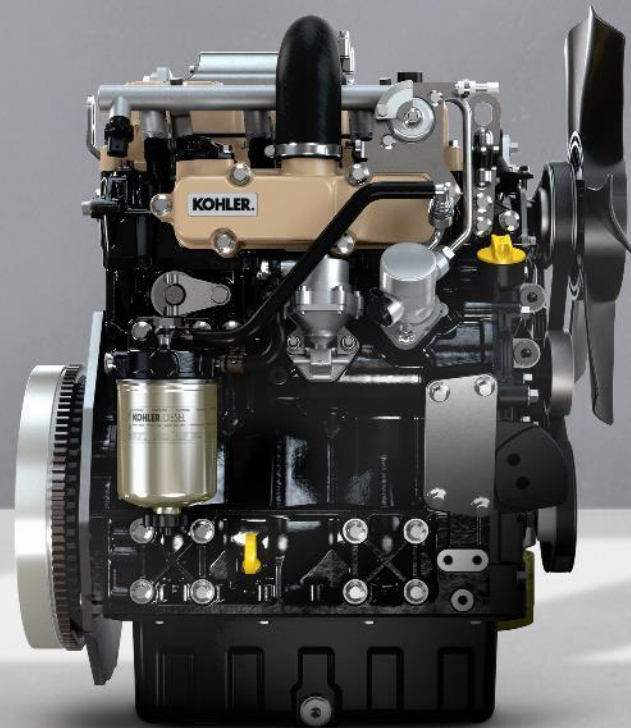


KOHLER. | Engines

Small Displacement *Series*

Update – July 3rd, 2024

KOHLER. | Engines



Presenter

Abhiroop Garg

Professional Background –

- Product Manager, Global Diesel Engines, Kohler Engines – 2022 to present
- Diesel Engine Development Engineer – 2019-2022

Expertise and Credentials –

- Education –
 - M.Sc. in Automotive Engineering, University of Bath, UK
 - B.Tech. in Mechanical Engineering, VIT University, India
- Specializations – Market Analysis, Voice of Customer, Value Creation & Delivery, Product Portfolio Management, Internal Combustion Engine Development

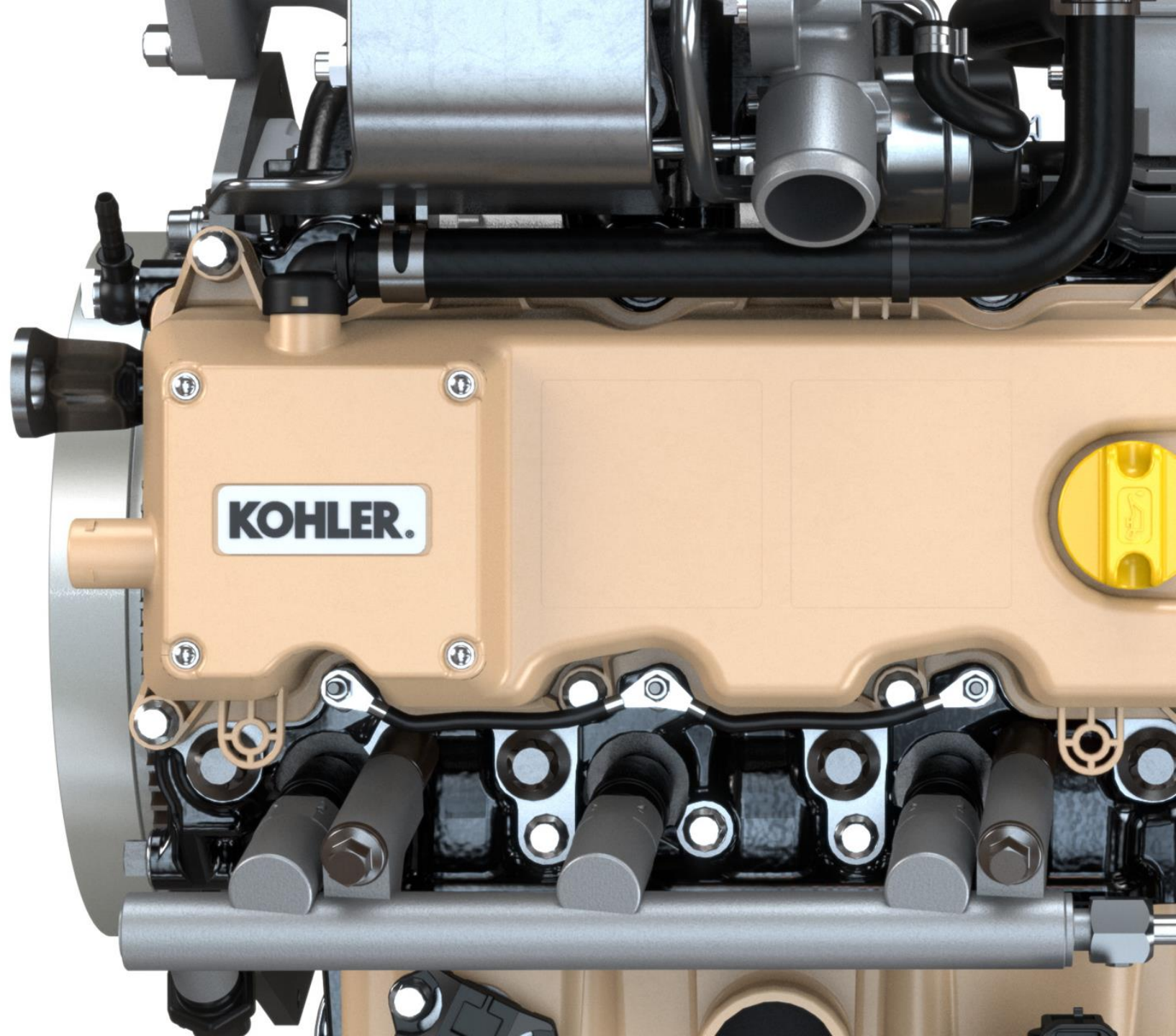
Fun Fact –

- 55,692 minutes of songs listened in 2023.



