



Future energy carriers and propulsion systems for buses and long distance trucks

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Senior Vice President
Volvo Technology AB

Welcome to Volvo Group

Volvo Group is one of the world's leading suppliers of transport solutions for commercial use.

We also provide complete solutions for financing and service.



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A3PS, Vienna November 18, 2010

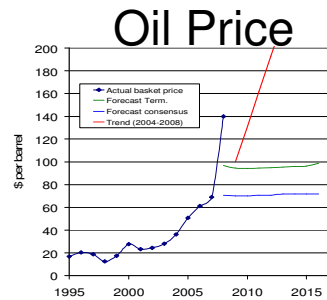
2 Date

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Volvo Corporate Values



Current global issues



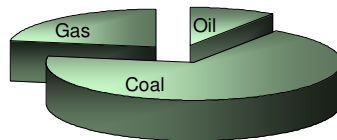
Global Warming



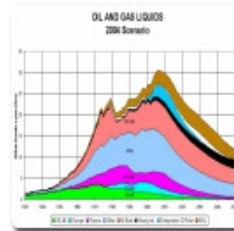
Global economy



Energy Reserves



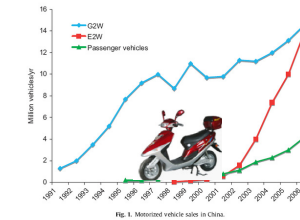
Peak Oil



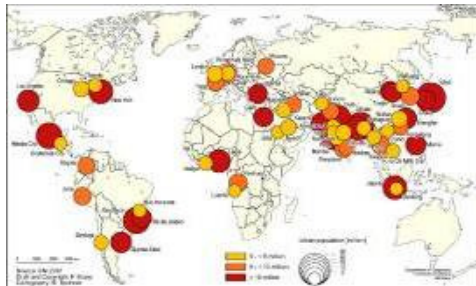
Fuel/Food



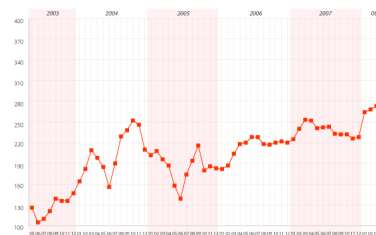
New technology



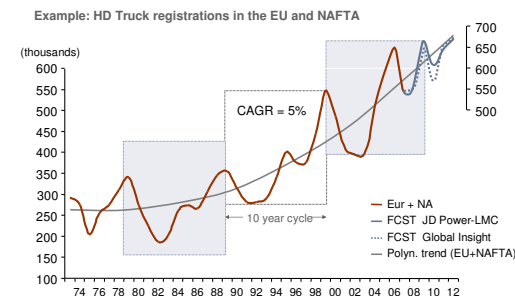
Growing cities



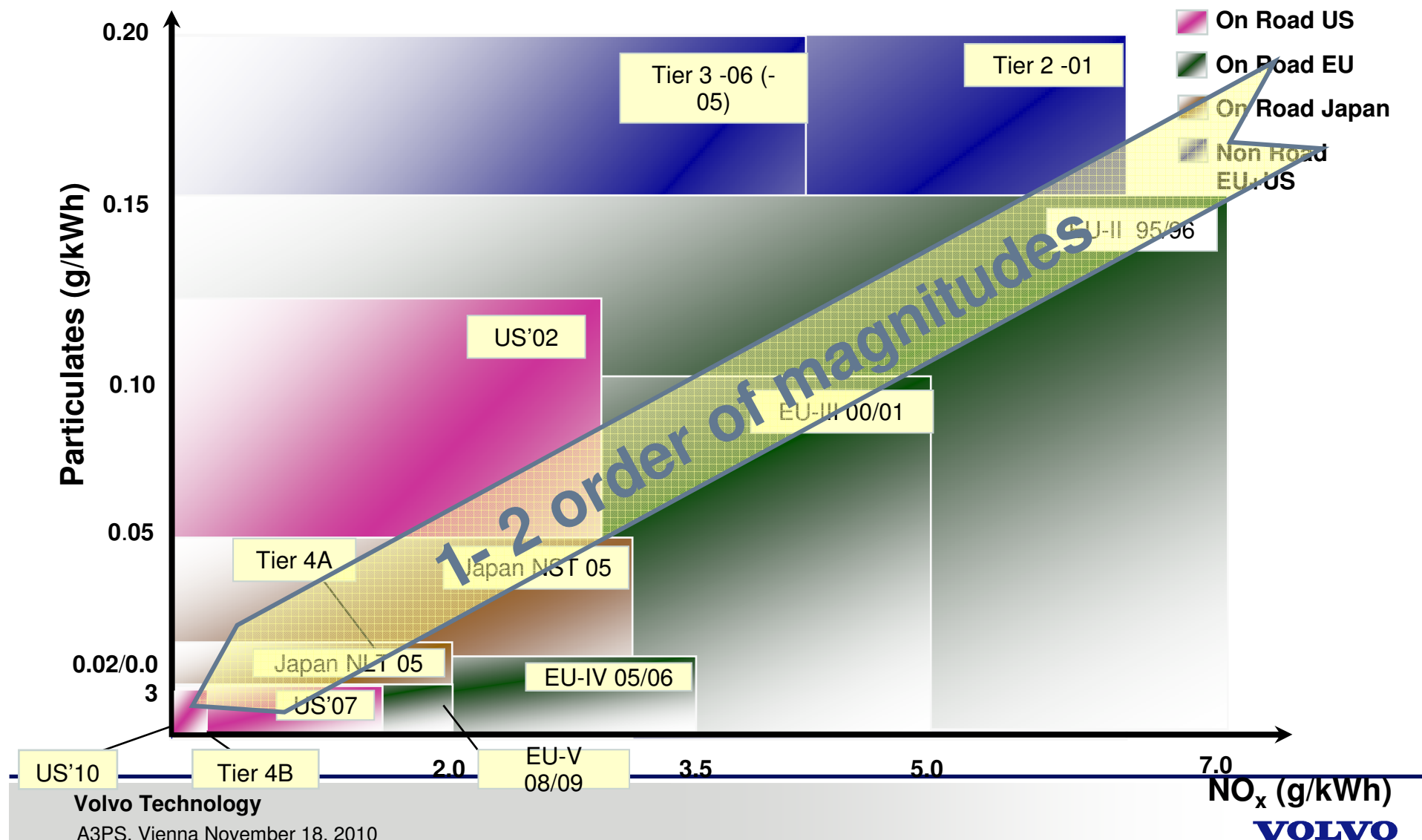
Raw material price



Business Cycles



Exhaust Emission Regulations



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European road transport advisory council

