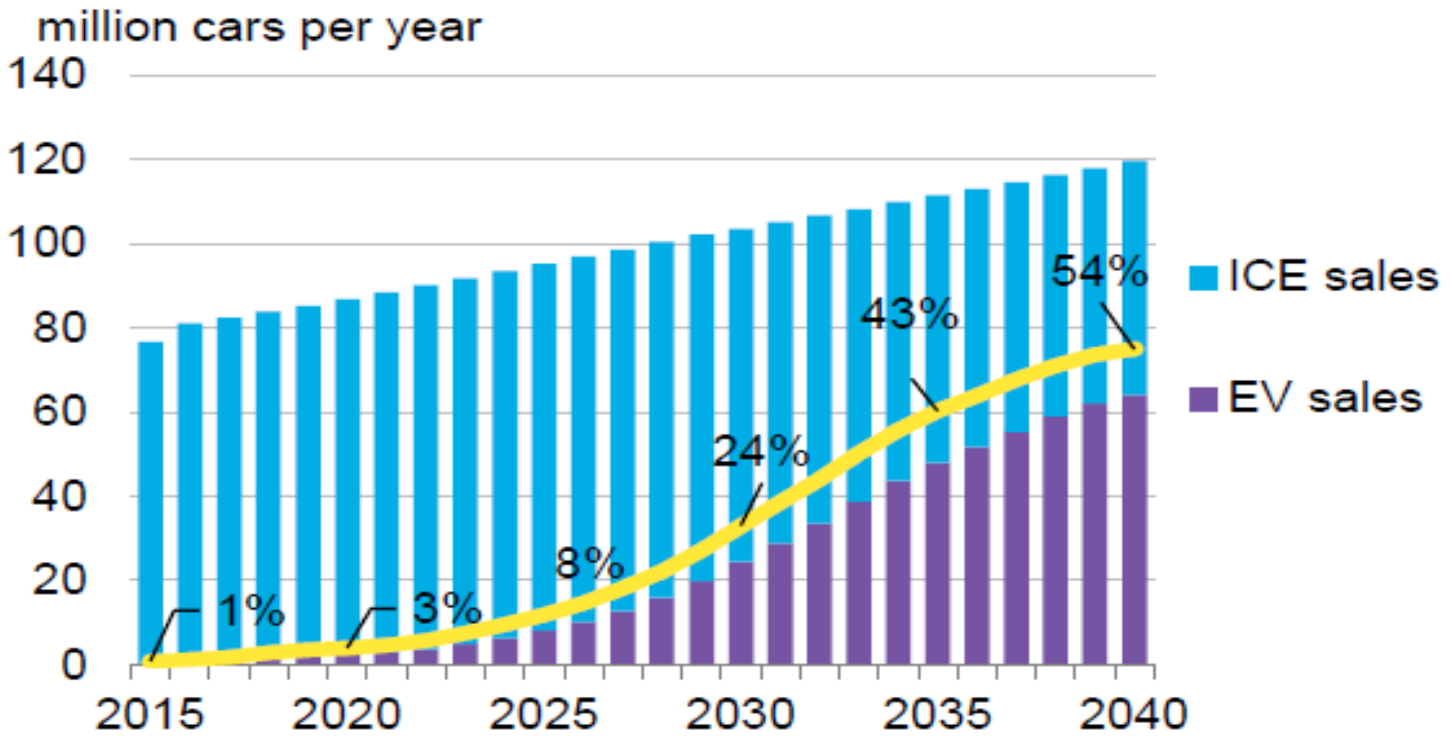
Electrical Vehicles : Market Forecast

Dr. Wolfgang Epple
Former Director Research & Technology
Jaguar Land Rover

June 2018

Electrical Vehicles : Market Forecast