Contents

- **Value Proposition**
 - Compactness
 - Productivity
 - Cost-effectiveness
 - Fuel Efficiency
- **Torque Density**
- **Total Cost of Ownership**
- **Applications Portfolio**
- **Production Facility**





The KSD Series is a ***versatile*** engine platform that ***boosts machine productivity, minimizes total cost of ownership*** and ***delivers uninterrupted performance***. Its ***extended durability*** and ***longer maintenance intervals*** are a result of ardent engineering efforts, and it is ***readily supported*** by the extensive KOHLER service network.

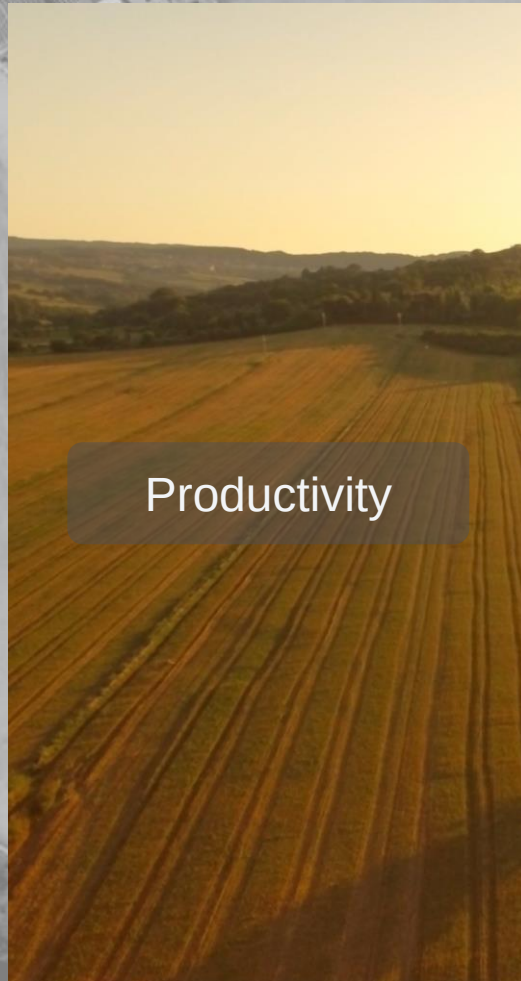
An aerial, grayscale photograph of a large industrial or construction site. The scene shows a vast, flat, light-colored area, possibly a dirt or gravel yard, with numerous tire tracks. In the upper left, there are several white vehicles, possibly cars or small trucks, parked near some structures. In the center, there are stacks of materials, possibly lumber or bricks. To the right, there are several large, rectangular objects, possibly trailers or large storage containers. In the lower right, a large, light-colored structure, possibly a building or a large container, is visible. The overall impression is one of a busy, large-scale industrial or construction environment.

Unmatched Advantages. **Delivered.**

Unmatched Advantages. Delivered.



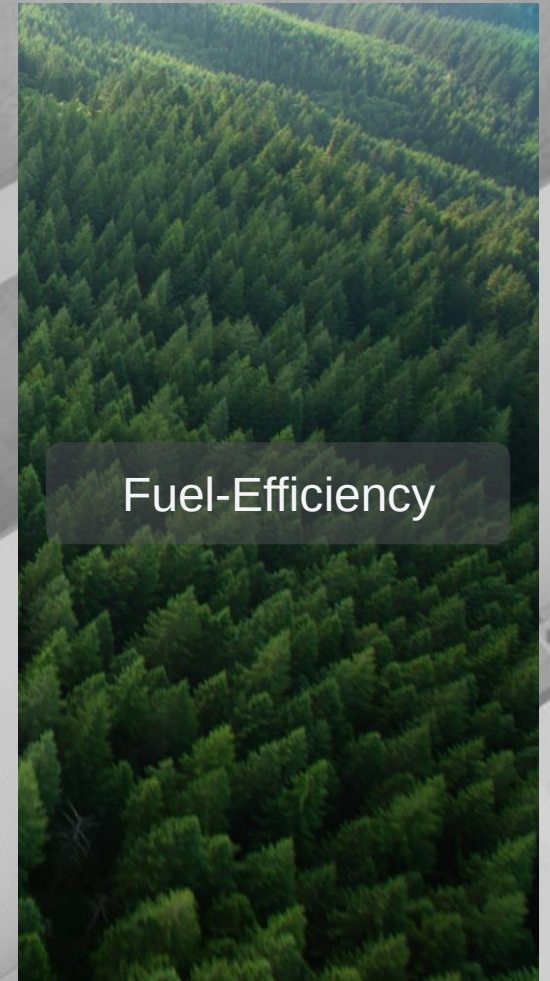
Compactness



Productivity



Cost-Effectiveness



Fuel-Efficiency

Unmatched Advantages. Delivered.

Compactness

- High torque-to-displacement ratio (emissions-capped power) = ***more torque under the same hood!***
- Engine fitment in challenging canopies = ***higher efficiency!***

Unmatched Advantages. **Delivered.**

Productivity

- Low downtime via high service intervals = ***Do more of what you love!***
- Well-established service network = ***Quicker resolutions (should they be needed!)***

Unmatched Advantages. **Delivered.**

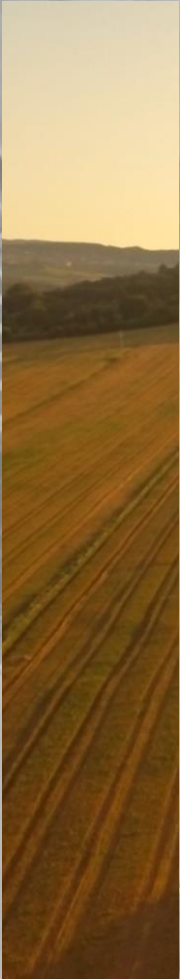


Cost-Effectiveness

- Lowest end-user TCO = ***satisfied customers!***
- Over 50 engine options = ***OEM engineering ease to limit implementation costs!***