Guiding objectives for 2030

| By 2030 Road Transport is 50% more efficient than Today | | |
|---|---|------------------------------------|
| | Indicator | Guiding objective for 2030 |
| Decarbonisation | Energy Efficiency: Urban Passenger | +80% |
| | Energy Efficiency: Long Distance Freight | +40% |
| | Share of Renewables | Biofuels: 25% Electricity: 5% |
| Reliability | Reliability of transport times | +50% |
| | Urban Accessibility | Preserve Improve where possible |
| Safety | Accidents with fatalities and severe injuries | -60% |
| | Cargo Lost to Theft and Damage | -70% |

Table 1. Clear guiding objectives for Decarbonisation, Reliability and Safety in Road Transport.
 The mission of '50% more efficient Road Transport' is articulated in leading indicators on Decarbonisation (3), Reliability (2) and Safety (2). Each indicator is furnished by a guiding objective for 2030 either indicating the improvement versus a 2010 baseline, indicated with '+' or '-' sign or an absolute level as is the case with 'Share of Renewables'.

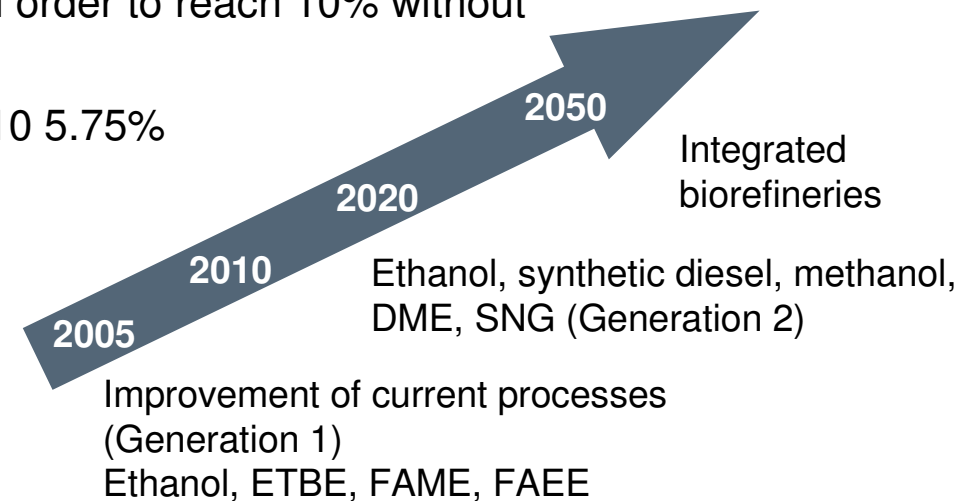
Biofuels will cover some of the demand

- Targets and current status in EU

- 10% renewable fuels for road transport 2020
- 2:nd generation technologies needed in order to reach 10% without compromising sustainability*
- 4% in EU-27 2009, indicative target 2010 5.75%

- Vision for EU

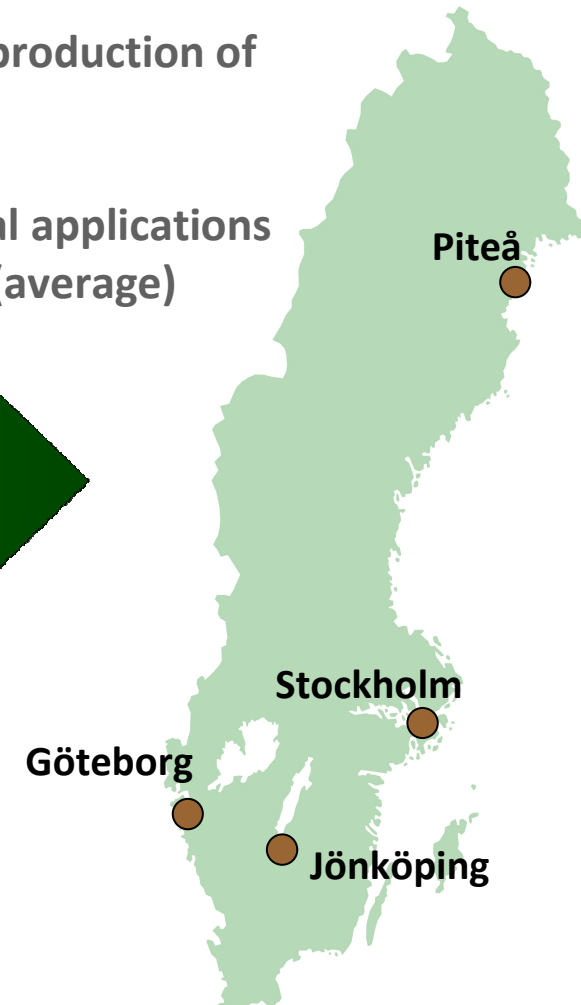
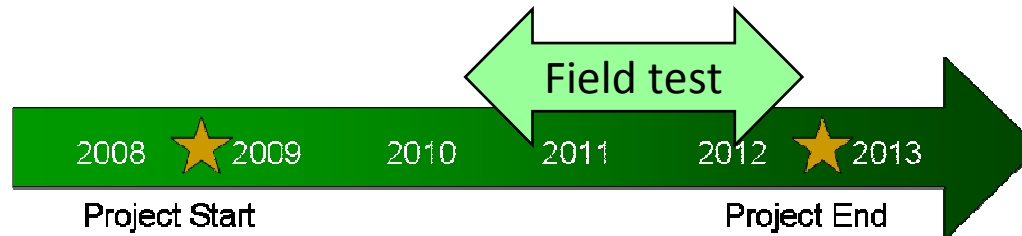
- 25% renewable fuels 2030



