eMobility

Global Trends and Impact on OEMs, Suppliers and other Industries

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MD P3 South Africa (PTY) LTD

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East London
25 August 2011

Agenda

- P3 Group
- Global Regulations and Incentives
- EV/HEV Production Forecast
- Industry Trends
- eMobility Value Chain in South Africa

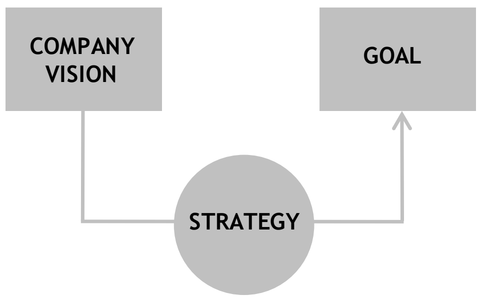
P3 Group is a global Management and Engineering Consulting Firm

- P3 founded in 1996 in Germany
- Today 1200 consultants in 33 offices in all major markets
- Specialised in the Automotive, Aviation, Telecommunication and Energy Industries
- Consulting OEMs, suppliers, government entities, investors
- P3 South Africa founded in 2010

We offer 3 core competencies to the eMobility industries

Strategy Consulting

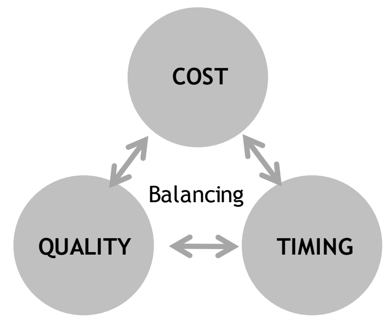
At the corporate level, P3 helps clients meet their goals in the most efficient method possible



List of services (select):
- Business plan
- Market entry strategy
- Acquisition strategy
- Sales strategy
- Product portfolio alignment with the market

Professional Management Services

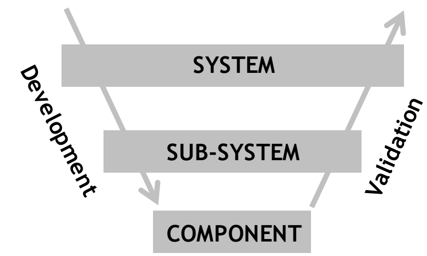
For business, P3 helps clients balance cost, quality, and processes for new products



List of services (select):
- Organization and process definition
- Cooperation management
- Program management including prototypes
- Supply chain management
- Cost and quality management

Engineering Solutions

Technically, P3 helps clients develop and validate new products for the market



List of services (select):
- Proof of concept
- Specification development
- Test strategies
- Software feature validation
- System integration

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INDUSTRY TRENDS

EMOBILITY VALUE CHAIN

Government policies are a major driver of the eMobility Industry in all markets

PESTEL Analysis on drivers of eMobility

POLITICAL –
Dependency on oil

ECONOMIC –
Rising /volatile oil price

SOCIAL –
Urbanisation and mobility

TECHNOLOGIC –
First mover advantage

ENVIRONMENTAL –
Emissions

LEGAL –
Government policies

Government policies are a major driver of the eMobility Industry in all markets

Government intervention:

Applying pressure:
Regulations and Penalties

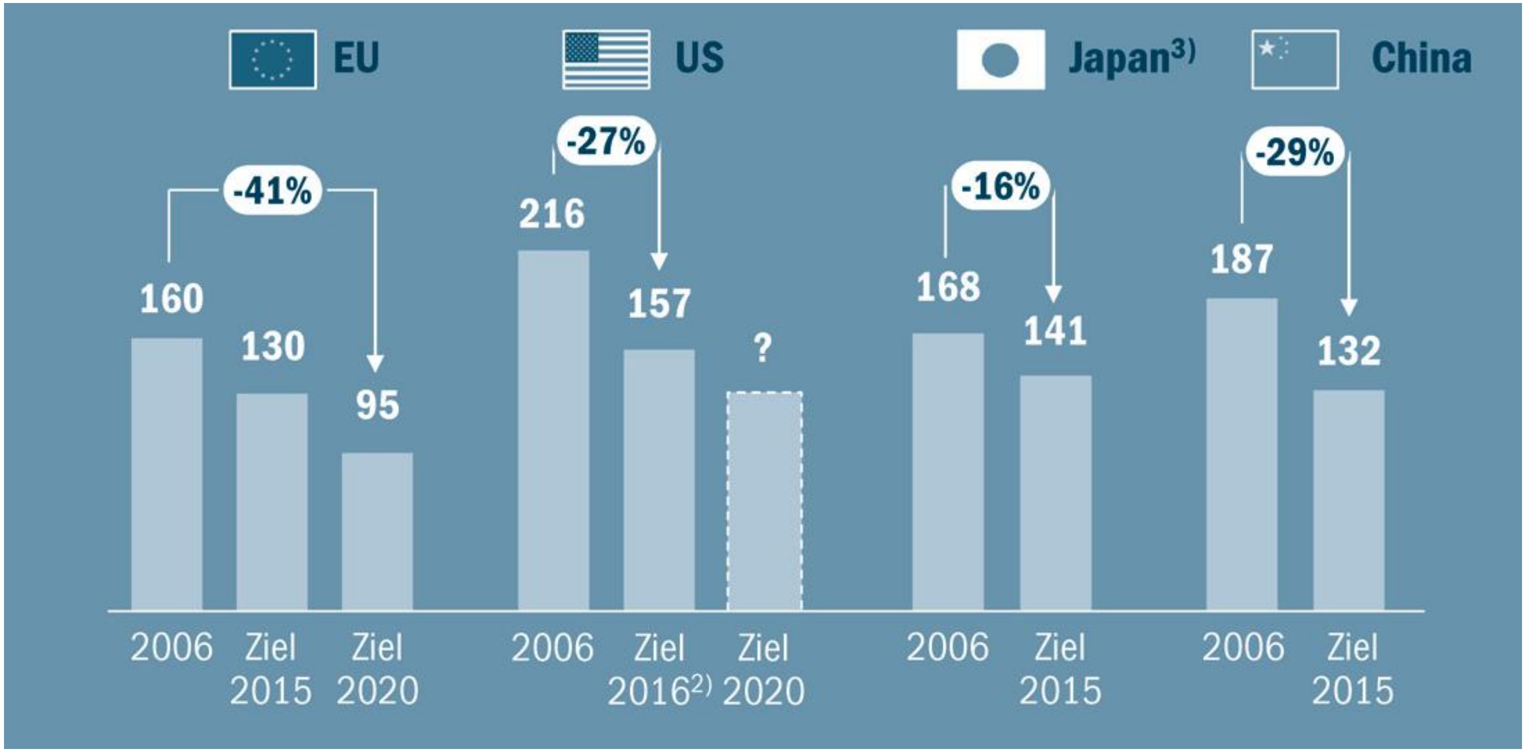
EV/HEV Industry

Offering support:
Industry and Customer Incentives

Market Mechanisms:

