

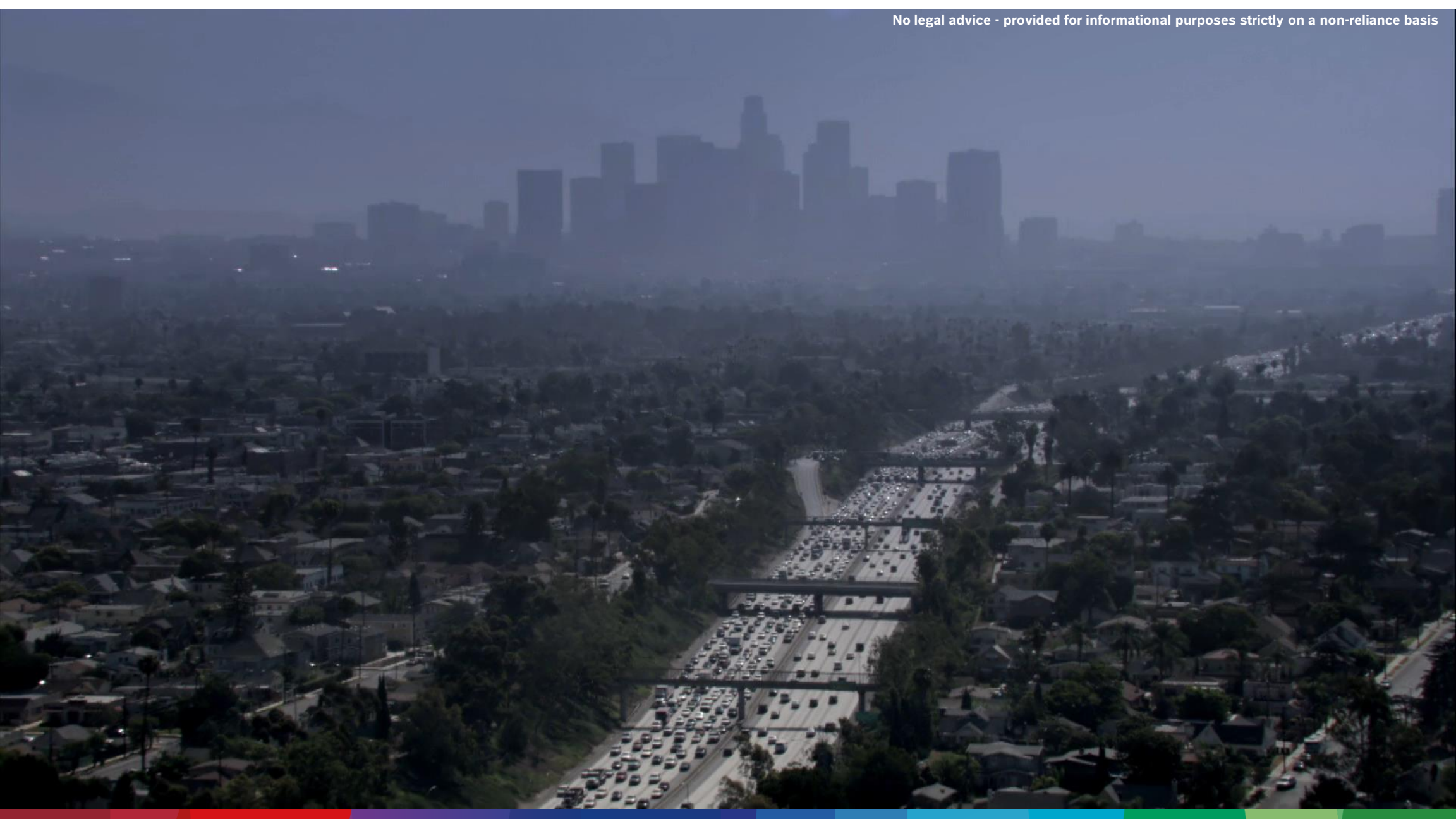
BOSCH BARI

RB/GF 182 reviewed by Arvizzigno and Damiani on 25.08.2017



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Amm. Delegato
Centro Studi Componenti per Veicoli





