Innovation for the track:
Breaking new ground in LNG supply

VTG Aktiengesellschaft
Agenda

1. VTG Aktiengesellschaft
2. The LNG tank wagon
3. LNG supply chain
VTG and Chart enable environmentally friendly LNG transportation by rail within Europe

<table>
<thead>
<tr>
<th>VTG</th>
<th>Leading private hirer of rail wagons in Europe</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>• Project management</td>
</tr>
<tr>
<td></td>
<td>• Definition of development goals</td>
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<td></td>
<td>• Coordination of development and design activities</td>
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<td>• Marketing and sales activities</td>
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<table>
<thead>
<tr>
<th>Chart</th>
<th>Leading producer of storage, transport and distribution systems for LNG</th>
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<tbody>
<tr>
<td></td>
<td>• Design, development and construction of the tank</td>
</tr>
<tr>
<td></td>
<td>• Clarification of technical issues concerning loading, unloading and security</td>
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<table>
<thead>
<tr>
<th>Waggonbau Graaff</th>
<th>100 years of experience in development and construction of premium rail wagons</th>
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<tbody>
<tr>
<td></td>
<td>• Design, development and construction of the underframe</td>
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<tr>
<td></td>
<td>• Final completion of the RTC</td>
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<td>• Tests and registration</td>
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Since 1914
VTG Aktiengesellschaft – leading European rail logistics and wagon hire company

**Railcar**
- around 90,000 wagons and 1,000 different wagon types for all products and industries
- wagon hire │ consulting │ fleet management │ new railcar construction │ maintenance
- driver of innovation in railcar technology and digitization

**Rail Logistics**
- single wagons │ block trains │ wagon pool solutions │ retrack networks
- for liquids, agricultural products and industrial goods
- independent, effective and innovative

**Tank Container Logistics**
- expertise in rail-based, water-borne and road transportation
- transportation of liquids and temperature-controlled products for the chemical, petroleum and compressed gas industries
- transport logistics │ end-to-end solutions │ management of customers' own tank containers
The LNG tank wagon
The LNG tank wagon – technical details
The LNG tank wagon – technical details

Technical details

- tank material: outside: carbon steel (S355NL2) | inside: stainless steel (1.4301)
- nominal volume: approx. 111 m³
- tank code: R10, 4BN
- calculation pressure (gauge pressure): 1.04 MPa = 10.4 bar
- test pressure (gauge pressure): 1.04 MPa = 10.4 bar
- operating pressure (inner tank): 0.7 MPa = 7.0 bar
- outer gauge pressure (outer tank): 0.1 MPa = 1.0 bar
- design temperature: -196 °C / +50 °C | holding time: 4 – 6 weeks
- insulation: vacuum insulation
- tare weight: approx. 45 t | max. payload line category C: ~ 36.6t | max. payload line category D: ~ 42.0t
The LNG tank wagon – technical equipment

Technical equipment

- filling and drain valve
- degassing valve
- safety valve
- pressure gauge
- WBG-buffer protection ACS 2013
- PBUC vaporization unit
- probe on the tank for checking the vacuum
- valve for monitoring the filling level when filling the tank
- valve for extracting LNG samples
- equipped with telematics system
## LNG: a fuel with a future
Demand for LNG will rise in the long-term

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<th>Environmental protection</th>
<th>Efficiency</th>
<th>Safety</th>
<th>Regulatory compliance</th>
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<tbody>
<tr>
<td>- up to 20% less CO₂ emissions compared to other fuels</td>
<td>- The storage and transportation of LNG takes up 600 times less volume than natural gas in an ambient condition</td>
<td>- Transport and storage risks lower</td>
<td>- SECA: Limits on sulphur in shipping</td>
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<td>- up to 90% less nitrogen oxide emissions</td>
<td>- In a gaseous state, LNG ascends and moves away from potential sources of ignition</td>
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<td>- Euro IV, V, VI: Emission limits for heavy haulage</td>
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<td>- almost no sulphur oxides</td>
<td></td>
<td>- National and regional noise control guidelines</td>
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The LNG tank wagon creates a new volume segment within the LNG supply chain.
Advantages of transporting LNG by rail

Transportation of large quantities per transport batch at low costs

Flexible inland supply compared to ship

Long distances can be bridged

Direct delivery to the end-customer

Permanent supply with LNG
### MID-scale LNG supply chain: necessary infrastructure

#### Investments in transport modes
- LNG terminals
- tank depots
- bunkers

#### Rail-specific investments
- sidings
- loading and unloading points for LNG

#### Interface topics
- LNG tank wagons as temporary storage units
Many thanks for your kind attention.