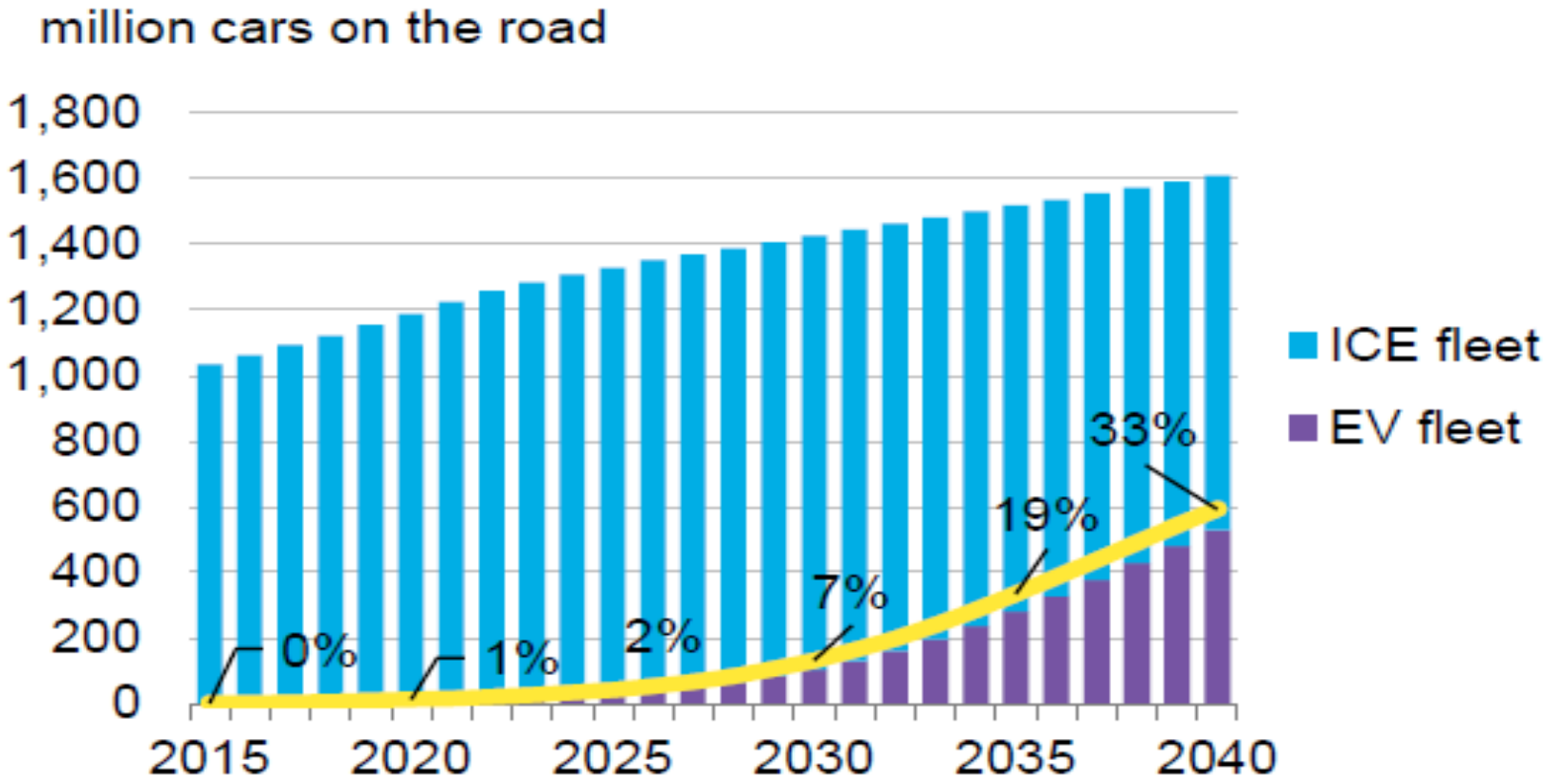
Annual Global Light Duty Vehicle Sales



Source : Bloomberg New Energy Finance

Electrical Vehicles : Market Forecast

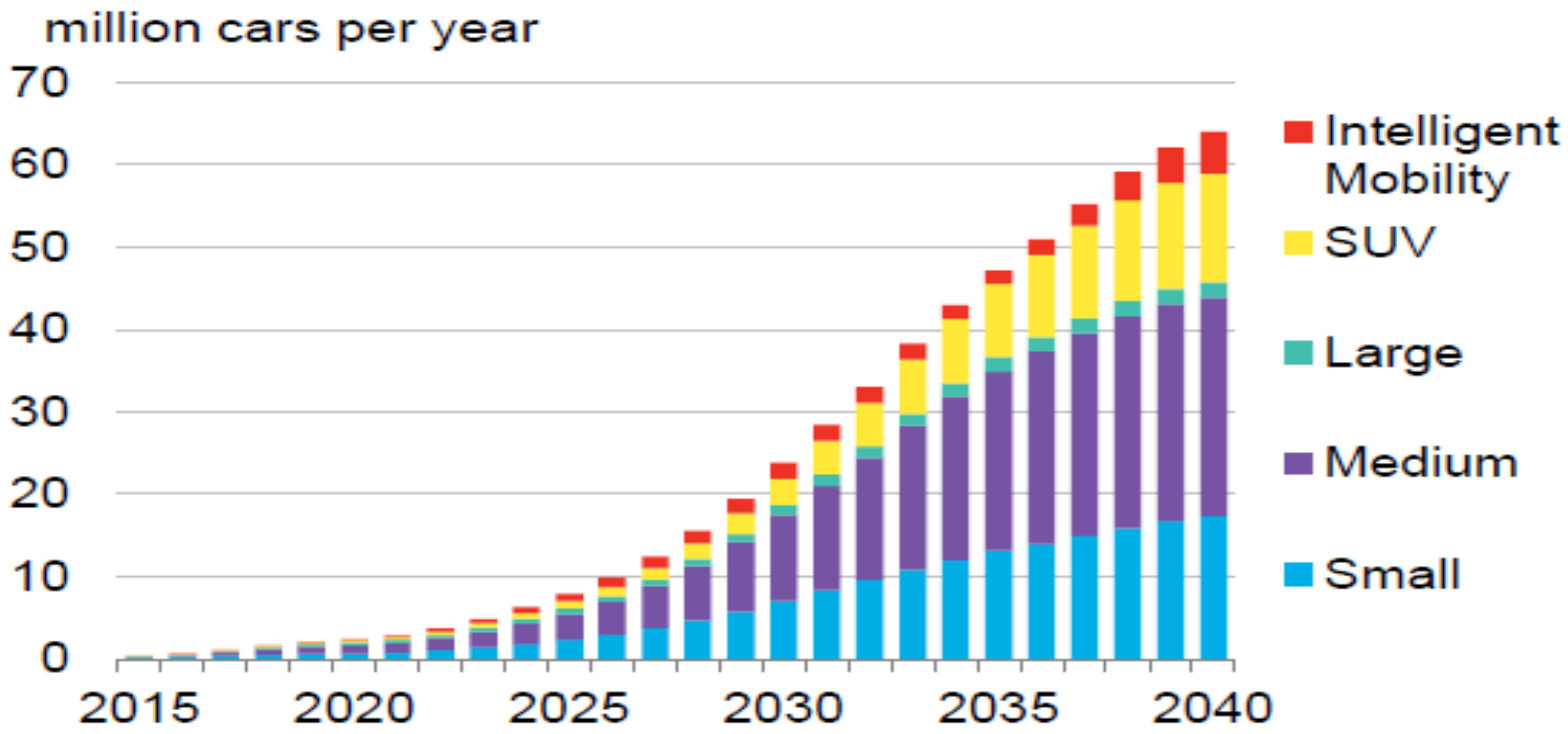
Global Light Duty Vehicle Fleet



Source : Bloomberg New Energy Finance

Electrical Vehicles : Market Forecast

Annual Global EV Sales by Vehicle Class



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Electrical Vehicles : Challenges and Opportunities