Mobility & Urbanisation - Cities of the Future

Three paths to the attractive and sustainable car of the future



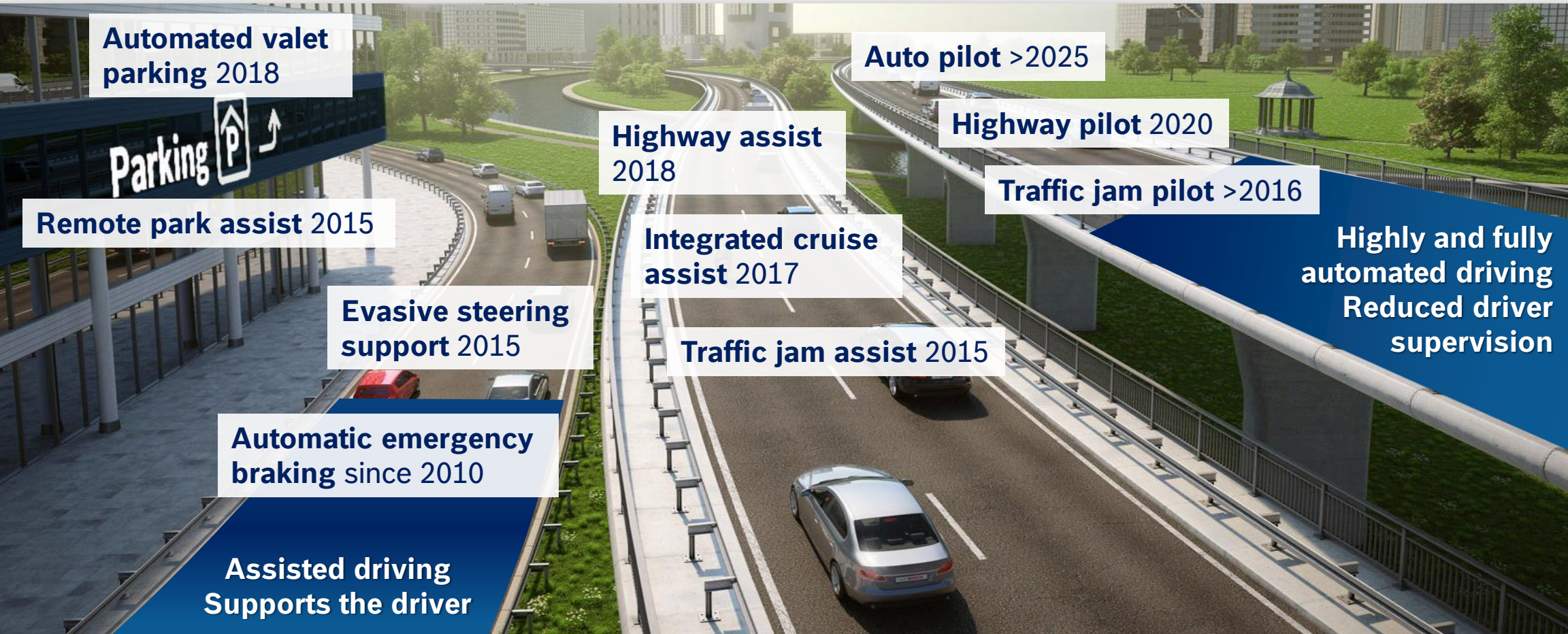
costs hybrid electric motor
roaming power electronics
e-bike **electrified** range
driving enjoyment charging infrastructure
market ramp-up battery
e-scooter smart charging plug-in

legislation assistance systems
emergency braking assistant
automated auto pilot
highway pilot sensors
redundancy electric steering
valet parking digital environment

augmented reality electronic horizon
internet of things smartphone integration
connected
vehicle to vehicle cloud
vehicle to infrastructure
services fleet management
entertainment eCall

