



ACCELERATING THE LPG TRANSITION

**Global Lessons from Innovative
Business and Distribution Models**

REVIEWED IN JULY 2018



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Management Overview

This report examines how ten countries have transitioned (switched), or are planning to switch, from traditional fuels such as wood, coal, charcoal, animal waste, and kerosene, to liquefied petroleum gas (LPG) as a cooking fuel. It identifies some findings that might be applicable for other countries.

The ten countries include three in South America – Brazil, Ecuador and Peru; three in Africa – Ghana, Kenya and Senegal; three in Asia – India, Indonesia and Sri Lanka; and Turkey.

A review of this document was conducted in 2018.

KEY FINDINGS:

- 1 LPG is a clean, powerful, versatile and exceptional energy that is well suited for cooking applications
- 2 The total population represented by the ten countries is two billion, or almost 30% of the world's population
- 3 Some of the key barriers to switching remain those discovered in the *Rural Energy Challenge* project conducted by the WLPGA and the UNDP:
 - Low density of LPG target population
 - Low purchasing power and even sometimes barter communities
 - Need for local credit facilities
 - Inadequate LPG cylinder size
 - Lack of safety culture and poor enforcement of regulations
 - Strong competition of cheaper alternative energy sources (sometimes subsidised)
 - Inadequate energy state policy to stimulate downstream LPG development (sometimes driving major players away)
 - Weakness of LPG distribution networks in remote rural area

- 4 There is reasonable correlation between GDP/capita and LPG consumption per capita. Most of the countries reviewed have shown an increase in both GDP/capita and LPG per capita consumption in line with this correlation since this report was first published
- 5 A successful switching programme needs a champion. That champion can be government, private industry or another key stakeholder in the process
- 6 The value proposition to the consumer must be compelling. It must be simple, easy to understand, convincing and affordable
- 7 Several of the ten countries used subsidies to make LPG more affordable – unless subsidies are carefully applied they can be a waste of resources, and often may remain a burden on state finances
- 8 A strong brand is needed to market LPG. Multi-branded distribution channels should be avoided
- 9 LPG requires effective and enforceable regulations to allow the industry to grow in a safe and sustainable manner. Non-compliance must be heavily penalised
- 10 The application of good safety and good business practices is important to create a safe and level playing field for the market, and to encourage investment

1.0

Background & Purpose



In December 2013 the WLPGA published the *Cooking for Life Roadmap to a Billion* which outlined the problems, opportunities and plans for achieving the Cooking for Life Goal. The goal was to facilitate the transition of one billion people from traditional fuels (e.g. solid biomass, coal, charcoal, wood, etc.), and other dirty and dangerous fuels such as kerosene, to cleaner burning LPG by 2030.

The Roadmap outlined some examples of tactical steps that the WLPGA could undertake to advance the Cooking for Life goals.

These included:

- 1. Responding to requests to intervene in a country or market as part of a regulatory educational process, in coordination with interested local WLPGA member companies and relevant national LPG associations**
- 2. Identifying information gaps that exist and conducting studies to fill them, partnering with appropriate academic and research organisations as appropriate**
- 3. Capturing success stories and lessons learned of conversions happening around the world, with an emphasis on scalability and sustainability**

The objective of this report is to address one of these tactical steps of the Roadmap - (3) above - by capturing some stories and lessons learned of conversions happening around the world, with an emphasis on scalability and sustainability.

The decision to produce this report followed an approach from Professor Kirk R. Smith – Professor of Global Environmental Health at the University of California, Berkeley.

The WLPGA agreed to consider sponsoring this project to review several current and past innovative initiatives from around the world in selected countries where there has been an attempt to accelerate access to LPG among populations using solid biomass (wood, crop residue and animal waste), coal, charcoal and kerosene.

The proposal received support to proceed from the WLPGA Industry Council at its meetings in Miami (October 2014) and Seoul (January 2015).

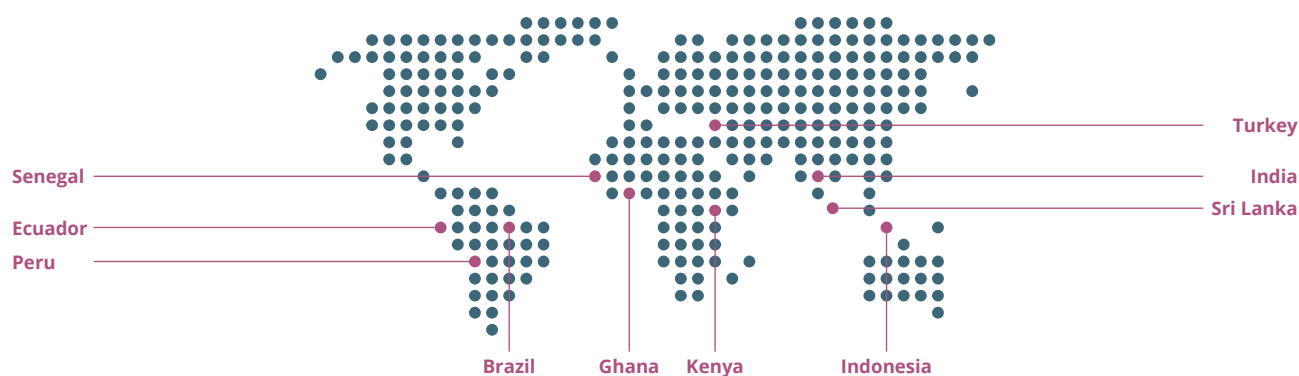
The original project was partly funded by the WLPGA, together with additional contributions pledged from The Global LPG Partnership and The Global Alliance for Clean Cookstoves. This latest review is totally funded by the WLPGA.

A steering committee, under the Cooking for Life programme, was established to agree the original terms of reference.

This included the selection of ten countries where there has been an attempt to transition from solid biomass (wood, crop residue and animal waste), coal, charcoal and kerosene to LPG.

The original criteria for selection was agreed as follows:

- There is evidence of an LPG transition programme that would make a significant contribution towards the objectives of the project**



- Detailed information about the programme is likely to be available from stakeholders in that country, including government
- WLPGA members are present in the country or have interests there
- The final list would have good geographic diversity.

The ten countries selected by the steering committee were Brazil, Ecuador, Ghana, India, Indonesia, Kenya, Peru, Senegal, Sri Lanka and Turkey.

The total population represented by these ten countries is two billion, or almost 30% of the world's population.

In each one of these countries there has been efforts to transition from traditional fuels to LPG.

Some of these efforts have taken place some years ago (Brazil), while others are undergoing plans now (Turkey).

Some of these countries have received strong government backing (Indonesia) while others rely on the private sector (Sri Lanka).

For each of the ten examples this report contains some country background, a review of the LPG market over the past 10 years with a more recent assessment based on the *2018 WLPGA Global Statistical Review*, which includes 2017 data.

Nearly all the countries have realised an increase in their LPG per capita consumption corresponding to an increase in their GDP per capita.

Reference has been made throughout this report to the findings taken from the study '*The Rural Energy Challenge*' because those findings still apply.

There is a description of each of the ten countries, together with the transition initiative taken by that country, in Section 8.0.

For those reading this who are new to the LPG industry it is recommended to turn to Section 5.0 which provides some information about LPG and how it compares with traditional fuels and kerosene.

2.0

Summary

The objectives of this report are to suggest, through the examples from the ten countries selected, some tactical steps for the industry to achieve the goals of the *Cooking For Life Roadmap to a Billion*.

This report includes a summary and brief analysis, from each of the ten countries, of initiatives by national governments, the LPG industry, non-governmental organisations, development institutions, and other organisations around the world, to accelerate the usage of LPG for cooking, particularly in those areas where the percentage of households using solid biomass (wood, crop residue and animal waste), coal, charcoal and kerosene, is high.

There are some examples of successful projects and distribution models – and some not so successful. It is a desk top study, supported by discussions with focal points in each country. In some cases, it was possible to meet some of these focal points, to discuss the initiatives, and conduct peer reviews of the findings.

Some of the important keys to a successful transition from traditional fuels and kerosene to LPG were highlighted in previous work undertaken by the WLPGA and the UNDP in *The Rural Energy Challenge* study and these are referred to again in this report because they are still relevant (see also Appendix 1).

If there are to be some overriding key success factors to provide from this report, having studied the initiatives in each of the ten countries that have been highlighted here, it would be that three issues have to be in place for a successful transition.

THREE KEY SUCCESS FACTORS WHEN SWITCHING FROM TRADITIONAL FUELS & KEROSENE TO LPG

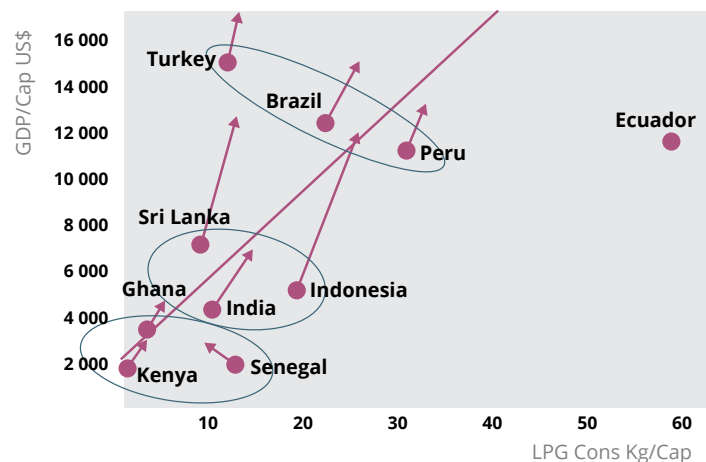
- 1 '...there has to be motivation for change...'
- 2 '...the value proposition to the consumer must be compelling, simple, easy to understand, convincing and affordable...'
- 3 '...the application of safety and good industry practices is vital to allow the LPG industry to grow in a safe and sustainable manner...'

- **Drivers** – for a country that is considering a programme to switch its population from traditional fuels and kerosene to LPG there must be a driving force behind it. That might be the government backing the programme (e.g. Indonesia, Peru), the private sector (Sri Lanka, Kenya), or a combination of drivers (e.g. Brazil, India, Turkey).

- **Proposition** – the value proposition to the consumer must be compelling, simple, easy to understand, convincing and affordable. Simplicity is important with the design of the hardware – stoves, pots and pans etc. LPG is very different to traditional fuels. Education, demonstrations and peer support, all have a key role to play in convincing users to switch. The affordability of LPG is frequently seen as a barrier to change. There should be innovative ways to keep that barrier as low as possible. Subsidies, grants, microfinance may all have a role to play but there is caution here with subsidies. There are many examples where subsidies have become a burden (Ecuador, Senegal, India, Indonesia...). The Internet of Things (IoT) may now enable these entry barriers to be lowered (refer 8.6).

- **Safety and Good Business Practices** – the consumer perception that LPG is unsafe is sometimes difficult to change. It is vital that good safety and good business practices are enforced. The LPG equipment must be kept in good order and fit for purpose. It is equally important that not only the consumer, but all the people involved in the supply and distribution channel, are aware of their roles and responsibilities to keep the LPG industry safe and allow it to grow in a sustainable manner. LPG will be new to many people in these new markets and they all need to be educated about the product, and the storage, handling, distribution and use of LPG.

MOST OF THE COUNTRIES HAVE IMPROVED THEIR PER CAPITA CONSUMPTION OVER THE PAST 3 YEARS AND FOLLOWED THE CORRELATION CURVE



Residential LPG demand per capita has a broad correlation with GDP per capita and a look at the ten countries selected showed this in the original report (above).

The three African countries follow the general trend in most parts of East, Central and West Africa, of having low levels of LPG consumption per capita.

The three Asian countries lie slightly higher up the chart and together these six countries present the best opportunities for growth.

The outlier country is Ecuador which has a per capita consumption almost twice that expected for a country with a per capita GDP of around US\$12,000.

LPG in Ecuador is heavily subsidised making it an attractive proposition for neighbouring countries - Peru and Colombia - to receive illegal cross border product. It is also understood that an illicit diversion of LPG cylinders gets channelled into other sectors, such as transport, driven again by artificially

low prices. Otherwise actual per capita consumption in Ecuador would likely be closer to 25 - 30kg/person/year.

The arrows show how each country has developed (GDP/cap & LPG consumption per cap) since this original report by applying the 2017 country data, and the consumption data from the 2018 WLPGA Global Statistical Review. Almost all countries have improved in both respects and follow the correlation line. The exceptions are Senegal and Ecuador.

Safety in the LPG business is paramount. So too is the application of good business practices which will strongly influence investor confidence. In some countries, for example Kenya, there is much work to be done to manage the LPG industry in a safe and sustainable manner.

The Rural Energy Challenge was an important project undertaken by the WLPGA and the UNDP several years ago to examine the rural usage of LPG in seven countries (see box below and Appendix 1).

Two of those countries, Ghana and Turkey, were re-visited in this study.

The barriers to LPG penetration, which were highlighted in *The Rural Energy Challenge*,

are still very much in evidence from the feedback found from the ten countries examined here.

In addition, there are some new observations that were discovered. These also need to be considered by countries seeking to transition from traditional fuels to LPG.

THE RURAL ENERGY CHALLENGE

Over ten years ago the WLPGA and UNDP jointly undertook a project called *The Rural Energy Challenge* (see also Appendix 1). This was a public/private partnership aimed at addressing the lack of access to clean energy and improving living standards through the use of LPG.

The target groups were populations living in rural, peri-urban and suburban areas of developing countries and the aims were to identify and address barriers to rural market development.

One of the key conclusions from *The Rural Energy Challenge* was that despite the cultural diversity that existed in the countries selected there were many similarities in terms of barriers to LPG penetration.

These were:

- 1 Low density of LPG target population
- 2 Low purchasing power and even sometimes barter communities
- 3 Need for local credit facilities
- 4 Inadequate cylinder size
- 5 Lack of safety culture and poor enforcement of regulations
- 6 Strong competition of cheaper alternative energy sources (sometimes subsidised)
- 7 Inadequate energy State policy to stimulate LPG use (driving major players away)
- 8 Weakness of LPG distribution networks in remote rural area

Some additional observations were found in this report in respect of the above eight points:

1 - Low density of LPG target population

- This is not only a deterrent to investment in the distribution channel because of the lack of critical mass, it is also likely to encourage bad business practices. Unauthorised and poorly trained dealers see opportunities to service a low volume market through short cuts, impacting on good LPG cylinder management practices (Ghana).

2 - Low purchasing power and even sometimes barter communities

- LPG does not appear to be a relatively cheap fuel when compared to traditional fuels, especially for the first-time user who must acquire the necessary equipment (LPG cylinder, stove, regulator and hose). One of the biggest challenges is how to lower that entry barrier for new users. Assistance here can certainly help (Indonesia) but misdirected fuel subsidy programmes are unlikely to reach the consumer and are vulnerable to be channelled off into completely different markets such as supporting an illegal Autogas industry (Ecuador). More recently, pilot studies have proved that LPG is cheaper to use than charcoal.

3 - Need for local credit facilities

- The use of microfinance has been shown to be a powerful tool, especially when channelled through a trusted local focal point. New initiatives like this are best introduced by a local community leader who has the trust of the local population (Sri Lanka).

4 - Cylinder size – selecting the right size

- If the cylinder is too large the entry barrier is raised not only because of the higher initial cost of the cylinder but also the higher refilling cost. In addition, the larger the cylinder the higher the tare weight and eventually the package becomes too heavy for the consumer - who is often a female - to carry (Peru).
- If the cylinder is too small the consumer loses confidence and becomes frustrated when it frequently becomes empty. The contents of a steel LPG cylinder are not easy to see. From an operations perspective the need for

frequent refilling, and the associated increased number of cycles through the filling plant, causes greater wear and tear on the cylinder and increases operational costs (Indonesia).

- 5 - In addition to having an adequately sized cylinder, thought must also be given to facilitating change from traditional fuels to LPG in the kitchen. It will be an advantage to create a working environment with LPG that is not so dissimilar in terms of utensil compatibility, cookstove height etc.



A consumer who is used to cooking with particular utensils does not appreciate using a new gas stove that cannot accommodate them.

6 - Lack of a safety culture and poor enforcement of regulations (and severe penalties for non-compliance)

- The withdrawal of some of the larger multinational companies from the global LPG business over recent years has perhaps made the need for safety and regulations enforcement even more acute. So too the need for heavy penalties for non-compliance). The need for training, coupled with a strong consolidated government lobbying body, has become a bigger issue since the days of The Rural Energy Challenge. This is particularly the case in developing countries where the LPG industry is still growing and where a

country LPG association is either non-existent or in its infancy.

- This is an important development that bears more discussion, perhaps in a separate report. It will likely have an impact on the price, availability, and other parameters that impact the subject of this report.

7 - Strong competition of cheaper alternative energy sources (sometimes subsidised)

- For many people, in most of the

countries under review, the relative cost of LPG versus traditional fuels appears to be higher creating a barrier to entry. Kerosene subsidies are not uncommon to encourage the transition away from biomass but, as Indonesia discovered, they are a financial drain on the national budget, particularly when subsidised kerosene illicitly enters other fuel markets such as diesel.

8 - Inadequate energy State policy to stimulate LPG development (sometimes driving major players away)

- The LPG industry requires high levels of investment - in storage tanks, vehicles, filling plants, cylinders etc., - and if governments are to encourage LPG markets to be developed they need to provide investors with a high degree of confidence that these assets are being protected from illegal practices



by enforcing a level playing field. Sound policies supported by good enforcement will encourage investment. If bad practices are prevalent, investors will be put off (Kenya). Recently the Kenyan government has stepped in to address this by planning investment themselves in storage and handling infrastructure.

9 - Weakness of LPG distribution networks in remote rural areas

- One of the advantages of LPG is its portability and having the ability to be able to reach populations in the most remote rural areas (Turkey). Once cylinders leave the filling plant the control over safety and business practices diminishes. Peri-urban and rural development of LPG markets requires strong controls through the distribution channel.
- The 'last mile' challenges of reaching the households, often located in

remote areas, with accessibility and communication issues, is something that distributors need to address. This might be through harnessing modern technology to assimilate urban solutions using IoT for example.

Reviews of the original LPG transition initiatives in each of the ten countries are set out in Section 8.0 of this report together with an update.

The approach taken in each of the ten case studies highlighted in this report differs from country to country and some have been more successful than others. The important message is there is no one simple solution to transition a population away from traditional fuels.

In each of the reviews in Section 8.0 there is a brief description of the country, along with a chart showing the historic LPG consumption and production over the

last ten years from 2008 to 2017 using the latest data from the *2018 WLPGA Global Statistical Review*.

Each country demonstrates initiatives that have been used, or highlights challenges faced, to illustrate the different ways to promote the transition from traditional fuels to LPG.

LPG is one of those products where the packaging – the cylinder – is more expensive than the contents. This presents a challenge when trying to compete with something that appears inexpensive, or is often free. Especially so when the target market has limited disposable income for energy.

In addition to this, the use of LPG for the first time requires other equipment. A regulator to connect onto the cylinder valve, a flexible hose to carry the LPG to the appliance, and the appliance – or stove – itself.

3.0

Scope & Methodology

This is a desk top study. Information has been gathered from published material and selective interviews with government bodies, non-government organisations and other stakeholders, including WLPGA members.

In some cases, this has been possible through country visits when attending other events.