Unmatched Advantages. **Delivered.**



Fuel-Efficiency

- Low fuel consumption = ***Low operating costs!***
- Clean and efficient engine functioning in all conditions = ***No black smoke!***





Unmatched Advantages. **Delivered.**

Best-in-class Torque Density*

Highest ***torque delivered per liter of displacement*** in the emissions-capped <19kW engine power category

Mitigates lost productivity
due to emissions-driven downsizing

Allows OEMs to adapt machines to higher torque output = ***More work per unit machine!***



Naturally Aspirated Platform

90 Nm @ 1800 rpm
78 Nm @ 1000 rpm

An entry-level engine offering for cost-effective performance upgrades



Turbocharged Platform

105 Nm @ 1500 rpm
80 Nm @ 1000rpm

The right balance of performance and costs to develop category-winning products



Turbocharged Platform with Aftercooler

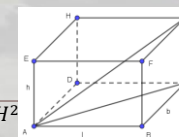
120 Nm @ 1400 rpm
95 Nm @ 1000 rpm

Highest performing variant to upgrade the machine class and compete against ATS machines

Unmatched Advantages. Delivered.

Best-in-class torque density

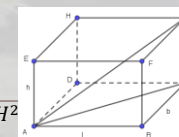
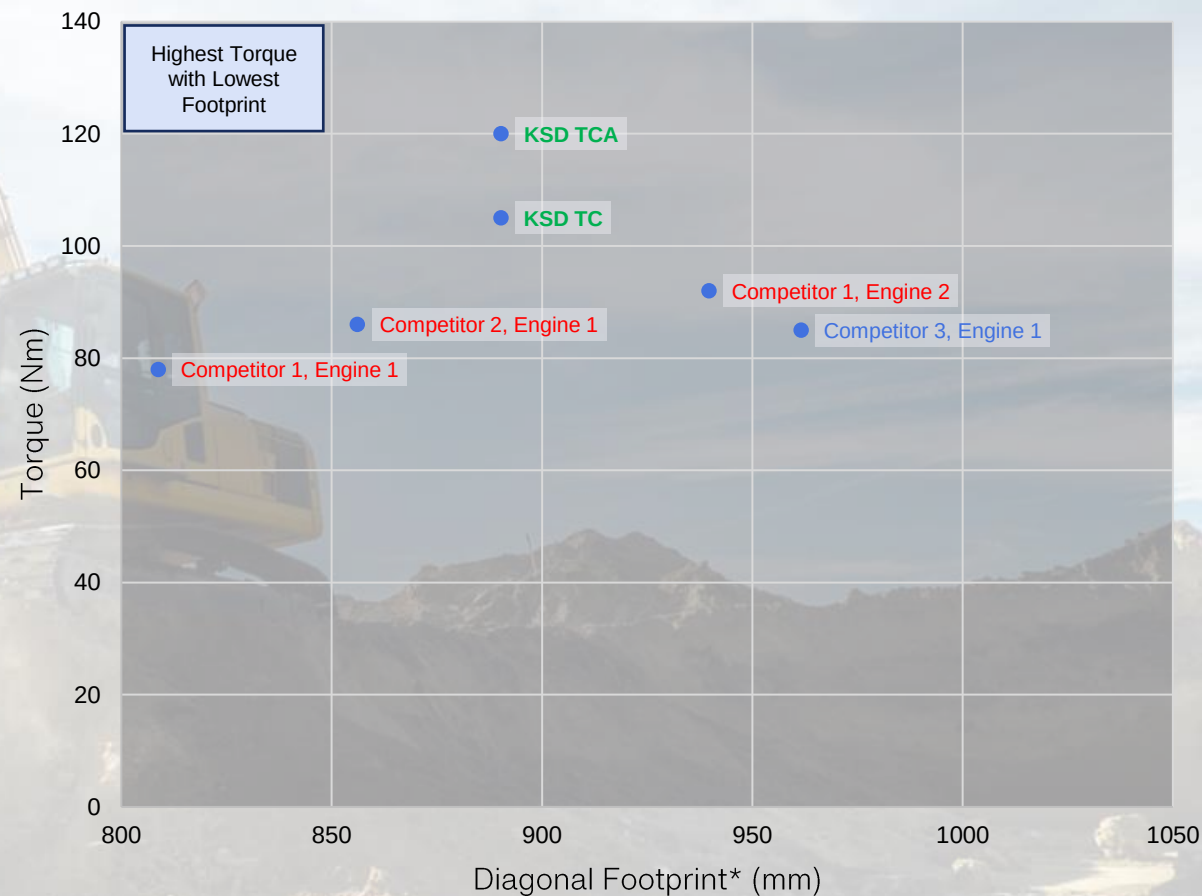
- Highest ***torque delivered per liter of displacement*** in the emissions-capped <19kW engine power category
- ***Mitigates lost productivity*** due to emissions-driven downsizing
- Allows OEMs to adapt machines to higher torque output = ***More work per unit machine!***



Unmatched Advantages. Delivered.

Best-in-class torque density

- Highest **torque delivered per liter of displacement** in the emissions-capped <19kW engine power category
- **Mitigates lost productivity** due to emissions-driven downsizing
- Allows OEMs to adapt machines to higher torque output = **More work per unit machine!**



