

# Global E-Mobility Outlook

IHK München

2018 FEB 19

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Choose certainty.  
Add value.



Since 150 years TÜV SÜD stays true to its founding principles of protecting people, environment and property against the adverse effects of technology.



**24.000 Employees**

**800 Locations**

**64 Countries**

**2,2 Billion Revenue**





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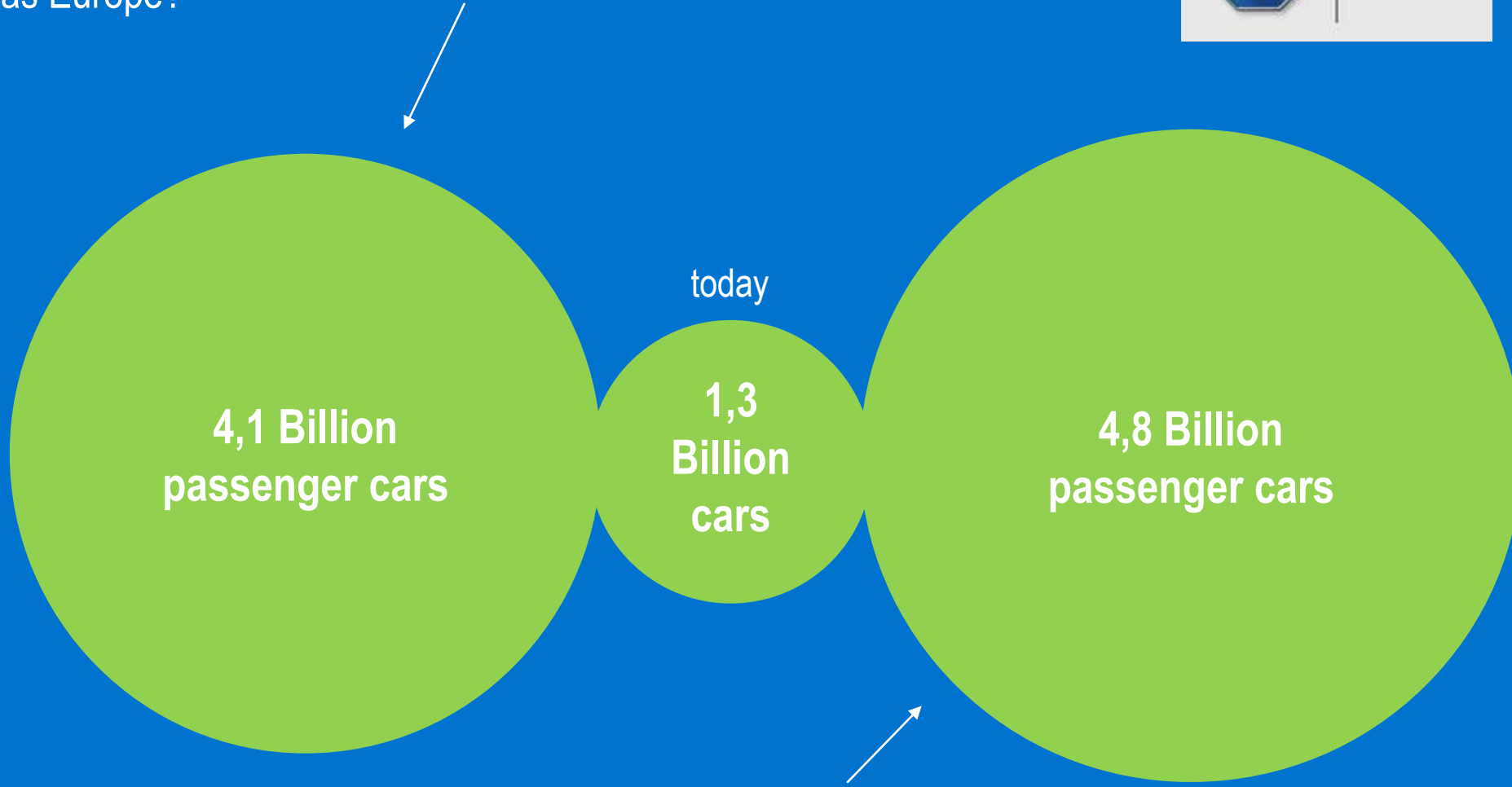
**1.3 Billion** vehicles are on the road globally

**89 Million** will be produced in 2016

this leads to additional

**100 Million** vehicles every **3** years

What if the whole world has the same motorization rate as Europe?



And what if the whole world had the same motorization rate as North America?

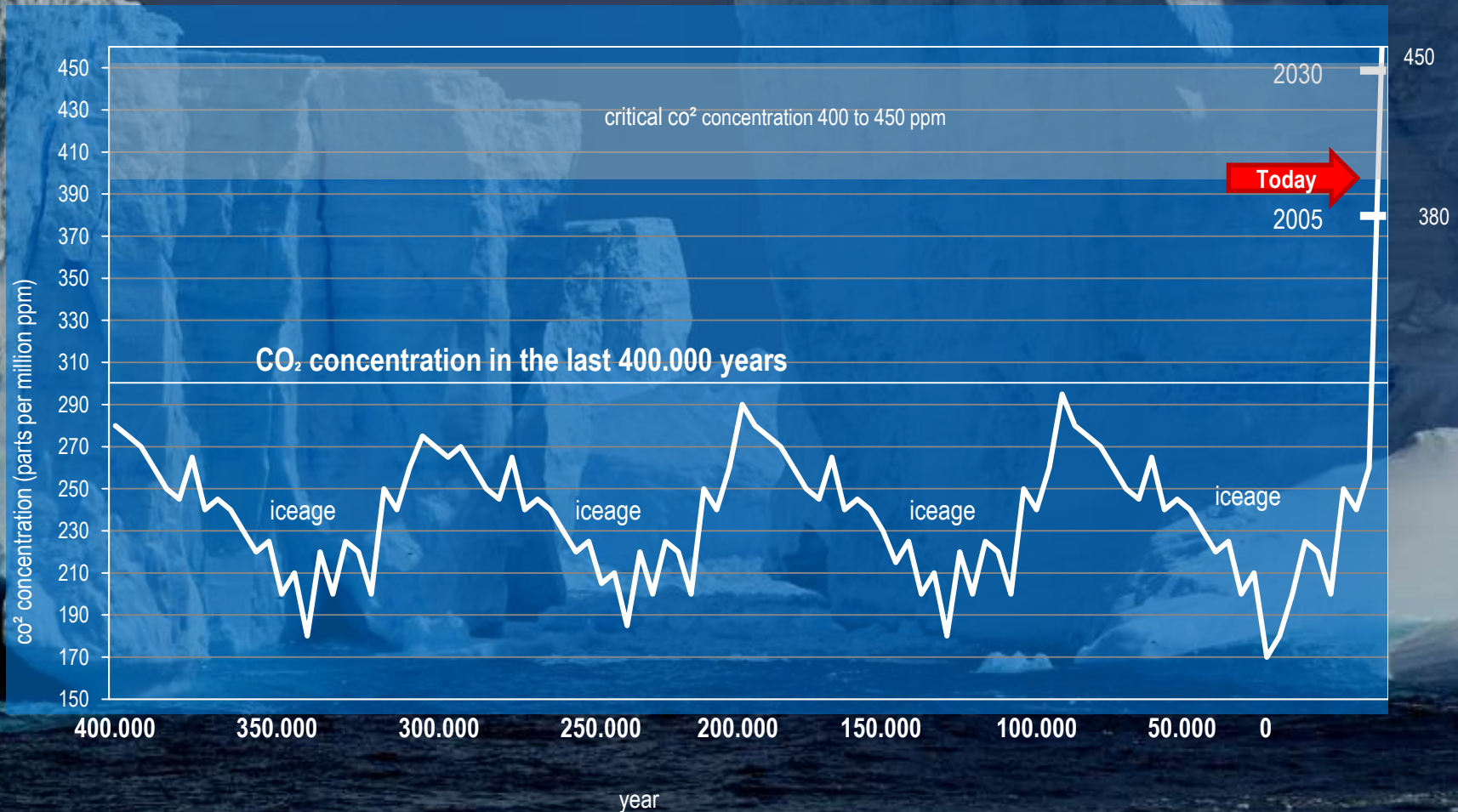
Data source: International Organization of Motor Vehicle Manufacturers





Choose certainty.  
Add value.

