

April 2020

# COMPANY OVERVIEW

**Garrett**  
ADVANCING MOTION

WHO WE ARE



# Garrett mission



Garrett is a cutting-edge technology provider that enables vehicles to become safer, more connected, efficient and environmentally friendly

We lead the development of innovative and differentiated solutions which empower the transportation industry to redefine and further advance motion



# Pioneering technology solutions provider



## Turbo Technology

- Reduce fuel usage
- Reduce exhaust emissions
- Enhance engine performance



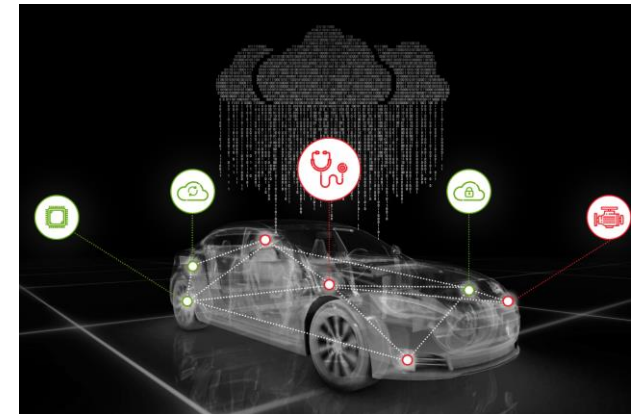
## Electric & Hybrid

- Optimize fuel economy
- Step towards a zero emissions future
- More responsive driving



## Connected Vehicles

- Protect vehicles against cyber attacks
- Diagnose and predict anomalies
- Avoid breakdown and liabilities



