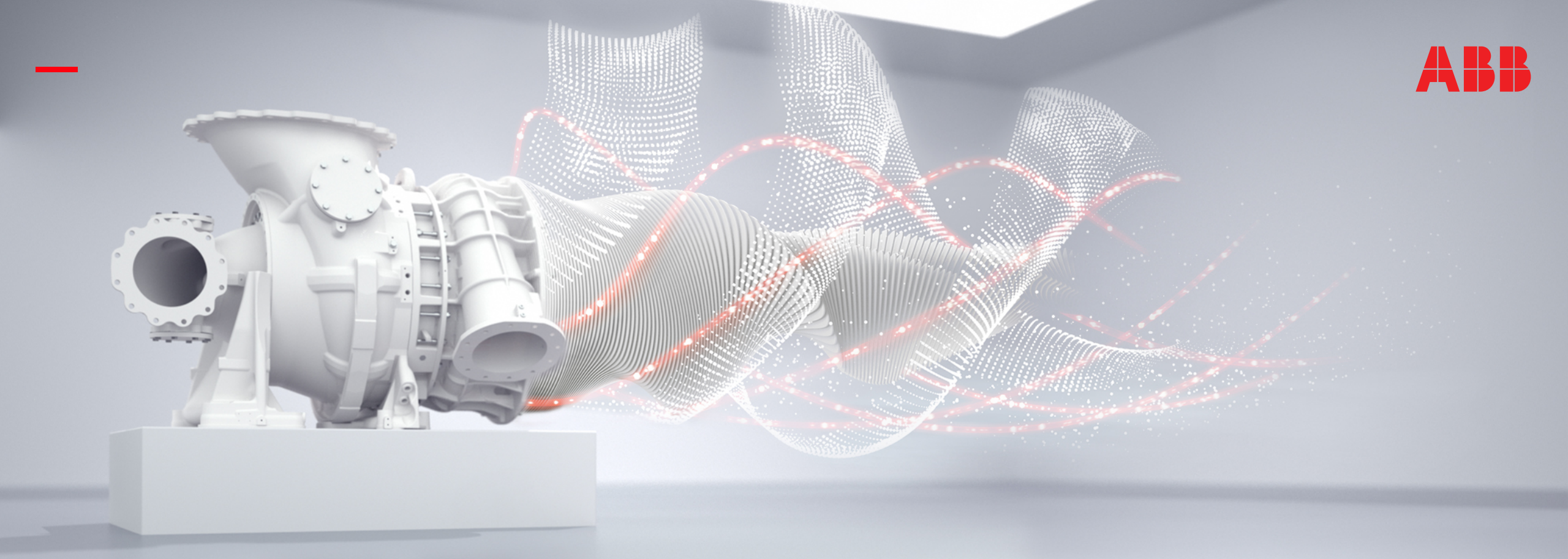


NAPLES SHIPPING WEEK, SEPTEMBER 2018

Turbocharger upgrade

The efficiency booster

Alberto Pochiero, Regional Technical Manager, South East Mediterranean Region

ABB Turbocharging

112 years of customer care

- A global leader in the manufacture and maintenance of turbochargers for 500 kW to 80+ MW diesel and gas engines
- Leading-edge technology and innovation enables our customers to perform better and produce fewer emissions, even in the toughest terrains
- Approximately 200,000 ABB turbochargers in operation globally on ships, power stations, gen-sets, diesel locomotives and large off-highway vehicles
- Over 100 Service Stations in 50+ countries and a wide service portfolio providing tailored solutions with Original Parts and Original Service anytime, anywhere

