

Hydrogen fuel cells for mobility

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WORLD HYDROGEN ENERGY SUMMIT
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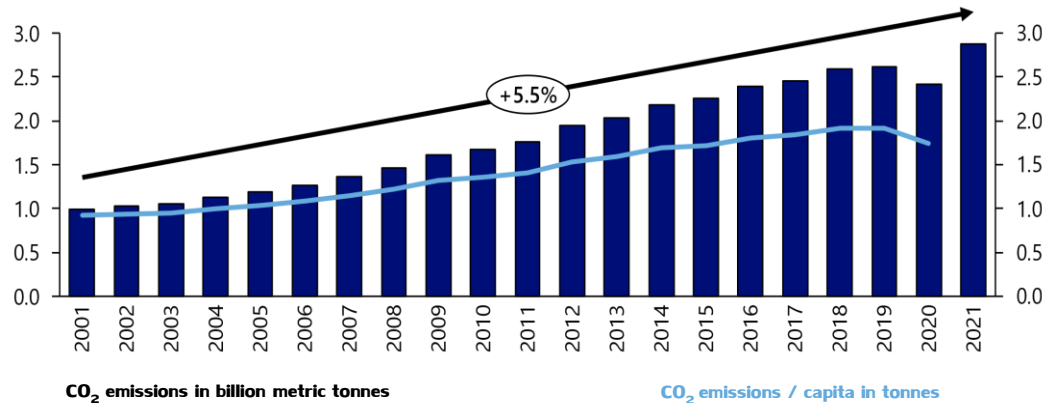
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Summary

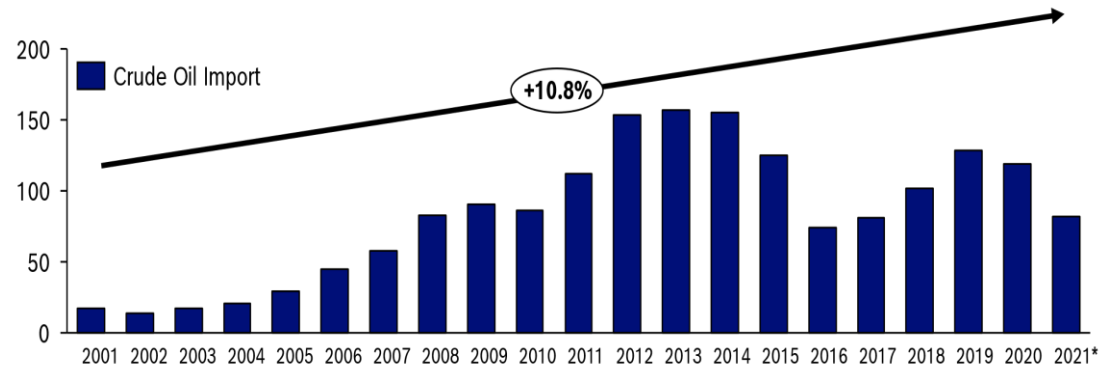
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Requirement for green hydrogen – CO₂ emissions / imports

CO₂ emissions in India - in billion metric tonnes



India crude oil import trend (US\$ billion)



Note*: 2021 crude oil import Apr-Dec

CO₂ emissions in India – sector wise 2019



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Favourable hydrogen trends – INDIA



- National hydrogen mission announced in Union Budget 2021 to achieve self reliance in energy by 2047
- Policies for promoting H₂ supply chain
- AIS-157 regulation rolled out for FCEVs



- 16 plants up and running
- Major players in pipeline
- Reliance committed US\$ 80B as a part of 1-1-1 mission



केन्द्रीय बजट
UNION BUDGET

ARAI
Progress through Research



- Demonstration projects
- Investment commitments of US\$ 150 billion

Market

Legislation

Hydrogen generation

OEM/
mobility provider

Technology

Research

Current INDIAN market
trends

- Sustainable future mobility solutions for CV segment
- Focus on fuel cells
- Major OEMs and infra players are involved in development activities



