

MAN Energy Solutions
Future in the making



MAN's fully integrated Tier III emission solution

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Agenda



- 1 Introduction**
- 2 System Optimization**
- 3 Challenges & Solutions**
- 4 Summary**

1 Introduction

Driving Force – Regulations on NOx Emissions



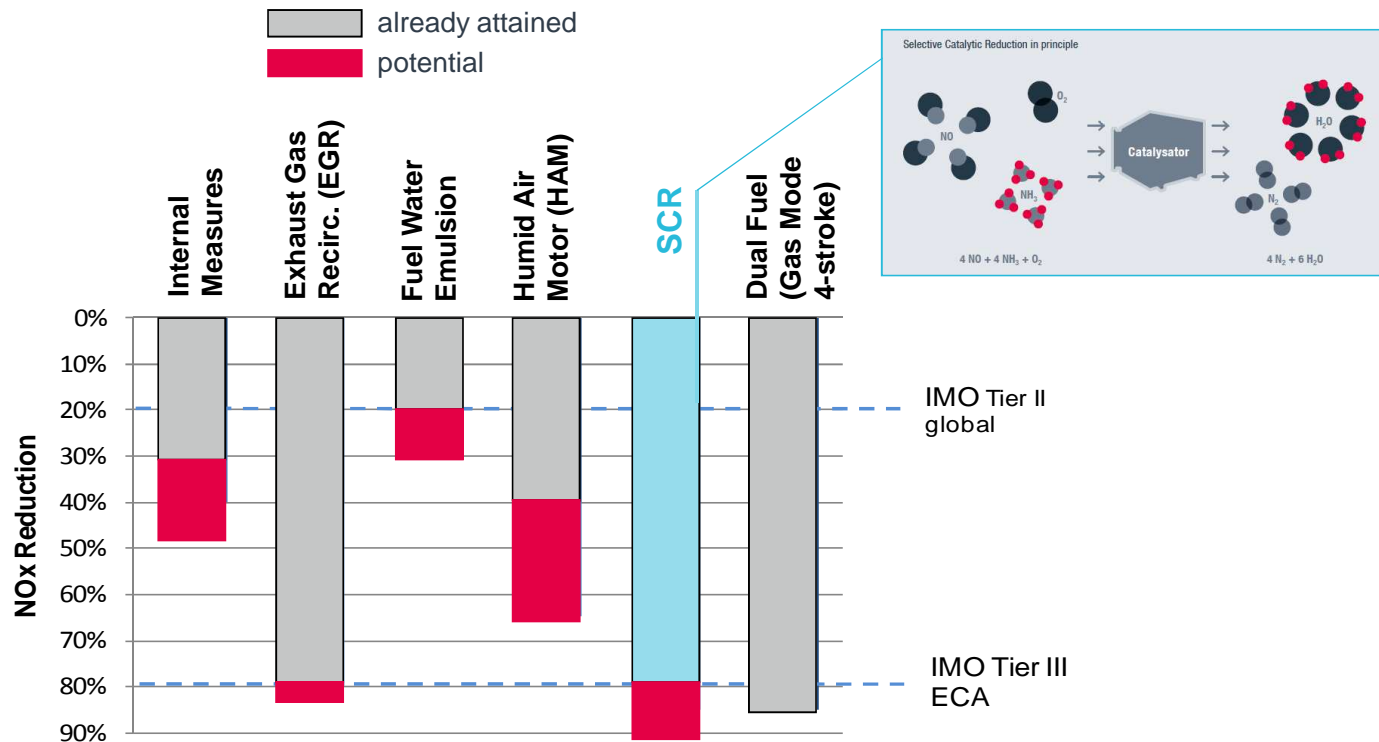
Emission Controlled Area (ECA) & Local Regulations



- All fueled ships with keel laying 2016 entering North American NECAs (200nm coastline) will need either SCR or EGR technology
- **More ECAs likely to come:** Coasts of Mexico, Alaska and Great Lakes, Singapore, Hong Kong, Korea, Australia, Black Sea, Mediterranean Sea, Tokyo Bay ...
- Local regulations e.g. China Inland waterways enforced besides IMO regulations