Mobility & Urbanisation - Cities of the Future

Autonomous driving: A revolution coming step by step



Automated valet parking 2018

Auto pilot >2025

Highway pilot 2020

Highway assist 2018

Traffic jam pilot >2016

Remote park assist 2015

Integrated cruise assist 2017

Evasive steering support 2015

Traffic jam assist 2015

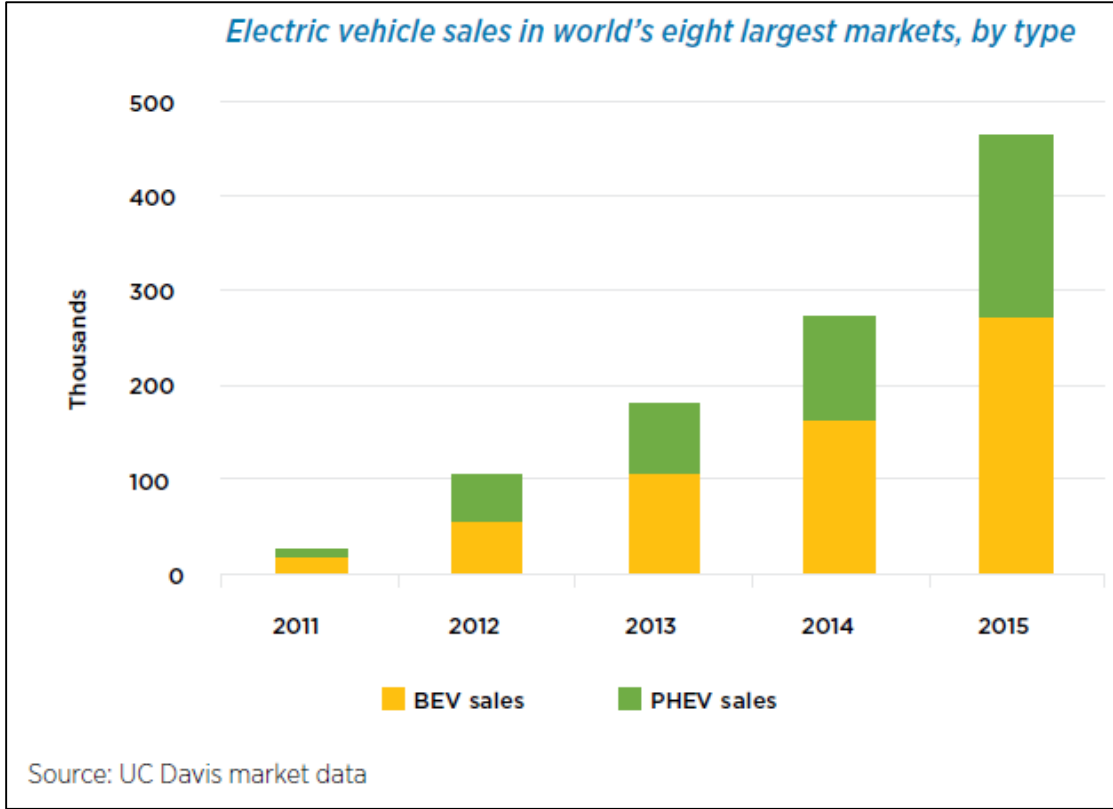
Automatic emergency braking since 2010

**Highly and fully automated driving
Reduced driver supervision**

**Assisted driving
Supports the driver**

Electric Vehicles

Actual status of EV sales



Global EV sales by country, 8 biggest markets

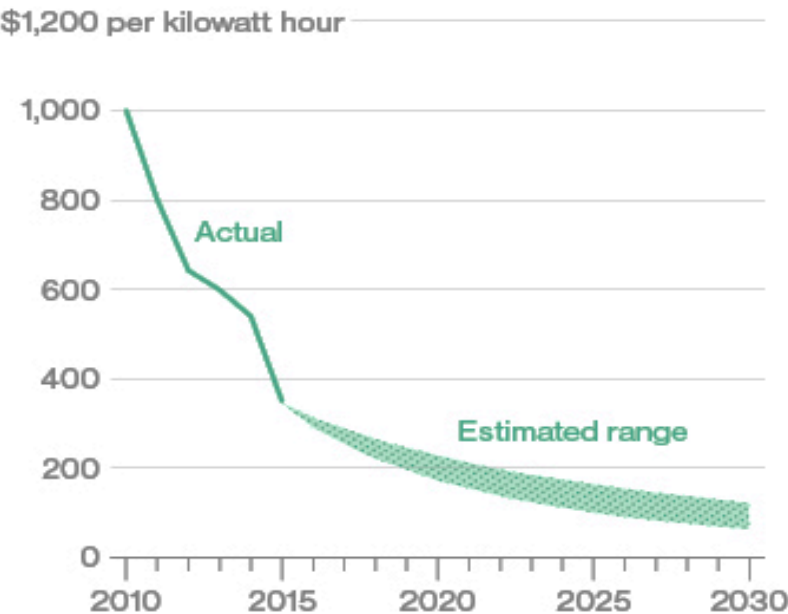
	Country	Est Total PEVs. Feb 2016	Est. PEV Sales 2015	PEVs as % of 2015 market	Total LDV market 2015
