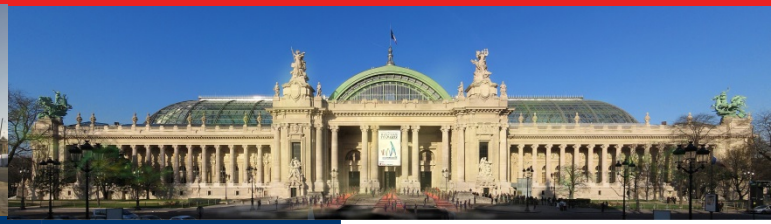
26th World Gas Conference

1 – 5 June 2015, Paris, France



LNG FUEL FOR INTERNAL COMBUSTION ENGINES FROM AN ENGINE MANUFACTURERS PERSPECTIVE

RALF GROSSHAUSER
MAN Diesel & Turbo SE

IGU
WGCPARIS2015
WORLD GAS CONFERENCE

Global Megatrends as Drivers for Gas Fuel

TRANSPORT

Growing global trade, transport and travelling

- The world maritime trade volume will double until 2030

ENERGY

Continuous growth of world population outside Europe and increasing urbanisation

- Energy demand will almost double until 2030
- Strong increase of importance of decentralized energy production

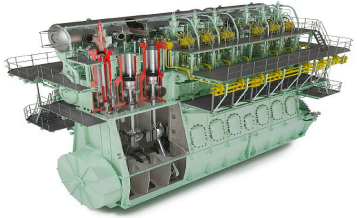
CLIMATE

Change of climate e.g. through increasing CO_2 emissions

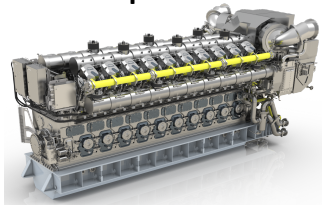
- Introduction of emission limits
- Better efficiency
- New biofuels
- Preference for gas fuel

MAN Gas Engine Portfolio

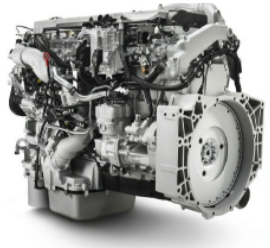
Low speed < 300 rpm 3-80 MW

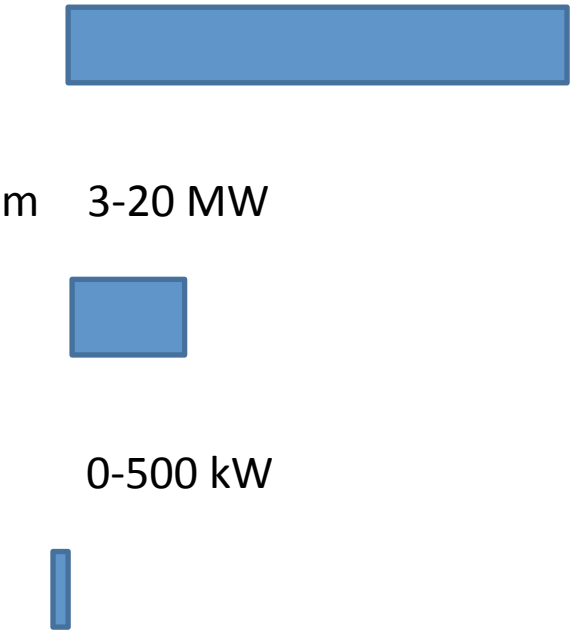


Medium speed < 1000 rpm 3-20 MW



High speed > 1000 rpm 0-500 kW





Dual Fuel Engines (Diesel principle):

- 100 % fuel flexibility;
  fuels: HFO, MDO, MGO, natural gas
- Lean Burn Gas combustion
  ignited by pilot oil injection
- High or low pressure gas supply/admission

