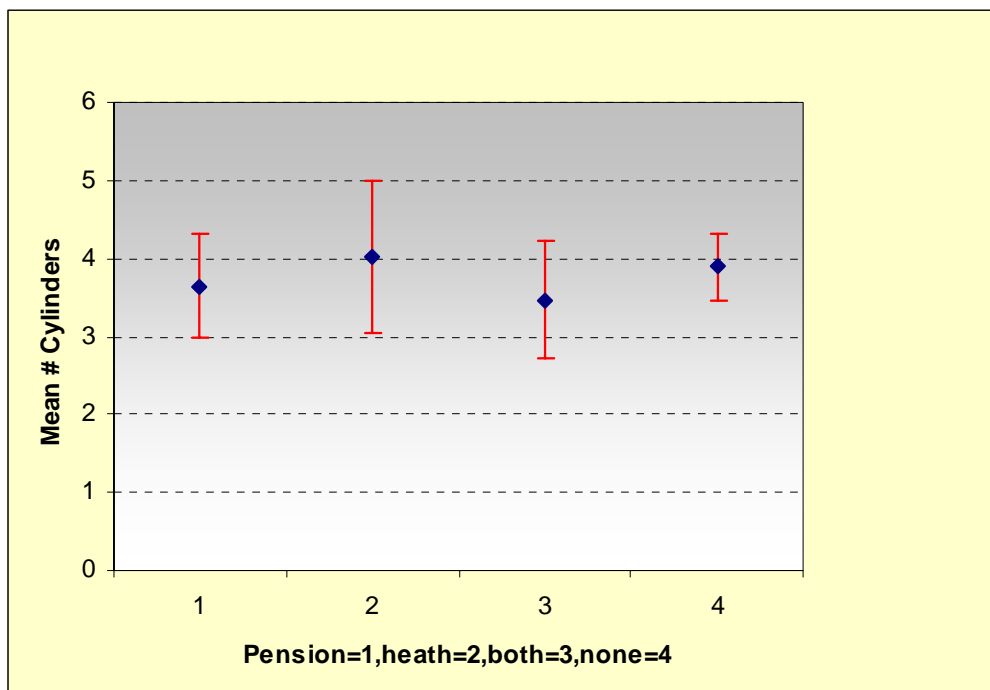


Figure 9: Mean # of Cylinders per Annum by Income Group