# Garrett at a glance

**\$3.2B**

2019 Revenue

**~7,500**

Employees

**~1,200**

Engineers

**40**

Vehicle manufacturers served globally

**5**

R&D Centers

**12**

“Close-to-Customer”  
engineering centers

**100+**

New applications annually

**1,400+**

Patents issued or pending

**13**

state-of-the-art  
manufacturing facilities

**50,000+**

Turbos / day

**100M+**

Garrett turbos in use globally



Turbo Technology

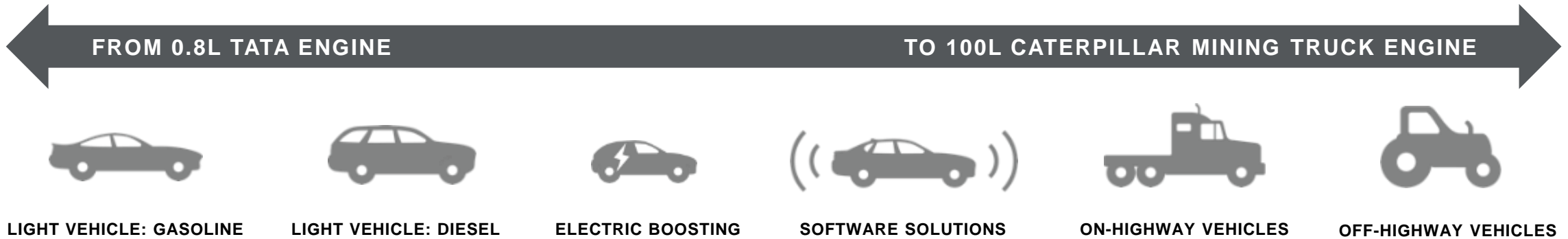


Electric & Hybrid



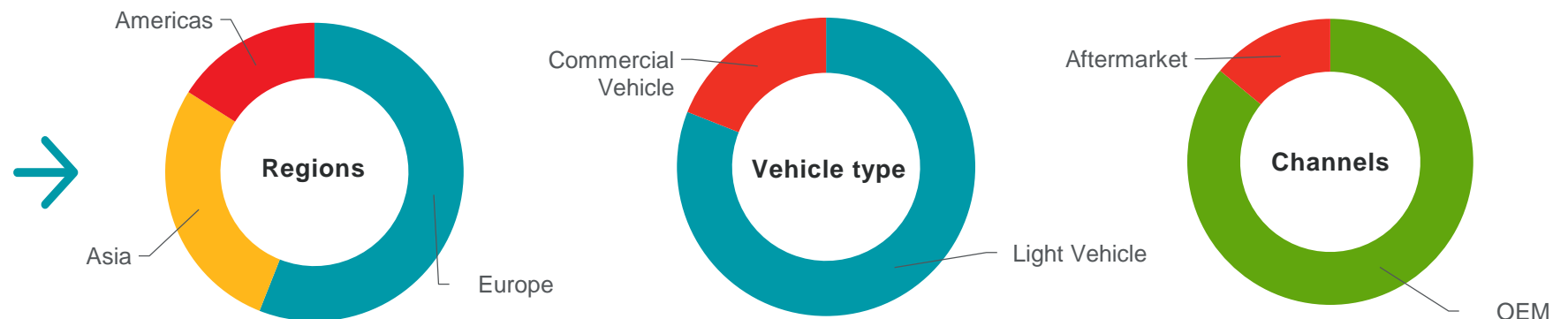
Connected Vehicles

# Broad product portfolio, serving all markets



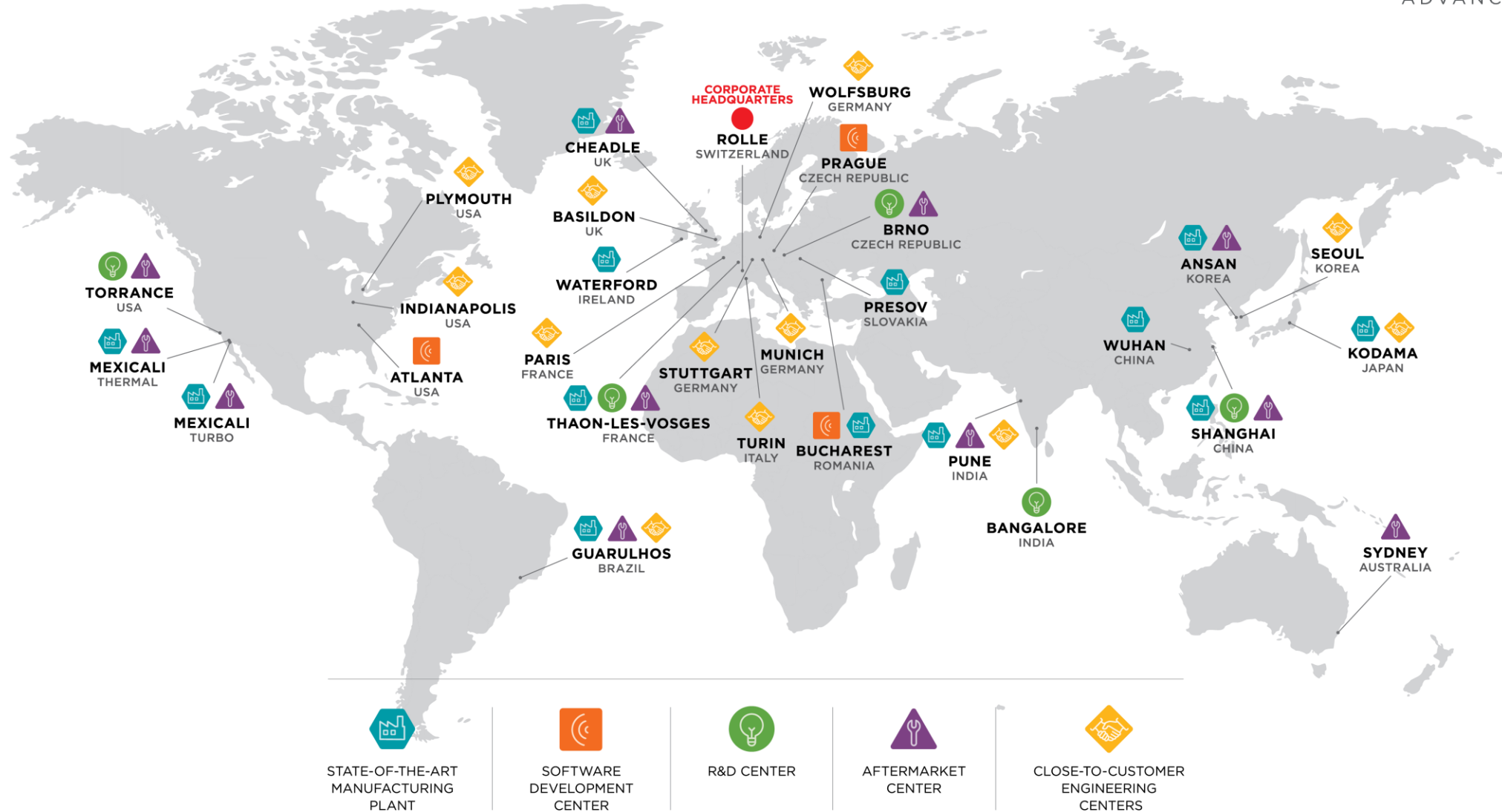
## 2019 Revenue

**\$3.2B**



All vehicles, all segments, all regions

# Global footprint, local player



# Differentiated integrated supply chain strategy



## Differentiated internal manufacturing technologies

- Home-grown “Industry firsts” (high-speed electron-beam, laser welding...)
- Proprietary super high speed balancing
- 100+ manufacturing patents and trade secrets

## Standardized manufacturing processes

- Global engine programs sourced from multiple plants
- Maximized flexibility and assets utilization
- Resilience to industrial risks

