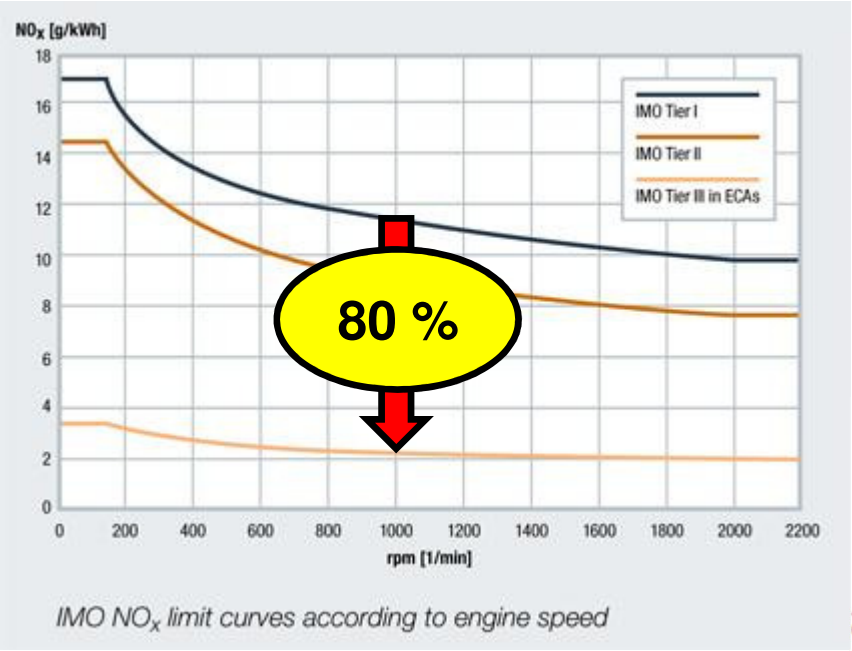
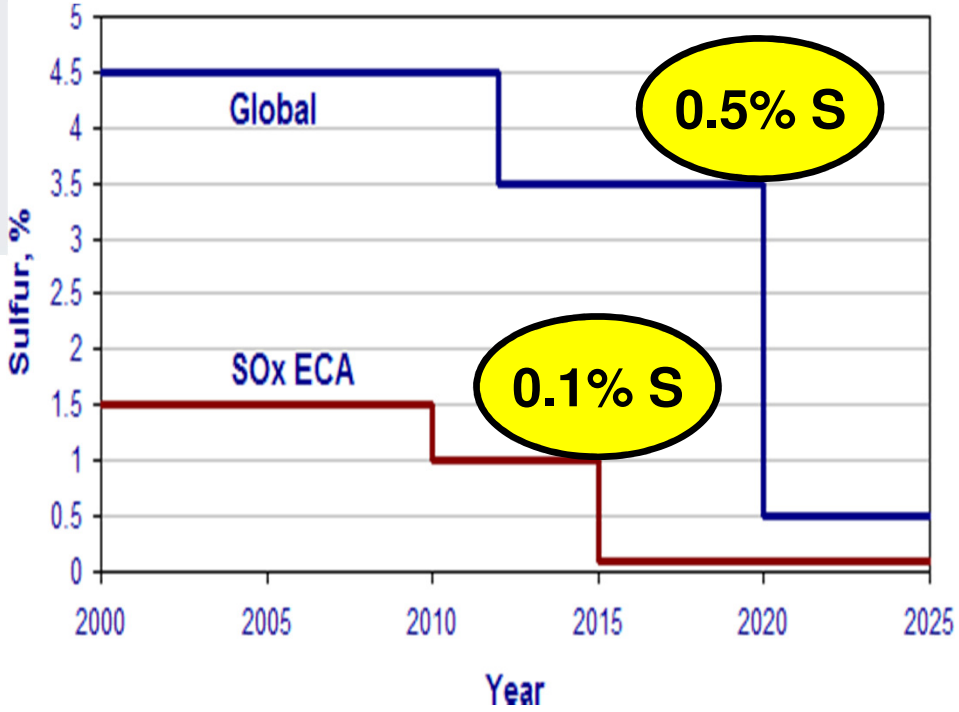
SYSTEM EFFICIENCY
THE NEXT BIG CHALLENGE