Unmatched Advantages. **Delivered.**

Total Cost of Ownership

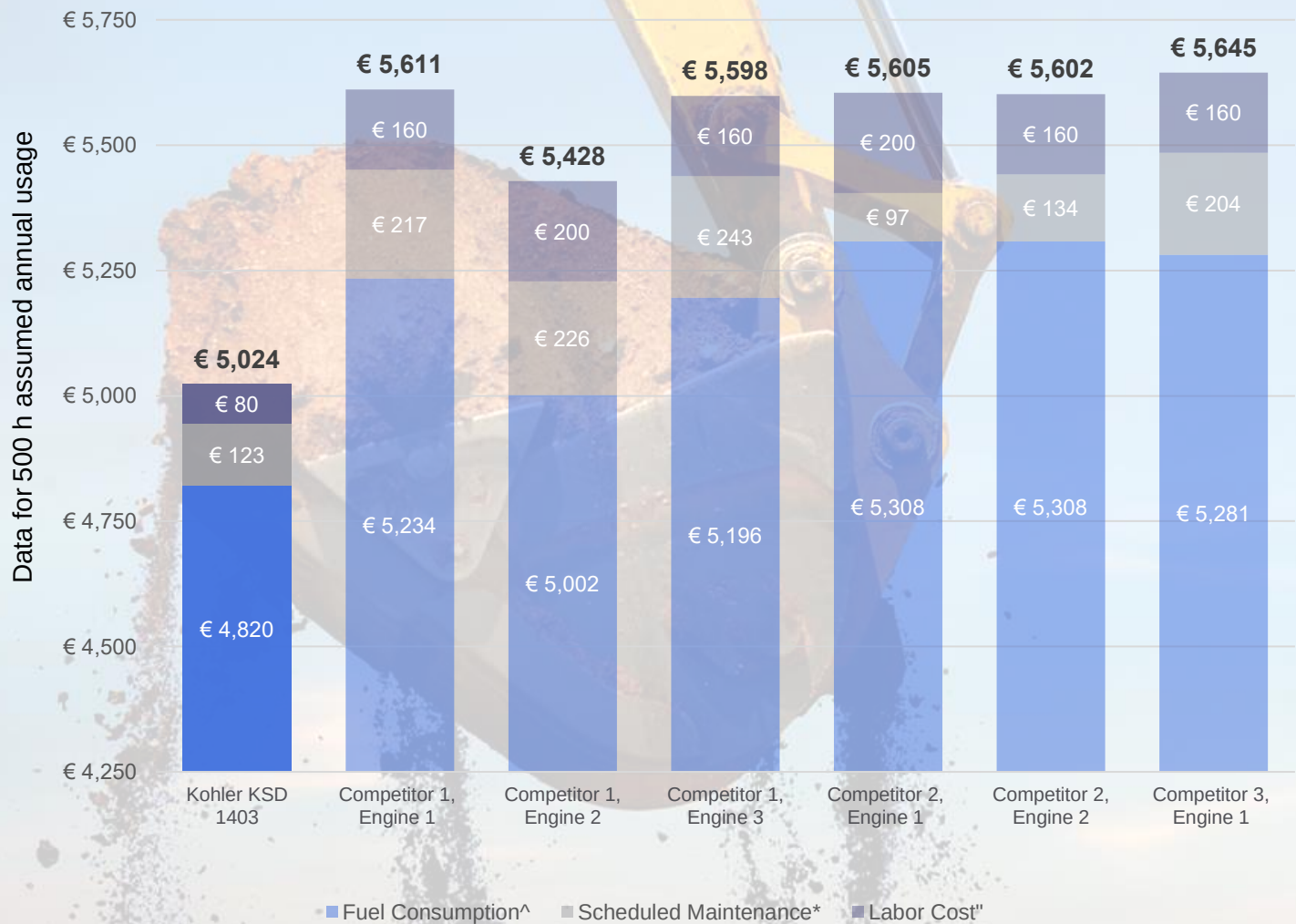
€240 maintenance costs*
saved per 1000h used

€509 maintenance costs*
saved per 2000h used

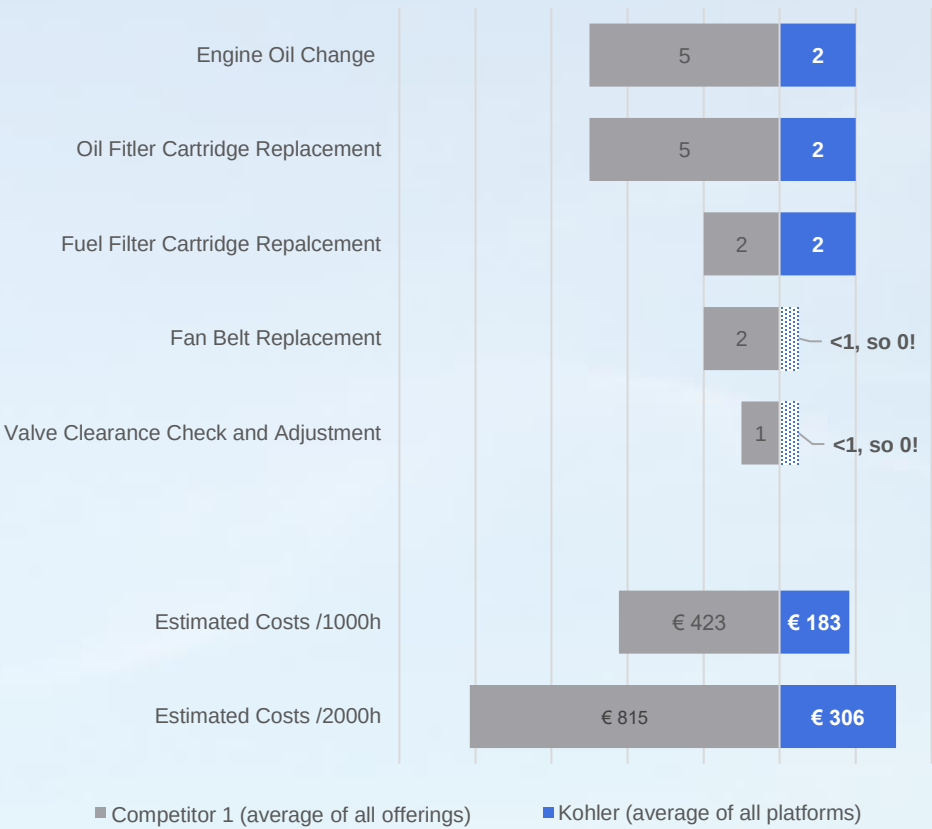
Up to 11% lower annual TCO*

Unmatched Advantages. Delivered.

Total Cost of Ownership



Maintenance Intervals (per 1000h) & Related Costs



The more you use, the more you save!