**13**

state-of-the-art  
manufacturing facilities

**50,000+**

Turbos / day

**100+**

New applications annually



# Long-term customer relationships with 40+ manufacturers

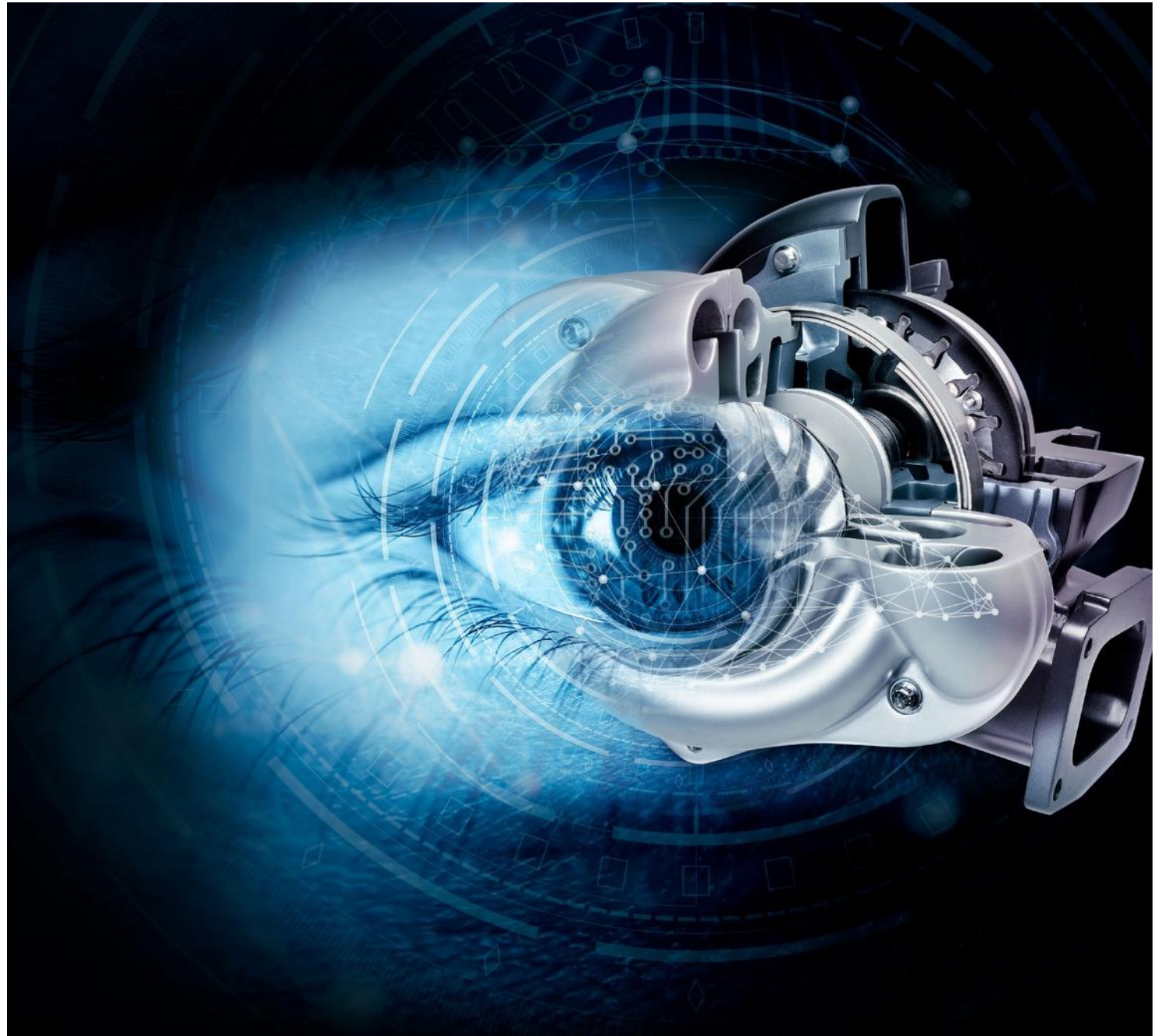


**SINGLE SUPPLIER PER ENGINE**  
**20+ YEARS CYCLE**



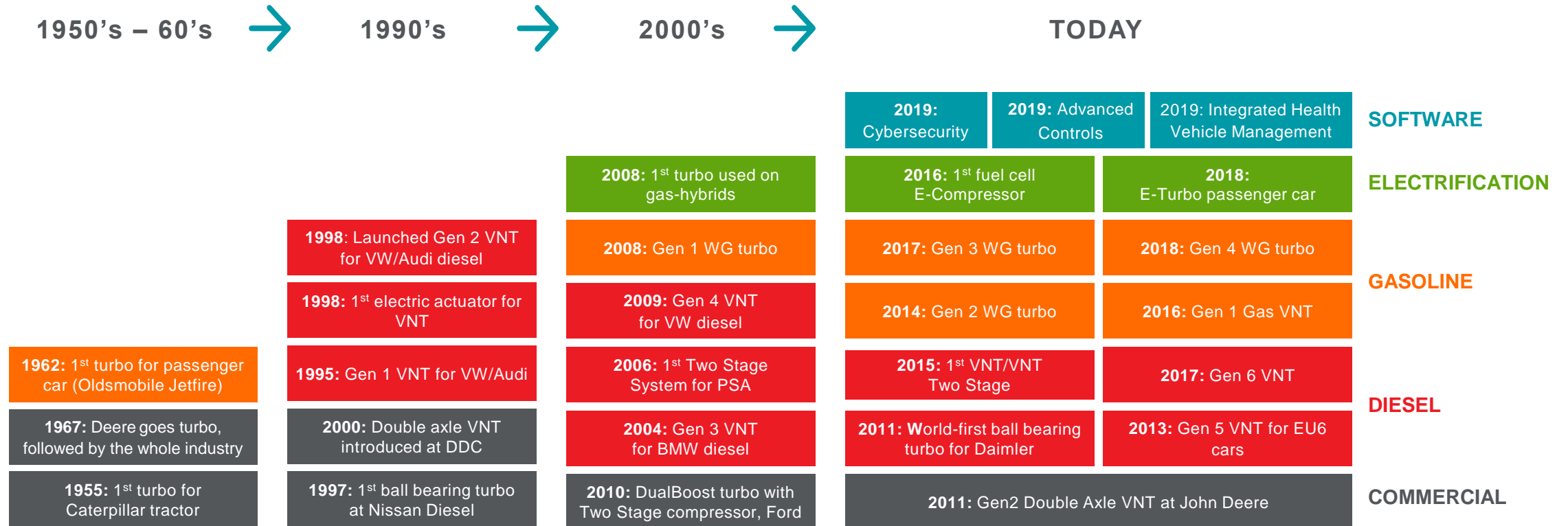
Early engagement leads to long-term global business relationships

