LPG use in Australia to 2030

A strategy for the future use of LPG for stationary energy applications

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1 Introduction

Prior to 1970, the use of LPG in Australia was largely insignificant owing to the fact that Australia's refineries produced relatively small volumes of LPG. A decision taken by Australia's Bass Strait oil producers to extract LPG from indigenous oil and gas streams in 1974 resulted in the establishment of a world-scale fractionation plant at Western Port Bay in Victoria – and Australia's LPG industry was born.

Today, the Australian LPG industry contributes more than $3.5 billion a year to the national economy. LPG is used both as a transport fuel and for stationary power across a range of industry sectors, including manufacturing, agriculture, mining and Australia's leisure industry.

The growth of Australia's natural gas industry is delivering new supplies of LPG that are both abundant and less GHG intensive than LPG that has been historically sourced from Australian refinery operations (Today, almost 90% of the LPG used in the stationary energy sector is sourced from natural gas processing).

In 2009–2010, LPG consumption in the stationary energy sector for 39% of all LPG sold into the Australian domestic market. This market is typically referred to as the 'stationary LPG market' and comprises eight discrete segments:

- residential
- manufacturing
- materials handling (a subset of the transport and distribution sector)
- commercial
- agriculture
- mining
- remote and emergency power
- leisure

This paper examines the historical performance of the market in recent years, discusses the strategic issues that are likely to shape the market in the future, and outlines a strategy for the development of the market to 2030 and beyond.

Further information about this strategy for the future use of LPG for stationary energy applications can be obtained by contacting:

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2 The stationary LPG market

This section provides an overview of the stationary LPG market in Australia in terms of:

- market size
- market structure
- growth
- segment analysis
- market outlook (BAU).

A key challenge associated with the conduct of the assessment discussed in this section related to the uncertainty surrounding market data. In particular, significant discrepancies were observed between historical sales projections and actual sales, while other problems were observed in respect of incomplete data.

2.1 Market size

In 2010, 771 kt of LPG was sold into the stationary LPG market, which is equivalent to approximately 38 PJ of energy per annum.

A summary of the 2010 sales volumes in each of the eight market segments is provided in Table 1.

Table 1 **Historical sales by segment (annual tonnage in 2000, 2005 and 2010)**

Segment	2000 (kt)	2005 (kt)	2010 (kt)
Residential	148.6	150.4	156.7
Manufacturing	148.1	127.6	138.8
Materials handling	40.2	55.9	66.1
Commercial	216.2	213.5	186.9
Agriculture	39.4	47.9	55.0
Mining	13.0	27.8	37.9
Remote and emergency power	21.6	31.0	59.2
Leisure	30.1	47.7	70.5
Total LPG sales (kt)	**657.0**	**702.0**	**771.0**
Total energy sales (PJ)	**32.4**	**34.6**	**38**

2.2 Market structure

For the purposes of this paper, the stationary LPG market comprises eight sub-segments. A summary of the typical LPG applications for each segment is provided in Table 2.

Analysis of the proportion of LPG sold into each segment reveals that the commercial, residential and manufacturing segments accounted for half of the total LPG sales in 2010 (Figure 1).

Table 2 **Stationary LPG market segment description**

Segment	Typical LPG applications
Residential	▪ Household cooking ▪ Space and water heating ▪ Other domestic appliances
Manufacturing	▪ Aerosols ▪ Engineering/fabrication ▪ Process drying, kilns, furnaces and boilers ▪ Petrochemical use of LPG
Materials handling	▪ Forklifts, small cranes and lifts ▪ Airport equipment
Commercial	▪ Restaurants (e.g. patio heaters and cooking appliances) ▪ Laundry service ▪ Construction (welding) ▪ Health/education
Agriculture	▪ Heating/sanitation of livestock sheds ▪ Flame weeding ▪ Bore and irrigation pumps ▪ Crop drying
Mining	▪ Mine haul trucks (torque topper) ▪ Mine staff accommodation ▪ Ancillary equipment
Remote and emergency power	▪ Electricity generation
Leisure	▪ Barbeques and portable camping stoves ▪ Marine ▪ Outdoor mosquito traps

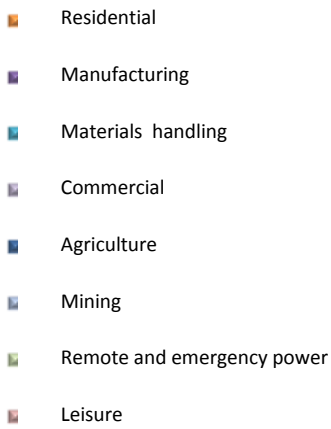

Figure 1 **Relative market share of stationary LPG market segments (2010)**

2.3 Market growth

It was shown in Table 1 that the stationary LPG market grew by 5.6 PJ between 2000 and 2010. This growth equates to an average annual growth rate of only 1.7% in the ten-year period since 2000 and is less than half the average annual growth in gross domestic product over the same period.

Comparison of actual energy sales with previous industry forecasts (ACIL Tasman 2008) reveals that aggregate sales of LPG were 7% below industry projections in 2005 and that the gap tripled in 2010 (Table 3).

An analysis of the growth trends for each of the eight segments reveals varying levels of growth (Figure 2).

Table 3 **LPG energy sales (2005 and 2010) – predicted vs. actual**

	2005			2010		
	Predicted sales (PJ)	Actual sales (PJ)	Difference (%)	Predicted sales (PJ)	Actual sales (PJ)	Difference (%)
Total sales	37.2	34.6	–7%	49.3	38	–23%

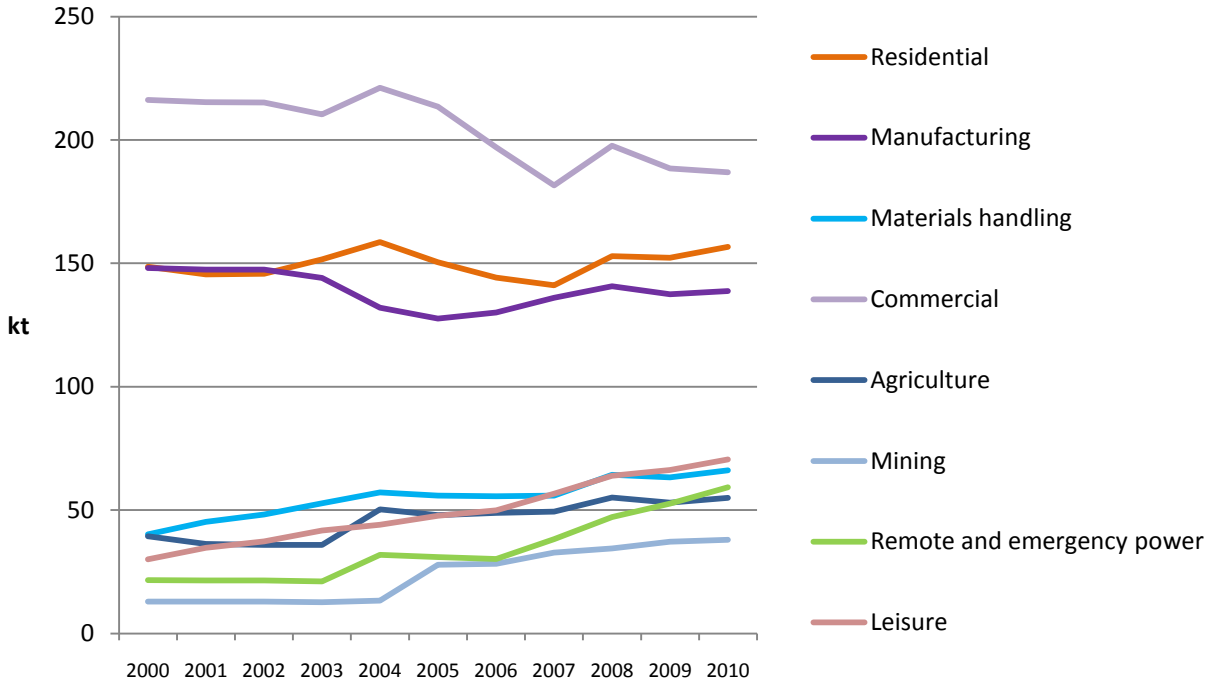

Figure 2 **LPG sales by market segment (2000–2010)**

2.4 Market performance

The analysis presented above suggests that while growth in sales of LPG in some of the smaller market segments has been strong, sales in the larger (and more traditional) market segments have been falling in real terms. In essence, the stationary LPG market appears to have lost some ground over the past 10 years despite the relative buoyancy of the wider stationary energy market in Australia.