€240 maintenance costs* saved per 1000h used
€509 maintenance costs* saved per 2000h used
Up to 11% lower annual TCO*

Engine TCO only
*Estimates include spare part cost and exclude labor for valve adjustment for 500h/y usage
**Calculated as 500 working hours/y
*Scheduled Maintenance includes oil changes/500h, coolant change per 2y and replacements as above table
^Fuel consumption calculated using published values for fuel consumption, 1.75 €/L prices and fuel density of 0.85 kg/L
*€40/h labor cost assumed with 2h intervention on each visit – revenue lost due to machine idle time not considered

Unmatched Advantages. Delivered.

Global applicability



Superior Fuel Economy and User Comfort



Longer, Easier Machine Usage

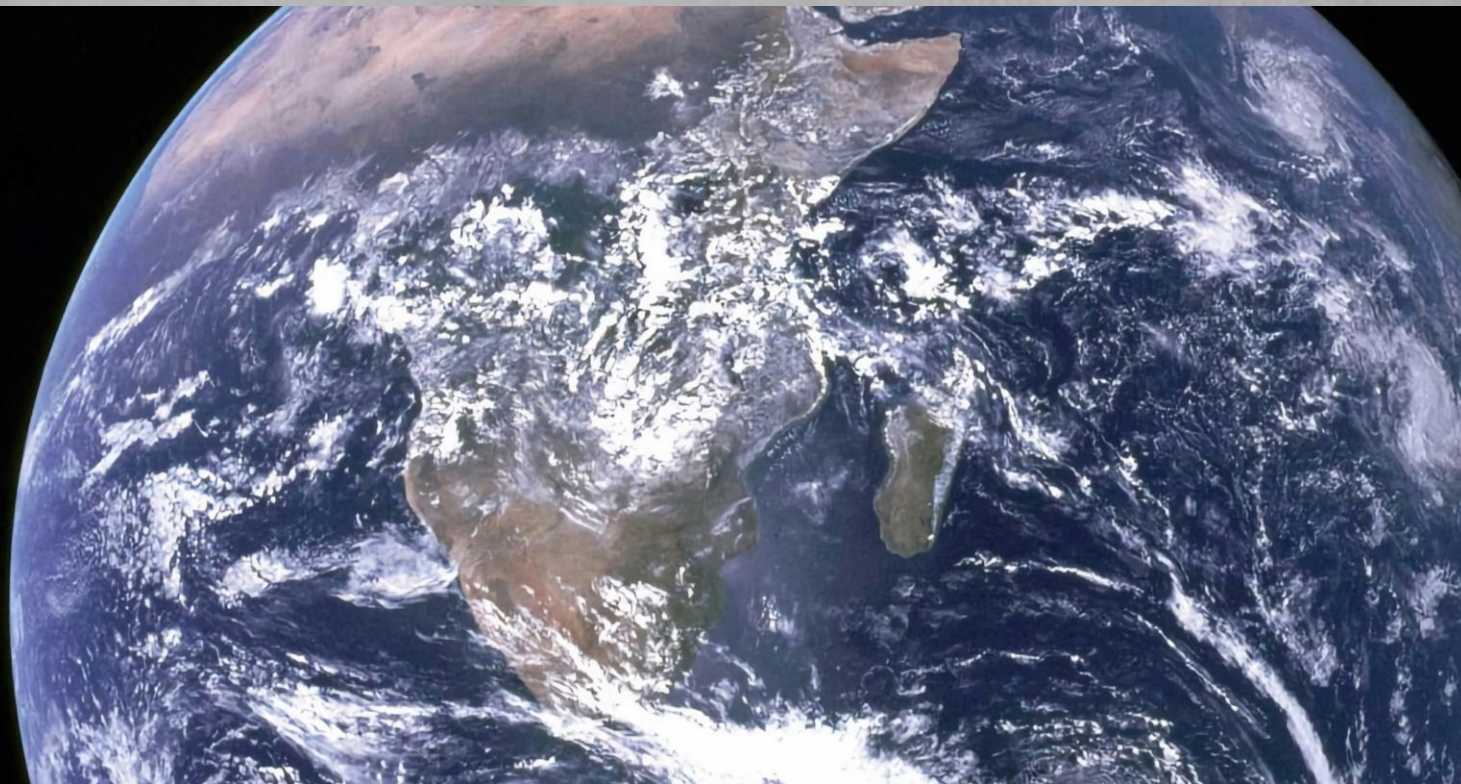


Unmatched Advantages. Delivered.

Global applicability

Streamlined inventory
management for the global
customer -

- EU Stage V
- EPA/CARB Tier 4 Final
- China IV
- India CEV VI/ TREM V



Unmatched Advantages. Delivered.



Superior Fuel Economy and User Comfort

- ***Up to 7%* better fuel economy*** in full-power operating conditions
- ***Earlier arrival at full power*** (1800rpm v. 2600rpm) reduces fuel consumption
- ***NVH reduction***



Unmatched Advantages. Delivered.