# TECHNOLOGY DIFFERENTIATION



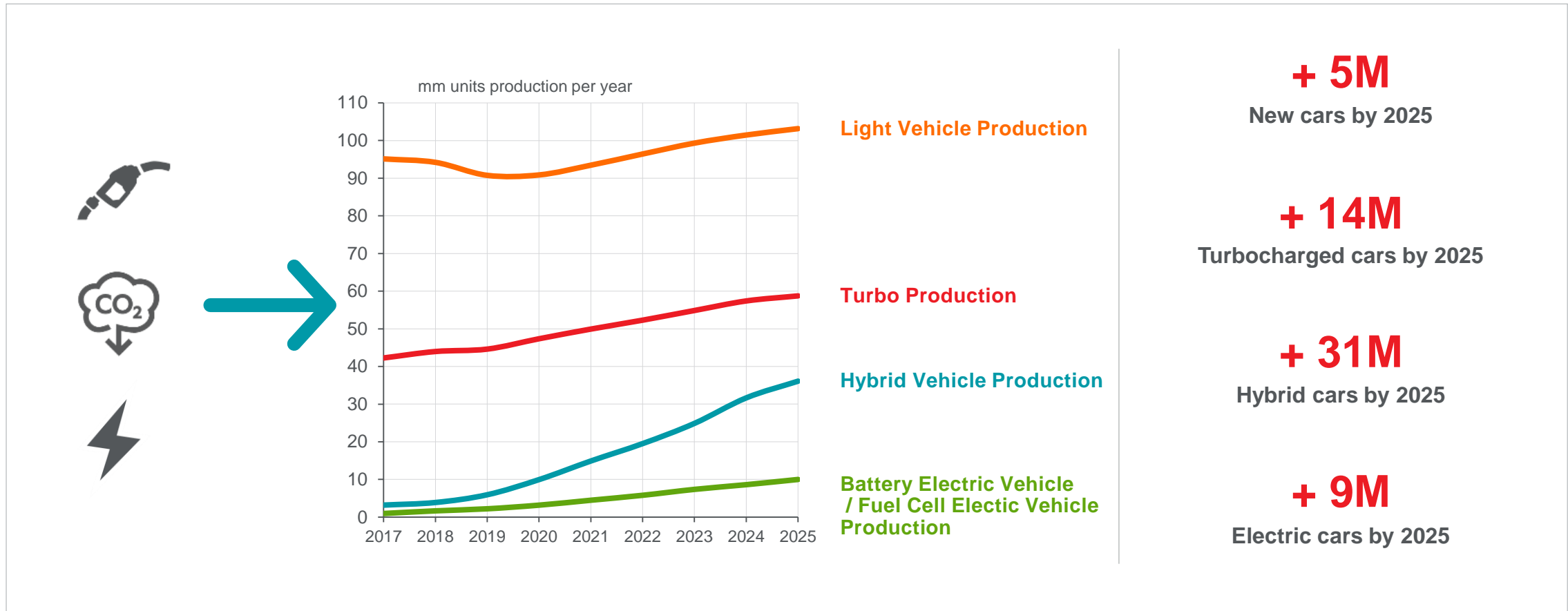
# History rich in innovation

## Milestones



Note: WG – Wastegate turbine (fixed geometry); VNT – Variable Nozzle Turbine; EVR – Exhaust gas recirculation; IVHM – Integrated Vehicle Health Management

# Regulatory changes driving need for new technologies

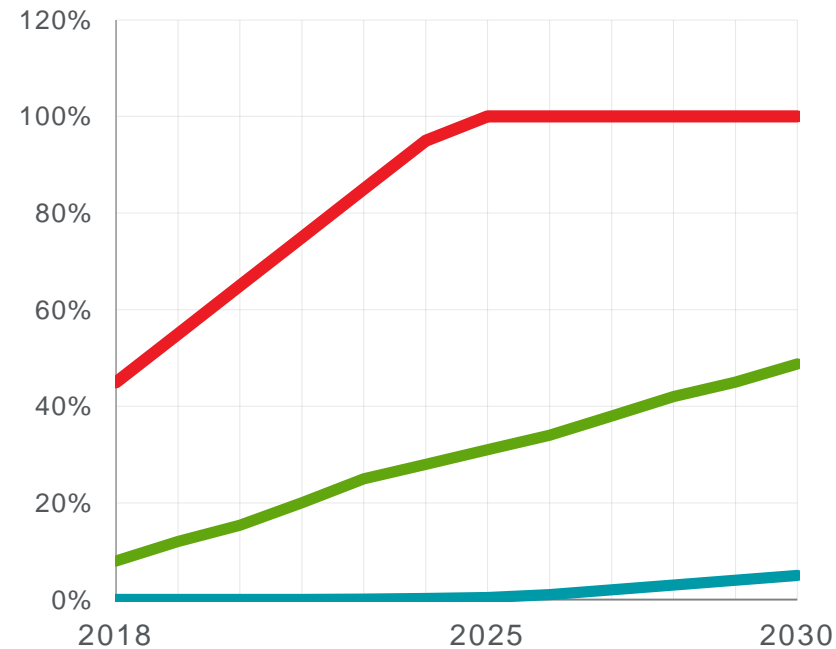
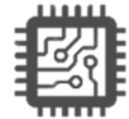


