

# ***Potential for Household LPG Use in South Africa***

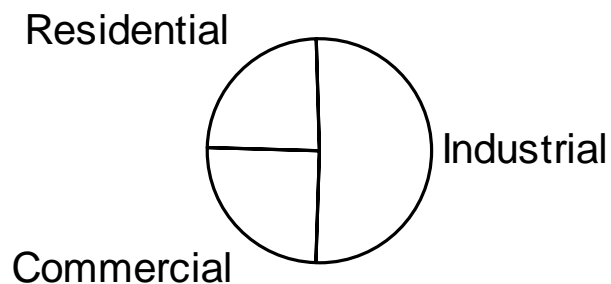
***Jayant Sathaye***

# *Residential LPG Case Study*

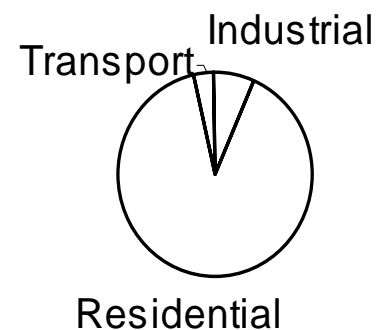
- Evaluate the market potential of LPG in households in Eastern Cape province of South Africa
  - *Cost / benefit analysis of LPG distribution*
  - *Consumer preferences and perceptions*
  - *Future potential*