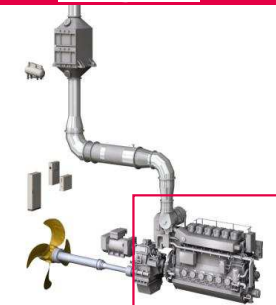
NO_x-Reduction Technologies

Comparison of Reduction Potentials



MAN - IMO Tier III Solution

MAN - IMO Tier II Engine



Scope of supply is no longer just a Tier II engine

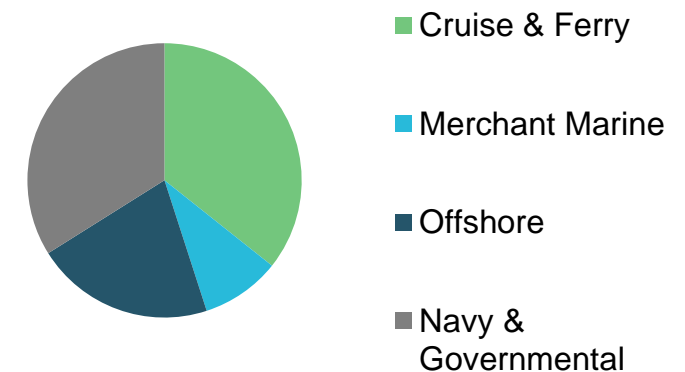
- SCR set as standard technology for 4-stroke diesel engines to fulfill IMO Tier III
- Also Dual Fuel market is relevant for SCR-technology – Full Tier III flexibility despite fuel types used
- SCR is no more a feature for our customers it is a must have

SCR - Market Overview

IMO Tier III Fleet



Order Intake - Overview in segments



- Total of more than 170 MAN SCR-LP Systems sold in all market segments
- More than 1.1 GW total installed power with SCR
- SCR is regarded as standard solution on the market → USP's are in total system optimization

2 System Optimization

System Optimization

Creating benefits for our customers

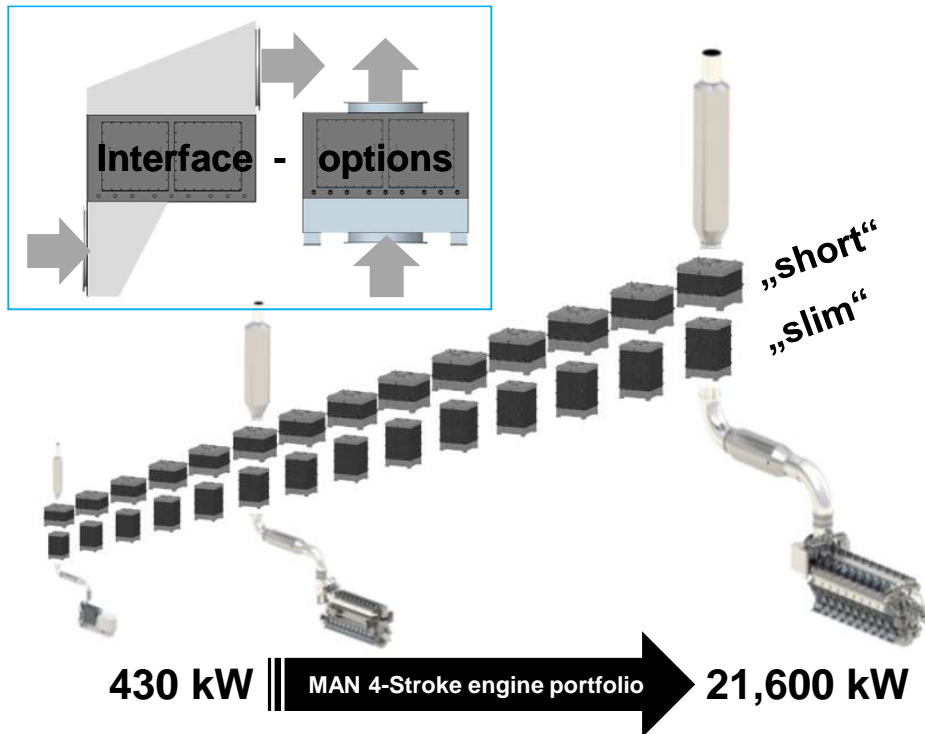
- **Flexibility** of SCR-system integration
- **Synergies** with high pressure SCR technology
- **Emission Certification**
- **ECOMAP 2.0**
- PrimeServe Assist via **MAN CEEON**
- **SCR Training at PrimeServ Academy**



