



AW Briefing

Electric Vehicles- Advanced Battery Technology

**Market Overview and Supporting Battery
Technologies
for Electric Vehicles**

**Presented By: Nick Ford
Senior Consultant
24th February 2009**

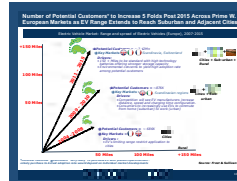
F R O S T & S U L L I V A N

Market Overview and Supporting Battery Technologies for Electric Vehicles

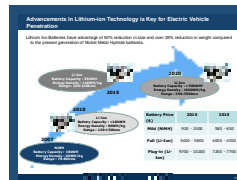
Presentation Agenda



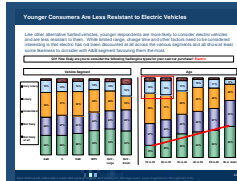
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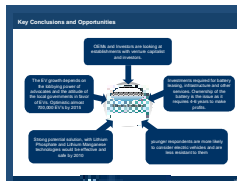
Market Overview into Electric Vehicles



Supporting Battery Technologies



Consumers' Attitudes & Perceptions

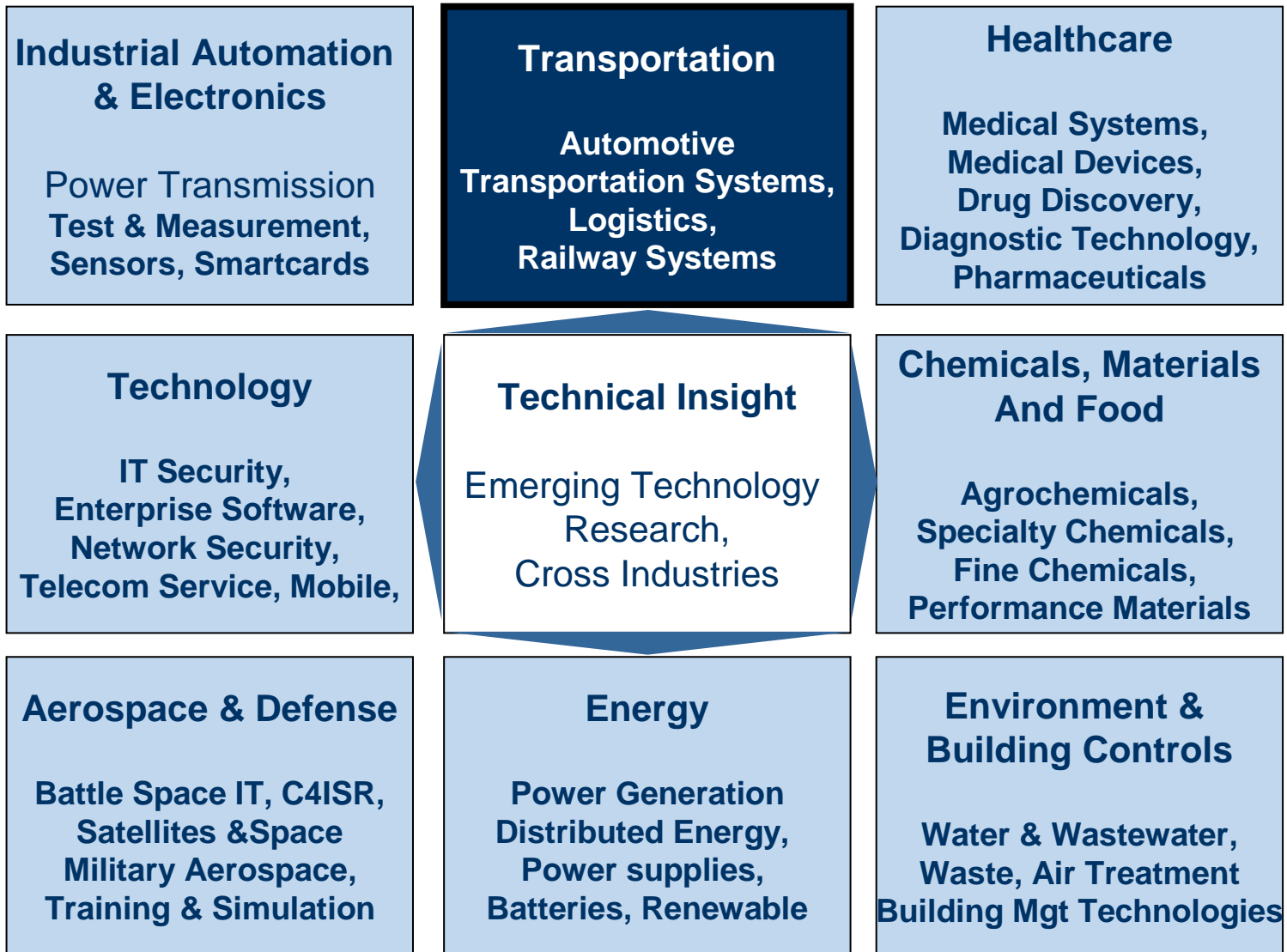


Conclusions and Questions

Our Global Presence Leading Consulting & Research Group, 2000 Staff in over 30 Offices. 40 Years of Global Partnerships With International Blue Chips



