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Mozambique Domgas Small Scale LNG



Small Scale LNG (SSLNG) is the use of small liquefaction and regasification facilities that enable flexible supply chains to deliver to multiple smaller distributed users.



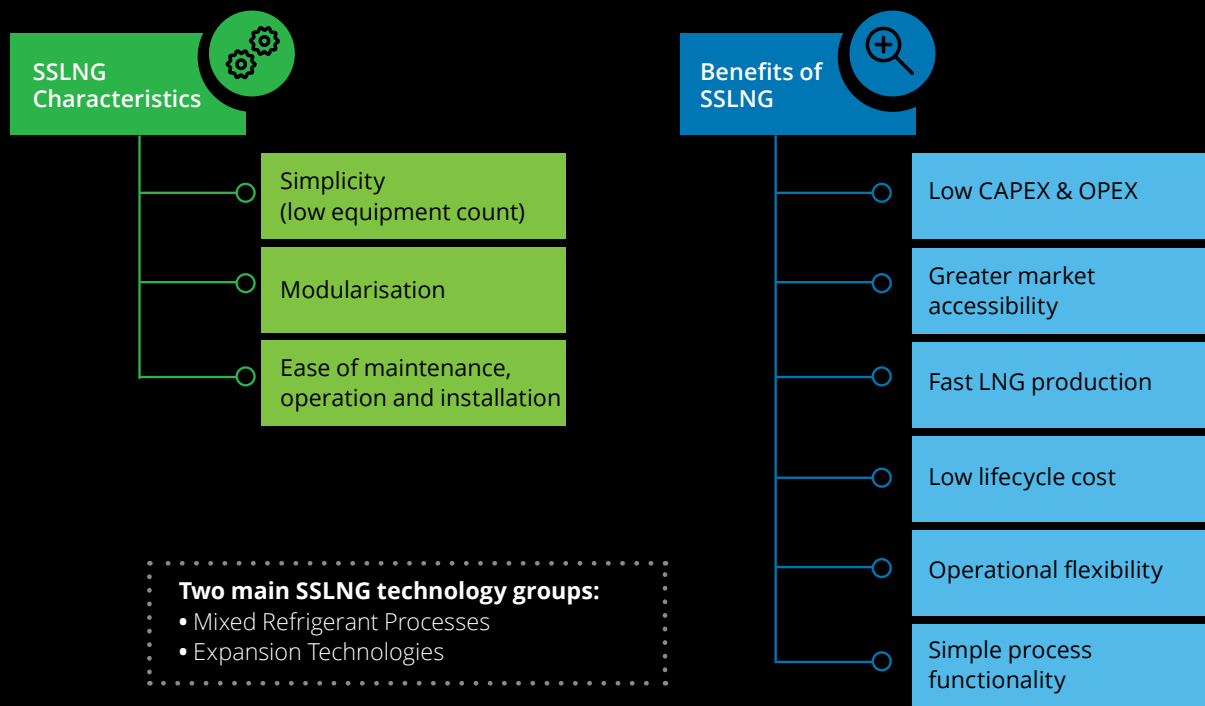
The current global quest for utilising cleaner energy while still remaining cost competitive has fuelled the rising demand for more flexible natural gas supply methods such as Compressed Natural Gas (CNG) and Liquefied Natural Gas (LNG). Natural Gas is commonly distributed in gaseous form to end users via a network of pipelines and is a very low cost source of energy; however, the challenge experienced by small end users is that access requires sufficient capital, long term supply agreements or access to existing natural gas pipeline infrastructure.

Small Scale LNG (SSLNG) is the use of small liquefaction and regasification facilities that enable flexible supply chains to deliver to multiple smaller distributed users.

These users would normally consume energy with short supply agreements, at lower quantities or in remote locations that would previously be unserved by conventional natural gas infrastructure. The International Gas Union (IGU) defines small scale liquefaction and regasification facilities as plants with an installed capacity under 1 million metric tons per annum (mtpa) and SSLNG carriers would have less than 30 000 m³ of capacity.

