Value creation through electric vehicles

João Saint-Aubyn, Iberian Energy Practice

Roland Berger
Strategy Consultants

El Escorial, July 29th, 2009

Objectives of the document

- Introduce our expertise and credentials in Electric Vehicles
- Review outlook and trends – common ground
- Share the perspective in the issue from a Government's point of view
- Debate the potential implications and options

Source: Roland Berger Strategy Consultants

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We are the leading management consultancy in Utilities

SELECTED EXAMPLES

...

IBERIA

...

Source: Roland Berger Strategy Consultants

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The Automotive Competence Center advises leading companies in the automotive industry

Selected clients (1)

OEMs

DaimlerChrysler
Nissan
Toyota
Renault
GM
Fiat
BMW
Audi
PSA Peugeot Citroën
Honda

Suppliers

Visteon
Valeo
Siemens
Johnson Controls
Denso
Magna
TRW
brose
faurecia

Services Providers

Sixt
Cetelem
Volkswagen Bank
MAHAG
Toyota Financial Services
Nürnberger Versicherungsgruppe
Bergé y Cía., S. A.
debis
Europcar

Financial Investors

Deutsche Bank
Apax Partners
Permira
Deutsche Beteiligungs AG
The Carlyle Group
The Blackstone Group
PAI partners
RHJ International

1) Clients which had made public our assistance

Source: Roland Berger Strategy Consultants

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We are the leading Strategy Consultancy in Electric Vehicles – all major European efforts

E-MOBILITY CLIENTS

Enel

edp

RWE

Governo de Portugal

DAIMLERCHRYSLER

Italian car manufacturer

etc.

SELECTED E-MOBILITY ENGAGEMENTS

ELECTRIC UTILITIES	> Strategy and business model definition and quantification > Cross industry technical standardization > Implementation and execution of model/concept > Joint pilot structuring and steering - development
OEMs	> Cooperation agreements and negotiations > Partner and model solution
Governments	> Vision, architecture, concept and business case > Network of partners - design and establishment

Source: Roland Berger Strategy Consultants

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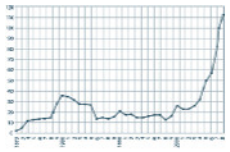
Fundamental framework in place and strong forces at work in favor of e-mobility

Customer acceptance

- High fuel prices lead to **advantages in life cycle-costs** for electric vehicles
- Cost differences of about 15 to 30% expected[1)]
- Rapidly increased acceptance – RB surveys



Political backing

- EU: strict fleet CO_2 emission targets for car manufacturers
- USA: zero emission cars as condition for market access
- China: significant problems with traffic pollution

Fundamental framework e-mobility in place

New market players

- New **car manufacturers**: Miles, Think!, Tesla
- New **business models**: Project Better Place, City of Westminster, Electric cars – now!

Battery technology innovation

- Li-ion technology is becoming ready for **mass production**
- Range extenders and battery swap stations **solve limitations on range**

1) Example for 2020 (EVs / PHEVs) in Germany; depending on country-specific price and tax framework

Source: Roland Berger Strategy Consultants

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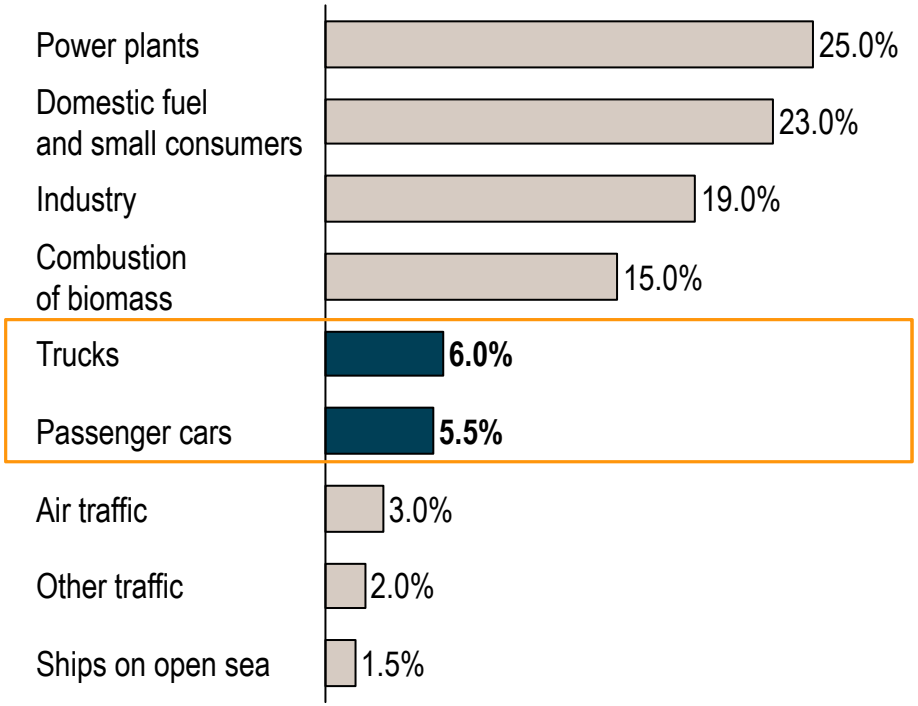
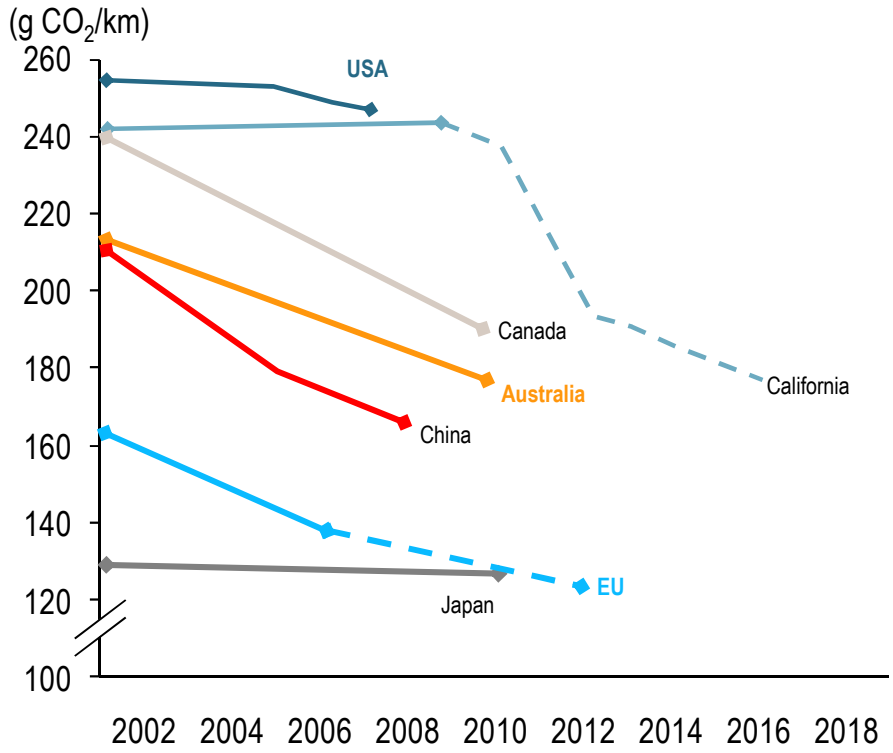
High share of CO_2 emissions by vehicles is triggering reductions measures across the World