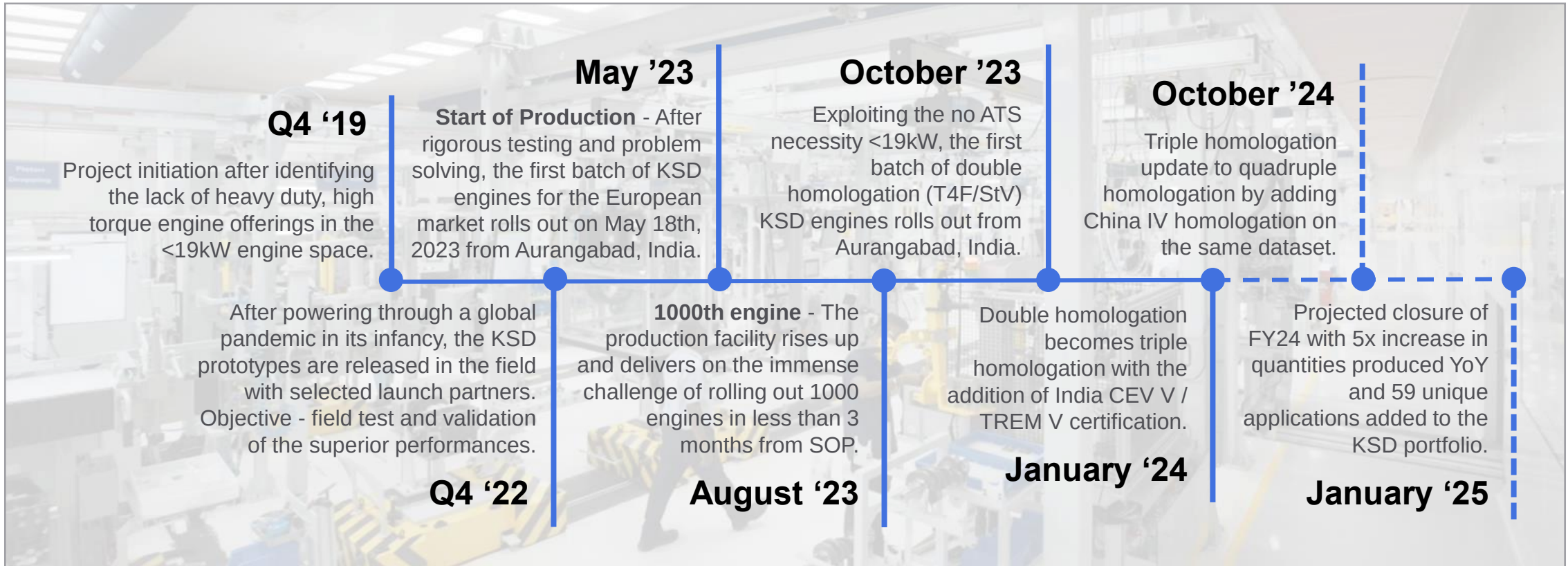


Longer, Easier Machine Usage

- ***Standard 500-hour service interval*** (2x most standard offerings in the market today, upgradeable to 1000 hour with simple component swap)
- ***Drop-in*** electronic design



Key Milestones

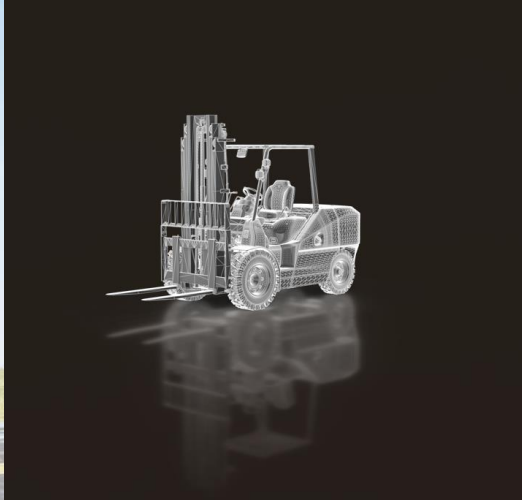


Powering the Future. Today.

2023 Launch Partners

2024 Applications Portfolio

2023 Launch Platforms



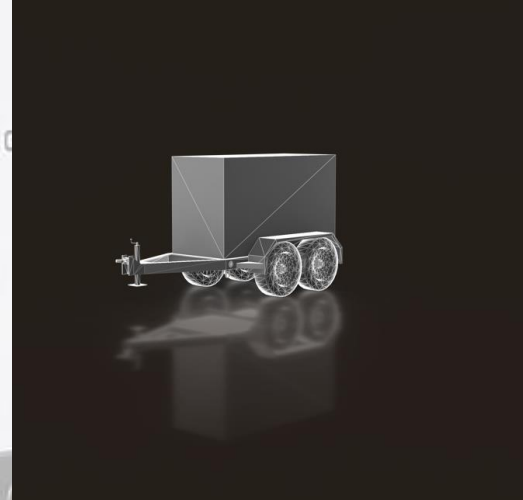
Forklifts

- ~10% fuel saving in typical duty cycle vs. incumbent production engine



Aerial Lift Platforms

- Better load response vs. current incumbent engine



Portable Gensets

- Longer service interval of 1000h by changing oil quantity and filtering capacity



Mini-excavators

- Higher load acceptance and better extreme condition operation vs. incumbent engine