Source: IHS February 2020

**More environmentally friendly cars by 2025**



# Digital disruption driving need for new technologies





**Connected Vehicles  
Reaching 100%**

**Autonomous Vehicles  
Level 2 and 3**

**Autonomous Vehicles  
Level 4 and 5**

# Garrett's differentiated technology offering

	TURBOCHARGERS	ELECTRIC PRODUCTS	AUTOMOTIVE SOFTWARE
			
INNOVATIVE SOLUTIONS	<ul style="list-style-type: none"> <li>• Wastegate</li> <li>• Two Stage</li> <li>• Variable Geometry Turbine</li> </ul>	<ul style="list-style-type: none"> <li>• Mild Hybrid</li> <li>• Plug-in Hybrid</li> <li>• Fuel Cell Electric</li> </ul>	<ul style="list-style-type: none"> <li>• Cybersecurity</li> <li>• Integrated Vehicle Health Management</li> <li>• Advanced Controls</li> </ul>
BENEFITS	<ul style="list-style-type: none"> <li>• Fuel economy &amp; fleet CO2 compliance</li> <li>• Compliance with emissions standards</li> <li>• Reliability and asset up time</li> </ul>	<ul style="list-style-type: none"> <li>• Best CO2 for hybrid powertrains</li> <li>• Enhanced driving pleasure</li> <li>• Full portfolio of E-Boosting solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Safety &amp; security</li> <li>• Reliability / assured functionality</li> <li>• Vehicle up-time</li> </ul>

# Turbocharging – technology at the cutting edge

Journal bearing clearance

**0.0004 inches of oil film**

**7 times thinner than human hair**

Average compressor flow

**20 cubic meters per minute**

**The capacity of a utility van**

Wheels tip speed

**1,300 miles per hour**

**supersonic, more than 1.7 times  
the speed of sound**

Being shaken

**at 25g vibration level**

**fighter jets can withstand ~14g**

From 50,000 RPM to 200,000 RPM

**in less than 2 seconds**

**3 seconds for F-16 engine to  
spool up to maximum thrust**

Rotor group rotating speed

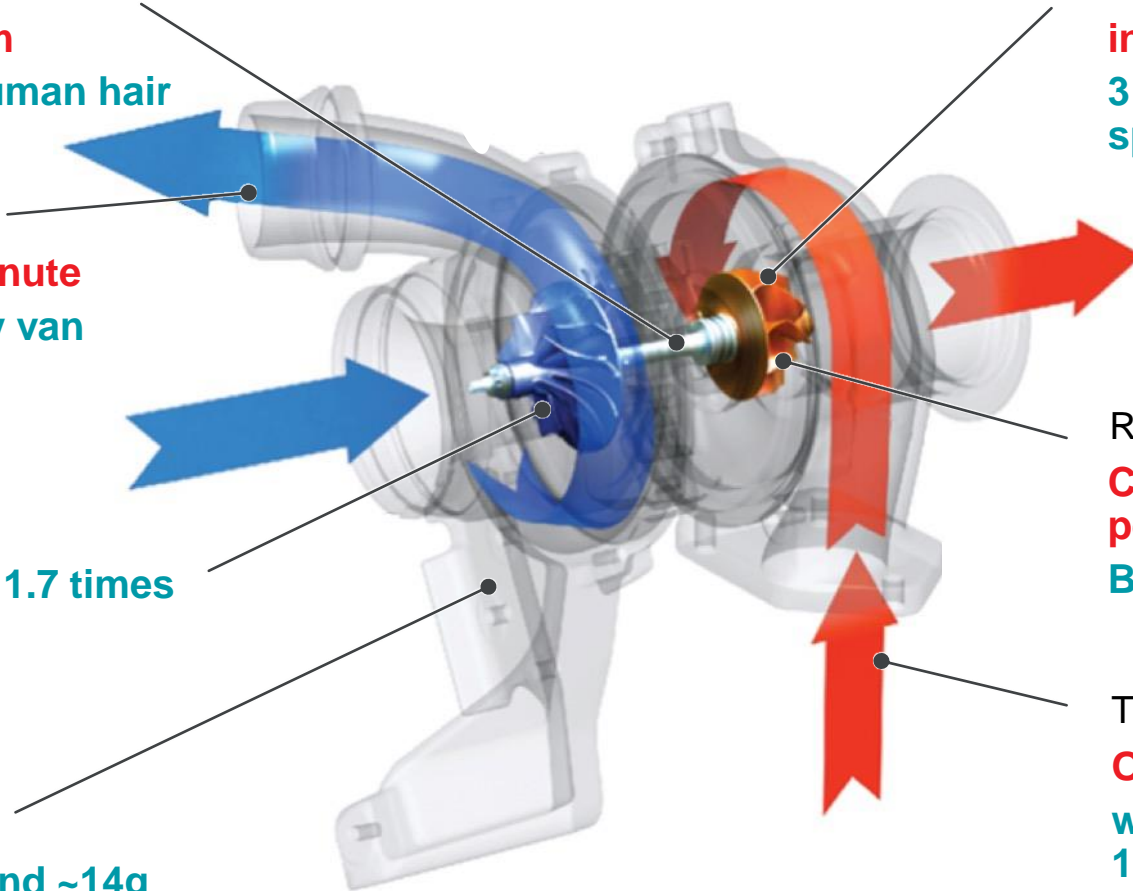
**Can reach 350,000 revolutions  
per minute**