Consequence of a growing EV/HEV market:
Customer demand/acceptance
Availability of Technology
Cost of Technology
Standardisation
Infrastructure

Governments in major automotive markets have defined CO_2 fleet emission limits in their legislation



NOTE: Different test cycles not adjusted. Values are indications only.
SOURCE: IEA WEO 2008; Roland Berger 2011

OEMs must reduce CO_2 emission of their new fleets by ~40% in order to reach EU target

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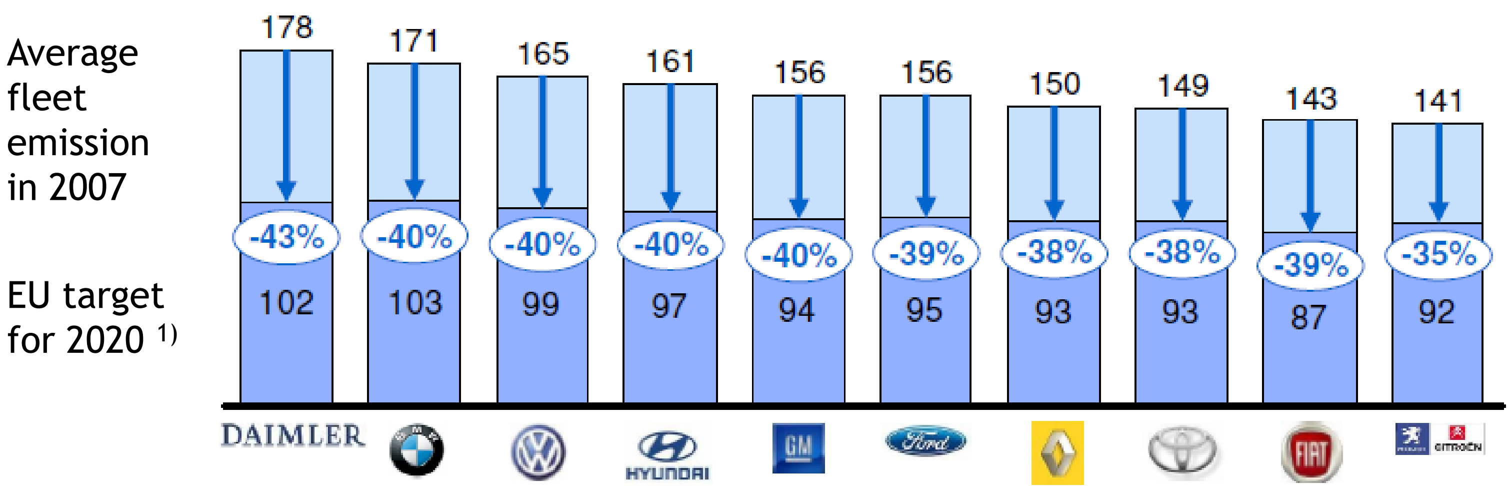
CO_2 emissions in g/km



[1] Assumption that EU 95 g/km target will be adjusted to OEM's average fleet weight
SOURCE: European Comission; Association Auxiliaire de l'Automobile; Global Insight; 2008

Optimisation of ICE powertrains is not sufficient to meet 95 g/km

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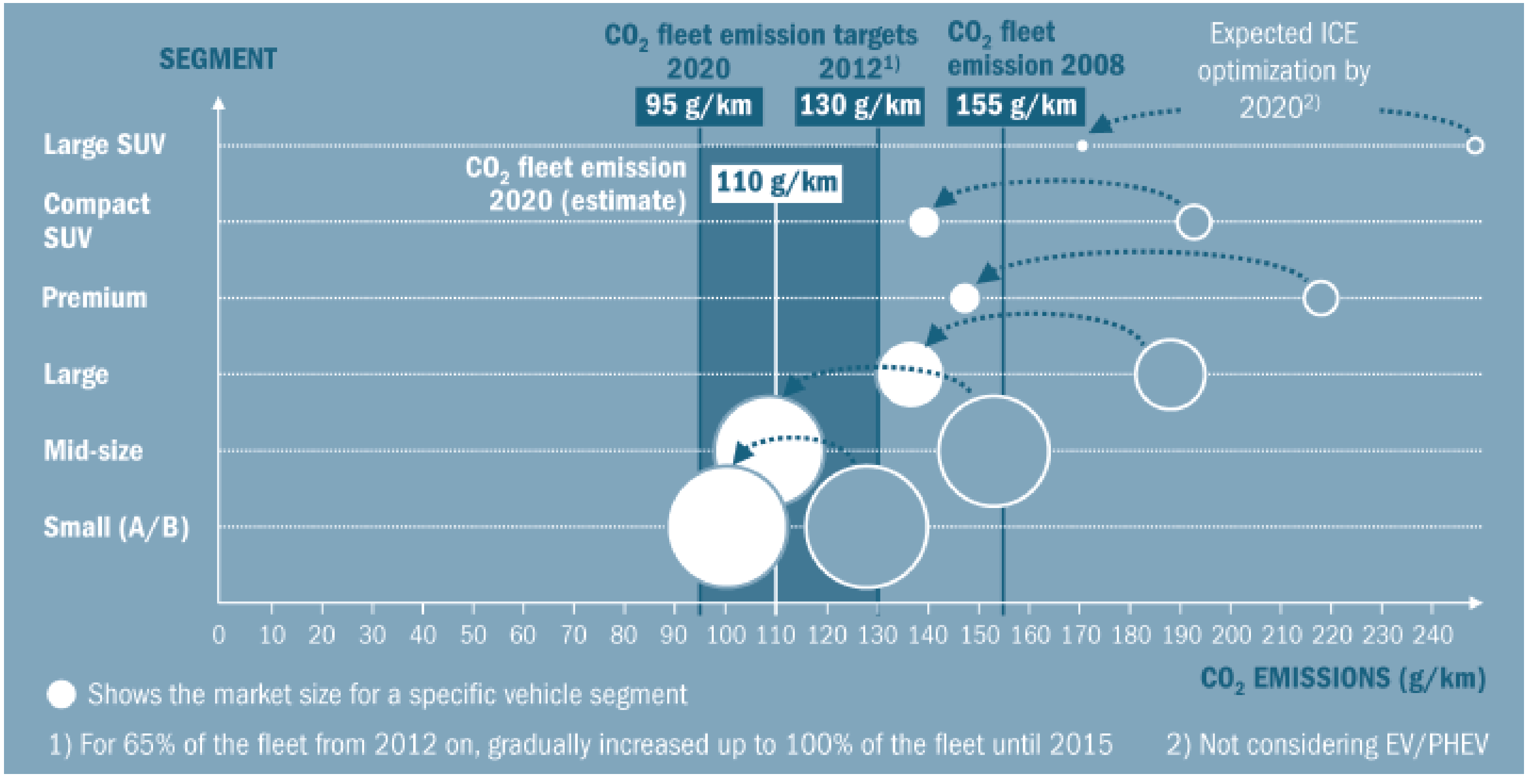
CO2 fleet emissions in EU as of 2008 (blue) and prediction for 2020 after expected ICE optimisation excluding drivetrain electrification (white)



