

An Introduction to Small Scale Liquefied Natural Gas (SSLNG)

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Overview of the LNG market

What is traditional LNG?

Cameron LNG liquefaction terminal



When gas fields are too remote from gas markets to be connected by high pressure pipeline, the gas can be cooled to -161°C and stored as a boiling liquid for transportation by ship and road-tanker.

Marine transport by LNG vessel



Large LNG projects typically transport LNG (gas cooled to -161°C) by ship. Although as shall be seen later SSLNG projects are transporting gas by road tanker and smaller LNG ships.

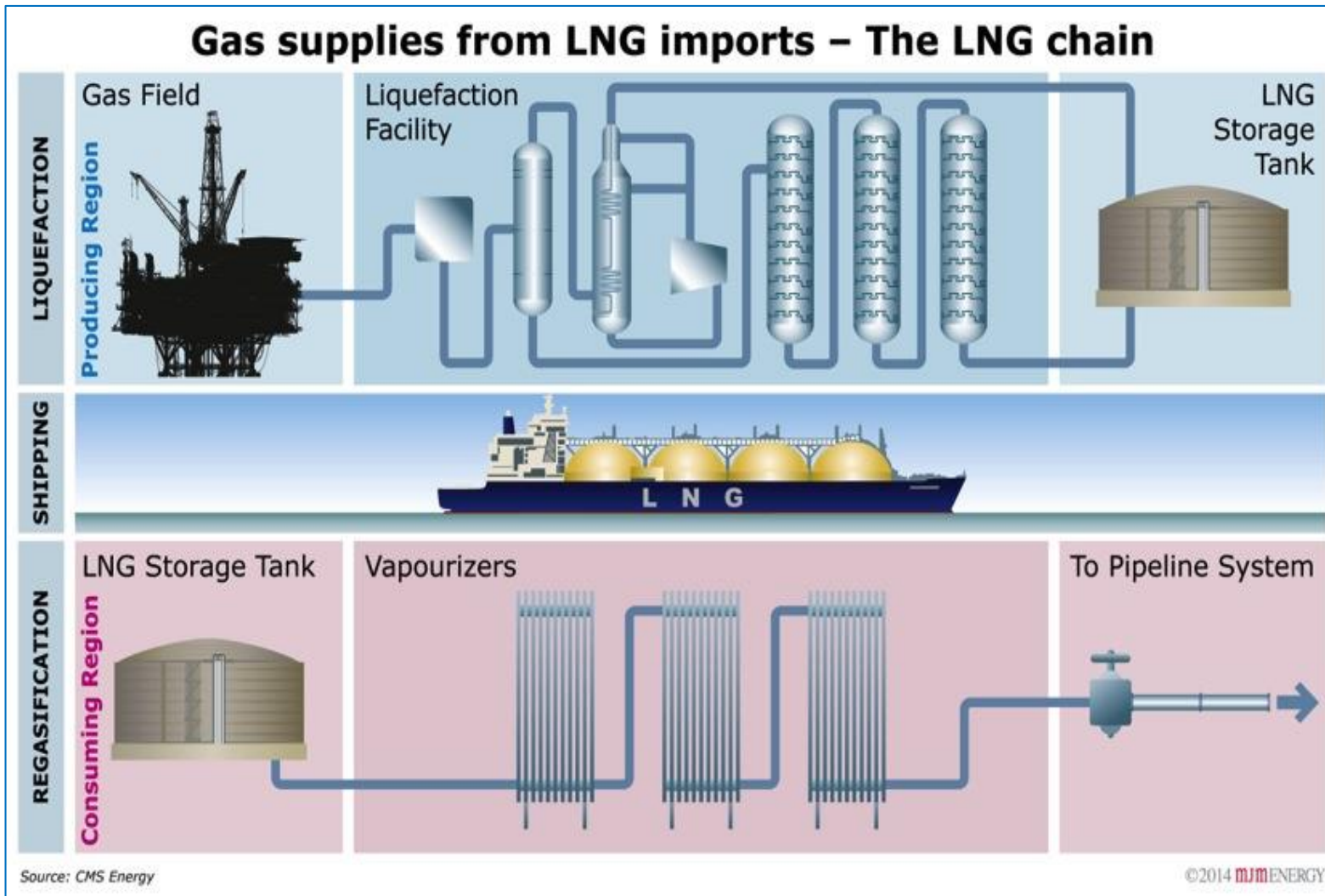
South Hook LNG regasification terminal



Upon arrival in the consuming country LNG is stored as a boiling liquid, which is then regasified for delivery to customers. LNG can also be used for peak-shaving and the growing market for SSLNG.