Karl M. Wojik, December 2013

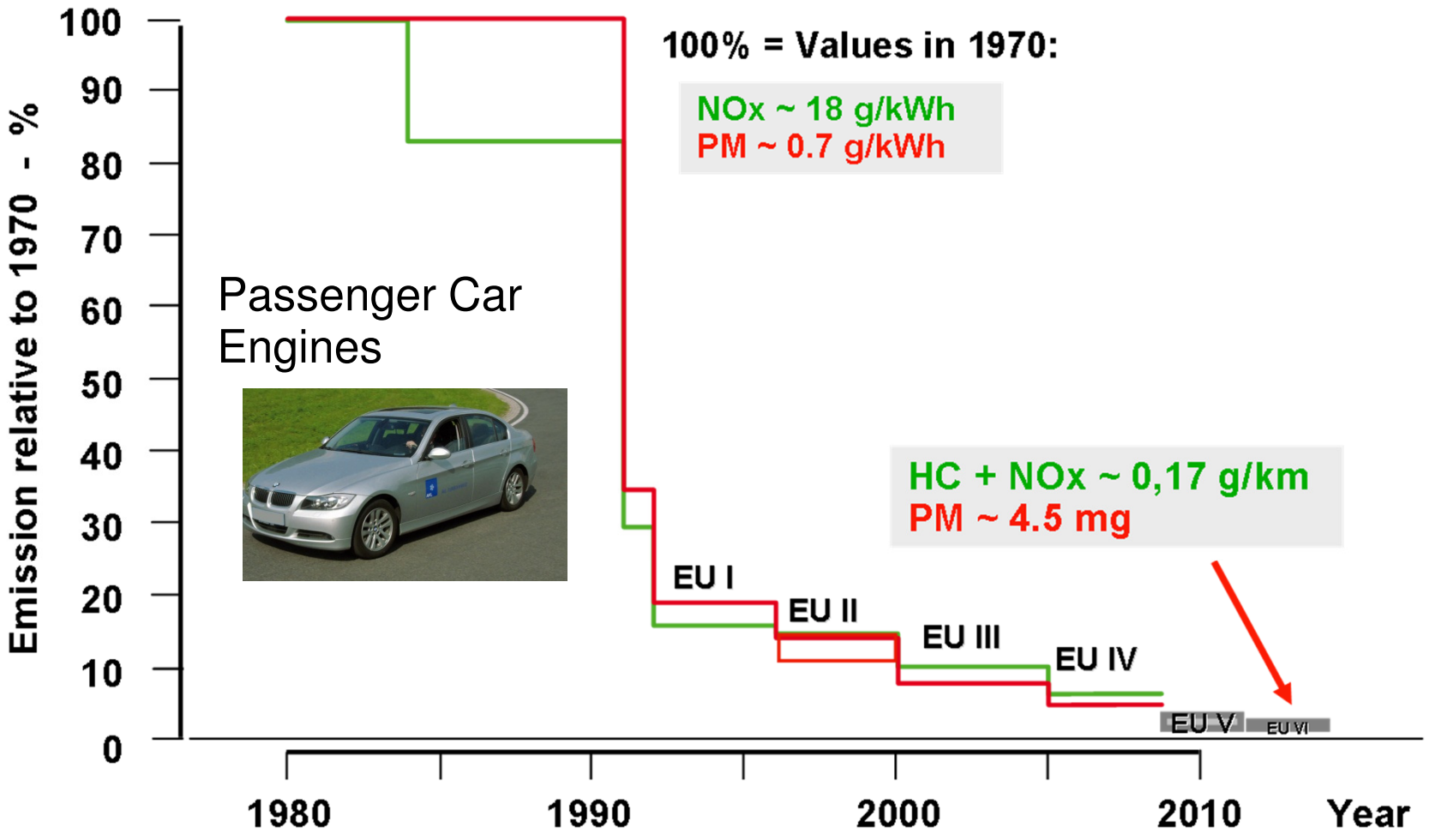
TODAY´S CHALLENGES
LOW NOx AND LOW FUEL SULFUR