ABB Turbocharging Service

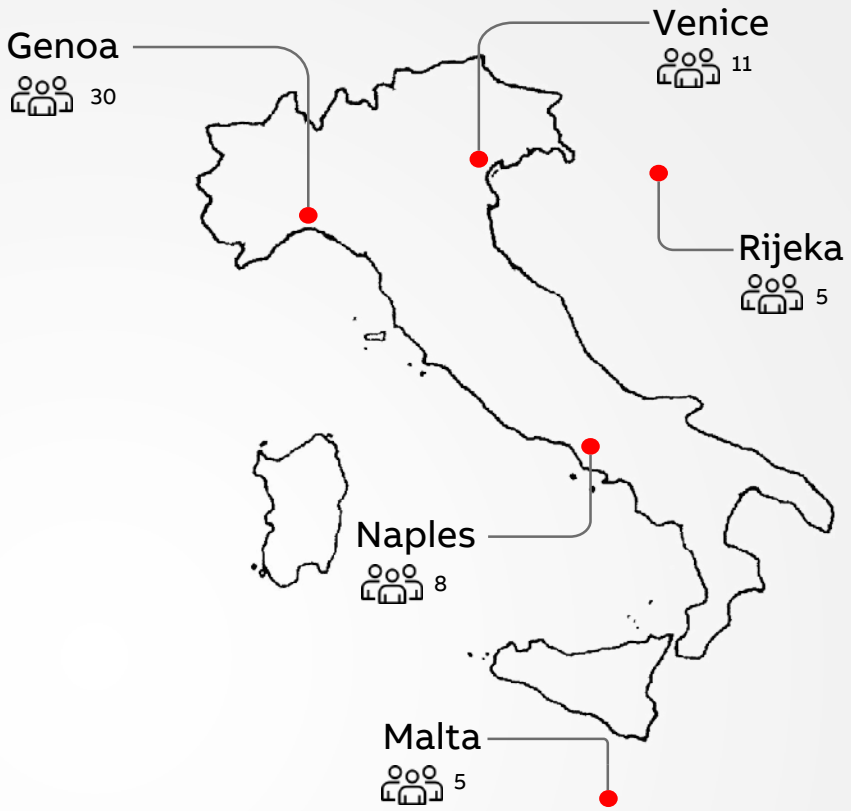
Local Business Unit: Italy

59 employees

25 service engineers

> 1.450 service jobs per year

Please contact:
giorgio.rolando@it.abb.com



Engine operation

Performance indicator and efficiency development of Diesel engines

MEP

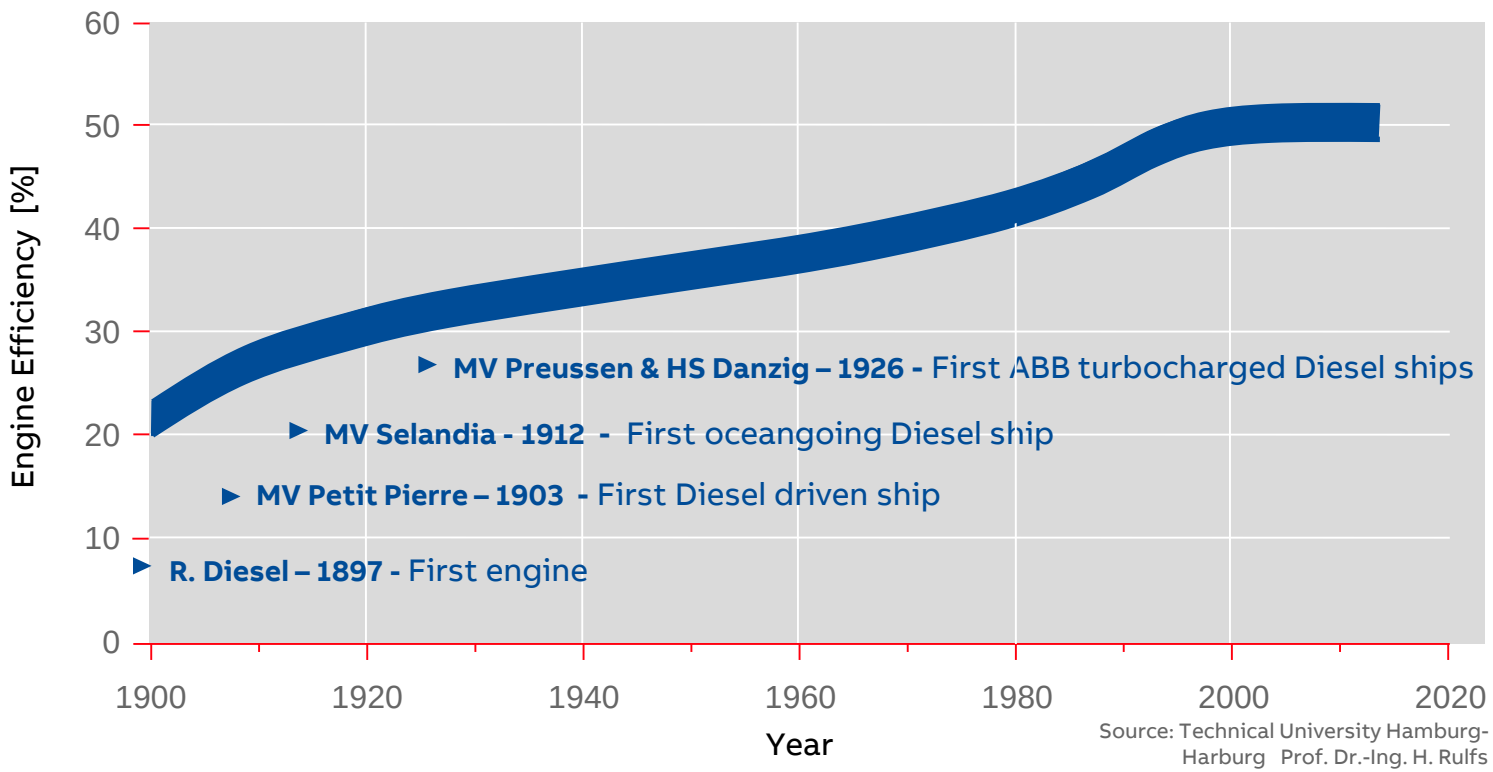
End '70:

- 2 stroke engine: 8,5 bar
- 4 stroke engine: 14 bar

Current days (peak values):