- The Package of customizing at maximum cost efficiency, a customer-friendly certification process in combination with the benefits of digitization services, the MAN SCR-System generates new advantages for the customer

Flexibility

MAN Modular SCR System Concept for entire Four-Stroke engine portfolio



Module	Variant driver
Honeycomb	Reactor-design
Control unit	per engine/plant
Comp. Air module	per engine/plant
Pump module	Urea flow (plant)
Dosing unit	Urea flow
Mixing unit	Exhaust gas flow
Urea inj. lance	Exhaust gas flow
Reactor kit	Exhaust gas flow

Fully configured SCR System

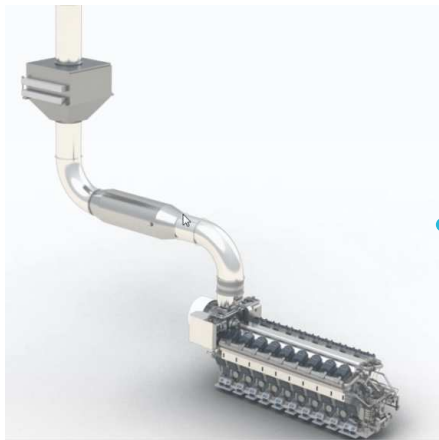
- Standardized portfolio for max. flexibility and fast order management
- Enabling of centralization of SCR modules for multi-engine applications
- SCR Modular Kit fits all marine and stationary applications (4S and 2S)

Synergies

with high pressure SCR technology



MAN SCR-LP



Same spare parts and auxiliary systems
for all MAN engines

MAN SCR Honeycomb



SCR Control Unit



Interface Cabinet

Media supply systems



Compressed Air Reservoir



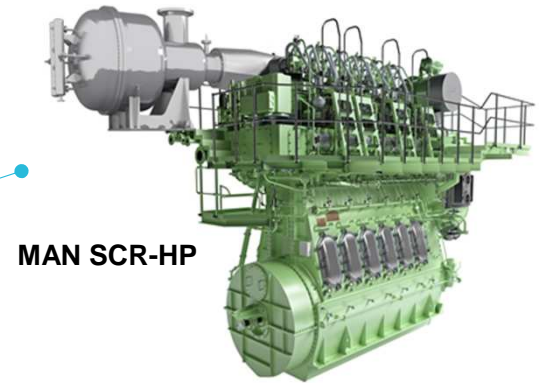
Urea Pump Module



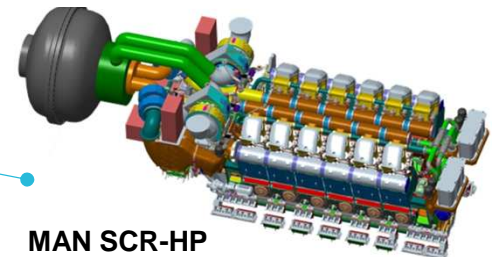
Urea Dosing Unit



Soot Blowers



MAN SCR-HP



MAN SCR-HP

- SCR Modular Kit fits all marine and stationary applications (4S and 2S)
- Identical spare parts for 2S, 4S and Power in PrimeServ Aftersales
- Maximum simplification for operators and customers

Emission Certification

IMO Tier III Scheme B: MAN ensures efficient process for shipyards and operators

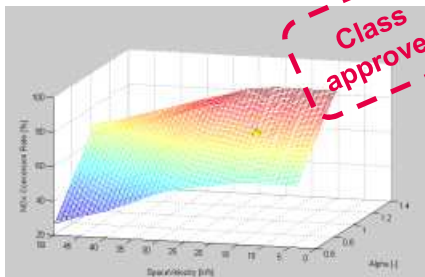


MAN Testbed

1. IMO Tier II
Parent test



2. MAN SCR
Modelling
Tool
(derived from
lab-testing)



ClassNK
Lloyd's Register
DNV-GL
CCS
BUREAU VERITAS
RINA
ABS
EIAPP Certificate



On-board

Technical File According to Revised MARPOL Annex VI and MEPC Technical Code 2014	
Engine Group Certification	
Engine type	6L27/38
IMO engine group	2738
Engine serial number	28034-02-11
Year of engine built	2015
Rated power	1795 kW
Rated speed	950 rpm
Application	E2