Anthropogenic CO_2 emissions (%; 2007)



Reduction policies



In Europe: Road transport ~ 20%, passenger cars ~ 12%

Source: VDI; EU; Rew Center on GLobal Climate Change; Roland Berger Strategy Consultants

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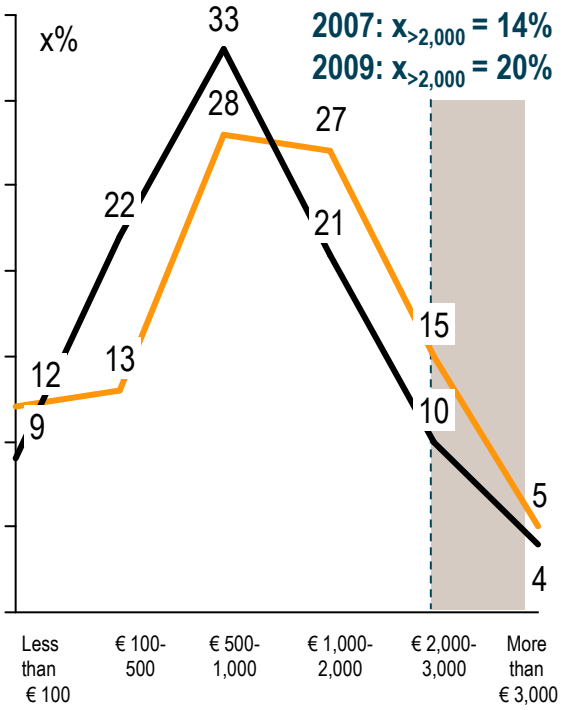
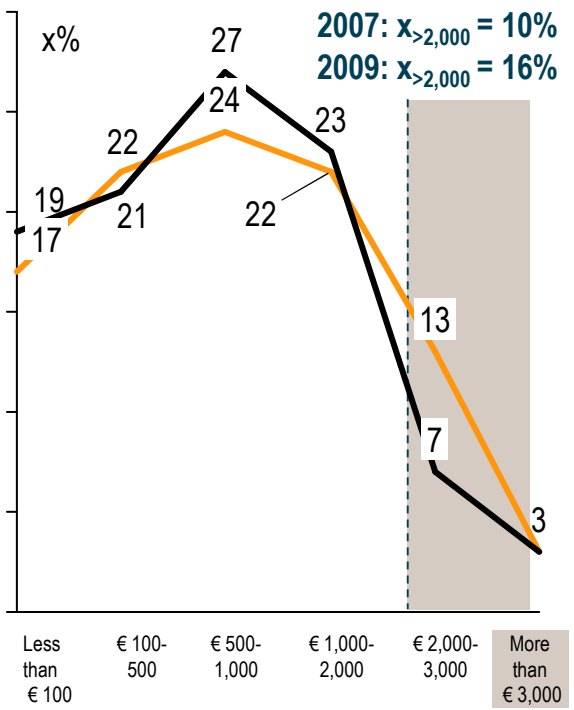
The willingness to spend more on a car with reduced CO_2 emissions has grown over the last two years – Roland Berger Survey 09

How much extra would you be willing to spend on a new car in order to make an active contribution to cutting carbon emissions?