2024 Applications Portfolio



Industrial

- BM Forklifts
- APUs
- Air Compressors
- Airport Baggage Loaders



Construction

- Stand-on Skid Steers
- Mini-Dumpers
- Stone Crushers
- Loaders



Others

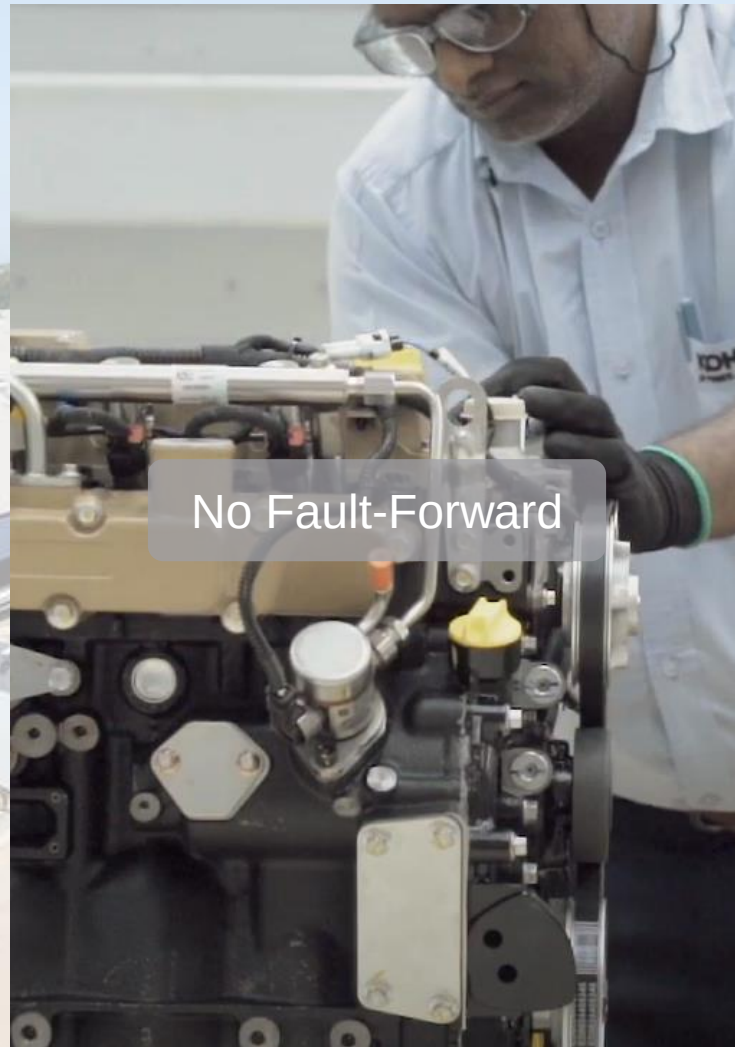
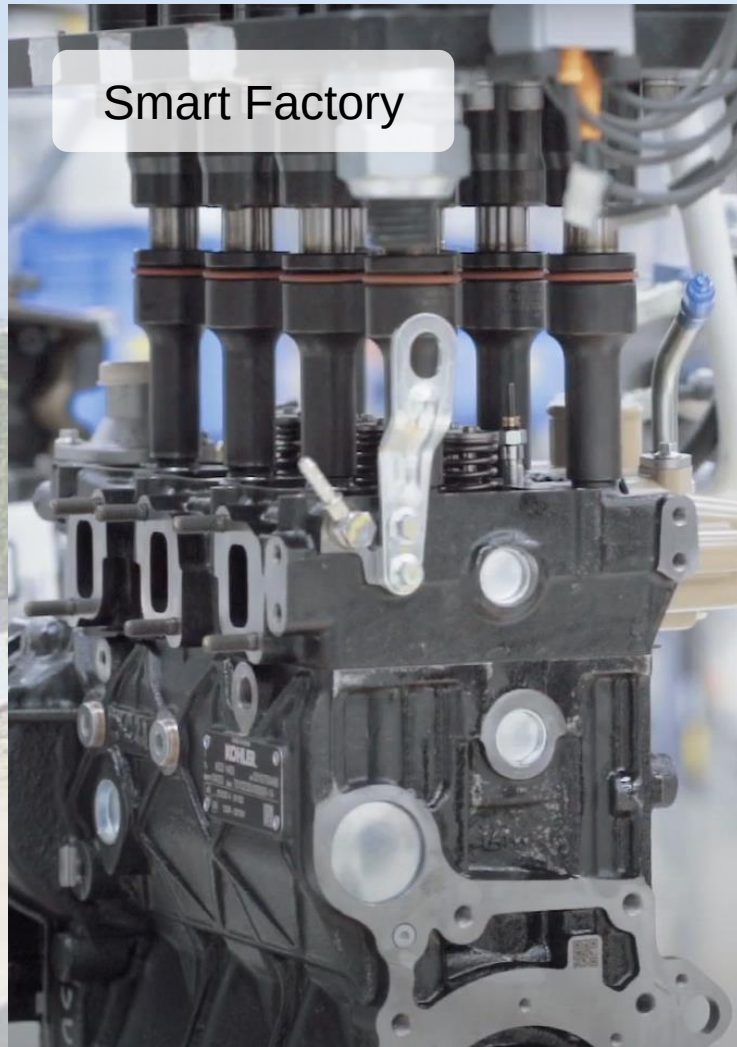
- Tractors
- Sprayers
- Woodchippers
- ZTRs
- Winches



Tireless Production. Delivered Sustainably.

📍 Aurangabad, India

Tireless Production. Delivered Sustainably.

