

The Ideal Market for LPG Power Generation

An exploration of the key characteristics
which can make a country an ideal market
for LPG Power Generation



This study defines the key market characteristics which make a country 'ideal' for using LPG as a fuel for power generation.

Key market characteristics:

1. Seeking to fill power gaps of up to 250 MWe
2. Existing power generation relying heavily on diesel / HFO
3. High wholesale electricity prices
4. Already using LPG (with high propane content)
5. Limited (or non-existent) natural gas grid
6. Domestic production of LPG
7. Policies which encourage a focus on emission reduction
8. Well-functioning regulatory policies & enforcement

1. Introduction

This study has been commissioned by the World LPG Association (WLPGA) in order to highlight the key market characteristics which are necessary for a country to be considered an 'ideal' market for using LPG as a fuel for power generation.

The outcome of this research is a list of eight distinct market characteristics which – if achieved – would likely result in a market where using LPG to generate electricity would be an obvious choice.

This study is intended to be used to by LPG industry players, manufacturers, national LPG associations, policy makers and other stakeholders that are considering how best to promote LPG as a fuel for power generation. The recommendations listed at the end of this study have been compiled to provide direction for helping achieve this.

From a country which already uses LPG in large volumes, to a country which has high wholesale electricity prices. From a country which has limited (or non-existent) natural gas grid infrastructure to a country which has a well-functioning regulatory framework. There are many different factors which can make a country a promising – or unfavourable – market for LPG power generation. Each has been outlined in this study.



Eight 'ideal' market characteristics for LPG power generation have been identified in this Study.

By identifying the market characteristics which make a market ideal for LPG power generation, it is the intention that this will allow the LPG industry to:









- Develop a framework for identifying the most promising potential markets for LPG power generation.
- Identify the top prospect markets for LPG power generation.
- Develop a strategy for targeting these identified countries.

It should be noted that a country does not need to have all of the market characteristics which are described throughout this study (and in any case, there is unlikely to be any country in the world which meets all of the listed criteria). Instead, the characteristics should be considered as a 'wish list' which outlines the desirable features of a market which is ideal for LPG power generation.

2. Key Market Characteristics

The following table details the list of key market characteristics which make a country ideal for power generation from LPG.

Each of the characteristics listed below is described in more detail in the following pages.

Market Characteristic	Brief Supporting Rationale	H / M / L Priority
Seeking to fill power gaps of up to 250 MWe	Countries which have power shortages and are looking to make investments to fill short-term power gaps will likely offer opportunities for LPG, especially in more remote regions with no natural gas infrastructure.	
Existing power generation relying heavily on diesel / HFO	Countries which rely heavily on using liquid fuels (e.g. diesel and heavy fuel oil) to meet their power generation needs, are often exposed to high prices and/or have plans to move away from this fuel for environmental reasons. This creates an opportunity for LPG to be considered as an alternative fuel.	
High wholesale electricity prices	Markets with high wholesale electricity prices are likely to offer more attractive pay-back periods for LPG power generation investments.	
Already using LPG (with high propane content)	Countries which are already consuming large volumes of LPG are likely to have the necessary infrastructure in place to facilitate the use of LPG within the power generation sector. In most countries with high LPG consumption, the fuel is primarily used for residential applications (e.g. cooking). When used for power generation, it is also important that LPG has a high propane content.	
Limited (or non-existent) natural gas grid	The best opportunities for LPG are likely to be in markets with a limited – or non-existent – natural gas grid. Countries with an extensive natural gas grid will present few opportunities for LPG.	
Domestic production of LPG	Countries which are producing significant quantities of LPG domestically will likely have a access to a more cost-effective source of the fuel versus countries which have to import, often at high prices.	
Policies which encourage a focus on emission reduction	Countries which are seeking to lower their carbon emissions may well be looking to LPG as an alternative fuel, especially as a ‘bridging’ solution until natural gas grids have been developed.	
Well-functioning regulatory policies & enforcement	LPG power generation investments will be most successful in markets which are well governed and where the regulatory framework is conducive to doing business.	

 High priority  Medium priority  Low priority

2.1 Seeking to fill power gaps of up to 250 MWe

One of the biggest opportunities for LPG power generation is in countries which are looking to make investments in power plants up to approximately 250 MWe in capacity. Within the LPG industry, this size of power plant is deemed to be the 'sweet spot' for LPG power generation (primarily because LNG – liquified natural gas – requires large scale to become cost-effective; LPG can be deployed more cost effectively at lower volumes, a big advantage for LPG).