LTPEM – automobile applications

- Power 70 – 260 kW
- More focus on CV application

SOFC – static applications

- Power MW (scalable solutions)
- Backup power | data center



~ 18 research institutions

Focus on fuel cell stack

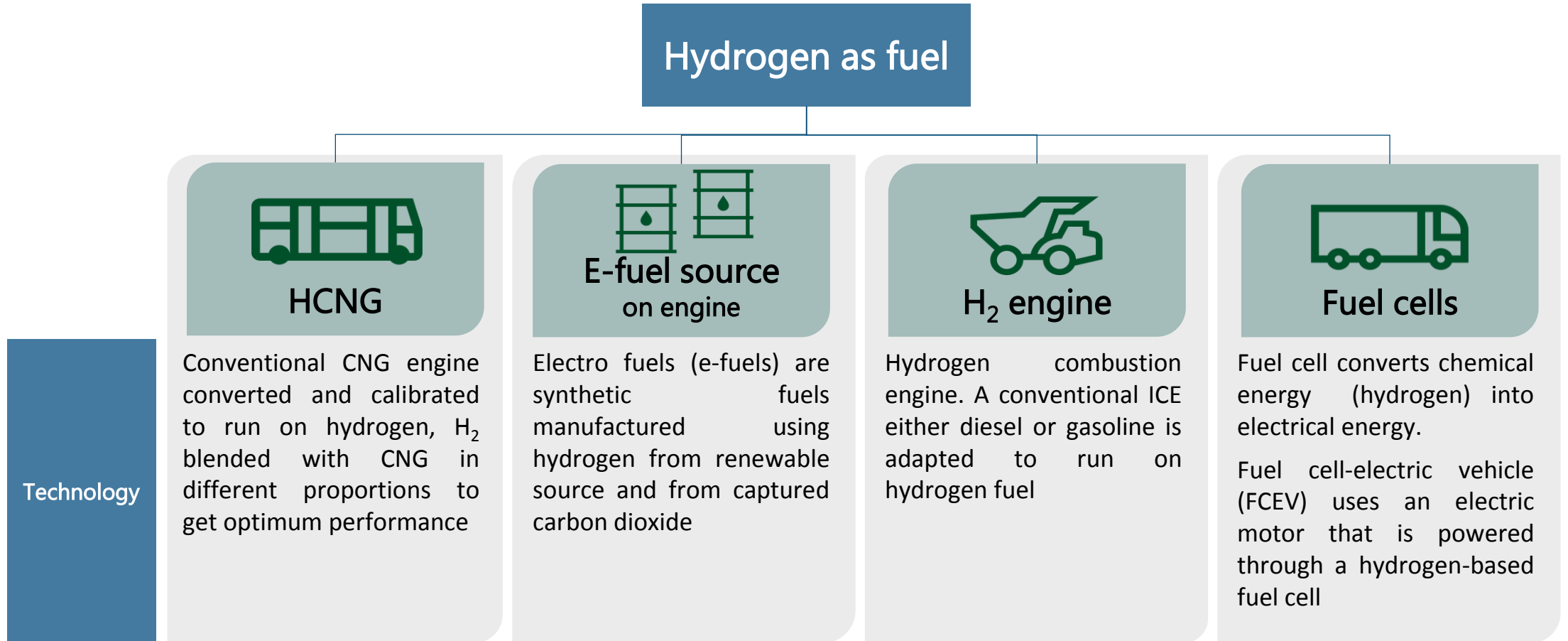
- Improving MEA durability >35 000 h
- Volumetric power density > 7 kW/l

Balance of plant parasitic power reduction



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H₂ based mobility options



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FCEV position in overall vehicle spectrum