IMO Identification number	
IMO-XXXX	
MAN Logo ¹	Data matrix code ²



On Board Confirmation Test
for parent engine only

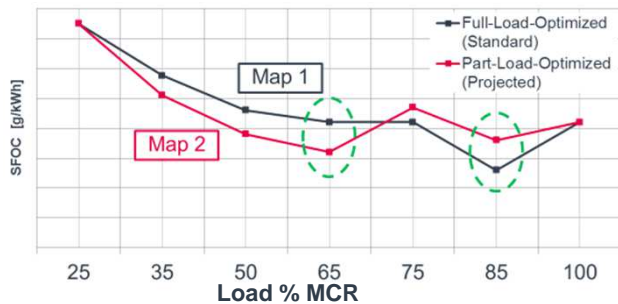
- Easy and convenient IMO Tier III certification by MAN
- On Board Confirmation Test only for the parent system

ECOMAP 2.0

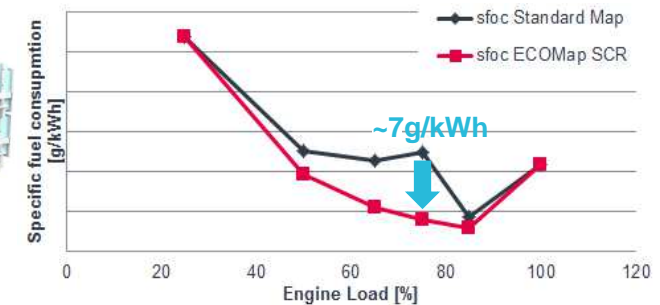
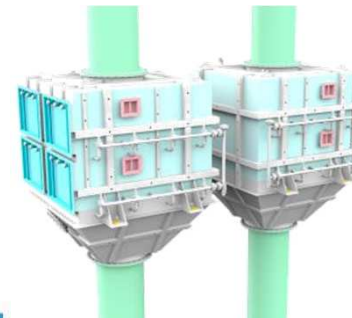
Next step in fuel economy with MAN's Common Rail & SCR System



MAN Common Rail System



MAN SCR-LP System



ECOMAP 1.0 – Map Selection Concept

- Engine can be equipped with more than one injection map
- Each of the engine maps is IMO Tier II compliant
- Acc. to map selection rules (no random switching)
- Improvement of 3 to 5 g/kWh