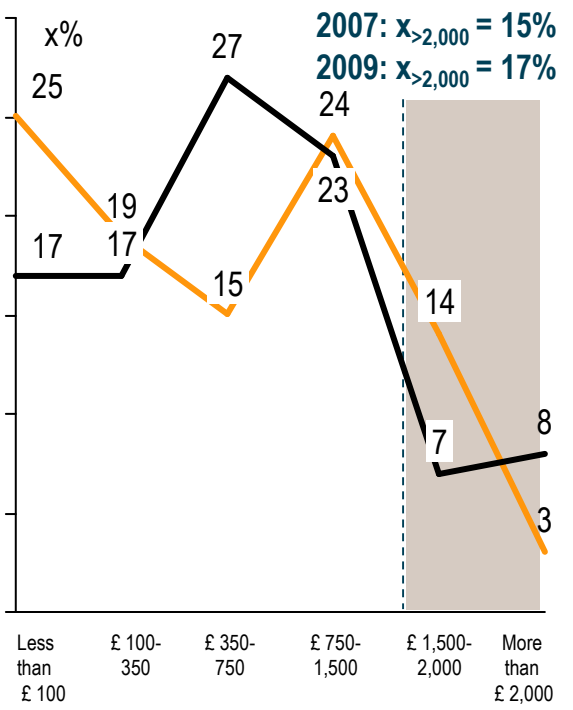
Germany [%]



France [%]



UK [%]



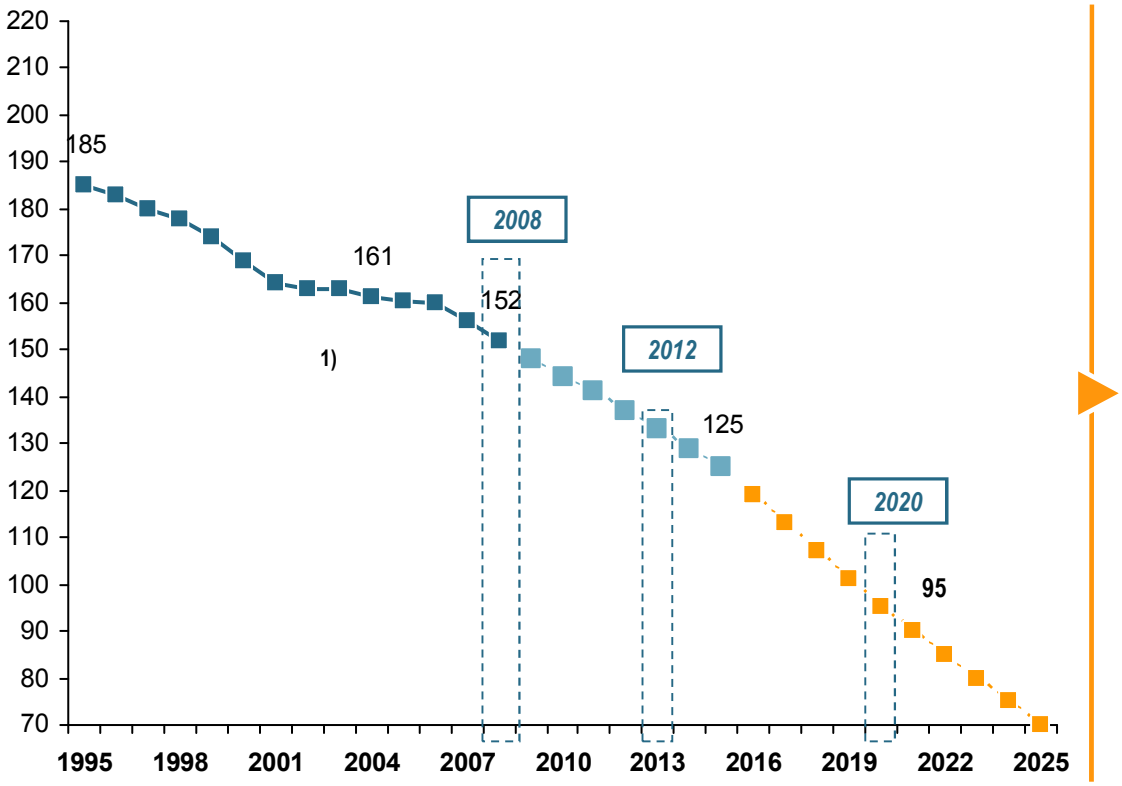
2009 2007

Source: Roland Berger Strategy Consultants customer survey

Roland Berger Strategy Consultants

The EU is supporting this trend by introducing aggressive CO_2 fleet emissions targets

EU CO2 car emissions (As is / Target in g/km)



STATUS QUO

- **Engagement** of ACEA to reduce CO_2- emissions to 140 g/km in 2008 and to 120 g/km in 2015
- The EU commission is asking the EU 27 members to reduce emissions to no more than **130 g/km in 2012**[2)] (5,2 l Petrol, 4,8 l Diesel)
- **Target for 2020: 95 g/km** (4,0 l Petrol, 3,6 l Diesel)
- **Possible scenario** <Target is 70 g/km starting from 2025 (2, 9 l Petrol, 2,6 l Diesel)

1) EU15
2) Additional 10 g/km through tires and air conditioning improvements; overall, the emission has to be lower or up to 120g/km