8 Key Business Sectors and Technical Insight



Automotive & Transportation Group

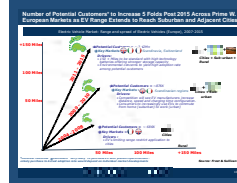
Chassis	Powertrain	Safety & Driving Assistance	Infotainment & Telematics	Electric & Electronic Systems	Aftermarket & Garage Equipment
 <ul style="list-style-type: none"> • Integrated Chassis Control Systems <ul style="list-style-type: none"> • Advanced Steering Systems • Chassis Modules and Systems • Advanced Braking and Stability Control <ul style="list-style-type: none"> • Drive Line Technologies • Suspension Systems • Mechatronics • Tyre Technology 	 <ul style="list-style-type: none"> • Next Generation Diesel Engine Technologies <ul style="list-style-type: none"> • Alternative Fuels/Vehicle Energy Systems inc Hybrids, Fuel Cells, 42 Volts <ul style="list-style-type: none"> • Power'n Modules/Systems • Diesel Particulate Filters <ul style="list-style-type: none"> • Next Gen Combustion Tech • HCCI, laser • Transmission Tech 	 <ul style="list-style-type: none"> • Driver Assistance Sys <ul style="list-style-type: none"> • ADAS • Active and Passive Safety • Legislation / Regulations • Commercial Vehicle Safety Sys <ul style="list-style-type: none"> • Sensors • Pedestrian Protection • Obstacle Sensing • ACC/Nightvision 	 <ul style="list-style-type: none"> • Intelligent Transportation Systems/Tolling/Road User Charging / GPS <ul style="list-style-type: none"> • Navigation Sys • China Infotainment Market • Interior Modules & Sys <ul style="list-style-type: none"> • Wireless Communication / Bluetooth • CV Telematics <ul style="list-style-type: none"> • RVD 	 <ul style="list-style-type: none"> • Semiconductors • In-Vehicle Network Architecture <ul style="list-style-type: none"> • Automotive Software • Wiring Harnesses • Mechatronics • Nanotechnology / SRP • Interior / Exterior Modules <ul style="list-style-type: none"> • Auto Lighting 	 <ul style="list-style-type: none"> • Engines & Transmissions • Suspension & Brakes <ul style="list-style-type: none"> • Starters & Alternators • Accessories <ul style="list-style-type: none"> • HVAC • Tyres • Handled Diagnostics • Mechanical Testing  

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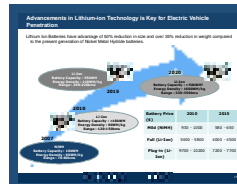
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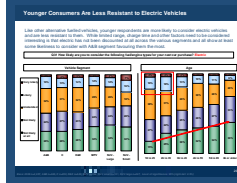
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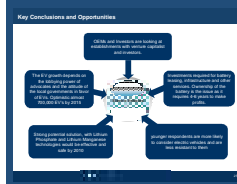
Market Overview into Electric Vehicles