Source: www.biofuelstp.eu *IFPRI report 2010

BioDME - Field test

- BioDME project demonstrates full chain from production of fuel from biomass to the utilisation in vehicles
- 14 Volvo DME trucks in customer operation
- Demonstrate and verify DME technology in real applications
- Planned yearly distance 100 000 km per truck (average)



Volvo's position on Future Fuels

- Diesel fuel, increasingly from biomass resources, will remain the dominant fuel for at least two decades
- Natural gas and biogas will be used regionally
- DME is a strong candidate for a more long-term future fuel:
 - CO₂ neutral if produced from biomass
- All fuels can be combined with hybrid drivelines



Technology is there - Fuel availability a problem



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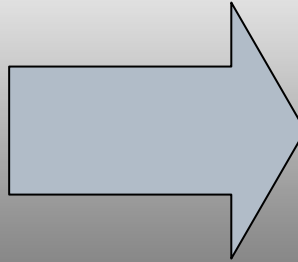
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Energy efficient R&D LH technology solutions

- Energy efficiency
- Energy saving
- Energy recuperation



Powetrain efficiency

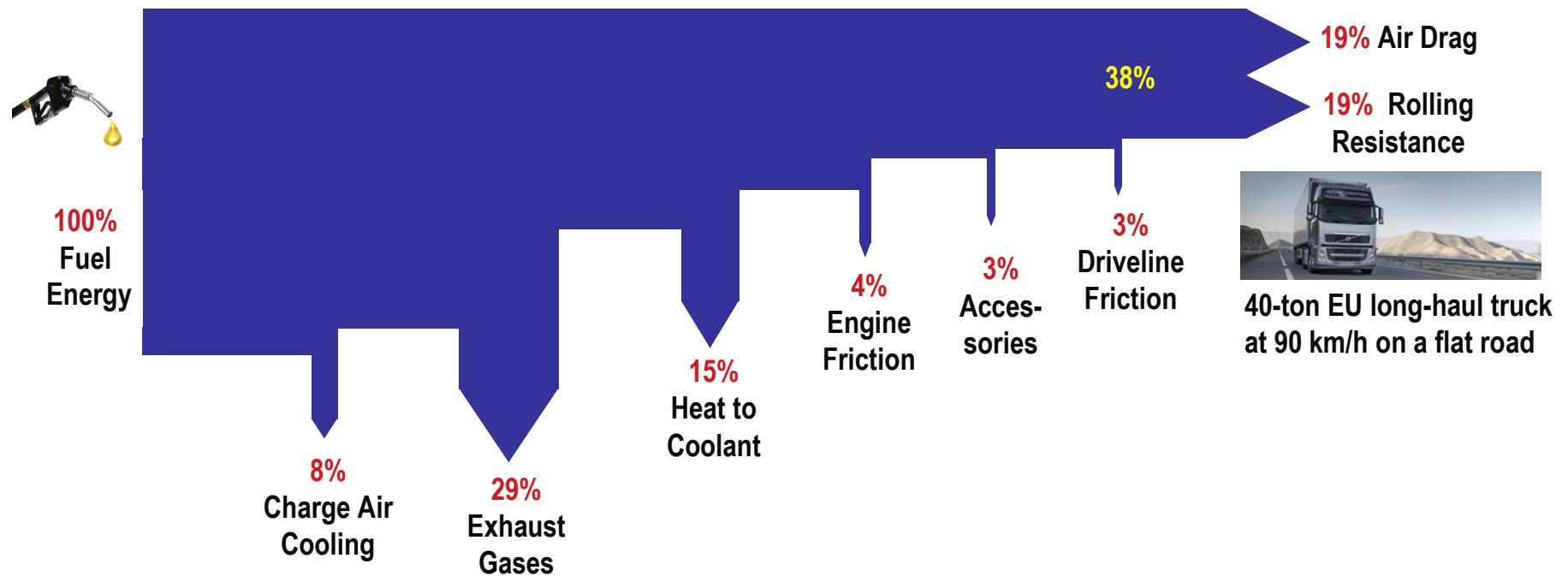
- Efficient energy conversion
- Efficient powertrain utilization
- Reduced friction
- Waste heat energy recovery
- Brake energy recovery

Vehicle efficiency

- Total vehicle energy management
- Efficient & functional Aerodynamics
- Reduced friction and low friction tiers
- GPS based energy usage rout planning
- Driver utilization of vehicle FE potential