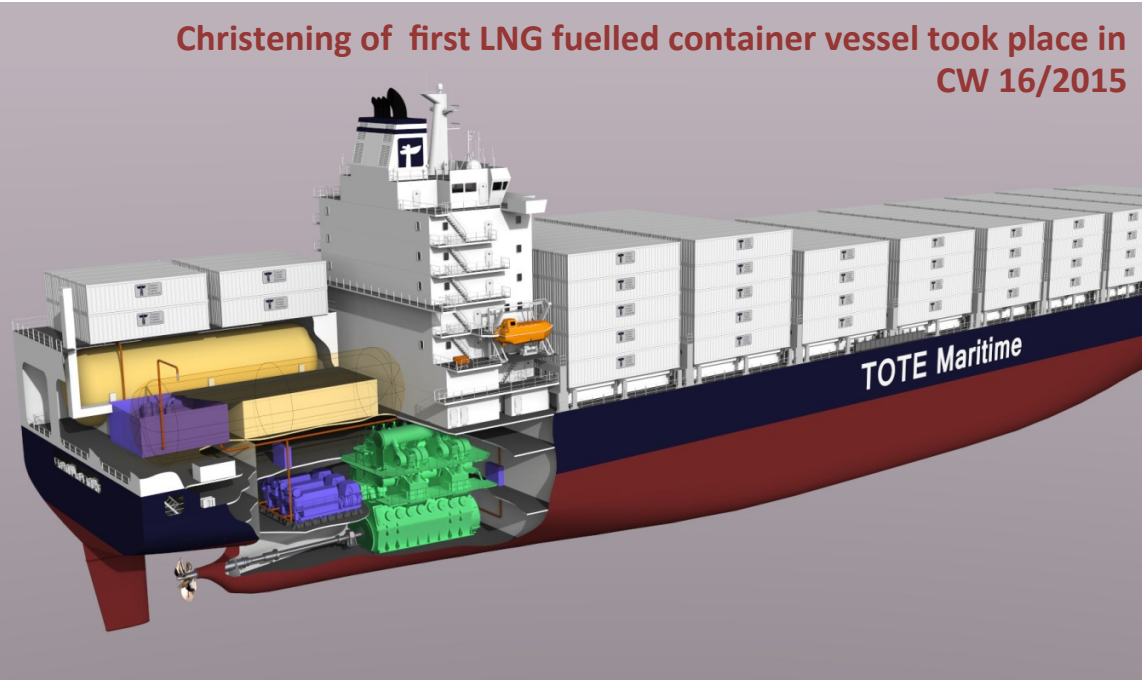
Gas Engines (Otto principle):

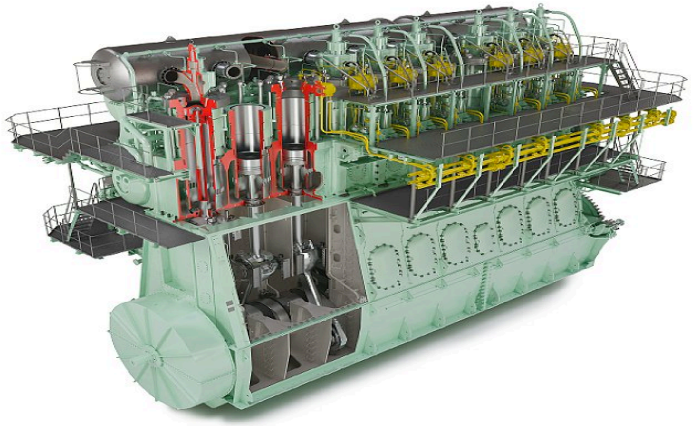
- Fuels: natural gas
- Lean Burn Gas combustion
- Ignited by sparkplug in gas-floated pre-chamber or directly by sparkplug
- Low pressure gas supply/admission

MAN Maritime Applications

Challenges: - Installation of tanks and admission systems
- Standards, rules and regulations to be globally equalized
- Infrastructure and bunkering for refueling to grow

Christening of first LNG fuelled container vessel took place in CW 16/2015



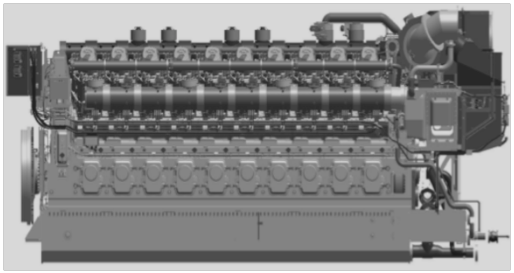


- Gas- / Dual Fuel-2-stroke engine
- Dual Fuel: Fuel Flexibility
- High pressure gas supply
- Optimized combustion process
- High efficiency at reduced emissions
- In combination with Exhaust Gas Recirculation (EGR) und Waste Heat Recovery (WHR) significant reduction of CO_2-, NO_x- und SO_x-emissions

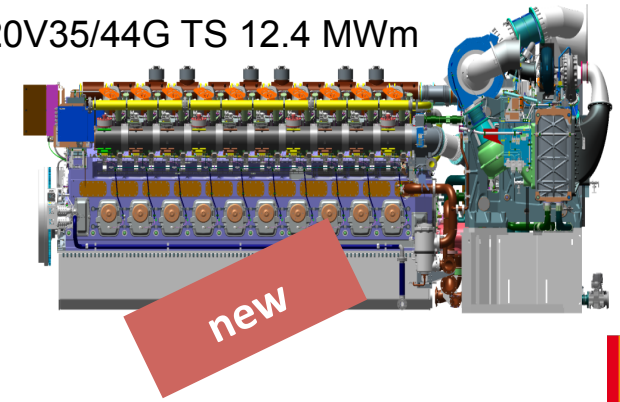
MAN High Efficient Power Generation Application