SOURCE: JD Power; Roland Berger; 2009

OEMs are facing stiff penalties if they do not meet targets

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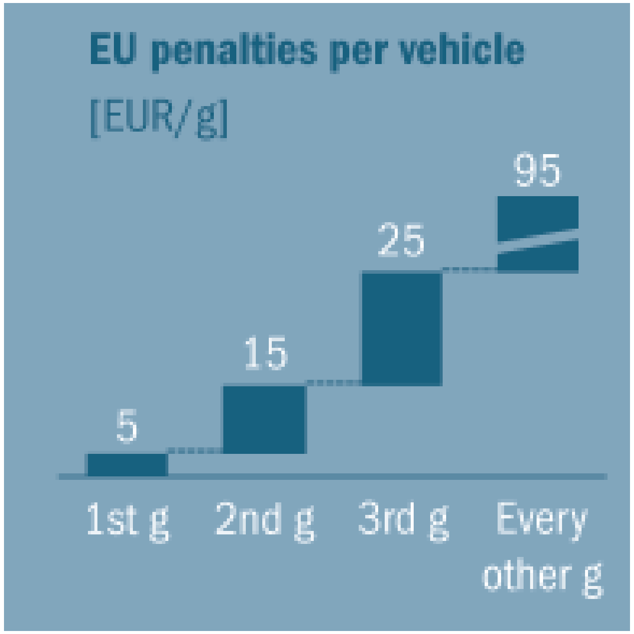
OEM penalty per vehicle is calculated for each g/km in excess of the 95 g/km target



Example:

155 g/km vehicle:	5460 EUR
110 g/km vehicle:	1185 EUR
95 g/km vehicle:	0 EUR

SOURCE: EU Commission, Parliament and Council; JAMA; J.D. Power; Roland Berger 2009

US $44 billion on economic stimulus and incentives directed by governments to greener vehicles

	Billion EUR
Australia	1.17
Austria	0.06
Belgium	0.39
China	1.58
Denmark	0.55
France	8.55
Germany	0.95
Italy	0.71
Japan	1.21
South Korea	0.34
SE Asia	0.28
Spain	0.58
UK	0.65
US	27.40
Total	**44.42**

Selected examples:

- Stimulus Package eMobility
- European Green Car Initiative
- E-Drive battery & component manufacturing initiative
- 5-year program for traction batteries
- '10 cities – 1000 cars' by 2011

SOURCE: Press research; IAA 2010; Deloitte 2010

Many countries offer customer incentives to stimulate the early EV market

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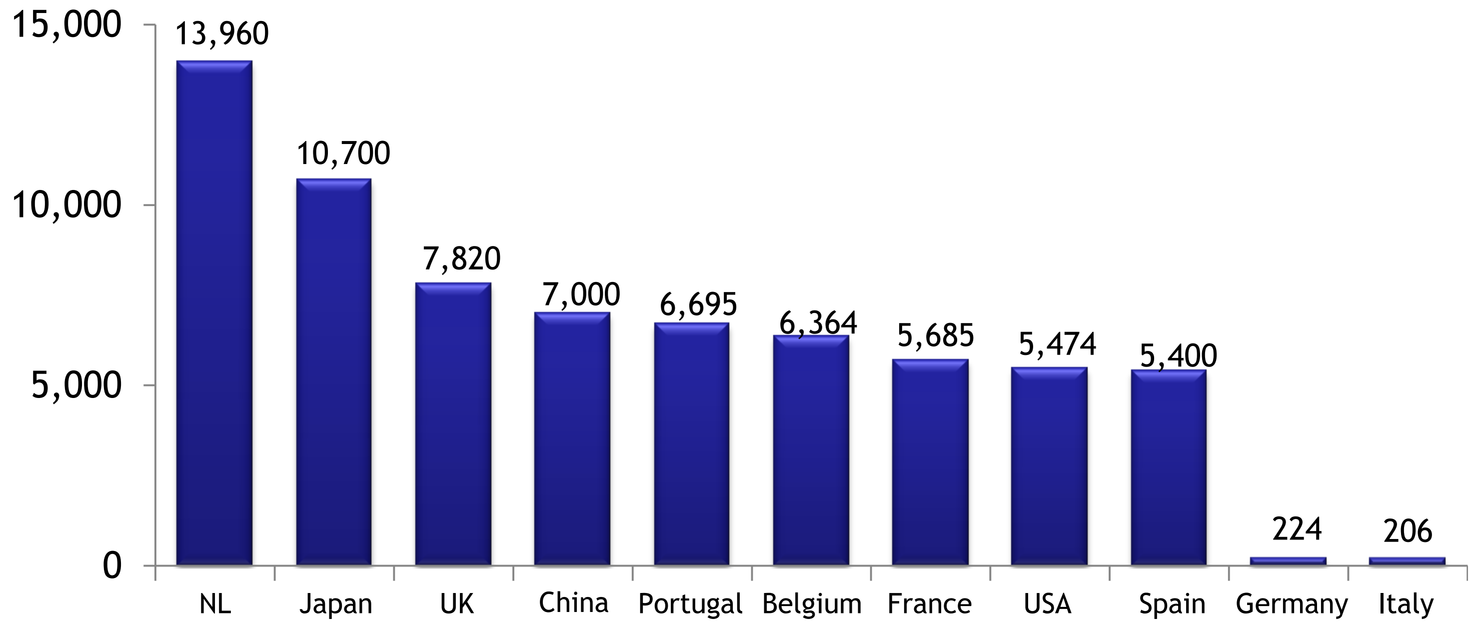
One-time and ongoing customer incentives over a 3 year holding period for a small EV

