Natural Gas & Liquid Natural Gas (LNG): Energy Transition

What role will natural gas play in reducing emissions? What will influence integration of LNG into German energy markets?

Natural Gas’s global growth position is underpinned by: its advantages over other fossil fuels in emissions abatement, its cost competitiveness, and its complementary (non-disruptive) integration into existing energy infrastructure and smart energy solutions that can balance the fluctuating supply of renewable energy. Its efficiency, storage capabilities, abundant availability, and economic viability legitimizes its “keystone” role in Germany’s Energy Transition.

Gas is widely accepted as best practice in bridging the German Energy Transition. Germany’s continued commitment to a cleaner and renewable-based energy market will require additional gas infrastructure investment. To hedge against ever-tightening emissions regulations and a projected natural gas import gap, the German government has announced its support for investments in LNG propulsion systems and infrastructure.

Opportunities: Market Making Legislation

- Currently, Germany has no significant LNG market. Except for minor bunkering facilities, LNG infrastructure is non-existent.

- Market driver: Germany’s Energiewende (“Energy Transition”) and the country’s ambitious climate goals, necessitate the construction of additional gas infrastructure. German Government and EU Legislature view investments in Natural Gas infrastructures as a priority.

- With coal-fired and nuclear power phase-out and strong demand for clean mobility solutions, domestic gas demand is predicted to experience continued growth through 2040.

- By requiring Transmission System Operators (TSO) to foot 90% of the grids connection costs, governmental regulators (June 2019) have confirmed Germany’s political pledge to establish large scale feed-in infrastructure domestically.

- With large-scale LNG (import terminals with pipeline feed-in) maritime delivery the following LNG market segments should attract investment: bunker supply (bunker barge, road tanker, rail bunker), LNG depot (inland port, refueling station, peak-shaving storage, small-scale liquefaction), off grid (local regasification, virtual pipeline), LNG fuels (heavy road and mining, maritime vessels and marine APU, inland barges).

- Germany is facilitating small-scale LNG investments with incentives aimed at diversifying German LNG demand.

Industry Numbers: Gas in Transition

- Rising gas consumption predicted; annual growth rate: 2.2% until 2040

- Germany as a net gas importer: 89 BCM in 2018, equals 95% of total demand

- German (Europe’s largest) natural gas market over USD 200 bn in 2018, LNG share of less than 1 percent is 94.5% dependent on pipeline imports.

- German production is in steady state of decline: from 20% of it national consumption in 2000 to around 5% in 2018.
Biggest growth segments: power generation, district heating and mobility.

European Union’s gas demand: ~500 Billion m³ (BCM) in 2017

European domestic production, current 30% of EU consumption, has started a descent. By 2030, EU production will account for < 10 percent of its demand.

Investment Environment/Legislative Policy: Securing Supply and Diversifying Demand

Germany is buoying LNG fuel demand in trucking and water-transport by offering incentives, which make LNG propulsion-systems more affordable.

By requiring transmission system operators (TSO) to foot 90% of the grid connection costs, governmental regulators (June 2019) have made the framework for large-scale LNG investments more feasible; three re-gas terminal currently in the planning phase.

EU regulation mandates clearer fuel solutions in transport and cross-border mobility.

Germany is a large contributor to globe’s gas sectoral know-how and engineering procurement and construction (EPC) workforce.

Statistical charts slide show: Energy Streamlined

Streamlined Energy Transition
LNG Offers Significant de-Carbonization Potential

What will influence Liquid Natural Gas (LNG) integration into German Energy markets?

Steady Demand Growth for Gas with Declining European Gas Production
Replacing and Building Missing Infrastructure
Efficient Use of Existing Infrastructure
Coal Baseload Competition
Renewables Intermittency
Smart Energy Systems
Nuclear Retirement
Security-of-Supply
Peak Shaving
German Primary Energy and Power Generation
Natural Gas’s Crucial Baseload Role in Nuclear/Coal Phase-out

Primary Energy Sources
13,550 PJ (Germany 2017)

- Natural Gas: 24%
- Petroleum: 31%
- Renewables: 13%
- Lignite (Coal): 11%
- Nuclear: 6%
- Biomass (Wood): 4%

Power Consumption Sources
655 Mrd. kWh (Germany 2017)

- Natural Gas: 33%
- Nuclear: 17%
- Biomass (Coal): 14%
- Lignite (Coal): 29%
- Renewables*: 9%
- Others**: 13%

* Includes Geothermal and Waste Incineration
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Sources: RWE; BDEW: Statistisches Bundesamt (Feb. 2014), Arbeitsgemeinschaft Energieberater e. V. (May 2016)

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Natural Gas Growth Segments in Germany
Mobility & Power Generation Predicted High Growth Segments

Source: Esen (Energieprognose Deutschland 2018-2040)

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Gas vs. Coal Effluents
Gas Offers a Cleaner Alternative for Energy Production

Source: Energy Institute Administration (Natural Fuel, www.natfuel.com)
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European Gas Imports in 2018 (BCM)
Germany: Europe's Largest Gas Importer, Virtually No LNG

Source: Gaspe 2019
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EU Natural Gas Imports
Imports totaled 408.7 Bcm, with 5.5% YoY Growth (2017)

EU Natural Gas Imports

<table>
<thead>
<tr>
<th>Source</th>
<th>2017 Bcm</th>
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<tbody>
<tr>
<td>Russia</td>
<td>164.8</td>
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<td>Norway</td>
<td>111.5</td>
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<td>LNG</td>
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<td>Libya</td>
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<tr>
<td>Others</td>
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</tbody>
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Trend: Sinking Growing


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LNG Global Snapshot
LNG Deliveries* (BCM)

Source: International Energy Association, OECD Stats 2018

* Deliveries under 200 Mln m³ not included
Regulations: Maritime Fuel Emission
Technological Solutions Result in LNG as Best Practice

Maritime Emission Regulations Necessitate Evolution of Industrial Preference

Four out of five shipbuilder decision makers now see LNG as preeminent technology of the future.

Source: International Maritime Organization (IMO), MARPOL

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Global Double-Digit Growth in Maritime LNG Fuel

LNG is not exclusively used for power generation.

LNG Fuelled Ships (2018)

Source: Shell LNG Outlook 2019; Shell interpretation of CNV-GL & Wood Mack
Note: "Other vessels includes fishing vessels, dredgers, etc.
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LNG Fueling European Transport
Additional LNG Infrastructure to Facilitate Demand Projections

Growth in LNG Maritime Fuel (MTPA)

Number of LNG Heavy-Duty Trucks on European Roads

- 280,000 LNG trucks expected by 2030
- 155 LNG fuel stations in 2018
- Co-financed by EU, BioLNG EuroNet is building 39 LNG stations, 2,000 LNG trucks and a BioLNG production plant

Source: Shell LNG Outlook 2019; Shell interpretation of DNW-GL & Woodmac
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Europe’s Diversifying LNG Demand
Road Map of LNG Markets Segments in Germany

- Fuel for Maritime & Inland Mobility
- Fuel for Heavy Road Transport
- Fuel for Rail & Aviation
- Gas-to-Liquid (GtL) Synthesis
- LNG Pipeline Feed-in
- Small Scale Liquidation
- Heavy Road Transport
- Development of Small & Medium Scale LNG
- Inland Port Infrastructure & Refueling Deserts

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