- **Dual fuel capability: Gas or HFO**
- **6 x 18V51/60DF**
- **Steam turbines combined cycle**
- **Total output > 110 MW**

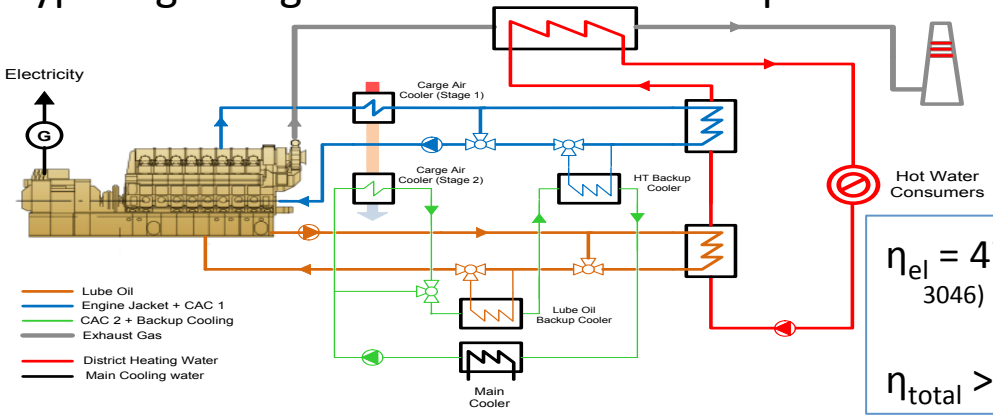
20V35/44G 10.6 MWm



20V35/44G TS 12.4 MWm



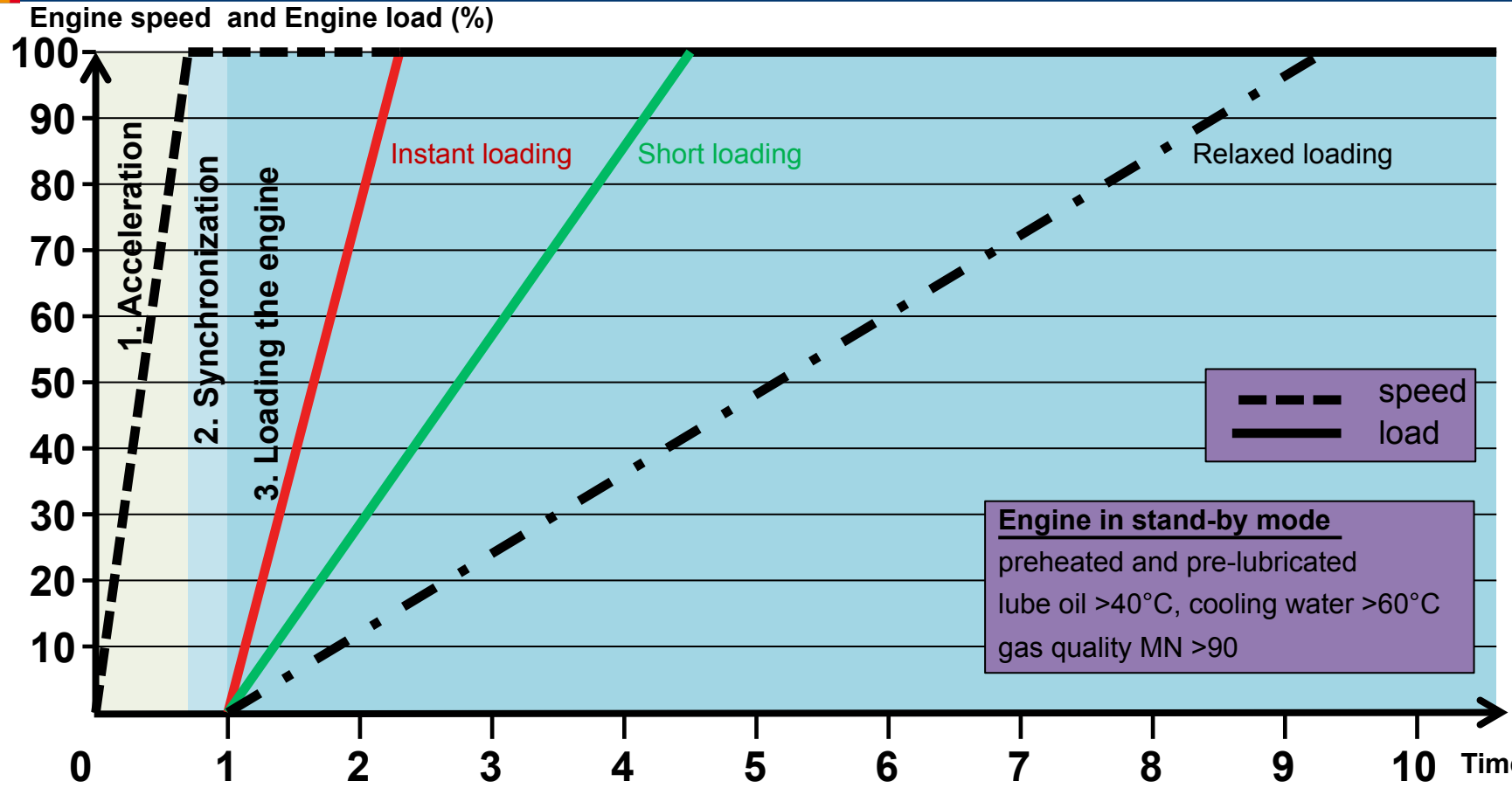
Typical gas engine combined heat and power scheme (CHP):



