



Development of electric cars in Finland and challenges in R&D

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valmet automotive
Part of Metso

Development of electric cars in Finland and challenges in R&D

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History of electric- and hybrid vehicle development in Finland

- First electrical car to Finland in 1909 to use in Helsinki fire department, in use until 1927
- Elcat built electric cars couple of decades since 1980's
 - Talbot Horizon 1981, 1985
 - Subaru-based Elcat Cityvan -cars to post of Finland and energy companies
 - Conversions from different models (e.g. VW beetle, Citroen AX and VW Passat)
 - Totally ca. 250 electric cars
- Valmet Automotive has developed electric concept car together with Finnish energy company Fortum
 - ➔ Valmet creates electric vehicle cluster to Finland with partners
- Kabuss, John Deere, Patria, Sandvik, Rocla and Kalmar have developed different kind of mobile machines

Electric- and hybrid vehicle development in Finland



R&D of electric cars in Finland

Valmet Automotive



Universities and colleges



Other companies (conversions)



Valmet Automotive – In the frontline of electric vehicles



THINK City – electric car

- Valmet Automotive and THINK AS established partnership in August 2009
- The production started in December 2009
- THINK City is also suitable for highway driving, range 160 km
- Valmet Automotive is responsible for manufacturing and logistics and participates in product development



Garia – luxury golf car and LSV

- Garia A/S, Denmark and Valmet Automotive established partnership in January 2009
- Engineering and manufacturing of Garia electric golf car in Uusikaupunki
 - Aluminum frame
 - Engine: 3.0 kW AC motor
 - Batteries: 6 x 8 V as standard
 - Range: 50 km per charge
- Production started in December 2009
- LSV version to US in 2010



Fisker Karma – plug-in hybrid

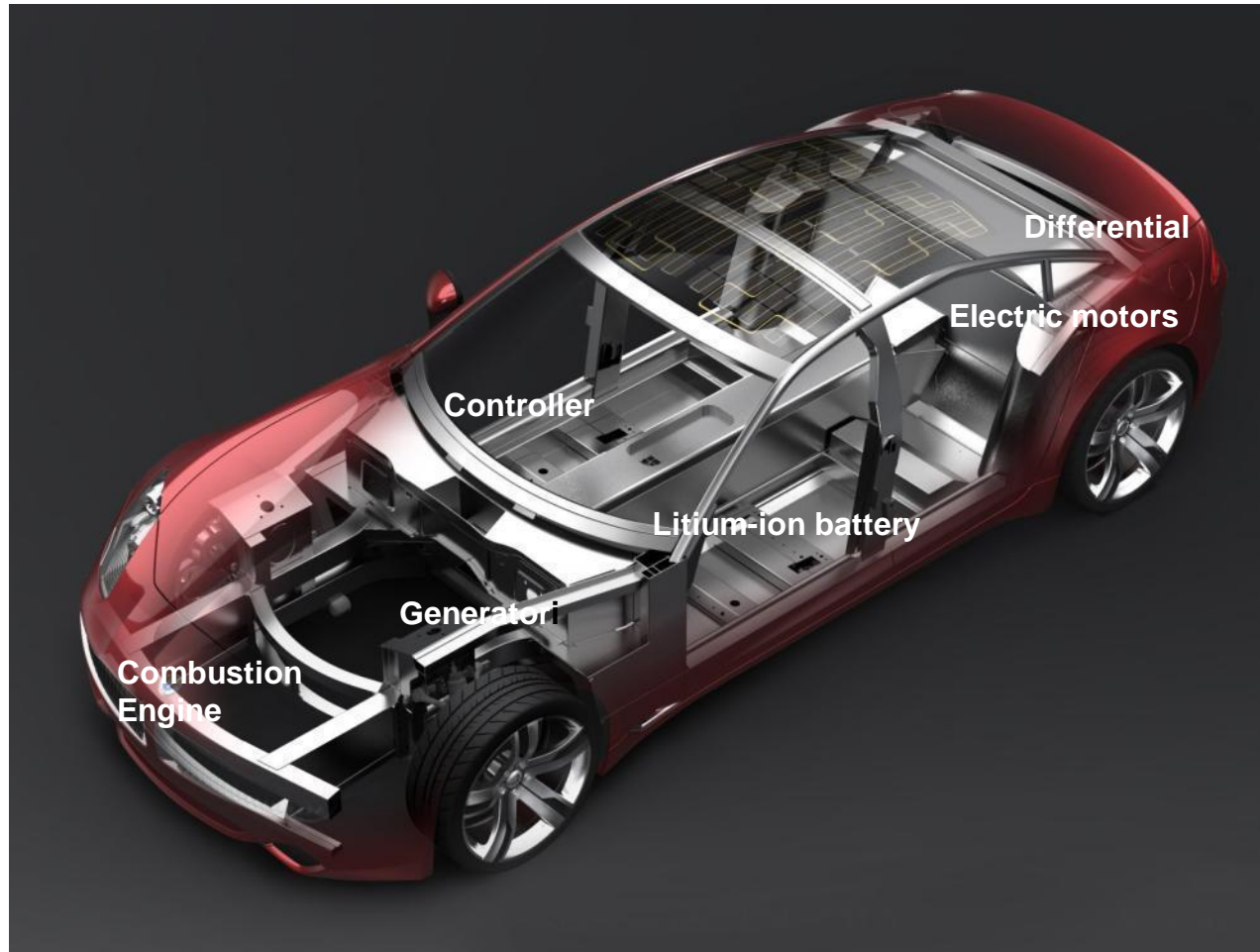
- Fisker Automotive Inc. and Valmet Automotive signed the cooperation agreement in November 2008
- Valmet Automotive is an engineering and manufacturing partner of Fisker Automotive
- Production starts in early 2011, the plan is to produce 15,000 cars annually
- Karma S – concept of a retractable hardtop (Detroit 2009)