Analysis of the performance of each market segment gives rise to the segment observations provided below.

Residential

With the exception of the period between 2005 and 2007, LPG sales in this sector grew on a year-by-year basis between 2000 and 2010. Overall, the sector recorded a net growth in sales of 8.1% between 2000 and 2010 which equates to an annual average growth rate of 0.81% over the 10-year period – half the aggregate rate of growth experienced across the market.

The suboptimal growth in sales within this sector is likely to be attributable to a number of factors, but is considered to be primarily attributable to the improved efficiency of LPG appliances and energy conservation activities by consumers (i.e. reduced water use).

Other contributing factors are considered to be the introduction of renewable energy technologies (and associated government rebates that disadvantage LPG appliances), improved access to natural gas for households in some states, and the fact that government policy has become almost entirely electric centric in recent years.

Manufacturing

LPG sales to the manufacturing sector fell by 13.8% between 2000 and 2005, before climbing by 8.7% between 2005 and 2010 – a net decline of 6.3% between 2000 and 2010. It is suggested that much of this decline can be explained by the mixed fortunes of the Australian manufacturing sector over the past 10 years.

The other major contributing factor to the overall decline in LPG sales in this sector is considered to be the active targeting of the manufacturing sector by the Australian natural gas industry – particularly in Victoria.

Materials handling

Between 2000 and 2010, LPG sales to this sector increased by 64% – an average of 6.4% per year. While this figure appears to be very positive relative to other segments, much of the growth can be attributed to the overall growth of the transport and distribution sector in Australia in the 10 years since 2010, suggesting that LPG has simply been holding ground.

The widespread deployment of LPG-powered forklifts, with attendant national support infrastructure, is also likely to provide part of the explanation for the growth of LPG sales within this segment.

Commercial

Sales data for the period 2000–2010 reveals that LPG sales in the commercial sector fell by 13.6%. Given that this sector is the largest of all the sectors in the stationary LPG market (at 24.2% of all LPG sales), the decline in this market accounts for much of the suboptimal growth in the aggregate market.

The observed decline in this segment is considered to be directly attributable to fluctuations in the price differential of LPG relative to alternative energy sources – both conventional and non-conventional.

Expansion of the natural gas supply network in eastern Australia and the provision of government incentive programs for the installation of heat pumps in recent years, are two examples of the changing nature of competition that have impacted on LPG sales in this segment.

Agriculture

LPG sales to this sector increased by 39.4%, albeit from a relatively small base (this sector accounts for only 7% of the total market). The average annual growth rate of 3.9% over the 10-year period is roughly equivalent with gross domestic product growth over the same period and more than twice the growth of the aggregate LPG market.

Key drivers of the demand for LPG in the agricultural sector are likely to have been the mobility of LPG as a power source and the flexibility of the energy for on-farm and other agricultural operations.

Mining

LPG sales to the Australian mining sector nearly tripled in the 10-year period between 2000 and 2010. This growth needs to be considered in the context that the sector contributed 2% of all sales in the stationary LPG market, rising to 5% in 2010.

The portability and flexibility of LPG for remote applications is likely to provide the primary explanation for growth in LPG use in this sector, but care should be exercised in extrapolating the growth results to date given that the addition of a small number of mining customers (with associated high energy demand) can greatly affect annual LPG sales.

Remote and emergency power

LPG sales in this sector grew by a factor of 2.7 over the period 2000–2010. Similar to the mining sector, the growth occurred off a relatively low base volume in 2000, with total sales in 2010 accounting for only 7.6% of all non-automotive LPG sales in 2010.

The drivers for LPG demand in this market are considered to be the same as those for the mining sector, signalling a significant opportunity for further growth in the near term.

Leisure

The leisure sector is another segment that experienced significant sales growth between 2000 and 2010, with the 2010 sales volume being 2.3 times higher than the 2000 sales volume. The 10-year growth experienced in this segment has resulted in this segment moving from being the sixth highest contributor to market sales in 2000, to being the fourth highest in 2010 (at 9% of aggregate annual sales).

The growth in LPG demand within this segment is attributed to a number of social factors (i.e. increased outdoor dining and ageing of the population) and the increased affordability of gas outdoor appliances such as gas barbeques and patio heaters.

2.5 Market outlook

A business as usual (BAU) forecast of stationary energy LPG demand to 2030 was developed around anticipated growth derived by combining historical and projected growth rates for each segment of the market. These growth rates (Table 4) were developed around the segment outlook summarised in Table 5. The resulting outlook is shown in Figure 3 and projects growth in LPG demand at an annual average rate of 1.2% per annum between 2010 and 2030. Achievement of this demand will require the continuation of efforts to maintain and defend existing market share, with a significant focus on arresting the historical decline in LPG demand within the commercial and manufacturing sectors.

Table 4 **Projected average annual growth rates in LPG demand to 2030**

Segment	2000–2010 (actual and derived) (%)	2000–2010 (projected) (%)	2020–2030 (projected) (%)
Residential	0.6	0.7	0.7
Manufacturing	–0.6	0.3	0.3
Materials handling	5.2	0.8	0.8
Commercial	–1.3	0.3	0.3
Agriculture	4.1	1.5	1.5
Mining	14.5	2.5	2.5
Remote and emergency power	11.7	0.7	1.0
Leisure	8.9	4.7	4.0

Table 5 **Factors affecting segment demand for LPG to 2030**

Segment	Typical LPG applications	
	Positive	Negative
Residential	▪ Phase-out of electric hot water ▪ Limited further extension to natural gas networks	▪ Regulatory pressure on the use of unflued heaters, potentially resulting in future phase-out ▪ Continued expansion of natural gas reticulation ▪ Improvements in efficiency of competing electric appliances (despite continuing higher GHG emissions of these appliances), increased awareness of energy conservation and technology opportunities
Manufacturing	▪ Nil	▪ No significant change, but any growth offset by general trend towards reduced manufacturing activity in Australia ▪ Threat of LNG substitution
Materials handling	▪ Increased movement of goods	▪ Likely market encroachment from alternatives such as electric forklifts
Commercial	▪ Increased consumption from existing users	▪ Expansion of natural gas network
Agriculture	▪ Limited alternatives (e.g. diesel) with low GHG emissions	▪ Sustained variations in weather conditions will continue to create volatility in agricultural output that will in turn impact on LPG demand patterns (i.e. increased volatility of demand from season to season)
Mining	▪ Capacity expansion in next 12 months and existing expansions in the resources sector expected to drive growth	▪ Threat of LNG substitution
Remote and emergency power	▪ Possibility of segment development uncertain but movement away from diesel will support growth	▪ Nil
Leisure	▪ Increased affordability of outdoor heaters ▪ Attraction towards outdoor dining/living	▪ Market saturation/maturity in the longer term ▪ Increased focus on energy efficiency and GHG emissions potentially challenging the efficacy of heating outdoor air