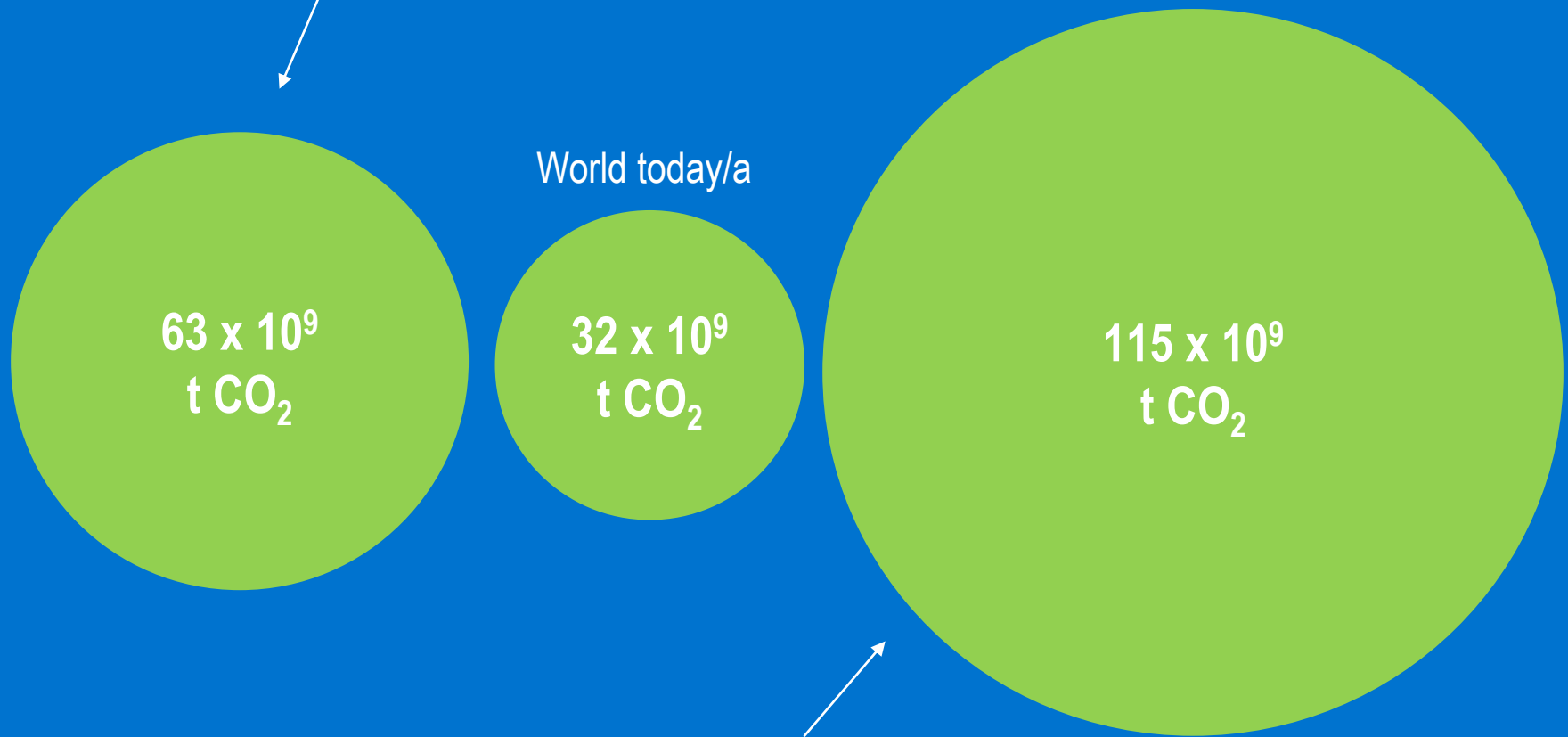
## Historical CO<sub>2</sub> concentration



What if the entire world population emitted the same amount of CO<sub>2</sub> as an average European citizen?



Choose certainty.  
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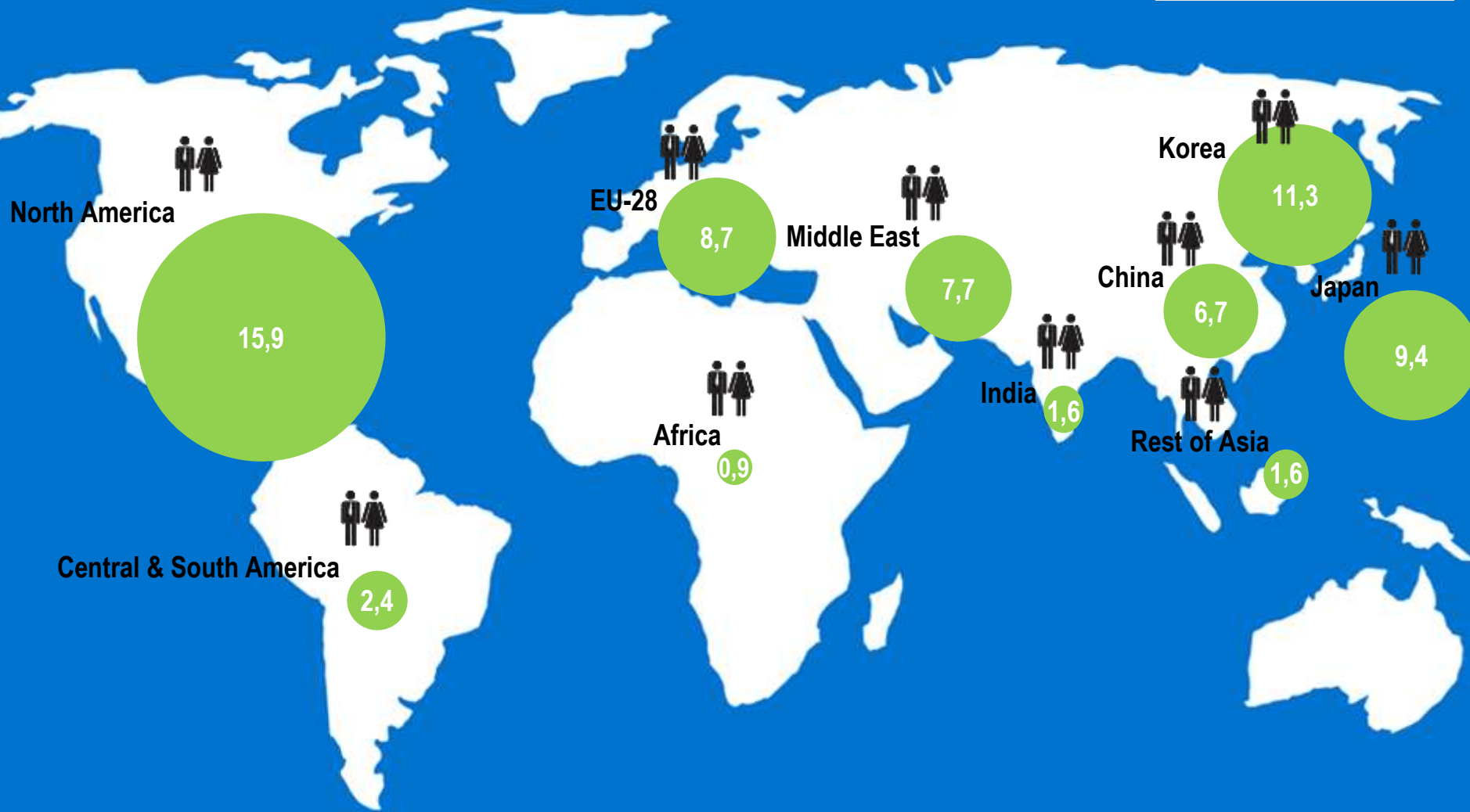


And what if the entire world population emitted the same amount of CO<sub>2</sub> as a North American?