Overview of the LNG market

The LNG supply chain

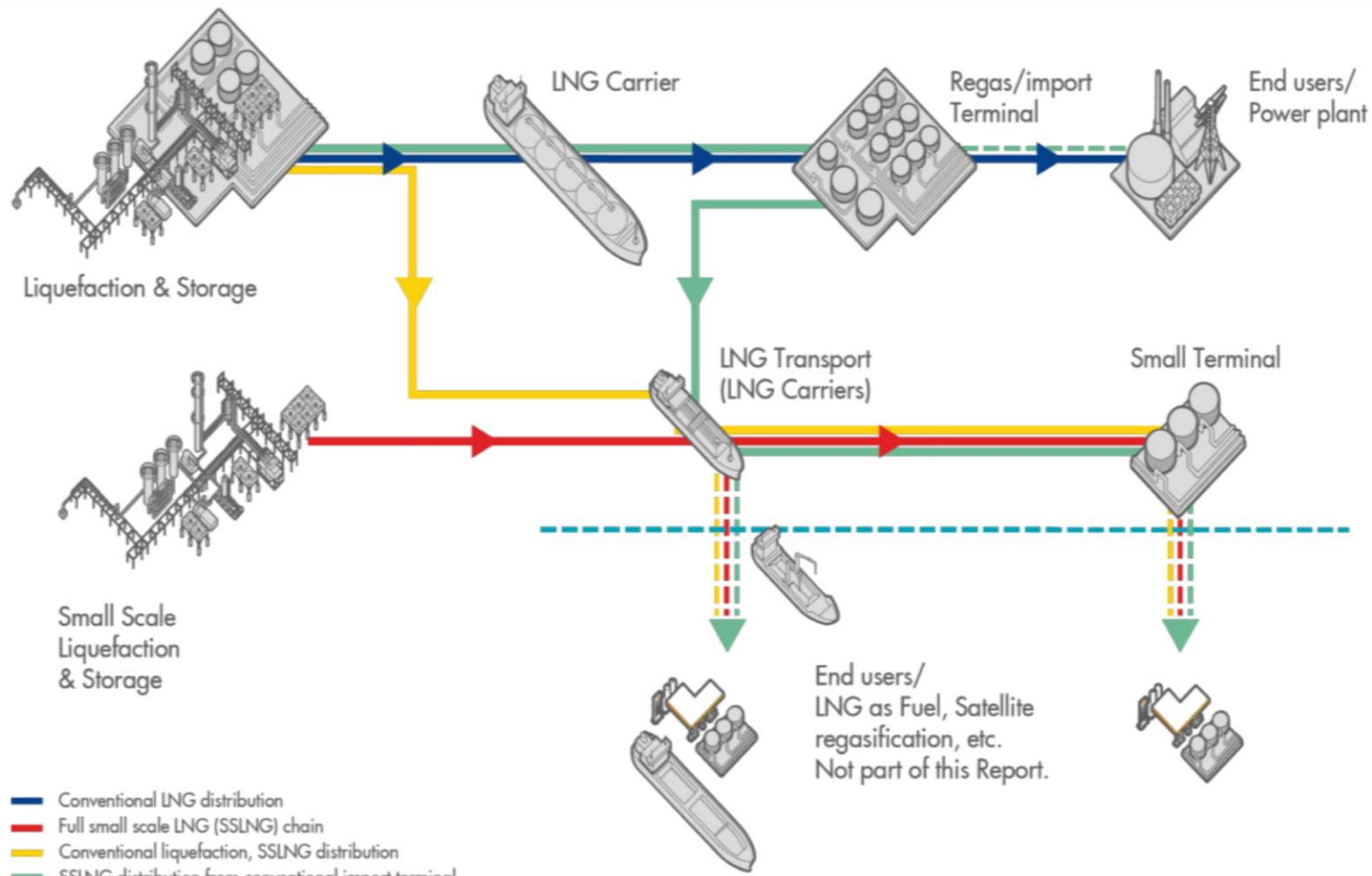


LNG supply chain technologies

- Traditional LNG – This is capital intensive and so requires large volumes of gas to underwrite CAPEX costs.
- The LNG supply chain shares processes similar to the natural gas supply chain, with several additional steps.
- The LNG chain can be split into five categories: Production, Liquefaction, Transportation, Storage and Regasification.