Supporting Battery Technologies



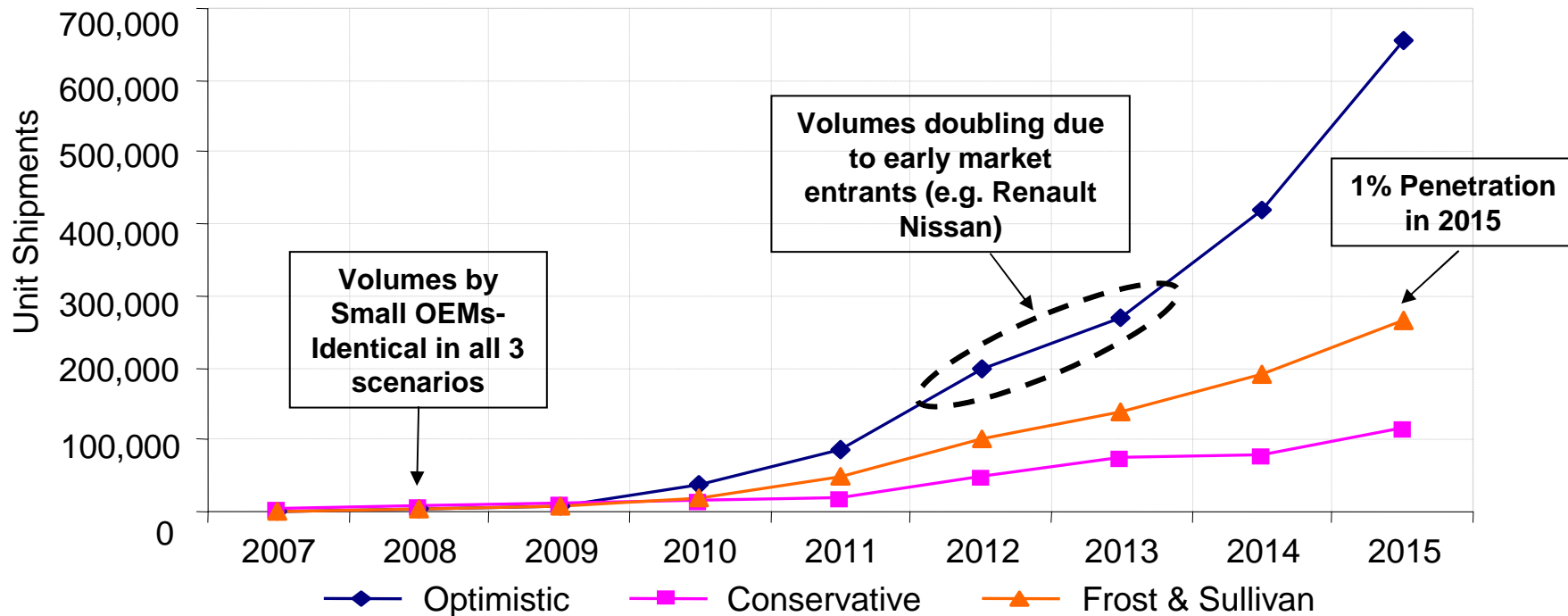
Consumers' Attitudes & Perceptions



Conclusions and Questions

EV Market Entry Strategies of The Top OEMs is Expected by 2011 and is to Grow Post 2013.

Electric Vehicle Market: Scenario Analysis (Europe), 2007-2015



Note: All figures are rounded. Source: Frost & Sullivan

Optimistic Scenario:

Early adaptation and high growth rate of electric vehicles owing to early market entrance and capacity expansion of Renault-Nissan, Mitsubishi, Daimler, PSA, BMW, VW, Toyota and Others. Leasing model achieving tremendous success across key regions.

Frost & Sullivan Scenario:

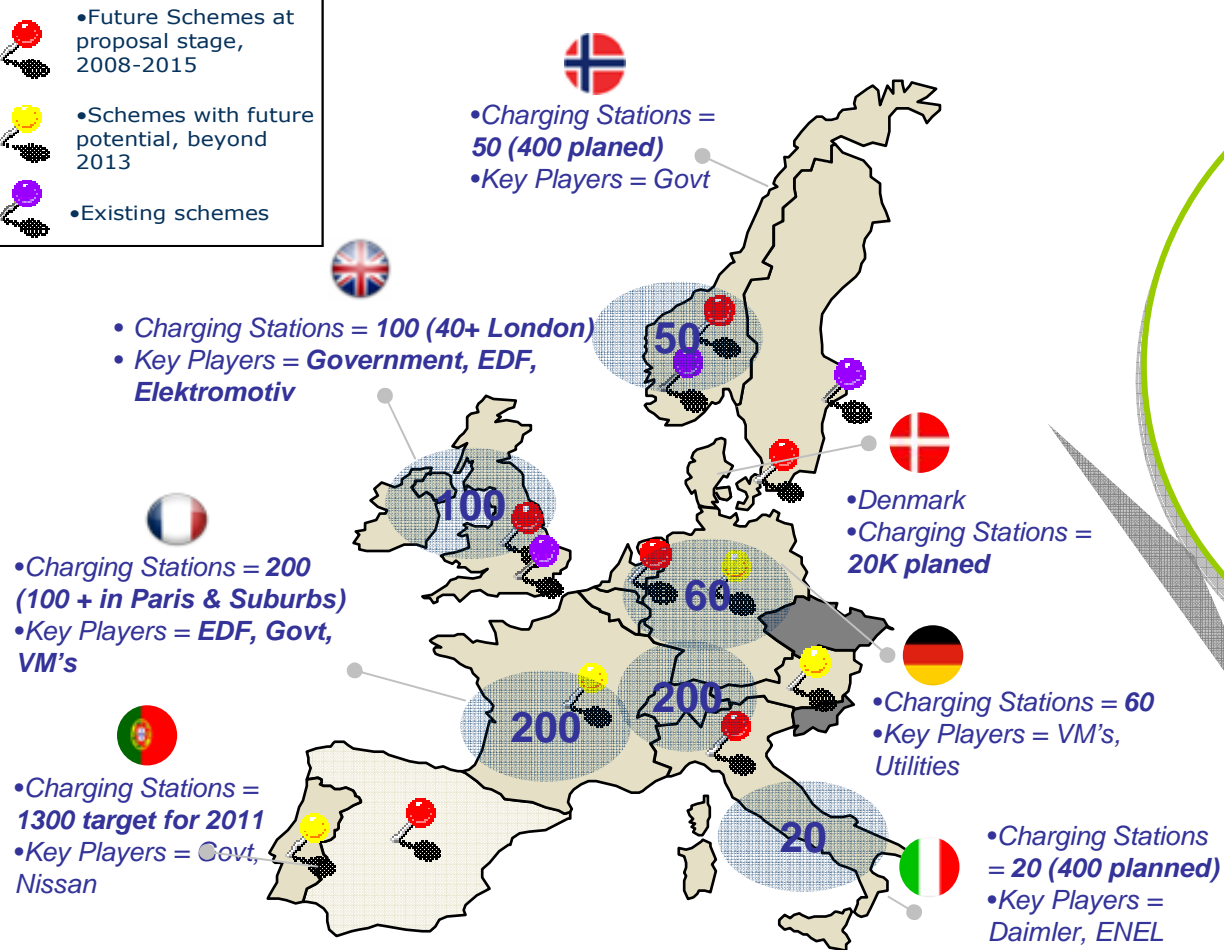
Not all the mentioned to make an early market entrance. OEMs opting for pilot regions to evaluate leasing and financial models. Good tax and insurance benefits offered in some regions.