WLPGA Director David Tyler was the lead author of the work but the Cooking For Life Steering Committee, along with representatives of the University of California at Berkeley (UCB), the Global Alliance for Clean Cookstoves (GACC) and the Global LPG Partnership (GLPGP), have been responsible for reviewing and approving the final report.

A key requirement of the study is to assess the initiatives in relation to the safety and conformity to WLPGA Good Industry Practices.

Where possible the country reviews include analysis of:

- The country itself, some key facts, especially relating to the population and economy
- Pilot projects if implemented prior to launch of the programme
- Policy objectives and rationale/justification of the programme
- Design and implementation of the programme, the stakeholders and partnerships involved, and choice of instruments (direct and cross-subsidies or other incentives and grants; demonstrations of the use of LPG, social marketing, etc.) to promote the use and dissemination of LPG, especially to poor and remote populations
- Financial aspects of the programme (costs, pricing policies, relative fuel costs, level of support, source of funding, timetables, impact etc.)
- Technological aspects of the programme (choice of equipment, technology, technological development, the application of IoT, etc.)
- Logistical impact (storage facilities, cylinder filling plants, road vehicles, distribution channel etc.)
- Barriers – technical, logistical, social, economic, public perception, lack of primary infrastructure, and political – that were encountered and how these were overcome
- Success rates, measured for example in numbers and percentages of household switching away from traditional fuels (e.g. solid biomass, coal, charcoal, wood etc.) and kerosene (for existing programmes)
- Monitoring and evaluation processes
- Lessons learned and future plans



4.0

Target countries

The list of target countries includes those that have mainly focused on a traditional fuel to LPG transition programme. Some are in the planning stage (Turkey) and have been included because of they have a particularly interesting initiative.

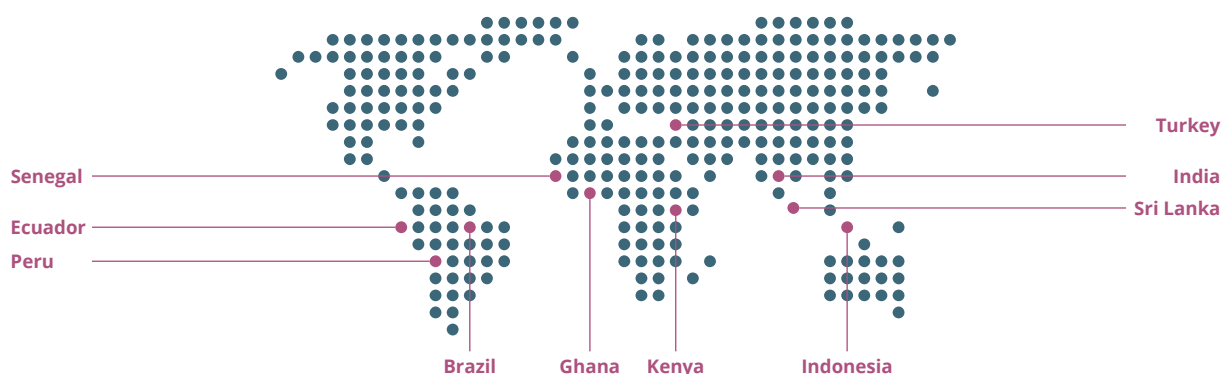
Some have focused on a kerosene to LPG transition but most of the countries focus on moving away from traditional fuels (coal, charcoal, wood, rice husks, animal waste).

In selecting the list of countries, the steering committee considered the following criteria:

- Evidence of an LPG transition programme that would make a significant contribution towards the objectives of the project
- Detailed information about the programme is likely to be available from stakeholders in the country, including government

- WLPGA members are present in the country, or have interests there
- The final list would have good geographic diversity.

The following countries were selected: Brazil, Ecuador, Ghana, India, Indonesia, Kenya, Peru, Senegal, Sri Lanka and Turkey.



In selecting these countries, the steering committee have identified examples where reproducibility, scalability and sustainability are most likely to be applied.

The kerosene to LPG conversion programme conducted in Indonesia over the last ten years – which involved 58 million users – was one of the largest ever projects to encourage the transition from kerosene to LPG in a country.

While it is important to note that conversion from traditional fuels to LPG presents different challenges, a review of the

Indonesian programme, which focused on moving away from kerosene, is important as many of the common lessons on issues such as affordability, distribution, safety, and infrastructure have applied.

India and Sri Lanka are two other countries in Asia that have been included. India has used subsidies for decades to encourage the use of LPG, but this created a huge financial burden for the Indian State and the subsidies were not reaching their target. A Direct Subsidy Transfer (DST) scheme was introduced in 2015 to address these issues and this has



progressed well. The Sri Lankan example targets a rural group through a private initiative.

Africa is represented by Ghana, Senegal and Kenya. The low per capita consumption of these three countries presents great opportunities for the LPG industry but the challenges are many, not least affordability and business practices.

The three South American countries included are Brazil, Peru and Ecuador. Brazil used subsidies to switch most of its population to LPG in the 1980's and 1990's. Peru and Ecuador have more recent examples of switching.

Turkey, as a relatively developed country, has been included as it is encouraging the use of LPG in remote rural schools where wood fired stoves are used to heat the class

rooms. Because it doesn't focus on cooking perhaps it is not an obvious example for this study. However, it is aimed at improving the health of children and reducing infant mortality and the concept of moving away from traditional fuels in a heating application can readily be extended into cooking with LPG. Also children can be great ambassadors for change in a family.

5.0 LPG an Exceptional Energy

LPG is one of the cleanest forms of energy available, both in terms of handling and combustion.

The properties of LPG, especially its portability, hot flame, low emissions, low carbon footprint and high energy value, makes it an outstanding choice for cooking. As a result, nearly half the world's demand for LPG is in the residential sector for cooking, hot water and space heating.



5.1 WHAT IS LPG AND WHERE DOES IT COME FROM?

LPG is a by-product of natural gas production and crude oil refining and so technically it is a fossil fuel. This, unfortunately, frequently puts LPG into the same category as other traditional fossil fuels such as diesel, kerosene and fuel oil.

This association is unfair because the clean burning attributes of LPG, associated with its low carbon footprint, together with its clean handling properties (LPG will never create the same pollution hazards that an oil spillage does) makes it a 'five-star' fossil fuel.

With the increasing number of natural gas fields being developed around the world, continued refining of crude oil and the discoveries of shale gas - particularly in North America - the supply outlook for LPG has never been better.

This increasing supply is also starting to have an impact on international prices of LPG. LPG in 2015 was half the price it was in 2014 creating an exciting opportunity for penetrating low income households with this modern energy. Whether this is a lasting phenomenon is unknown, but it does lower the entry barrier.

5.2 HOW IS LPG TRANSPORTED FROM THE NATURAL GAS FIELDS AND REFINERIES?

Although LPG is used as a gas it can be easily turned into a liquid by applying moderate pressure.

LPG is transported in a liquid state like other liquid fuels such as diesel and gasoline. The only real difference is that the LPG storage vessels are pressurised.

One unit of liquid LPG can produce around 250 units of vapour. So, LPG in a liquid state provides the opportunity for large amounts of energy to be transported to the point of application where it is then turned into a gas by releasing the pressure.

Pressurising LPG to create a liquid state allows the product to be easily moved through the distribution channel from the point of production right through to the consumer. It is only at the point of consumption that LPG is turned into a vapour, by releasing the pressure, to create the gas. This 'releasing the pressure' is done by opening the valve on a cook stove for example.



LPG is produced in large quantities requiring large storage facilities and large ships to start moving it closer to the market.

Apart from the familiar steel spherical tanks often associated with LPG storage there are other types of storage such as cylindrical tanks (or bullets), mounded storage and even large underground caverns if the ground conditions allow.

These storage facilities can be as large as 100,000 metric tonnes (MT). The size and type of storage will depend on several factors including on-site and off-site risks, available space, demand offtake, economics and topography.

THE LPG INDUSTRY EXISTS BECAUSE BY THE EXERTION OF PRESSURE IN A CLOSED CONTAINER LPG CAN BE COMPRESSED TO LIQUID FORM



AND the liquid occupies only about 1/250th as much space as the gas would



The ability for LPG vapour to be converted to liquid under pressure allows it to be transported efficiently by ship, rail and road and be carried to consumers in small cylinders in the most remote rural regions



Traditionally LPG has been stored in spherical tanks; these spheres would typically each contain around 1-2,000MT of LPG



One of the most popular methods of storing LPG in depots and customer premises is in above ground cylindrical tanks



Mounded LPG storage tanks provide increased security from external effects such as flame impingement from a nearby fire

VAPOUR PRESSURE

The pressure of the vapour of LPG in a storage container, whether it is in a very large gas carrier (VLGC) or a small 3kg cylinder, will increase as the temperature of the LPG increases. This provides the opportunity to reduce or increase the vapour pressure throughout the distribution channel by reducing or increasing the temperature of the product. This is useful during storage because by chilling the LPG, it reduces the vapour pressure, and this reduces the structural requirement of the pressurised container. This is why refrigerated storage is used. Similarly by increasing the temperature of LPG the vapour pressure increases. This is useful if we want more vapour for a particular application but it is also something to be aware of if the LPG storage vessel is subjected to heat. If the LPG tank or cylinder is in a fire for example we need to cool the surface by applying water to reduce the vapour pressure and lower the risk of loss of containment. Propane has a higher vapour pressure than butane and also boils at a lower temperature. The boiling point (the temperature when the liquid turns into a vapour) is about zero degrees for butane which means butane would not be suitable for use in cold climates because it would not produce any vapour to burn.

The effect of temperature on vapour pressure is apparent with aerosols when LPG is used as the propellant. Shaving foam or deodorants for example always seem to more 'energised' when they are warm. This is because the vapour pressure inside the container is higher.

More information about LPG properties can be found in this link: <https://youtu.be/BjiUF4OsPj8>



LPG ships range in size from a few hundred metric tonnes to tens of thousands of metric tonnes



Road tankers are a common method of transporting LPG from terminals to depots, or consumers, even in very cold weather

LPG in large coastal storage facilities will typically move product to the markets using very large gas carriers (VLGC's). These can contain 45,000MT or more of LPG.

Smaller coastal tankers can contain typically 5 – 10,000MT and barges even less (a few hundred MT).

Apart from ships, LPG is also transported by rail tank car, pipeline and road tankers. The latter can contain as little as one or two metric tonnes.

As the product moves through the distribution channel it can be transferred through small bulk tanks and cylinders. These cylinders can typically range from 50 kilograms (kg) down to as small as 1kg. A typical LPG distribution channel is shown in Appendix 2.

Once the LPG has been transferred into cylinders it can be moved to the most remote locations allowing even rural villages, well off the distribution grid, to receive this modern clean energy.

Imaginative forms of transport emerge across the world to bring LPG to the final consumer including bicycles, tricycles, boats and canoes; even in rucksacks. This illustrates the importance of further addressing the 'last mile'.

In all cases LPG remains in a liquid state throughout the distribution channel by being contained in pressure vessels.



LPG cylinders come in a range of different sizes. A small cylinder can supply a household for cooking for many days, a tall one enough for a small restaurant



LPG cylinders should always be transported upright to reduce the risk of a liquid leak

5.3 WHY DOES THE WLPGA CALL LPG AN EXCEPTIONAL ENERGY?

Apart from the ease of transporting LPG, making it extremely easy to reach the most remote rural areas, LPG has unique properties allowing it to be used effectively and efficiently in many applications.

The ability to easily liquefy LPG at very moderate pressure (not much higher than the pressure in a bicycle tyre) enables large quantities of energy to be stored safely in small containers.

The temperature of an LPG flame exceeds 1,800 degrees Centigrade, hot enough to cut through steel. The hot flame makes it a very popular fuel for cooking, especially when using a wok, which requires high flame temperatures.

Being a gas, an LPG flame can be controlled very easily allowing a cook stove to switch from full flame to simmering in less than a second. This is something traditional fuels are unable to do, leading to energy loss, wastage and inefficiency.

LPG is a very clean fuel, both in storage (if LPG is spilt there is no mess), and when burning (it has a low carbon footprint and produces little emissions, and virtually zero particle matter (PM)). However, the power of LPG is the reason why so much attention is placed on safety throughout the distribution channel.



Simple LPG lanterns enable rural communities to extend their days into the evenings

LPG can also be used to generate light using simple LPG fuelled lanterns, displacing dangerous kerosene lights which are often no more than a rope in a can.

Apart from being an exceptional fuel in a burner, LPG also has excellent engine fuel properties. It has an octane number that exceeds gasoline. This allows LPG to be used in engine applications as well as burners and lanterns. This versatility gives LPG the ability to provide not only heat and light, but also electricity, through the application of a gas engine driven generator.

Introducing electricity into a remote rural community through an LPG fuelled generator will transform people's lives. Apart from providing lighting to the community, electricity allows the introduction of other modern facilities which are taken for granted such as refrigerators, televisions, mobile phones and the internet.

It is all these attributes that led the WLPGA to apply the 'Exceptional Energy' brand.

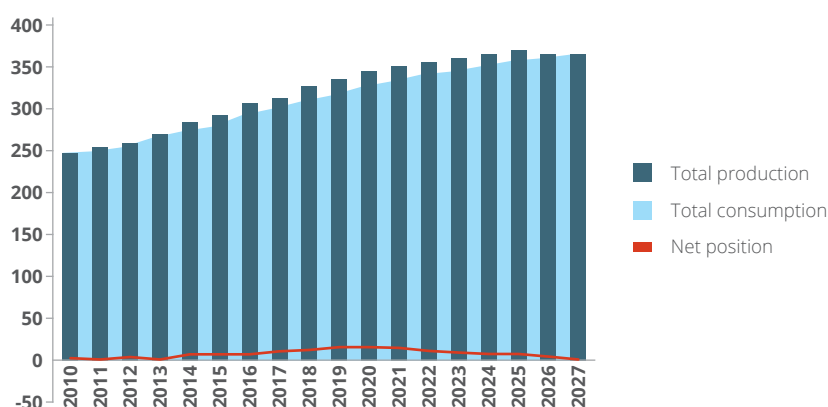
5.4 WILL THERE BE SUFFICIENT SUPPLIES OF LPG TO MEET FUTURE DEMAND?

Because LPG is a by-product, the supplies rely on the availability of natural gas and crude oil refining.

Today there is already a gap between supplies and demand and LPG is flared off in some countries because the cost of moving it to demand centres exceeds the value of the product.

Recent production of shale gas deposits in North America and elsewhere, and the associated LPG, together with planned natural gas fields, all indicate that this surplus will continue ensuring sufficient LPG supplies for the foreseeable future, at least the next decade.

WORLD LPG PRODUCTION AND CONSUMPTION 2010-2027 (MN T)



Argus Media predict an LPG surplus almost throughout the next decade peaking at 12mMT in 2020

5.5 HOW IS LPG PRICED?

Historically the international pricing of LPG has been driven by the Middle East producers who have been the dominant global players.

This is changing, with the USA now the world's largest exporter of LPG in 2017, following the development of shale deposits.

In 2016 the expansion of the Panama Canal was opened, cutting weeks off the journey time of VLGC's heading towards the fast-growing regions of Asia, and increasing the utilisation of LPG ships.

This US production has applied pressure on traditional LPG suppliers and as a result prices have fallen, but they have since recovered.

The LPG industry is often accused of having a product which is unaffordable to low income groups. The reality is that the traditional fuel alternatives to LPG – such as charcoal, coal, wood and animal waste – may be initially cheaper but their inefficiency distorts their lower price.

A rural family lighting a wood fire at the middle of the day to cook lunch may have to sustain that fire throughout the rest of the day to cook the evening meal. This is not only wasteful it is generating dangerous emissions for long periods, impacting on the health of the family members.

An LPG stove can be switched on and off whenever a meal is to be cooked. Limiting the amount of energy used, keeping the cost (and emissions) down and contributing to the overall efficiency of the process. A recent pilot programme in Kenya (refer Section 8.6) has demonstrated that the actual cost of using LPG is lower than charcoal.

5.6 WHAT IS THE OUTLOOK FOR LPG?

The LPG industry has a product that is well suited to be used as a cooking fuel. Potentially it can be also used to provide lighting, heat and electricity to those three billion people who have no access to modern energy.

LPG can be easily transported from the major production centres around the world, with an existing infrastructure that is in place and proven, to remote consumers. However, there are still challenges to be faced in some rural areas.

LPG is one of the cleanest forms of energy available, providing the opportunity to displace the dirty and dangerous traditional fuels such as charcoal, coal, wood, animal waste and kerosene.

In doing so the use of LPG can release some of the women in society from the chore and dangers of collecting wood, reducing the impact this has on deforestation; give them the opportunity of doing more meaningful

work; improving the air quality in the kitchen, living conditions and health; provide the opportunity for introducing electricity into people's lives and creating opportunities for extending their day through lighting at night; increasing the opportunities for education through modern communications; and so much more.

The challenge is to make this happen.

The examples showcased here in this report are taken from ten countries where efforts have been made to transition consumers from traditional fuels to LPG.

They are not all success stories, but they provide ideas and initiatives that perhaps can be considered by others who have yet to take that step.

The challenge of the WLPGA Cooking For Life programme is to encourage the transition of one billion people from traditional fuels to LPG by 2030. It is hoped these ten examples provide some ideas for that to be achieved so that this population can access modern energy for the first time.

But what of the current traditional fuel alternatives? Understanding the risks of continuing to use traditional fuels such as charcoal, coal, wood, animal waste and kerosene are equally important to drive the transition.

6.0

Traditional fuels

Traditional fuels such as charcoal, coal, wood, animal waste, rice husks and kerosene are the only fuel option available for billions of people.

These traditional fuels are challenging to collect, and they need a dry area to store them. Kerosene is dangerous to have around the home. All produce unhealthy air pollution emissions in households.

A feature of developing countries, where populations have low disposable incomes, is the availability of fast moving consumer goods being offered for sale in small affordable quantities. The challenge for the LPG industry is to make the product available in a similar manner.

In this original report an example was given of an initiative in Kenya where a company called Pimagas dispensed LPG in small quantities. Quantities that could be sold for the same price as a bag of charcoal or a small pile of wood.

Instead of selling a full cylinder, small amounts (100 grams) of LPG was dispensed through a vending machine. Although imaginative, and potentially game changing, this idea created safety challenges with respect to cylinder maintenance.

The cylinder cycled between the home and the vending machine without any inspection or maintenance which was unacceptable. In the few years since that initiative was piloted other organisations have developed technology using the IoT to achieve the same effect. A smart valve on the cylinder allows the consumer to buy small quantities of LPG using a smart phone and internet banking. This is discussed in Section 8.6.

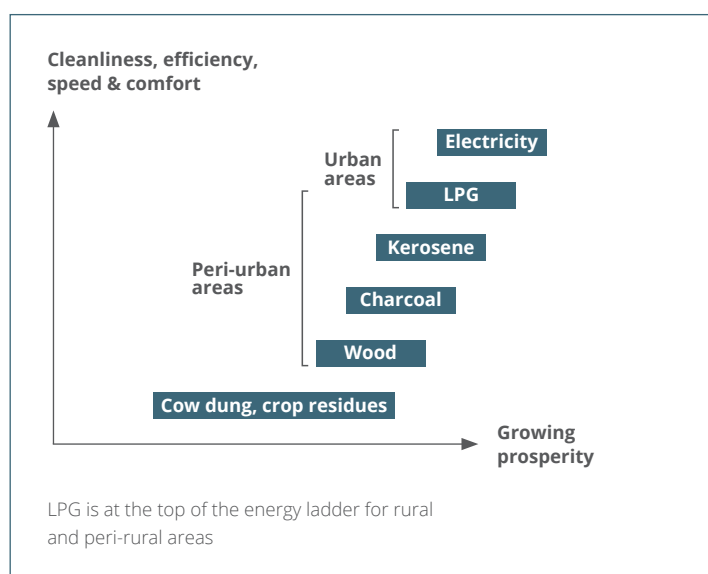
6.1 CROP RESIDUES, ANIMAL WASTE ETC...