ECOMAP 2.0 – System Optimization with SCR

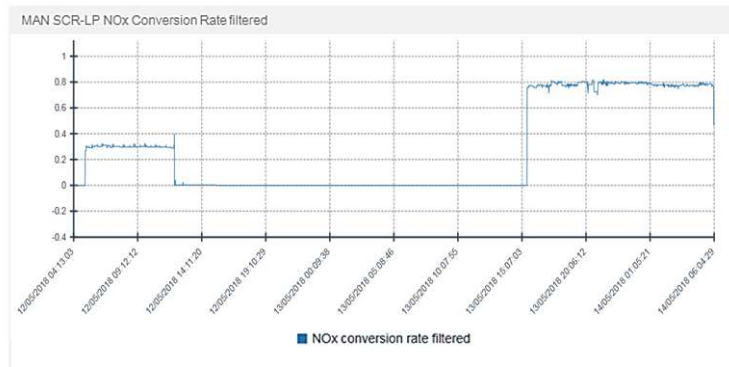
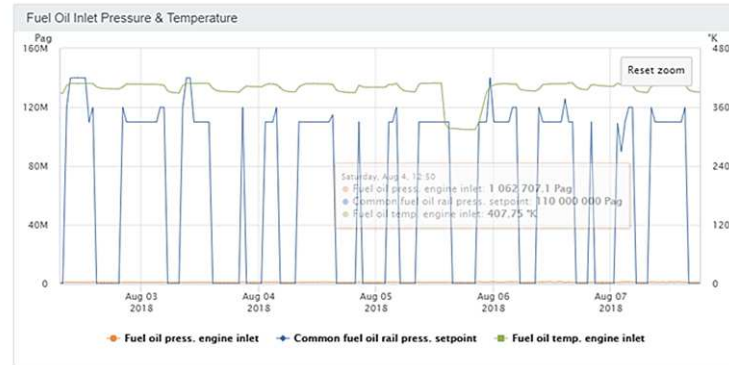
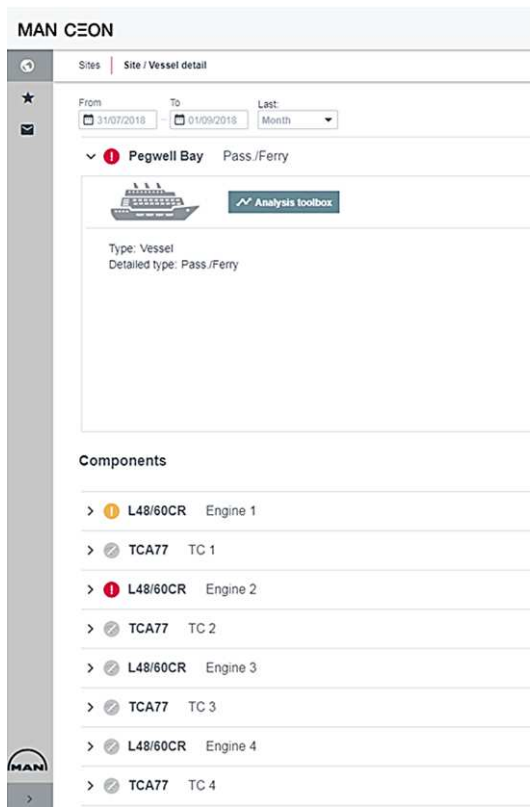
- Set engine to lowest fuel oil consumption but high NOx emission
- SCR operation mandatory to reach IMO Tier II / III
- Up to 7 g/kWh fuel consumption savings
- Up to 3 % CO2 emission reduction

MAN CĒON

PrimeServe Assist



Real Time Transparency



A service solution to empower you
in optimizing...



Safety & Security



Availability

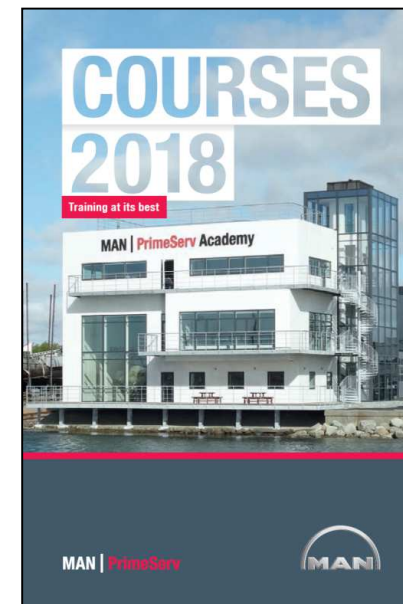


Efficiency

- Overview of all system parameters for customer fleet
- Live - MAN expert support via video-chat

