The Global Presence of Vossloh AG

- Vossloh is represented in more than 100 countries worldwide.
Facts & Figures: Transportation

- Vossloh generates a turnover of approx. **€ 450 millions** with **1,900 employees** in Transportation.
Vossloh Locomotives Kiel
The Site
Facts & Figures: Vossloh Locomotives

- European segment leader
- >90 years of experience
- **Mid-cab Diesel locomotives**
  - Shunting and mainline duty (400 – 2,000 kW)
- **Ultra-modern** development, design & production
- **Cost-efficient & Flexible**
- Ecological & green
- **Diesel hydraulic & Diesel electric propulsion system**
Facts & Figures: Vossloh Locomotives

- Headquarters & Production facility
- Production of up to 70 locos/year
- Assembly area: approx. 30,000 m²
- Departments in Kiel
  - Design
  - Research & Development
  - Homologation
  - Production
  - Refurbishment
  - Testing and taking into operation
  - Customer Service
- Approx. 350 employees
Locomotives from Vossloh are …

- **future-proof**
  - Easy integration of future technology such as electrical energy storage, fuel cell, multiple engine or dual mode ⇒ Upgrades possible and foreseen

- **reducing the fuel consumption**
  - The point of operation for the Diesel engine is optimized. Besides we are only using components with a high efficiency. Therefore Vossloh Kiepe developed a new efficient traction chain.

- **very reliable and nearly always available**
  - All components are thoroughly reviewed and absolve several quality gates, because only the best is good enough for our customers. We guarantee an outstanding locomotive availability.
Vossloh Locomotives Kiel
Product - Portfolio
Vossloh Locomotives GmbH

G 6 / DE 12 / DE 18, the product platform
Vossloh Locomotives GmbH
Platform approach

<table>
<thead>
<tr>
<th>Description</th>
<th>Axel assembly</th>
<th>Picture</th>
<th>Engine power [kW]</th>
<th>Operating Weight (t)</th>
<th>Max Speed Höchstgeschwindigkeit (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G 6</td>
<td>C</td>
<td></td>
<td>700</td>
<td>60 / 67,5</td>
<td>80</td>
</tr>
<tr>
<td>G 12/ G 18</td>
<td>B'B'</td>
<td></td>
<td>1200/1800</td>
<td>80 / 90</td>
<td>100</td>
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<tr>
<td>DE 12/ DE 18</td>
<td>Bo'Bo'</td>
<td></td>
<td>1200/1800</td>
<td>80 / 90</td>
<td>120</td>
</tr>
</tbody>
</table>
Vossloh Locomotives GmbH

Platform approach

DE 12 - DE 18
diesel-electric

G 12 - G 18
diesel-hydraulic

60% Same parts

G 6
diesel-hydraulic

40% Same parts
G 6 the 3 axle Shunter
Platform evolution

G 6 Plattformfahrzeug

<table>
<thead>
<tr>
<th>Antriebsmodule</th>
<th>G 6 DE</th>
<th>G 6 ME</th>
<th>G 6 Hybrid</th>
<th>G 6 Eco Hybrid</th>
<th>G 6 BAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>![G 6 DE image]</td>
<td>![G 6 ME image]</td>
<td>![G 6 Hybrid image]</td>
<td>![G 6 Eco Hybrid image]</td>
<td>![G 6 BAT image]</td>
<td></td>
</tr>
</tbody>
</table>
Vossloh Locomotives GmbH
The Gas Project with LPG, until 2011

<table>
<thead>
<tr>
<th>Loco</th>
<th>G 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td>1 MW</td>
</tr>
<tr>
<td>Speed</td>
<td>100 km / h</td>
</tr>
<tr>
<td>Usage</td>
<td>Shunter</td>
</tr>
</tbody>
</table>

- Concept for Fuel tank: 27% less volume than Diesel
- Gas engine, (modified Diesel Engine): 25% less performance than Diesel
Engine

- **Basis**
  - Deutz TBG 620 V12K
  - Piston, cylinderheads, airintakesystem modified
  - Adapted tubes and turbochargers for deployment conditions

- **LPG System**
  - Directly connected to the engine
  - Transient mode
  - Monovalent LPG operation

- **Injectionsystem**
  - Complete new design to apply the 4 stroke Otto principle
Fuel tank & auxiliaries

- **Storage conditions**
  - Pressure 6 – 10 bar
  - Storage temperature as ambient conditions
  - Usage of standard tanks
  - Endurance time unlimited
  - Achieved Volumen 77% of Dieseltank
  - Range 66% of Diesel

- **Auxiliaries**
  - Preheating device for engine has been realized in the concept
Fuel Station

- Stationary Fuel technology
  - as usual for LPG
  - limited experience in rail operation as per today
LPG Learnings

...for Rail applications in Europe, and before loco building

- succes on transient operation
- return of experience for inlet tubes and valves generated
- limited range of operation (performance and fuel capacity)
- new requirements for safety standards necessary
  (crash, maintenance, tunnel, pitches, stations …)
- limited savings of LPG vs. Diesel
- new process for homologation of the system needed
- no special tax fundings due to the limited emissions benefits

Conclusion: possible, but low benefits vs. Diesel
Hydrogen Forecast

...for Rail applications in Europe

- succes on transient operation will be possible
- inlet tubes and valves to be modified
- range of operation depends from storage technology (pressure > 10 bar !)
- high requierements for safety standards to apply
  (crash, maintanance, tunnel, pitches, stations …)
- New process of homologation

Conclusion: will be a matter of future interest!
Perfect Fit for Industrial Logistics