# CO<sub>2</sub> emissions per Capita [t / capita]



Choose certainty.  
Add value.



Data source: International Energy Agency

# Global CO<sub>2</sub> emissions – cumulated 1850-2013



Choose certainty.  
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Emissions of USA & EU account for 55 % of overall CO<sub>2</sub> pollution

Share of states of historic CO<sub>2</sub> emissions

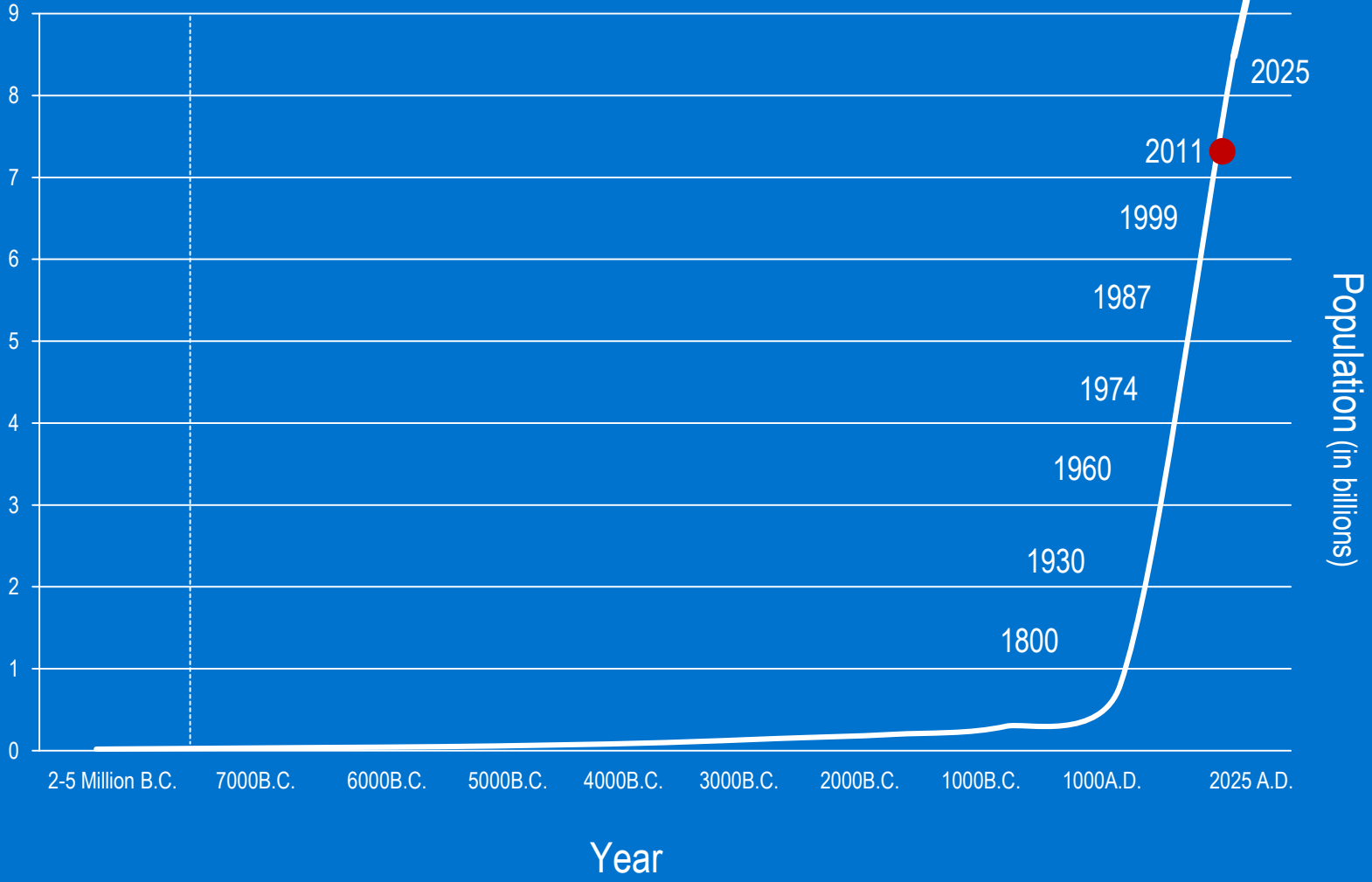




# World Population Growth – 10 Billion by 2050

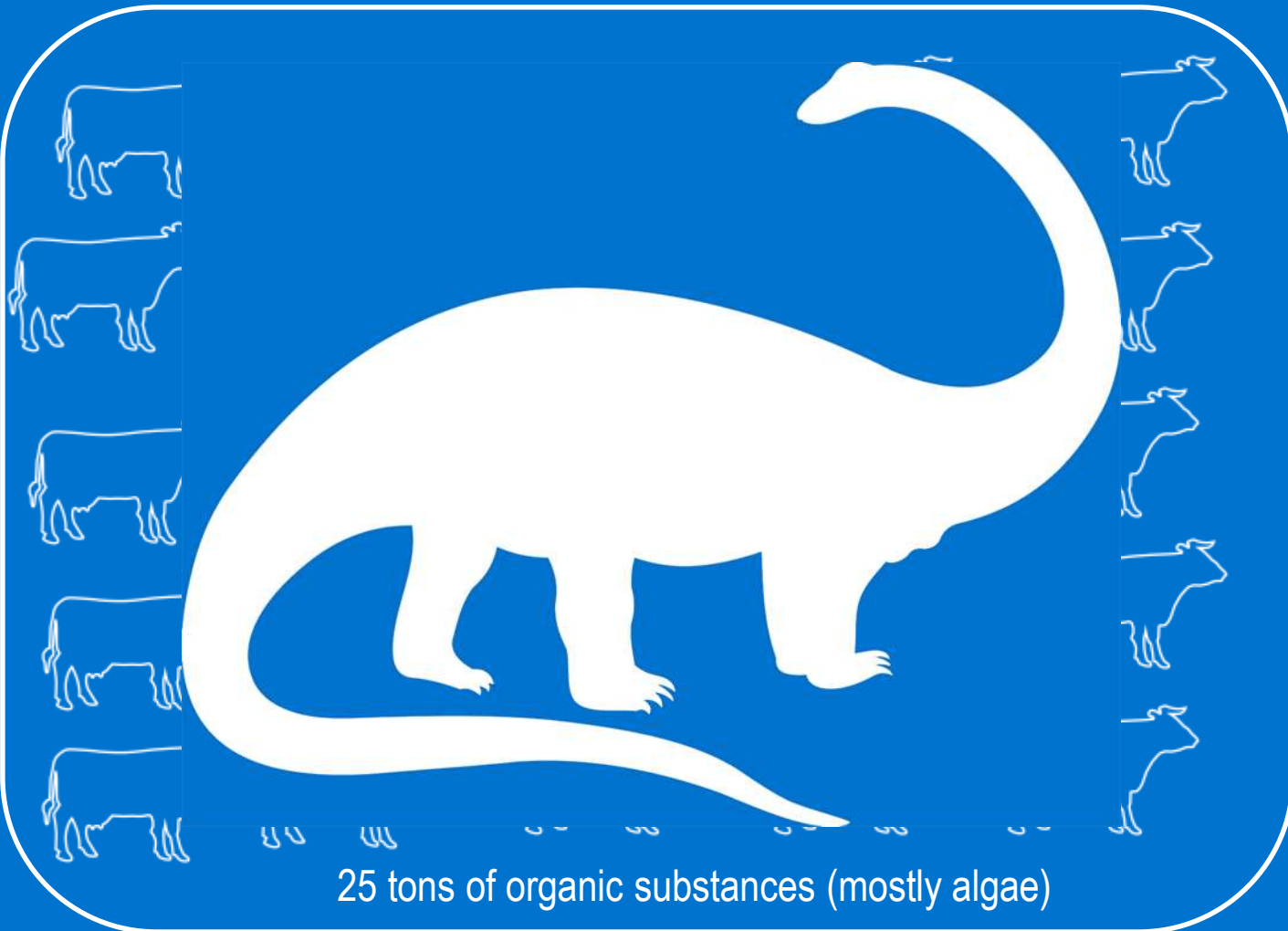


Even more relevant: The affluent population will triple or even quadruple by 2050 compared to today's levels!