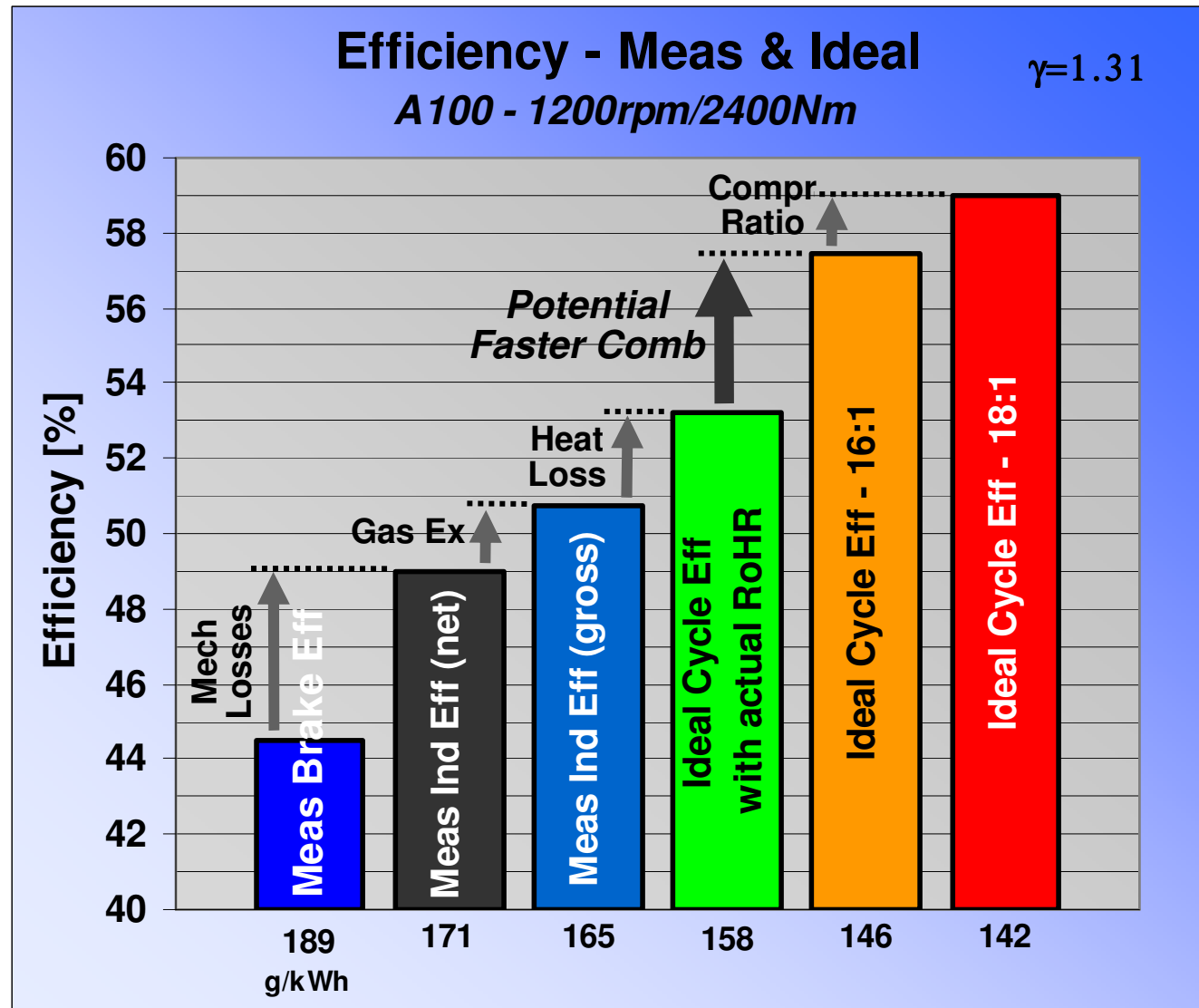


What happens to energy in the fuel?

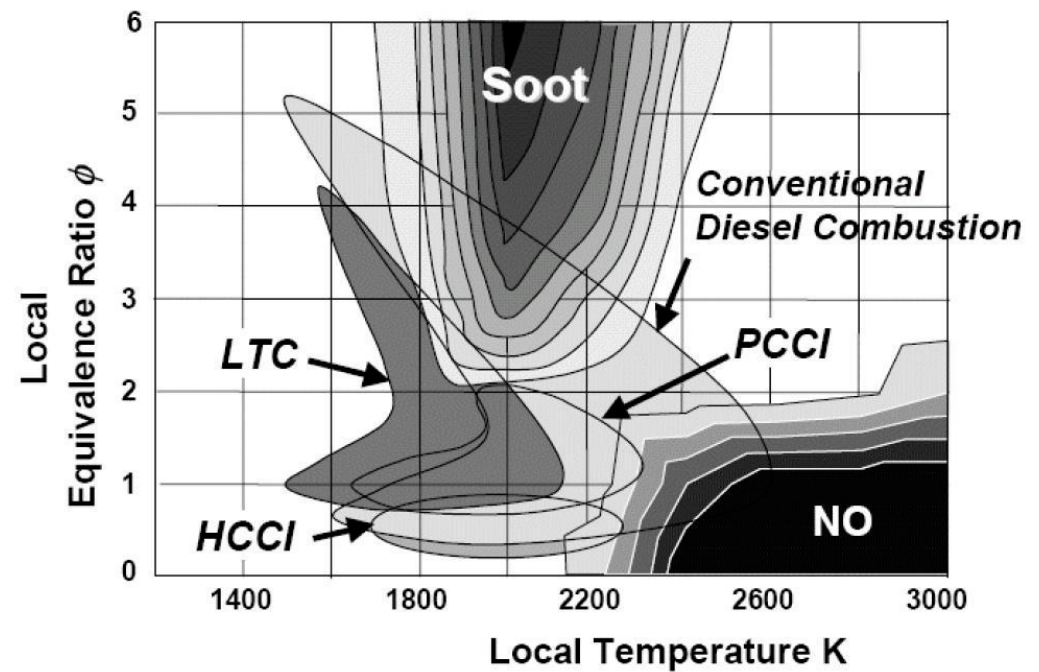
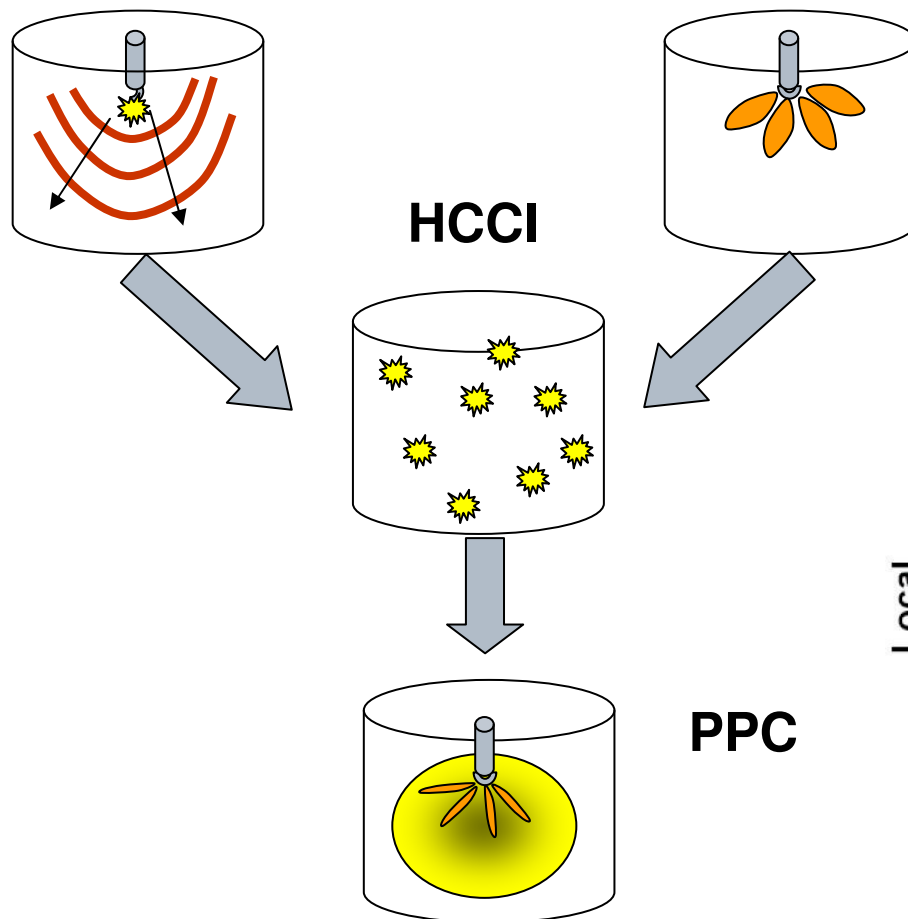