For so many of the world's population the only primary energy available is waste material from crops and animals. These products are at the very bottom of the energy ladder.

The energy value of these products is not easy to measure because they vary so much in content. But one thing they have in common is when they are wet they are very difficult to ignite and burn.

In countries where rainfall can be intense during certain times of the year this is a major inconvenience.

This also applies to wood, charcoal, coal and animal waste.



The use of animal waste is often the only form of energy available



This woman spends hours collecting wood for cooking her family's meals

6.2 WOOD

The most common traditional fuel is wood. Even in the developed world wood is a popular form of heating. However, the use of wood in the developed world is frequently a secondary form of heat and used as much for aesthetic reasons as primary heating. It would rarely be used to cook unless it was used in a recreational barbeque.

For many people wood is the only realistic form of energy available for both cooking and heating with alternatives being other traditional, equally dirty, fuels.

The collecting of wood is often the task for the women in the household. It is a time consuming and often dangerous occupation as the source of the wood is commonly a long way from the home, in remote locations where personal attack is a risk.

The wood that is collected is from small trees, trees that have had no chance to grow to maturity. Wood taken from large trees is both very difficult to collect, carry and burn. The risk of deforestation is therefore greater because the trees have been cut at the early stage of their life. Sometimes these trees are endangered species.

Wood is difficult to burn when wet, creating challenges during the wet seasons. It also must be stored and kept dry.

The task of collecting wood often takes hours and once back at the home the women must light the fire and prepare the meal. The burning of wood is a dirty business, especially when wet. Apart from the smoke it generates the food is contaminated with ash (particulate matter).



Children collecting charcoal from a roadside stall in Africa

Wood smoke causes respiratory illnesses and for many leads to an early death. It is estimated household air pollution from the use of solid cookstove fuels (coal and biomass) causes more deaths than malaria, typhoid and polio combined.

Burning wood also creates social problems. When the mother is away collecting wood, her young children often must be looked after by the grandparents.

6.3 CHARCOAL AND COAL

Charcoal and coal are also dirty to handle, and coal often contains contaminants that make its emissions even healthier than biomass.

The distribution channel for charcoal is often through road side stalls. It is frequently the task for small children to collect the daily amount of charcoal needed to cook for the family.

This is often done using plastic bags which re-filled and weighed by the stall holder. Children are at risk because they are carrying money.

Coal is also sold in the form of briquettes. These will have holes through them to facilitate burning. Coal briquettes are burnt in specially designed cooking stoves often made from clay.

6.4 KEROSENE

Kerosene in many countries is manufactured as an aviation jet fuel for commercial aircraft (Jet A1) as well as being sold as a residential fuel (residential paraffin). Refineries may often produce just one grade of kerosene

to meet both applications and call it DPK (or dual-purpose kerosene).

With aviation travel growing strongly around the world, and thousands of aircraft in the air all the time, the demand for aviation kerosene is growing.

However, despite this, many countries subsidise the use of kerosene in the residential sector to encourage users of traditional fuels to climb the energy ladder.

The idea of manufacturing a fuel designed for modern day jet engine aircraft, and at the same time sell that same product into the residential market for use in kerosene stoves in kitchens at a subsidised price, is almost absurd.

But what it does demonstrate is that kerosene is an extremely inflammable product. Witness the strict controls on airfields warning about ignition sources during plane refuelling operations. These warnings are of course nowhere to be seen in the rural residential kitchens.

Kerosene is therefore a dangerous fuel to have around the home because of the risks of spillage and fire.

Also, for many people kerosene is often purchased in small quantities using discarded soft drink bottles. The contents are then sometimes mistakenly drunk by small children.

There is also growing recognition that the emissions from burning kerosene in simple lamps and stoves causes ill-health in much the same way as biomass smoke.



Kerosene being sold to children in soft drink bottles

7.0

General observations

Each of the ten countries have had to tackle the challenges of switching from traditional fuels and kerosene to LPG.

Any country embarking on a successful switching programme will need a 'Champion', a clear and simple proposition and the need to adhere to good safety and business practices.

7.1 DRIVERS FOR CHANGE

In each of the ten country cases studies there were drivers for change.

In Indonesia it was the government, supported by the state oil and gas company - Pertamina - that took on the massive task of switching 58m kerosene users to LPG.

In Sri Lanka it was a private company working with the tea plantation industry to drive the change from wood to LPG across the tea plantations.

In Turkey it was the private sector working with the regulatory authority to initiate change.

It matters not who it is. There must be a driver who is persistent, and committed, and is prepared to work resolutely to make the change happen.

7.2 PROPOSITION

The cost of the initial package (LPG cylinder, regulator, hose and stove) is beyond reach for so many people. And then there is the ongoing cost of the refills when the cylinder is empty, and the need for regular maintenance of the assets.

Various schemes have been used to lower these barriers. Subsidies, grants, giveaways, micro finance, incentives. They have all been tried to a greater or lesser extent in a variety of different ways.

The initial entry barrier was removed entirely in Indonesian during the kerosene to LPG conversion programme by giving the complete package (3kg cylinder, regulator, hose and stove) away free of charge. And then following up with a subsidy on the LPG in the 3kg cylinder through a government replacement programme.



Piles of wood alongside the road in Timor Leste

The cost of this was more than outweighed by the elimination of the kerosene subsidy that was being abused in the distribution channel through adulteration and costing the government billions of dollars.

The on-going challenge of consumers having to find money to pay to refill the LPG cylinder has been tackled in several countries in various ways.

By providing subsidies (Brazil), embarking on micro finance schemes (Sri Lanka) or developing schemes to sell smaller quantities of LPG (Kenya).

The main challenge with subsidising the LPG is that it is very difficult to target the subsidy effectively.

If countries subsidise only a single cylinder size, or one market segment, it is difficult to stop that subsidised product from entering other segments illicitly.



Composite LPG cylinders allow the contents to be seen through the wall of the pressure vessel but they are more expensive than steel



Although this consumer has successfully switched to LPG, the kerosene stove (top right-hand corner) still remains in the kitchen

A stack of logs, or a bag of charcoal, or a bunch of sticks, or a bucket of rice husks or a pile of animal waste - are all very visible forms of energy.

For all its advantages LPG is a product you cannot pick up and store in the same way as a pile of wood. The consumer cannot see the stock of fuel diminish.

One of the inherent challenges of the LPG industry is for the consumer to know how much product remains in the cylinder. Technology is starting to deal with this through innovative material in which LPG cylinders are manufactured that allow the contents to be seen. These composite cylinders tend to be more expensive than steel, adding to the entry cost barrier for LPG.

Consumers new to LPG are dealing with a very different form of energy, contained and concealed in a vessel, and one that requires thorough education and understanding. Not just at the consumer level but throughout the supply distribution chain

Switching from wood to coal, or animal waste to charcoal, does not require a deep understanding of the properties and characteristics of the respective traditional fuels. It is all reasonably self-explanatory

If this is not done effectively confidence in this new clean energy will be lost.

In this Indonesian kitchen, where the consumer has been introduced to LPG, the old kerosene stove remains in the corner, even though the new LPG cookstove and 3kg cylinder take centre stage.

Often, there is still a lack of confidence to throw out traditional stoves and hence people use either the LPG or the traditional stoves, depending on the task. This phenomenon is known as “fuel stacking”.

Full confidence in the new LPG package must still be earned.

7.3 SAFETY AND GOOD BUSINESS PRACTICES

Educating the consumer (and other stakeholders) – to effectively and safely present the proposition – are most important considerations.

The distribution channel also needs educating. Dealers in traditional fuels will see LPG as a threat. Managing this issue is vital to a successful transition programme as was found in Indonesia. Kerosene dealers rioted during the campaign to switch kerosene consumers to LPG.

One of the most important considerations is the safe control and maintenance of the LPG equipment, especially the cylinder and valve.

The cylinder is one of the most important assets in the LPG industry and companies investing in cylinders want to make sure their asset is not only protected but also well maintained. This ensure the safety of the business and encourages future investment. After all what company is going to invest in a market where illegal filling is rife and cylinder assets are abused?

Each of the ten countries had a similar but a different story to tell. They have all been given a short descriptor to illustrate the key message.

8.0

Country reviews

WHO?	WHAT?	WHY?
 Brazil	'...THE BIG SWITCH...'	Enormous transition programme over two decades that resulted in 95% of the population having access to LPG
 Ecuador	'...BONO SOLIDARIO...'	Subsidies encouraging illicit use of LPG in non-targeted segments skews consumption
 Ghana	'...REBOOTING...'	Restarting a campaign using lessons learned from earlier years
 India	'...DBTL...'	Smart attempt to target subsidies directly into the consumers bank account in a focused way
 Indonesia	'... BRIGHT GAS ...'	Follow up campaign to stop misuse of the subsidised 3kg cylinder
 Kenya	'...SMART VALVE...'	Potential game changer of selling LPG in small quantities at a price outlay which is similar to traditional fuels
 Peru	'...CONCINA PERU...'	Government initiative encouraging switching through subsidised LPG package with 10kg cylinder
 Senegal	'...FRAGMENTED...'	Small fragmented distribution network creates challenges on safety and efficiency of operations
 Sri Lanka	'...TEA CHANGE...'	Non-government initiative focusing on tea plantation workers
 Turkey	'...THE EDUCATOR...'	Government backed programme targeting rural communities through schools

8.1 Brazil

‘...The Big Switch...’



SUMMARY

- 207 million population
- Over 95% of the population use LPG for cooking
- Strong penetration of LPG following introduction of subsidies
- Several other key success factors attributed to growth including good business practices
- Several incentives had been removed before 2001
- Last subsidy removed in 2001, prices doubled, demand fell off
- Consumption since returned to pre-2001 levels
- Wood and charcoal still feature in residential energy mix (25% of households)



COUNTRY BACKGROUND

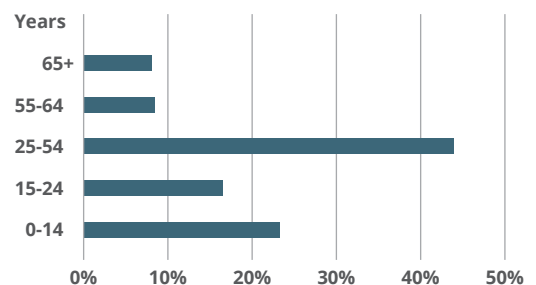
Brazil is the fifth most populated country in the world. More than half of the 207 m population is considered middleclass but poverty and income inequality levels remain high.

Well-funded public pensions have nearly wiped out poverty among the elderly, and ‘Bolsa Família’ and other social programmes have lifted tens of millions out of poverty.

Brazil is the eighth-largest economy in the world but is recovering from a recession in 2015 and 2016 that ranks as the worst in the country's history. Brazil's economy is characterised by large and well-developed agricultural, mining, manufacturing, and service sectors, and a rapidly expanding middle class. The economy outweighs that of all other South American countries, and the country is expanding its presence in world markets.

After strong growth in 2007 and 2008, the onset of the global financial crisis hit Brazil in 2008. The country experienced two quarters of recession, as global demand for Brazil's commodity-based exports dwindled and external credit dried up. However, Brazil was one of the first emerging markets to begin a recovery. In 2010, consumer and investor confidence revived, and GDP growth reached 7.5%, the highest growth rate in the past 25 years. Growth has since slowed following government measures. In 2017, Brazil's GDP grew 1%, inflation fell to historic lows of 2.9%, and the Central Bank lowered benchmark interest rates from 13.75% in 2016 to 7% in 2017. Unemployment is at historic lows. GDP – per capita was US\$15,500 in 2017, no change from 2016.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Nearly 44% of the population are between 24 and 54 years old

60% of Brazil's total installed electricity capacity is being generated from hydroelectric plants. The country produces over 2.5m bbl/day of crude oil with reserves of over 13bn bbl allowing it to become, soon, a net exporter. However, Brazil is a net importer of natural gas, importing 19bcu m in 2015.wqsa.

LPG INDUSTRY IN BRAZIL

The LPG industry started in Brazil in the late 1930s. Demand has exceeded production during the last two decades and the country has relied on imports to meet the growing

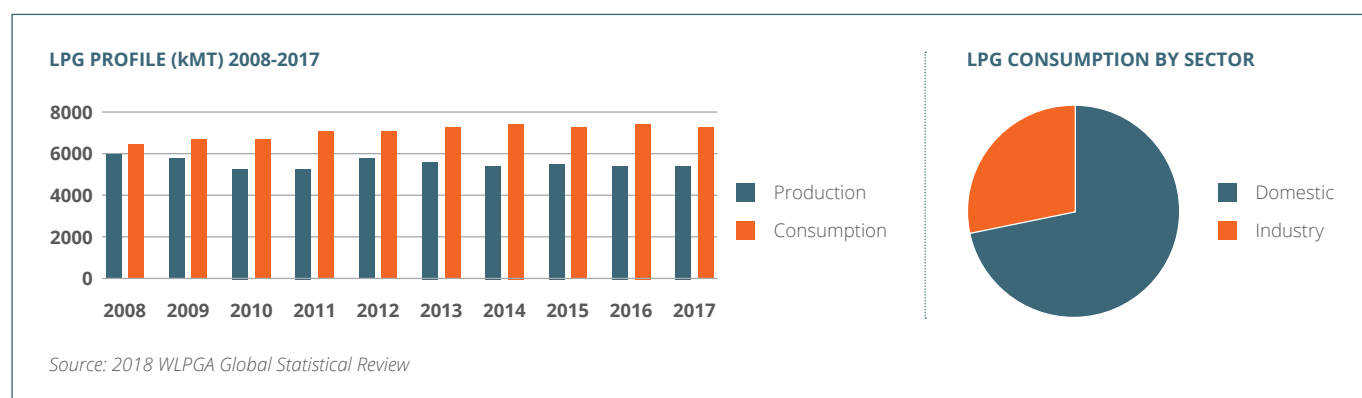
demand for LPG. Over 70% of demand for LPG in Brazil is in the residential sector.

The national oil company Petrobras was established in 1953 and started to produce LPG in 1955. Several new distributors joined the market in the 1950's and the 13kg cylinder became standard.

The latest published statistics from the WLPGA indicates that in 2017, 5.45mMT was produced locally with the balance being imported.

LPG demand grew steadily until 2001 when subsidies were removed, then demand fell away. It has since recovered and has remained above 7mMT/year since 2011.

Most of LPG demand in Brazil is concentrated in the residential sector. There is no Autogas because of government policy and the remainder of demand comes from the industrial sector.



‘...The Big Switch...’

Up until the 1960's much of the population relied on traditional fuels. The large migration from solid fuels and kerosene to LPG didn't occur until the 1960's and towards the end of the 1970's. In those 20 years around 95% of the population switched to LPG.

The main reasons for this were:

- Urban migration
- Increasing wealth of the population
- Government subsidies on the price of LPG making it affordable
- Efficient and well managed distributing companies with good logistics
- Good, efficient and effective regulations
- Brand concept on every aspect of the industry... a company could only fill its own branded cylinders
- Customer was free to choose the brand of choice and the cylinders had to be swapped by the LPG distributing companies
- LPG distributing companies sold the empty cylinders to the consumer on 'instalments' which made the cylinder affordable by reducing the initial cost



Up until 2001 LPG was subsidised in Brazil by other petroleum products, it took several years cutting different incentives and subsidy. The last subsidy was removed that year and prices practically doubled, causing a shift to alternative fuels.

Investment in natural gas distribution, especially following the recent growth in imported product from Bolivia, is creating competition for LPG.

According to some commentators the LPG industry in Brazil provides more than 350,000 jobs in over 15,000 companies.

Today a significant amount of the population still has a dual cooking system. An LPG stove indoors and a wood burning stove at the back of the house. This is especially popular in rural areas.

In the hot and less developed north-northeast of Brazil LPG is used mainly for cooking while in the southern part of the country it is also used for water heating and industries. In poorer areas, where purchasing power is lower, when subsidies are decreased, families switch from LPG to firewood.

In 2008 the Brazilian government considered a series of programmes to increase the access of LPG among the country's lower income groups. The proposals, which included possible tax cuts and the creation of a voucher system for low income groups, were considered but not implemented.

LPG is used as cooking gas in nearly 95% of Brazilian households. The penetration of LPG is so effective in Brazil that the populations of neighbouring countries, living close to the Brazilian borders, often source their LPG needs across the border. But many low income Brazilian households are forced to use firewood to reduce expenditure.

One of the problems with firewood is that when it rains it becomes difficult to light. LPG sales increase during periods of flooding.

LPG is a proven energy in times of natural disaster and when landslides, caused by flooding, damaged the natural gas pipeline from Bolivia, many industries turned to LPG in order to make up the shortfall in natural gas supply.

Despite the versatility and reliability of LPG, charcoal and wood still have a strong position in Brazil's energy mix. The barbecue is very important. However, 95% of barbecues use charcoal because users prefer the 'taste'.

According to one company, '...the barbeque is like soccer, it is a part of life...' and '...there is a cultural barrier with charcoal and LPG...' The company says '...we have been selling LPG barbecue stoves and we try to change the perception on what is best. We have been doing this for the past ten years...'

According to one Brazilian Institute approximately 25% of the household energy matrix still includes wood and charcoal in their energy mix. Today the per capita consumption of LPG in Brazil is around 20kg/year.

The last household survey available by the Institute of Geography and Statistics of Brazil in 2002 stated that over 95% of all households in Brazil use LPG.

8.2 Ecuador

‘...Bono Solidario...’*



SUMMARY

- 16 million + population
- Extensive use of wood and coal as a cooking fuel in 1950's
- Switch to gasoline and kerosene
- Promotion of LPG through subsidies since late 1980's
- 15kg cylinder of LPG costs just us\$1.60
- Subsidy costing US\$700m/yr
- Per capita consumption of LPG in Ecuador appears very high compared to GDP/Capita
- Suspected illicit use of LPG in other sectors and cross border smuggling
- Plans to withdraw subsidies and promote electric cookstoves
- No sign of any impact yet on LPG demand



COUNTRY BACKGROUND

Ecuador is a small Andean country with a population of over 16 million. An estimated 2 to 3 million of Ecuador's population live abroad.

The government has increased its social spending to ameliorate poverty and the conditional cash transfer programme, which requires participants' children to attend school and have medical check-ups, has helped improve education and healthcare.

GDP per capita was US\$11,200 in 2017, a fall from US\$11,400 in 2016. Ecuador produces over 540,000 bbl/day of crude oil (with over 8bn bbl of known reserves) and 497m m³ of natural gas.

However, the country is a net importer of finished oil products.