Choose certainty.  
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25 tons of organic substances (mostly algae)



1.250 x   
for 50 liters of gasoline





Choose certainty.  
Add value.

# Nations Unies

## Conférence sur les Changements Climatiques 2015

COP21/CMP11

### Paris France



SECRETARE EXECUTIVE CONUCC

PRESIDENT

SECRETARE





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< 1.7°C UN agreed on stabilization of temperature rise

that means stabilization of CO<sub>2</sub>-concentration < 450 ppm

anually we add another 2.5 ppm to 400 ppm existing concentration

that leaves us another 20 years to get to 0 ppm increase !

But what does this really mean?



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Real Estate

Transport

Power Supply

Industry

0 CO<sub>2</sub>

0 CO<sub>2</sub>

0 CO<sub>2</sub>

-90% CO<sub>2</sub>

by 2050 (industrialized countries!)

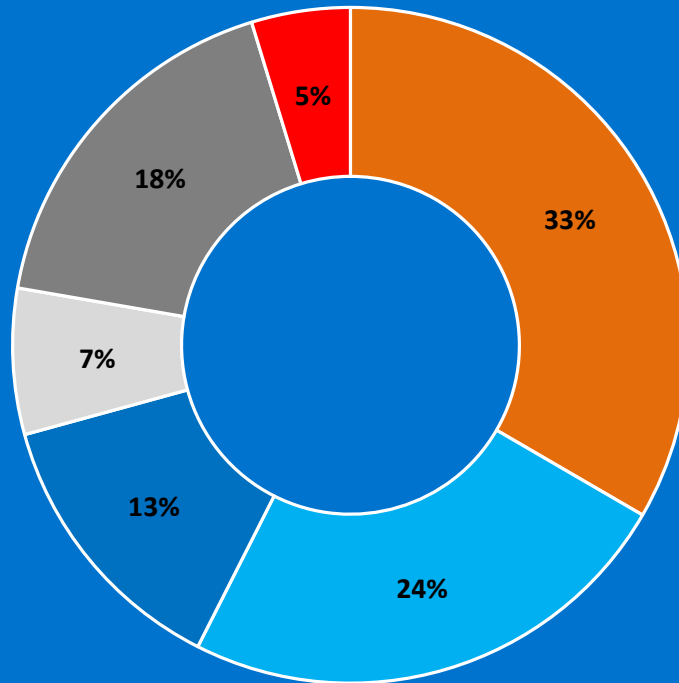
# Real Estate: Plus Energy House (TU Vienna)



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■ PV ■ Wind ■ Hydroelectric ■ Gas ■ Coal ■ Nuclear

Energy source	Investments 2015 (in billion US\$)
PV	148
Wind	107
Hydro	98
Gas	31
Coal	78
Nuclear	21

# What options do we have for „zero emission“ transport?



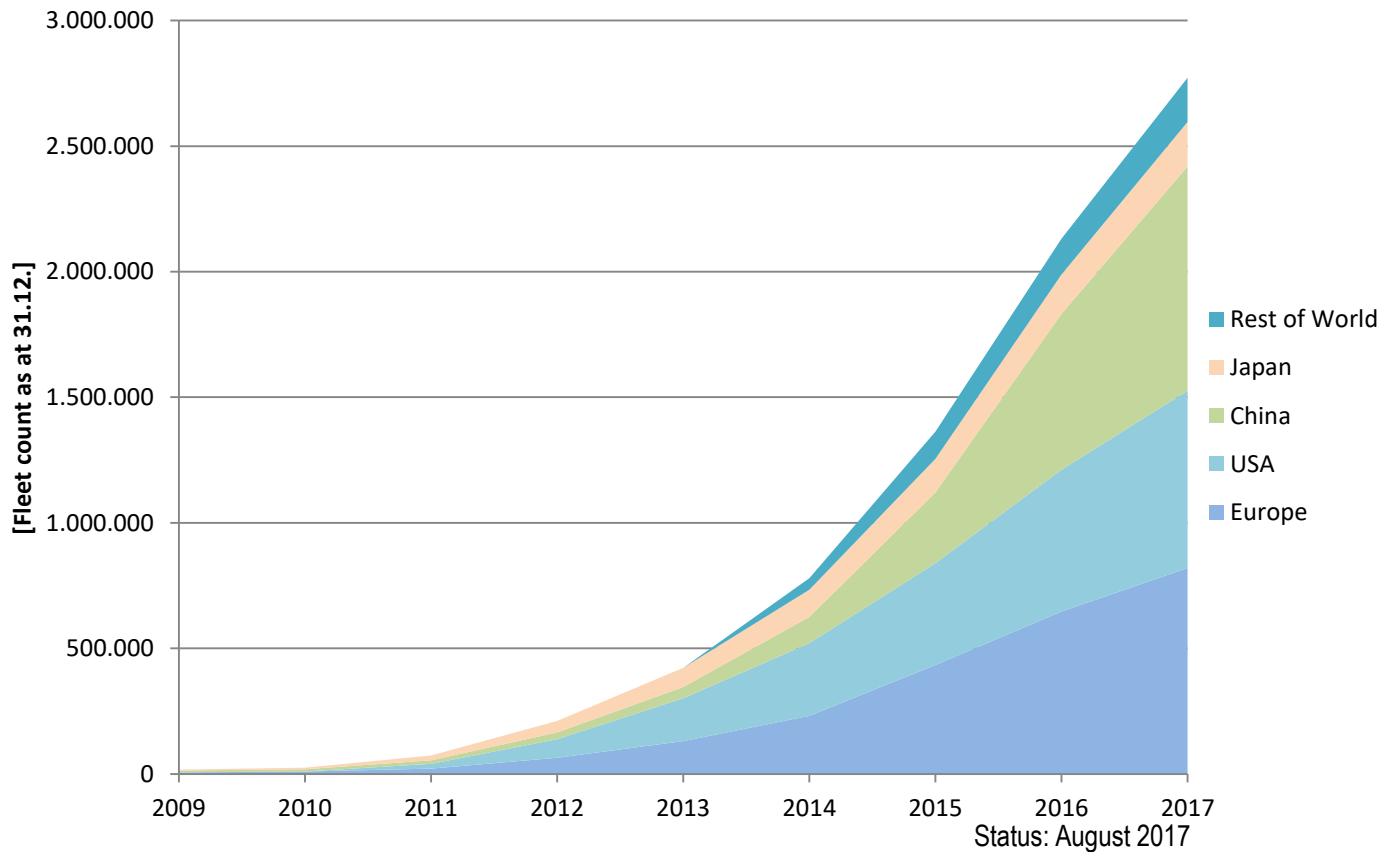
500 KG



# Global EV and PHEV market by 2017



- Cumulative numbers for BEV and PHEV: Sales volume increased in 2016 to more than 765k units/a!
- More than 890k units have been sold in China alone!
- Thus market growth will increase significantly and PHEV are not even really present yet!