Conservative Scenario:

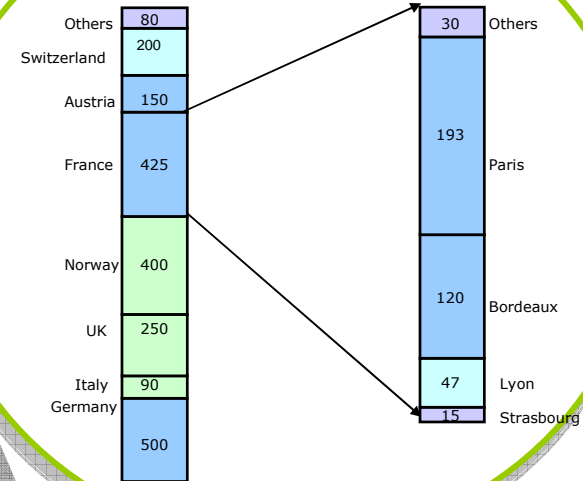
Advancement of competitive technologies such as fuel cells. Legislation relaxed for competitive technologies and congestion charging not implemented in key cities.

At least 13 Congestion Charging Cities to be in Operation in Europe by 2013, all Key Cities Have Good EV Potential

- Future Schemes at proposal stage, 2008-2015
- Schemes with future potential, beyond 2013
- Existing schemes