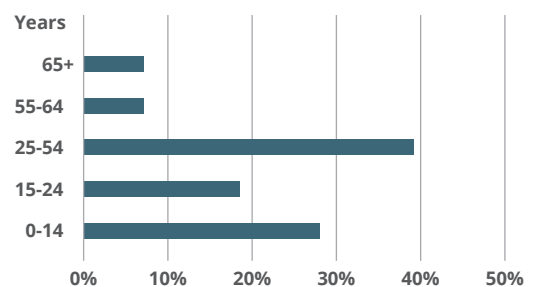
LPG INDUSTRY IN ECUADOR

The LPG industry in Ecuador has grown steadily from 2000 to 2010 but then demand flattened out and has remained steady at just over 1mMT/year since 2010.

Residential demand is reported in the official statistics to make up 95% of the total which puts LPG/capita consumption at just under 60kg/year; high for a country with a GDP/capita around US\$11,200.

With a subsidised price of only US\$1.60 for a 15kg residential cylinder, much of the country's reported residential demand is likely being illegally smuggled across the borders to

POPULATION DISTRIBUTION (%) BY AGE GROUP

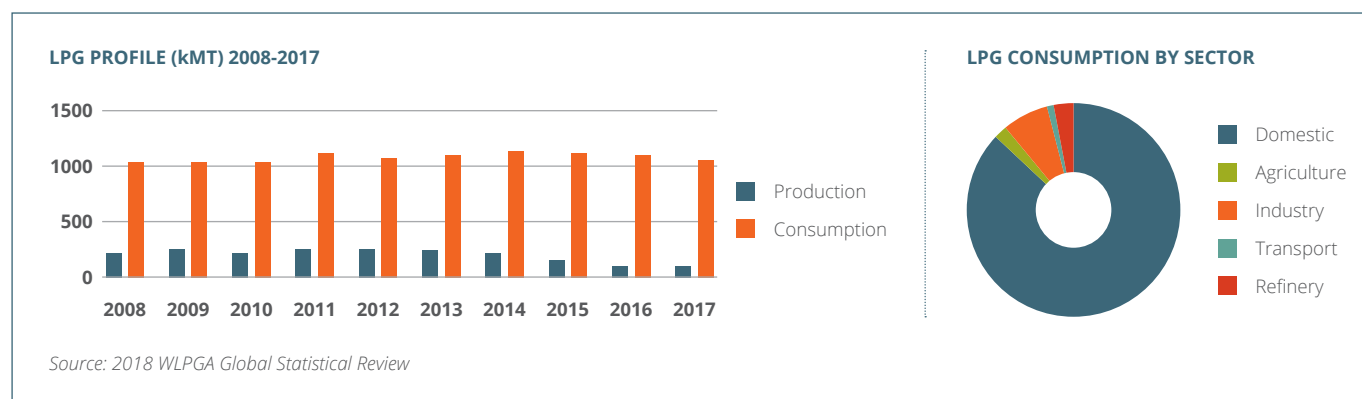


Over 45% of the population is below 24 years of age

Colombia and Peru or being used in non-residential application in the country.

There is a small demand reported for LPG in the industrial sector with transport and agriculture making up the rest.

With local LPG production generally declining since the 2012 Ecuador relies heavily on imports to meet demand. In 2017, the latest published statistics from the WLPGA indicated that 150kMT was produced from local refineries and nothing from gas processing.



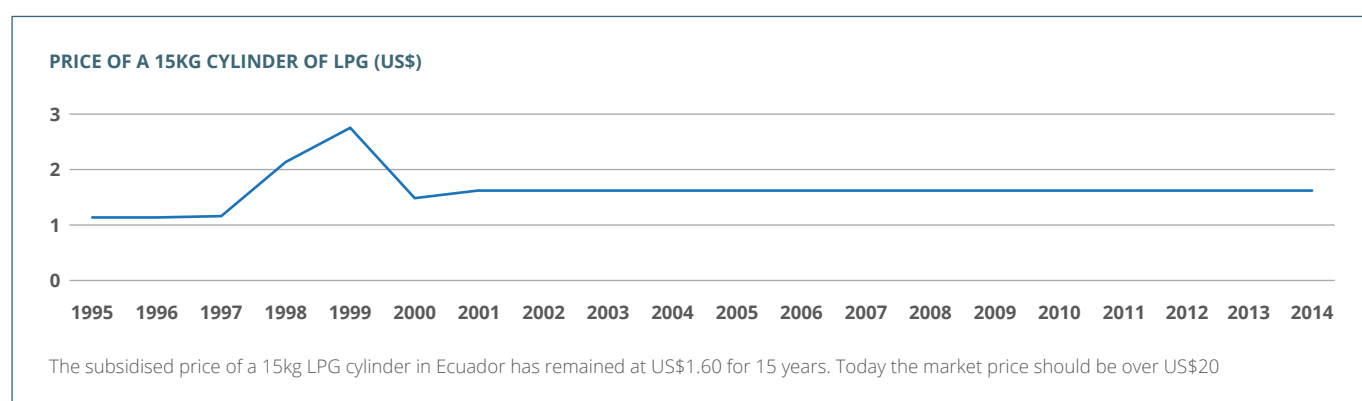
Ecuador began using LPG in the mid 1950's. At that time firewood and coal were the main cooking fuels. LPG was introduced into the market to improve the quality of life of the Ecuadorian rural population as well as reducing deforestation.

However, in the 1960's and 1970's low octane gasoline was still the most popular cooking fuel and this was leading to a number of fires in the homes, and burns, especially to children.

As a result, the government introduced policies against the use of gasoline and in the 1980's the use of kerosene was encouraged through the delivery of kerosene stoves to rural areas. There were continued health problems associated with the use of these traditional fuels and kerosene and so a further government plan was introduced, called *Bread, Roofs and Jobs*, encouraging the use of LPG through subsidies and giving 'empowerment and leadership' to the people.

LPG is heavily subsidised in Ecuador and apart from a period towards the end of the 1990's when the price more than doubled following massive inflation and a financial crisis in Ecuador, albeit from low levels, LPG demand growth has been steady.

In 2000 the government fixed the retail price of a 15kg cylinder at US\$1.60 and it has remained at that level.



The growth in the use of LPG in Ecuador remained at around 6-8%/year, since its introduction in the mid 1950's, until 2000 when growth rates fell. The sustained growth was driven more by price rather than the benefits that LPG brought to the consumer.

When LPG was first introduced the consumer was offered three sizes of cylinder; 5kg, 10kg and 15kg. The smaller cylinders were aimed at facilitating market entry but it created increased operational costs and the 15kg cylinder is now the main offering for residential consumers and 45kg for the commercial and industrial markets.

The high subsidy for the 15kg cylinder, aimed at the residential cooking sector, has also encouraged the use of LPG into other applications such as water heaters, barbeques, space heating and other applications outside the residential sector. This has led to controversy with the subsidy.

With the cost of a 15kg cylinder of LPG in Ecuador being US\$1.60, the prices for a similar cylinder in the neighbouring countries of Colombia and Peru have been over ten times higher. In 2011 in Peru a 15kg cylinder cost US\$22 and in Colombia US\$16. This encouraged the illegal movement of LPG across the borders and for a country dependent on imports it is a real challenge. Some reports suggest that up to 25% of LPG is pirated to Peru and Colombia.

The impact of this creates LPG shortages in the border areas of Ecuador because of the more attractive alternative market across the border.

This would also explain the relatively inflated per capita consumption levels reported in Ecuador.

Incidents with LPG are reported to be quite common because of poor handling.



LPG cylinders being distributed in Ecuador

‘...Bono Solidario...’*

A programme called ‘Bono Solidario’ or Solidarity Bonus - better known as ‘Bono Pobreza’ or Poverty Bonus – was created in 1998 to offset the effects of the financial crisis and improve the economic life of the poorest families in the country.

LPG is the fuel of choice for cooking by 90% of the population, with firewood and charcoal preferred by 7% (source: 2010 Census INEC [National Institute of Censuses]).

Growth has slowed since 2007 because of controls being introduced to try and stop the illegal smuggling of LPG to neighbouring countries and attempts to limit the use of LPG to cooking use.

Both are aimed at limiting the continued impact of LPG subsidies which cost the government an estimated US\$700m/year.

In 2009 Petrocomercial, the State petroleum company, launched a plan in the coastal province of Esmeraldas to sell LPG directly to end users. The aim of this initiative was to take greater control over the LPG supply and distribution channel and attempt to stop the illegal and disruptive activities that were occurring, mostly smuggling, supply problems and price speculation. In addition, this direct approach was supported by a campaign aimed at guaranteeing quality of the consumer proposition, quantity and safety.

Ecuador’s Non-renewable Natural Resources Minister, Wilson Pastor, suggested the possibility of gradually cutting LPG subsidies to middle and high-income households.

The Minister of Industry announced that the subsidy for LPG will continue until 2017, but it remains in place. It was planned to remove the subsidy and instead promote electricity as the primary cooking fuel.

Twelve local companies were to manufacture induction cookstoves to support the scheme which is also open to imported foreign made induction stoves. The induction cookstove (ICS) programme was introduced in 2014, in advance of the change in LPG subsidy. The date of changing the subsidy will depend in the end on enough ICS being in place at the time. In the meantime, however, the cost of LPG equipment is being allowed to rise via taxes, duties, etc. so that there is already a shift of incentives.



LPG cylinders being delivered



Domestic chores in Ecuador

* Solidarity Bonus

According to the Minister of Industry, an Ecuadorian household currently spends an average of US\$8/month when cooking with LPG. However other reports suggest it is nearer US\$6/month in rural areas and US\$4/month in urban areas. It is intended that the same amount that is spent on LPG be spent monthly to pay for the new induction cookstove over several years.

The announcement has caused concern amongst the LPG distributors in the country who understandably see their livelihoods threatened as the LPG price will suddenly increase and make it uncompetitive for cooking and perhaps water heating. Not just to the local market but also to their cross-border activities.

In support of this initiative to move away from LPG to electricity the Ecuadorian government has set out to change the energy matrix by investing in eight hydroelectric plants.

Special emphasis has been placed on an 'efficient cooking' campaign which proposes the use of induction cookstoves, and not LPG, to tackle the LPG subsidy burden.

The Ecuadorian government announced that it will make available three million induction cookstoves of which 500,000 will be given away to the low-income populations.

The Chinese manufactured induction cookstoves will be accompanied by an offer of subsidised electricity rates. The government will also offer, for those who purchase the induction kitchens, finance terms of up to 72 months where the cookstove can be paid off in instalments with the monthly electricity bill.

In the current plan everyone who takes up an ICS will get 80 kWh per month free electricity - not just the poor groups. Being the first time in the world such a programme has been attempted, there are likely to be many alterations as it moves forward.

The government's policy is targeted at all groups to stop the use of subsidised LPG without major political risk.

The chart above right, from an INEC-CVD Population and Housing Census in 2010, demonstrates just how much the affluent

POPULATION GROUP TYPE	COOKING	BUSINESS	VEHICLE	WATER HEATER
20% Poorest	97.7	2.3	0	0
20% Wealthiest	78.0	9.2	0.3	12.5
Total	89.0	6.1	0.5	4.4

Cooking with LPG dominates usage patterns according to census

classes benefit from subsidised LPG, not just for cooking and water heating but for business too.

The use of LPG for socioeconomic intended use is also outlined in this chart showing clearly the dependence of LPG in the family kitchen, especially the low-income groups.

If three million induction cookstoves were made available to the Ecuadorian population the impact on the country's LPG demand would be dramatic. Estimates have been made of a possible reduction of up to 90% of the current LPG demand. This would certainly solve the subsidy problem.

- The price of a cylinder of 15kg LPG has remained at US\$1.60 for twenty years. There might be a high political cost if the subsidy was removed with any elections planned
- The price of the induction cookstoves, and the cooking utensils that are needed to use with them, are significant. Even with installment payments
- Ecuadorians have been using LPG for many years and their cooking habits

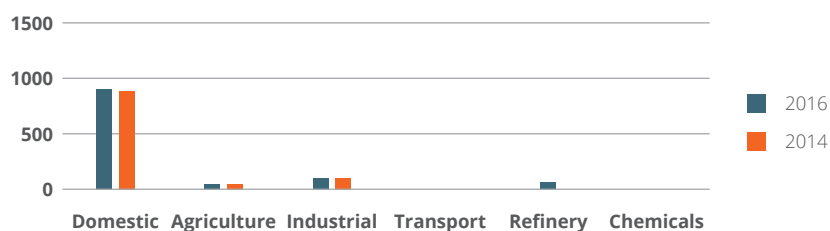
are well established. Cooking with gas is very different to cooking with electricity

- Their kitchen stoves are still in good condition and have many years life left in them '...so the householders argue "...why change?" ...'
- The fall in oil and gas prices have affected Ecuador's economy and there will be a reluctance to change (especially with the growing unemployment rate)
- Against this economic uncertainty there is a real risk of deferring the introduction of the hydroelectric plants because of lack of revenues although there has already been heavy investment so there is a motivation to complete them.

In these circumstances it is not surprising to see the government hold off introducing the induction stove programme and continue the use of LPG.

The case in Ecuador highlights the difficulties faced when an extremely attractive pricing regime has been established for a long period and a decision is taken to alleviate the financial burden of a subsidy programme.

LPG DEMAND 2014-2016 (kMT)



There appears to have been no significant change in LPG demand despite the introduction of the induction stove programme

8.3 Ghana

‘...Rebooting...’



SUMMARY

- 27+ million population
- GDP/capita US\$4,600 in 2017
- Natural resources and agriculture employs half the workforce
- Growing oil industry
- National government driven LPG promotion programme started in 1990
- Based on refinery upgrades and cross subsidies
- Limited success due to several factors including misdirected subsidies
- High dependence still on wood and charcoal in rural area
- Questionable standards undermine the LPG industry
- Only 10% of the population use LPG
- Government programme being re-booted



COUNTRY BACKGROUND

Ghana has a population of 27.5 million with nearly half being employed in the agriculture – mainly small landowners – and natural resources sectors. Ghana's economy has been strengthened over the last two decades by relatively sound management, a competitive business environment and sustained reductions in poverty levels. The services sector accounts for 50% of Gross Residential Product (GDP).

Gold and cocoa production, and individual remittances, are the major sources of foreign exchange. Oil production at Ghana's offshore Jubilee field began in late 2010. Additional oil projects are being developed and are expected to come on line in a few years. Estimated oil reserves have increased to almost 700 million barrels and Ghana's growing oil industry is expected to further boost economic growth.

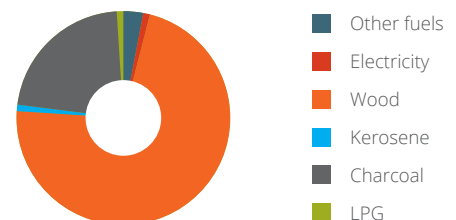
LPG INDUSTRY IN GHANA

The consumption of LPG in Ghana has grown steadily over the last decade, declined in 2013 but has since recovered. Ghana needs to import LPG to meet its demand which is mostly in the residential and industrial sectors.

LPG demand per capita has risen to over 6 kg per year driven by a government driven programme to transition the population away from traditional fuels to LPG.

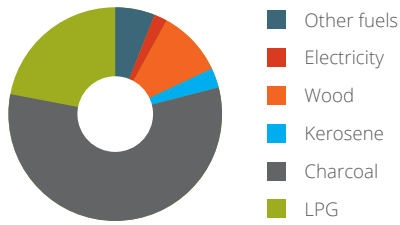
More than 85% of households in Ghana rely on traditional fuels, mainly wood and charcoal, to meet their cooking needs. In rural areas this figure is higher (see chart below taken from a recent census).

COOKING FUEL CONSUMPTION IN RURAL AREAS



Wood dominates as the primary cooking fuel in rural areas of Ghana

COOKING FUEL CONSUMPTION IN GREATER ACCRA



Charcoal is king in the capital

In addition to that, Ghana's forests are being unsustainably felled to produce these fuels and they are disappearing at a rate of approximately 2% per year.

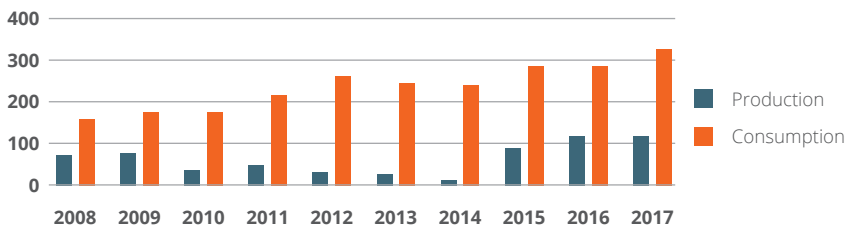
The situation in Greater Accra is slightly different (see chart left) with charcoal dominating. Between them, wood and charcoal still accounted for nearly 70% of usage for cooking.

Only around 10% of the population in Ghana uses LPG for cooking purposes, and most of these consumers are located in urban areas.

Over 50% of the population are under 24 years old and 35% under the age of 14 years.

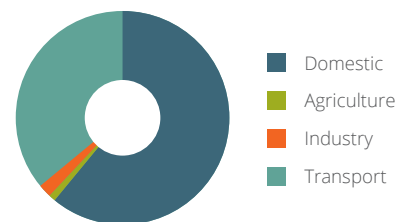
LPG is subsidised in Ghana and despite the official demand statistics by sector, many commercial vehicles have been converted to run on LPG since, with the subsidy, its ex-pump price is cheaper than that of gasoline. This is a key concern.

LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG CONSUMPTION BY SECTOR



'...Rebooting...'

In order to stimulate better living standards, the government of Ghana started a national LPG promotion programme in 1990. The LPG programme was based on expanding residential refinery production by upgrading the Tema oil refinery and applying a uniform petroleum price fund (UPPF) which fixed margins on many petroleum derived products. The government used gasoline sales to cross-subsidize LPG and provide incentives for LPG sales at distances more than 200 km from the refinery.

The success of the programme has been limited due to several reasons:

- The Ghanaian rural population is fragmented and makes a challenging target for LPG penetration
- Income levels are low and even bartering takes place within the communities
- The entry barrier for obtaining an LPG stove and cylinder is high for these communities and the need for local credit facilities, through possibly micro finance, has not been available
- The size of cylinder used was inadequate
- There was a lack of a safety culture and poor enforcement of regulations to ensure good business practices
- The strong competition from cheaper, subsidized kerosene, was another challenge

- There was inadequate state policy to stimulate LPG development and a weak LPG rural distribution network made it difficult to get the LPG to the rural communities.

Several recommendations have been suggested to examine this initiative. These were to:

- Establish a national LPG industry association
- Initiate a transparent dialogue with stakeholders and the State to discuss structure, incentives, safety and law enforcement levels
- Develop an affordable and appropriate LPG package
- Activate local micro-credit facilities
- Seek bilateral/multi-lateral funding
- Test these recommendations in the field



The Government of Ghana's energy policy initiative has since been complemented by others providing business development services. There have been some lessons learnt from this programme.

- 1 - Technology gaps** - The national LPG promotion programme is still in effect today, but unreliable LPG supply remains one of the key challenges. The Tema oil refinery has suffered from periodic shutdowns creating shortages in local LPG supply.

Once consumers are encouraged to switch from traditional fuels to LPG any lack of supply creates a loss of confidence which may encourage users to revert back to the traditional fuels they previously used.

Using LPG for the first time requires explanation and education. The physical properties and characteristics of traditional fuels are very different to that presented by LPG to consumers.