**In fall 2016 total number of EV on the road exceeded 2 Million vehicles!**

**Total vehicles on the planet : 1300 Million!**

Source: ZSW (2009-2014,), TÜV SÜD 2017





Climate change, local pollution / air quality in cities



Local pollution / air quality in cities

**Global technology domination in electric vehicles (NEV)**



(In) dependence on oil) imports, India spends 80 Billion US\$ on oil imports  
- own production is in decline – demand is still growing!

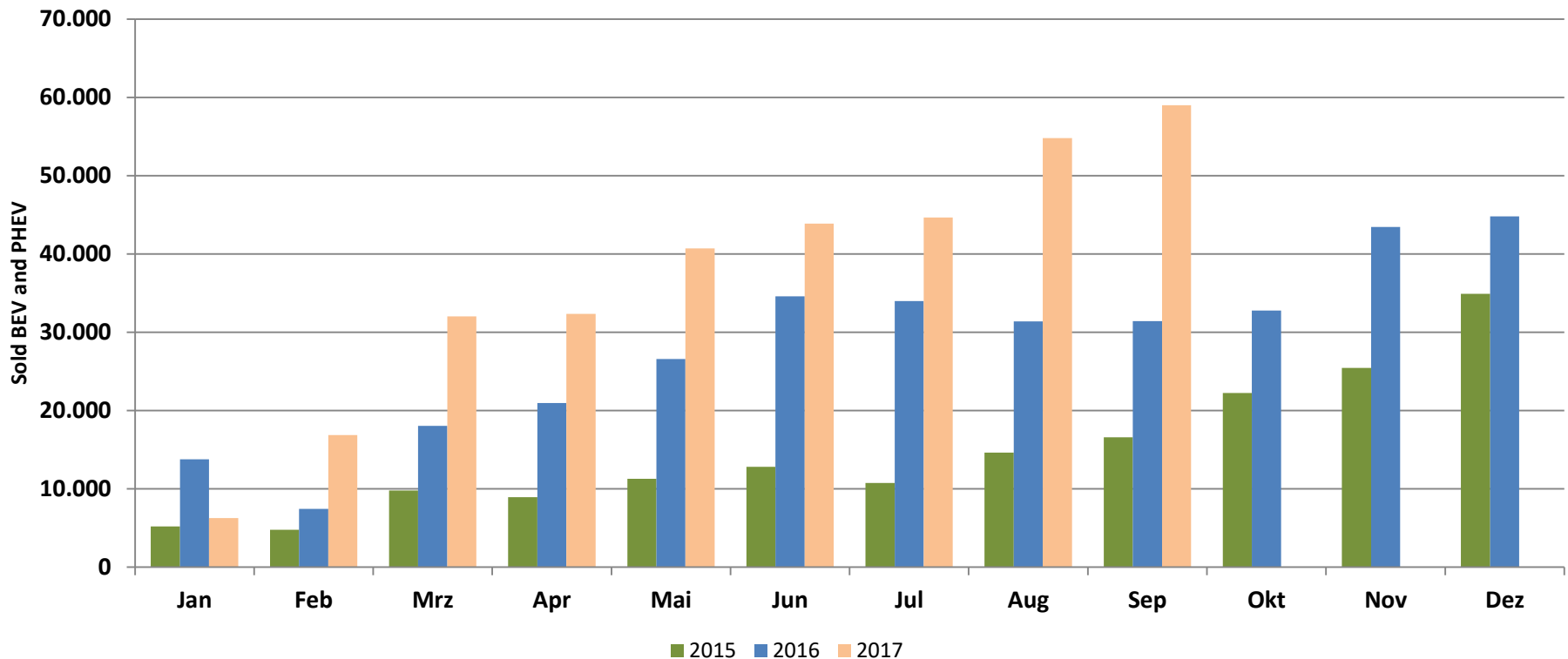


Industries: New radical players, keep global market share! Survive!

# Markets: China outperforms all



- Sales are up to >40-55k units per month
- Except of Tesla no Western/ European / Japanese brand plays a role in the top 20 e-vehicle charts (Tesla 17<sup>th</sup>)
- China is using e-Mobility as one key element of their growth stimulus package in the next 5 years
- There is a clearly visible industrial strategy behind the e-vehicle sales stimulation measures!



Source: Timer Auto, Monthly Market Performance of Domestic New Energy Vehicles

All foreign OEMs must act, not to lose market share in China, the trend is clear!



- **Even if German OEMs succeed to keep Diesel cars in the German market!**
  - Rest of Europe/RoW will ban Diesel cars, municipalities will ban Diesel cars in cities!
  - BMW achieves 38% of its revenue in China, profit is close to 50% from China!
  - VW Group achieves 50% of its total rev. in China! Profit share is close to 60%!

My prediction: China will ban all combustion engines in big cities starting from 2025!  
(Beijing, Shanghai, Guangzhou, Shenzhen, others will follow)

China is already dominating the global market for electric buses! More than 100k electric buses are on the road in China! Sales in Europe increase! (Paris, London, Amsterdam...)  
3000 Fuel Cell buses planned for 2018, 10,000 for 2019!

Dynamic encounters:



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German postal service became a vehicle manufacturer!