1	USA	>415 000	>115 000	0.6%	17 500 000
	California	>189 000	>62 000	3.1%	2 100 000
2	China	300 000	207 000	0.8 %	22 000 000
3	Japan (est)	150 000	25 000	>1.0 %	4 200 000
4	Netherlands	91 000	43 000	9.6%	420 000
5	Norway	90 000	34 000	>20%	170 000
6	France	>70 000	27 000	1.5%	2 000 000
7	Germany	>50 000	24 000	0.75%	3 500 000
8	UK (est)	>38 000	>28 000	>1.0%	2 700 000
	Europe		>193 000		
	World	>1 100 000	>450 000	0.5%	88 000 000

Source: UC Davis market data

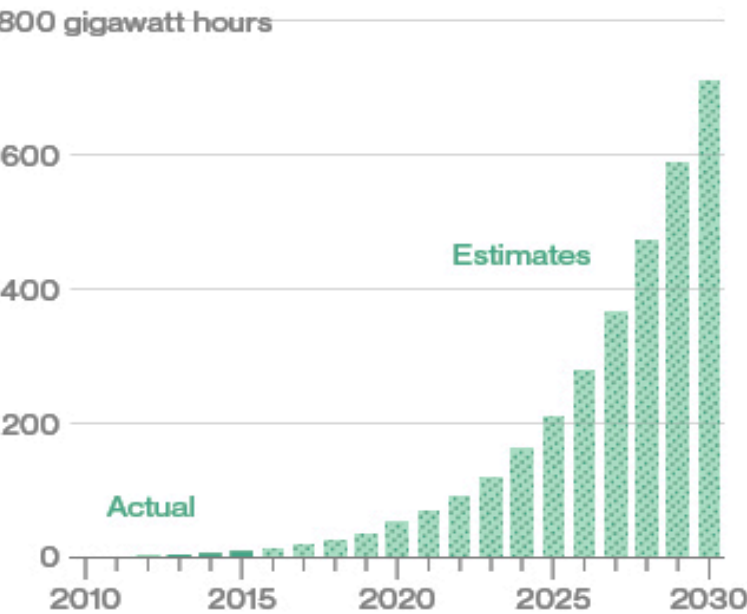
Behaviour of the battery cost

Batteries make up a third of the cost of an electric vehicle.
As battery costs continue to fall, demand for EVs will rise.