- 2 stroke engine: 21 bar
- 4 stroke engine: 30,1 bar

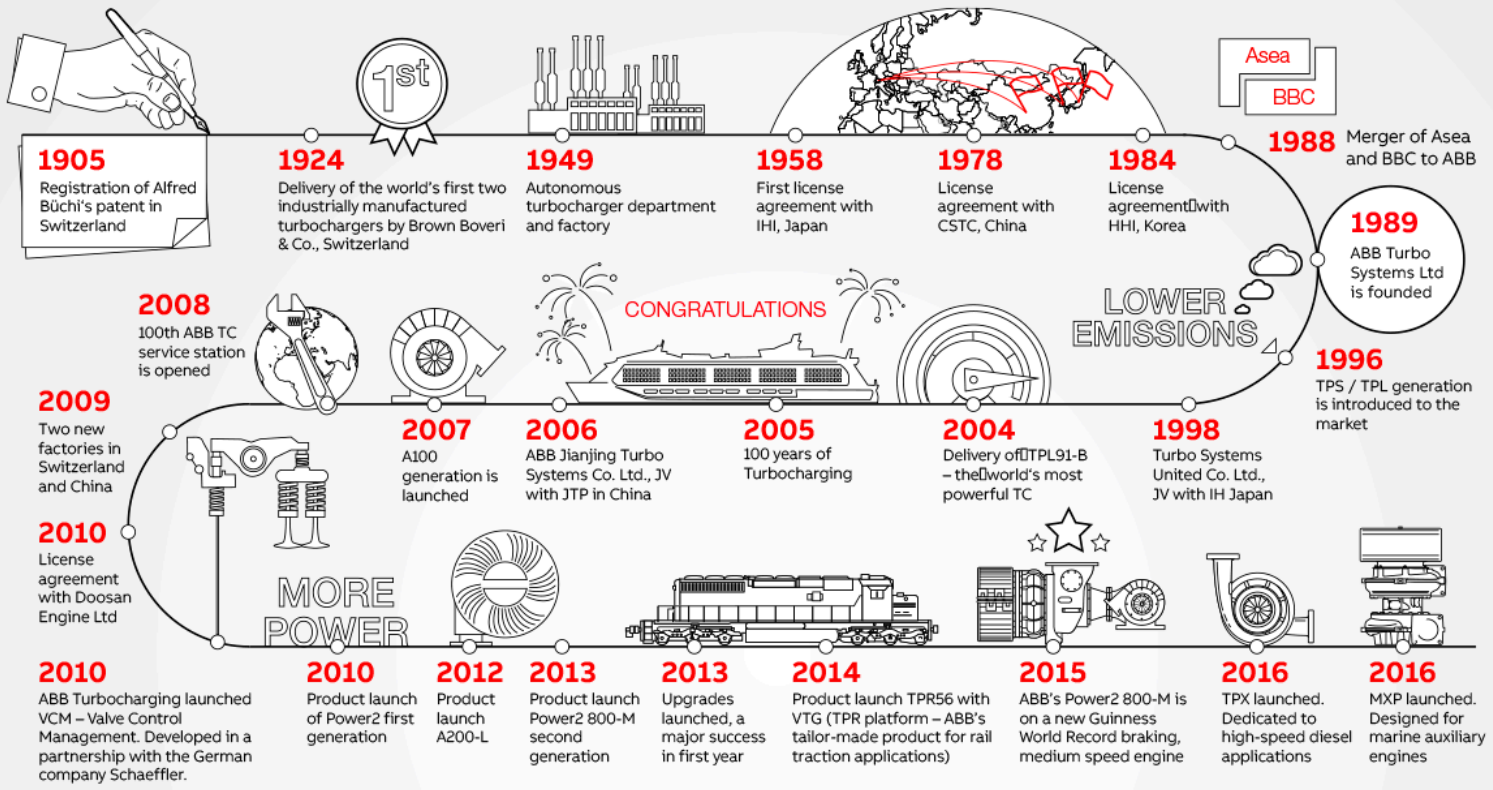
Engine Efficiency



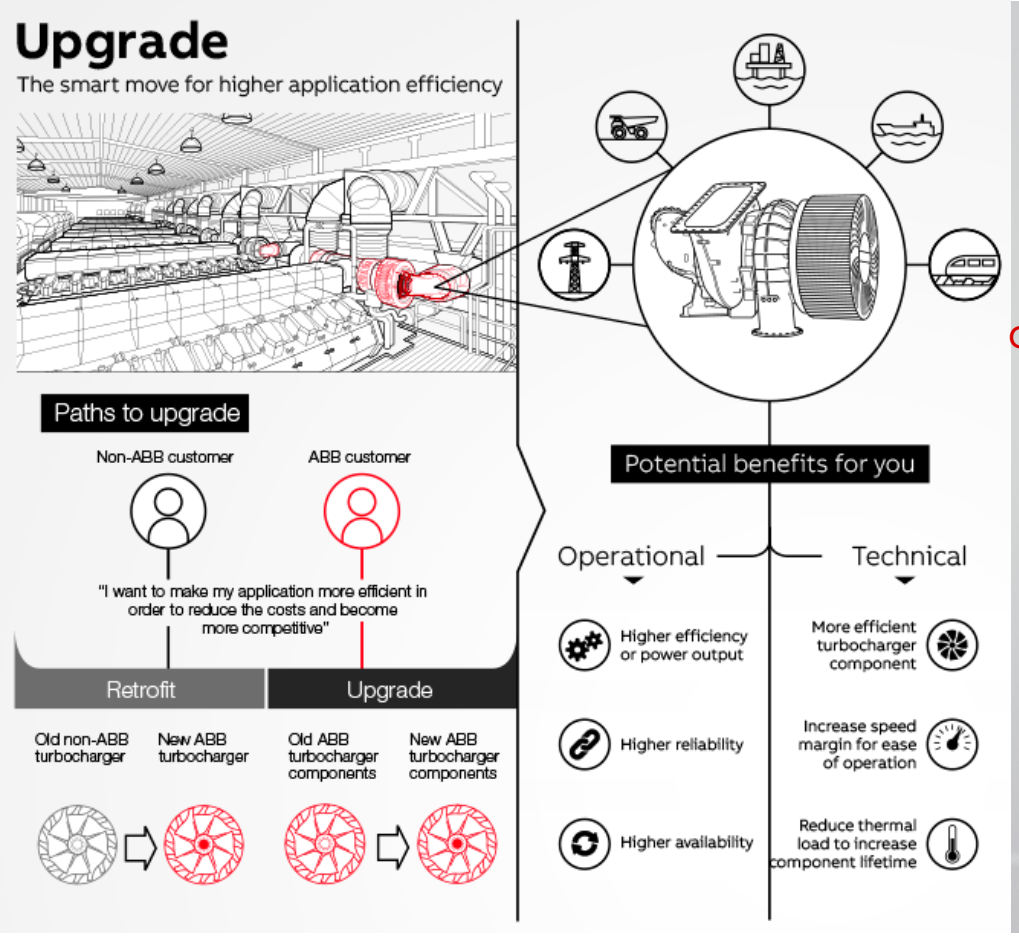
Source: Technical University Hamburg-Harburg Prof. Dr.-Ing. H. Rulfs