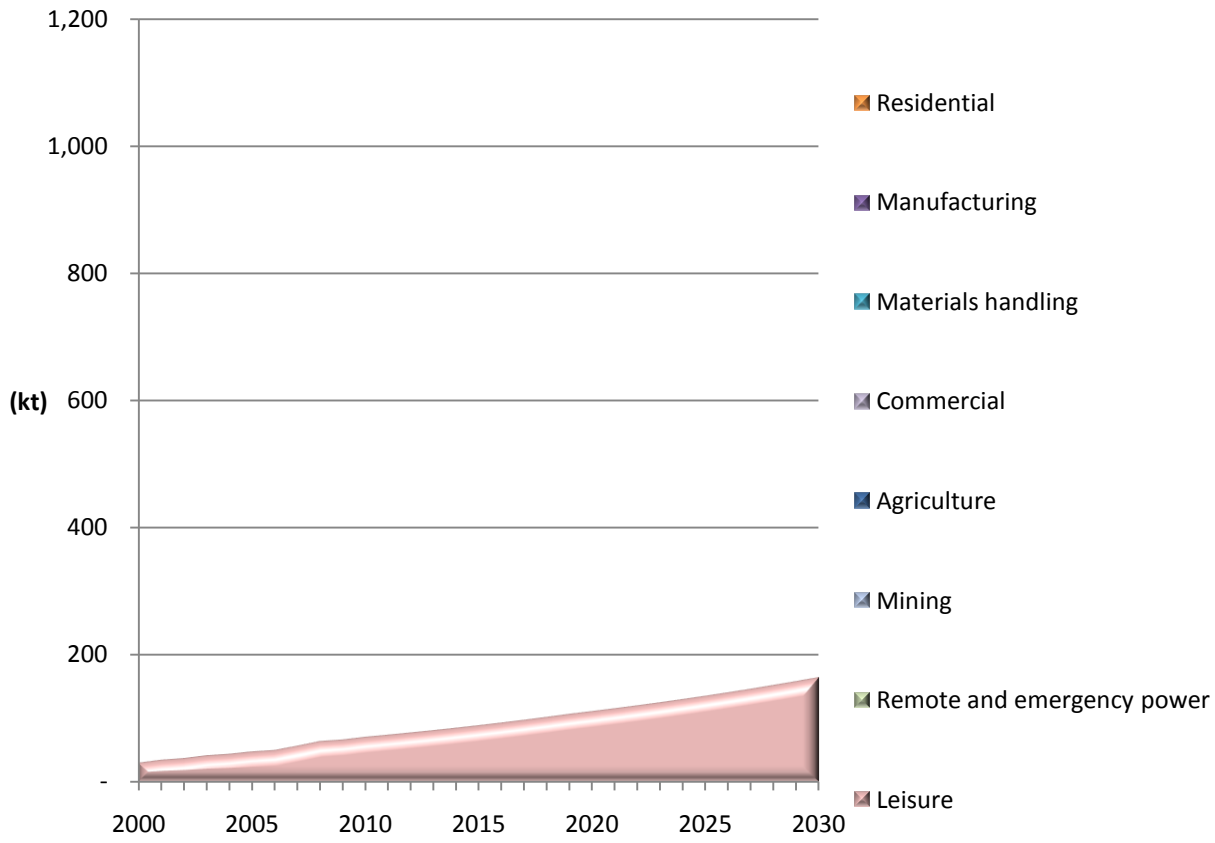

Figure 3 **Forecast BAU demand for stationary energy LPG in Australia to 2030**

As a subset of the Australian stationary energy market, the stationary LPG market is likely to be shaped by four strategic influences in the next 10–20 years:

- energy availability
- electricity pricing
- greenhouse emissions
- community resilience.

This section provides a brief discussion of these influences and their potential impact on the shape of the stationary LPG market in Australia.

3.1 Energy availability

Domestic primary energy demand more than doubled to 5772.3 PJ over the period 1973–2008. Long-term energy projections show that this trend will continue (although at a slower rate), rising another 35% by 2030 (ABARE 2010).

Demand for electricity generation in Australia is expected to grow by 50% to 2030 (ABARE 2010). To date, domestic stationary energy demand has been easily met by Australia's abundant, indigenous resources.

However, the outlook in the near term is for a decline in Australia's energy self-sufficiency for the following reasons.

- Coal, Australia's largest energy resource and biggest export, accounts for 72% of electricity generation (ABARE 2010). However, despite its current low cost and abundance along the eastern seaboard, where the majority of electricity is generated and consumed, the use of coal for power generation is likely to become severely limited under the current climate change agenda.
-
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- Natural gas, Australia's third largest energy resource, fuels approximately 16% of stationary energy demand. However, the industry is becoming increasingly focused on the export market which is due to surpass domestic consumption as early as 2020. This demand could potentially increase domestic natural gas prices in the near future (i.e. owing to a possible movement to international parity pricing in the domestic market).
- Constraints imposed by limitations in Australia's electricity generation infrastructure are also likely to create a tightening in the relationship between electricity supply and electricity demand over the next 20 years. The capital costs associated with the maintenance and supplementation of this infrastructure are likely to place increased pressure on electricity pricing across Australia. LPG offers the lowest unit cost of infrastructure for expanding Australia's stationary energy supply.

The above issues, together with the growing climate change agenda (and the associated carbon price and MRET), are key factors contributing to Australia's future electricity supply.

By 2030, the share of electricity produced from natural gas and renewables is projected to increase at the expense of black and brown coal. Gas-fired power has dominated growth in the electricity generation sector to the point where it accounted for 80% of new power stations established in 2008–2009. Natural gas is predicted to double its share of generation capacity from 19% to 37% by 2030, and renewables are expected to increase from 7% to 19% over the same time frame (Figure 4)

It should be noted that the ultimate stationary energy mix in 2030 will be somewhat dependent on the starting price (and future-term escalation) of a carbon price. Under modest price settings, the impact of a carbon price on the future energy mix is likely to be isolated to favouring renewable generation sources at the expense of brown coal as the carbon price increases (MMA 2008).

3.2 Electricity pricing

In most cases, the market potential for LPG will be affected by any movement in the future price differential between electricity (as the incumbent energy source) and LPG for stationary energy uses. While natural gas may also have an influence to some extent, electricity is likely to set the baseline for energy switching in the stationary energy market.

The greatest impact on future Australian electricity prices is likely to be associated with the introduction of a price on carbon. The retail price of electricity will increase as the emissions permit price increases, although the relative increase will diminish as permit prices increase. Figure 5 shows that under a carbon price of $10–25 per tonne, retail prices are likely to increase by 45–62% by 2030.

Notably, a carbon price impacts most heavily on the highest emitting sources of electricity. Hence Victoria, with its significant brown coal contribution, incurs the greatest electricity price increases.

It should be noted, however, that a carbon price is not the only factor that will impact on retail electricity costs in the future. Increasing network costs have recently brought about the approval of a greater than 17% price rise for NSW energy consumers, with cost impacts greater in rural areas (ABC 2011).

The cost of administering government renewable energy schemes has also been cited as a key contributor to retail energy price increases, and these costs are likely to also increase with the increasing obligations under MRET to 2020.

Any objective assessment of the current supply outlook for electricity in Australia points to an increasing tightening of supply and the introduction of a carbon price, creating upward price pressures for electricity consumers. These pressures will inevitably create a market appetite for alternative or supplemental energy sources that can help households and businesses reduce their exposure to these price rises.