Advancing technology is making even smaller units feasible and opening up new markets. LNG can be transported by road or train to be delivered into skid mounted storage at the point of use, providing flexible and deployable energy at significantly reduced costs to the user.

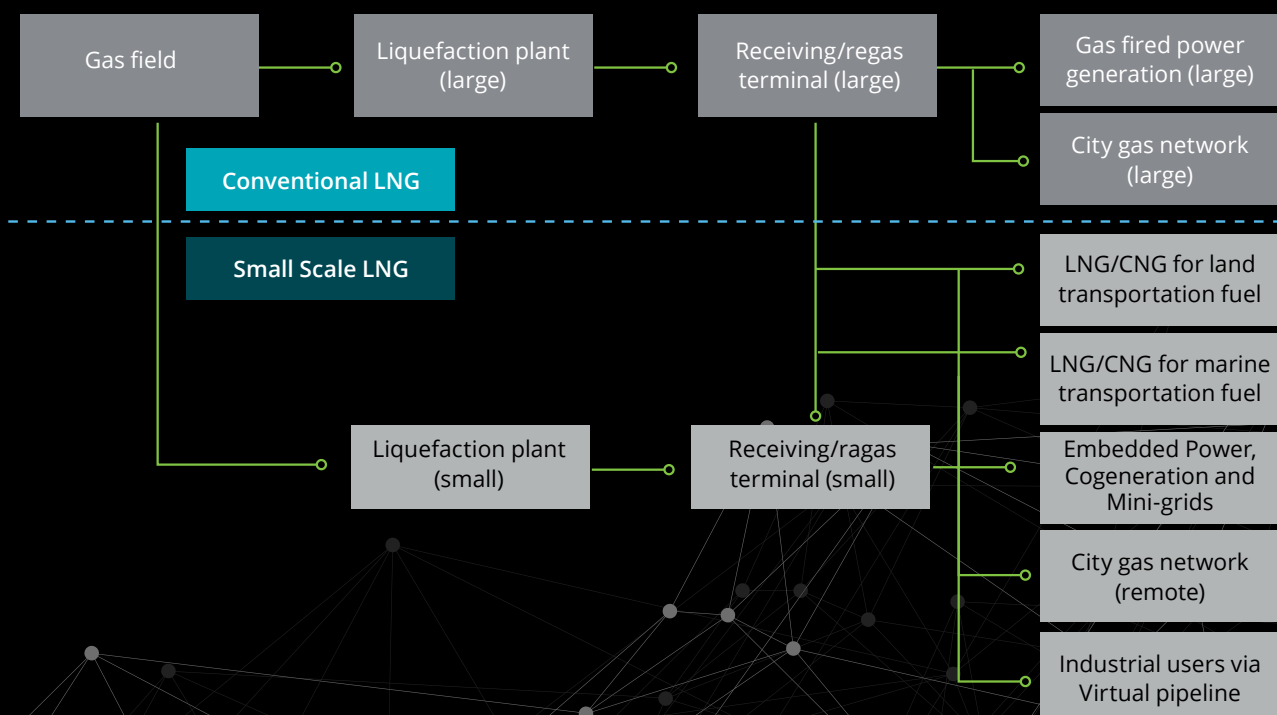
Figure 1: The characteristics and benefits of SSLNG are not only based on efficiency, but there are other factors that play the most important role when selecting the SSLNG technology



Conventional LNG value chains use LNG technology to transport gas between two otherwise discounted points. This leads to regional markets where a single large user (normally gas-to-power) or an existing established natural gas network is supplied by long term off take agreements. SSLNG technology enables LNG to be produced and supplied economically at smaller volumes.