Source: ACEA; Press; European Parliament; Roland Berger Strategy Consultants

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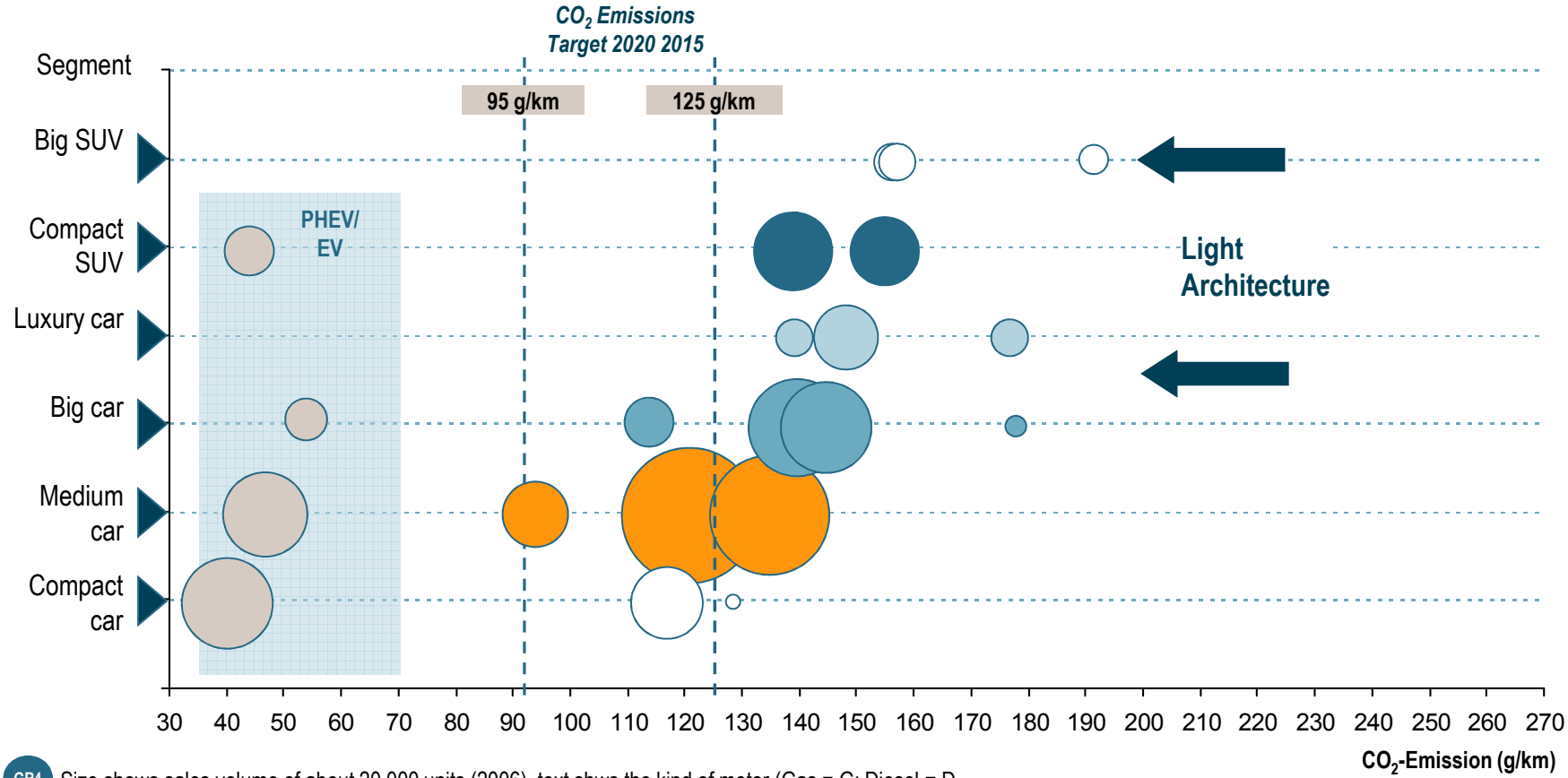
Plug-in-hybrids (PHEV) and Electric Vehicles (EV) are the only chance to effectively reduce emissions in the M/T – L/T

Possible car portfolio with PHEV / EVs



GR4 Size shows sales volume of about 20.000 units (2006), text shws the kind of motor (Gas = G; Diesel = D

Source: JD Power; BMW; Roland Berger Strategy Consultants

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Electric vehicles are also far more energy efficient than vehicles with conventional engines – full cycle

Comparison of well-to-wheel efficiency – Conventional Engines and EV

WTW[2] – Energy Efficiency (%)

Electric Vehicle (electricity from NG[1])	**29% =**	42% NG Plant	X	92% Transmission	X	75% Motor		
Electric Vehicle (electricity from Coal)	**24% =**	35% Coal Plant	X	92% Transmission	X	75% Motor		
Conventional engine	**17% =**	83% Oil Refinery	X	20% Motor				

> The **efficiency of an electric vehicle** has a **comparative advantage** due to, mainly, the **electric motor efficiency** and the low grid transmission losses

> **Electricity to EV** could be **generated** from **other sources** – more efficient than NG or Coal (hydro) –, or from renewable sources (wind, solar, etc.)