A lack of knowledge in this area can not only be unsafe but can make operating the equipment difficult. It might be possible for cooking appliances to be compatible when used with both traditional fuels and LPG stoves. This ensures an easier transition. In Ghana the rounded bottom pot is commonly used and introducing an LPG stove that does not accommodate these will be an unnecessary challenge.

- 2 - Delivery mechanisms** – it is important to avoid a gap in terms of delivery mechanisms. In the case of Ghana there appears to be a lot of small and medium sized LPG enterprises involved in the industry because the unattractive capped margins encouraged larger companies to exit the LPG market. On the other hand, the small and medium sized LPG distributors find their businesses limited in important ways.

These companies found financial challenges because there was an unwillingness on the part of the local banks to make loans for seed or growth capital. Even established LPG businesses with proven track records had trouble securing short term loans for working capital or acquiring the refinery lifting guarantees at reasonable rates.

These businesses also suffered by the supply shortages. Some were able to secure supplies by purchasing their own bulk trucks and obtaining the legal status as an Oil Marketing Company (OMC), but even then, security of supply often relied on maintaining good relationships with the people at the refinery.

- 3 - Inadequate margins** – supplying to rural areas, which are further from the main distribution facilities, creates economic challenges because the cost of reaching these consumers



increases due to the fragmented consumers. This is compounded because rural consumers generally have lower disposable incomes. Without access to micro finance, the entry barriers presented by this – for an LPG stove, hose, regulator, and cylinder - are too high for these consumers making transition too much of a challenge.

4 - Illicit use – LPG is an extremely versatile energy source enabling it to be used in hundreds of different applications. Apart from being an excellent cooking fuel it also has extremely good engine fuel properties which is why it is the number one alternative transport fuel to gasoline and diesel fuel. If LPG is being subsidised for residential fuel use there is a risk the product is used illicitly in other applications. This is particularly serious if residential cylinders are used in road vehicles because they are not designed for this application and it creates a serious safety risk. In Ghana the official LPG statistics indicate no transport use for LPG but in practice LPG is used in taxis in a significant manner creating a serious risk. The use of LPG as a fuel for taxis, when done in a proper manner, is a sensible policy for countries which are serious about

reducing harmful emissions in urban streets. However, there is no place for the illicit use of residential LPG cylinders in vehicles. The practice is very dangerous.

With an already inadequate and intermittent supply of LPG, its use in taxi cabs detracts from its potential to replace firewood and charcoal for cooking.

To compound the problem, it is virtually impossible to modify the existing policy to promote LPG for cooking over its use as an automotive fuel.

- As the same cylinders are used both for cooking and transport, it is difficult to limit LPG sales for cooking purposes only
- Many taxi owners have invested significant resources converting their vehicles to run on LPG and are benefiting greatly from the relatively cheaper price compared to gasoline (petrol). They form an important lobby who are strongly opposed to any reduction or removal of the subsidy

The Ghana LPG policy was first introduced in 1992 by the government as a source of residential cooking energy to help curb the

environmental hazards associated with fuel wood and charcoal. The then Ministry of Fuel and Energy embarked on a nationwide LPG drive by freely distributing 5kg and 14kg cylinders to households and educational, health and penitentiary institutions. Most of the cost of the LPG was absorbed by the government and an LPG fund was also established.

During this period, there was a reduction in fuel wood consumption from 80% in the early 1980's to 73% in 1996. The number of households using LPG rose from 4% in 1998 to 9.5% in 2006.

In 2010, in the most recent report available, Ghana Energy commission reported that the government was committed to increasing the use of LPG from 10% of the population, to 50%, by 2015.

There has been a general shortage of LPG supply over the years due to a subsidy that reduced price, while demand and supply facilities remained unchanged.

To increase the supply of LPG, the government of Ghana, together with Togo and Benin, signed an agreement with Nigeria to build a pipeline to transport natural gas from Nigeria through to Ghana in 2000. In that time, wood fuel and charcoal accounted for 40% and 34% respectively of primary cooking fuels as compared to LPG (18%).

With the ongoing electricity crisis, the government is under enormous pressure to provide solutions. With the appropriate regulations and adequate supply, LPG will take a lot of pressure from the overburdened national grid.

However, there are some serious concerns about business practices and standards with a recent incident leading to action from the government to close 21 LPG stations.

There have been protests about the cylinder re-circulation module, which was proposed by the National Petroleum Authority (NPA), to ensure that LPG filling points are sited out of densely populated areas and commercial centres.

8.4 India

‘...DBTL...’



SUMMARY

- 1.28 billion population
- LPG used by 63% of the population for cooking
- Subsidised LPG being misused in other applications (Autogas, commerce, industry etc.)
- ... and affluent residential consumers also benefiting directly to consumers' bank account
- Direct Subsidy Transfer of LPG (DBTL) launched in Nov 2014
- Supported by Aadhaar, a unique 12 digit identification
- Government backed plan to transfer subsidy
- 'Largest cash transfer scheme in the world' – US\$1.9bn already transferred in 2015
- Prime Minister encouraging people to 'Give it (subsidies) Up' campaign
- Initial feedback positive with over US\$600m savings in 'leaked' subsidies



COUNTRY BACKGROUND

India has a population of 1.28 billion people making it second behind China as the world's most populated country. Hindi is the most common language although English is widely spoken.

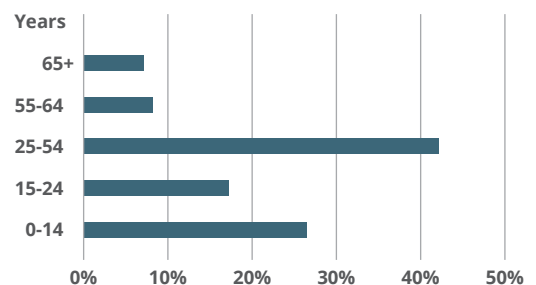
India is developing into an open-market economy. Economic liberalisation measures began in the early 1990's and helped to accelerate the country's growth, which averaged around 7% per year from 1997 to 2011.

In 2017 economic growth slipped to 6.7% from 7.1% due partly to shocks of "demonetization" in 2016 and the introduction of GST in 2017. The economy is expected to benefit from lower crude prices, and the new government is planning structural reform initiatives with a renewed emphasis on 'made in India' focusing on the residential manufacturing sector, with 62% of the population aged between 15 and 59 years old.

The outlook for India's long-term growth is moderately positive due to a young population and corresponding low dependency ratio, healthy savings and investment rates, and increasing integration into the global economy.

India's diverse economy encompasses traditional village farming, modern agriculture, handicrafts, a wide range of modern industries, and a multitude of services. Half of the work force is in agriculture, but services are the major source of economic growth, accounting for nearly two-thirds of India's output with less than one-third of its labour force.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 40% of the population is under the age of 24 years

Source: CIA

India has capitalised on its large educated English-speaking population to become a major exporter of information technology services, business outsourcing services, and software workers. India's economic growth began slowing in 2011 because of a decline in investment, caused by high interest rates, rising inflation, and investor pessimism about the then government's commitment to further economic reforms and about the global situation.

In late 2012, the Indian Government announced additional reforms and deficit reduction measures, including allowing

higher levels of foreign participation in direct investment in the economy. The outlook for India's long-term growth is moderately positive due to a young population and corresponding low dependency ratio, healthy savings and investment rates, and increasing integration into the global economy. In 2017 GDP/cap was US\$7,200.

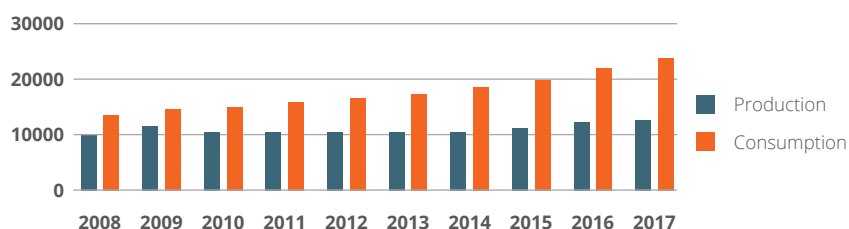
LPG INDUSTRY IN INDIA

The LPG industry in India started in 1955 by Burmah Shell in Mumbai. In those early days LPG was used exclusively for cooking. State Owned Enterprises (SOE's) [Indian Oil Ltd., Bharat Petroleum Corporation Ltd.,

and Hindustan Petroleum Corporation Ltd.] entered the market in 1965 and developed new applications for LPG in the non-residential, industry and transport sectors.

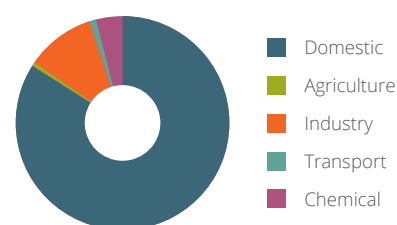
India now has one of the largest LPG markets in the world with demand in 2017 exceeding 23mMT according to the 2018 WLPGA Global Statistical Review. For a while local LPG production kept pace with demand but more recently that has fallen away and now India imports over 10mMT a year of LPG and that is forecast to continue to grow with the continued demand.

LPG PROFILE (kMT) 2008-2017

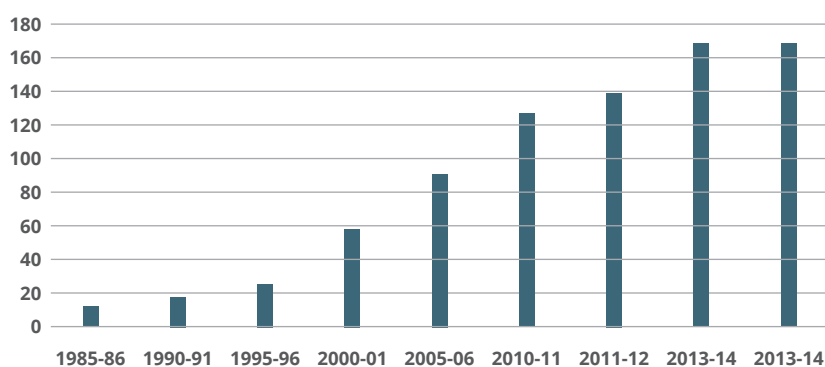


Source: 2018 WLPGA Global Statistical Review

LPG DEMAND BY SECTOR



RESIDENTIAL LPG USERS IN INDIA (MILLIONS)



There has been a rapid growth in residential LPG consumers [in millions] in India over the last 20 years
Source: IOC

Residential demand dominates the industry where subsidies have historically encouraged penetration into this sector.

This growth of LPG demand into the residential sector was driven by the use of subsidies. Private companies have

entered the market but almost entirely in the non-residential sectors. They find the presence of subsidies in the residential sector too much of a challenge.

The LPG residential sector is provided for with 5kg and 14.2kg cylinders, home

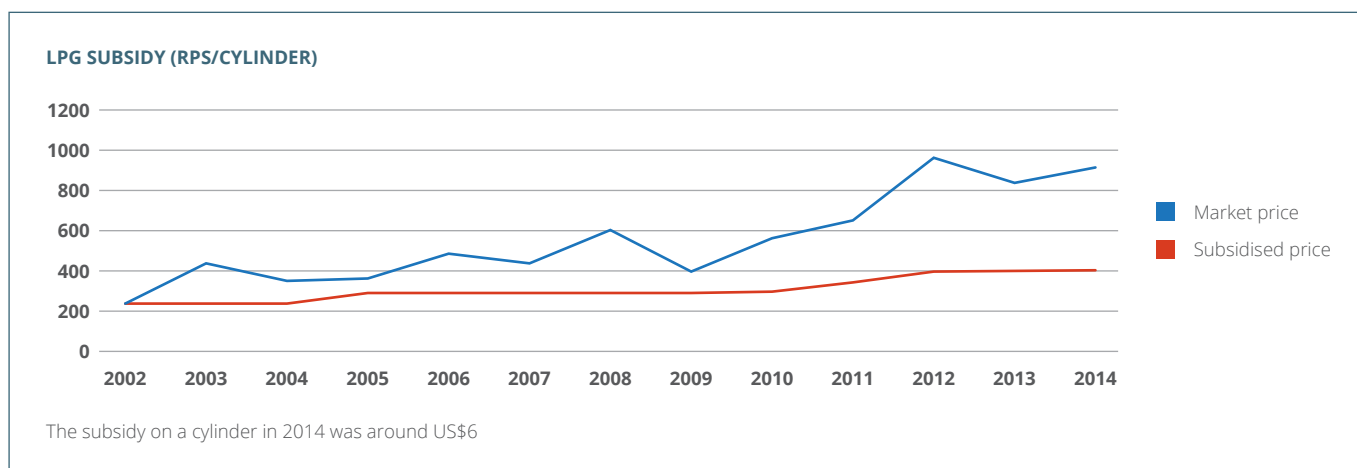
delivered through a distributor network. The non-residential sector is serviced with 5kg, 19kg, 35kg and 47.5kg cylinders, also supplied through a distributor network.

The unit cost of supporting residential LPG subsidies has risen gradually (next page) with the subsidy on the LPG fuel to the household sector in early 2014 amounted to almost half the market cost.

What compounded this for the government was the misuse of subsidies encouraged by the lack of control to the end user. This attracted the attention of the new government.

An ambitious programme was launched in 2014 to address the issue of LPG subsidies in India. The concept of having subsidies paid directly into the bank accounts of worthy recipients required careful planning and support from several stakeholders.

The programme, an outcome from a task force set up in 2011, was called Direct Benefit Transfer (DBTL).



‘...Direct Benefit Transfer (DBTL)...’

There was a large proportion of residential consumers who could not afford to buy LPG at the international market price and this led to the introduction of subsidies.

There was a large proportion of residential consumers who could not afford to buy LPG at the international market price and this led to the introduction of subsidies.

To promote LPG as an environmentally friendly fuel, the Government of India has, for several years, provided a subsidy on each LPG cylinder being sold for residential purposes, protecting consumers from both international prices and price fluctuations.

However, LPG at market price was also available for users consuming it for purposes other than residential use e.g. commerce (hotels, restaurants), industry, and the automotive sector as a transport fuel etc.

The price differential between subsidised LPG and non-subsidised LPG lures retailers and distributors - or their staff - to divert cylinders for subsidised residential use to non-residential consumers. This results in an additional subsidy burden on the Government. The cost of subsidising residential LPG was costing the government around US\$7bn in 2014.

To minimise this leakage of subsidised LPG to both residential users, who can afford the market price, and also to non-residential consumers, the Indian government needed to improve the way the subsidies were provided, so as to:

- Ensure the entitlement reached the intended consumer
- Reduce the misuse of subsidies by eliminating the diversion into other sectors
- Improve the availability of LPG for genuine customers
- Reduce the subsidy burden

A task force was established in 2011 to examine the issues and recommend a way forward. Several recommendations were made, including putting a maximum number on the subsidised cylinders going to a household and the introduction of an Aadhaar (a unique 12-digit identification number) based subsidy transfer mechanism.

It is the introduction of the Aadhaar - linked to the LPG consumer number and the bank account details of the consumer - that has led the way for the Direct Benefit Transfer (DBTL) scheme. Initially the scheme was designed to link Aadhaar of each consumer with the LPG account and bank account separately. Subsequently during 2014, this was extended to consumers who had not yet obtained their unique identity number by linking their bank account directly with their LPG account.

The DBTL controls the payment of LPG subsidies through an ambitious plan to target the subsidy directly to the, worthy,



residential user by transferring the funds directly into their bank account removing the possibility of subsidy misuse.

To enrol into the scheme the LPG consumer must first obtain their Aadhaar number, and then link it to their bank account and their LPG customer account. For those consumers who do not have an Aadhaar number it is possible to link their 17-digit LPG customer number with their bank account number.

Under the DBTL scheme, a permanent financial advance, enabling the customer to pay the full market price for the LPG, is transferred to the customer's bank account immediately after joining the scheme. This effectively overcomes the entry barrier of using LPG for the first time.

This is then done after every subsequent delivery of a cylinder.

The scheme is new and is being heralded as the largest cash transfer scheme in the world.

It was launched in November 2014, initially in 54 districts of India, and the rest of the country followed from the beginning of 2015. There was a 'grace and parking' period to allow consumers to join the scheme.

One of the key challenges was to publicise and communicate the scheme to the target group. A variety of methods were used including the use of posters and banners at prominent locations, advertisements on TV, radio and newspapers, the launch of a dedicated web site (www.MyLPG.in), targeted SMS messages, and even using a microphone

on a motor cycle through markets and distributing pamphlets at service stations.

Other methods included the use of vans and trucks. A call centre with over 300 staff was established to answer any queries of consumers who were joining the scheme. In addition, a consumer grievance unit was established to deal quickly with any complaints.

To implement the scheme more effectively, a number of stakeholders were involved. A reseller network of around 15,000 LPG distributorships, more than 100,000 branches of 400 different banks, officials of the Unique Identification Authority (UIA), district administration and oil and gas company officials, worked round the clock for collecting & validating the UIN/Bank

details of every consumer. These details were then updated in an LPG database for making the customer cash transfer compliant.

Some of the key challenges faced in implementing the scheme included:

- Poor connectivity at distant and remote town
- Low literacy rates in rural areas
- Non-availability of UIN or bank accounts with LPG consumers

To address these challenges a series of communication programmes were launched to explain the benefits to at district meetings.

The assessment to date of the DBTL scheme, from both within India and external observers, has been positive:

- The self-selection process of DBTL discouraged some LPG consumers from joining the scheme (These consumers probably included consumers who previously were taking advantage of a subsidy they didn't really need and to continue might have led to some embarrassment)
- The need for Aadhaar and bank account information has resulted in very targeted consumers resulting in the 'weeding out' of previous duplicity fraud
- There have been some serious savings in subsidy payments through the reduction of subsidised product being diverted to other uses
- The waiting time for LPG deliveries has been reduced
- Inactive bank accounts have been activated
- A Rp568 (US\$9) float was made available to users following the permanent advance
- There is a potential for other schemes to be introduced onto the back of the DBTL model

Communicating the DBTL initiative to so many people was one of the key success factors and this was achieved through a variety of means at local level.

This local communication was supported by mass media through newspaper articles which brought also spread the word.



The Indian government is expecting to save Rps40bn (US\$625m) annually in subsidy 'leakage' following the successful implementation of the scheme.

There are currently 213 million LPG customers enrolled under the scheme which is around 90.7% of the entire LPG Customer Population (as at 2018).

More than USD 10 billion worth of LPG subsidy has been transferred to bank accounts of LPG customers under the scheme.

Failure rate is less than 0.4 % which is mainly due to customer closing/shifting their bank account.

The Indian programme is evolving. The heavy media campaign, with the personal support from the Prime Minister, has resulted in many consumers voluntarily giving up their LPG subsidies. The government goal is to convince 10 million to do so. Each consumer who gives up the subsidy is linked to a new below poverty line consumer taking it up.