Conventional LNG value chains require a large consumer in order to support the cost of LNG infrastructure; normally gas-to-power. The SSLNG supply chain allows supply to numerous smaller end users. In this value chain, more users and increased flexibility increase efficiency. SSLNG value chains are often built off the back of conventional LNG value chains. Once conventional LNG is available in a region or port, the investment required to establish SSLNG is lowered. This allows for LNG use cases and applications that would otherwise be uneconomical.

Figure 2: Comparison of conventional LNG and SSLNG value chains. Conventional LNG value chain uses bulk transport to connect the liquefaction to remote distribution networks. Small scale uses remote storage of LNG and smaller transport of LNG in liquid form to connect end users that do not have natural gas distribution network access, (typically tens of m3) mounted on specialised LNG trucks or rail cars to LNG or Compressed Natural Gas (CNG) fuelling stations or small scale storage facilities. Conventional LNG requires long term offtake agreements to balance the high initial cost. SSLNG often piggy backs off existing projects/infrastructure and opens up new end users.





Applications of SSLNG are currently in three major end uses: marine fuel (bunkering), fuel for heavy road (and rail) transport, and power generation in off-grid locations. As technology enables more flexible supply, other markets will emerge.

Table 1: SSLNG markets. SSLNG allow for flexibility and cost-effective delivery, short term supply agreements become possible and end user quantities can be scaled up or down fairly easily because of modular design.

Land Transport Fuel



Transportation in natural gas-fired vehicles (NGVs), including CNG fuelled vehicles that store gas in high-pressure containers and LNG fuelled vehicles that store natural gas in a liquid state in ultra-low temperature containers.

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Marine Transport Fuel



Offshore carriers and cruise ships fuelled with LNG; this plant type is the solution for LNG ship fuelling. On demand, these terminals can be equipped with additional LNG distribution facilities, e.g. truck- and container-loading facilitating a virtual pipeline.

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Power Generation in Remote Areas



Application in remote locations where there is no natural gas pipeline grid is in the vicinity. SSLNG-to-power is the fuel supply solution for local gas fired power plants, which on demand, these terminals can be equipped with LNG distribution facilities, e.g. truck- or container-loading facilities.

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Industry and Transport



Use of LNG in heavy machinery and trucks in the mining and resources sectors, and at construction sites.

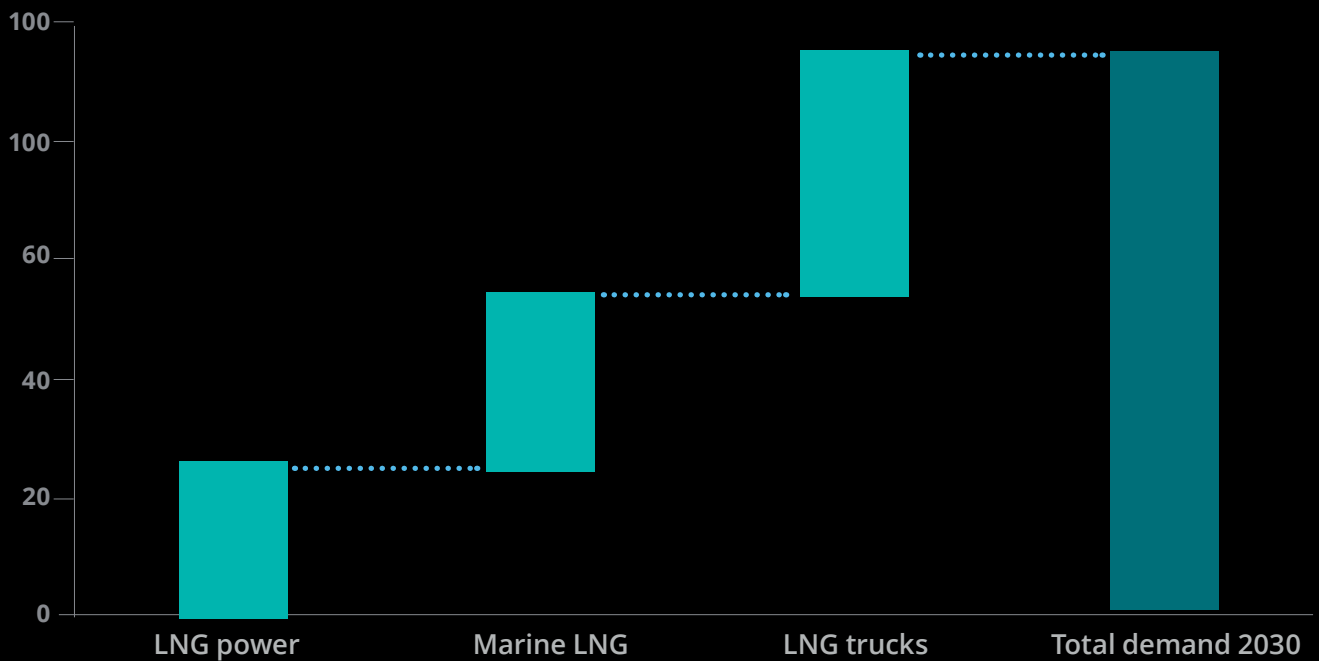
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Opportunities for SSLNG are particularly prevalent in markets where other forms of energy are expensive, unavailable or unreliable. Even in energy markets where competition is high, SSLNG can compete due to low energy unit costs and flexibility. Growth projections for the SSLNG market are high, with the IGU predicting a global demand for SSLNG of 30 million tons this year. Demands are expected to increase with estimates of be between 75 and 95 million tons by 2030, with 26% in power, 32% in marine bunkering and 42% in fuel for heavy road transportation.