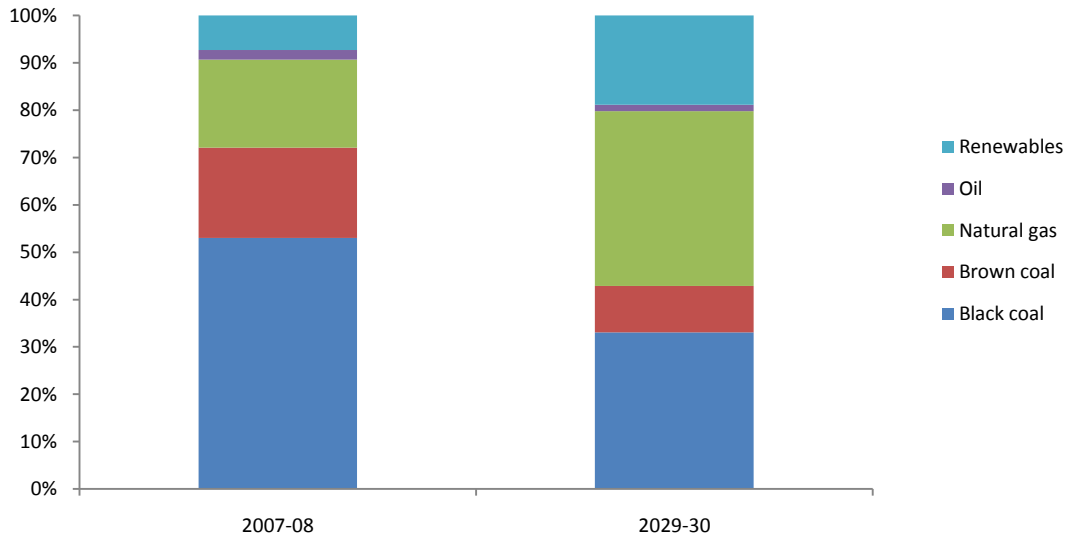

Figure 4 **Outlook to 2030 – Electricity generation fuel mix (ABARE 2010)**

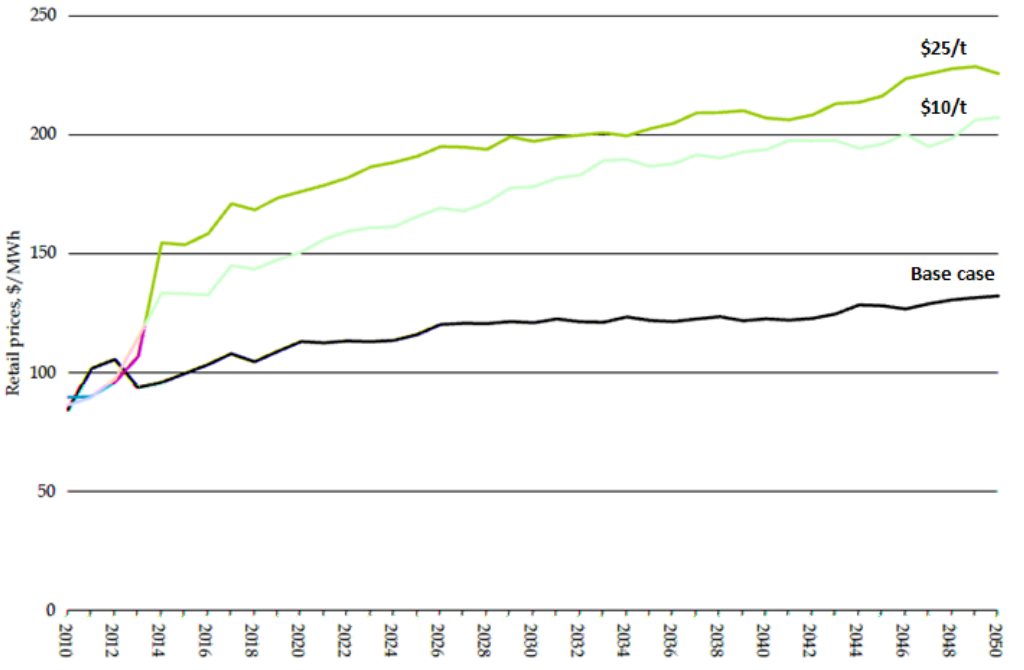

Figure 5 **Forecast Australian wholesale electricity prices ($/MWh) (MMA 2008)**

3.3 Greenhouse emissions

In Australia, stationary energy GHG emissions have grown by 52.1% since 1990 and now account for 53.9% of Australia's total GHG emissions. Australia's dependence on coal for power generation plays a significant role in this growth. As shown in Figure 6 the majority of this increase (63.4%) can be accounted for by the combustion of coal (particularly brown coal).

With ABARE predicting that gross electricity generation is expected to grow by 50% – from 247 TWh to 366 TWh by 2030 (ABARE 2010) – there is a significant need to address the impact of the stationary energy sector on Australia's GHG emissions. This need is reflected to a degree in the forecast future stationary energy mix, which increases the contribution from natural gas and renewable energy sources. Renewable energy is zero emissions, and conventional natural gas turbines typically produce 32% less GHG emissions for each unit of energy output when compared with the average Australian blend of black and brown coal, with combined cycle gas power providing an even greater emissions reduction (59%). The net result of the above changes, largely as a result of a carbon price, is a slow decline in GHG emissions from the stationary energy sector to 2030. The trajectory of this decline is dependent on the carbon price, with modelling for Treasury results shown in Figure 7 for different carbon start prices (i.e. ranging from $5 to $25) under a carbon pricing mechanism.

As shown, without a price on carbon or an alternative mechanism to reduce the contribution of coal to Australia's electricity generation, GHG emissions from stationary energy continue to escalate to unsustainable levels. A carbon price is, however, likely to bring emissions from the sector to levels only marginally above 2000 levels by 2030.

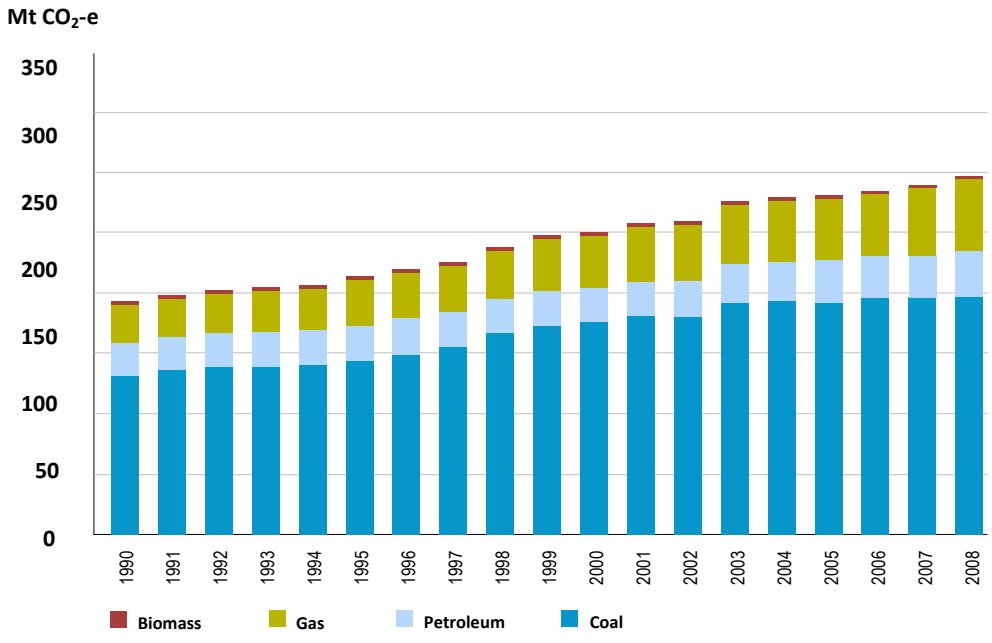

Figure 6 **Stationary energy net CO_2-e emissions by fuel (1990–2008) (DCCEE 2010)**