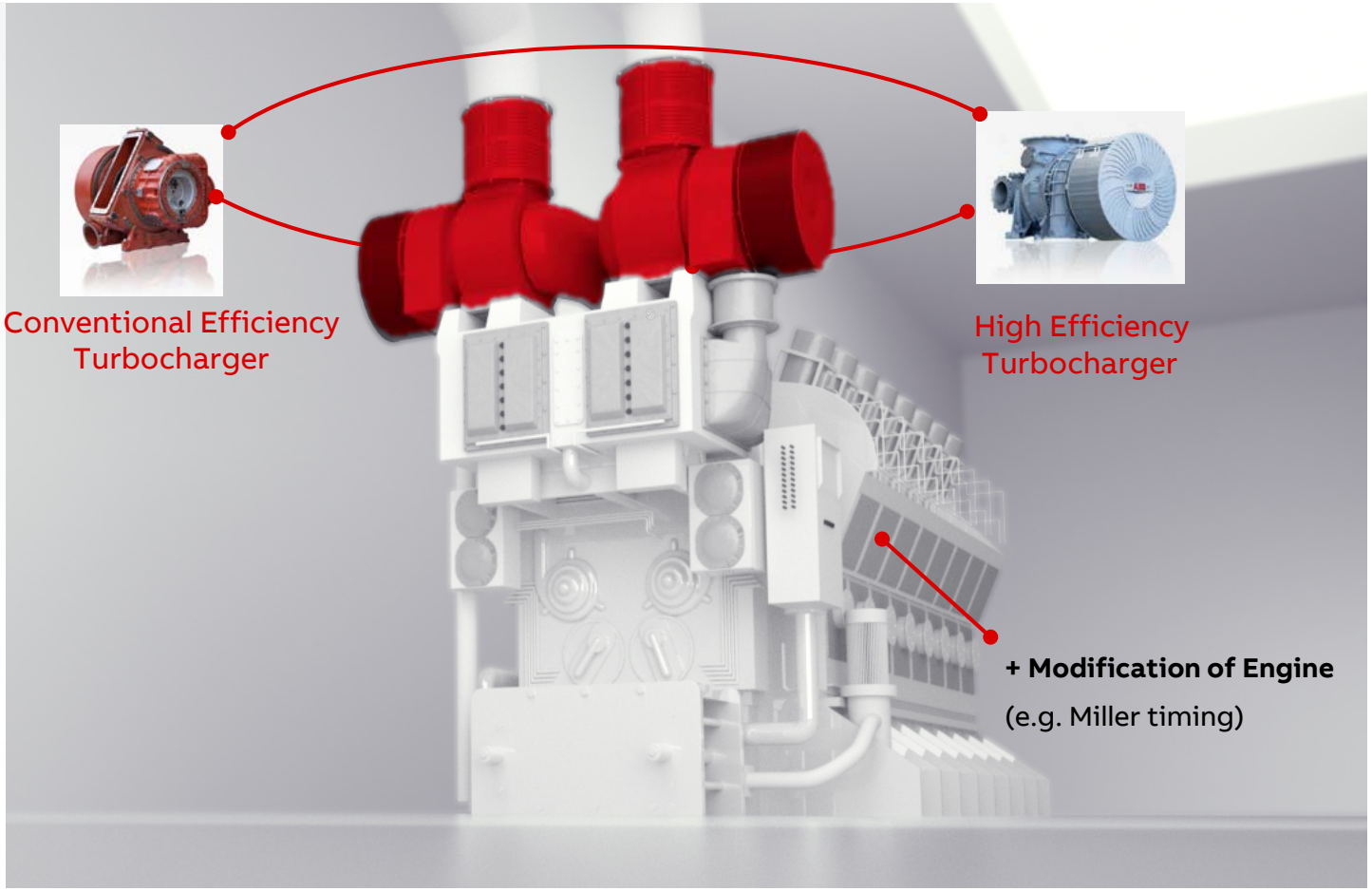
Reasons to be technology path setters

ABB Turbocharging's journey



Upgrade Definition





Turbocharger Upgrade

ABB offers several upgrade solutions in cooperation with the engine OEM

Improvements

Boosting engine performances by replacing:

- Complete Turbocharger or
- Components (e.g. compressor wheels)

Benefits

Reduced fuel consumption

Wider speed margin

Significant reduction of thermal wear and tear

- lower operation cost
- operation flexibility
- reduced maintenance cost
- longer components lifetime
- lower emissions
- environmental improvement