8.5 Indonesia '...Bright Gas...'



SUMMARY

- 260m population
- Widespread country consisting of 17,000 islands suits LPG's portability
- Kerosene subsidy driven out by ambitious LPG conversion programme
- One of the world's largest residential energy transition programmes
- Indonesia has gone from a net LPG exporter to one of Asia's largest LPG importers in 10 years
- Thousands of jobs created, new infrastructure built, massive environmental improvement
- However over 90% of LPG sold today is in 3kg cylinders - below cost
- The conversion programme has become a victim of its own success
- Non subsidised 5.5kg cylinder being introduced to attract 3kg users
- Campaign based on improved proposition (higher C3 content, smarter cylinder, home delivery)
- Supported by an 'embarrassment' campaign discouraging affluent users away from 3kg cylinder



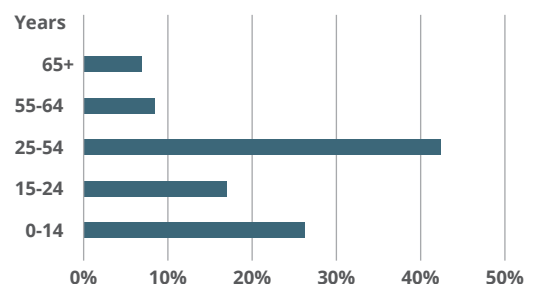
COUNTRY BACKGROUND

Indonesia has a population of 260m people. It is the world's fifth most populous country. Gross Domestic Product (GDP) per capita is US\$12,400 (2017) and the country has an economic growth rate of 5% (2017 estimate).

GDP in 2017 was spread mainly across agriculture (13.9%), industry (40.3%), and services (45.9%). Within agriculture the main activities were rubber, palm oil, poultry, beef, forest products, shrimp, cocoa, coffee, medicinal herbs, essential oil, fish, and spices. Industry activities included petroleum and natural gas, textiles, automotive, electrical appliances, apparel, footwear, mining, cement, medical instruments and appliances, handicrafts, chemical fertilisers, plywood, rubber, processed food, jewellery, and tourism. Indonesia is rich in crude oil and natural gas with crude production in 2016 over 830,000 bbl/day. Natural gas production was around 72.8 billion cu m.

Indonesia, a vast nation of over 17,000 islands, has grown strongly since 2010. During the global financial crisis, Indonesia outperformed its regional neighbours and joined China and India as the only G20 members posting growth. The government has promoted fiscally conservative policies but still struggles with poverty and unemployment, inadequate infrastructure, a complex regulatory environment, and unequal resource distribution among regions. The government also faces the challenges of reducing fuel subsidies.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 40% of the population are under 24 years of age

LPG INDUSTRY IN INDONESIA

Indonesia provides a good example of how governments, by being a Champion, can proactively drive switching to LPG and the benefits that can accrue.

In 2007 Indonesia embarked upon what was to be one of the most ambitious transition programmes from traditional fuels to LPG that has ever been undertaken. The announcement by the government to convert 50 million users of kerosene, primarily used as a cooking fuel, to LPG within five years was greeted with scepticism by many.

All citizens meeting the programme requirements had the right to receive the

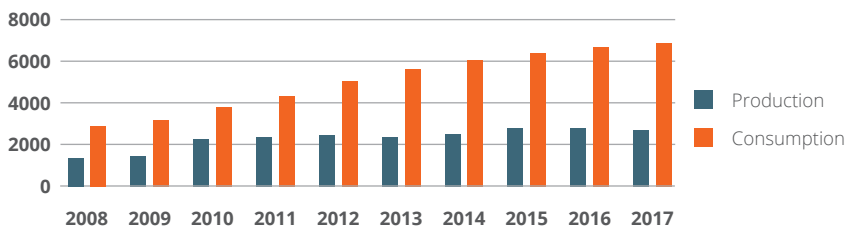
free 'initial package', consisting of a 3 kg LPG cylinder, a first gas-fill, and a one-burner stove, hose and regulator. The programme proved highly successful.

The state oil and gas company Pertamina were tasked with implementing the programme and have silenced their critics by meeting the targets. Almost the whole country (>98%) has been covered by the programme which has now been extended with Pertamina now embarking on completing the task by reaching out even to those most remote areas of Indonesia. The new target was increased to around 58 million households, or around 250 million users and this has been met.



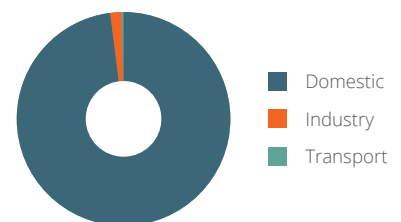
The 3kg LPG package provided free to kerosene users

LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG DEMAND BY SECTOR



Prior to Indonesia's kerosene to LPG programme, kerosene was subsidised, with the subsidies accounting for 9%-18% of total state expenditures. The country was also able to export LPG that was surplus to requirements. Once the campaign got under way the country started to import LPG (from 2011).

The key driver for this ambitious kerosene to LPG conversion programme was the removal of the kerosene subsidy. The elimination of

these subsidies was very important, not only because of the burden on public finances, but also because kerosene was being illicitly diverted to other areas of the economy and smuggled out of the country.

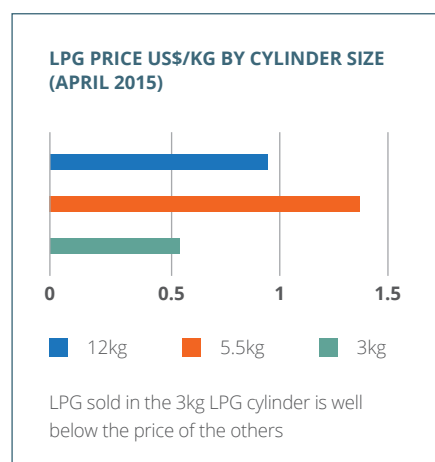
The temptation to channel this low-cost product into other main fuels, especially diesel, was too great for many in the distribution channel. The subsidy was being abused, was not benefiting the consumer

and it encouraged a dirty, dangerous cooking fuel to exist in the kitchen.

The conversion scheme (*ref: Kerosene to LP Gas Conversion Programme in Indonesia - A Case Study of Residential Energy, WLPGA*) involved government giving away a free starter package which included a 3kg cylinder, hose, regulator and stove to each of the target users.

‘...Bright Cook...’

The programme targeted households and micro-businesses. In July 2012, Pertamina, the state-owned oil and gas corporation, reported that it had distributed 54 million packages and saved Rp. 61.6 trillion (US\$6.5 billion) in fuel subsidies since the start of the conversion programme. By 2015 the target had been adjusted and over 58 million of these packages had been distributed. The LPG in the 3kg cylinder is also subsidised (but not to the same extent as the kerosene was). LPG is also available in Indonesia in larger cylinders, but these don't receive the subsidy.



Safety concerns have been raised due to individuals siphoning off LPG from the small, cheaper, cylinders to transfer it to larger cylinders. This practice has been largely blamed for some of the LPG cylinder incidents in Indonesia which led to several deaths and injuries in the early stages of the kerosene-to-LPG conversion campaign.

The prices of gasoline, diesel, kerosene (for households and small businesses), and LPG are controlled and subsidised. LPG sold in 3-kg cylinders is heavily subsidised at Rp 5,500 (\$0.38)/kg. LPG in 6-kg and 12-kg cylinders is sold at different (higher) rates depending on the market conditions.

Apart from displacing kerosene, and all its inherent dangers with clean burning LPG, the programme had several other side benefits:

- A new LPG equipment manufacturing sector (cylinders, valves etc.) emerged creating thousands of jobs
- Thousands of trees were saved because of the lower CO₂ emissions
- To cope with the sudden increase in demand a new storage and handling distribution model was created in Indonesia

The traditional 12kg LPG cylinders are supplied to the market at a non-subsidised price (US\$0.95/kg in April 2015). However, to sustain the 3kg programme the LPG supplied to this sector is subsidised (US\$0.52/kg in April 2015) and this has led to the package dominating the business.

It is estimated that over 90% of all LPG sold in Indonesia is in the 3kg cylinders. The programme has been a victim of its own success because many, more affluent, users have switched away from the more expensive larger cylinders to use the subsidised product.

It is also clear today that some of the 3kg cylinders are being used in applications other than in residential kitchens and small



3kg LPG cylinder which has become too popular because of its subsidised price

medium sized enterprises (SME's), defeating the original objective and creating an unnecessary financial burden on Pertamina and the Indonesian government.

To combat this abuse, Pertamina has embarked on a programme of trying to move users of the 3kg cylinder to a new proposition. 'Bright Gas' is the ideas being introduced to achieve this.

The new proposition is based on:

- A larger (5.5kg cylinder) more attractive package
- The same cylinder valve (to enable easy switching)
- A higher propane content to provide a 'stronger' flame
- A home delivery service
- A market related, non-subsidized, price (US\$1.35/kg in April 2015)

In addition, to discourage users of the 3kg cylinder – who can afford to pay the market rate – to abandon it in favour of the new 5.5kg cylinder, the 3kg cylinder will carry a label which says 'Hanya Untuk Masyarakat Miskin' (fuel for the poor people).

The 5.5kg cylinder is being priced to generate a positive margin and trials are underway to test the market using an above the line campaign.

8.6 Kenya

‘...Smart Valve...’



SUMMARY

- 47.6 million population
- LPG industry grew strongly until 2009, then collapsed
- Most of the population are dependent on traditional fuels
- The LPG industry has many challenges with cross filling of competitor cylinders prevalent
- The concept of dispensing small quantities of LPG dismantled the entry barriers
- Micro filling was flawed but the IoT is solving that
- Smart valve technology brings metering onto a cylinder
- The initiative also helps stop illegal filling



COUNTRY BACKGROUND

Kenya has a population of nearly 48 million with over 40% under the age of 14 years and unemployment is high at 40%. Kenya's has the largest economy in East Africa but that is now under threat. Low prices of primary goods that Kenya relies on has hampered economic growth. Recent acts of terrorism in Kenya and the surrounding region threatens Kenya's important tourism industry. GDP per capita was reported as being US\$3,500 in 2017, an increase on the previous year. Agriculture remains an important part of the economy with tea, coffee and wheat amongst some of the important products. Small scale consumer goods, horticulture, oil refining, aluminium and cement make up some of the other industries. Services are also important.

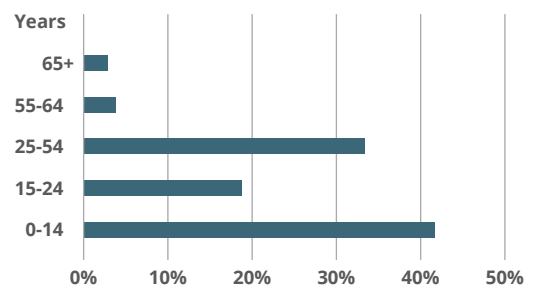
LPG INDUSTRY IN KENYA

The LPG industry in Kenya grew to almost 90kMT/year in 2009 and since then has grown to around 200kMT in 2017. Most of the demand is in the residential sector although the industrial sector features strongly.

The LPG industry in Kenya is very fragmented and despite the good intentions of the larger, established LPG marketers and government, illegal practices are widespread across much of the industry. Many of these bad practices are carried out by smaller LPG operators and the impact is damaging to the potential growth of the industry.

It is the declared intention of the Kenyan government to encourage the use of LPG as a measure to counter deforestation, and to this end the government has laid

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 40% of the population is under 14 years old

Source: XXX



out several policy initiatives that it hopes will reduce the price of LPG for consumers. One was to standardise LPG cylinders, valves and regulators, which it was hoped, would allow consumers to choose their LPG supplier based on cost alone.

Standardising the valve on the residential LPG cylinders in 2009 – in an attempt to make LPG more accessible to the community – has not helped to control illegal filling because different valves made illegal filling more difficult for the companies that were practising that.

The impact of these illegal practices on potential investors to the Kenyan LPG industry is naturally negative. No company is prepared to invest in a business where their assets are being used by others. One international

company reported in 2018 that ‘...80% of our cylinders are being refilled by others...’.

A more recent initiative by the government is to invest in infrastructure by managing major import terminal projects in Mombasa and Nairobi to reduce the cost of imported LPG.

The use of charcoal and wood is widespread in the country and the lack of disposable income makes the penetration of LPG into the residential energy sector very challenging. A typical fuel purchase of 50 Kenyan shillings (US\$0.50) would buy a plastic bag of charcoal, a bundle of wood or a half-filled drinks bottle of kerosene.

With the cost of a residential cylinder of gas, together with a traditional LPG stove, being

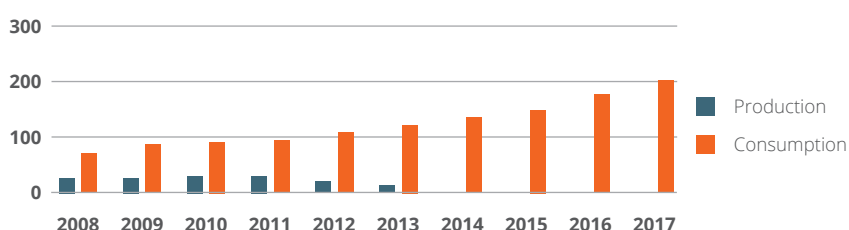
out of reach from most of the population a private company took the initiative and ran a trial based on selling very small quantities of LPG using a vending machine.

The result was the opportunity to sell a very small quantity of LPG for the same amount that a bag of charcoal would cost.

There are some serious safety issues involved with the concept and these have still not been resolved.

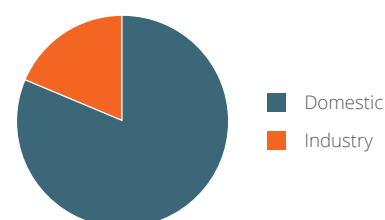
Since the first edition of this publication there has been further development from two companies in the challenge to market small quantities of LPG using the Internet of Things (IoT).

LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG CONSUMPTION BY SECTOR



‘...Smart Valve...’

The initiative followed extensive research and development over a period lasting more than 24 months. The research centred on the access to and utilisation of clean modern energy services amongst low income households in Kenya focusing specifically on LPG.

Charcoal for example is currently bought by the consumer in small tins or plastic bags. Typically, the cost of a tin of charcoal shown in the photo opposite would be 50 Kenyan shillings.

The new model is based on a full LPG cylinder, complete with ‘smart valve’ regulator and stove, being given ‘on consignment’ to a consumer in return for a deposit (around US\$30). The consumer accesses small quantities of LPG by using a smart phone linked to their bank account. In this was the amount of money spent on fuel is no more than that spent on charcoal or kerosene.

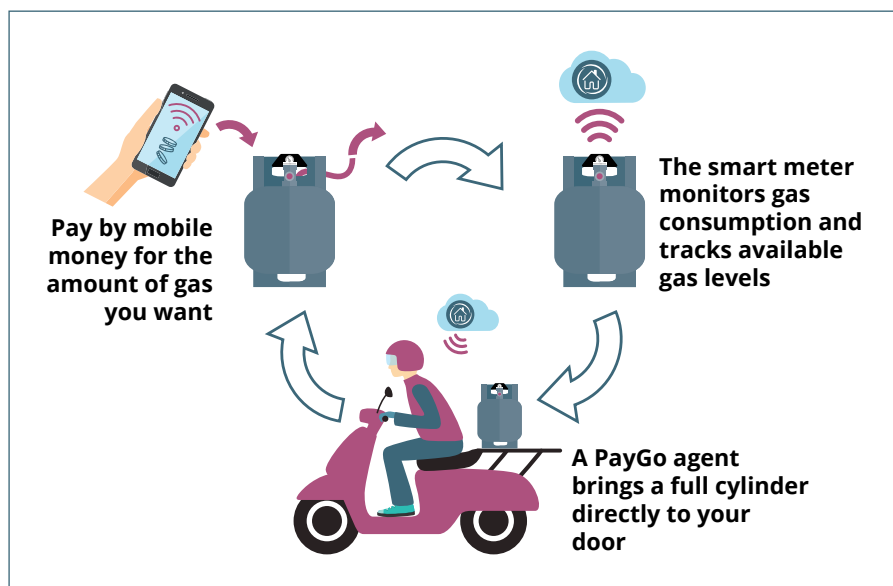
The LPG supplier will come and replace the cylinder for a full one when it is nearly empty. They know when to do this through the purchasing history. The consumer does not have to worry about running out of gas and therefore is not tempted or required to seek out an illegal filler for replenishment.

The supply chain is direct - eliminating the multiple middlemen that characterise the supply chains of wood, charcoal and kerosene - by having no middlemen between the company and customer.

Trials are underway to prove the concept and hardware. The early signs are positive.



Charcoal being sold on the street in Nairobi



8.7 Peru

‘...Cocina Perú...’



SUMMARY

- 31 million population
- Heavy dependence on firewood and kerosene for cooking in rural areas
- Government launches Cocina Perú
- Programme targets nearly 1 million people to switch from traditional fuels to LPG
- LPG kit consists of 10kg LPG cylinder, regulator, hose and stove
- Coupons issued to redeem for 10kg of LPG
- Heavy emphasis on LPG demonstrations and safety training
- Programme supported by Repsol



COUNTRY BACKGROUND

Peru has some prominent neighbouring countries that includes Brazil, Chile Colombia, Bolivia and Ecuador. Its population of 31 million is mainly Amerindian (45%) and Spanish is the main language. Over 80% of the population are Roman Catholic.

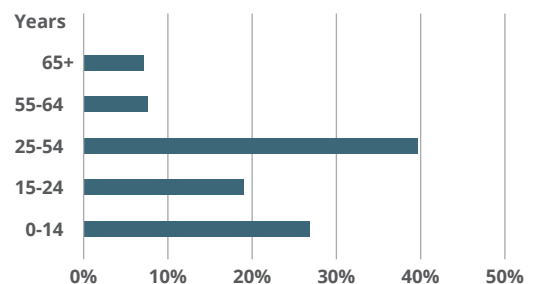
Peru's urban and coastal communities have benefited much more from recent economic growth than rural, Afro-Peruvian, indigenous, and poor populations of the Amazon and mountain regions. The poverty rate has dropped substantially during the last decade but remains stubbornly high at about 30% (more than 55% in rural areas). Peru's malnutrition rate began falling in 2005, when the government introduced a coordinated strategy focusing on hygiene, sanitation, and clean water. However, many poor children drop out of school to help support their families.

Peru was a country of immigration in the 19th and early 2 centuries but has recently become a country of emigration. More than two million Peruvians have emigrated in the last decade, principally to the US, Spain, and Argentina.

Peru's economy reflects its varied topography - an arid lowland coastal region; the central high sierra of the Andes; and the dense forest of the Amazon, with tropical lands bordering Colombia and Brazil.

A wide range of important mineral resources are found in the mountainous and coastal areas, and Peru's coastal waters provide excellent fishing grounds. Peru is the world's second largest producer of silver and third largest producer of copper. The Peruvian economy has been growing at between 3% and 4% over the past few years with low inflation.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 45% of the population are under 24 years old

Dependence on minerals and metals exports, and imported foodstuffs, makes the economy vulnerable to fluctuations in world prices.

Inequality persists and continues to pose a challenge to the goal of social inclusion and a more equitable distribution of income. Poor infrastructure hinders the spread of growth to Peru's non-coastal areas.

Since 2006, Peru has signed trade deals with the US, Canada, Singapore, China, Korea, Mexico, Japan, the EU, the European Free Trade Association, Chile, Thailand, Costa Rica, Panama, Venezuela, concluded negotiations with Guatemala, and begun trade talks with Honduras and El Salvador, Turkey and the Trans-Pacific Partnership.

Peru also has signed a trade pact with Chile, Colombia, and Mexico, called the Pacific Alliance.

Since the US - Peru Trade Promotion Agreement entered into force in February 2009, total trade between Peru and the United States has doubled.