> Oil refining is efficient, though the **energy efficiency** of a typical **internal combustion gas engine is low** (17%-23% range)

1) NG: Natural Gas; 2) Well-to-Wheel

Source: Roland Berger Strategy Consultants

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Technological advancements of Li-Ion batteries seem to have overcome all obstacles for mass production

State-of-the-art of Li-Ion batteries technology

KEY FACTS	SOLUTION
SECURITY	The use of new materials (Iron phosphate and manganese) avoid "overheating"
DURABILITY	The new batteries assure > 3.000 timecycles without significant load reduction
COSTS	The use of new materials allow lower costs (Target: < 150 EUR/kWh in 2020)
AVAILABILITY	Production has started already

Source: CARB battery study 07, Roland Berger Strategy Consultants

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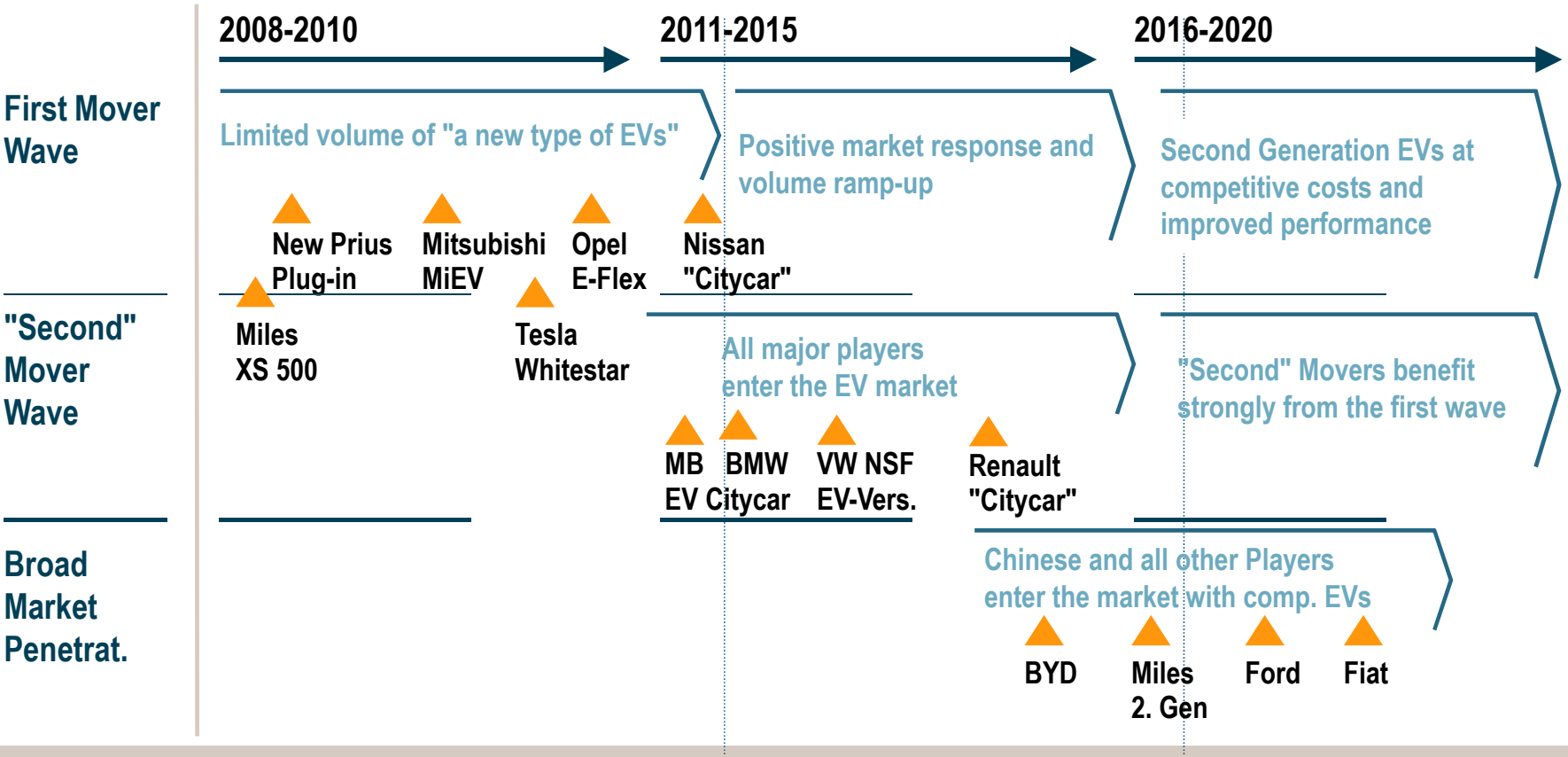
By 2020 all established OEMs and a lot of new players will have entered the EV market in the EU