Cost for lithium-ion battery packs

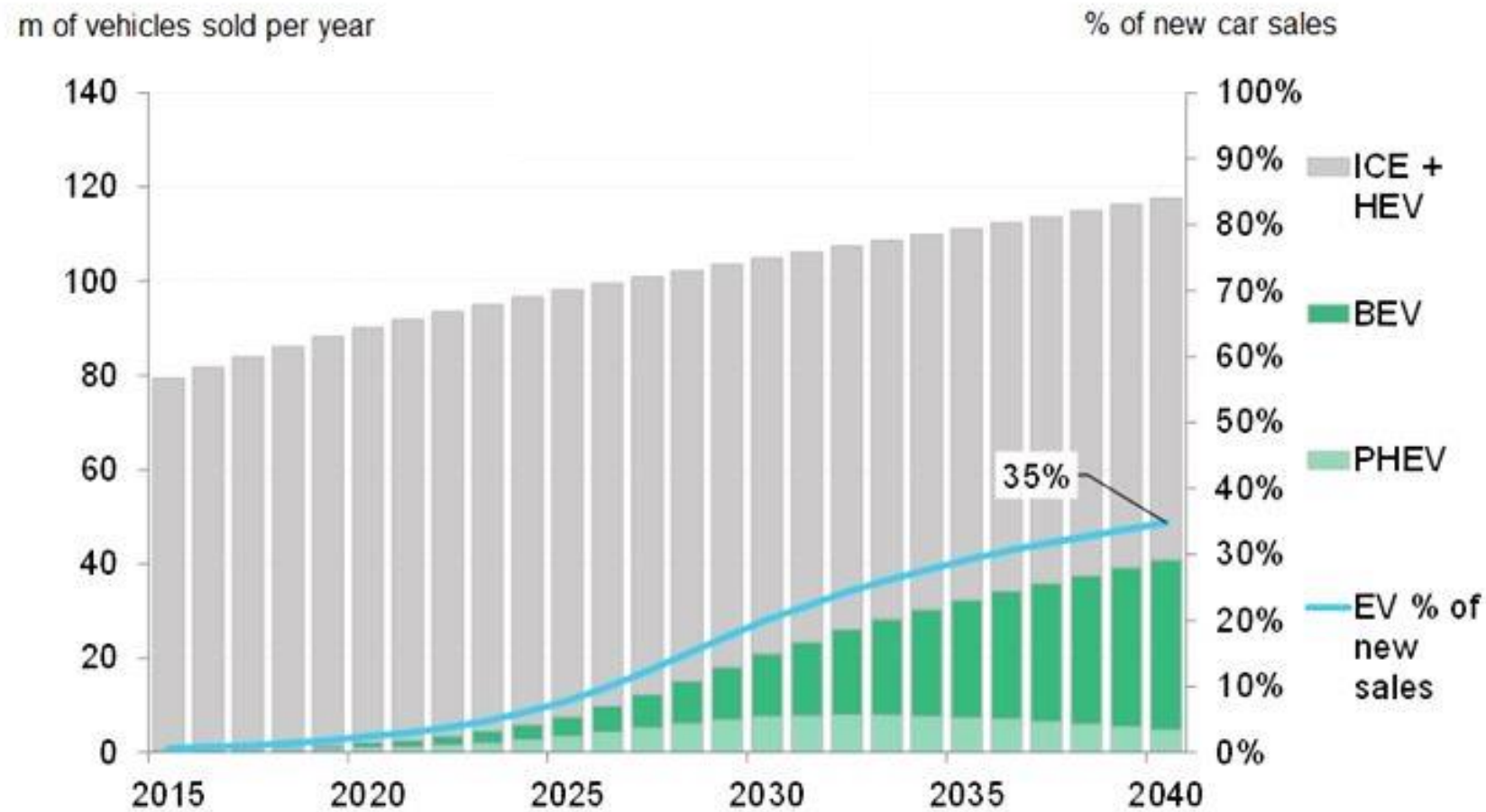


Yearly demand for EV battery power



Source: Data compiled by Bloomberg New Energy Finance

Market forecast for Electric Vehicles



[Source: Bloomberg New Energy Finance]

Electrification Activities of Bosch group

Drives for e-bikes



Electrical drives for passenger cars Hybrids, Plug-In & EV



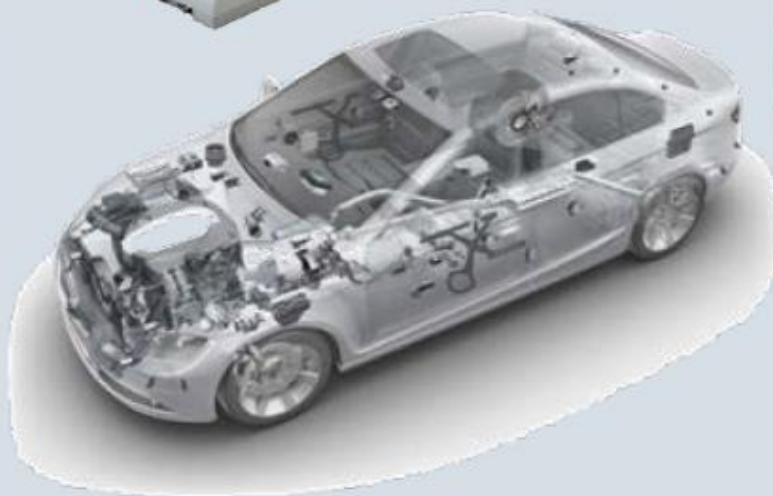
Hydraulic hybrid system & electrical drives for commercial vehicles