Fuel cell-electric vehicles complement the portfolio of electric vehicles

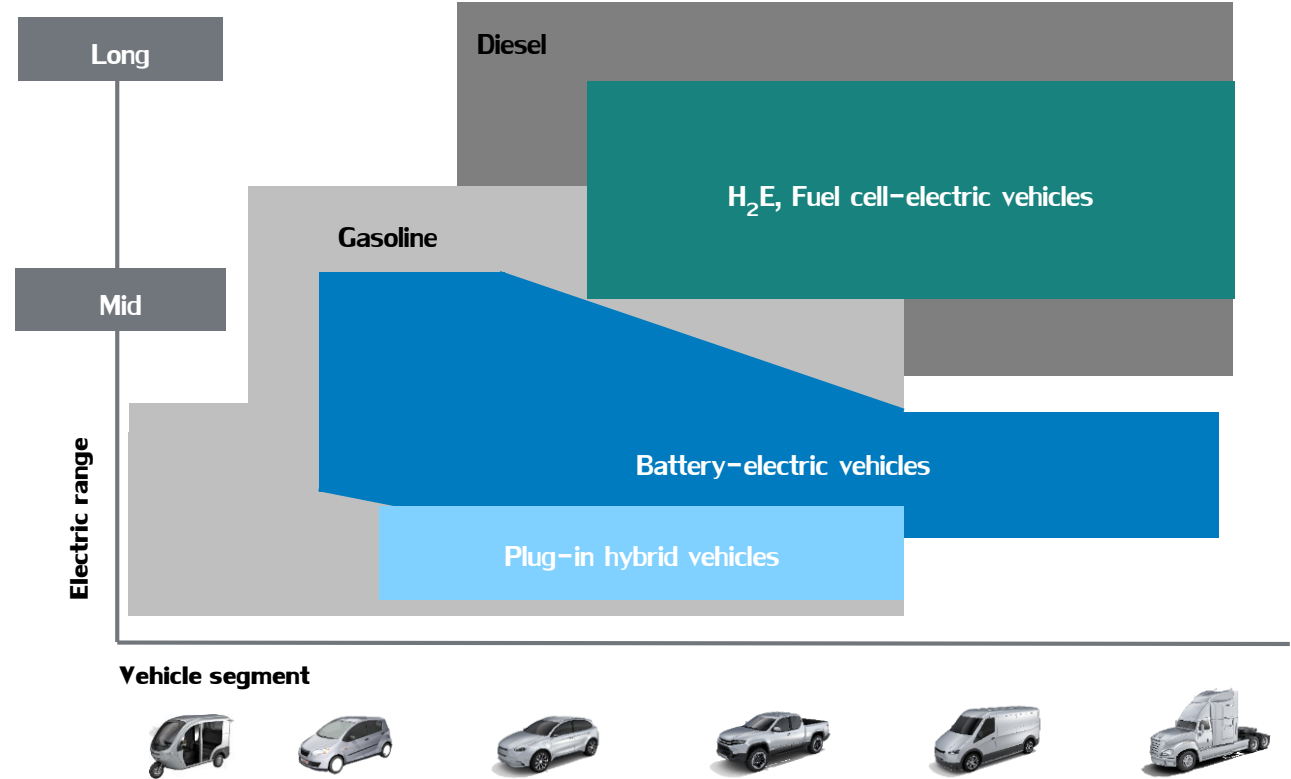
Commercial vehicles

- ▶ A solution for long-distance transport
- ▶ Economically attractive for many areas of application with the availability of competitive hydrogen price.