EU: Overview of estimated electric vehicle market penetration



Source: Roland Berger Strategy Consultants

Many players are already actively moving – public cases

RWE The energy to lead	> Pilot together with Daimler in Berlin > Some governmental support	> Announcement June 2008 > Pilot phase from 2009
DONG energy	> Joint company with Project 'Better Place' in the course of incorporation > Commercialization of infrastructure and a Renault Nissan-EV	> Announcement March 2008 > Pilot phase from 2009 > Commercialization from 2011
EDF	> Cooperation with local authorities and operators of shopping malls infrastructure tests in UK > Fleet test with Toyota for testing PHEVs in the EDF-fleet > Tests with about 30 cars (EVs / PHEVs) from Dassault and Heuliez	> UK: rollout 2008 > France: First cars are operating, "commercial launch" with Toyota scheduled for 2010
e·on	> Stake in consortium (amongst others VW for fleet test) with PHEVs in Germany (max. 25 cars) > Study PHEVs with "Green party" and solar association	> Fleet test started end of June 2008 > Test period: 4 years
	> Cooperation of the Portuguese government with Renault Nissan (Partner of "Project Better Place" – supporting the development of infrastructure and fiscal benefits for EVs	> Announcement July 2008 > 4-months analysis for next steps
VATTENFALL	> Cooperation with Saab, Volvo, ETC Battery and Swedish Energy Agency for tests with up to 10 PHEVs in Sweden > Cooperation with BMW for a Pilot in Berlin	> Field test announced in early 2008 > Start scheduled for 2010

Source: Companies, Roland Berger Strategy Consultants analysis

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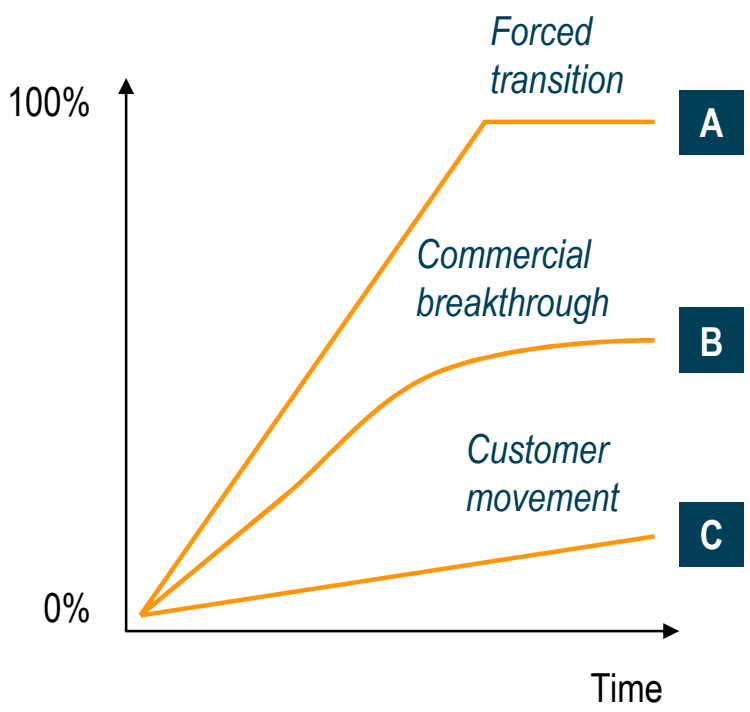
Speed of market transition to electric vehicles per country depends on specific country framework

Market share of electric vehicles (illustrative)



A Forced transition

> Legislation/regulation rules transition towards electric vehicles
> Examples: ban of scooters with combustion engines from different Chinese cities

B Commercial breakthrough

> E-mobility players actively develop market – including infrastructure offer
> Speed for market penetration depends on specific framework (prices, taxes, road toll, etc.)
> Attractive offers and price advantage vs. combustion engine drives transition

C Customer movement

> Even without actively pushing the market some people will change
> "Green issues" and early adopters drive market transition

Source: Roland Berger Strategy Consultants

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Project Better Place addresses the issue of autonomy offering battery charging and replacement spots

Concept business model "E-Mobility": Project Better Place

Vehicle offer

- Focus on **pure EVs** ("Zero-Emission")
- **Fast battery exchange** to solve range issue
- Client owns vehicle or leases vehicle from OEM
- **PBP own battery** (part of **mobility offering**)

Infrastructure offering

- **Offer to client to upgrade electric infrastructure** at home (where necessary)
- **Wide area infrastructure** at public places
- **Proprietary IT-Solution** (without Com-Module no access)
- **Wide area availability** of battery exchange stations

Sales & Service

- **Mobility offering similiar to "Mobile communication"** (incl. battery leasing and electricity supply) over own distribution channel
- Customer gets **mobility contract directly from PBP** (or in OEMK shop?)
- **Fleet customers get** at the beginning (or always?) the **complete offer** (vehicle/battery/electricity?) from PBP
- Own service network?

Distribution / Invoicing electricity

- **"Large customer" contract with utility**
- **High share of renewable energies** (to ensure positive CO2 figure "Well-to-Wheel")
- Invoicing / payment through proprietary IT-system