Turbocharger Upgrade

A recent success story

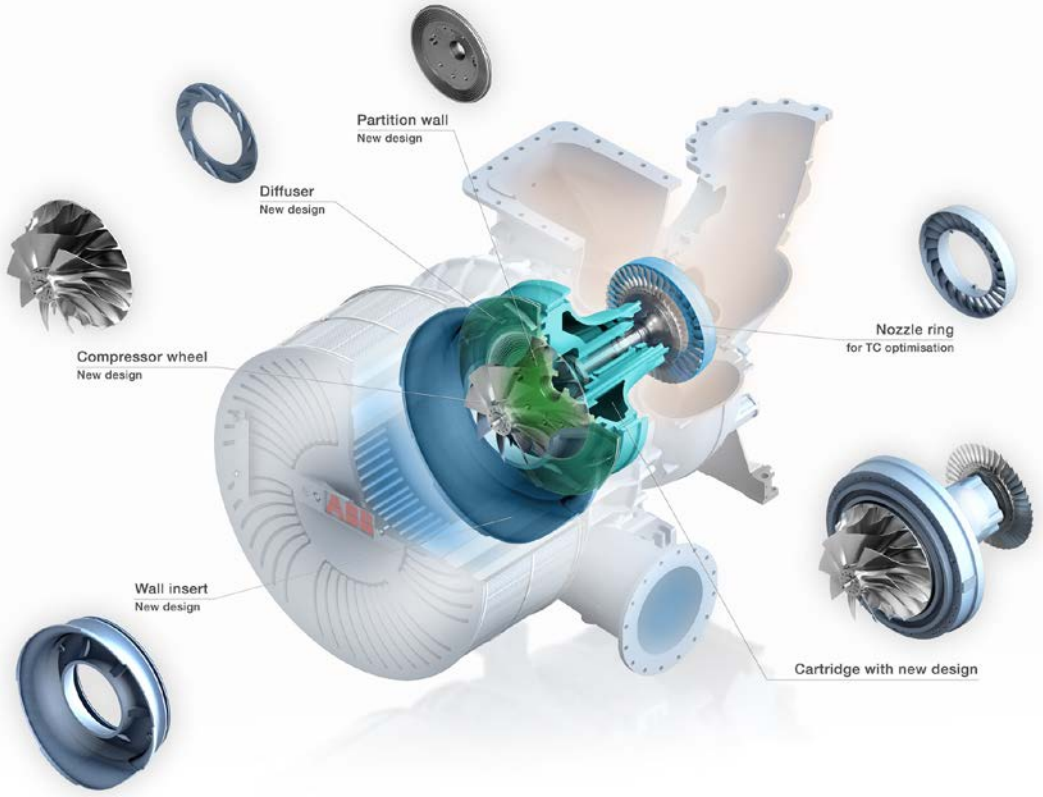
Upgrade idea:

- Due energy efficiency solutions previously implemented on board the vessel, during port stay less electrical power is need (engine only runs at part load)
- **First pilot** engine upgraded end year 2016

Project Main data	
Owner	Global worldwide cruise vessels operator
Application	Cruise vessel, 3.000 passengers
Engine	4 Stroke, diesel Medium Speed, 6 engines installed
Rating	About 10MW; IMO Tier 1 (RINA)
Operation	Diesel electric (constant speed)
Current TC	TPL77-A30
Upgrade	Miller timing conversion, TPL77-A32 for engine part load optimization
Project	Engine OEM in cooperation with ABB