# Problem: Old power outlet sockets and not appropriate wall cabelings



Image: ZVEI

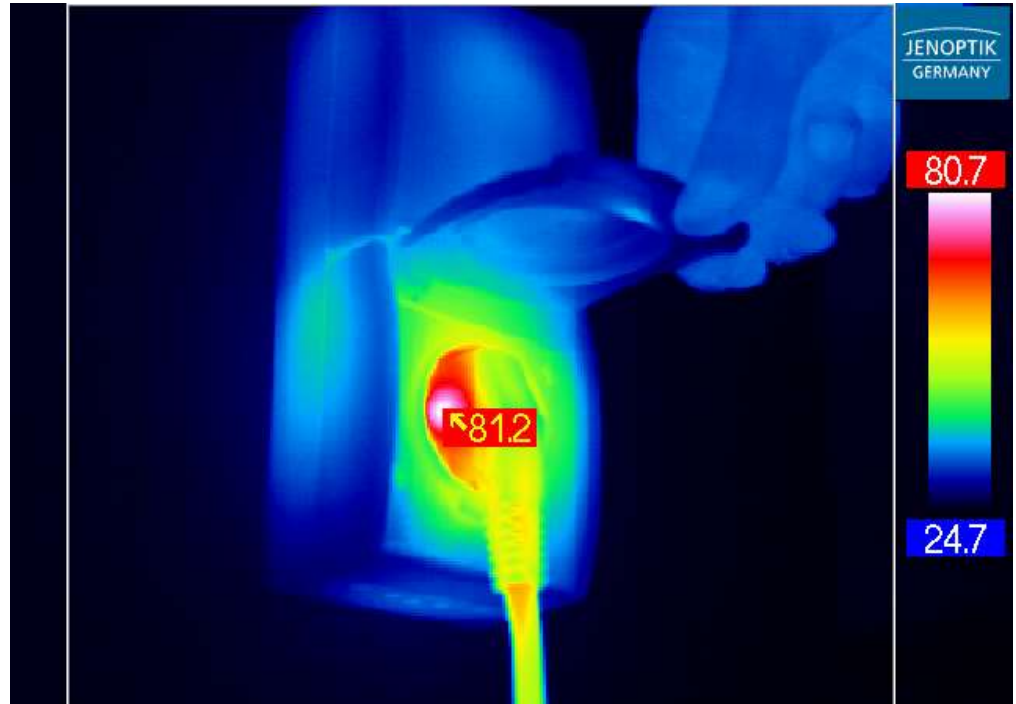
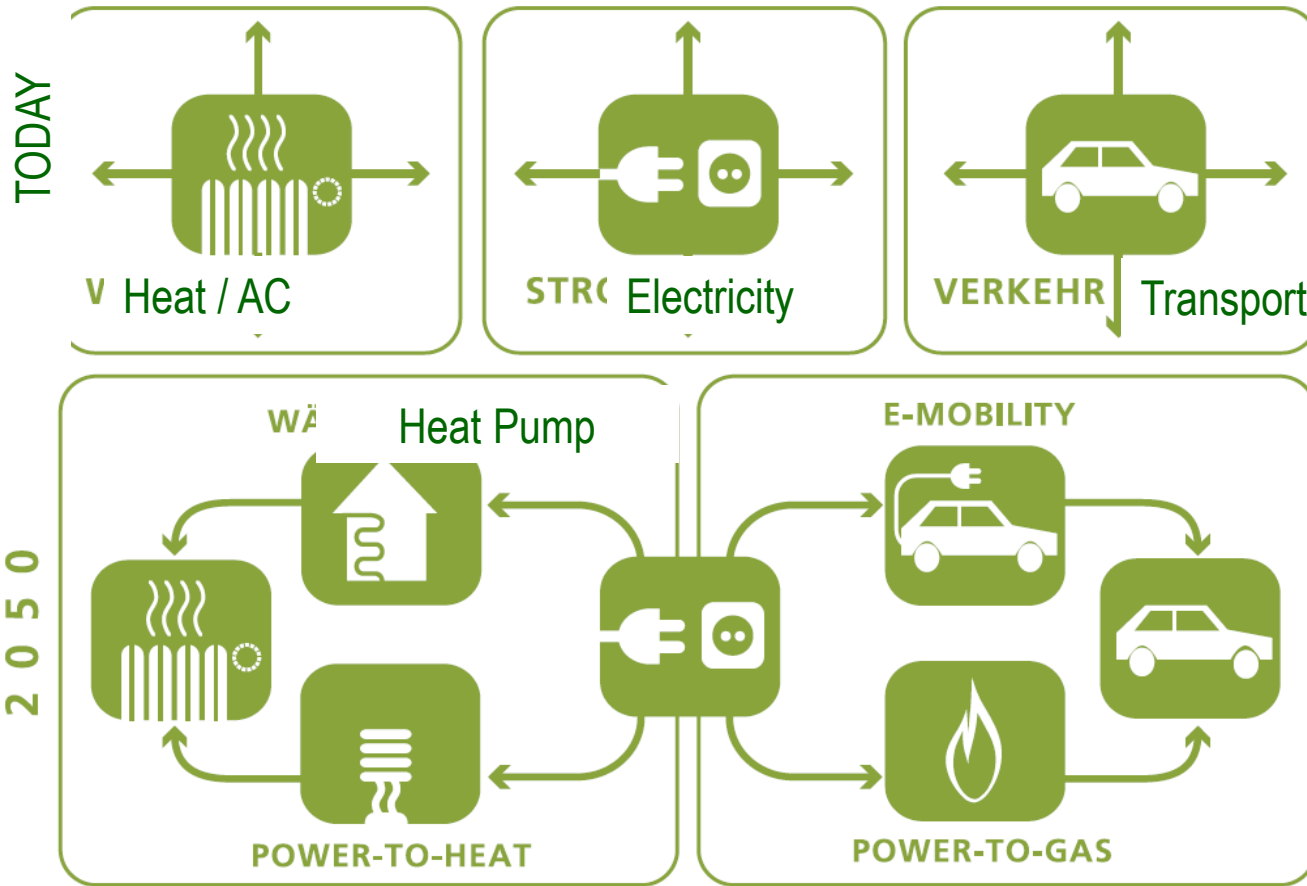


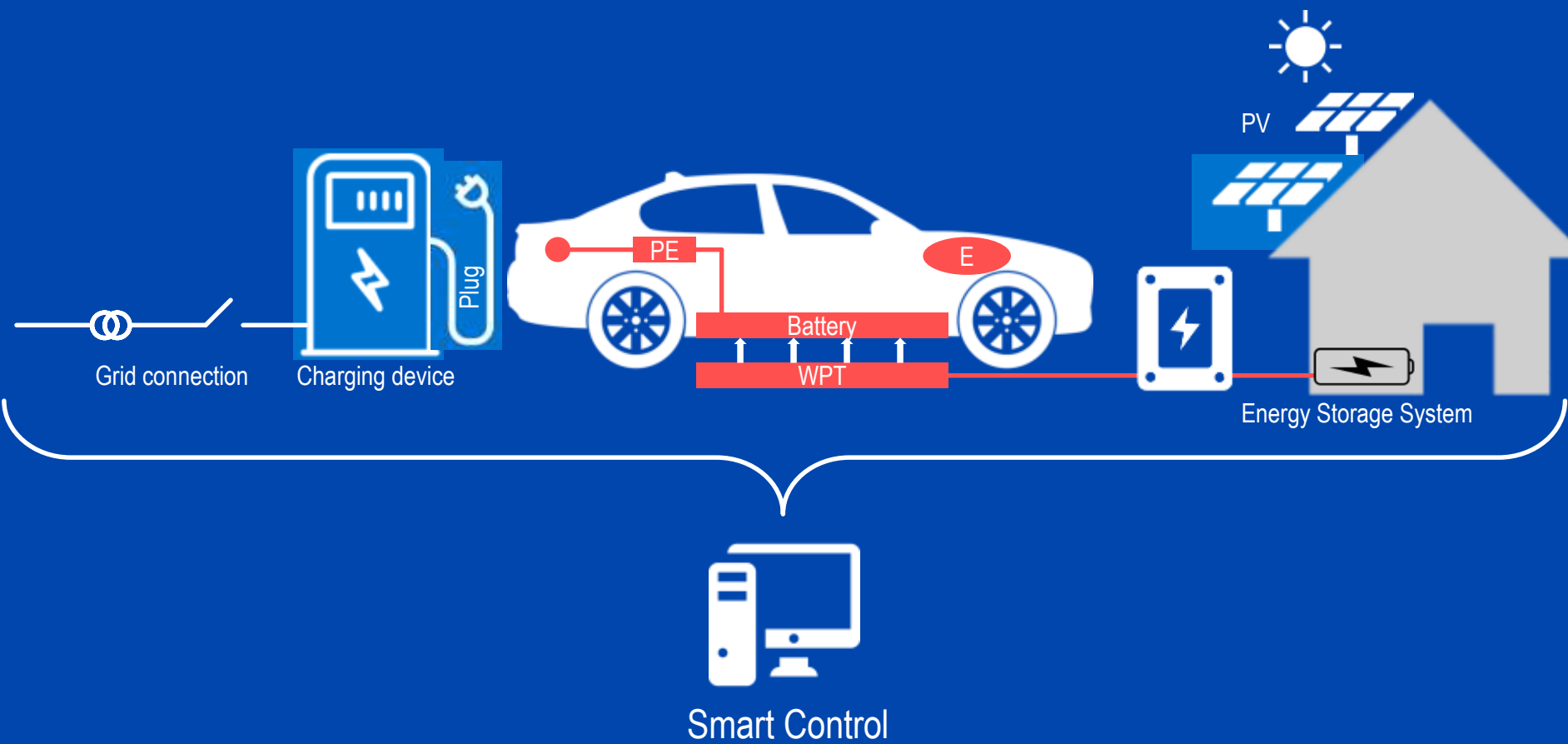
Image: E.ON

Furthermore holistic thinking is necessary – e-Mobility is a “system” !