SCR Training at PrimeServ Academy

Professional training for SCR operation & maintenance



Hands-on Trainings
on original SCR Reactor



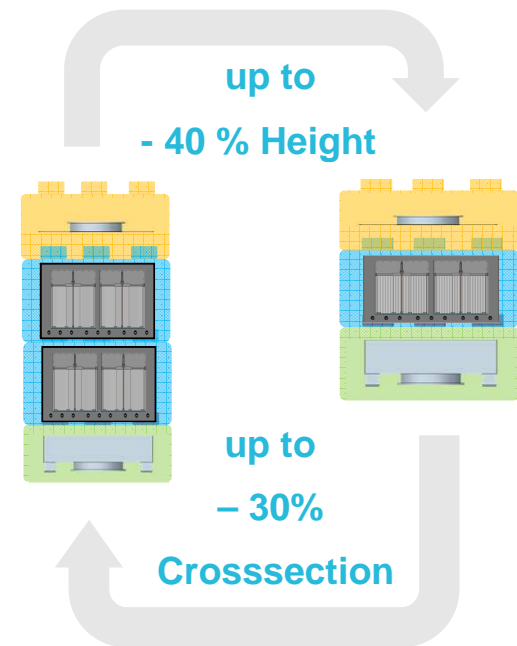
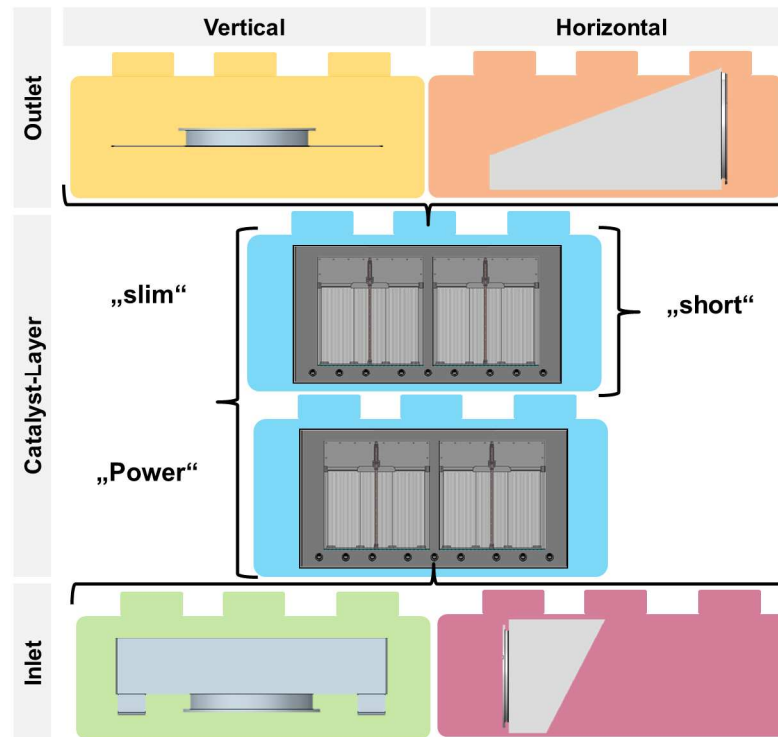
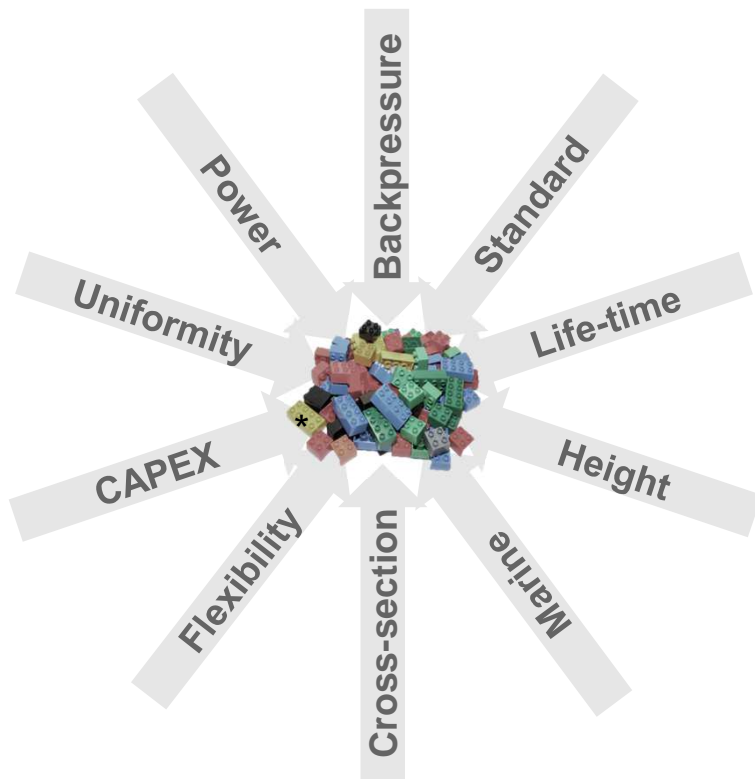
Book your training!