In EUR per vehicle, compared to respective ICE model



NOTE: Includes one-time incentives, ongoing incentives, CO_2 taxes ; based on 3-year holding period; best case assumed; some incentives are limited to first vehicles that are registered
SOURCE: press research, online research; 2011

Other incentives for early adopters

Free city entry

Car-pool lanes

Free parking lots

SOURCE: Press Research

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Overview of EV and HEV technologies that have been considered in the data analysis

Electrification

EV

- Propelled exclusively by the eMotor

Nissan Leaf

PHEV
Plug in Hybrid

- Vehicle can be powered by the ICE or the eMotor.
- Batteries are charged by regenerative braking, by the ICE and/or by plugging in to the an electrical outlet

Chevrolet Volt

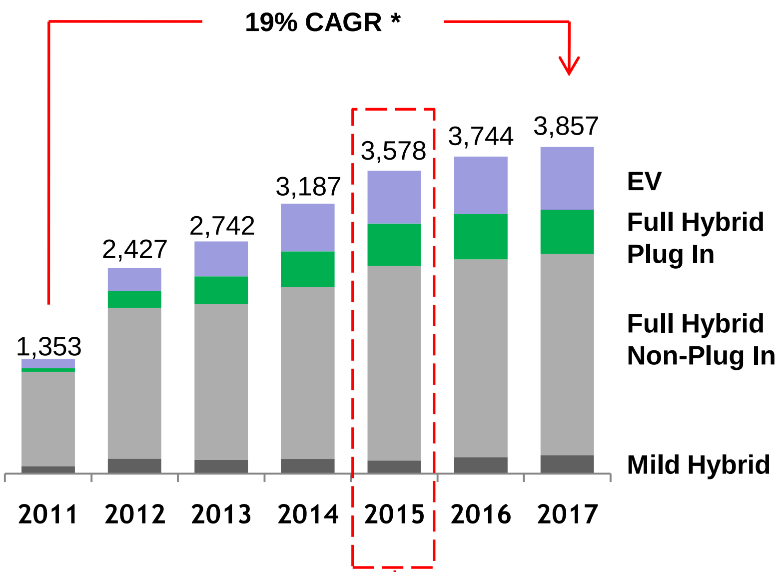
HEV
Hybrid

- Vehicle can be powered by the ICE or the eMotor.
- Batteries are charged by regenerative braking and/or by the ICE

Toyota Prius

Even most conservative forecasts foresee the global EV/HEV production to grow fast

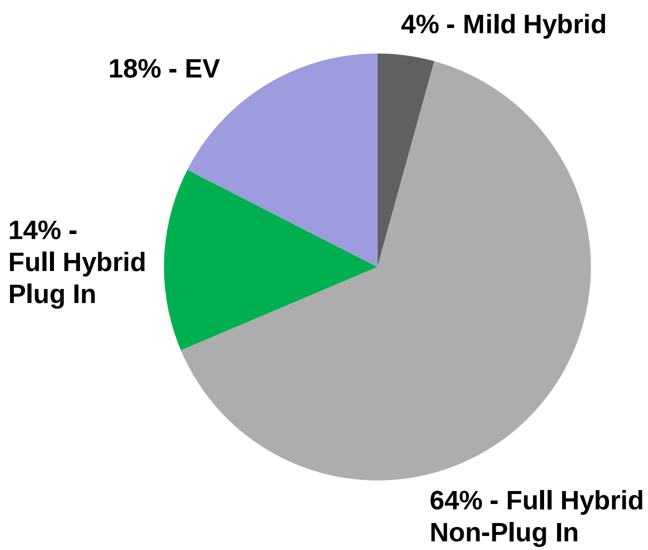
Global EV/HEV production growth by type (‘000 units)



* CAGR: Compound Annual Growth Rate

Global EV/HEV production in 2015 by type (%)

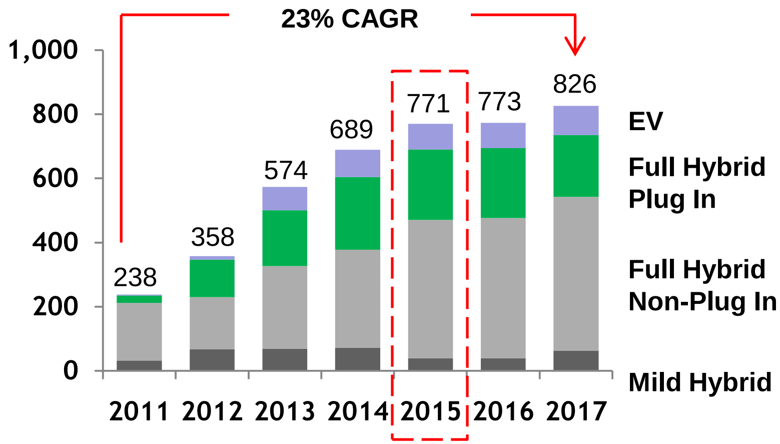
Total EV/HEV vehicles in 2015:
3.6 Mill vehicles produced



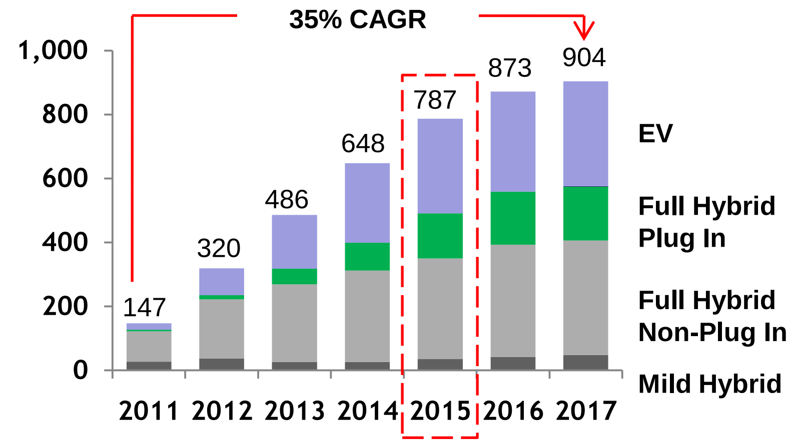
NOTE: Volumes are based on planned production volumes of OEMs, marketing surveys of potential buyers typically predict higher numbers
SOURCE: Analysis based on CSM data Apr 2011