From GIB-T fuel economy task force (M. Lejeune)

Improving combustion efficiency



Advanced Combustion Concepts

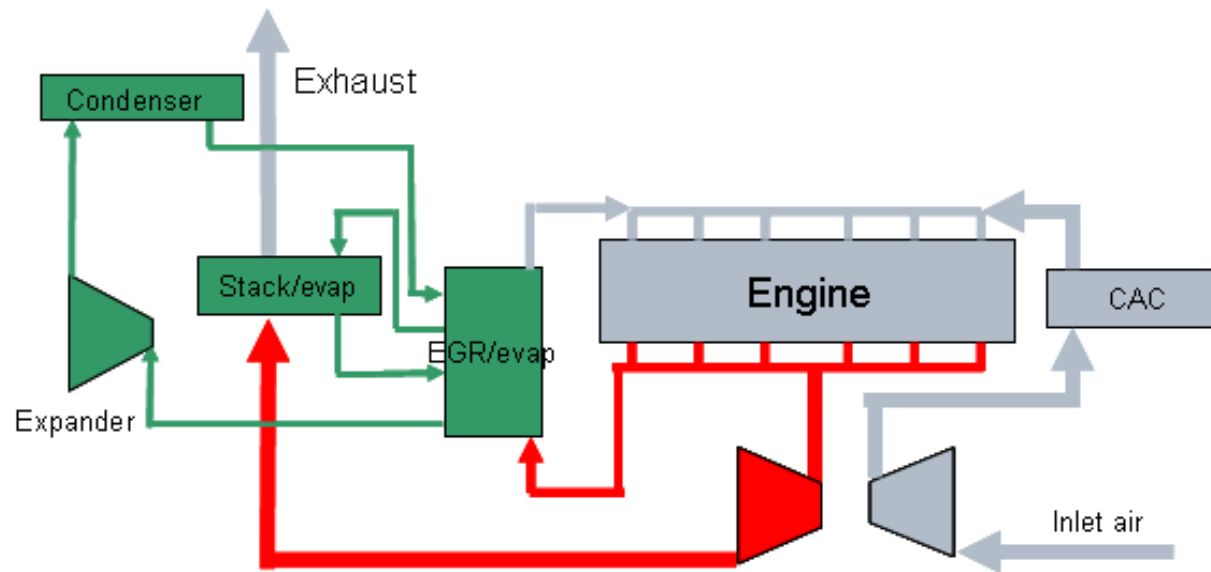


Waste Heat Recovery

- Turbo-compounding:
 - Mechanic
 - Electric
 - Electro-mechanic
- Bottoming cycling (Rankine system)
- Thermo-electric solutions
- Heat-to-Cool

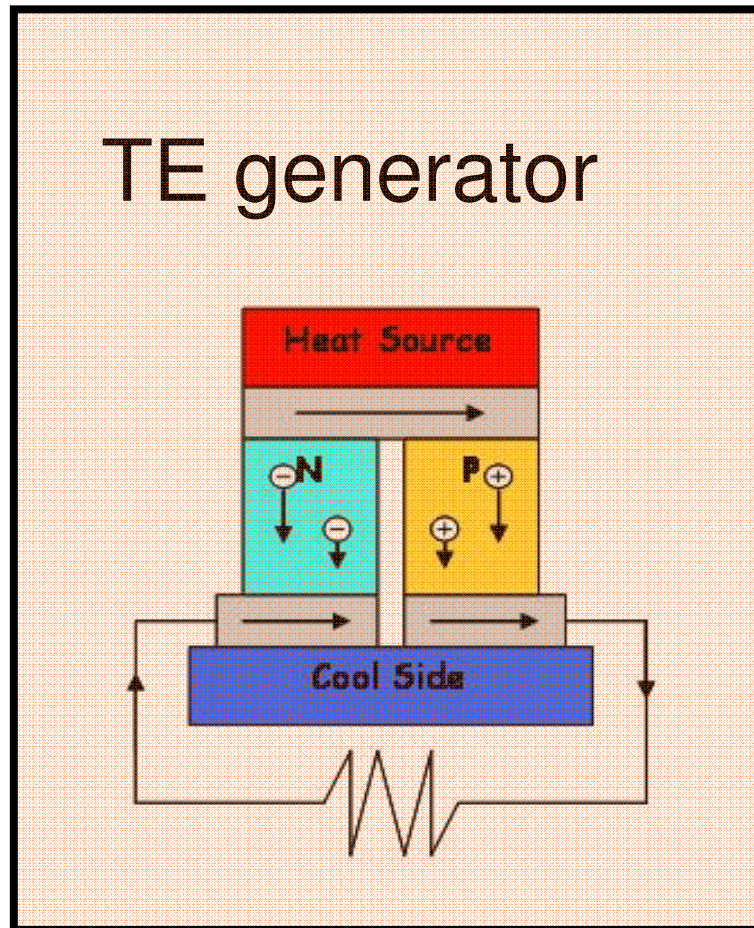
Rankine Waste Heat Recovery

- Rankine WHR: Potential 4-8% on long haul
- Working fluid depending on heat source
- Piston, turbine or scroll expander
- Mechanical or electric coupling