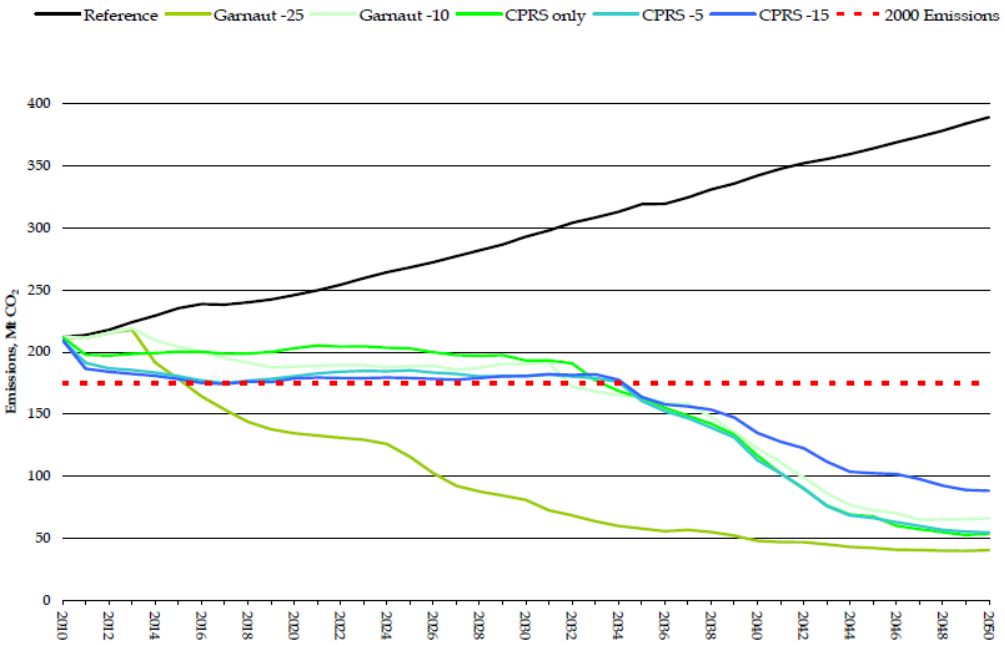

Figure 7 **Forecast emissions from electricity generation in Australia (Mt CO_2-e) (MMA 2008)**

3.4 Community resilience

The concept of community resilience is new and has gained ascendancy in public policy discussion under the umbrella of climate change adaptation. While there are numerous definitions of the concept, it is perhaps best summarised as the ability of a given community to maintain core social and economic functions in the face of natural disasters and climate change events.

Natural disasters can bring about large-scale change to a community that will have catastrophic and long-term impacts on both the social cohesion and net economic output of a community. By putting strategies in place to both lessen the adverse impact of these disasters, and enhance the capacity of the community to recover quickly from these events, the consequent social and economic loss can be minimised.

While much of this debate rightly places emphasis on the restoration of the essentials of life (food, water, clothing, shelter and sanitation), second tier issues include restoration of energy access. Given that access to energy is intricately linked to economic output of first-world communities, the rapid restoration of energy access (be it temporary or restoration of permanent energy infrastructure assets) can serve to minimise economic loss and improve the capacity of a given community to recover from a natural disaster.

The increasing prominence of this issue in the public agenda has given rise to a subsequent discussion about the value of energy diversity and investment in 'back-up' energy systems as a means of improving the energy resilience of contemporary communities.

4 Challenges and opportunities

Analysis of the wider market influences on the Australian stationary energy market, and of the observed trends on the stationary LPG market gives rise to the identification of a series of future challenges and opportunities for the Australian LPG industry. Specific challenges include:

- carbon pricing
- energy competition
- technology competition
- appliance efficiency
- investment attraction
- adverse community perceptions
- limitations in current industry data.

Key opportunities for improving the market share of LPG within the broader stationary energy market include:

- energy mobility
- improved energy affordability
- improved energy resilience of Australian communities.

4.1 Key market challenges

Carbon pricing

The potential impact of carbon prices on the relative operating costs of applications that use LPG and electricity will depend not only on the GHG intensity of energy (kg CO_2-e/GJ) supplied but also on the relative energy efficiency.

The GHG intensity of electricity is 289.8 kg CO_2-e/GJ compared to 68.8 kg CO_2-e/GJ for LPG, resulting in electricity generation producing approximately four times as much GHG emissions as LPG when considered on an energy equivalence basis. It should be noted, however, that some of this advantage is lost as a result of LPG appliances being less energy efficient than equivalent electric appliances or equipment.

The net effect of this lower energy intensity but higher energy consumption for LPG can be seen in Table 6, which reveals that the impact of a $25 per tonne carbon price is not likely to substantially alter the cost relativities of LPG and electricity for households in Australia.

Table 6 Carbon price impact on annual operating cost of LPG vs. electricity applications

Application	Relative energy efficiency of LPG vs. electricity (%)	Estimated operating cost per year (or week) ($)		Carbon price impact @$25/t CO_2-e		Total household operating cost including carbon price impact	
		LPG	Electric	LPG	Electric	LPG	Electric
Energy cost ($/GJ)*		$53.33	$61.16	$1.72	$7.25	$55.05	$68.41
Residential water heating (off peak)	96	$853	$600	$28	$71	$881	$671
Residential space heating	75	$533	$585	$17	$69	$551	$655
Residential cooking	57	$133	$111	$4	$13	$138	$124
Materials handling†	17	$267	$68	$9	$8	$275	$76

* Based on $120 per 45 kg cylinder equal to 2.25 MJ/kg and a standard 2011 electricity tariff of $0.22/kWh.

† Note that operating costs for materials handling are per week.

Energy competition

While the impact of carbon pricing is a principal area of focus for understanding potential changes in the relative demand of competing energy sources over time, the fundamental driver of future market demand will continue to be availability and price.

When considered in the context of competition from competing energy sources, the following observations are pertinent to any future projection of LPG demand in stationary energy markets.

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- LPG is available nationwide; the price is based on the Saudi Aramco contract price and is closely linked to oil price as it shares a common use as petrochemical feedstock.
- Electricity markets on the other hand are local, and have relatively low exposure in global terms (with the exception of some export competition for fuel sources). While the underlying wholesale price of electricity is important, network costs are the single largest contributor accounting for 40–50% of the cost of electricity to a household while wholesale electricity purchase costs constitute only 20–30% of residential electricity bills (CEC 2011). As a result, any potential impact of carbon costs is expected to constitute only up to 15% of a residential electricity bill under a 15% GHG reduction trajectory by 2020 (CEC 2011).
- Natural gas coverage is expanding but is

- Renewable energy is dependent on availability of space and environmental conditions, but has become an increasingly attractive proposition due to rebates and technology supply.

Given the low base price of natural gas, it is hard to perceive a situation where LPG will be competitive with natural gas unless residential connection costs become prohibitive.

There may, however, be an opportunity to increase the use of LPG in the residential sector by targeting the substantial numbers of households that are currently not connected to natural gas – and are unlikely to be connected in the foreseeable future.

Technology competition

Technology applications that use LPG are central enablers in the market outlook for stationary energy LPG to 2030. Similarly, competing technology substitutes have the ability to erode LPG market share, particularly if they improve the relative energy efficiency and offset any gains provided by increases in electricity and natural gas prices.