**B787 engines reach only 14,000 RPM**

Turbine inlet temperature


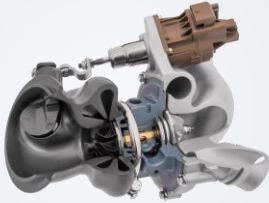





**Over 1,900 degrees Fahrenheit**

**window glass melts at  
1,800 degrees Fahrenheit**



# Garrett light & commercial vehicle turbo portfolio

## Turbos

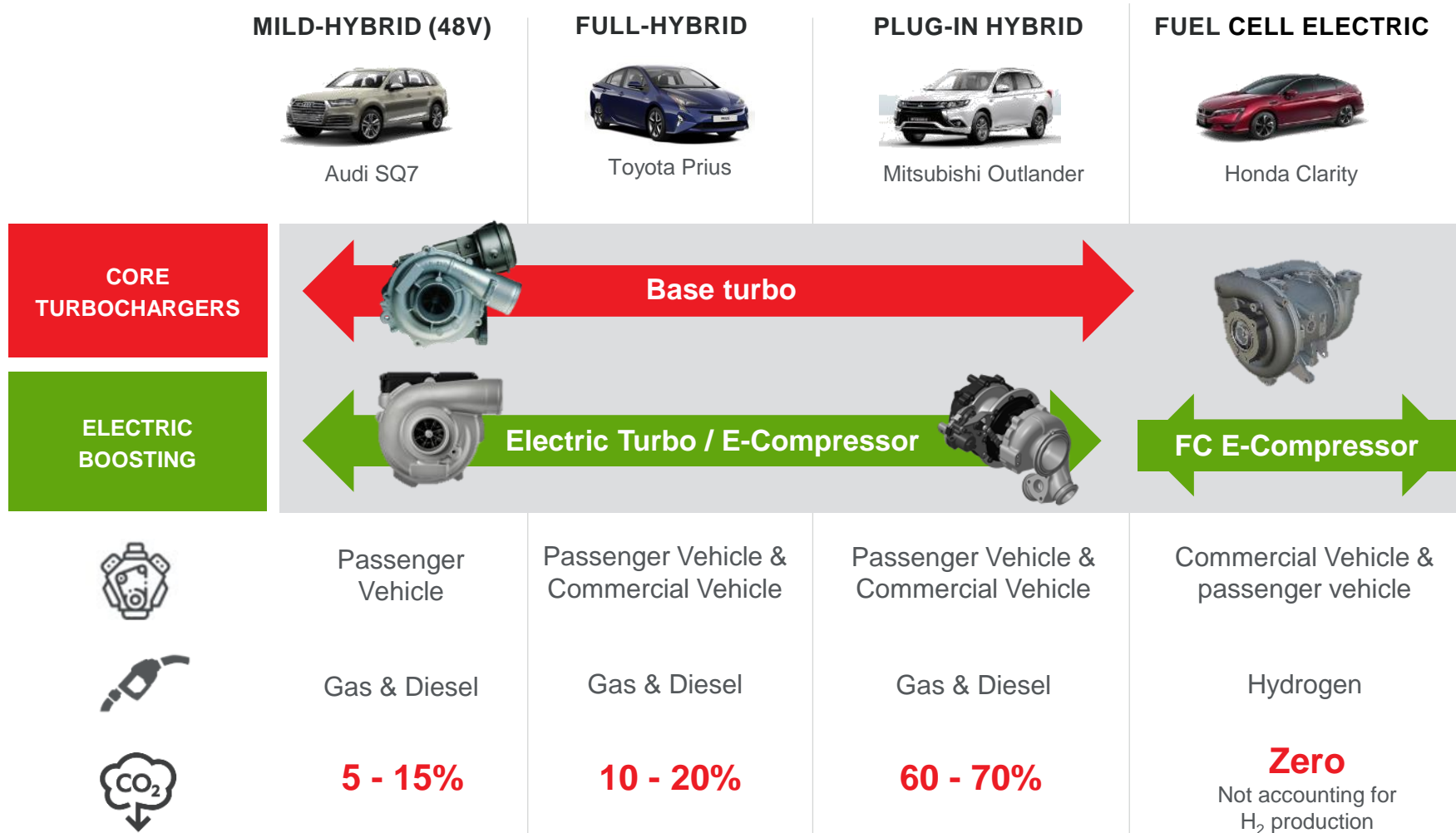
FREE-FLOAT	WASTEGATE	VARIABLE NOZZLE TURBINE (VNT™)	
			
DOUBLE AXLE VNT	TWO STAGE	TURBO-COMPOUNDING	ELECTRIC BOOSTING
			

## Benefits

- Broadest portfolio with dedicated engineering support
- Fuel efficiency through state of art aerodynamics, bearing systems and control
- Higher performance, better fuel economy and emissions control enabled by innovative variable nozzle turbine designs
- Optimized for transient behavior to improved drivability and fun to drive






# Turbocharging electrified powertrains



- 76% hybrid powertrains and 100% hydrogen fuel cell powertrains turbocharged by 2025
- Full CO<sub>2</sub> potential unlocked with electric boosting
- Hydrogen fuel cell electric vehicles require high performance E-Compressor

# Garrett electric boosting portfolio

	<b>ELECTRIC COMPRESSOR</b> Mild Hybrid Plug-in Hybrid	<b>ELECTRIC TURBO</b> Mild Hybrid Plug-in Hybrid	<b>TWO STAGE ELECTRIC COMPRESSOR FOR FUEL CELLS</b> Fuel Cell Electric
			