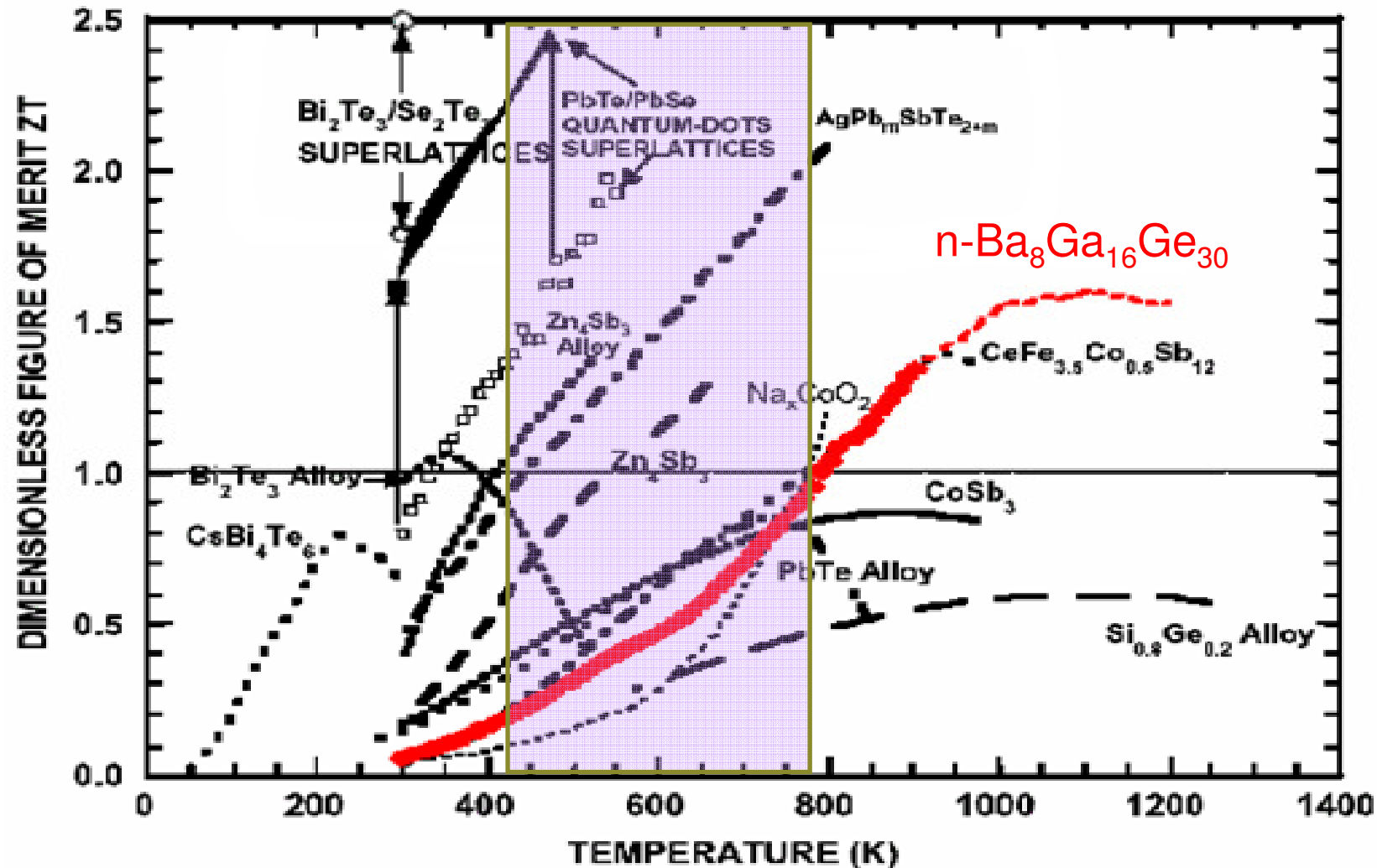
Thermoelectric power generation

- N-type conductors have negative electrons as majority carriers
- P-type conductors have positive holes as majority carriers



- Positive characteristics
 - ❑ Solid-state devices
 - ❑ Simple set-up
 - ❑ No moving parts
 - ❑ No greenhouse gases
 - ❑ High reliability
 - ❑ Low maintenance
 - ❑ Long lifetime

Thermoelectric materials



Saramat, A., Svensson, G., Palmqvist, A.E.C. et al. J. Appl. Phys. 99, (2006), 023708.