Passenger cars

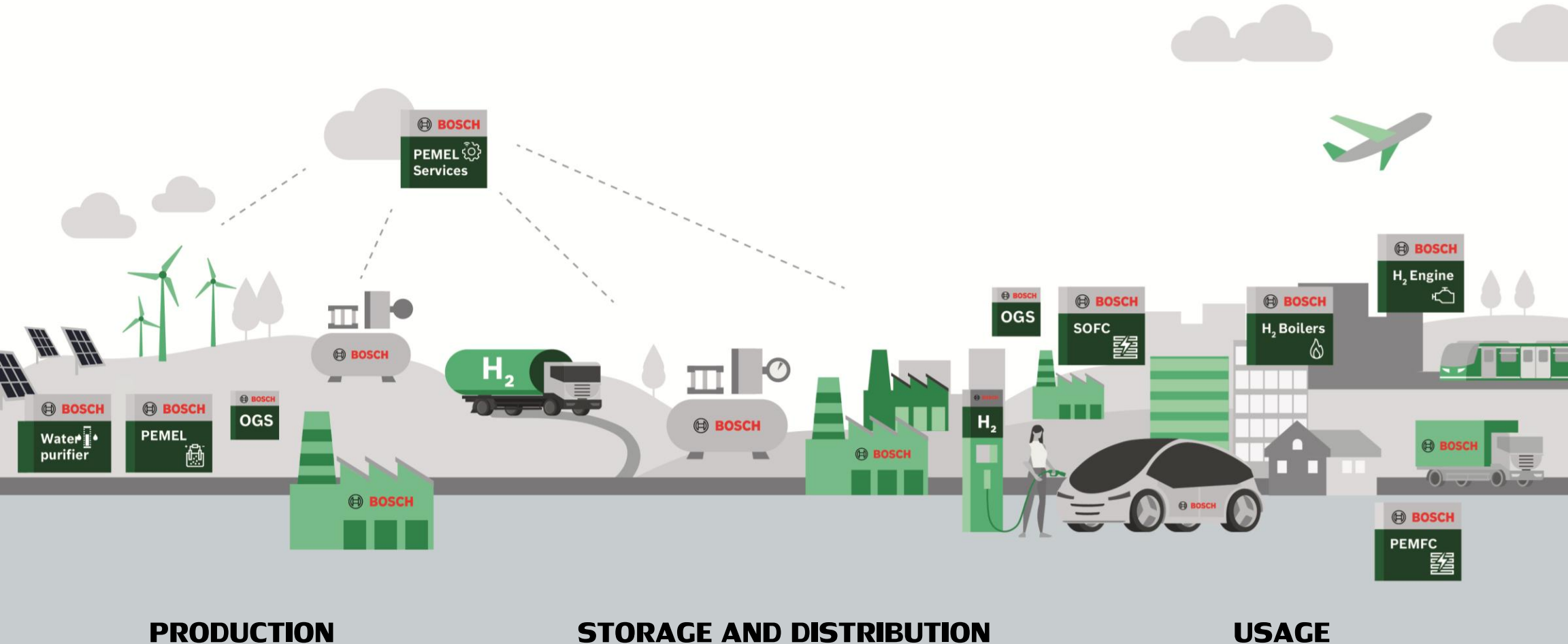
Overcoming range limitations for e-mobility applications

- ▶ Passenger cars can be filled up fully in 3 minutes
- ▶ Long range





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Bosch focus on the hydrogen value chain



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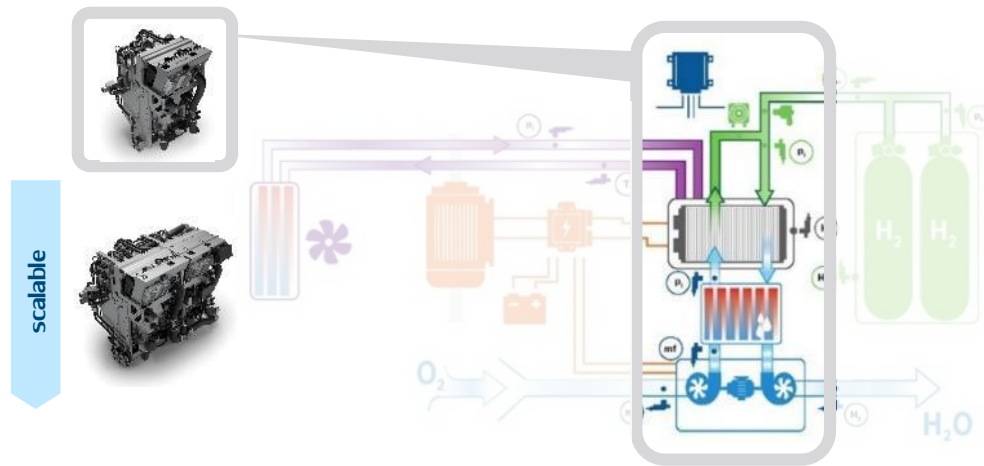
Extensive portfolio for every need