Each major market is growing to a different mix of vehicle electrification

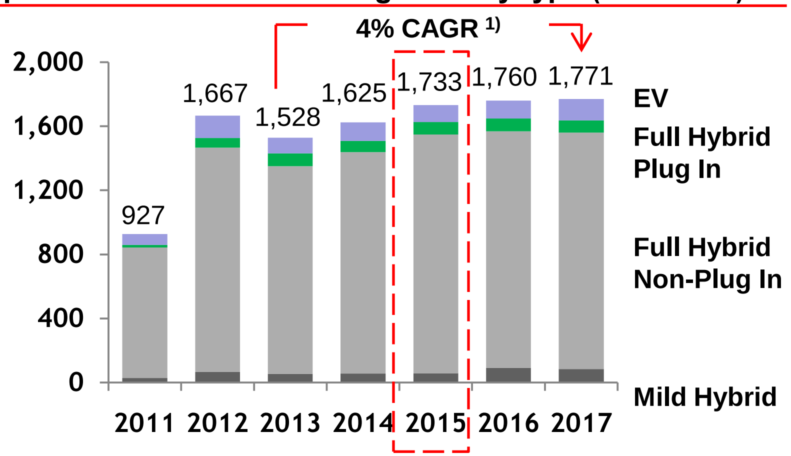
N. American EV/HEV market growth by type (‘000 units)



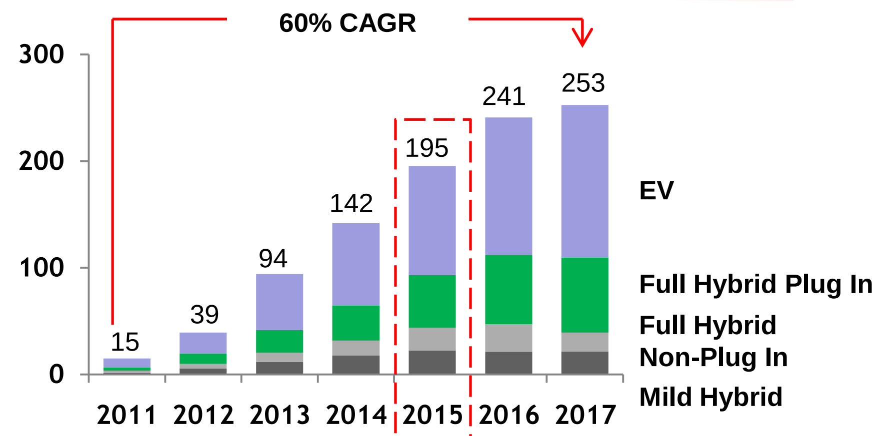
European EV/HEV market growth by type (‘000 units)



Japan/Korea EV/HEV market growth by type (‘000 units)



China EV/HEV market growth by type (‘000 units)



[1)] 2011-2012 Japan/Korea growth omitted due to March 2011 market distortion
NOTE: Volumes are based location of production site
SOURCE: Analysis based on CSM data Apr 2011

In both NA & EU, the EV/HEV market is so far dominated by few Top OEMs. Newcomers will enter the market

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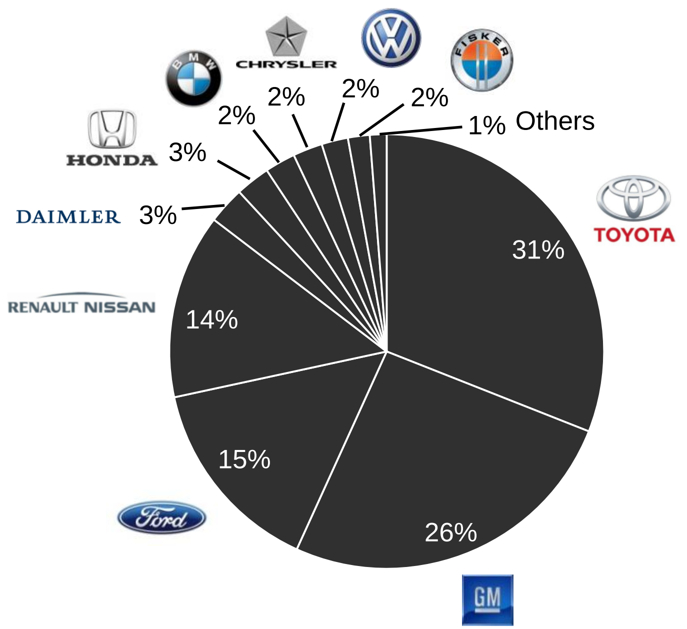
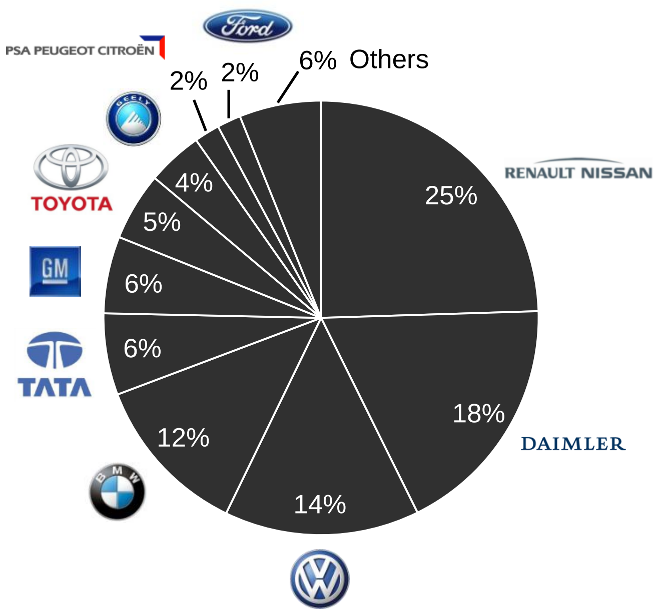
NA EV/HEV market landscape – 2015