# ***LPG Consumption Percentage by Sector***

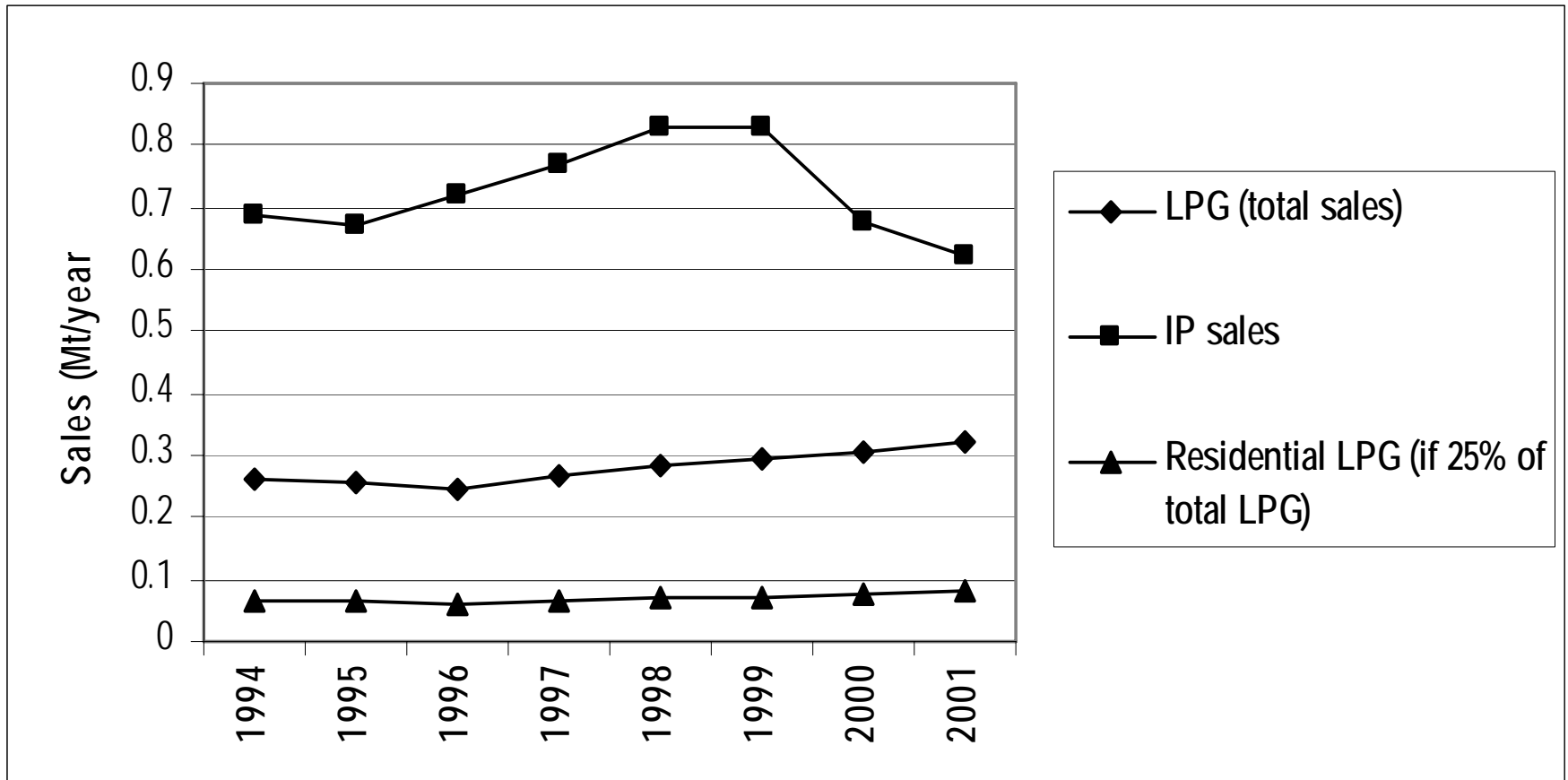
**South Africa**



**Africa**



# *LPG and Illumination Paraffin Sales, South Africa*



IP – Illumination paraffin (kerosene)

## ***Residential LPG Consumption Per Capita in Selected Countries***

<b><i>Country (source)</i></b>	<b><i>Annual LPG consumption (kg per capita)</i></b>
Algeria (a)	47.8
Egypt (a)	36.2
India (a)	5.4
Kenya (a)	0.7
Senegal (a)	10.3
South Africa (b)	2.6
United States (a)	43.8

Sources: (a) WLPGA/World Bank (2002:85); (b) Estimate based on residential consumption of 105 000 tonnes/year (LPGSASA, 2002, pers.com.)

*Cost by Activity for a Customer Refilling or Exchanging Gas Cylinders from a Petrol Station in the Town of Matatiele.*

	<b>Refilling a No.7 cylinder (3 kg) (Rands)</b>	<b>Exchanging a 9 kg cylinder (Rands)</b>
<b>Cost (Rands per cylinder)</b>		
<b>Bus fare (two ways)</b>	<b>4</b>	<b>4</b>
<b>Cylinder transport charge</b>	<b>2.50</b>	<b>15</b>
<b>LPG cost per cylinder</b>	<b>22</b>	<b>62.50</b>
<b>Total cost per cylinder</b>	<b>28.5</b>	<b>81.5</b>
<b>Unit Cost (Rands per kg)</b>		
<b>Excluding transport</b>	<b>7.33</b>	<b>6.94</b>
<b>Including transport</b>	<b>9.50</b>	<b>9.06</b>

## ***Averaged sampled retail prices for residential LPG***

	<i>Refilling a 3 kg cylinder Rands/kg</i>	<i>Exchanging a 9 kg cylinder Rands/kg</i>
Rural Matatiele	7.33	6.67
Urban Cape Town	9.05	8.14
Urban / rural retail price differential	23%	20%

***Rural prices are lower than urban prices of LPG.***

## *Retail prices for LPG cooking appliances and LPG cylinders*

	<i>Retail prices including VAT (Rands)</i>	
	<i>Cape Town (city/suburb)</i>	<i>Matatiele (rural town)</i>
<i>LPG cylinders (purchase)</i>		
No.7 (3 kg)	180	200
No.10 (4.5 kg)	230	265
<i>LPG cylinder deposits</i>		
9 kg	85	85
19 kg	85	85
48 kg	85	85
<i>Stoves</i>		
Camping-type screw-in cooker plate (single)	45	55
Two-ring LPG cooker (no regulator)	260	255
Four-ring stove and oven (basic)	3000	1400
Up-market gas hob and oven	6700	n/a
Simple heavy-duty burner, single ring	90	n/a
Simple heavy-duty burner, double ring	180	n/a
<i>Required for low-pressure appliances:</i>		
Hosing and pressure reduction valve	120	