Planned Charge Points By 2010

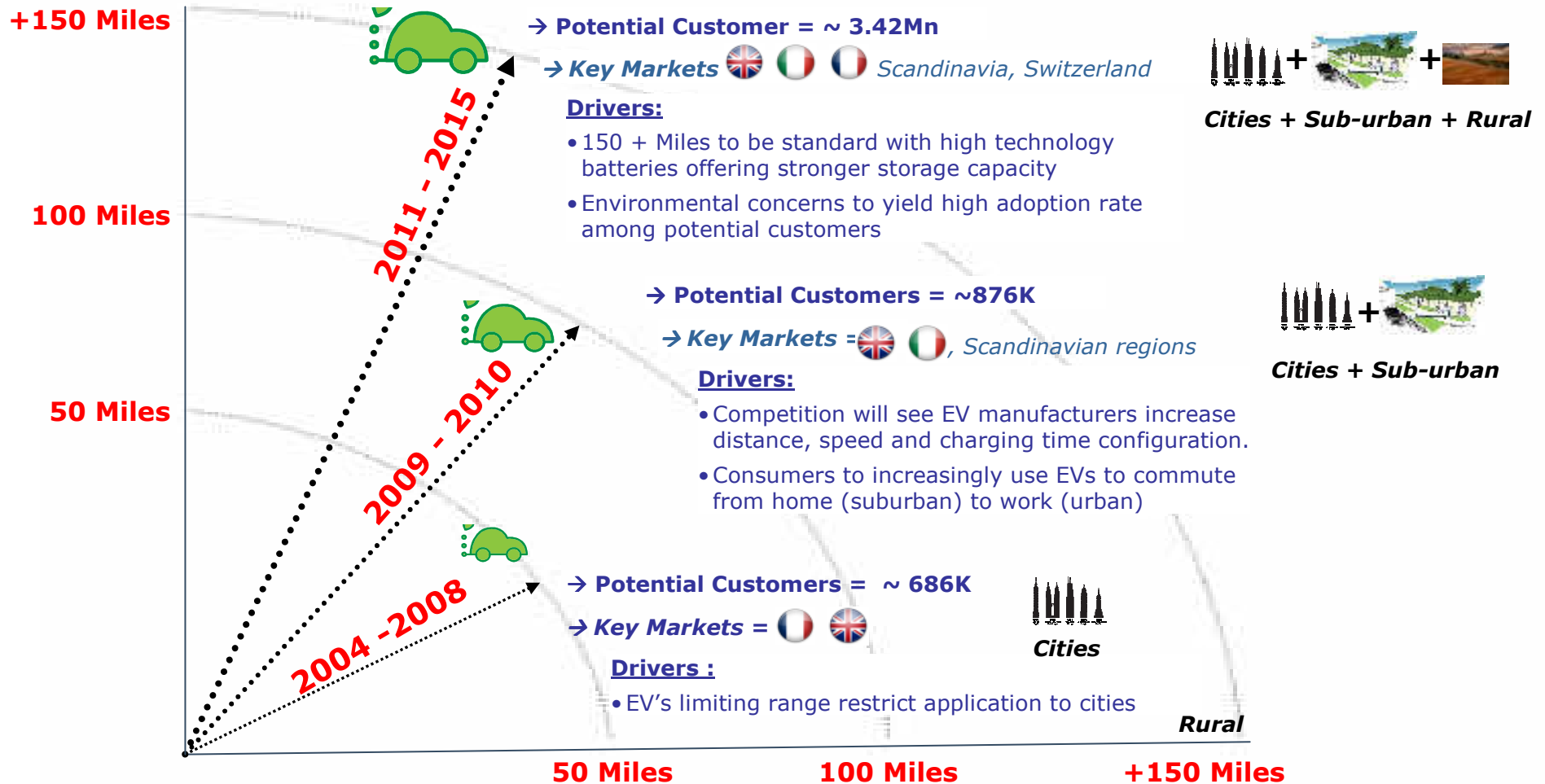


Source: Frost & Sullivan

- Strong Co-relation exists between regional markets adoption of congestion charging (and other green initiatives) and uptake of charging station
 - E.g. London and Norway
- Pioneering efforts from relevant industries could facilitate faster expansion of infrastructure

Number of Potential Customers* to Increase 5 Folds Post 2015 Across Prime W. European Markets as EV Range Extends to Reach Suburban and Adjacent Cities

Electric Vehicle Market: Range and spread of Electric Vehicles (Europe), 2007-2015

