Waste heat recuperation

- Voith Steamdrive
- Voith Steamtrac
Steamdrive / Steamtrac
Balance of a combustion engine

100% Fuel

~38% Efficiency

* Friction / Heat radiation

\[
\dot{Q} = m c_w (c^* A) \sqrt{\frac{x}{x}}
\]
Steamdrive / Steamtrac
Basic Design

- Closed vapor cycle
- Expander energy to drive auxiliaries or traction
- Condensation due to connection to cooling system
- Vaporization by utilization of waste heat i.e. exhaust heat (EGR and residual exhaust gas)
Steamdrive / Steamtrac

Additional power potential from engine exhaust heat after turbo charger and recuperated engine exhaust heat.
Steamdrive / Steamtrac
Utilization Examples

Steam **Traction**
Boost operation using exhaust heat

Steam **Drive, Auxiliary**
Generator, driven by heat dissipated from cooling system
SteamTrac / Steamtrac
Utilization Examples

Steam **Traction**

Steam **Drive, Auxiliary**

for both systems possible heat sources:

- exhaust
- EGR
- Retarder and transmission oil
- Cooling water
- Charge air
- Compressor
- ...
Steamtrac
Development and Testing Schedule

Expander, control system and feed pump tests on component test stand since 05/2007
Steamtrac
Development and Testing Schedule

11/2007 system testing on a engine test bench.
Steamtrac testing Rail
Next Steps

=> 2008 Steamtrac testing in Railpack on Railpack test bench
=> 2008 Steamtrac testing in Railpack in a Railcar
SteamTrac
Maxima 40 CC – 3600kW diesel engine

- Fuel savings across driving profile approx. 10%
- 12% higher performance at rated load
- 20% higher performance at part load

Utilization of exhaust heat from Steamtrac for additional transmission input power:
- + 248 kW
- + 285 kW
- + 439 kW
SteamDrive / SteamTrac
Time scheduling

- Rail DMU Railpack
- Truck / Bus
- Industry
- Rail Locomotive
- Marine
Voith Steamtrac / Steamdrive
Applications outside of railcars

Rail
- DMUs / Locomotives / Auxiliary systems

Road
- Truck / Bus

Industry
- Engine test bench, block heat an power plant, pipeline compressor

Marine
- Ferries, Cargo ships