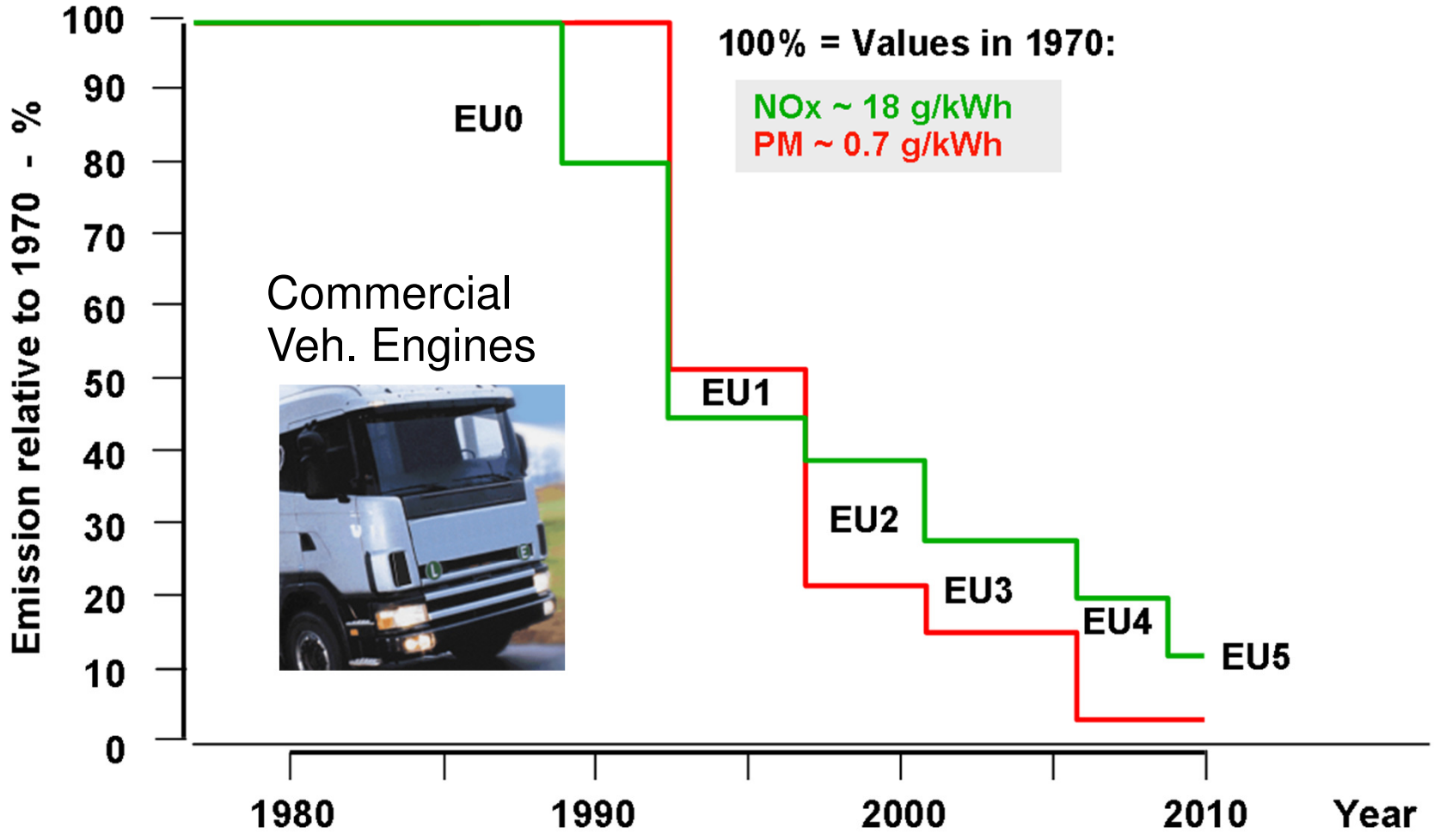
IMO NO_x limit curves according to engine speed