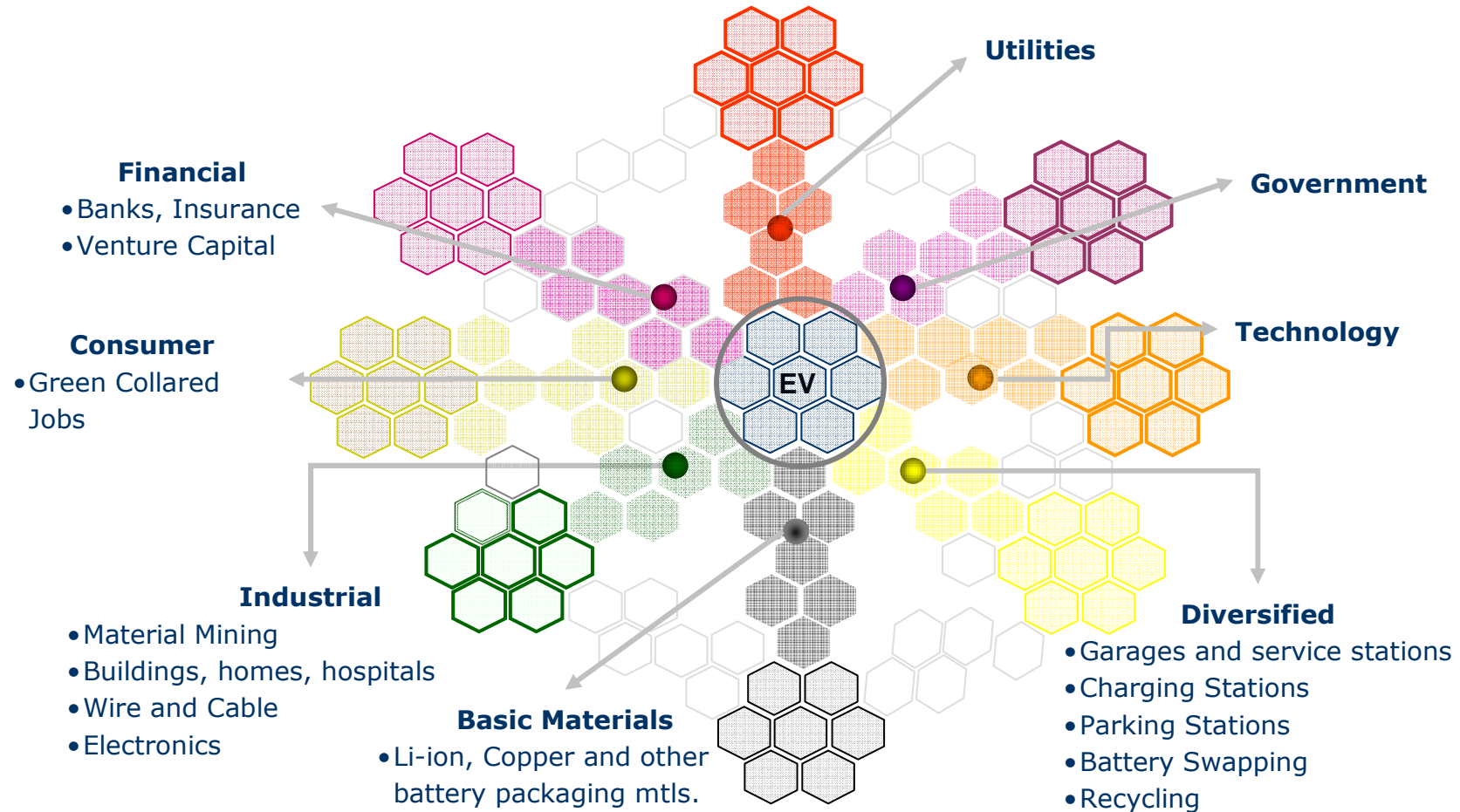


*Potential Customer → Customers "Very likely" to purchase EV with present specifications .
 •Likely purchase to Actual adoption rate would depend on individual market developments

Source: Frost & Sullivan

Innovative Business Opportunities Arise From Partnerships Formed Between Diverse Industries in Order to Expand Infrastructure to Support EV

IDENTIFICATION OF ALTERNATE AND UNIQUE BUSINESS MODELS TO SUPPORT EV INFRASTRUCTURE



New Business Models that will address additional Electric Vehicle (EV) energy requirements will be formed at the intersection of several diverse and cross functional industries

Source: Frost & Sullivan

Leasing Business Model Provides Best Return: Future Leasing Models to Sell 75% of EVs; The Rest 25% Sold Traditionally

INNOVATIVE BUSINESS MODEL

	Business Scheme 1	Business Scheme 2	Business Scheme 3	Business Scheme 4
TYPE	Energy Package	Maintenance Package	Part Subsidy	Full Subsidy
COVER	Battery lease + Electricity	Energy Package+ Insurance+ Maintenance	Maintenance Package+ Discount	Maintenance Package+ 100% Discount
ENERGY	Monthly Bill	Flat: Max 2000km/month	Flat: 25,000km/year	Flat: 30,000km/year
CONTRACT	NA	NA	4 years	7 years
SUBSIDY	NA	NA	50% car price	Free car
MONTHLY LEASE BREAKDOWN	Up to €150	Up to €300	€500- €800	~ €900- €1500
	<p>Rent paid to the Battery Leasing Company</p> <p>+ monthly Bill based on the usage- to Utility</p>	<p>Total Premium, Electricity (16%), Insurance, Maintenance (20%), Battery Lease (50%)</p>	<p>Total Premium, Insurance (10%), Electricity, Maintenance (10%), Battery (5%), Car Recovery (25%)</p>	<p>Total Premium, Electricity (6%), Insurance (6%), Maintenance (4%), Battery, Car Recovery (17%)</p>

Other Possible Leasing models

Source: Better Place, Frost & Sullivan

Flexible Mileage

Unlimited Miles

Max number of miles

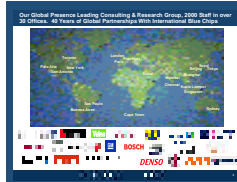
Pay as you go

Flexible Contract

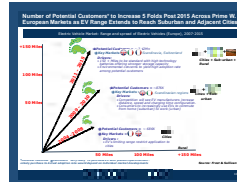
The customer opts for the number of years and flexible mileage- customized lease

Market Overview and Supporting Battery Technologies for Electric Vehicles

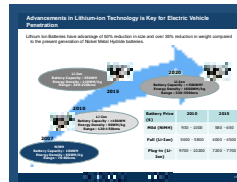
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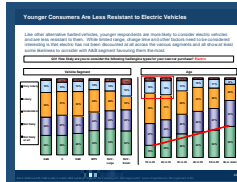
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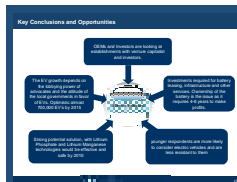
Market Overview into Electric Vehicles