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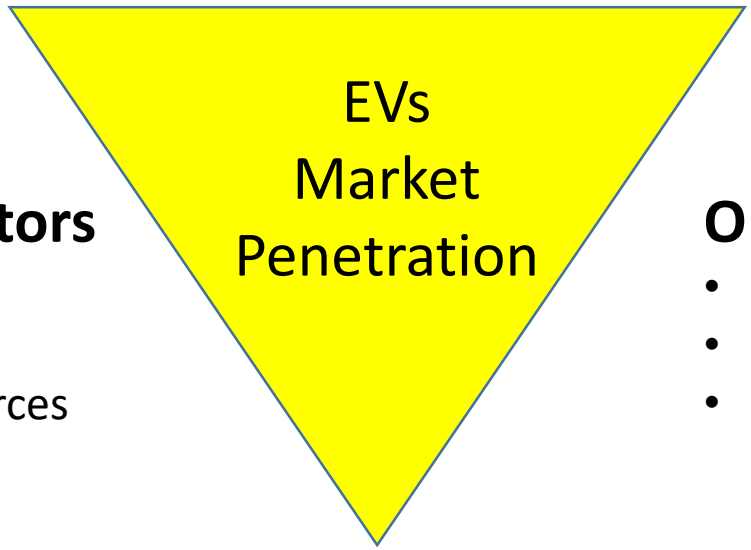
Electrical Vehicles : Challenges and Opportunities

Customers

- **Want [Emo]**
- **Need [Ratio, 4Rs]**



External Factors

- Regulation
- Subsidies
- Energy Resources
- Infrastructure

OEMs

- **Survival**
- **Profitability**
- **Emissions**

Electrical Vehicles : Challenges and Opportunities

A Customers

- **Want/Emotion :**
  Very limited pull from customers (+/- 1,5 % in 2017), because the want/emotional aspect is essentially only satisfied through TESLA's announcements to deliver an outstanding car. Not enough offers available !

- **Need/Ratio :**
  - Not yet a 'business case' for customer
  - Other than strict regulations in China very limited macro pressure for customers to switch to EV
  - 4**R**s : **r**etail price, **r**efueling, **r**ange, **r**esidual value

- → **Very small numbers of EVs (<2%)**

Electrical Vehicles : Challenges and Opportunities

B External Factors

1. **Regulatory environment** relating to EV (global or regional)
   a. Emissions (CO_2 compliance in Europe, US, China)
      After 'Dieselgate' there is major threat in particular for European OEMs
   b. Autonomy of regions and big cities – local regulations

2. **Subsidies/benefits**
   a. Monetary
      direct sales incentive / tax relief
   b. Nonmonetary (free charging, commuter lane, parking, privileged access)

Electrical Vehicles : Challenges and Opportunities

B External Factors

3. Energy Resources

a. Limited fossil energy
b. Major investment of Oil-companies in infrastructure

4. Infrastructure

a. Substantial growth of charging stations globally
b. High share of superchargers
c. Additional Investors

Electrical Vehicles : Challenges and Opportunities

C OEMS (and supply chain)

1.Rational for implementing EV

a. Shakespeare : to be or not to be
   Once the shift to EVs has taken place, there is exponential growth

b. Changeover to EV for existing OEMs can not be digital, it's gradual
   → Lead time

c. Customer benefits in combination with autonomy :
   package/roominess/different use of time while driving

Electrical Vehicles : Challenges and Opportunities

C OEMS (and supply chain)

2.Critical points to consider, when an OEM plans to implement EV ?

a. Transition from ICE (20-28% of product cost) to new business case for OEM and customer
(High level calculation to demonstrate challenges)

b. Workforce allocation/reduction : Today some 2k components to handle/assemble for drivetrain with ICE (internal combustion engine), tomorrow a few hundred components.