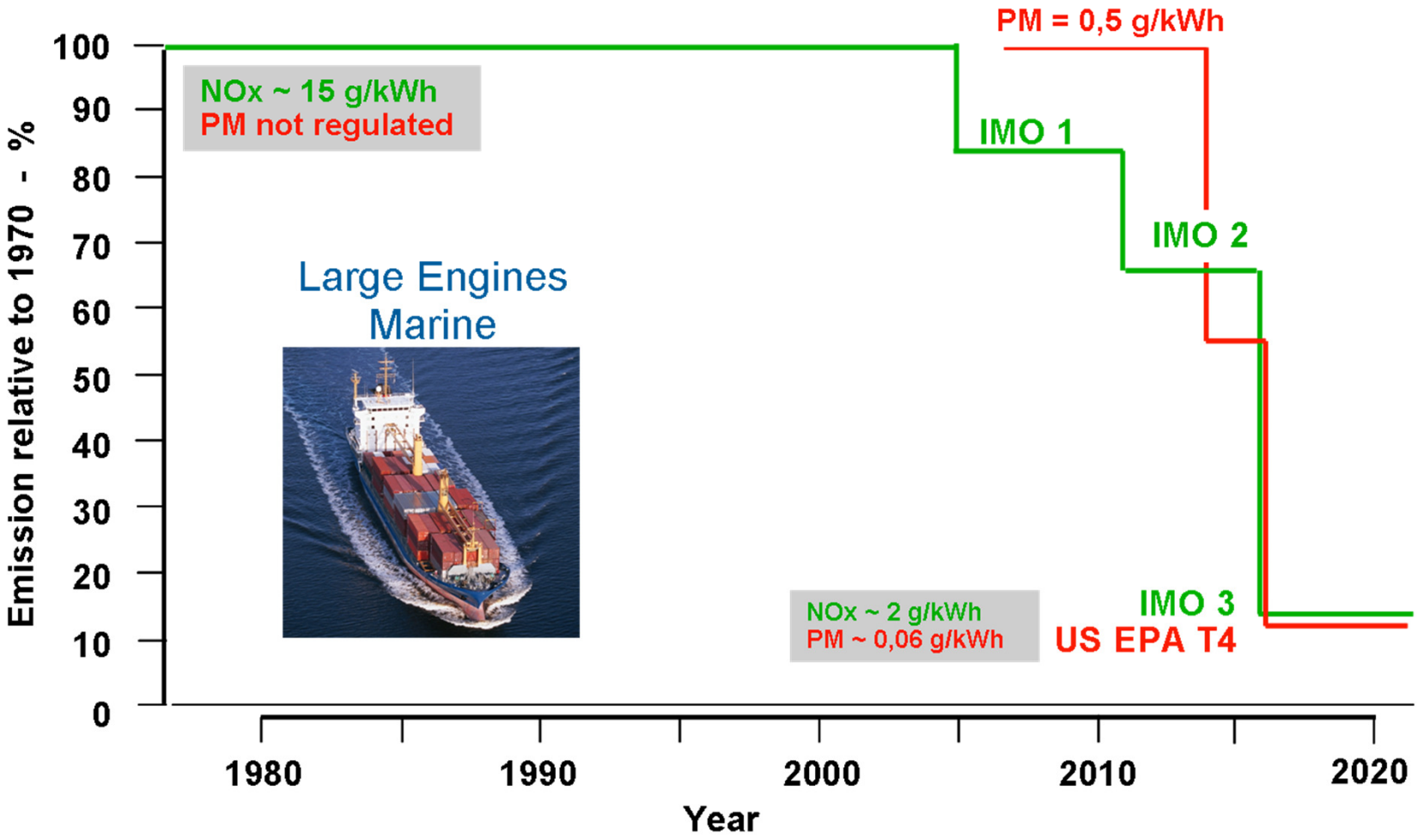
HISTORY OF EMISSION LEGISLATION
PASSENGER CAR >> TRUCK >> MARINE