Supporting Battery Technologies

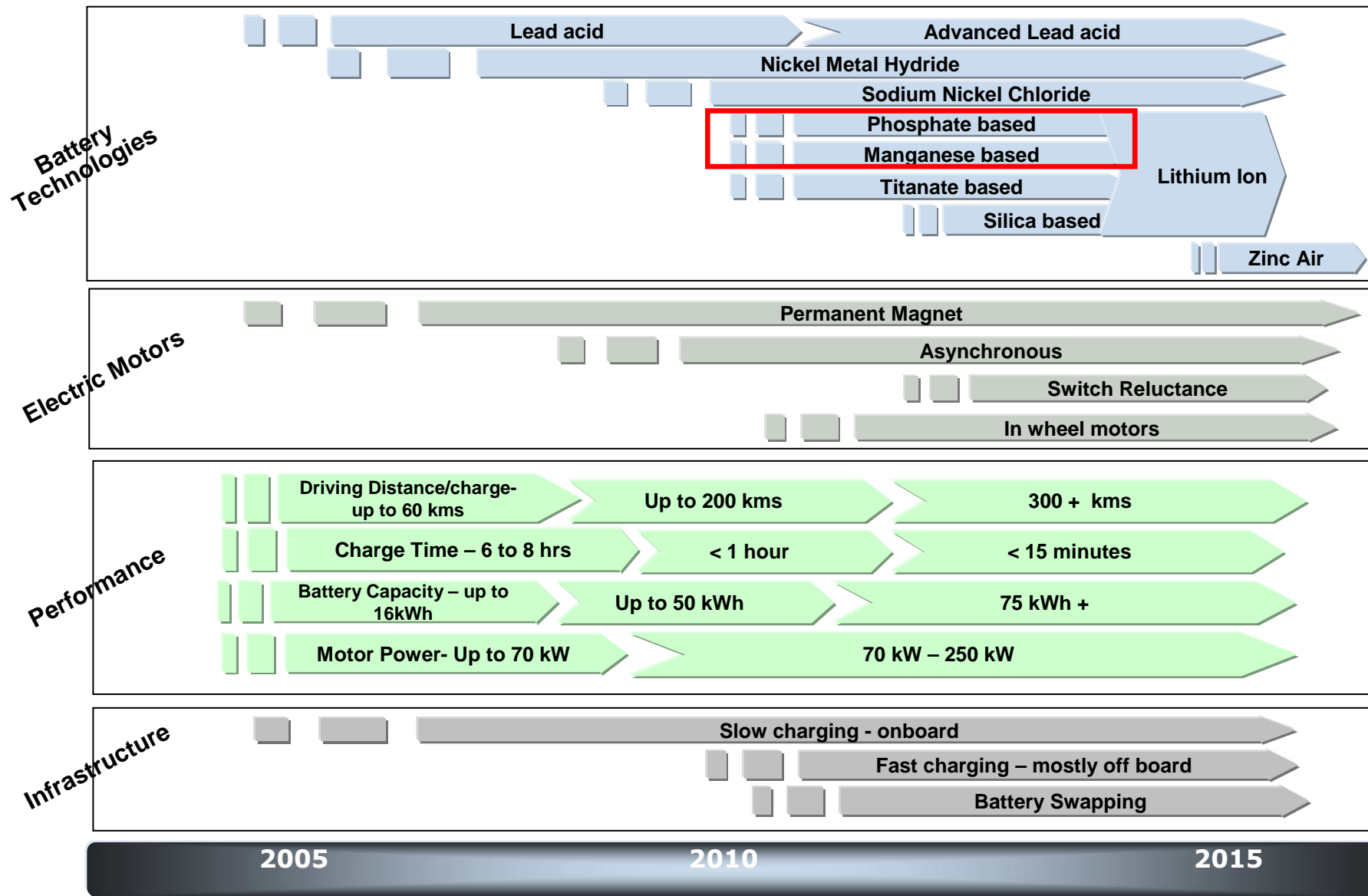


Consumers' Attitudes & Perceptions



Conclusions and Questions

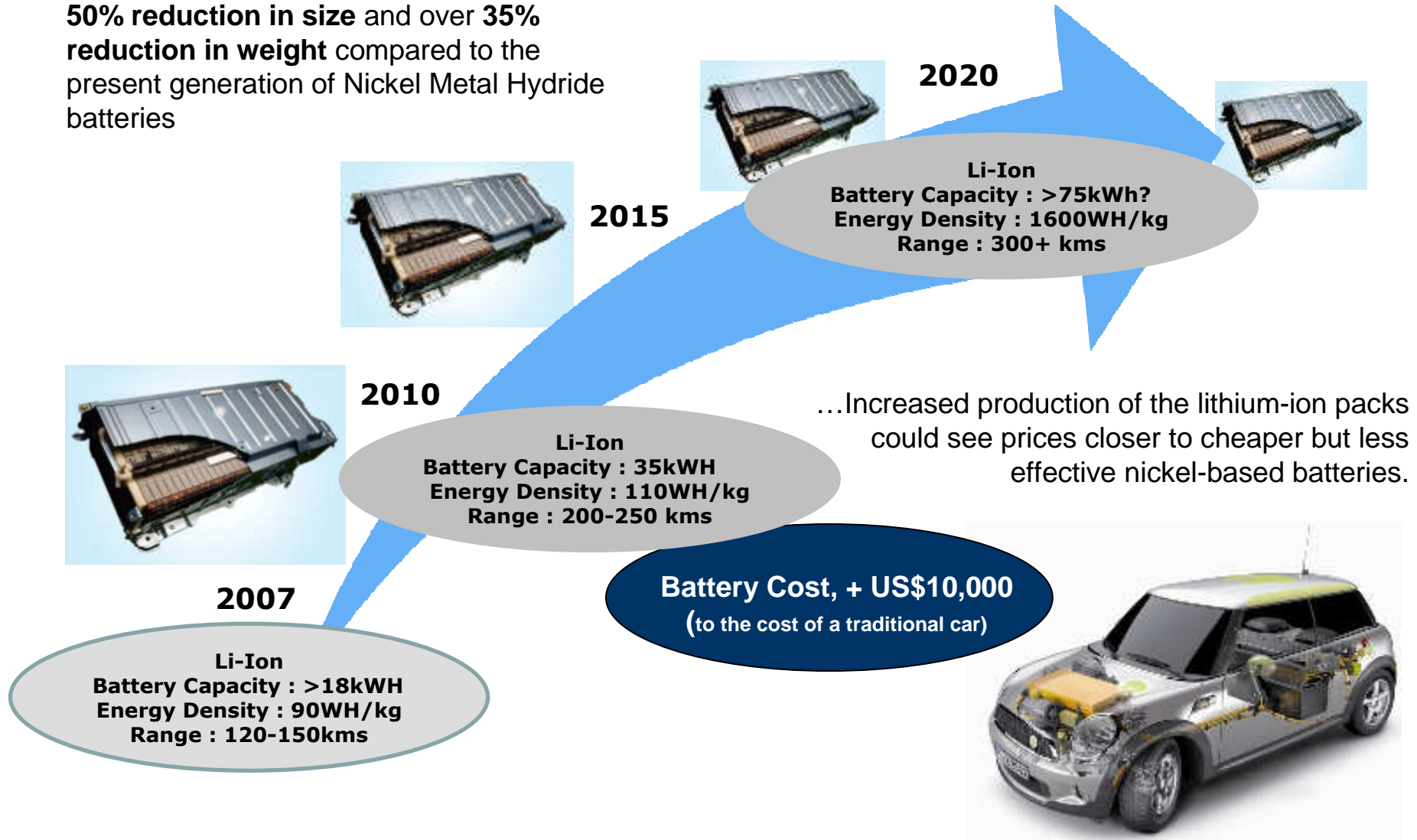
EV Technology and Product Roadmap- Charging Times to Drop from 6-8 hours to <15 minutes by 2015; But All Fast Recharging to be Made Off-Board



Source: Frost & Sullivan

Advancements in Lithium-ion Technology is Key for Electric Vehicle Penetration

- Lithium Ion Batteries have advantage of **50% reduction in size** and over **35% reduction in weight** compared to the present generation of Nickel Metal Hydride batteries