## **Prices for LPG cylinders and cooking appliances in South Africa and West Africa (US\$)**

	<b>Urban South Africa</b>	<b>Urban South Africa</b>	<b>Cameroon</b>	<b>Côte d'Ivoire</b>	<b>Senegal</b>
	<i>3 kg cylinder + screw-on stove top</i>	<i>9 kg cylinder + 2-ring stove (without regulator)</i>	<i>6 kg cylinder + burner and cooking stand</i>	<i>6 kg cylinder + burner and cooking stand</i>	<i>6 kg cylinder + burner and cooking stand</i>
<b>Cylinder deposit</b>	-	<b>9</b>	<b>13</b>	<b>13</b>	<b>10</b>
<b>Cylinder purchase price</b>	<b>20</b>	-	-	-	-
<b>Cooking appliance</b>	<b>5</b>	<b>26</b>	<b>15</b>	<b>23</b>	<b>10</b>
<b>Total</b>	<b>25</b>	<b>35</b>	<b>28</b>	<b>37</b>	<b>20</b>

**Sources:** SA data: from study;. Other countries: World LP Gas Association/World Bank (2001)

## Cooking energy costs in the case study area

	<i>Fuel price</i>		<i>Monthly cost for 120 kWh useful cooking energy</i>	<i>Unit energy cost of useful cooking energy</i>	<i>Unit energy cost of consumed energy</i>
			<i>R/month</i>	<i>R/kWh</i>	<i>R/kWh</i>
<b>Paraffin</b>	2.90	R/litre	87	0.72	<b>0.28</b>
<b>LPG</b>	6.60	R/kg	106	0.87	<b>0.48</b>
<b>Electricity (standard HomeLight tariff)</b>	0.40	R/kWh	68	0.57	<b>0.40</b>
<b>Electricity (BEST + HomeLight tariff)</b>	0.29	R/kWh at 170kWh/month	50.50	0.42	<b>0.30</b>

## ***Appliance costs as a percentage of annual energy costs***

	<i>Appliance cost (incl. LPG cylinder costs) (Rands)</i>	<i>Annual energy cost (Rands)</i>	<i>Appliance cost as % of annual energy cost</i>
Paraffin (wick stove)	50	1044	5%
LPG No.7 and cooker top	245	1272	19%
LPG 9 kg and 2- plate cooker	285	1272	22%
Electric 2-plate stove	180	768	23%

# Comparison of alternative fuel attributes

	<i>Biomass (open fire and 3-legged pot)</i>	<i>Paraffin (with wick stove)</i>	<i>LPG (with own cylinder and stove top)</i>	<i>Electricity (with two-plate stove)</i>
<i>Appliance price</i>	Low (but pot quite expensive)	Low; pressure stoves higher	Higher	Medium
<i>Fuel price</i>	Low, but if bought, variable	Medium	Higher	Medium
<i>Appliance availability</i>	High (pot)	High	Medium	Medium
<i>Fuel availability</i>	Variable	High	Medium / variable	Variable but increasing
<i>Information / awareness</i>	Familiar	Familiar	Less so	Less so

## **Performances of dung, wood, paraffin, and LPG fuels, and electricity**

		<i>Cooking options</i>				
<i>Performance factor</i>	<i>Impact of this factor</i>	<i>Dung in brazier</i>	<i>Open wood-fire</i>	<i>Paraffin wick stove</i>	<i>LPG, with 2-plate cooker</i>	<i>Electricity, with 2-plate cooker</i>
<i>Preparation time before being ready to cook</i>	Time, inconvenience, wasteful start-up fuel consumption and increased exposure to emissions if fire preparation time is long.	Quite long – difficult to start fire in typical conditions	Can be wasteful, but skilful use can utilise early flames	Short	Short	Short
<i>Peak power</i>	High peak power saves time, and increases efficiency e.g. when bringing water to the boil. It allows high-temperature cooking (e.g. frying).	Poor, in typical applications	Can be high, but with low efficiency	Poor	Quite high	Quite high
<i>Turn-down ratio</i>	A good turn-down ratio increases efficiency during simmering phases of cooking and may be needed to avoid burning food.	Typically poor because peak power low	Moderate, with skilful fire management	Moderate to poor	Quite high, except in windy conditions	Quite high, unless hotplate has limited power settings
<i>Ease of control</i>	Allows for more efficient, more skilful and more convenient cooking over a range of cooking temperatures.	Poor	Requires skills and may be difficult in varying conditions	Moderate to poor	Easy	Easy, if hotplate has continuous power settings