Fisker Karma

- Plug-in hybrid (full hybrid)
- Lithium-ion battery pack
- Two electric motors, 408 hp
- Electric range 80 km (50 miles), and another 400 km (250 miles) with the gasoline engine
- Total range 480 km (300 miles)

Fisker Karma - Structure



"EVA" – by Valmet Automotive 2010



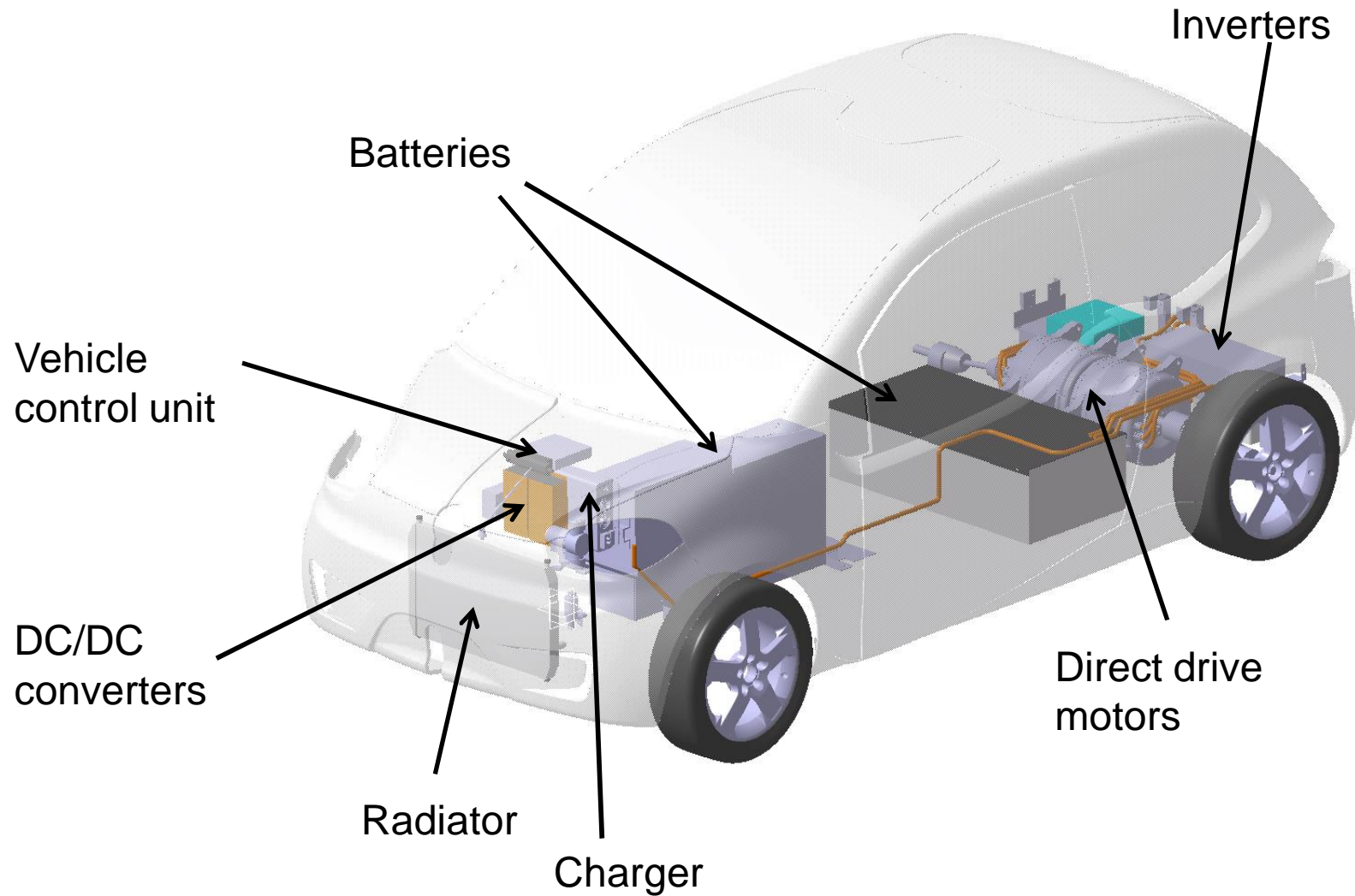
Electric concept vehicle "Eva"

- New solutions for e.g. ecological powertrain, lightweight body structures and recharging systems
- The aim was not to create a new electric car brand, but a concept car, which can also be developed to series production
- Partnership with the energy company Fortum, developer of electric motoring and charging technologies
- A Finnish expert network was created – 14 partners involved



- 2+2 seater, 2 doors
- Range 160 km, top speed 120 km/h
- Rear wheel drive
- 2 x direct drive permanent magnet synchronous motors
- Lithium-ion battery 35.5 kWh
- Charging time (80 % SOC) 10 h
- L 3800 mm, W 1650 mm, H 1600 mm