Furthermore, the global SSLNG market accounted for USD 29.31 billion in 2018 and is expected to reach an estimated value of USD 49.66 billion by 2026, growing at a compound annual growth rate (CAGR) of 6.81% during the forecast period of 2019-2026.

Figure 3: Global demand for SSLNG by segment (2030 forecast) Source: Engie Strategy & Research



The risk of participating in the SSLNG industry is reduced because the underlying gas processing technology is similar to that of conventional large scale LNG. The risk for building out SSLNG infrastructure can be reduced by leveraging large scale LNG technology and techniques. Specific attention needs to be given to the cryogenic materials required to handle LNG. Both the design of and fabrication techniques using specialised materials are not always available and the cost of these skills can be significant due to their scarce nature. Recently, modularised designs have allowed the development cost to be reduced and speeds up project development.

Table 2: SSLNG value chain cost breakdown example for plant construction. In the upstream, liquefaction construction requires an investment of around \$850 million USD for a plant capable of handling 1 mtpa (according to comparative analysis of similar projects in Europe). In the midstream, each 30 000 m3 LNG ship in the fleet would cost \$85 million to \$100 million. Regasification and storage plants (ship berthing, storage tanks, etc.) would cost \$0.6-\$0.8/mscf, being the investment cost for a tank of 28 000 m3 as \$60 million. The weighted average unit cost of onshore regasification is set to \$285/tonne in 2018.

Source: Technology and Science for the Ships of the Future (book published 2018 by IOS Press)

Liquefaction	Shipping	Regasification & Storage	Total
\$1.32-\$2 / GJ	\$0.94-\$1.14 / GJ	\$0.57-\$0.76 / GJ	\$2.84-\$3.88 / GJ