In existing LPG market segments, a wide variety of competing technologies are emerging while most LPG applications, with the possible exception of forklifts, continue to suffer from limited economies of scale issues as a result of smaller production volumes due to limited market share. Any investment in improvement of LPG technologies will likely necessitate a significant increased equipment cost that will, in turn, reduce end-user attractiveness of LPG.

In emerging markets such as diesel replacement for remote power generation, the negative perceptions of LPG engine reliability and power characteristics must be overcome.

A summary of the principal competition arising from the development of technology in discrete segments is provided in Table 7.

Table 7 **Prospects for competing technology substitutes**

Segment	Technology threat	Timeframe to realisation
Residential	Induction cooking	Now
	Heat pumps / solar hot water	Now
	Water/energy saving devices	Now
	Reverse cycle air-conditioning	Now
	Combined heat and power technologies (LPG Cogeneration)	1-5 years
	Combined heat, power and cooling technologies (LPG Tri-generation)	1-5 years
Manufacturing	Biofuel-based aerosol propellants	+5 years
	Changes to fabrication processes	+5 years
Materials handling	Battery electric forklifts	Now
Commercial	Electric space heating	Now
	Small-scale LNG supply in remote areas	1–5 years
	Combined heat and power technologies (LPG Cogeneration)	1-5 years
	Combined heat, power and cooling technologies (LPG Tri-generation)	1-5 years
Agriculture	Genetically modified crops vs. LPG flame weeding	+5 years
	Solar powered irrigation pumps	Now
	Solar grain drying	1–5 years
Mining	LNG mine haul	1–5 years
	Renewable electricity generation	Now
Remote and emergency power	Fuel cells	+10 years
	Renewable electricity generation	+5 years
Leisure	LED lanterns	Now

Appliance efficiency

A review of the analysis presented in Table 6 reveals that the energy efficiency of LPG appliances tends to be lower than that of electrical technologies, resulting in a lost opportunity to realise both energy savings and greenhouse emission benefits from using LPG.

While this comparative energy efficiency disadvantage is unavoidable for some applications such as electric forklifts and LPG forklifts (i.e. electric motor efficiency versus combustion engine inefficiency), there appears to be a good case for investigating opportunities to improve the combustion efficiency of LPG appliances for residential, commercial and leisure use.

Investment attraction

Analysis of the performance of the market over the last 10 years gives rise to two significant observations about the recent performance of the stationary LPG market.

- The market has grown at approximately 50% of gross domestic product, suggesting that LPG's share of the stationary energy market is declining in real terms.
- Comparison of actual annual sales with previous industry projections reveals that the actual sales performance of the market was 7% below projected sales in 2005 and 23% behind projections in 2010. While part of this anomaly can be attributed to inaccurate data for construction of past projections, it is clear that the LPG market is currently underperforming.

The combination of these performance observations and the gathering strength of market competition (from other energy sources and alternative technologies) contributes to a relatively unattractive picture for future investment in the stationary LPG market.

As a consequence, there is a need for the LPG market to develop a framework that improves the overall climate for investment in both LPG infrastructure and improved LPG appliances for core market segments.

Adverse community perceptions

It is suggested that the LPG industry is currently facing two significant consumer perceptions that need to be addressed for the industry to continue to grow sales in the residential and small commercial segments.

The first issue relates to perceptions that LPG is unsafe. Analysis of these issues reveals that, like all energy sources, LPG can be unsafe if consumers do not maintain or if they misuse appliances. There is a need for the LPG industry to tackle this issue head-on and work with consumers and other stakeholders to improve community understanding of the need to maintain LPG appliances.

The second issue relates to apparent concerns about continuity of energy supply for household and business customers and the aesthetics of LPG cylinders.

This issue also needs to be addressed and could be resolved by introducing metering systems (potentially with supplier telemetry) or by simply making the consumer more aware of the different methods for ensuring continuous LPG supply.

Limitations in industry data

The magnitude of effort associated with the collation of robust industry data for the purposes of this paper was considered to be disproportionately high. Significant inconsistencies were observed in published industry forecasts, government figures and historical sales data. In addition, the available sales data was incomplete for some years, requiring a degree of interpretation to preserve the integrity of the strategic analysis.

This paucity in data is considered to be a major challenge for industry and government alike. Industry cannot adequately assess the case for significant future investment or produce robust plans to guide future development of the industry. For government, the principal challenge relates to the accurate assessment of the current and potential future role of LPG in accommodating the projected energy demands of the Australian economy – constituting a significant risk of policymakers either underestimating or overestimating the future contribution of the Australian LPG industry.

While the data issues were resolved with the cooperation of major industry players for the purposes of this study, there is a clear need for the industry to develop a mechanism for capturing and collating reliable data, and then disseminating it to key industry and government stakeholders.

4.2 Market opportunities

Energy mobility

Perhaps the greatest asset of LPG and the associated LPG storage and distribution infrastructure that has been established over the past 40 years, is the portability of the gas for use.

Effectively, LPG comprises 'bottles of energy' that can be transported almost anywhere in Australia. In addition, the flexibility afforded by LPG means that it can be used as an energy source in the home, in outdoor restaurants, in commercial environments and in remote mining communities.

It is strongly suggested that these characteristics of mobility and flexibility provide much of the explanation for the significant growth in use of LPG that has occurred in the emerging markets of leisure, mining and remote power.

Conversion of this opportunity will likely require increased focus on emerging markets and better leverage of existing national storage and distribution infrastructure to support continued growth of the emerging market segments.

Improved energy affordability

Growing community and business concerns about the rising cost of electricity means that there is an opportunity for LPG to become an alternative to wholesale dependence on electricity, by providing a solution that allows households and businesses to diversify their energy consumption.

Diversification of energy consumption away from electricity offers an opportunity to 'hedge' against the risk of rapid rises in electricity prices in the face of an increasingly uncertain electricity price and supply outlook. While such an approach is unlikely to result in a substantial decrease in current energy prices, the sale of substantial volumes of LPG into the wider stationary energy market can create a level of energy competition that potentially ensures energy affordability in the longer term.

While LPG does not deliver the quantum of environmental and sustainability benefits of renewable energy sources, it is considered to be a far more affordable option for decreasing wholesale reliance on the national electricity grid.

Increased market adoption of innovative LPG appliances, such as solar/LPG hot water systems, provides an opportunity to realise substantial economic and environmental benefits for households by realising synergies between LPG and renewable energy sources.

Improved energy resilience of Australian communities

The combination of natural disasters and the increased frequency of climate-related storm events is likely to place increased pressure on the Australian economy in terms of post-disaster recovery efforts.

Examination of recent Australian and New Zealand disasters (such as the 2011 Christchurch earthquake, the 2011 floods in Queensland and Victoria, and Cyclone Yasi in north Queensland) highlight the importance of restoring access to energy as soon as possible to mitigate against social hardship for households and economic loss for business and industry.

Given that large-scale energy and gas distribution infrastructure tends to fail during the course of these events, the time taken to repair this infrastructure and restore access for households and business can be substantial and can involve significant economic loss.

LPG, with its portability and mobile infrastructure, has the capacity to play a significant role in improving the energy resilience of local and regional communities across Australia. By diversifying energy use in the home and in businesses, people can build a degree of self-sufficiency in regard to sourcing energy needs both during and following major storm events and natural disasters.

Conversion of this opportunity will likely require better leverage of existing infrastructure, development of response plans with government and industry stakeholders (e.g. the insurance industry) and being proactive in the marketing of an energy resilience offering for businesses and households across Australia (this package might comprise a bundled offering of LPG appliances and LPG supply).