Overview of the LNG market

Description of Small Scale LNG (SSLNG)



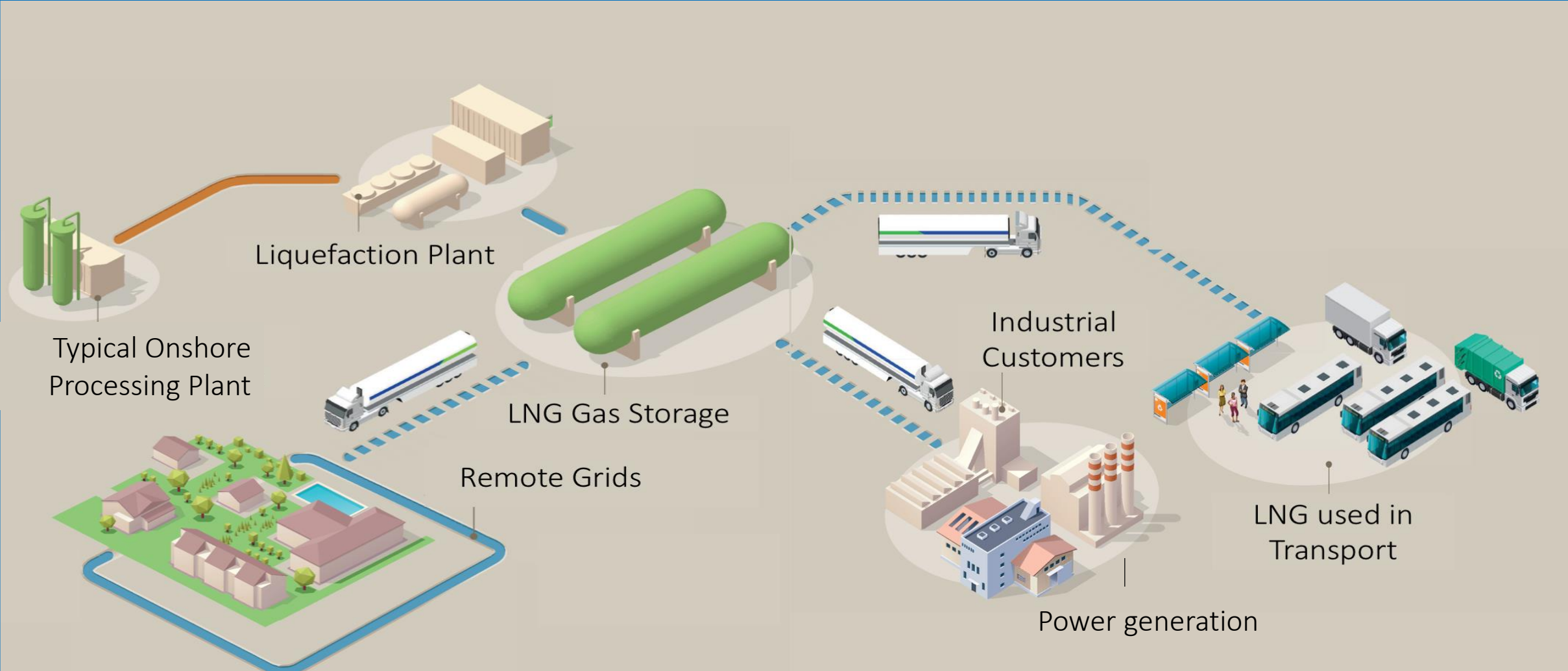
(Source: International Gas Union 2014 – Small Scale LNG)

The development of the SSLNG industry

- Conventional LNG business – Consists of a liquefaction plant, transport, regasification and end-users.
- SSLNG value network – SSLNG can be sourced from either an existing scale LNG facility, (liquefaction or regasification) facility, or from an SSLNG liquefaction facility itself.
- SSLNG serves a wider range of end users via truck or ship.

Overview of the LNG market

Schematic example of SSLNG



Overview of the LNG market

Description of Small Scale LNG (SSLNG)

The development of the SSLNG industry

- SSLNG is suitable for smaller volumes and markets – Large scale LNG use may not be suitable due to low levels of demand, geographical isolation, insufficient funds etc.
- Growing energy demand – Ever-increasing global demand for LNG includes a growing market for the use of LNG on a smaller scale, driven by a combination of economics and environmental factors.