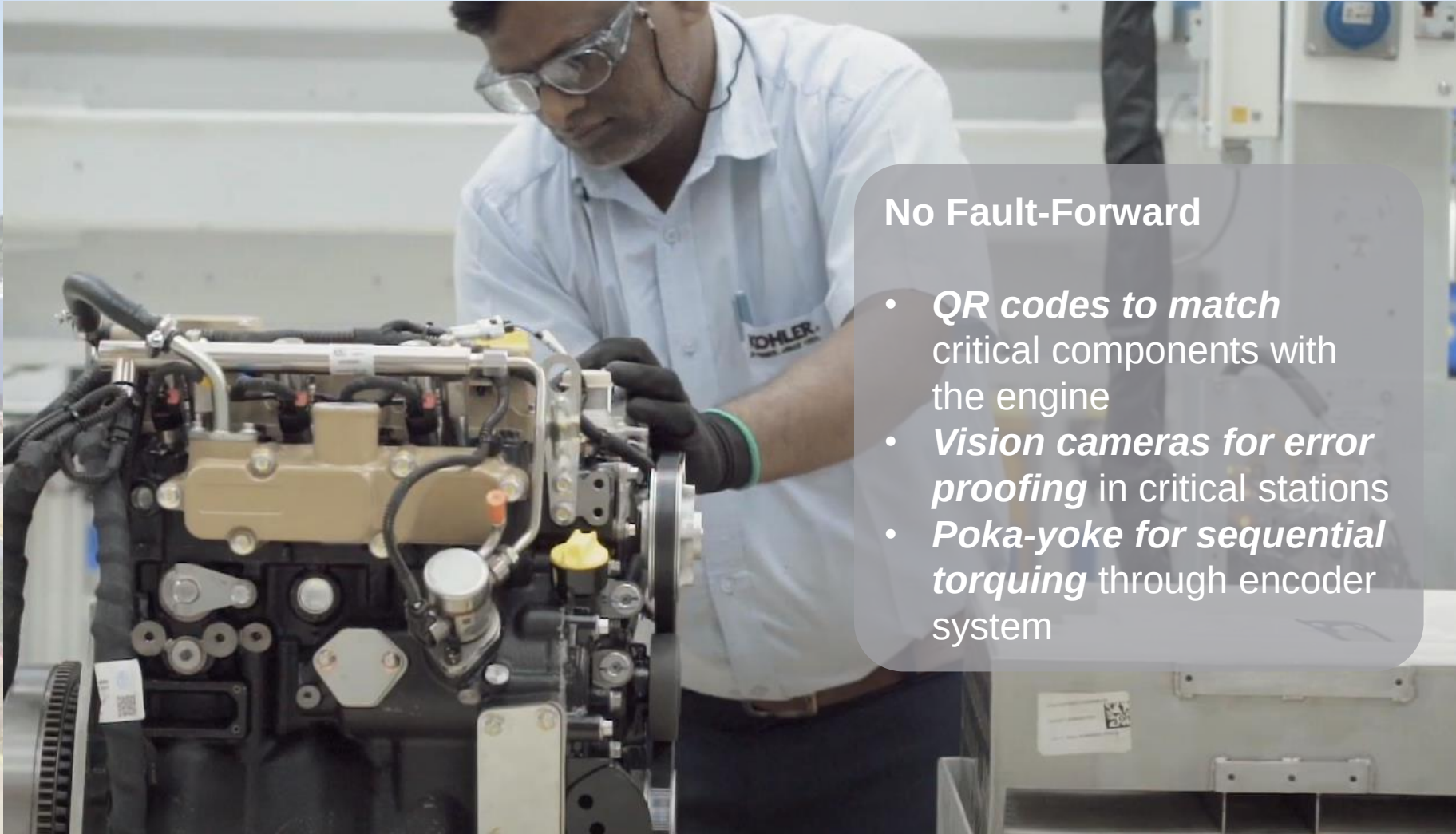


Tireless Production. Delivered Sustainably.

Smart Factory

- ***Pick-to-light*** kit preparation
- ***Operator*** login and access ***based on skill set***
- ***Digital*** work instructions

Tireless Production. **Delivered Sustainably.**

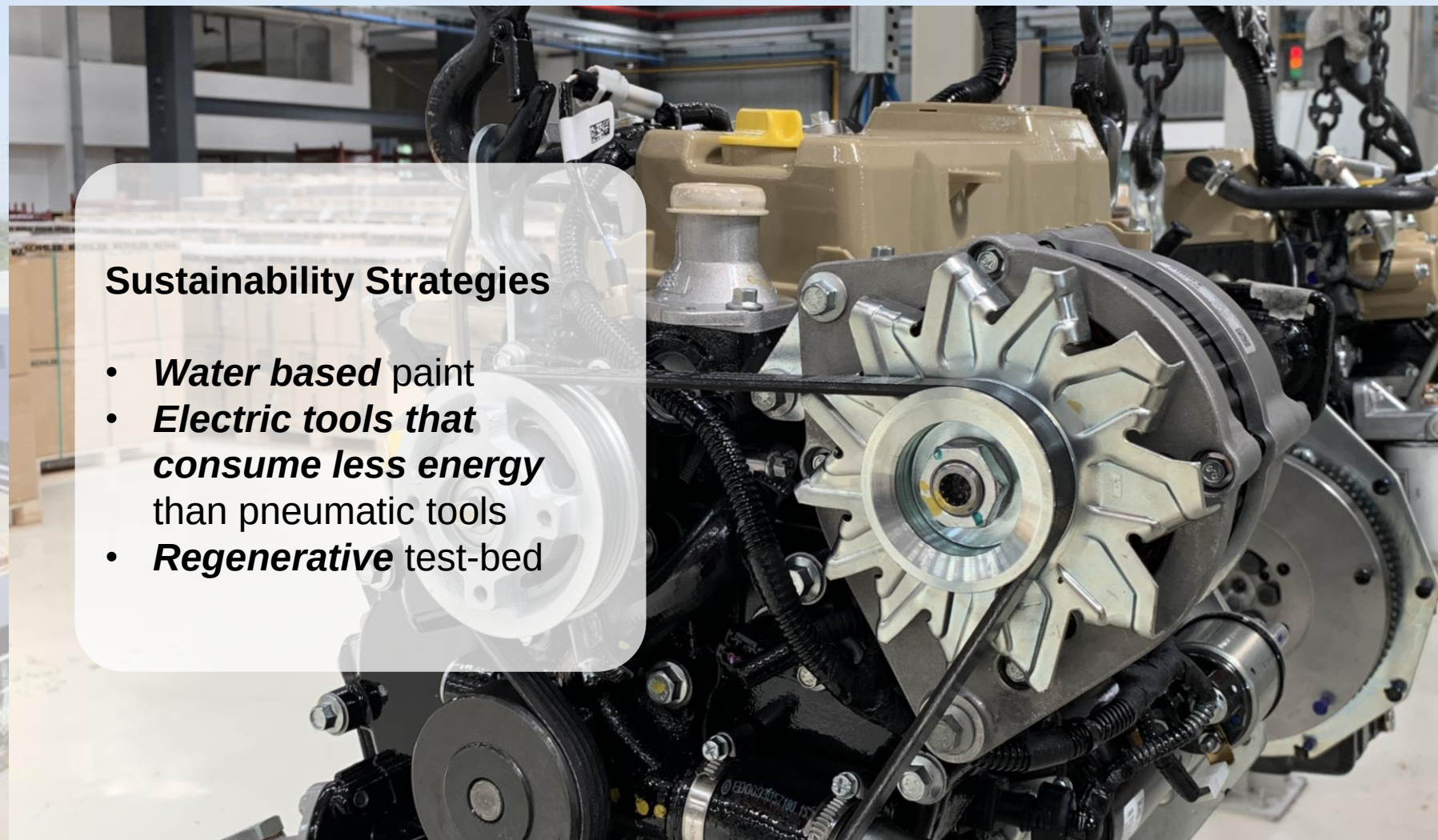


No Fault-Forward

- *QR codes to match* critical components with the engine
- *Vision cameras for error proofing* in critical stations
- *Poka-yoke for sequential torquing* through encoder system



Tireless Production. **Delivered Sustainably.**



Sustainability Strategies

- ***Water based*** paint
- ***Electric tools that consume less energy*** than pneumatic tools
- ***Regenerative*** test-bed

Thank you!