5 A framework for future market development

5.1 Strategic objectives

Consideration of the material presented in this paper suggests that there is an opportunity for the LPG industry to play an increasingly significant role in supporting Australia's requirements for the provision of a reliable, affordable and flexible energy source (Figure 8).

As such, the LPG industry has an obligation to work with key government and industry stakeholders to assist with the realisation of this potential.

The LPG industry's 40-year investment in the establishment of storage and distribution infrastructure means that it is well placed to leverage this infrastructure to support national energy security and climate change objectives within a commercial framework. Realisation of this potential will likely require the establishment of partnerships with government, industry and non-traditional stakeholders.

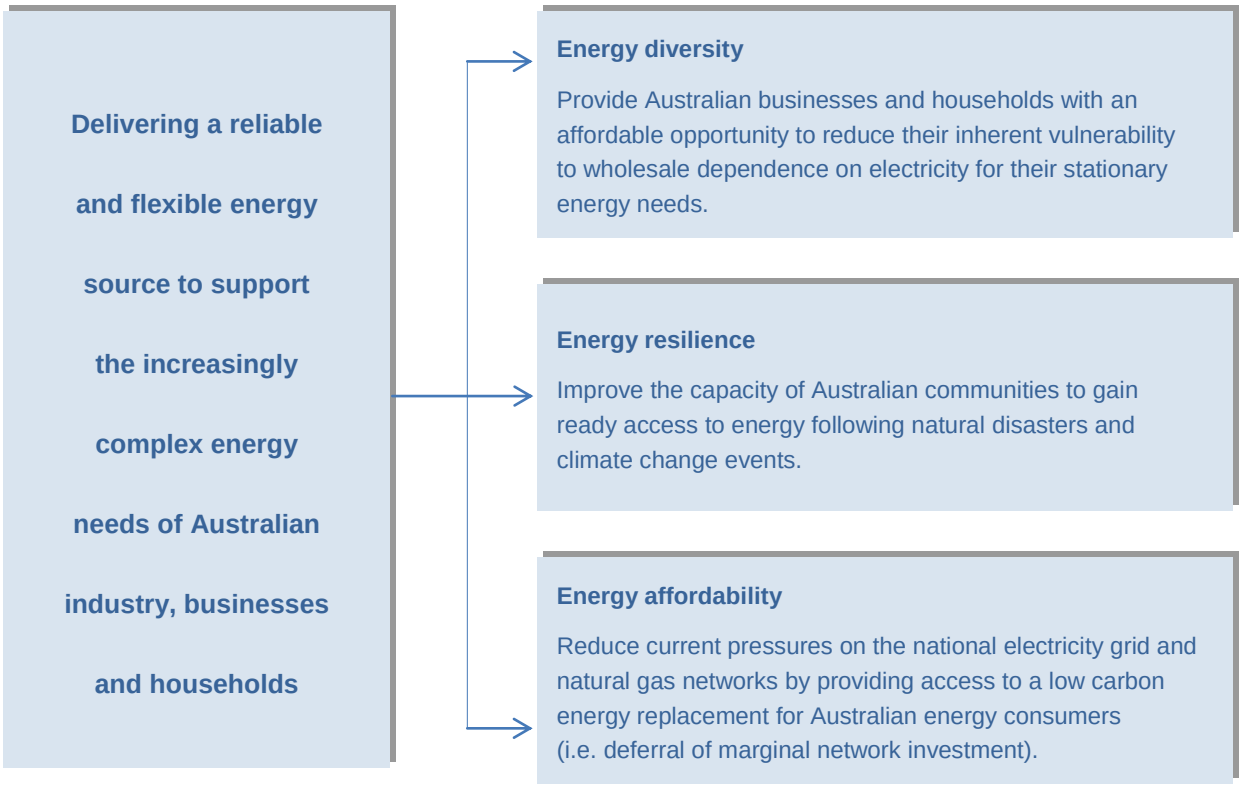

Figure 8 **The strategic objectives for development of the stationary LPG market in Australia to 2030 and beyond**

5.2 Key strategic directions and supporting actions

Analysis of the strategic discussion in the preceding sections suggests that the future development of the stationary LPG market could be premised on the pursuit of five strategic directions.

Strategy 1

Leverage existing national storage and distribution infrastructure

The LPG industry has developed a significant national asset in terms of the production, storage and distribution of LPG. Unlike the electricity and natural gas industries, this 'infrastructure' is flexible and provides the opportunity to deliver energy in a variety of markets in locations ranging from the centre of Australia's capital cities to remote locations in the far north and north-west of the country.

The relatively low cost of this infrastructure means that LPG can be developed as a complementary energy source for households and businesses, increasing energy diversity for end users and thereby improving energy security and energy affordability.

The implementation of this strategy will likely require the pursuit of parallel actions across multiple fronts, including:

- working with government and the natural gas industry to identify opportunities to provide access to gaseous energy in residential areas where investment in natural gas infrastructure is geographically impractical, economically marginal, or likely to impose high costs on consumers;
- investigating the opportunities to use remote metering to improve continuity of gas supply for LPG users and/or application of smart grid applications for monitoring LPG storage levels in households;
- revising existing LPG standards in respect of LPG fittings, LPG appliances and LPG bottle design to ensure that Australian Standards reflect industry best practice.

Strategy 2

Protect and enhance existing markets

Over the last 10 years, the LPG market has grown at a suboptimal rate, due mainly to declining sales in the larger traditional markets (i.e. commercial, manufacturing and residential). The long-term viability of the market will require redress of the current decline of these major markets and consolidation of the strong growth experienced in the emerging market segments of leisure, mining and remote power.

The achievement of this strategy will require pursuit of the following major actions.

- Developing and implementing a coordinated national marketing campaign for promoting LPG hot water systems as an alternative to electric hot water systems in the face of the Australian Government's progressive phase-out of domestic electric hot water heaters. This action should be pursued in tandem with advocacy efforts aimed at redressing current financial distortions created by existing subsidies for heat pumps.
- Working with key building industry associations (e.g. Master Builders Association, Master Plumbers Association, Australian Property Council, HIA, Australian Building Code, Australian Plumbers Association) to resolve key issues constraining the market adoption of LPG in respect of residential and commercial building design.

- Developing a national customer charter for LPG distributors and LPG appliance installers (i.e. voluntary industry standard) to address consumer concerns about service levels. A possible model for such a charter might be the voluntary Victorian LPG Retail Code.

Strategy 3

Develop a national energy response plan for natural disasters

This strategy seeks to take advantage of the inherent advantages of LPG as an energy source that is durable in the face of natural disasters and that can be used to provide ready access to energy for communities in post-disaster situations.

The implementation of this action will require coordination with a number of traditional and non-traditional actions in the pursuit of the following principal actions.

- Establishing a national LPG response taskforce for the planning of 'first response' actions in post-disaster situations, with the aim of restoring energy access to affected communities. This taskforce would likely comprise representatives of industry, commerce, the Australian insurance industry, government and social justice organisations.
- Developing and promoting bundled product offerings that support diversification of energy use in households. These offerings would ideally incorporate access to LPG appliances and a fuel supply contract (allowing contracted customers to pay-down capital switching costs over time via contracted fuel purchase).

Strategy 4

Improve information flows

This strategy comprises two specific elements. The first involves the improvement of industry and government access to robust industry data for the purposes of industry planning and policy making. The second involves the provision of consumer information in respect of the maintenance of LPG equipment and safe LPG operating practices to address perceived safety issues.

It is envisaged that the implementation of this strategy will require pursuit of the following specific actions in partnership with government, industry stakeholders and consumer organisations.