<b>CUSTOMER BENEFITS</b>	<ul style="list-style-type: none"> <li>• Full speed within 0,25s</li> <li>• 2-3% better fuel economy</li> <li>• 20% NOx reduction (Diesel)</li> <li>• Enables Lambda 1 (Gasoline)</li> </ul>	<ul style="list-style-type: none"> <li>• 4x faster than a conventional Turbo</li> <li>• 2-4% better fuel economy (regen)</li> <li>• 20% NOx reduction (Diesel)</li> <li>• Enables Lambda 1 (Gasoline)</li> </ul>	<ul style="list-style-type: none"> <li>• Enables 40% downsizing of fuel cell stack</li> <li>• Reducing volume, weight and cost</li> <li>• Optimal power consumption due to architecture &amp; high efficiency design</li> </ul>
<b>GARRETT EXPERIENCE</b>	<ul style="list-style-type: none"> <li>• Specific aerodynamics</li> <li>• High speed electric machines</li> <li>• System integration</li> </ul>	<ul style="list-style-type: none"> <li>• System packaging</li> <li>• High speed electric machines</li> <li>• Boost and Energy Management</li> </ul>	<ul style="list-style-type: none"> <li>• Innovative high efficiency Aerodynamics</li> <li>• High speed electric machines</li> <li>• Air bearing</li> </ul>
<b>ARCHITECTURE</b>	<ul style="list-style-type: none"> <li>• Aerodynamics and motor matched for optimal speed</li> <li>• Sealed for life bearings</li> </ul>	<ul style="list-style-type: none"> <li>• Integrated Turbo &amp; high speed Motor/Generator</li> <li>• Stand alone or Integrated Power Electronics</li> </ul>	<ul style="list-style-type: none"> <li>• Two Stage series compressors</li> <li>• 100% Oil-free foil bearing technology to avoid pollution of fuel cell stack with oil and provide the lowest noise &amp; vibration possible</li> </ul>

# Garrett connected vehicle software

## MULTIPLYING COMPLEXITY

### Internal Combustion Engine

*Atertreatment + E-boosting + . . .*



### Electrified Powertrain

*Hybridization + battery SOC/SOH + . . .*



### Autonomy

*Sensors + actuations + . . .*



### Connected

*Threat surfaces + updates + . . .*

## UNSOLVED CHALLENGES

**Optimize** complex systems

**Validate** for real-world

**Ensure** in-use compliance

**Detect** health degradation

**Diagnose** accurately

**Differentiate** fault vs. hack

## GARRETT SOLUTIONS

### ADVANCED CONTROL

#### *Algorithms & Health Indicators*

- Industrial process controls heritage
- 25+ patents
- In production



- Fuel economy
- Reduced development time
- Best in class algorithms
- Best in class performance

### IVHM\*

#### *Fault Modeling, Diagnostic Reasoning & Prognostics*

- Aircraft health management heritage
- 25+ patents
- SOP 2020



- Diagnostic Accuracy
- Reduction of no trouble found
- Dynamic test plans
- 100% debugged at SOP
- Unique methodology

### CYBER SECURITY

#### *Intrusion Detection & Diagnostic*

- Industrial security management heritage
- 40+ proprietary algorithms
- SOP 2021



- High detection rate
- Low false positive
- Low footprint
- Integrated with Tier 1 hardware

\*integrated vehicle health management

**New challenges require new technologies for control, health and security management**

**AFTERMARKET**



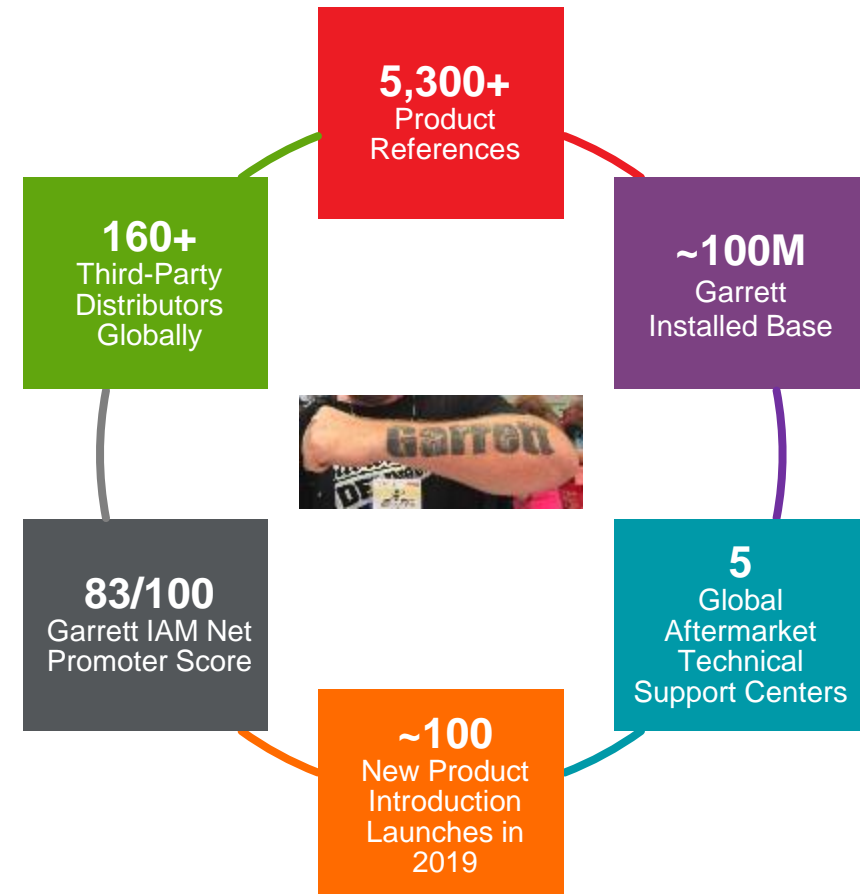


# Strong aftermarket platform with brand equity

## Broad aftermarket product portfolio

ORIGINAL EQUIPMENT / INDEPENDENT AFTERMARKET		<ul style="list-style-type: none"><li>• Original supply ensuring emission compliance</li><li>• Distributors network</li></ul>
REMANUFACTURE		<ul style="list-style-type: none"><li>• Remanufacturing of OE design</li><li>• Economic alternative with no trade-off on quality / durability</li></ul>
RED BOOST		<ul style="list-style-type: none"><li>• Economic turbo for high growth regions, with good reliability</li><li>• Original production line, portfolio expansion</li></ul>
PERFORMANCE & MOTORSPORTS		<ul style="list-style-type: none"><li>• Higher power, with reliability</li><li>• 50 years of racing support</li></ul>