Turbocharger Upgrade

TPL77-A30 to TPL77-A32

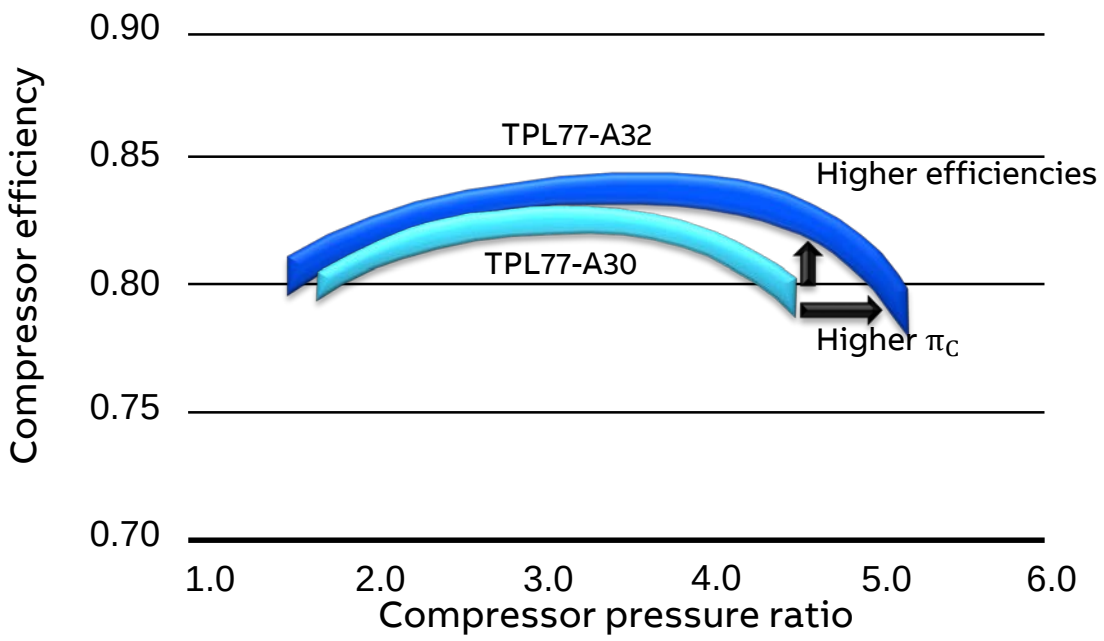


Upgrade benefits

Simulations

Upgrade of the compressor stage CV20 to CV32

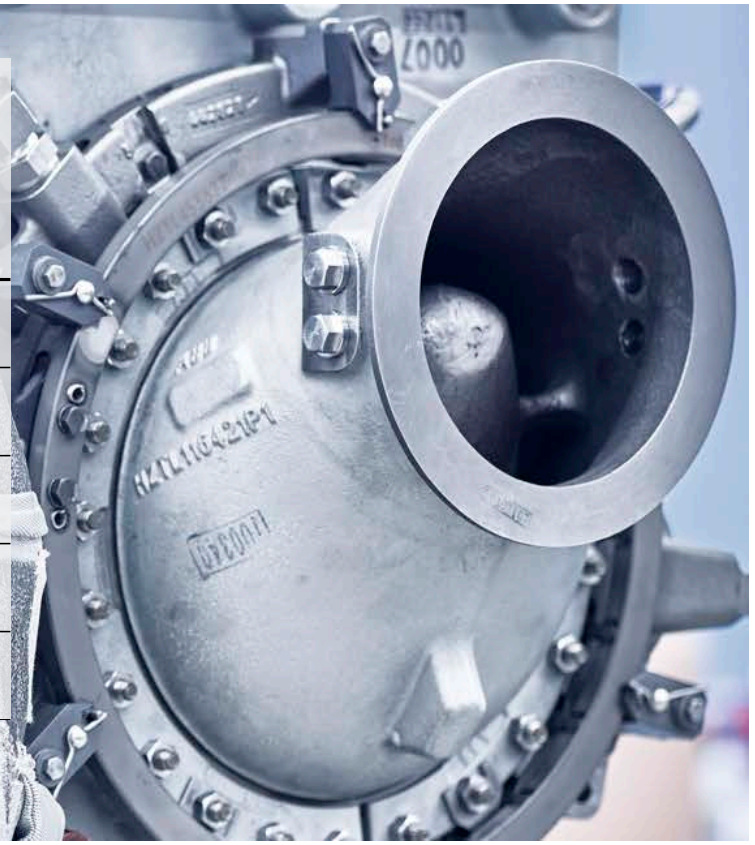
- The CV32 compressor stage of the TPL-C generation is implemented and adapted to the TPL-A series.