- Establishing an industry reporting protocol for the periodic capture, collation and dissemination of information on national LPG usage.
- Producing an annual state-of-the-market report that provides comprehensive data on aggregated national LPG sales, GHG emissions performance, LPG appliance innovations and key industry developments.
- Developing and distributing a national consumer guide providing plain English guidance on the maintenance procedures for LPG appliances in homes and businesses.
- Working with government and appliance manufacturers to develop a national appliance inspection service for LPG customers.
- Implementing an LPG awareness programme with Plumbers to address current misconceptions around practicality and price of LPG appliances for residential purposes.

Strategy 5

More effective advocacy on LPG use within the stationary energy market.

Analysis of past government actions promoting the use of specific energy sources for stationary energy uses in Australia (specifically residential use) in Australia suggests that policymakers are unaware of the substantial role that can be played by LPG in (a) reducing GHG emissions from stationary energy use, and (b) improving energy affordability for households in the face of rising electricity costs.

Recent government decisions in respect of the stationary energy market (e.g. Renewable Energy Credits, incentives for renewable energy in homes and rebates for electric heat pumps) have failed to adequately consider LPG as a viable energy source and distorted the market by effectively disadvantaging LPG by giving preference to energy sources that offer equivalent benefit.

This strategy seeks to redress these past failures and promotes a cohesive industry advocacy programme to prevent future market distortions.
It is envisaged that the implementation of this strategy will comprise the following specific actions:

- Targeted advocacy action to correct current policies that have served to distort the stationary energy market with particular focus on current rebate programmes and the electric hot water phase put programme.
- Conduct regular and periodic briefings with policymakers to improve knowledge of the degree to which LPG can support national aspirations in respect of GHG reduction and energy affordability.
- Active participation in legislative development programmes with a particular focus on Carbon Tax and fuel excise legislation to ensure that policy makers take due account of the impacts on the LPG industry.

6 Realising public and commercial good

A partnership approach

The analysis presented in this paper reveals that the LPG industry constitutes a national energy system that is currently underutilised in respect of its potential to deliver energy security and GHG benefits to the Australian community.

Realisation of this potential in the near term will likely require an investment of time and capital to advance actions that deliver both public and commercial good outcomes. Considered in isolation, the magnitude of some of these investments cannot be justified solely on the basis of commercial returns or solely on the basis of public good returns – essentially, the investment will only be justified in terms of the combined realisation of public good and commercial benefit.

Consequently, the participation of government and non-industry stakeholders will be required to advance a number of the actions identified in this strategy. These collaborative efforts are unlikely to be advanced under current institutional frameworks but rather will require the establishment of innovative government/industry partnership mechanisms – both formal and informal.

7 The way forward

The discussion in this paper reveals that the increased use of LPG to support Australia's demand for stationary energy has the potential to deliver the following principal benefits to the Australian community.

- Energy diversity. Increased use of LPG for stationary energy requirements provides Australian businesses and households with an opportunity to reduce their inherent vulnerability to wholesale dependence on electricity for their energy needs.
- Energy resilience. Improved capacity of Australian communities to gain ready access to energy following natural disasters and climate change events.
- Energy affordability. Reduces the current pressures on the national electricity grid and natural gas networks by providing access to a low carbon energy replacement for Australian energy consumers (i.e. deferral of marginal network investment).

Achievement of the above benefits will require implementation of an industry strategy comprising five strategic directions to 2030.

- Leveraging existing national storage and distribution infrastructure. Actions focused on taking better advantage of the inherent national energy benefits afforded by the existing national LPG network.
- Protection and enhancement of existing markets. Actions focusing on redressing the historical decline of traditional markets and consolidating gains in emerging markets.
- Developing a national energy response plan for natural disasters. This strategy proposes the formation of partnerships with government, industry stakeholders and external stakeholders to capitalise on the ability of the national LPG industry to improve Australia's energy resilience in the face of adverse weather events and natural disasters.
- Improved information flows. Actions aimed at (a) ensuring better industry and government access to market performance assessments, and (b) ensuring consumers are better informed about the safe and efficient operation of LPG appliances.
- More effective advocacy. Actions aimed at ensuring policy makers understand the potential national benefits of increased use of LPG for stationary energy applications with particular reference to GHG emissions reduction and energy affordability.

Achievement of the actions outlined in this strategy will require collaboration with government and other industries to support the realisation of both public good outcomes for the Australian community and sound commercial returns for industry participants.

8 Recommendations

It is recommended that the LPG industry work cooperatively with other industries and governments (state and federal) to advance the following strategic actions to support the development of the Australian LPG industry to 2030 and beyond.

Better leverage national LPG infrastructure (Strategy 1)

1. Work with government and the natural gas industry to identify opportunities to provide access to gaseous energy in residential areas where investment in natural gas infrastructure is geographically impractical, economically marginal, or likely to impose high costs on consumers.
2. Investigate the opportunities to use remote metering to improve continuity of gas supply for LPG users and/or application of smart grid applications for monitoring LPG storage levels in households.

Protect and enhance existing markets (Strategy 2)

3. Develop and implement a coordinated national marketing campaign for promoting LPG hot water systems as an alternative to electric hot water systems in the face of the Australian Government's progressive phase-out of domestic electric hot water heaters. (This action should be pursued in tandem with advocacy efforts aimed at redressing current financial distortions created by existing subsidies for heat pumps.)
4. Work with key building industry associations (e.g. Master Builders Association, Housing Industry Association, Master Plumbers Association, Australian Property Council) to resolve key issues constraining the market adoption of LPG in respect of residential and commercial building design.
5. Develop a national customer charter for LPG distributors and LPG appliance installers (i.e. voluntary industry standard) to address consumer concerns about service levels.

Develop a national energy response plan for natural disasters (Strategy 3)

6. Establish a national LPG response taskforce for the planning of 'first response' actions in post-disaster situations, with the aim of restoring energy access to affected communities. This taskforce would likely comprise representatives of industry, commerce, the Australian insurance industry, government and social justice organisations.
7. Encourage LPG suppliers to develop and promote bundled product offerings that support diversification of energy use in households. These offerings would ideally incorporate access to LPG appliances and a fuel supply contract (allowing contracted customers to pay-down capital switching costs over time via contracted fuel purchase).

Improve information flows (Strategy 4)

8. Establish an industry reporting protocol for the periodic capture, collation and dissemination of information on national LPG usage.
9. Produce an annual state-of-the-market report providing comprehensive data on aggregated national LPG sales, GHG emissions performance, LPG appliance innovations, and key industry developments.
10. Develop and distribute a national consumer guide providing plain English guidance on the maintenance procedures for LPG appliances in homes and businesses.

8 Recommendations

11. Work with government and appliance manufacturers to develop a national appliance inspection service for LPG customers.

More effective advocacy on LPG use for stationary energy (Strategy 5)

12. Targeted advocacy action to correct current policies that have served to distort the stationary energy market with particular focus on current rebate programmes and the electric hot water phase put programme.

13. Conduct regular and periodic briefings with policymakers to improve knowledge of the degree to which LPG can support national aspirations in respect of GHG reduction and energy affordability.

14. Active participation in legislative development programmes with a particular focus on Carbon Tax and fuel excise legislation to ensure that policy makers take due account of the impacts on the LPG industry.

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Glossary

ABARE	Australian Bureau of Agricultural and Resource Economics
BAU	business as usual
CO_2-e	carbon dioxide equivalent
CPRS	carbon pollution reduction scheme
GHG	greenhouse gas
GJ	gigajoule
kg	kilogram
kt	kilotonne
kWh	kilowatt hour
LED	light-emitting diode
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MJ	megajoule
Mt	megatonne
MWh	megawatt hour
MRET	mandatory renewable energy target
PJ	petajoule
t	tonne
TWh	terawatt hour
vs.	versus