Source: PBP, Roland Berger Strategy Consultants

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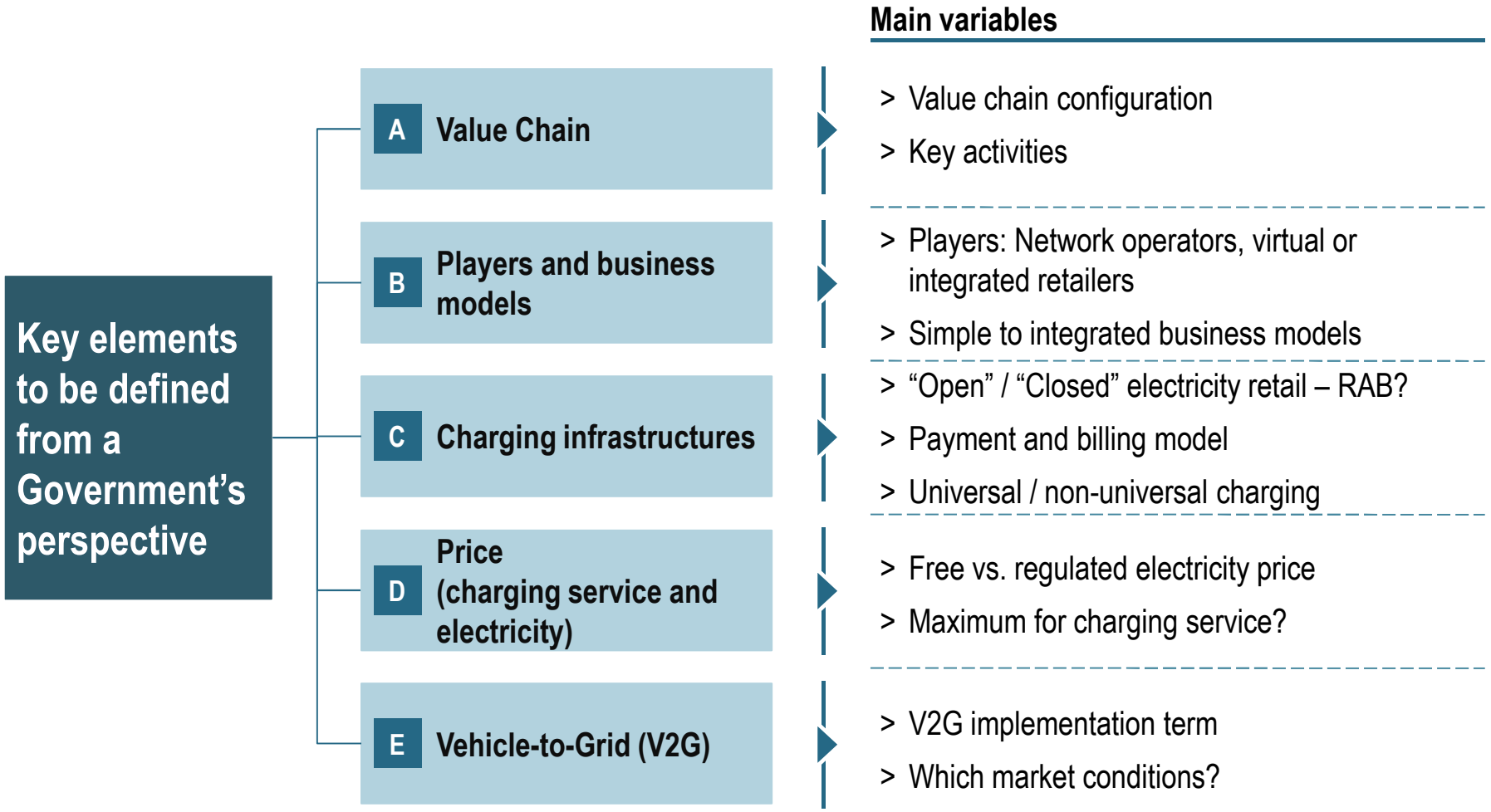
Some Governments have been defining key aspects of their E-Mobility model architecture



Source: Roland Berger Strategy Consultants

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Electric vehicles could offer several tangible value creation opportunities – need to clarify/quantify model?

Direct advantages	> **Battery development** key for wind portfolio > **Cars as batteries** for optimum dispatching > Development of **smart grid network architecture**
Energy distributor / infrastructure provider	> **Energy supply** for EVs / hybrids – **increased demand** > **Operation of charging infrastructure** "at home" or in public places, Call / Billing (direct customer access) > Provision of **fast-charging infrastructure** for surcharge
B2B- (Location-) Partner	> **B2B- location partner** – build / operate charging infrastructure with investment of partners (parking lots, shopping malls, …) > **B2B-fleet customers** – build / **operate charging infrastructure for customers**
Grid-for-Vehicle (G4V)/ Vehicle-to-grid (V2G)	> G4V – **central charging control** EVs / hybrids > As a future perspective – **V2G** > Second use of old batteries to store electricity
Additional B2C-Offerings	> **Combined products** – Smart Home & Drive, Customized Infrastructure – **package micro-generation** > Other **billing models**, e.g. **flat rate** > Additional **content based services**, e.g. parking guiding system

Clarification of business model and quantification needed

- > **Positioning in value chain**
- > **Implications for core business**
- > **Business plan**
- > **Partnerships**
- > **Value proposition**

Source: Roland Berger Strategy Consultants

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Conclusiones

- Sistema energético sostenible ✓
- Nueva economía ✓
- Empleos verdes (el tema mañana) ✓

- Muchas gracias a ISTAS por la invitación y a ustedes por su atención.