## **Performances of dung, wood, paraffin, and LPG fuels, and electricity (Contd.)**

		<b>Cooking options</b>				
<b>Performance factor</b>	<b>Impact of this factor</b>	<b>Dung in brazier</b>	<b>Open wood-fire</b>	<b>Paraffin wick stove</b>	<b>LPG, with 2-plate cooker</b>	<b>Electricity, with 2-plate cooker</b>
<b>Speed of temperature control</b>	As above.	Poor	Complex: fire control slow but can move pots	Rapid within limits	Rapid	Quite fast for spiral plates, slower for solid hotplates
<b>Overall cooking efficiency (end-use only)</b>	Reduces fuel consumption, and exposure to emissions. Higher efficiencies can imply lower fuel costs, but relative to the different fuel prices.	Very poor (e.g. 10%)	Poor (e.g. 15%)	Moderate (e.g. 30 – 45%)	Better (e.g. 45 – 60%)	Better (e.g. 60 – 75%) for end-user
<b>Cleanliness and hygiene</b>	Clean-burning reduces emissions, soiling of pots, and people's exposure to dirt and smoke. Dung collection can bring risks of foecal health hazards.	Very poor	Poor	Moderate	Good	Good
<b>Harmful emissions for energy-users</b>	Harmful (local) emissions raise the prevalence of respiratory disease, asthma, eye disease and possibly heart disease, cancer and adverse pregnancy outcomes. CO poisoning can be fatal.	Emissions are severe	Emissions are quite severe (outdoors) and severe indoors	Fumes can provoke asthma	Low noxious emissions, but CO danger if there is poor ventilation	Virtually no end-use emissions, but coal-fired electricity generation pollutes

## **Price, calorific value and efficiency assumptions used**

	<i>Local price (incl. VAT) Oct. 2002</i>		<i>Calorific value</i>		<i>Conversion efficiency (to useful cooking energy)<sup>[1]</sup></i>
<b>Dung</b>	0	Rands	12	MJ/kg	10%
<b>Non-commercial wood</b>	0	Rands	16	MJ/kg	15%
<b>Commercial wood</b>	0.3	Rands/ Kg	16	MJ/kg	15%
<b>Paraffin (kerosene)</b>	2.9	Rands/ Litre	37	MJ/litre	40%
<b>LPG</b>	6.6	Rands/ Kg	49.5	MJ/kg	55%
<b>Electricity</b>	0.40	Rands/ kWh			70%

<sup>[1]</sup> Calculations of quantities of useful cooking energy and corresponding unit costs are very sensitive to the conversion efficiencies which are assumed. In practice, conversion efficiencies vary according to the nature of the cooking task, the condition of appliances, ambient conditions, etc. Typical ranges in the literature are 50 – 60% for LPG cooking (e.g. World Bank/WLPGA, 2002:26; 2002:74; UNDP, 1997:100) and 30 – 50% for paraffin stoves. The table uses mid-range values for these efficiencies. Fuelwood is mainly used on open fires, but these are carefully managed, so a relatively high-range efficiency is taken for cooking with fuelwood on open fires (15%).

## *Rankings of cooking fuels in the case study area*

<i>Cost-ranking, lowest to highest</i>	<i>Perceived Ranking *</i>	<i>Assessed cost-ranking</i>
1	Biomass	Biomass
2	Paraffin	Electricity
3	LPG	Paraffin
4	Electricity	LPG

*\* Based on perceived cost, access, and safety concerns*