Source: Fraunhofer ISI

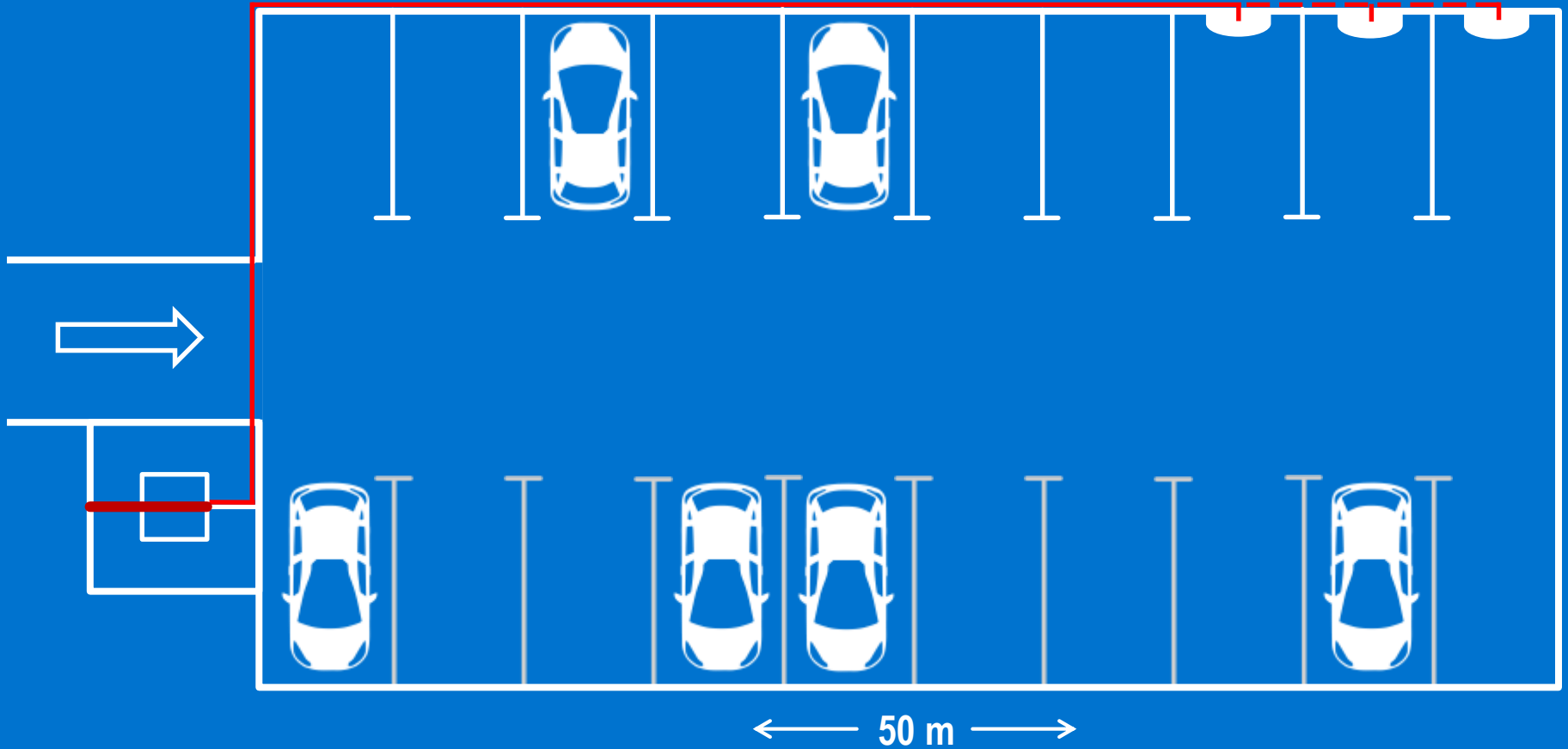
# Typical e-Mobility is a system – safety needs to have a system approach too!



# Home Charging – everything set?



Example: Town house style, 28 Units, 32 underground parking lots, 15 overground parking lots, built 2016



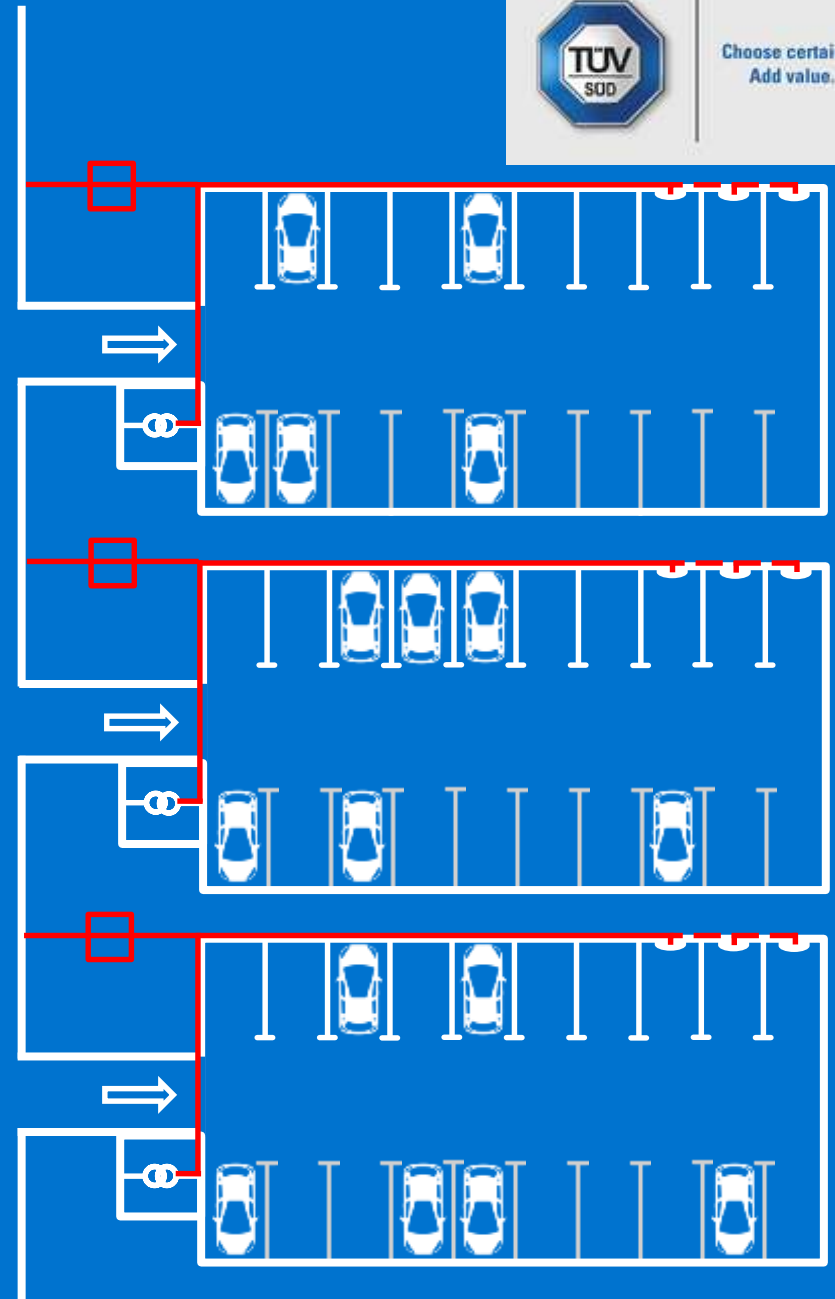




Mittelspannung



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# Highway fast charging



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STAU

STAU



# Fast charging at highways



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World largest fast charging site (Norway, 20 x 120 kW (2.2 MW total)

Holzkirchen near Munich

## Peak demand resting area „Holzkirchen“

(16 refueling points, 6 Minutes processing time, 10h peak demand, 14 hours 50% of peak demand)