- Production in N.A. in 2015 – 0.77 Mill units
- These Top 5 OEMs hold 88% of the market in N. America



EU EV/HEV market landscape – 2015

- Production in E.U. in 2015 – 0.79 Mill units
- These Top 5 OEMs hold 75% of the market in Europe



NOTE: Volumes are based on planned production volumes of OEMs,
SOURCE: Analysis based on CSM data Apr 2011

In Japan & Korea, EV/HEV markets are very concentrated, whereas China is very fragmented

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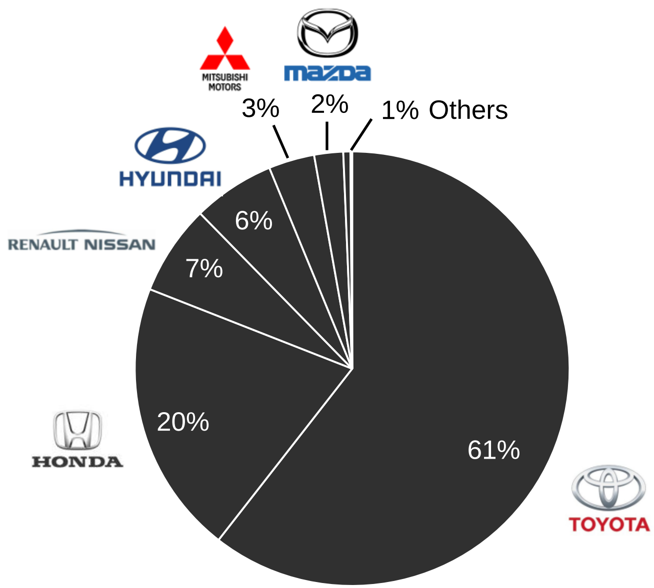
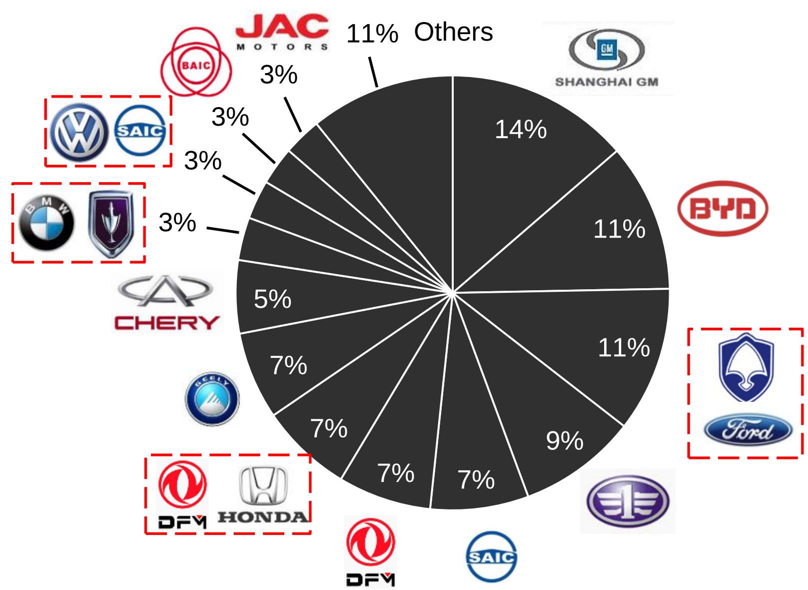
Japan/Korea EV/HEV market landscape – 2015

- Market size in Japan & Korea in 2015 – 1.73 Mill units
- These Top 5 OEMs hold 97% of the market in Japan & Korea



China EV/HEV market landscape – 2015

- Market size in China in 2015 – 0.2 Mill units
- These Top 5 OEMs hold 52% of the market in China



NOTE: Volumes are based on planned production volumes of OEMs,
SOURCE: Analysis based on CSM data Apr 2011

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EVs/HEVs are enabled by 3 major systems. Component market is expected to reach 50 Billion EUR p.a. by 2020 [1)]

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1. ENERGY STORAGE

Battery pack

Battery cells

Charger

2. ELECTRIC POWER

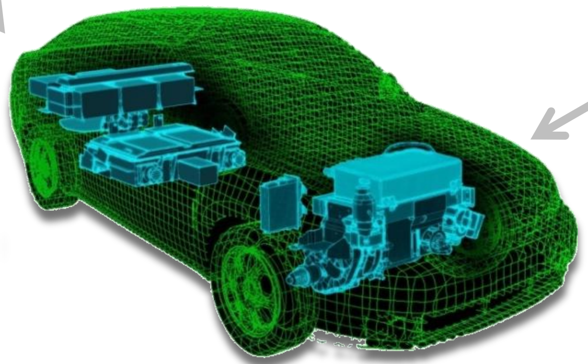
Motor

Inverter

EV/HEV gearbox

DC/DC Converter

Controller



3. ELECTRIC DRIVEN ACCESSORIES

Compressor

ED Water pump

ED Steering pump

Brake boost

MOTOR

- Permanent magnets
- Copper windings
- Laminations
- Bearings

INVERTER

- IGBT
- Capacitor
- Gate drive boards
- Bus Bars/ Inter-connects

[1)] Roland Berger estimates 20 - 50 bn EUR depending on scenario; McKinsey estimates 70 bn EUR in ‘Scenario 110’

The supplier market for new EV/HEV components and systems will see many new players in the next years

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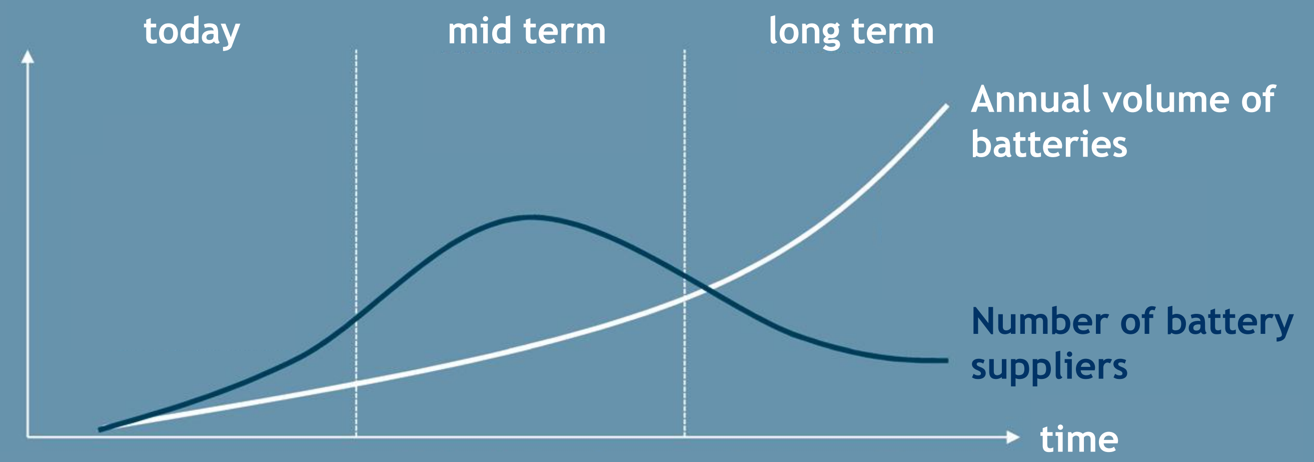
Conceptual graph for Li-Ion batteries