Battery systems



Aftermarket



Starters and generators for Start/Stop Systems



Regenerative braking systems



Navigation systems



Chargers for EV / PHEV

Charging stations for electric vehicles

Software for Infra- structure Integration









Research and pre- development for future electrical vehicle concepts



Today's Powertrain portfolio

Defined as EV in this report ✓ Primary ✓ Secondary

... To a portfolio of powertrains				Propulsion		Energy generation/source		
				ICE	E-motor	ICE ¹	Plug-in ²	Fuel Cell ³
ICE	 Volkswagen Golf	Internal Combustion Engine	Driving with conventional combustion engine only	✓		✓		
HEV	 Toyota Prius	Hybrid Electric Vehicle	Driving with combustion engine and/or e-motor	✓	✓	✓		
PHEV	 Mitsubishi Outlander PHEV	Plug-in Hybrid Electric Vehicle	Driving with combustion engine and/or e-motor, plug-in to recharge battery	●	✓ ⁴	✓	✓	
REEV	 BMW i3 with range extender	Range Extended Electric Vehicle	Driving with e-motor only, ICE & plug in (or fuel cell) used to recharge battery		✓	✓	✓	✓
BEV	 Nissan LEAF	Battery Electric Vehicle	Driving with e-motor only and storing energy in battery		✓		✓	
FCEV	 Hyundai ix35 fuel cell	Fuel Cell Electric Vehicle	Driving with e-motor only and storing energy in hydrogen		✓		✓	✓

From one technology...



Internal combustion engine

¹ In HEV, PHEV and REEV, energy is also generated through regenerative braking

³ Usually generates electricity that directly powers drivetrain; alternative concepts in discussion (e.g. fuel cell as range extender or FCEV with plug-in)

⁴ Primacy of ICE or E-motor in PHEV varies across models

SOURCE: McKinsey

Bosch Bari | Site presentation

CVIT Overview

Bosch Bari CVIT



Company: Centro Studi Componenti per Veicoli S.p.A.

Division: DS-B2

Business: Platform development
Plant Support ww for Common Rail High Pressure Pump
Research & Calibration on engine and Vehicles

Revenues: 30 mio Eur (FY 2015)
~ 220 patents (until 2015)

Employees: 269 (Status 01.01.2016)
80% graduated, 25% female

History



1985: Start of research activities

1988: First vehicle FIAT CROMA

1997: SOP CR system PC

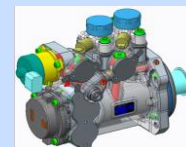
1999: Development start CP for CV

2003: First calibration project for Fiat 16

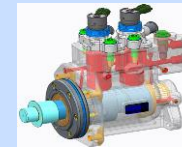
2015: Start new building

2016: Full responsibilities CP for CV

Pump Development



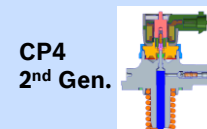
CPN6 DAI



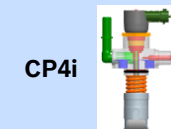
CPN6 oil



CPN6 fuel



CP4
2nd Gen.



CP4i



CP4
27/30

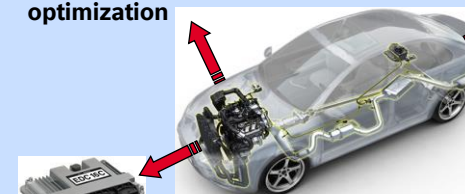
Research & Application



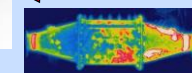
Diesel Combustion
optimization



DeNOx Calibration



Electronic unit for
engine control



Strategy for DPF
Regeneration

Electrified Vehicles using Bosch Products *extract*



PSA 3800 SHEV



BMW Hybrid 5/3 SHEV



PAG Cayenne S/PHEV



Volvo V60 PHEV



Porsche Panamera PHEV



Daimler S- class PHEV



BMW i3 EV@ **REX**



SAIC EP11 **EV**



VW Golf **EV**



VW up **EV**



Smart **EV**



Chrysler F500 **EV**

Bosch worldwide experience in powertrain electrification