η_{el} = 47,7 % (Iso 3046)

η_{total} > 90,0 %

MAN 20V35/44G Highly Flexible Operational Behavior



MAN Applications for Traffic and Transport

1943

First MAN Gas-Bus (Citygas)

1972

LNG-Bus (Concept Busses)

1992

First serial CNG-Bus in Germany, SL202

1994

Low-floor CNG-Bus Type A14 / Serial stage

1996 – 2000

CNG-Truck F2000 / Serial stage

1998

Low-floor CNG-Bus Type A23 / Serial stage

2013

Low-floor CNG-Bus Type A26, Euro VI / Serial stage

1998

LNG-Truck F2000 / small series

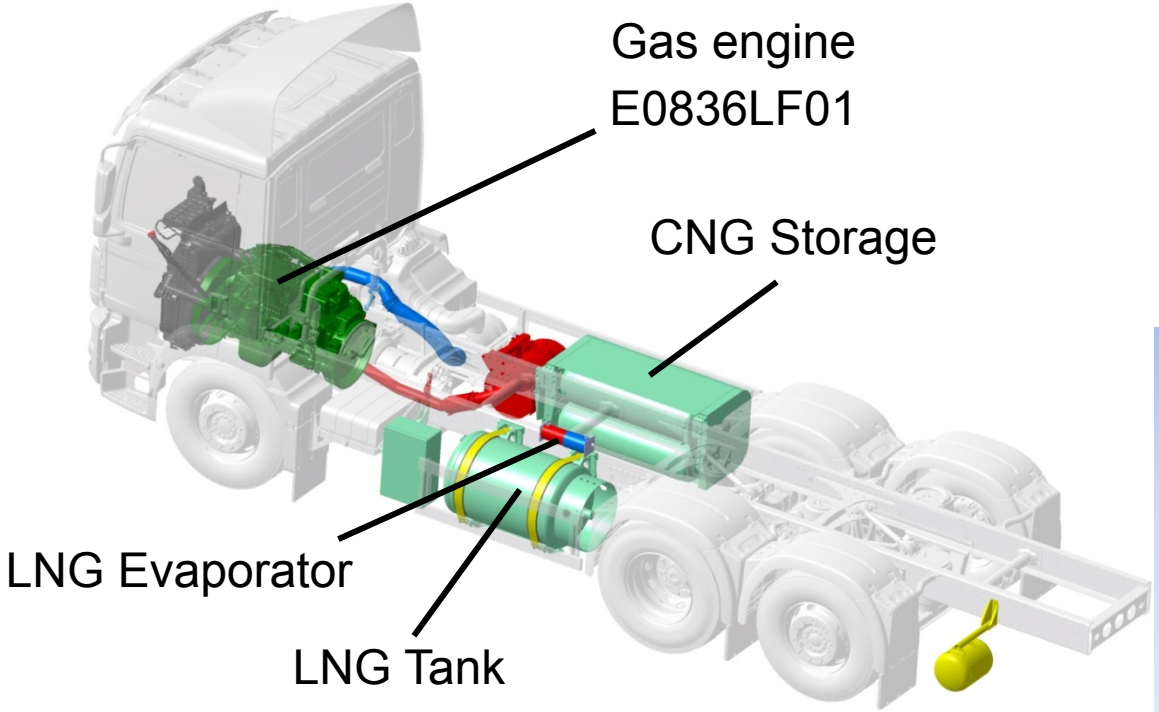
2014

CNG / LNG Concept Truck

2015

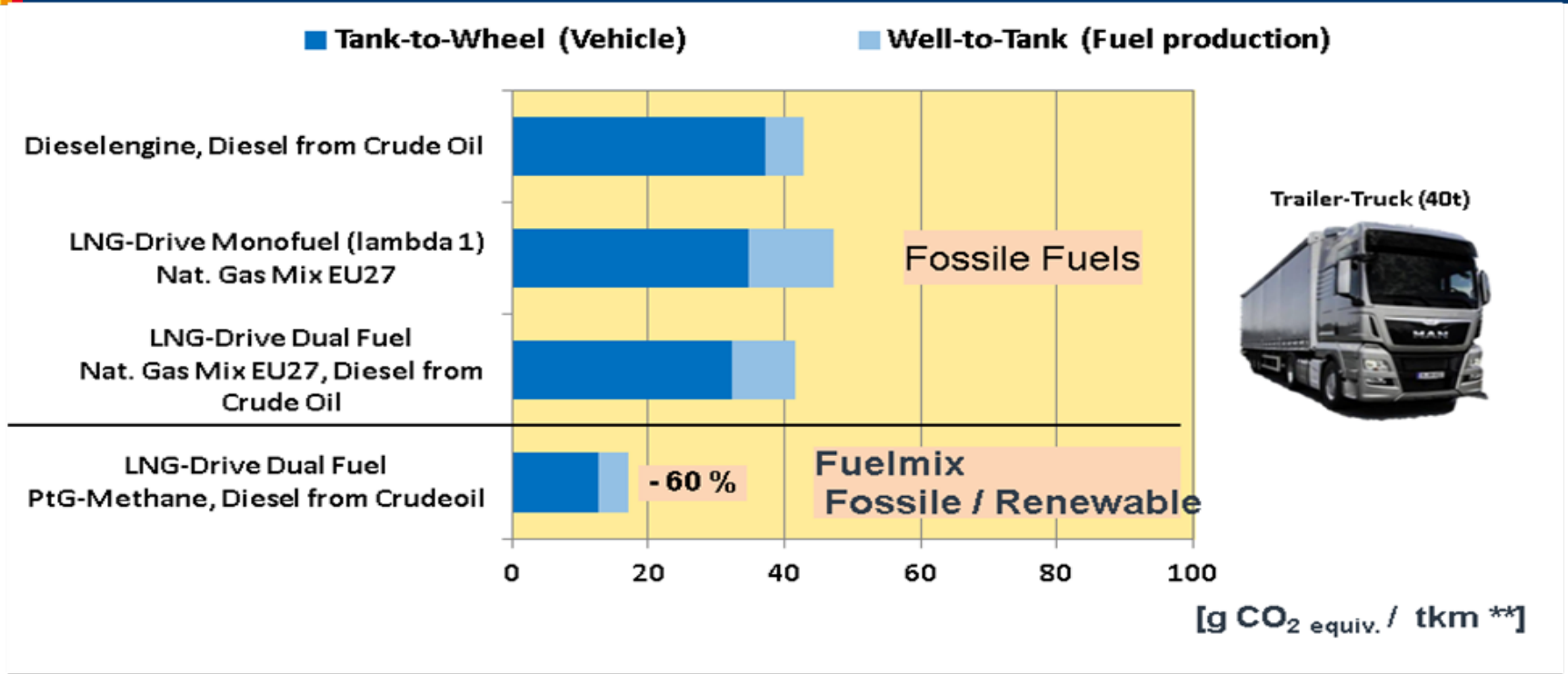
Bus of the Year 2015 Type A 23, Euro VI

MAN CNG/LNG Concept-Vehicle (TGM)



- Base-vehicle CNG-TGM 26.280 , 6x2/2, 26 t total weight
- High flexibility during trial operation through alternative use of CNG & LNG
- Operating pressure 7 bar @ -125°C, max. pressure15 bar (boil off)
- LNG evaporator up to 300HP power output, heated through cooling water

Conclusive view of GHG Reduction Possibilities



* CO_2 In operation balanced with reduction at Fuel production (according to Renewable Energy Directive RED)

** $CO_{2\ equivalent}$ Gram per km and ton Payload (Truck)

Sources: MTB (Vehicleoperation); VW AG (Fuel production)

Thank You very much for Your Attention

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