Typical players and description of market

- Typical size range for SSLNG – While there is no official definition SSLNG is typically defined based on throughput of 0.05 to 1.0 mtpa.
- Major investors – Typically this will include players such as Shell, Engie and Gazprom, who either want to serve the shipping bunker fuels or smaller power generation markets.

Reasons why the SSLNG market is growing

- Environmental drivers – SSLNG can displace diesel and other high carbon fuels.
- Reducing unit costs - Modular technology allows initial investments to be lower and faster project commissioning.
- Development of smaller remote markets – SSLNG allows smaller volumes of SSLNG to be trucked or shipped to smaller customers.

Detailed review of the SSLNG market

Onshore SSLNG transportation technology

SSLNG tanks can be transported via truck



SSLNG tanks can be transported by train



SSLNG tanks can be transported by ship



- **Typical onshore transportation** – LNG can be transported in smaller volumes within ISO Containers. These are cryogenic pressure vessels available in a variety of sizes. Most commonly 20, 40 or 60 foot are able to store LNG.
- **Mode of transportation** – The ISO tanks can be loaded onto ships, trucks and rail cars for transportation.
- **Technical constraints** – Containers have holding times dependent on the build of gas vapours. The fill level will change holding time and distance that can be covered before boil-off gas must be vented. Lower fill levels provide longer holding times but increase unit cost of each container. Although this is not expected to be an issue for Namibia.

Detailed review of the SSLNG market

Potential markets for SSLNG (Power Generation)

Power generation for isolated settlements



Power generation for remote sites (eg.mines)



Power generation for small on-grid power



- **Remote power stations** - LNG can provide the primary source of fuel for power stations in remote areas where no natural gas pipelines exist, and only liquid fuels such as diesel are used.
- **On-grid power** – In some cases SSLNG can displace liquid fuels supplying a power station.

Detailed review of the SSLNG market

Potential markets for SSLNG (Others)

SSLNG can be used as a fuel for lorries



SSLNG can be used to supply off-grid customers



SSLNG can be used to supply small vessels



- ***A growing and diverse market*** – SSLNG forms a small percentage of the total global use of LNG, however its application can also be seen in a wide selection of markets around the world.
- ***Growing markets*** – These include power generation, marine vehicles and off-grid gas supplies.
- ***Growing energy use*** - A universal driver for SSLNG use is increasing population size leading to increased demand.

Detailed review of the SSLNG market

SSLNG Case Study: Greenville LNG, Nigeria

The development of the SSLNG industry

- **Need for power generation** – Nigeria has a struggling electricity supply system and limited gas transmission infrastructure. A virtual pipeline scheme has been launched to transport LNG across the country.
- **The Greenville project** – This involves a small liquefaction plant, which will provide LNG for transportation using a fleet of 750 cryogenic tank trucks. Will allow for gas delivery to inland and Northern Nigeria where there is insufficient gas pipeline infrastructure.
- The project consists of a total of 74 mmscfd of gas deliveries and allow for a boost in power generation and industrialisation within Nigeria.



Detailed review of the SSLNG market

Potential costs for SSLNG

Gas supplied from
The gas field



LNG made using
SSLNG plant



LNG transported
by tanker



LNG transported
by tanker



\$1-2 / mmbtu

\$3.0/mmbtu
(± \$0.5/mmbtu)

\$1.5/mmbtu
(± \$0.5/mmbtu)

\$1.0/mmbtu
(± \$0.5/mmbtu)

Concluding comments

Potential benefits of using SSLNG

The development of the SSLNG industry

Good reasons for developing SSLNG include the following:

- ***Ideal where gas network infrastructure has not developed*** – SSLNG works well for markets with limited power or gas network infrastructure.
- ***SSLNG can supply isolated markets*** – SSLNG can provide an economic fuel to remote towns or industrial users such as mines or other remote industries.
- ***More economic than the equivalent liquid fuel*** – SSLNG can provide an economic alternative to diesel fuel.
- ***Environmentally friendly*** – SSLNG can provide a fuel with lower carbon emissions than coal or oil.
- ***SSLNG liquefaction equipment is modular*** – SSLNG Equipment can be modular allowing for “plug-in-and-play”.



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