EVA - Electric drivetrain



Experienced service provider

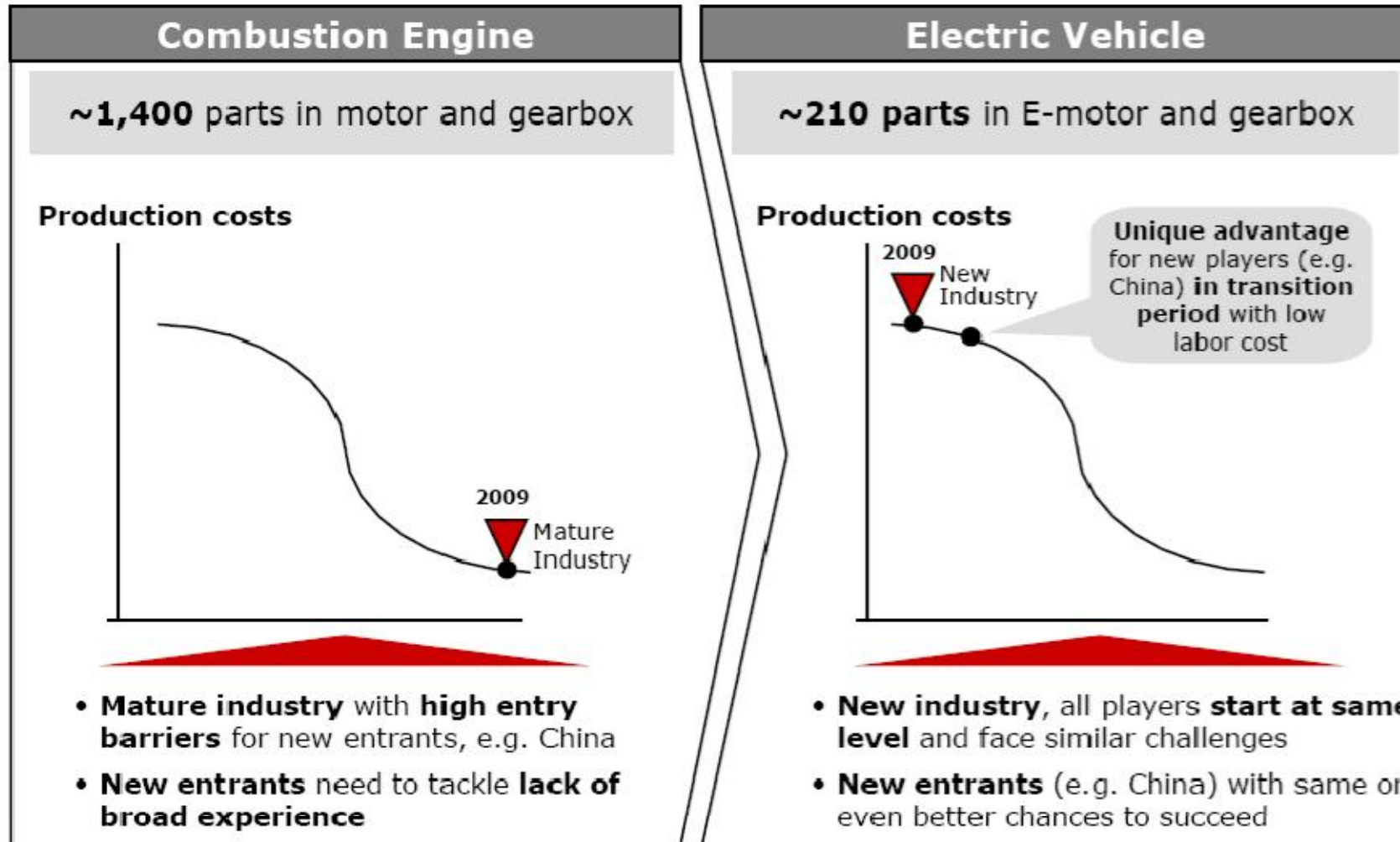
- Service provider of automotive industry: manufacturing, engineering and business services
- 40 years of experience
 - Over 1,1 million cars
 - Over 200 000 Porches
- Highly educated workforce
 - Over 800 employees, 150 engineers in product development
- Innovative engineering and manufacturing of electric vehicles
 - THINK City, electric car
 - Garia, luxury golf car and LSV
 - Fisker Karma, plug-in hybrid
- Owner: Metso



In the frontline of new vehicle technology



Opportunity to newcomers to business

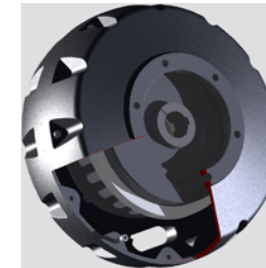


Challenges in EV R&D

Strong areas of Finnish industry to be used in EV business

- Power electronics

- Inverters (e.g. ABB, VACON)
- Chargers (e.g. Efore, UTU, Powerfinn)
- DC/DC -converters