The route to SSLNG supply in Southern Africa

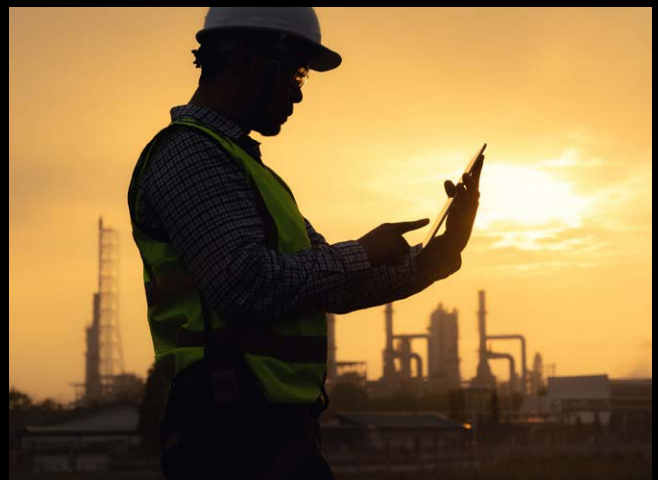
Many businesses, when considering small scale LNG in efforts to reduce cost and / or greenhouse gas emissions, encounter the limited availability in Southern Africa. Despite the hype, LNG has not been available in Southern Africa. Recent changes as well as potential upcoming developments indicate that this may change very quickly. There are a number of locations to watch as potential starting points for the supply of LNG in the region: 1) Matola, Mozambique 2) Richards Bay, Coega and Saldanha Bay, South Africa and 3) Indigenous South African LNG production

1. Investment in an FSRU in Maputo Harbour to supply a proposed Gas-to-power plant in Matola. The FSRU will regasify LNG before bringing the gas onshore. This means that LNG will still not be available, as additional investment would be required to store and distribute LNG; however, the investment required becomes smaller after the FSRU begins operating. The project is currently scheduled to begin operating in 2023.
2. Richards Bay has been indicated as a preferred location for importing LNG in the South Africa Integrated Resource Plan (IRP). Other locations under consideration include Coega and Saldanha Bay. While Richards Bay has access to exiting natural gas pipeline networks, Coega and Saldanha are relatively close to peaking plants. These peaker plants currently run on Diesel, and converting them to run on LNG may significantly reduce their operating costs. Timelines for these projects are unclear as they are dependent on approvals by South African Government agencies as well as private sector consortiums.
3. Lastly, small amounts of LNG will be produced regionally. In the Free State, a start-up company plans to produce small quantities of LNG to be supplied for trucking along the N3 transport route. Production of 50 tons per day will begin in Q2 2021, increasing to 645 tons per day by 2023. Although small compared to other LNG projects, it will be a good test case for the small scale LNG appetite in the region.

In the Southern African region, SSLNG provides a great opportunity in the electricity and energy sectors, due to the challenges faced with securing reliable electricity supply from state-owned utilities.

SSLNG opportunities are suitable where it is easier to secure product off-take agreements for energy supply in remote areas where gas pipelines are not available. Increasingly, end user gas buyers are looking for agile purchasing terms that treat LNG as a commodity to be traded, rather than entering long-term fixed contracts. Therefore, SSLNG is an attractive way of delivering natural gas to areas of demand because of (1) its ability to produce LNG at remote locations and (2) readily available technologies to conveniently transport the LNG to small end users cost effectively. The primary challenges for entering SSLNG lies in developing the markets and infrastructure downstream of the plant production units due to the fact that SSLNG is structurally very different from large scale LNG businesses (even though the processes are similar in both businesses). Constructing small modular plants typically takes between 24 and 36 months to deploy, equivalent to short to medium term construction timelines.

In the Southern African region, SSLNG provides a great opportunity in the electricity and energy sectors, due to the challenges faced with securing reliable electricity supply from state-owned utilities. Users can use SSLNG as an alternative to diesel generation. Even the best state-sponsored utility power build out can take years to deliver, even without delays, and this is especially true in remote and rural areas. Meeting regional energy needs can now be done in a flexible and agile way using SSLNG. With mega-LNG projects under development in Mozambique ([Mozambique Domgas series](#)), regional LNG and natural gas supply will be increasing rapidly, and the price point will be favourable to many end users, presenting opportunities to change the energy mix in Southern Africa at all points in the potential SSLNG supply chain.





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