- Contacto: Joao_Saint-Aubyn@es.rolandberger.com

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BACKUPS

Second coming

Batteries have been around for over 200 years, and as early as 1900 they were already being used to power cars

1800 – Alessandro Volta invents the voltaic pile – the first battery

1832 – Robert Anderson invents the first electric carriage

1859 – French inventor Gaston Planté develops the first practical rechargeable lead-acid battery – the basis of today's conventional car battery

1897 – Regenerative braking first used in a car to recharge its battery, by P. A. Darracq in Paris

1899 – Waldmar Jungner invents the nickel-cadmium rechargeable battery. Almost 100 years will pass before it is used in hybrid cars

1900 – MORE ELECTRIC AND STEAM-POWERED CARS ON THE ROAD THAN THOSE POWERED BY THE INTERNAL COMBUSTION ENGINE

1908 – Henry Ford launches the Model-T

1912 – Electric car production peaks

1930s – Electric cars all but gone from the streets

1970s – M. S. Whittingham at Binghamton University, New York, proposes a design for lithium batteries

1975 – The nickel hydrogen battery patented – rapidly adopted for powering low Earth orbit satellites

1986 – The nickel-metal hydride battery (NiMH), a variation on nickel hydrogen, patented by entrepreneur and inventor Stanford Ovshinsky

1990 – Commercialisation of the NiMH battery

1991 – First commercial lithium-ion battery sold by Sony of Japan

1997 – Toyota Prius hybrid electric car launched, partly powered by NiMH batteries

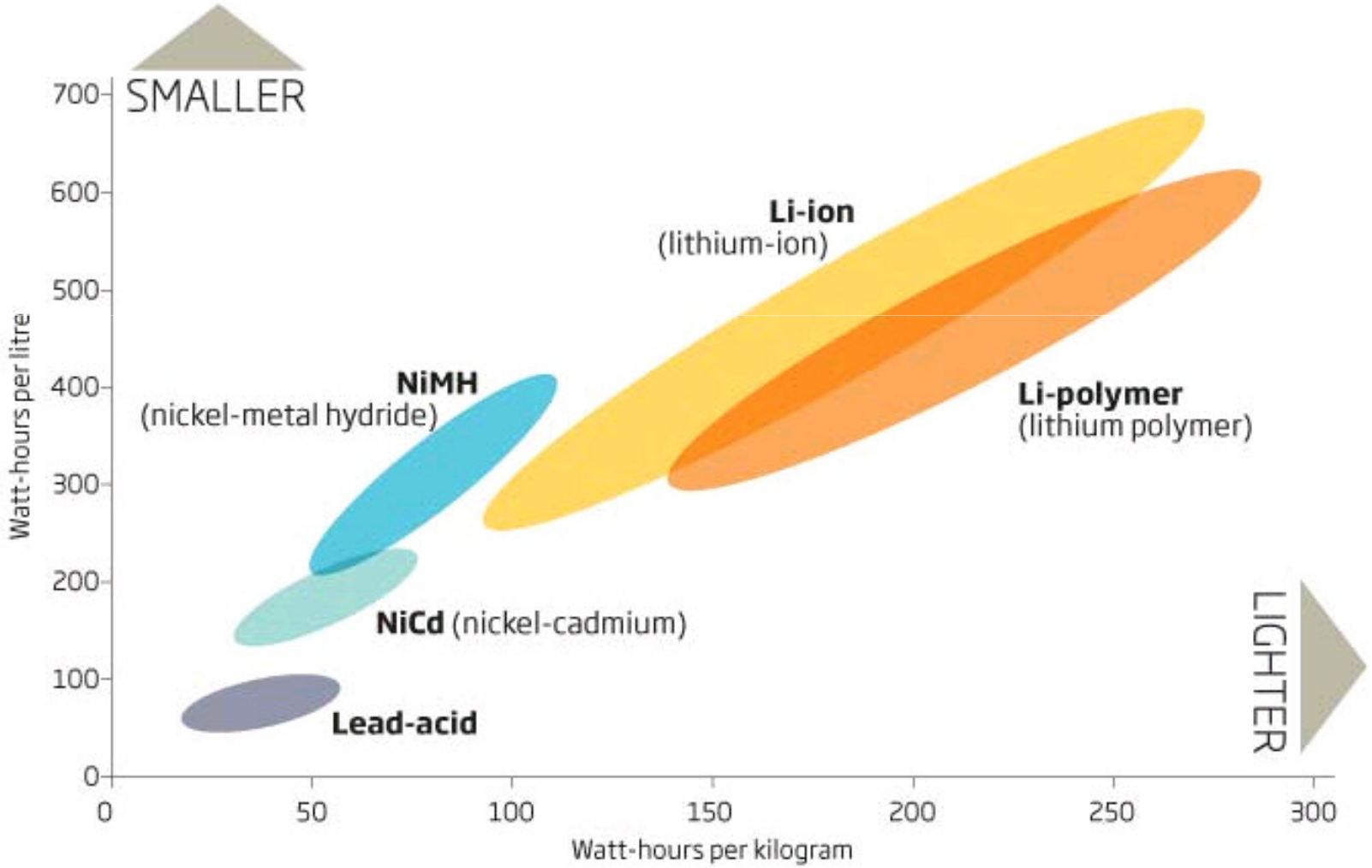
2006 – Tesla Motors launches the world's first all-electric production car – the Tesla Roadster – powered by lithium-ion batteries

2009 – US government pledges to invest $2 billion in battery development

Source: NewScientist July 20th ("Electric cars: Juiced up and ready to go")

Smaller, lighter, better batteries

Packing a big punch for their size, lithium-ion batteries are the most likely to power the electric cars of the near future



Source: NewScientist July 20th ("Electric cars: Juiced up and ready to go")