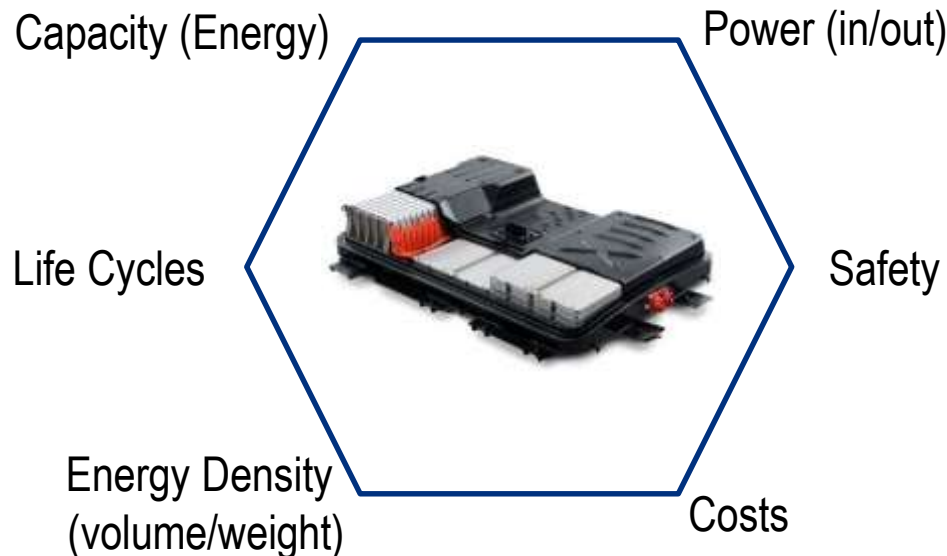
Total refuelings peak-day:	3264
Charging power:	150 kW
Charging time	30 Min.
⇒ No charging points:	96
⇒ Peak power demand	14,4 MW

Highway resting areas in Germany:  
380

Requires roughly 38k chargers  
with 5.7 GW power

(calculations by Blandow, TÜV SÜD)

- No „relevant“ technology change in the next 3-5 years
- Batteries are getting bigger (300-500 km range, 40-90 kWh)
- Batteries need to have fast charging (and HPC150/350) capabilities
  - Reduced resistance of anode and cathode (e.g. Ni doting, nano coat)
- Higher capacity (bigger!) batteries require higher densed packaging







Product Safety

Rescue work

Recycling / Decommissioning



<b>Toronto, Canada Auburn Hills, USA *)</b>	<b>Garching, Germany *)</b>	<b>Shenzhen, China</b>	<b>Singapore *)</b>	<b>Suwon, Korea</b>	<b>Utsunomiya, Japan</b>
Complete service portfolio for cell, module and system testing	Complete service portfolio for cell, module and system testing	Performance, environmental and abuse testing on cell and module level – system level in 2015	Performance and environmental testing on cell, module and system level	Performance testing on cell, module and system level, Abuse test on cell level	Environmental and abuse test on cell, module and pack level

\*) ISO/IEC 17025 accredited test lab or accreditation in 2015, Issuance of CB certificate / report possible

# TÜV SÜD Battery Lab Germany: EV scale battery safety testing up to 800 kg



Safe,  
Professional  
&  
Clean  
Testing!



# Full vehicle immersion and propagation test (thermal runaway) by TÜV SÜD!







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300 HP, V6  
Diesel engine



380 HP electric  
Motors 2x



Source: E-Force One AG

E-Motor: Maintenance free, oil free, no moving parts, minimum 10 Years, 95% efficiency!



## TÜV SÜD Group

One-stop testing, inspection, certification and training.

**For a Safer and Greener Future.**

# Vielen Dank!



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# Backup



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# Martkets: The “Premium” challenge, Tesla put it upside down!



## US premium segment vehicle sales

- All established OEMs lost ground in 2016 in the premium segment, except of Tesla Model S, BMW 7-series and Jaguar XJ
- Tesla Model S outperformed all premium vehicles
- California (with 40 Mio people) traditionally was the most important premium market for Japanese and German OEM (for Germany now China)!
- In 2016 the new Model X rivaled the successful SUV segment additionally
- Thus: Audi Q7, Porsche Cayenne, VW Touareg, BMW X5/X6, Lexus LS
- In 2018 Tesla will rival even the compact class with it's Model 3!



## US premium segment vehicle sales

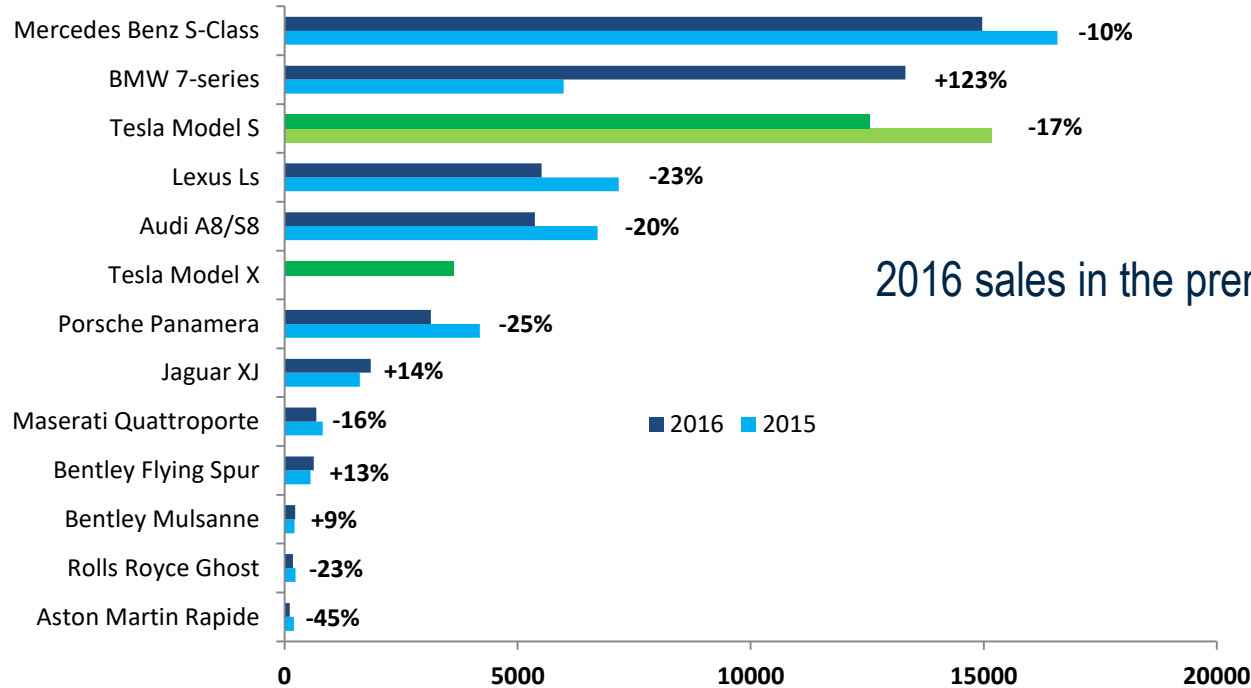
Model	2016 sales	2015 sales	Change
Audi A7	6558	7721	-15,06%
Audi A8	4149	4990	-16,85%
BMW 6-series	3947	8146	-51,55%
BMW 7-series	12918	9292	39,02%
Jaguar XJ	3834	3611	6,18%
Lexus LS	5514	7165	-23,04%
Mercedes Benz CLS-Class	4156	6152	-32,44%
Mercedes Benz S-Class	18803	21934	-14,27%
Porsche Panamera	3140	4985	-37,01%
Tesla Model S	29421	25202	16,74%
Tesla Model X	18223	x	
Total	110663	99198	11,56%



# Markets: Tesla's impact is not only in the US, Europe is challenging for "classic" players as well!



Official statistics hide away Tesla from premium statistics (not classified as premium car!)



- Tesla Model S outperformed all premium vehicles except of the all new Mercedes S-Class and BMW 7-series, but Model S is almost at similar sales levels!
- In the German premium market Tesla was not (yet) successful, while in others it gathered up to 60% of the premium market! (Norway, Denmark, The Netherlands, Switzerland , even Austria!)
- Model X and Model 3 are also about to start in Europe, Model X availability will be limited in 2016, Tesla focus is China and USA..