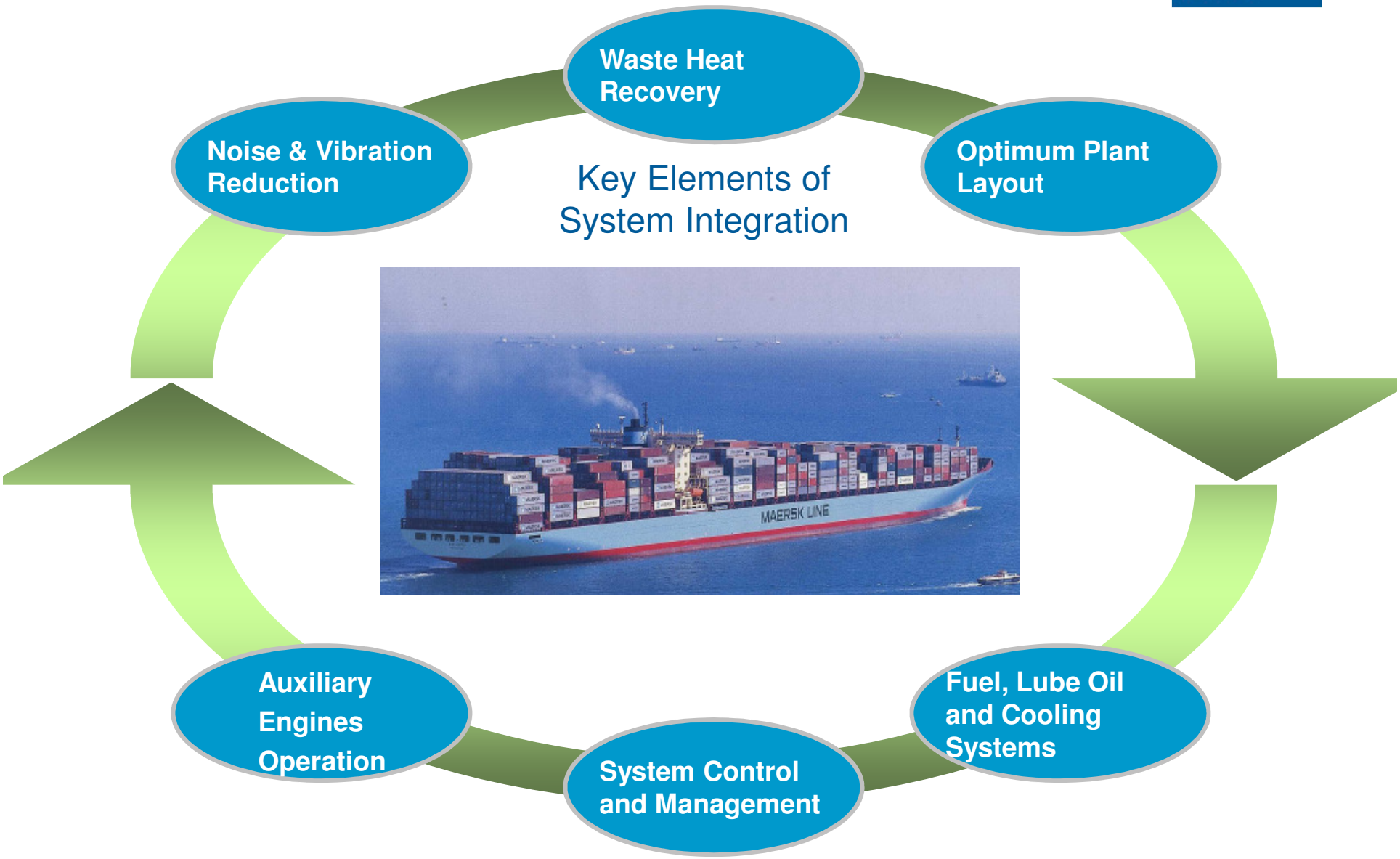
Emission Legislation Over Time
Commercial Vehicle Engines