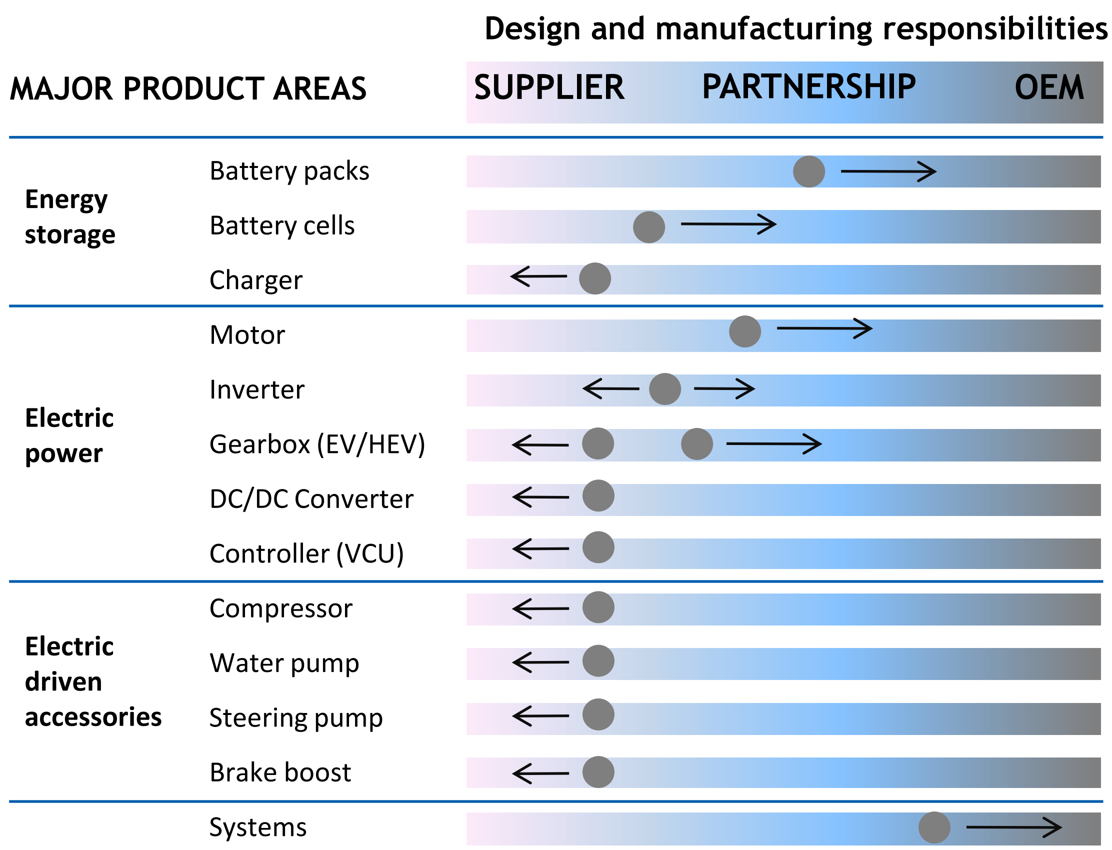


- Strong market growth
- High product variance

- Standardisation
- Cost pressure
- Consolidation

SOURCE: Roland Berger 2011

EV/HEV component and system market is very dynamic and already sees certain trends



- Trend by OEMs to in-source key EV/HEV components or to form partnerships
- Some suppliers offer entire systems for maximum participation in value chain
- Electric driven accessories will become commodities

Source: P3 Market Analysis of global OEMs and Tier1s 2011

Increased consolidation is occurring at all levels making it more difficult for new entrants in the future

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	xEV partnerships	Scope	Intent of partnership
OEM-OEM	GM, BMW, Chrysler, Daimler Non-equity partnership	• Hybrid power train technology	• Joint development of powertrain technology
OEM-OEM	Toyota, Tesla Motors Equity partnership	• Electric Power train	• Toyota: Develop electric vehicle technology • Tesla: Vehicle technology, brand and capital
OEM-OEM	Mitsubishi Motors, PSA Peugeot Citroën Non-equity partnership	• Hybrid power train technology	• Joint development of powertrain technology
OEM-TIER 1	Daimler, Bosch Joint Venture	• Traction Motor	• Bosch: Revenue from motor sales to other OEMS • Daimler: Licensing revenue from Bosch
OEM-TIER 1	Fisker, Quantum Technologies Equity partnership	• Electric drive system	• Fisker: development of key EV components • Quantum: Revenue from EV component sales
OEM-TIER 1	Remy, GM Non-equity partnership	• Traction Motor	• GM: Motor development expertise, reduced capital • Remy: Access to high volume motor programs
Tier 1-TIER 1	Magna, Blu Way Acquisition	• Electric powertrain components	• Magna: Leapfrog into EV component development • Bluway: capital and brand, access to customers
Tier 1-TIER 1	ZF, Continental Non-equity partnership	• Electric powertrain	• ZF: Gain EV component development technology • Continental: Powertrain integration capability
Tier 1-TIER 1	BorgWarner, UQM Technologies Non-equity partnership	• Electric powertrain	• Borgwarner: Gain powertrain component technology • UQM: Powertrain integration capability

Source: P3 Market Analysis 2011

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Global Regulations and Incentives