Hybrid Bus

- launched at IAA September 2008



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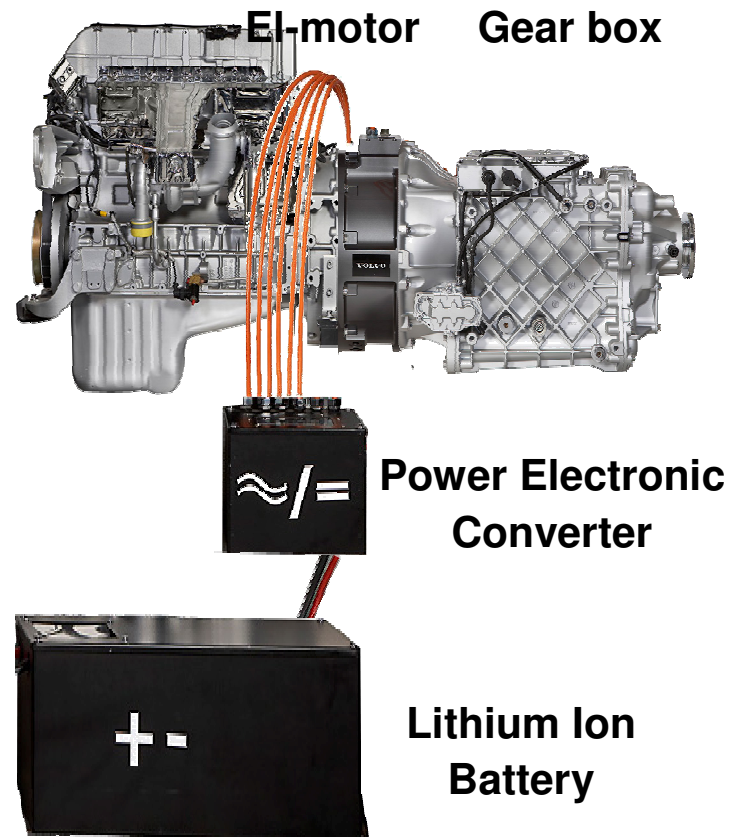
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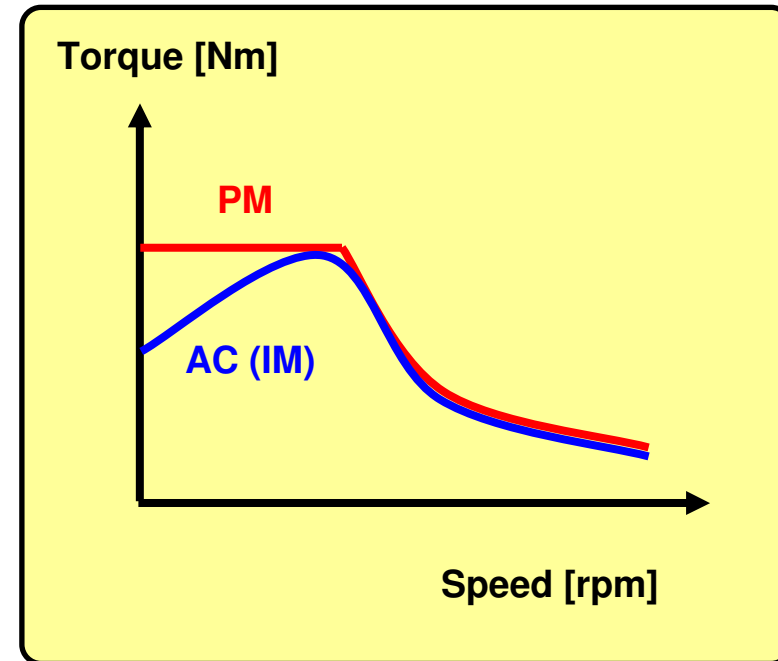
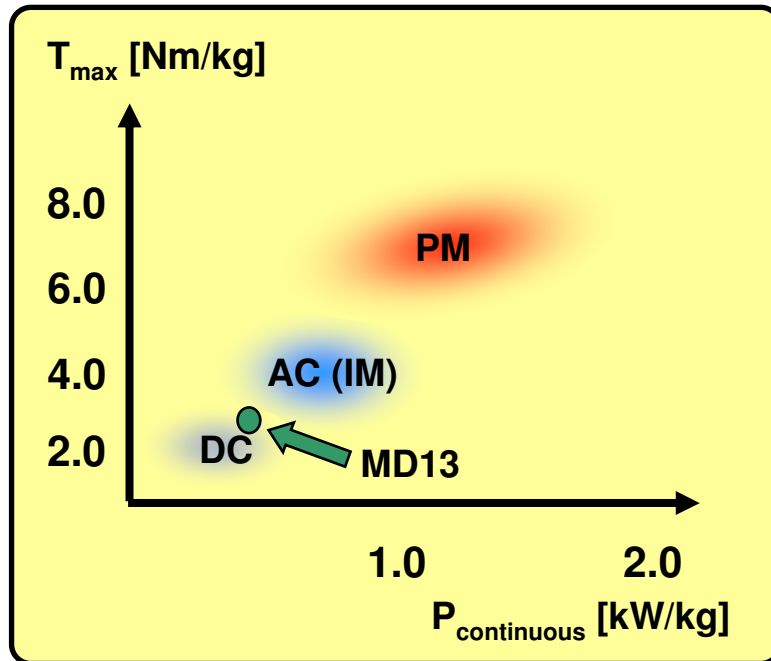
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Our parallel hybrid system - ISAM

- Electric launch and acceleration to traffic speed
- Smooth transition to diesel engine power
- Electric recuperation of brake energy
- Li-Ion energy storage