- Electric motors

- PMSM (e.g. AXCO Motors)

- Batteries

- Li-ion cells (e.g. European Batteries)

- Electronics

- Human-Machine-Interfaces
- Diagnostics / wireless solutions / cloud services



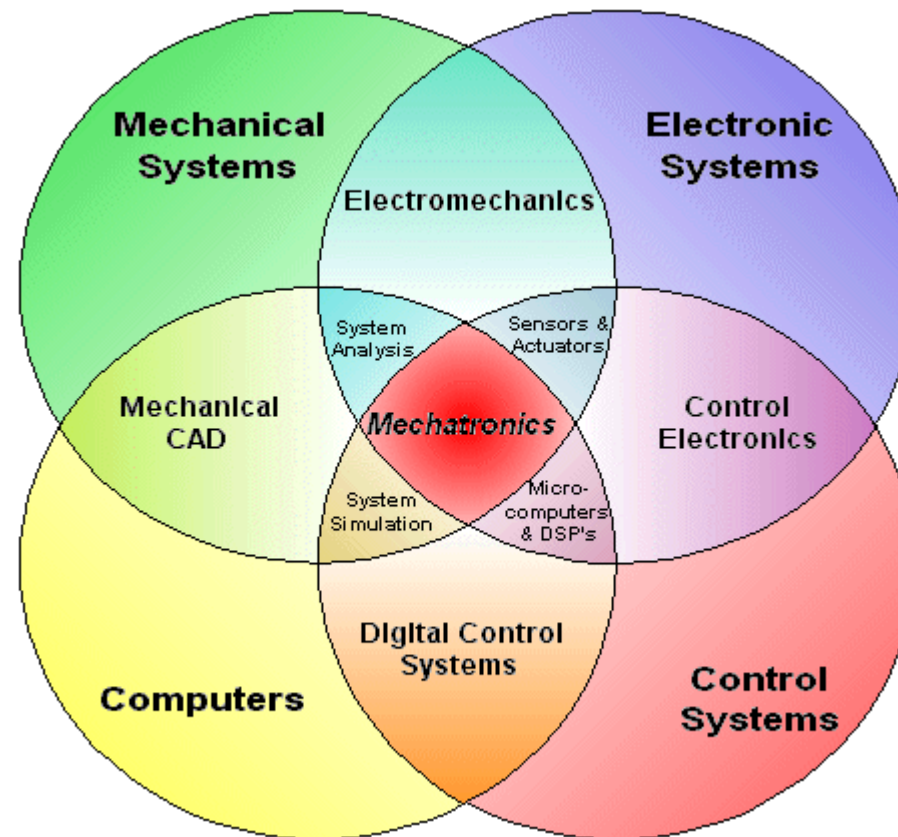
Challenges in EV R&D

Different areas of EV research

- Electric Motor Technology
 - PMSM
 - ASM
 - HSM
- Power Electronics
 - Inverters
 - DC/DC –converters
 - Chargers
 - EMC/EMI -problems
 - Battery technology
- Mechatronics
 - System integration
 - BUS technologies
 - Sensor technologies
- Energy Engineering
 - Electrical network
 - Energy supply (fast charging)
- Electrochemistry
 - Battery chemistries
- Information Technology
 - SW engineering (safety critical)
 - Embedded systems
- Mechanical Engineering
 - Lightweight body structures (aluminium, carbon fiber, composite)
 - Thermal management (flow analysis)