Emission Legislation Over Time
Large Engines - Marine

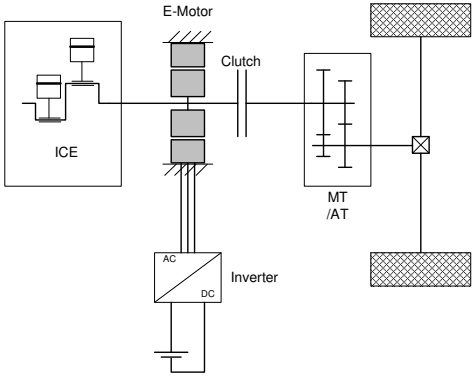


TOMORROW´S CHALLENGE
HIGH ENERGY EFFICIENCY



HYBRIDIZATION – 10 YEARS OF EXPERIENCE

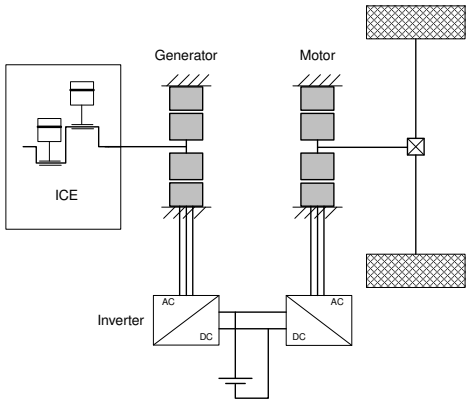
Parallel Hybrid



Direct Connection
IC Engine → Wheels

Volvo I-SAM Hybrid

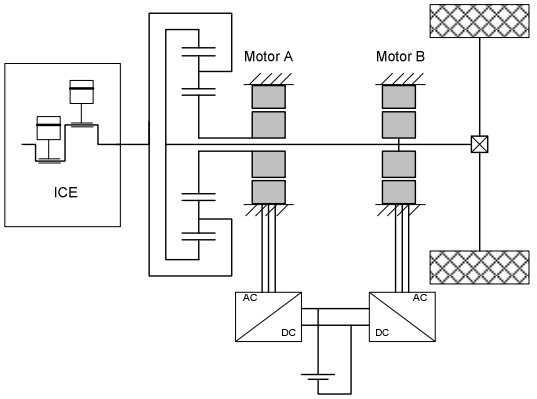
Serial Hybrid



2 Energy conversions

ISE Siemens Hybrid

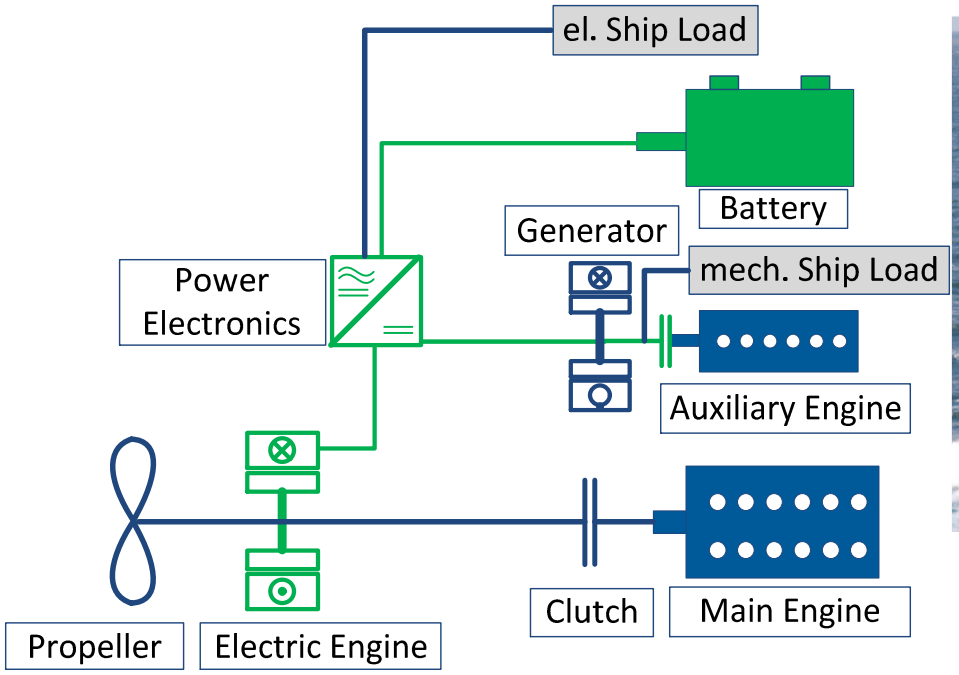
Powersplit Hybrid



„Reactive Power“ Flow
New transmission required

Toyota Prius

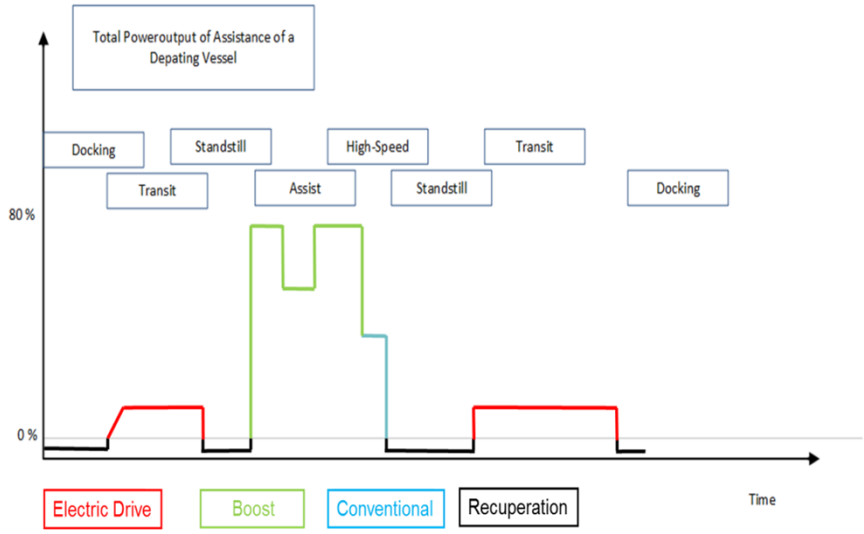
HIGH EFFICIENCY: HYBRIDISATION OF TUG BOATS REDUCES EMISSIONS – SAVES OPERATING COSTS