Upgrade benefits

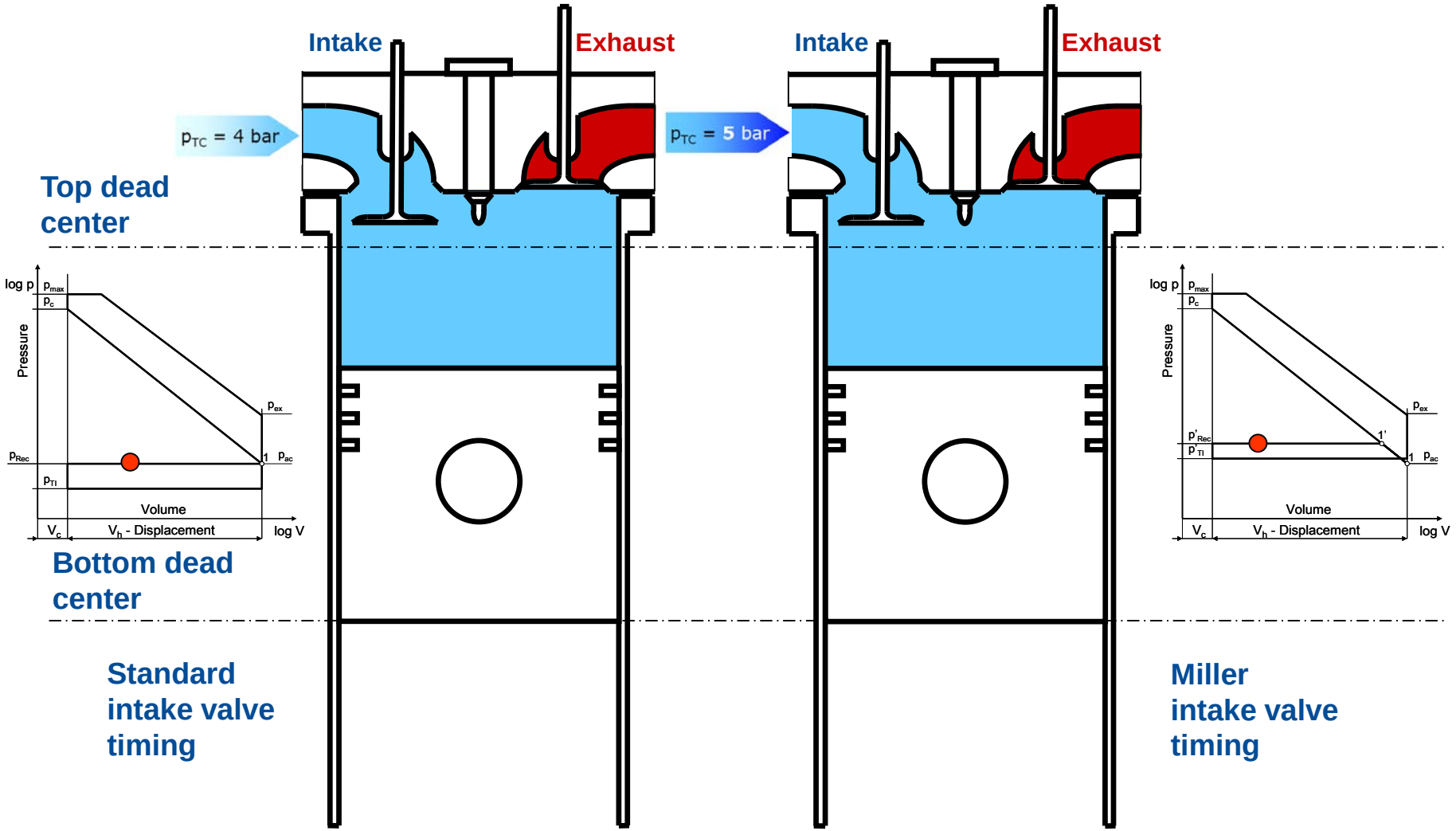
Simulations - Boundary conditions

	Ref: TPL77-A30	**Matching 1: TPL77-A32** Miller	**Matching 2: TPL77-A32** Miller
Engine power [MW]	10	10	10
Turbine	Standard	Part load opt Matching 1	Part load opt Matching 2
Compressor wheel	TPL-A	TPL-C	TPL-C
Up-boosting	-	YES	YES
Cam	Standard	Miller	Miller