Challenges in EV R&D

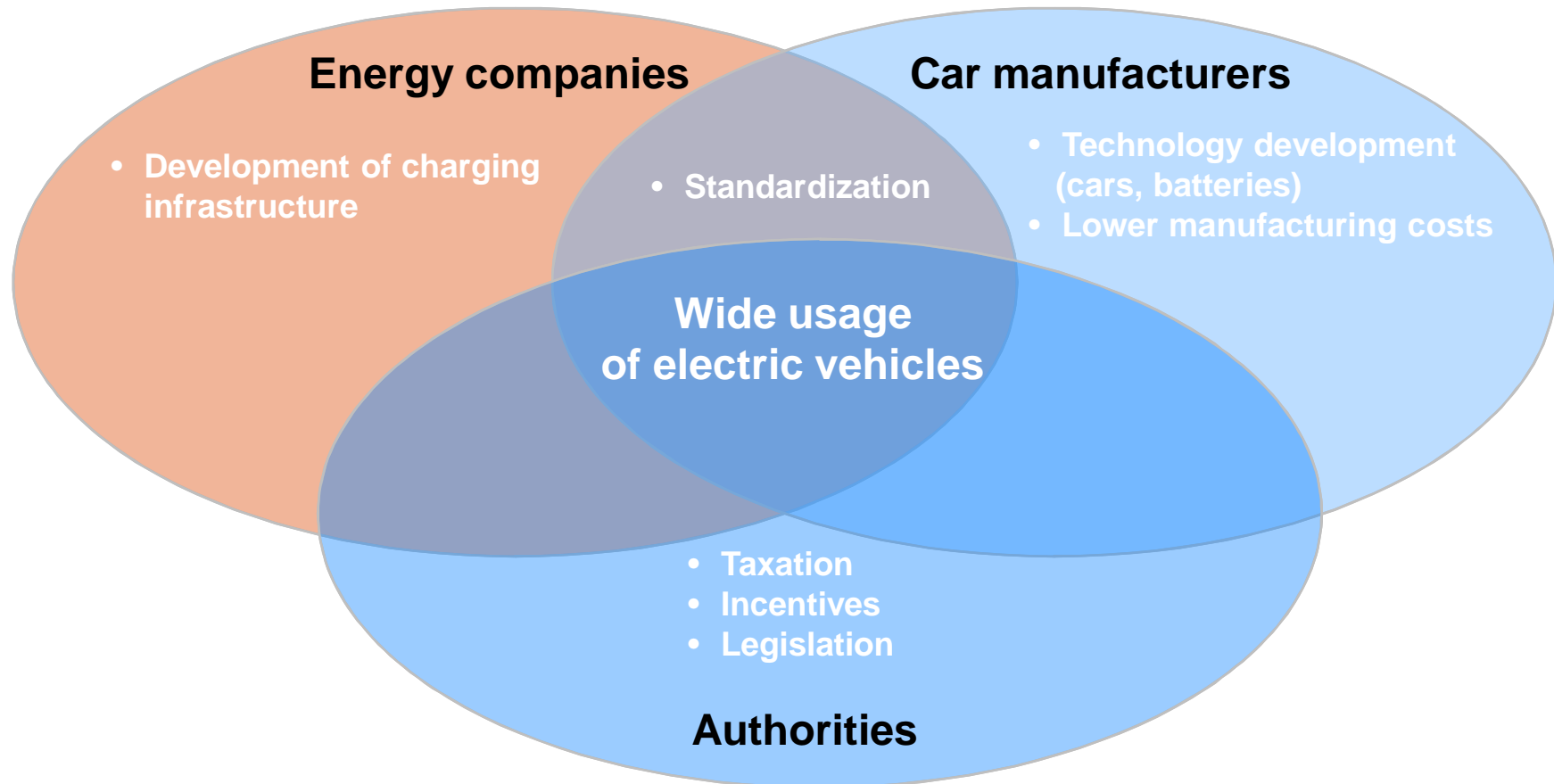
Car – Complex mechatronic machine system



Challenges in EV R&D

- Lack of skilled employees
 - A global problem → Education in the area must be increased
- Lack of companies working in the area
 - Too few end users in Finland
 - No engineering services available in critical areas
- Battery technology
 - Still too expensive (at the moment ca. 500-1000 €/kWh, target 250-350 €/kWh)
 - Technology still developing (no established chemistry)
 - Cooling/heating of batteries (cell temperature must be stable to get all efficiency)

Collaboration of different players needed





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