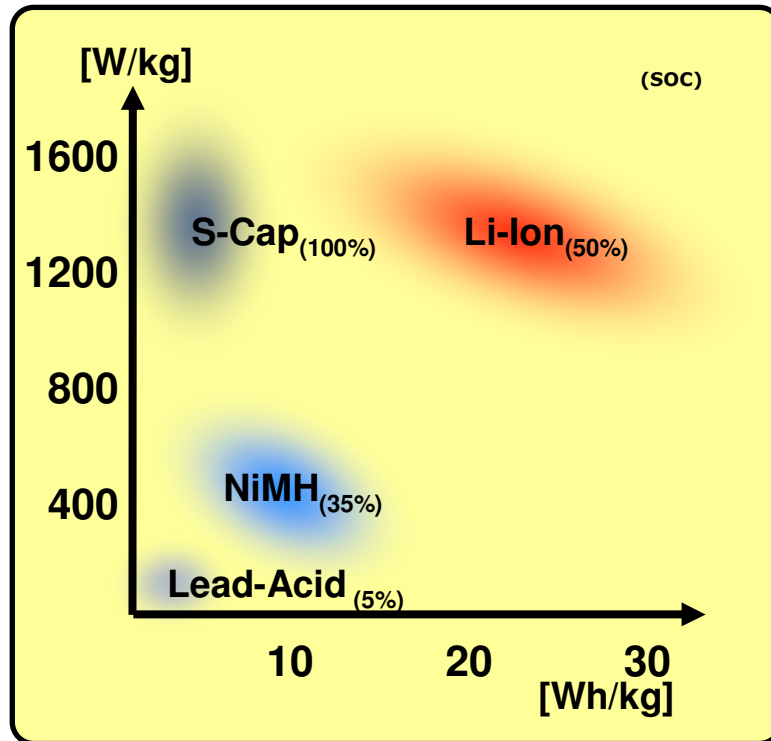


Electric Motors



Permanent Magnet Motors offers best opportunity for automotive applications; weight, low speed performance and best tolerance for misalignment in system assembly.

Energy Storage for HEV



Li-Ion

Possibilities for significant cost reduction.

Dual Storage System

Combining Super Capacitors and Energy storage allows for lower cost combinations.

NiMH

Today's industrial standard for Hybrid Vehicles.

Traditional lead-acid battery 100 kW / 30 sec >>> ~1500 kg weight

Li-Ion cell-stack 100kW / 30sec >>> ~100 kg weight

Most challenging issues for advanced ESS

Estimation of

- **SOC** State of Charge
- **SOH** State of Health

Life cycle Cost

Hybrid technology

LOWER FUEL CONSUMPTION



20-30%



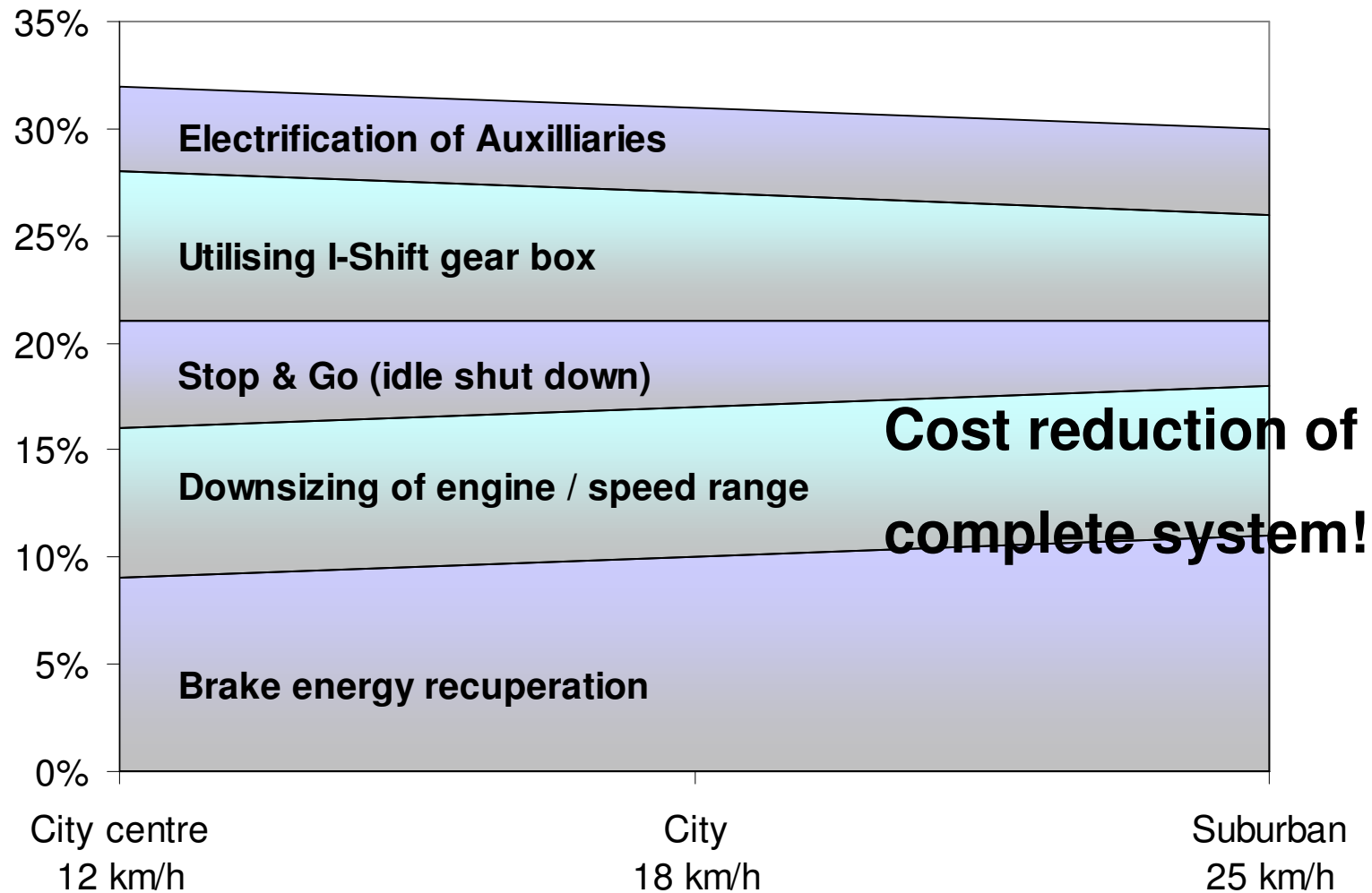
UP TO 35%



10-50%

Volvo 7700 Hybrid

-Analysing Success Factors



Summary

- ICE fuelled with Diesel, increasingly from biomass resources, will remain the dominant propulsion system for at least two decades.
- Natural gas and biogas will be used regionally, DME is a strong candidate for the future.
- Improved efficiency in the complete powertrain is of vital importance
 - Future combustion systems
 - Energy management
 - Waste energy recovery
- HD hybrids are on the market to stay
 - Energy storage system key barrier
 - Cost is in focus



Thank
you!

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