- PrimeServ Academy locations spread all over the world
- Hands-on training on original SCR Reactor

3 Challenges & Solutions

Challenges & Solutions

Fulfilling all requirements for the good of the product



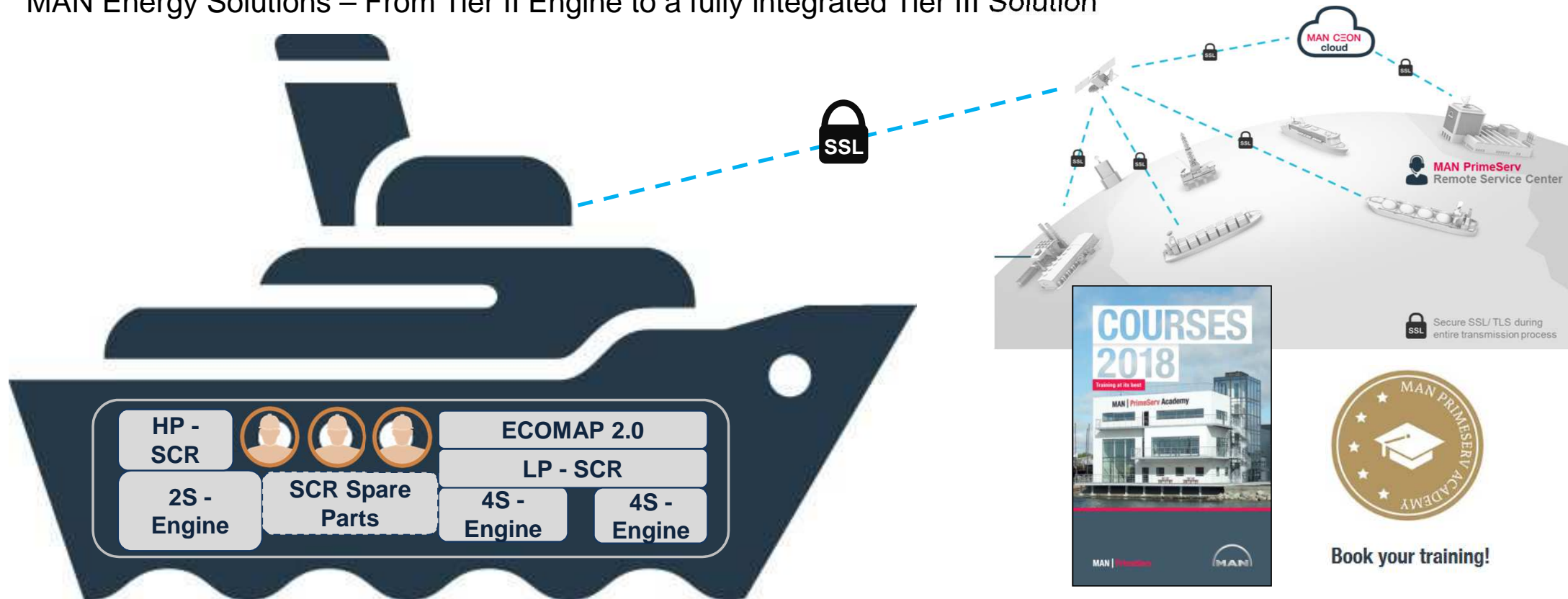
- Large variety of requirements may lead to challenges in engineering and design to cost
- The key to a satisfying product comes with the degree of modularization
- By using standardized modules, maximum flexibility can be achieved

*source: <http://www.savi-trendblog.de/2015/03/lego-und-duplo-steine-waschen/>

4 Summary

Summary

MAN Energy Solutions – From Tier II Engine to a fully integrated Tier III Solution



- The MAN Tier III solution fulfills a connection to all possible interfaces
- The result of this consequent system integration offers a big variety of benefits for our customers

Disclaimer

All data provided in this document is non-binding.

This data serves informational purposes only and is especially not guaranteed in any way.

Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.

Thank you very much!

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