Segment	FC modules	Stack	FC kit
 SUV  LCV  Pick-up  City bus  MD  Municipal	 80 – 132 kW	  Single stack up to 132 kW	<div> Balance of plant Components & submodules </div>  <div> Sensors & valves </div>  <div> Hydrogen storage system </div>  <div> PTU (incl. DC/DC) </div>  <div> FCCU </div> 
 Coach  HD  HD	  112 kW  75 kW	   132 kW  190 kW   250 kW	
	  224 kW / 300 kW		

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Fuel cell power module – system for commercial vehicles

System scope



Product description

- Fuel cell power module with 224 kW power (net, BoL*);
- Scope: Stack with anode & cathode submodules and certified system controls (hardware and software)
- Reliability and safety according to automotive standards
- Automotive software interface (e.g., CAN communication and diagnosis)

Value proposition

- One-Stop Fuel Cell power generation solution from reliable partner with comprehensive automotive experience
- Packaging enables integration into existing vehicle platforms
- Customized to right-sized power range; powertrain system design including degree of hybridization

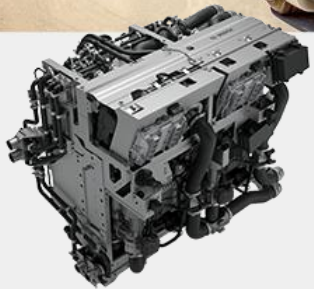
Status @ RB, next steps

- SOP: 2023 ✓

* BoL = begin of life

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On the road...



HD trucks

MD trucks



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Start of production fuel cell power module – July 13th, 2023



Production shop floor



Inauguration ceremony



EU pilot customer



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Bosch focus on hydrogen economy

- Between 2021 and 2026, we will have invested a total of ~ €2.5 billion in the development and manufacturing of H₂ based technologies
- By 2030, we have plans to generate sales of roughly €5 billion in this domain
- Relying on a global manufacturing network across Bosch
- There are more than 3,000 people at Bosch already working on hydrogen technologies, more than half of them in Europe



Bosch sets EUR 5 bn 2030 sales target with H2 tech, begins fuel-cell module production

The company operates along the entire hydrogen value chain, developing technology for its production and application. By 2030, Bosch plans to generate sales of roughly EUR 5 billion with hydrogen technology. In its solutions for the hydrogen economy, Bosch is relying on a global manufacturing network and the prowess of its German locations, the company said.



Bosch starts production of fuel-cell power module; targets EUR 5 billion in sales with H2 tech by 2030

Between 2021 and 2026, Bosch will have invested a total of nearly 2.5 billion euros in the development and manufacturing of its H2 technologies.



Stefan Hartung
 "purely only software" earlier to now hardware design, functional design, and "hardcore engineering services, Hartung said. A team of around 200 engineers in India are also involved in Bosch's new focus area of Hydrogen technology.

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Summary

- Hydrogen can be a potential climate-neutral fuel for the world
- India is potentially considering the green hydrogen production and usage as a fuel in many applications
- National Green Hydrogen Mission (NGHM) is paving path for cutting down dependency on oil imports.
- Bosch strongly advocate the establishment of a hydrogen economy and are involved in all stages of the hydrogen value chain.
- Fuel cell applications are widely considered as future power sources ranging from industries, chemical sectors, mobility and household stationary applications with added benefits
 - Highly efficient
 - Zero emission devices (except water)
 - Quiet operation
 - Modular in nature



THANK YOU