GDP per capita in 2017 was estimated at US\$13,300, a rise from the previous year (US\$13,100).

LPG INDUSTRY IN PERU

The LPG industry started in Peru in the late 1930's.

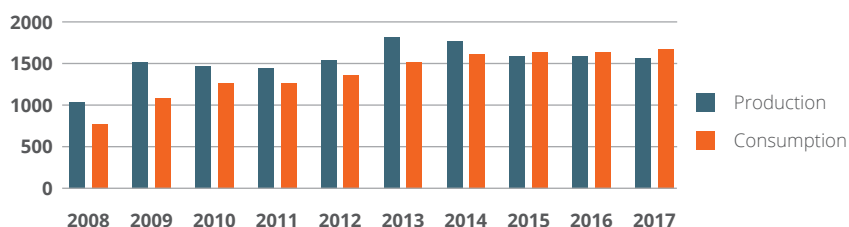
In 2018, the latest published statistics from the WLPGA indicates that 1.63m MT of LPG was consumed in 2017, with most of it being

locally produced. The country's principal LPG producers include state-owned oil company Petroleos del Peru, Argentina's Pluspetrol, Repsol YPF's La Pampilla refinery, US Aguaytia and Spain's Empresa de Energia Peruana (EPPSA).

LPG demand is mostly from the residential sector with the rest in industrial and transport. The demand for LPG has grown steadily over the last 10 years but has now started to flatten off.

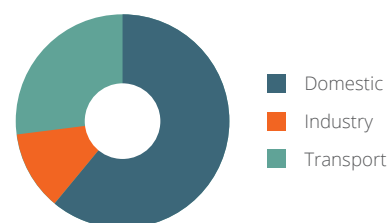
Today the per capita consumption of LPG in Peru is around 31kg/year, a small increase over the last 5 years.

LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG CONSUMPTION BY SECTOR



‘...Cocina Perú...’

Wood is used extensively as a residential cooking fuel in Peru creating serious health challenges for the local population. In response to this threat from traditional fuels the government responded with an LPG switching programme.



Wood smoke from indoor cooking causes serious health issues to Peruvian families. For this woman and her daughter, breathing while cooking for an hour ‘...is equivalent to inhaling the second-hand smoke of 400 cigarettes...’ (Environmental Health News)

The Peruvian Government’s Programme of Social Inclusion aims to encourage to use of LPG consumption in vulnerable sectors. It finances this through a Social Inclusion Energy Fund (Fondo inclusión social energético).

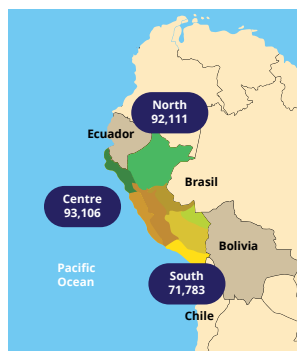
In 2012 the Ministry of Energy and Mining in Peru launched a National Family’s Kitchen Programme (Cocina Peru).

The objective was to serve as a mechanism of compensation and promotion of access to LPG for families of limited resources. The goal was the substitution of nearly

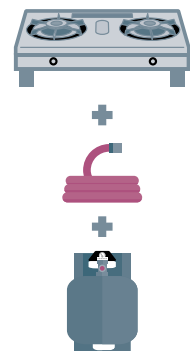
one million families, from kerosene and firewood to LPG, by 2016. The investment was around US\$50m.

The mechanism of this programme is to give access to LPG to families in poverty, by offering them a kitchen kit with a cook stove, gas regulator, hose and a 10kg LPG cylinder.

The campaign started in December 2012 and ran throughout 2013 and 2014. It consisted of the acquisition of over 300,000 LPG kits. This was followed up



Phase one of the Cocina project was completed in 2013 with over 300,000 kits delivered



The kit consisted of a LPG stove, regulator, hose and 10kg LPG cylinder

with a further campaign in 2014 promoting an additional 550,000 kits by 2016.

The ongoing programme was supported through the distribution of discount coupons of US\$16 for a 10kg LPG cylinder.

In support of this government initiative Repsol, through its foundation projects, focused on a twin headed campaign to:

- Convert 16,300 households to LPG and
- Conduct training for 127,400 new users in the correct usage of LPG

The accumulated investment for this Repsol programme, benefitting 143,700 families, was US\$1.15m.

A feature of the programmes was the intervention of the United Nations Office for Project Services (UNOPS) which conducted field audits to identify areas of improvement. They noted:

- The importance of safety training and the use of graphics
- The recipients appreciated the improved quality, ease of use and functionality of the kitchen
- The recipients valued the impact of LPG on their health, safety and time
- Cultural barriers remained when switching from firewood to LPG

Phase two of Cocina involves the distribution of 550,000 kits during the period 2014-2016.



Phase two of Cocina programme is under way



The Cocina programme utilised coupons to be redeemed in exchange for the LPG kits and a success factor for the introduction of LPG to new users was the hands on training and demonstrations that were carried out in the field

So far 260,000 have been delivered to three regions in the north, central and south of the country. Total investment in phase two is US\$33.7m.

The LPG kits were distributed, and experienced staff were on hand to demonstrate how to use them safely and effectively.

The programme attracted huge interest in the rural regions where firewood had been the primary source of energy for the population.



Simple graphics are effective to educate new users of LPG in safety

8.8 Senegal

‘...Butanisation...’



SUMMARY

- 14.7 million population
- Economy heavily dependent on agriculture, phosphates, fertilisers and fish
- Iron ore and oil exploration projects
- Reliance on donor and foreign aid
- IMF supporting reforms
- Unreliable power supplies
- ‘Butanisation’ policy introduced in 1974 with subsidies and tax exemptions
- 2010 Government report to remove subsidies...
- ...focus on energy, forestry and fiscal measures



COUNTRY BACKGROUND

Senegal has a population of 14.7 million with over 60% under the age of 24 years. The economy is heavily dependent on agriculture but exports phosphates, fertilisers and fish. Unreliable power supplies is a problem. So too is the rising cost of living.

This has led to public protests and high unemployment (15% in the 15-24 year range) prompting some migration to Europe.

Senegal has no crude oil reserves but does produce natural gas. The country's capital is Dakar which is located on the western most tip of Africa.

The economy has been growing strongly at over 6% during the past few years and GDP per capita in 2017 has remained stable at around US\$2,700.

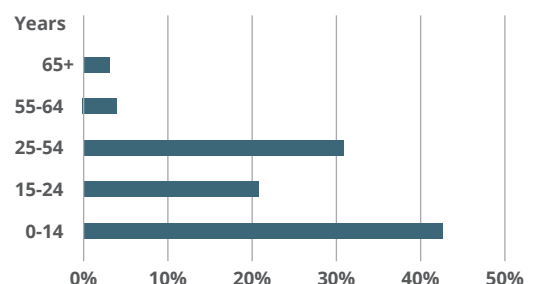
LPG INDUSTRY IN SENEGAL

The LPG market in Senegal has been through several ‘boom and bust’ cycles since 1974, the year the government launched its ‘butanisation’ programme. Demand in that year was around 3,000MT.

The Senegalese LPG market is centred around the country's capital, Dakar. More than 90% of the city's households now use LPG for cooking (ANSD 2006; Sarr and Dafrallah 2006; Sokona et al. 2003) with estimates of around 1.5 million LPG stoves in use.

Two thirds of those in the other main urban areas now own LPG stoves.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 40% of the population are under 14 years old

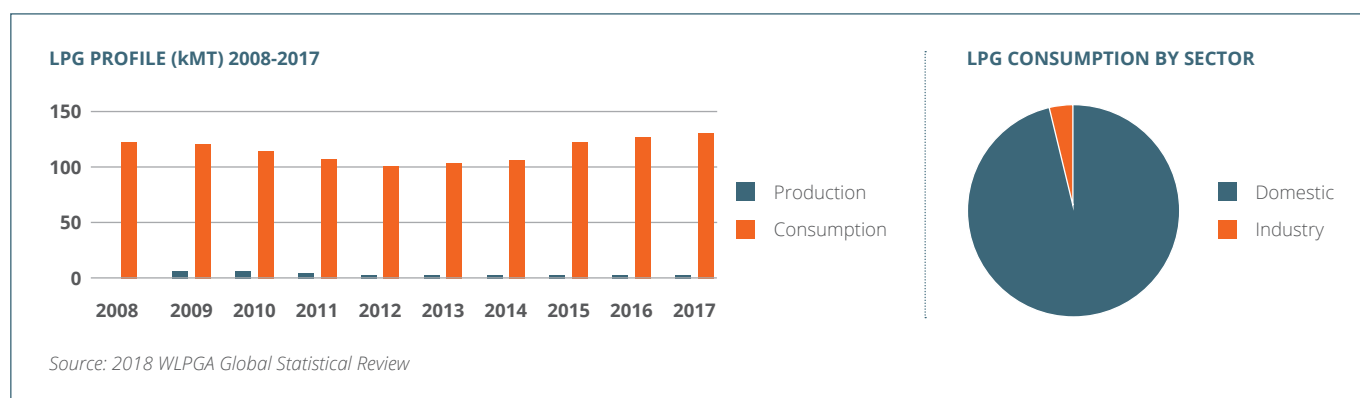
The Societe Africaine de Raffinage (SAR) has a legal monopoly on the production and importation of oil products in Senegal. Throughout the 1970's, the SAR refinery in the capital Dakar produced enough LPG to meet local demand, which was around 3,000MT/year throughout the decade.

In the 1980's LPG consumption surged leading to the need to import. During this

period government measures affected both supply and demand for LPG.

In 2017 LPG demand was over 130,000MT and relying almost entirely on imports.

Residential demand accounts for nearly all of this, according to official reports, with some industrial demand.



‘...Butanisation...’

During the early 1970's the environment was on top of the agenda for many Sahelian countries with concern over declining forest cover, soil erosion and local climate changes.

Senegal was facing a severe drought and a deforestation problem. Some of the drivers for this were overuse of grazing and pasture land, the expansion of farming into marginal and ecological fragile areas, bush fires associated with various rural activities and charcoal production.

At that time charcoal and wood were being used extensively (> 60%) across the country as the main energy sources. Household energy accounted for 90% of this, with wood and charcoal use increasing most rapidly in urban areas where populations were growing fastest.

In a survey of village women carried out in the 1990's, charcoal producers were seen as the ‘bad guys’. They were being

blamed for the destruction of wood and fodder, conflicts over water rights, the disappearance of game species and social problems.

It was recognised that although stopping charcoal production in Senegal would not halt land clearing, it was believed that it was a key cause of environmental degradation in the country.

The government needed to respond. It did so by devising strategies aimed at reducing the impact of biomass energy use through inter-fuel substitution, improved efficiency of wood stoves and charcoal kilns, and improved woodland management. This was the birth of the ‘butanisation’ programme.

The goal of the 'butanisation' programme was to increase LPG consumption and decrease the reliance on biomass, particularly among the most vulnerable, low income, sections of the population. At that time wood and charcoal represented around 60% of total energy consumption in Senegal.

At the time of the 'butanisation' programme the standard LPG package available for residential use was a 12.5kg cylinder, regulator, hose and stove. Not only was the cost too high for the low and middle income

households, it was also unsuitable for their cooking habits.

The government first allowed LPG equipment to be imported tax free and promoted LPG cooking appliances based on a 2.75kg cylinder, regulator, hose and simple cooking stove called the '*Blip Banekh*'. The stove was screwed into the top of the cylinder.

The initial package was found to be unsuitable because the cylinder was too small and the design flimsy. Initially the

uptake was slow and the scheme was later expanded to include an LPG subsidy (80%) for the 2.75kg cylinder.

The scheme was later further extended to include a more robust cooking stove together with an LPG subsidy (60%) for the 6kg LPG cylinder. It was thought that the 6kg cylinder was better suited to the cooking habits and income levels of the population and the subsidy made LPG cheaper, on an energy equivalent basis, than both charcoal and kerosene.

'BUTANISATION' - The effect of the LPG programme in Senegal was to substitute part of the charcoal consumed in urban areas with LPG. The government support was initially focused on customs duty exemptions on LPG equipment. Later, LPG subsidies were introduced. As the programme developed, cooking appliances was also subsidised. The programme led to a remarkable increase in LPG consumption. Nearly 85% of households in Dakar, and 66% of those living in other urban areas now own LPG stoves. Although the programme has not fully replaced other fuels with LPG it has at least encouraged some diversification of cooking fuels and brought significant environment benefits. However subsidies are now being phased out gradually because of their high financial cost.



The price structure was set by Presidential decree following joint recommendations from the Ministries of Energy and Trade. The LPG subsidies were financed from taxes on other oil products such as fuel oil.

Initially LPG use was concentrated among the rich households in Dakar, and its vicinity, but over the years the use of LPG has spread to poorer households all over the city and beyond.

However, 80% of the LPG consumed in Senegal is in Dakar. About 50% of the urban households now use LPG cookstoves. The reliance on imports has meant that prices are lowest in the towns near the west coast such as Dakar, Thies and Mbour where internal transport costs are low.

It is in these west coast towns where LPG has become the main cooking fuel because charcoal is brought in from towns as far away as 600km. In other towns LPG remains a back-up fuel for charcoal and wood.

The Senegalese Ministry of Environment estimate that the additional use of LPG has prevented the consumption of about

The use of fuel subsidies, and equipment and appliance subsidies, to encourage switching away from traditional fuels has been a common approach by developing countries in the past.

The cost of this has often been justified by the benefits to the environment, improvements in health and the support they provide to low income families.

To keep LPG prices stable, against a fluctuating international price, the government switched between subsidies and taxes.

The government applied three different price structures to the 2.75kg, 6kg and 12.5kg cylinders but only the two smaller cylinders were subsidised.

70,000MT of wood and 90,000MT of charcoal annually, representing a decrease of 15% in the rate of deforestation.

In 1985, the LPG subsidies were withdrawn as part of International Monetary Fund (IMF) loan requirements. Two years later, in what has come to be known as the 'gas riots', crowds of women marched towards the presidential palace protesting about the cost of LPG. The level of unrest was such that the subsidy was hastily reintroduced.

The LPG subsidies continued to be funded from taxes from other petroleum products and designed to encourage fuel switching.

In Senegal, after nearly four decades of LPG price subsidies, the International Monetary Fund (IMF) estimated in 2008 that not only were the subsidies fiscally unsustainable (in 2005 the cost of subsidising the consumption of LPG was 0.2 per cent of GDP) they were not hitting their intended target, the low-income groups.

The IMF also found that not only were less than 20% of these lower income groups benefitting from the LPG subsidies, over 60% of the higher income groups were receiving the benefit.

According to the World Bank, LPG subsidies have often deterred investment in several markets and even led to fuel shortages.

A government report published by the Ministry of Energy in 2010 (*La Politique de substitution du gaz butane aux combustibles ligneux au Sénégal*) made a number of recommendations in an attempt to tackle the LPG subsidy issue. It focused on three main policy areas, energy, forestry and fiscal:

1 - Energy policy

- A return to the actual prices of the different residential cooking fuels, through the progressive removal of subsidies on the 'popular' packaging
- Removal of 'price fixing' mechanisms but...
- ... maintenance of a price fixing limit for LPG – which has become a highly strategic product
- Replacement of the 'import parity price' by the 'customs declared value' in the price structure



- Building of new LPG storage facilities enabling economies of scale through the ability to handle larger cargoes and cutting freight costs
- Promoting the establishment of ... regional LPG filling centres
- Support by providing revolving credits, improving the household sector and other initiatives targeted to diversify the supply of cooking fuels

2 - Forestry

- Increasing the price of charcoal until it reflects the real cost of production - including replanting and production of standing timber
- Development of a taxation formula, equivalent to the price of standing timber and not the final product (charcoal)
- Extending forestry development to other regions where #PROGEDE intervenes and supports new plantations (village forests, trunk roads, private forests, etc...)

#The Sustainable and Participatory Energy Management project – PROGEDE – was implemented by the Government of Senegal between 1997 and 2004. Study on the cost of supply, transportation, and LPG distribution in Senegal, Trans African technology

3 - Fiscal

- Exempt LPG from customs duties and value added tax (VAT) at the community level (UEMOA) with a view to harmonising residential energy

policies and preventing illegal cross border trade of LPG and LPG cylinders

Although the 'butanisation' policy may not have succeeded in fully replacing charcoal and wood, it has at least encouraged the diversification of cooking fuels.

The elimination of the LPG subsidy continues as the private sector takes a more active role in the market.

As a result of competition between companies, LPG prices remain affordable for most households. It is now the primary cooking fuel in most urban households.

A feature of Senegal's private LPG sector has been the use of smaller, distributed filling plants to serve non-urban areas.

This has given rise to a growing illegal filling/ cross filling problem which will damage the industry and will need attention through the application of good practices, training, standards and enforcement.

8.9 Sri Lanka

‘...Tea Change...’



SUMMARY

- 22.4 million population relying mainly on wood
- No natural gas in the country
- Tea industry important for economy and employing 1m people
- Historically poor living conditions
- New initiative to target lpg into this community
- ‘Wathu praja diwi naguma’ (gas for cleaner cooking & healthy life)
- Supported by local lpg industry
- Based on 5 kg lpg cylinder, easy payments, local availability
- 50,000 families converted during last 18 months
- 200,000 targeted in next 3-4 years
- Major improvements in health, living conditions, productivity and environment



COUNTRY BACKGROUND

Sri Lanka has a population of over 22.4 million with 11% living in urban areas. Nearly 75% of the population are Sinhalese and Buddhism is the official religion. Nearly half of the population is in the age bracket 25-54 years.

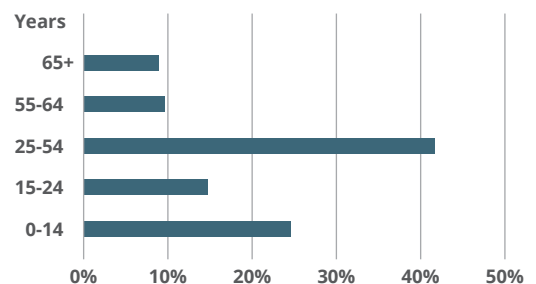
Sri Lanka continues to experience strong economic growth following the end of the 26-year conflict in the north of the country. The government has been pursuing large-scale reconstruction and development projects in its efforts to encourage growth in war-torn and disadvantaged areas, develop small and medium sized enterprises, and increase agricultural productivity.

Fiscal consolidation efforts and strong GDP growth in recent years have helped bring down the government's debt. Low tax revenues remain a major concern.

The global financial crisis and recession in 2008-2009 exposed Sri Lanka's economic vulnerabilities and nearly caused a balance of payments crisis. Agriculture slowed due to a drought and weak global demand affected exports and trade. In early 2012, Sri Lanka floated the rupee, resulting in a sharp depreciation, and took steps to curb imports. A large trade deficit remains a concern, but strong remittances from Sri Lankan workers abroad help offset the trade deficit. Government debt of about 80% of GDP remains among the highest in emerging markets.

Almost a third of the workforce is employed in the agricultural sector where tea remains one of the key crops. GDP per capita was US\$13,000 in 2017, a rise from US\$12,500 in 2012. This puts Sri Lanka around 120th in the world. Tourism has experienced strong growth since the end of the conflict.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 40% of the population are between 24 and 54 years old



Sri Lanka has over 4m kWh of installed electricity capacity with nearly 53% being generated from fossil fuels and 41% from hydroelectric plants. The country has no crude oil or natural gas reserves. It imports crude oil and has 35kbbbl/day of refinery production capacity.