Tug Boat with annual operation of 300 days and 4200 operating hours and estimated **15% fuel reduction** by hybrid technology

→ **saves 123 tons of MGO per year**

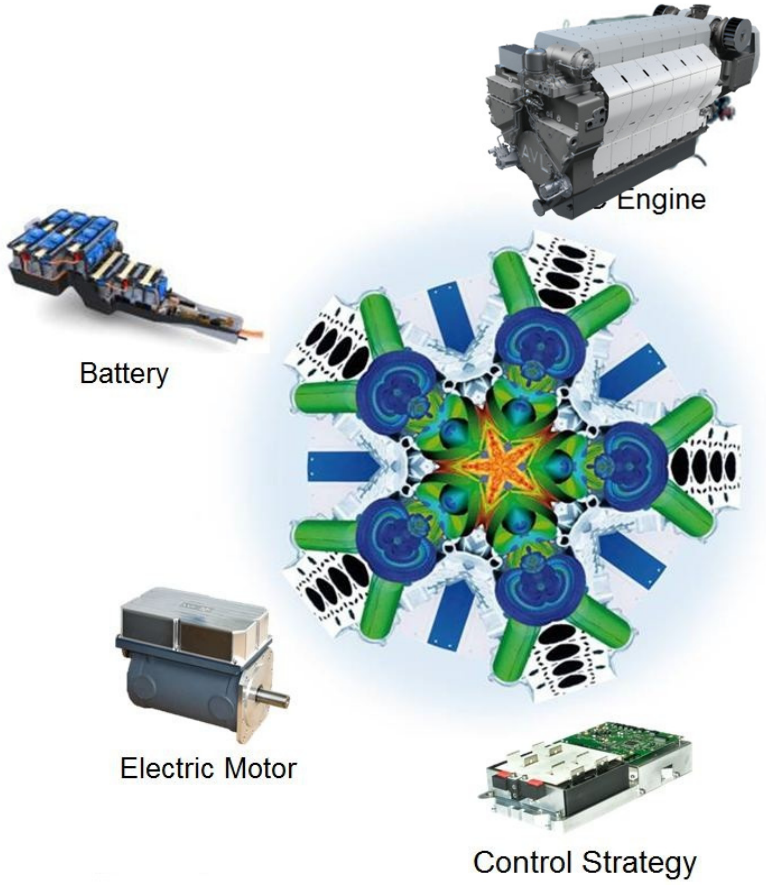
→ **saves 120.000 $ per year**



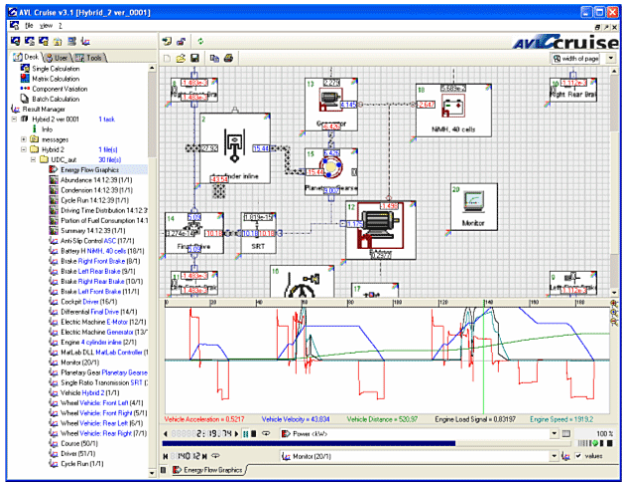
SYSTEM INTEGRATION BY MODEL-BASED DEVELOPMENT