Countries which have weak electricity grids in parts, and/or a rapidly growing electricity demand are likely to be candidates for this market characteristic.

The US Virgin Islands is one good example, illustrated by the conversion of their existing power generation facilities to LPG. Two power plants on St. Thomas and St. Croix with generating capacities of 198 MWe and 118 MWe, respectively, came online in 2017.

Other markets which are known to be making investments in 100 MWe-scale power plants are Argentina and Indonesia. Both of these countries have rapidly growing electricity demands and require rapidly deployed power plant solutions to avoid black-outs.



2.2 Existing power generation relying heavily on diesel / heavy fuel oil (HFO)

Within countries which rely heavily on oil (i.e. heavy fuel oil, or diesel) for electricity generation, there is a growing trend of diversifying the fuel mix in a bid to: mitigate the risks associated with fluctuating oil prices, increase energy independence (in the case of countries which need to import large volumes of oil), and reduce carbon emissions.

Even Saudi Arabia – the biggest oil exporter in the world – is launching a \$50 billion renewable energy programme to diversify their energy mix which relies heavily on liquid fuels.

This trend of diversification is likely to have a positive impact with respect to LPG power generation - especially in the cases where there is little or no natural gas grid. LPG can provide the dispatchable generation which oil currently delivers. Dispatchable generation (which can be turned up or down as required) will continue to be needed, even as the prevalence of renewables continue to increase.

2.3 High wholesale electricity prices

While many other factors need to be taken into account, countries with high wholesale electricity prices will tend to offer better investment opportunities for LPG power generation. The payback period for a power plant (regardless of the fuel type) is normally closely linked to average wholesale electricity prices – especially if operating in baseload mode.

Countries will often have high wholesale electricity prices if one or more of the following market conditions applies:

- Relying heavily on expensive fuels (e.g. oil) for power generation, often imported from other countries;
- Needing to make significant investments in infrastructure (e.g. electricity grid upgrades, new power generation capacity);
- Ambitious targets for renewable electricity penetration.

Note: Countries with high *retail* electricity prices do not necessarily have high *wholesale* electricity prices. This is because the price that end-users pay for electricity is made up of non-commodity costs in addition to the wholesale price of electricity (e.g. network charges, taxes, surcharges for renewable electricity, etc.). Germany is an example of a country with very high retail electricity prices, but low wholesale prices (due to the influx of high volumes of renewable electricity over the last 5 to 10 years).



2.4 Already using LPG (with high propane content)

One of the more important factors determining whether or not a market is a good opportunity for LPG power generation is the extent to which the country is already using LPG with a high propane content.

Even though the use of LPG for power generation is fairly limited today, many countries use LPG extensively for cooking, space heating and as a vehicle fuel.

Why is this important? Countries which use LPG extensively will have the necessary infrastructure in place (e.g. LPG import terminals, storage facilities, pipelines, distribution networks, etc.). This infrastructure is effectively a pre-requisite to using the fuel in any meaningful volumes.

Countries which do not have this infrastructure in place will have to invest in building these facilities before using LPG as fuel for power generation – especially for power plants in the 10s or 100s of MWe size range.

For power generation, it is also important to emphasise that LPG with a high propane content (and, therefore, lower butane content) is necessary.

2.5 Limited (or non-existent) natural gas grid

One of the most critical factors which dictates whether or not a country is a viable option for LPG power generation is the extent of the existing natural gas grid in that country. In countries with an extensive gas grid, natural gas will almost always be a more cost-effective fuel option when compared to LPG.

Therefore, an ideal market for LPG power generation will almost certainly have a limited (or non-existent) natural gas grid. Example countries include China (which still has vast regions with no access to natural gas) and India (in which natural gas accounts for less than 10% of total electricity generation).

Countries which have plans to develop natural gas grids in the future are also potential opportunities for LPG power generation. In these cases, a power plant may be built and fuelled by LPG in the short term, with the longer term plan to convert to natural gas once the gas grid is built. Ghana is one good example, illustrated by the 400 MWe Bridge Power Plant project which will be the world's largest LPG-fuelled power plant and was designed to be eventually converted to natural gas.



2.6 Domestic production of LPG

Countries which have their own domestic supplies of LPG are immediately at an advantage when it comes to using the fuel for power generation for the simple reason that they are less likely to be impacted by the costs associated with importing the fuel (e.g. construction and operating import terminals, transportation costs, etc.).