LPG INDUSTRY IN SRI LANKA

LPG demand in Sri Lanka has grown steadily over the last two decades except for a small fall in 2010.

Since then demand has recovered and is now around 380kMT/year.

The majority of LPG is imported and distributed mainly to the residential sector. There is some industrial demand for LPG, for example in the ceramics industry. There is also some Autogas use.

Per capita demand for LPG in Sri Lanka is rising and in 2017 was over 12kg/year.

The LPG industry in Sri Lanka is dominated by two companies who have both been instrumental in developing the market to meet the increasing demand.

It is estimated that over 80% of the population still rely on traditional fuels,

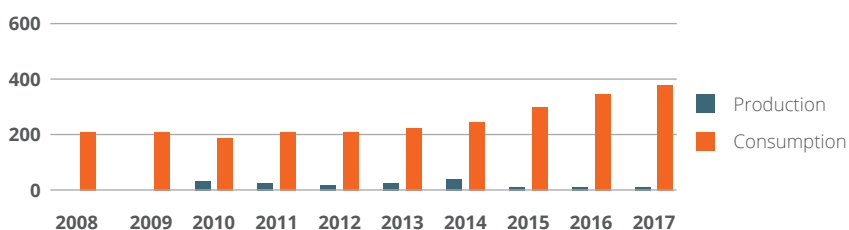
mainly wood, as their primary energy source which has led to serious deforestation issues.

With the absence of natural gas in the country LPG has great opportunities, especially in rural areas.

Sri Lanka relies on imports and there is a large existing import terminal built by Shell 20 years ago near Colombo on the west coast.

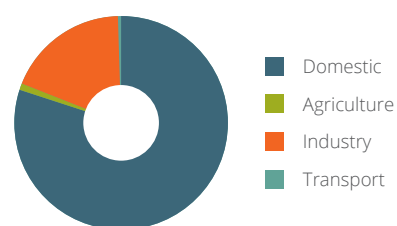
A larger import facility has been recently built in the south west of the country.

LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG CONSUMPTION BY SECTOR



‘...Tea Change...’

The tea industry in Sri Lanka is 185 years old. It is critical to the economy and employs around one million people.



Traditional wood burning stove



LPG stove being used



Historically tea plantation workers have not enjoyed the best of living conditions with poor housing, water and sanitation.

Their main source of energy is firewood. This generates smoke inside the houses, especially when wet.

Issues associated with burning wood include respiratory and cardiovascular related infections and diseases due to inhaling the smoke. The use of fire wood also causes burns to children and leads to fires, and homes being destroyed.

One of the local LPG companies, Laugfs Gas PLC, explored the possibility of encouraging the switching of wood burning stoves to LPG in 2014. They discovered that women and children collecting wood were being subjected to the risk of accidents, reptile attacks and harassment. Other social issues, apart from health, were the time spent away

from their families and the risks from an unguarded wood fire.

Laugfs took the initiative and developed a Corporate Social Responsibility (CSR) switching programme by establishing a small team to conduct further research. The team held discussions with the tea plantation community and discovered that although switching from wood to LPG reflected an elevation of status it was challenged with barriers. These included the high initial cost of switching to LPG, the lack of a dealer network to sustain the business, a lack of knowledge of the product and also a fear of using LPG.

It was also clear that for an LPG company to promote the switching programme a trusted mediator was needed. Laugfs prepared a proposal to the Plantation Human Development Trust (PHDT).

THE PLANTATION HUMAN DEVELOPMENT TRUST was established in 1992 to improve the living conditions of the tea plantation work force and drove initiatives to improve housing, infrastructure, water, sanitation, health, nutrition, child care and schooling.

Laugfs Gas and PHDT developed an initiative called Wathu Praja Diwi Naguma (Gas for Cleaner Cooking and Healthy Life). The scheme is based on a 5 kg cylinder with regulator, hose and stove being supplied to the households in a way that matches their monthly budget by using easy payments by instalments and no initial down payment.

The size of cylinder was selected because it was sufficient to provide more than three weeks of daily cooking requirements for the family and small enough not to be cumbersome and inconvenient in the kitchen.

The full 5 kg cylinder was also light enough for a woman to carry it back to her home. The LPG cylinders, refill and accessories

are made available for the convenience of the community through the Estate Cooperative Societies which are available on each tea plantation.

The Estate Cooperative Societies have emerged as a key Community Based Organisation (CBO) in the country through this initiative and make the LPG proposition available 24/7.

These Cooperative Societies are appointed as sub dealers to the LPG supplier and generate a margin for their service and support to the programme.

An important part of this fuel transition programme was to educate the new users

about the characteristics, safety issues and use of LPG as a cooking fuel.

Laugfs conducted pilot project selecting the Hatton region in the Nuwara Eliya District of Central Province. The pilot consisted of educational programmes to promote the benefits of LPG, examined the type of dealer network required and other logistical and impact criteria. Following the pilot project the programme was rolled out to other areas.

A customer service support group constantly monitors the whole process and conducts monthly evaluations.

As the programme focuses on social and welfare benefits it is considered a CSR initiative of Laugfs Gas. This enables the company to secure special rates from suppliers for the equipment. Managing the costs of this initiative is an important consideration.

According to a spokesman for Laugfs Gas, the result has been dramatic improvements in air quality in the home, leading to improved health of the workforce who now breathe more easily. In the first 18 months 50,000 families were converted and the balance, 200,000 families, have been targeted over the next three to four years.

For Laugfs Gas there are some positive benefits: LPG penetration is increased to new users, the concept can be applied to other sectors (rubber, coconut etc.), the CSR aspect enhances the brand and raises awareness, and partner relationships are developed.

Some negative aspects include cash flow issues, and opportunity costs where staff could be applied to more financially attractive projects.

For the consumer LPG has been found to be more efficient than firewood through the ability of the housewife to turn the flame down, or off, when there is no cooking to be done. Unlike firewood which cannot be 'turned down' and requires the fire to be sustained throughout the day, wasting energy and polluting the home.

The introduction of LPG also reduces the damage to the environment through less tree felling and improved air quality.

The task of chopping wood has also brought a safer environment with less personal injury and reduced fire risks, and attendance at work has improved improving the productivity of the workforce.



Sri Lankan tea worker

8.10 Turkey

'...The Educator...'



SUMMARY

- 80.8 million population
- 4.2mMT LPG demand - dominated by Autogas
- Residential LPG sector in decline for last ten years
- 25% of population under 14 years old
- Primary school education is a challenge in remote mountainous rural areas
- Government programme to convert heating in these schools from traditional fuels to LPG
- Aim is to improve air quality, increase attendance and educate children about clean energy
- Potential target of 3m



COUNTRY BACKGROUND

Turkey has a population of just over 80 million which puts it in the top twenty most populated countries in the world.

The country straddles the East and West, having borders with countries that include Bulgaria and Georgia.

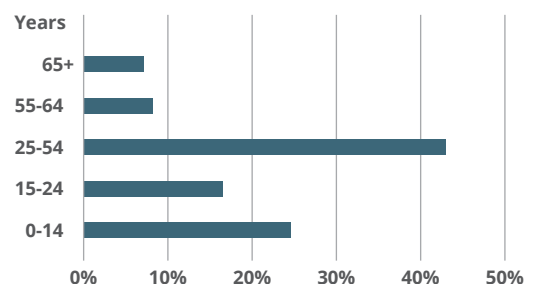
Turkey's largely free-market economy is driven by its industry and service sectors, although agriculture still accounts for about 25% of employment. An aggressive privatisation programme has reduced state involvement in basic industry, banking, transport and communications.

Traditionally textiles and clothing have been an important part of the economy but automotive, construction, and the electronics industry are becoming more important.

Oil began to flow through the Baku-Tbilisi-Ceyhan pipeline in May 2006 and brings up to one million barrels per day from the Caspian to market. Several gas pipeline projects will transport Central Asian gas to Europe through Turkey, which over the long term will help address the country's dependence on imported oil and gas.

The government has adopted financial and fiscal reforms as part of an IMF programme which has strengthened the country's economy. Turmoil within some of the countries in Turkey's neighbourhood has threatened the economy and investor confidence.

POPULATION DISTRIBUTION (%) BY AGE GROUP



Over 25% of the population are under the age of 14 years

LPG INDUSTRY IN TURKEY

The LPG industry in Turkey is dominated by its use as Autogas, a road transport fuel. Turkey has the largest Autogas market in Europe and is second to South Korea as the largest Autogas market in the world.

Total demand for LPG exceeded 4.2mMT in 2017. Residential demand was under 1mMT with a small amount being used in the industrial sector.

Residential demand peaked at 1.8MT in 2004 but since then has slowly declined.

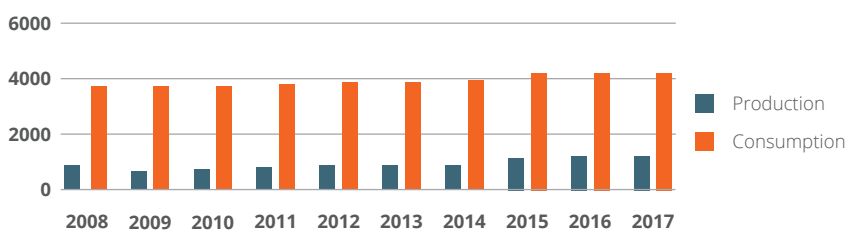
The expanding natural gas grid is the main reason behind the decline.

With GDP per capita around US\$26,500 the expectation is that LPG demand would be greater than 10kg/capita.

This has provided a stimulus for creating an opportunity for development of LPG in the rural sector, particularly in some of the more mountainous regions.

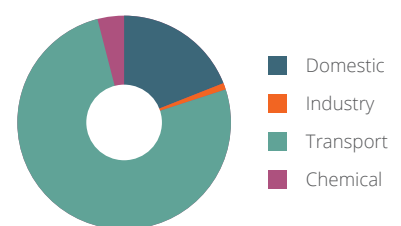


LPG PROFILE (kMT) 2008-2017



Source: 2018 WLPGA Global Statistical Review

LPG CONSUMPTION BY SECTOR



‘...The Educator...’

Rural populations represent 70% of the world's poorest people and 72% of the population of the least developed countries. Rural/urban inequalities are a major obstacle to sustainable development. Rural areas comprise human settlements of less than 10,000 people and the rural space is dominated by farms, forests, water, mountains and/or deserts.

Typically, rural people depend on agriculture for their livelihoods as farmers, nomadic herders, or fishermen; they deal with animal production, transformation and marketing of food and non-food agricultural products and services. Rural communities are diverse culturally, socially and economically.

Their labour is cheap because gainful employment options are limited. Usually rural people lack access to adequate basic social services because they lack a political voice and rural areas have a low national priority.

In Turkey it is estimated there are over one million students attending schools

in some of the most challenging parts of the country where temperatures drop to below freezing and heating is needed for two thirds of the year.

These schools have typically four or five classrooms with around 100 pupils. Wood and charcoal stoves are used for heating and the air quality is poor and the classrooms frequently cold. The use of traditional fuels also creates the need for high maintenance.

Following discussions between the LPG industry, the Turkish energy market regulatory authority (EMRA) and the

Ministries of Education and Health, a plan has emerged for a switch from these traditional inefficient stoves to LPG fired heaters, especially in the regions where natural gas is not present.

This initiative is included in this report, not because it is an existing case study, but because it is an example of an initiative where several stakeholders have joined together to find a solution that will not only improve the health of young people but it will also create a better environment to encourage better education for the rural population and create a platform for the children to communicate the benefits of LPG over traditional fuels back to their families.

According to the Constitution of the Republic of Turkey every citizen has the right to education and this is free of charge, and compulsory, at primary level except in specially licensed and foreign institutions.

The Ministry of National Education (MEB) runs the educational administration of Turkey and is responsible for drawing up curricula, coordinating the work of official, private and voluntary organizations, designing and building schools and developing educational materials.

Although primary education is compulsory from age five, pre-primary education (three to five years) is only optional. Creating a pleasant environment for pre-primary school children will discourage non-attendance.

The purpose of education at pre-primary level is to ensure physical, mental and sensory development of children and the acquisition of good habits. It is also to prepare children for primary education, to create a common atmosphere of growth for those living in inconvenient and challenging circumstances.

Pre-primary education is provided in kindergartens, day care homes, nursery classes within primary schools, and in private nurseries. They are all under the supervision of the Ministry of National Education and usually concentrated in larger towns and cities.

EMRA and the Ministry of National Education are raising a new and innovative project with the LPG industry targeting traditional fuels.



The idea is to convert the schools in some of the most challenging rural areas from using charcoal and wood to LPG.

According to both industry and government representatives the aim of the initiative is to focus on a number of schools with the objective of improving the health and reducing the mortality rate within this young age group, improving the attendance level at school and increasing the effectiveness of the children's education through better classroom conditions.

One of the key reasons for the success behind the initiative is that the promotion of the use of LPG to displace traditional fuels has not been hidden. It is a key driver for several of the stakeholders, especially the LPG industry and EMRA. For the government the prize is the opportunity to improve the well-being and quality of life of a significant part of the Turkish population through improved health (improving infant mortality rates) and education.

In order for the scheme to move forward, the old traditional wood/charcoal fired stove has to be replaced by an LPG system that includes an LPG storage tank (with sufficient capacity to provide energy throughout the winter months when access is difficult for a bulk LPG tanker). The cost of switching the old system to LPG is estimated to be

around US\$30,000 for each school.

The plan is for this to be funded by the LPG industry for a certain period of time while some tax concessions will be granted by the government.

These remote mountainous regions are also susceptible to natural disasters and the use of LPG as an energy in these circumstances are well documented (ref WLPGA report).

With up to 8,000 schools and an average family size of 4.2 people the potential reach of this programme is significant, with over three million people benefitting.

By focusing on schools the government is not only targeting the next generation, they are using that generation to carry the message of cleaner fuels for the kitchens back to their homes and educating their families.

Appendix 1

WLPGA/UNDP

The Rural Energy Challenge

Over ten years ago the WLPGA worked with the UNDP on a project called *The Rural Energy Challenge*. This was a public/private partnership aimed at addressing the lack of access to clean energy and improving living standards with LPG.

The target group was populations living in rural and peri-urban areas of developing countries and the aims were to identify and address barriers to rural, and peri-urban, market development.

Access to energy was identified as a key issue in meeting basic needs. These included cooking and heating in the home, tackling household tasks such as pumping water, manufacturing bricks and ceramics and supporting social services including health care and education.

Seven countries were selected for multi stakeholder workshops with the objectives of:

- 1** - Initiating dialogue between the public and private sectors, and consumers
- 2** - Agree priority actions to remove barriers to development
- 3** - Identify projects to demonstrate feasibility of rural market development

These workshops were held over a period of four years in Ghana and Honduras (2003), South Africa, Morocco, and Vietnam (2004), China (2005) and Turkey (2007).

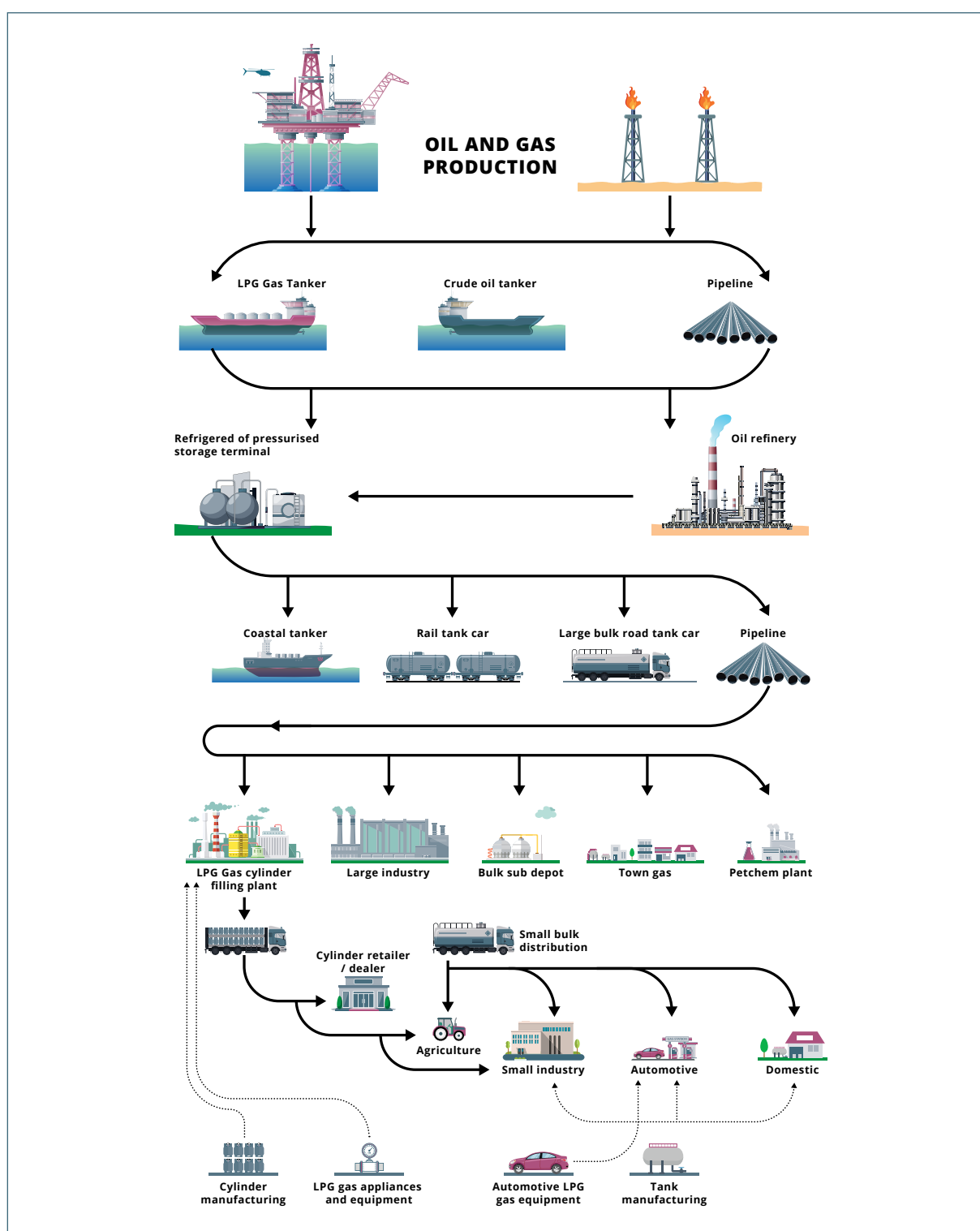
Despite the cultural diversity across these countries the outcome of the programme highlighted similarities in terms of barriers to penetration of LPG. These were:

- 1** - Low density of LPG target population
- 2** - Low purchasing power and even sometimes barter communities
- 3** - Need for local credit facilities
- 4** - Inadequate cylinder size
- 5** - Lack of safety culture and poor enforcement of regulations
- 6** - Strong competition of cheaper alternative energy sources (sometimes subsidized)
- 7** - Inadequate energy State policy to stimulate LPG development (sometimes driving major players away)
- 8** - Weakness of LPG distribution networks in remote rural area



Appendix 2

Typical LPG Distribution Channel



Notes

[illegible]



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