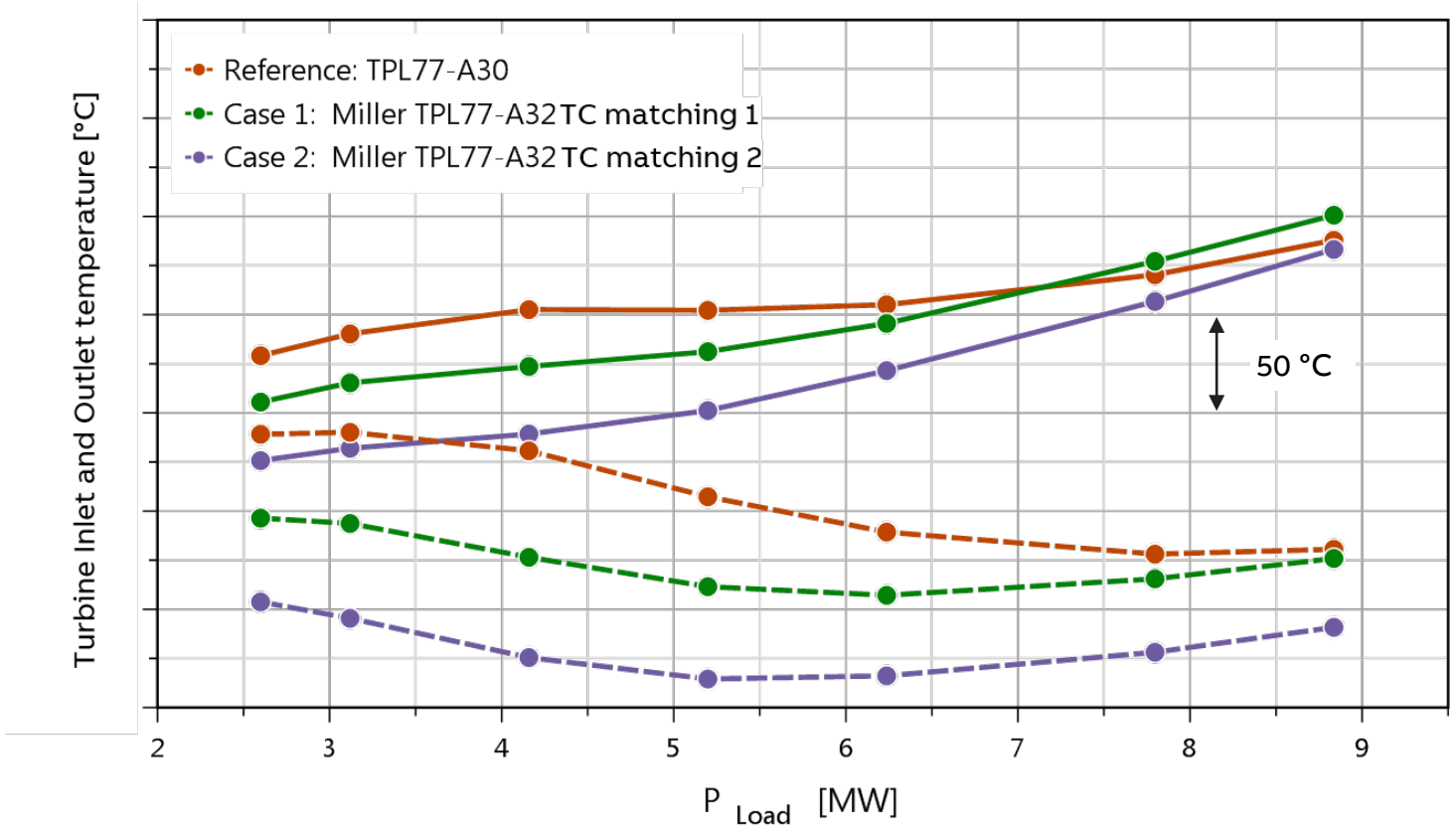
Motivation

The Miller Timing



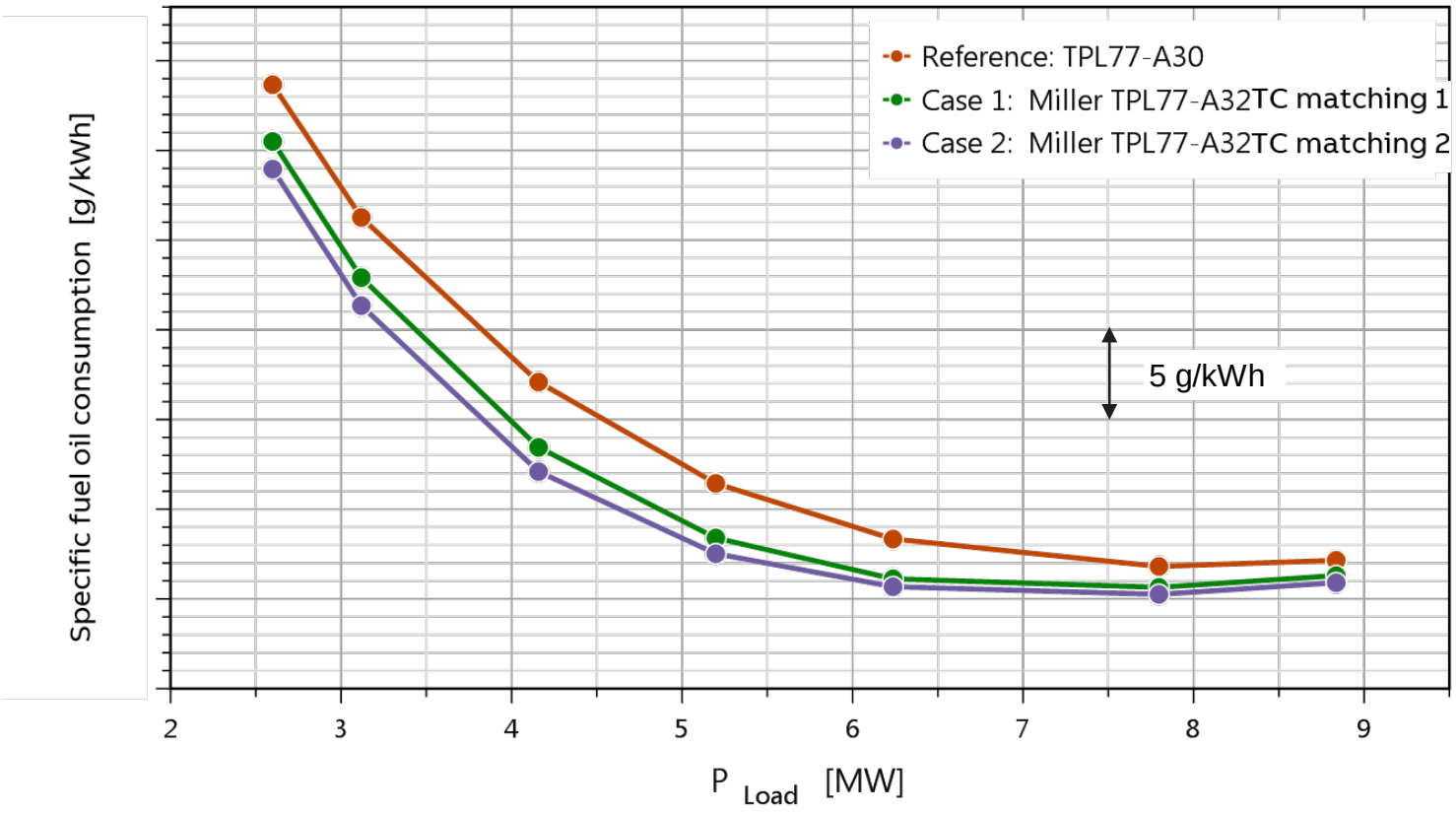
Results

Turbine inlet and outlet temperature



Results

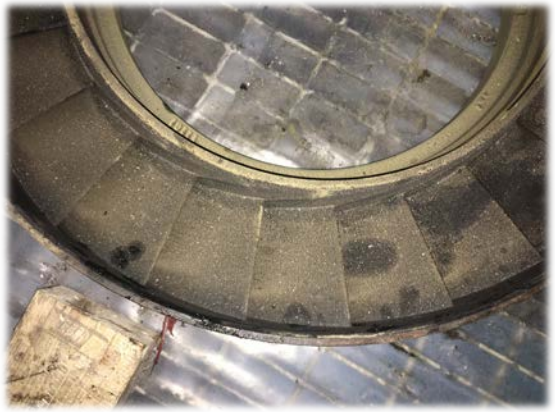
Specific Fuel Oil Consumption



Pictures at site

Withdrawn originally installed parts

Nozzle Ring



Cartridge

Turbine

Compressor Wheel

Pictures at site

New installed parts

Turbine diffuser and Nozzle Ring

Cartridge

Cartridge Air Side

Compressor Casing with air diffuser

Summary

Turbocharger upgrade to A32 in combination with engine upgrade to Miller successfully tested

- A32 enables Miller timing and turbocharger with higher efficiency
- Miller timing enables fuel savings while keeping NOx emissions below IMO limit

Customer benefits

- Significantly reduced fuel oil consumption at part load >5g/kWh
- Simple on board re-certification of IMO Tier 1 engine
- Reduced exhaust gas temperature at turbocharger inlet ~50°C
- «Green Image»
  - Reduced NOx emissions >1g/kWh
  - Reduced CO_2 emissions about 460 ton/year

ABB