A second important consideration is 'security of supply'. Countries which have their own domestic production of LPG will be better able to control the supply of the fuel for their own needs. Countries which are reliant on importing the fuel are exposed to risks such as shortages of supply if global demand significantly increases and/or if global production significantly drops, for example.

The vast majority of LPG is derived from fossil fuel sources, e.g. manufactured during the refining of crude oil, or extracted from natural gas streams as they emerge from the ground. Therefore, it is no surprise that the largest oil producing countries are also the largest producers of LPG. The USA, Saudi Arabia, China and Russia are the top four countries in the world for LPG production.

2.7 Policies which encourage a focus on emission reduction.

Most countries in the world have now made some form of commitment to reducing carbon emissions as part of the 'Paris Agreement' – the United Nations Framework Convention on Climate Change which has the ultimate aim of 'Holding the increase in the global average temperatures to well below 2 °C above pre-industrial levels.' As a consequence, there is little doubt that the efforts to decarbonise the world's economy will quicken rather than decline.

For many countries, decarbonisation efforts will do little to improve the prospects for LPG power generation, especially within countries which have wide-spread natural gas grids, or countries which already have very low grid carbon levels due to a high prevalence of hydro-power, for example. (In these cases, decarbonisation will focus on other sectors, e.g. transport).

Nevertheless, in countries which have limited natural gas infrastructure and have ambitions to de-carbonise their electricity generation portfolio, LPG is likely to be a feasible, lower carbon option to replace high-emitting fuels such as coal and oil. Indonesia, is one country which is looking to move away from using oil for power generation. The country is seeking to reduce a heavy reliance on the fuel (which accounts for more than 40% of total electricity generation).



2.8 Well-functioning regulatory policies & enforcement

In order to make large infrastructure investments (such as power plants), it is strongly desirable for a market to have a well-functioning regulatory environment, with laws which are readily enforced.

The World Bank publishes an annual 'Ease of Doing Business Ranking' which considers factors such as 'Getting Credit', 'Dealing with Construction Permits', 'Starting a Business' and 'Getting Electricity'. These are all factors which are likely to be important when developing an LPG-fuelled power plant. Countries which are ranked towards the bottom of the index are likely to be riskier markets for LPG power generation.

The countries which came top of the ranking in 2016 are, New Zealand (1), Singapore (2) and Denmark (3).

The bottom ranked countries are Somalia, Eritrea and Libya.

3. Conclusion

As discussed throughout this study, there are a number of market characteristics which can help to make a country a good prospect for using LPG as a fuel for power generation. It is unlikely that any one country will have all of these market characteristics, but it is nevertheless likely that the countries which are the most promising markets for LPG power generation will exhibit two or more of these conditions.

For example, Ghana (the country which is due to host the largest LPG-fueled power plant in the world) exhibits several of the discussed market characteristics.

In order to take advantage of the opportunities presented by the use of LPG for power generation, it is suggested that the LPG industry considers each of the recommendations outlined to the right.

4. Recommendations

The following is a list of the recommendations from the WLPGA study entitled: [Global LPG Power Generation: Market Development & Recommendations for Future Growth](#) which was published earlier in 2017 (available on www.wlpga.org).

- 1. Better positioning of LPG to policymakers and energy users:**
 - With fossil fuels increasingly facing an image problem against a back-drop of greater renewables uptake, it is now more important than ever to develop and communicate a vision of the role LPG can play in a decarbonising energy future.
- 2. Develop and deploy new business models for LPG which capture a larger share of the power generation value chain:**
 - We recommend a detailed investigation of the opportunities for LPG players to operate in new, higher margin parts of the energy value chains through the development of new services and solutions.
- 3. Indexation of LPG with diesel:**
 - We recommend that the sector explores the extent to which price indexing and the wider use of long-term LPG contracts can be used to help mitigate the risk of wide LPG price fluctuations, and its associated unpredictability.
- 4. Better understanding of the costs of local LPG infrastructure development:**
 - We recommend that an analysis be carried out to explore the relative costs / benefits of developing LPG infrastructure versus LNG infrastructure.
- 5. Better positioning for development finance for energy projects in emerging markets:**
 - The development and environmental benefits of LPG as a fuel should be strongly developed and promoted to financing institutions, such as the World Bank, International Finance Corporation, etc.
- 6. A comparison of emissions profiles of pollutants between LPG and other fuels:**
 - The LPG industry should undertake some independent analysis of the emission profile (e.g. NO_x, SO_x, CO, PM, etc.) of LPG versus other fossil fuels to highlight the superior emission profile of LPG.