c. Investment in new plant or modification of existing plants

Electrical Vehicles : Challenges and Opportunities

C OEMS (and supply chain)

3. How will the implementation of EV affect the profitability of the Automotive Industry ?

a. Substantial upfront investment in billions category

b. Simple, high level calculation using the car's categories
   i. Body
   ii. Interieur/Trim
   iii. Chassis
   iv. Electrical and
   v. Drivetrain (either ICE or Electrical)

c. Major drop in service requirements
   Less parts in drive train, less failures, less wear and tear
   Today's typical contribution split (at dealer) : 1/3 new car sales, 1/3 service and 1/3 parts,
   Tomorrow ?

Electrical Vehicles : Challenges and Opportunities

C OEMS (and supply chain)

4. Effect of China and Tesla on the Automotive Market ?

a. Driving customer's willingness to buy EVs
   Tesla had a tremendous impact on customer's **want** (product concept, top-down introduction).

b. Breaking barriers (and partly unspoken rules) and do the unthinkable

c. Money talks : subsidies in eg China and Norway have driven EV sales

d. Regulations enforce :
   * If OEMs don't achieve credits → no cars can be sold
   * If there is no permit for ICE-car then customers buy 'less convenient' EVs

Electrical Vehicles : Challenges and Opportunities

Conclusions

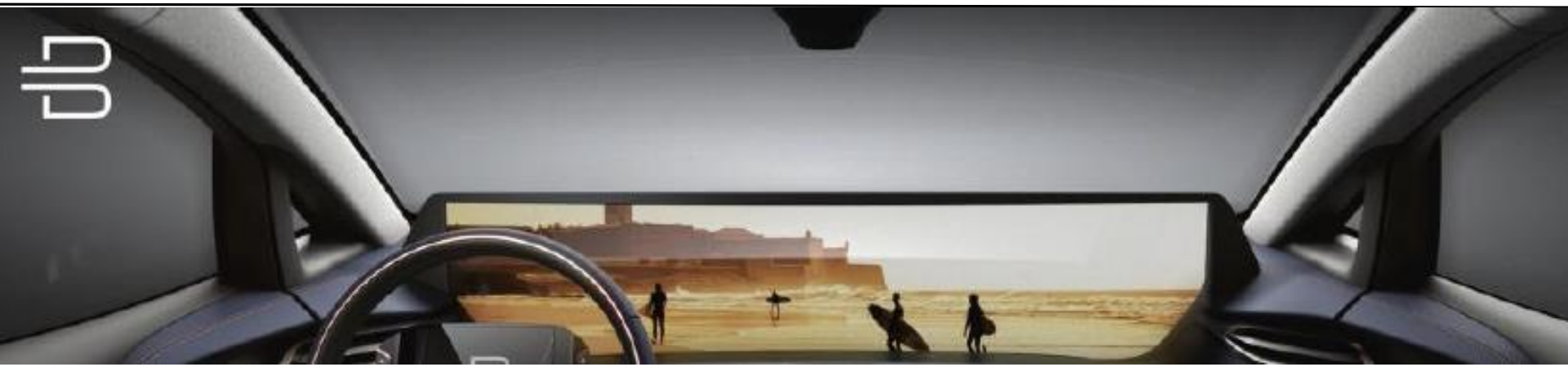
1. Whenever human beings want to get something,
   they find a way to make it happen.

2. Engineers can solve all technical problems.

3. The commitments, money and regulations which had been ‘released’
   within last year are ‘mind boggling’

→ **The transition to EV will happen**

Electrical Vehicles : Challenges and Opportunities



Thank You

Dr. Wolfgang Epple
Former Director Research & Technology
Jaguar Land Rover

Kaagangerstr. 134
D-82279 Eching
Germany
epplewk@gmail.com