EV/HEV Production Forecast

Industry Trends

eMobility Value Chain in South Africa

E-Mobility value chain - much more than an electric car

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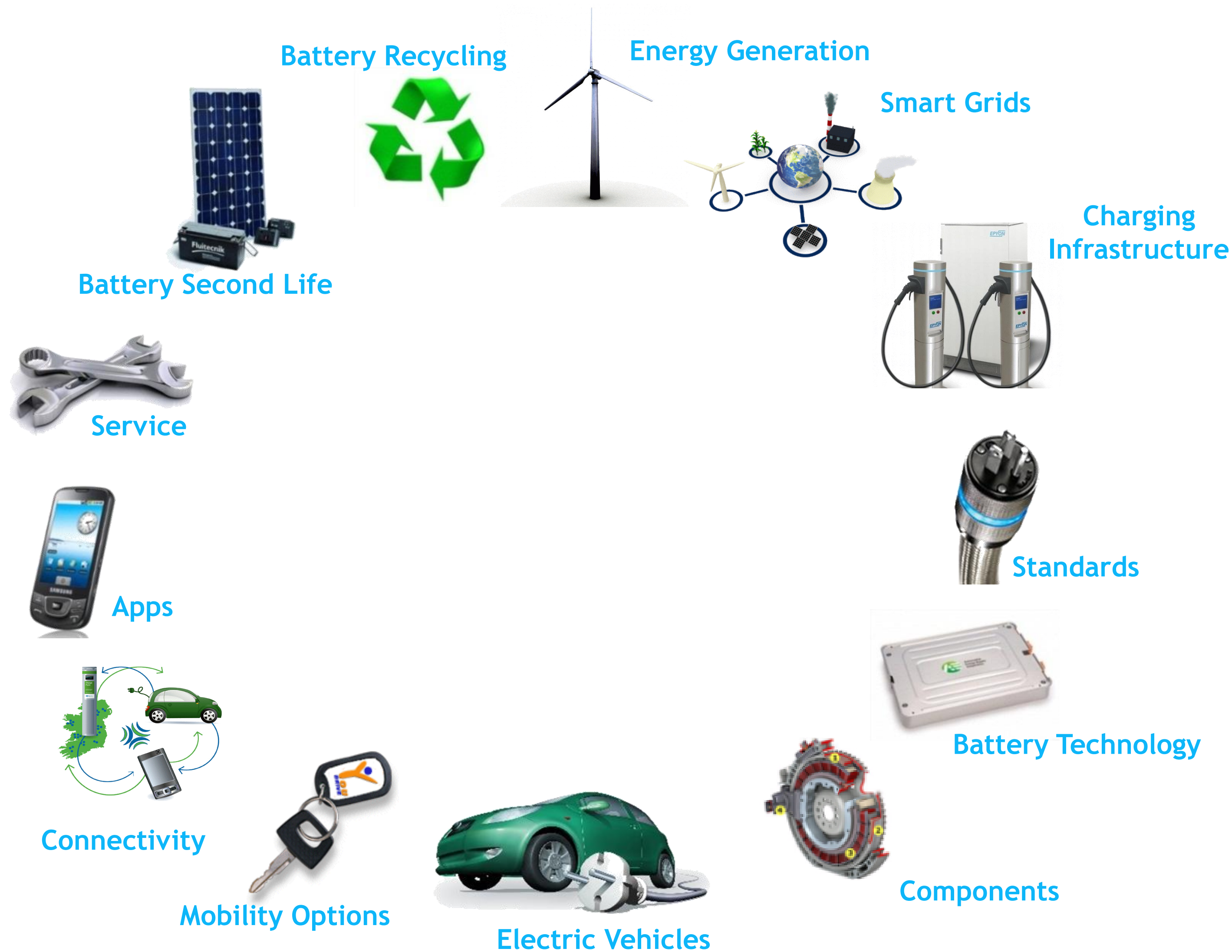

Energy generation and smart grids

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EMOBILITY VALUE CHAIN

- Opportunity to improve South Africa’s energy mix with solar and wind
- Boost to the green energy industry
- ‘Green electricity’ contracts for EV users
- Smart grids to handle decentralised feed-in of electricity from renewable energy
- Off-peak charging and potential use of plugged-in EV’s as energy buffers
- Smart metering and billing

Charging Infrastructure and standards

- Setup of public, semi-public and private charging infrastructure
- New revenue stream for utility companies
- Green marketing opportunity for other sponsors
- Demo-fleets to gather field data and to increase public awareness
- Definition of charging and billing standards

Batteries and other components

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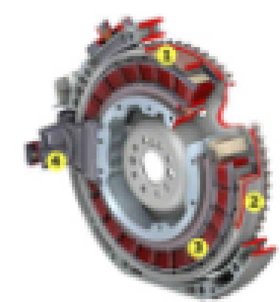
- SA offers valuable mineral resources required for EV components
- True localisation of automotive components by integration of mining into value chain
- Creation of a Tier1 and Tier2 industry to supply domestic and international OEMs, e.g.
    - Li-Ion batteries (cathode material, cells, packs)
    - electric motors
- Chance for local Tier1s to expand into product development



Electric Vehicles

- Opportunity to develop a vehicle in South Africa
- Creation of automotive development capability in South Africa
- Attractive job opportunities for young engineers
- Potential to supply Europe with a world class product and the African continent with a customised electric vehicle for this market

Mobility Options

- Chance to redefine mobility with new sales models where customer buys mobility instead of a car
  - Electricity included in monthly lease price
  - Car sharing for people who do not need / cannot afford an own vehicle
  - Complete mobility package: ‘Park and ride’ at Gautrain stations and usage of the train included in monthly mobility fee
- Opportunity for utility companies and other non-OEMs to enter this market

Connectivity and Apps

- ‘iPod on wheels’
- Connectivity of the vehicle to the grid and the data backbone
- Smartphone Apps to interact with vehicle
- Opportunity for South Africa in new fields with no legacy and no established suppliers

Battery second life and recycling

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- Opportunities for second life applications of batteries
    - Energy buffering for off-grid solar/wind farms
    - in rural areas
    - for cell phone towers
- Recycling of valuable resources and re-use in local battery plant

The eMobility Value Chain offers many attractions for South Africa

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- Foreign investment and tax revenue
- Unique chance of taking the South African OEM and supplier industry to the next level
- Exciting high tech industries attract young people to study engineering
- Job creation and skills development
- Technology leadership on the African continent and domination of the African eMobility market before China does it
- Greener economy and environment in South Africa

Thank you for your attention

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