Modeling for engine, battery, e-motor, inverter, etc…

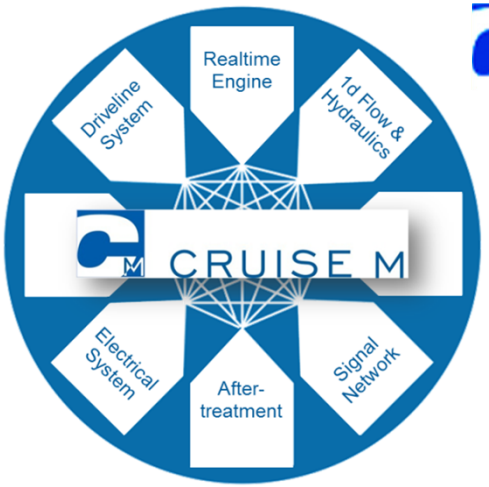
BOOST EXCITE FIRE® CRUISE



CRUISE



CRUISE M – CONTROL SYSTEM DEVELOPMENT OF MARINE ENGINES



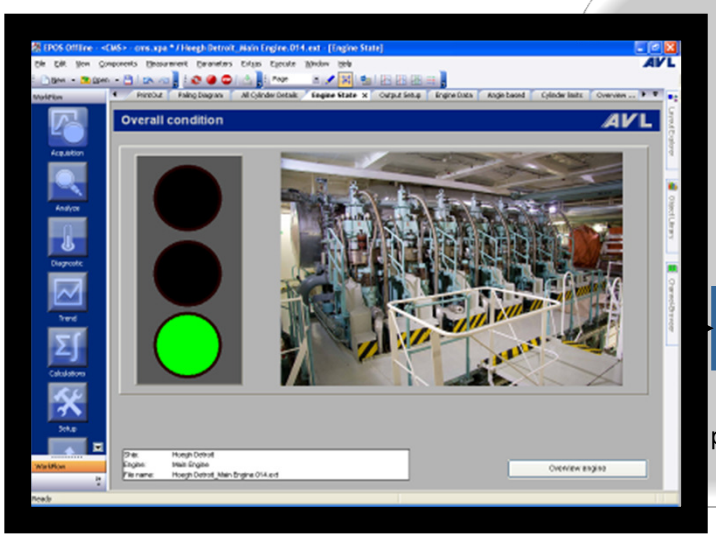
CRUISE

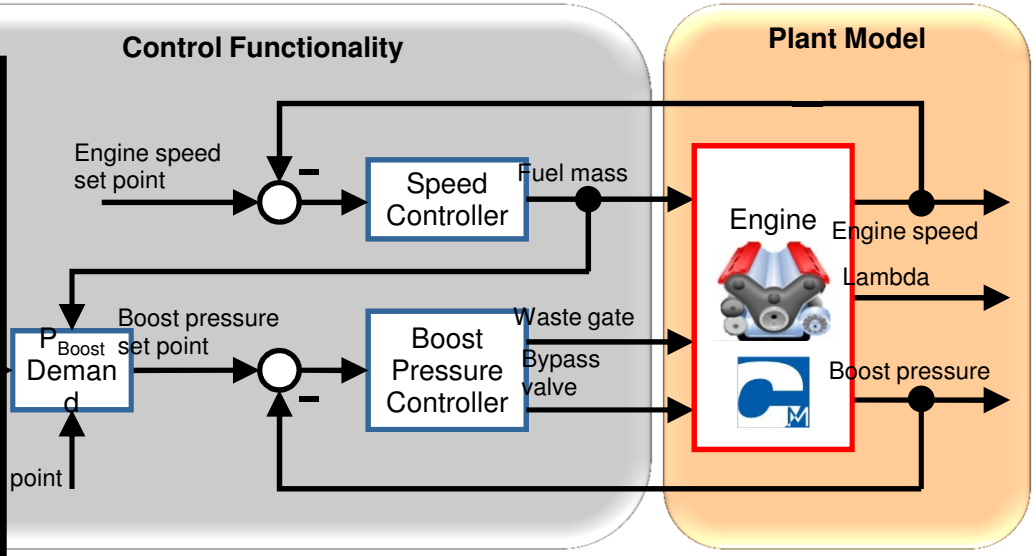
EPOS-Condition Monitoring
Model Based Development

leads to

- OPTIMUM ROUTE PLANNING
- LOWER FUEL CONSUMPTION
- LOWER EMISSIONS

EPOS





SYSTEM OPTIMIZATION
A GREAT OPPORTUNITY FOR THE FUTURE

- REDUCTION OF EMISSIONS
- REDUCTION OF FUEL CONSUMPTION
- REDUCTION OF CO2
- REDUCTION OF OPERATING COSTS
- **ENVIRONMENTALLY COMPATIBLE ECONOMY**