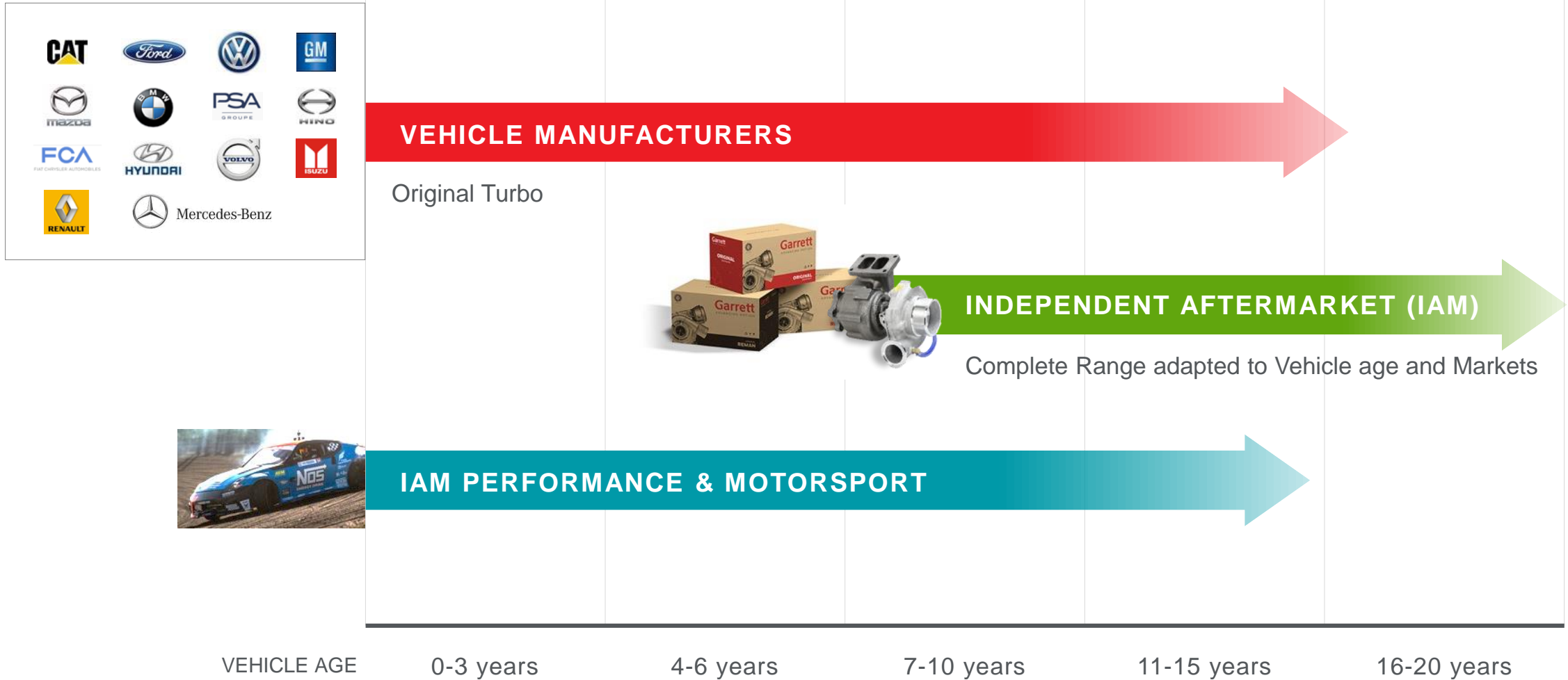
## #1 in global brand awareness



Note: IAM – Independent aftermarket

**Broad aftermarket portfolio serving a large installed base globally**

# Garrett aftermarket channels



# Garrett Motorsport technology

## Redefining the limits

### CUSTOMISED TECHNICAL OFFERINGS

- **Electric turbos:** Efficiency-optimized turbos combined with hi-speed electric machines for max transient (performance) and energy recuperation (fuel efficiency).
- **DualBoost turbos:** 30% faster transient performance and smaller/lighter packaging with better steady-state performance.
- **High-Temperature VNT™ turbos:** Robust 1050°C VNT turbine for both Diesel and Gasoline engines

#### Also available:







Ball bearing

High-temperature (MarM-247) turbine wheel materials

High temperature thin-wall (HK30) turbine housing castings

## Championship Wins

### FORMULA1, LE MANS, WRC....

26	<b>FIA World Rally Car</b> 100% since 2002	
20	<b>24 Hours of Le Mans</b> 100% since 2000	
14	<b>Indianapolis 500</b>	
11	<b>CART / Champ Car</b> 67% win rate	
10	<b>American Le Mans Series</b>	
8	<b>IMSA GTP / GTO</b>	
7	<b>FIA World Touring Car</b> 100% since turbo engine rule	
7	<b>Global Rallycross</b> 100% since series introduced	
4	<b>Super Formula</b> Turbo engines starting 2014	
4	<b>Super GT</b> Turbo engines starting 2014	
4	<b>FIA World Rallycross</b> Inaugural season 2014	



[www.garrettmotion.com](http://www.garrettmotion.com)



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