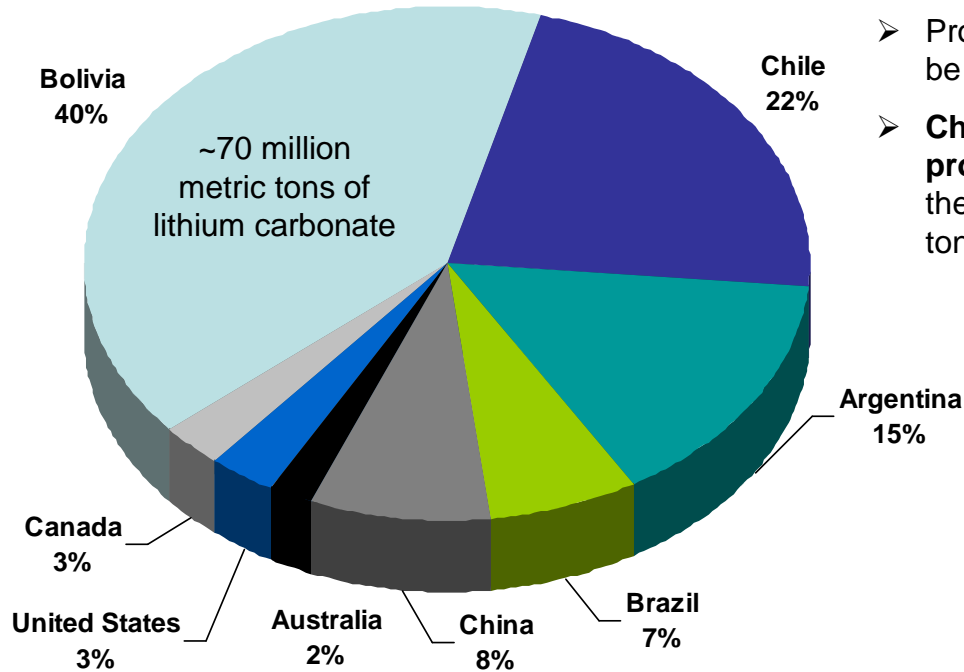
South America Accounts for 80 Percent of The Global Lithium Reserves



Bolivia

- **Unexploited** by international mining companies due to the political situation
- State-run lithium industry, which may include actual manufacturing of the coveted lithium-ion batteries
- \$5.7 million pilot plant to process raw lithium carbonate, hopes to produce its first 40 metric tons by the end of this year

World Lithium Reserves



Lithium Carbonate

- Production expected to be ~100k tonnes in 2009
- **Chile is the largest producer** of Lithium in the world with about 40k tonnes per year

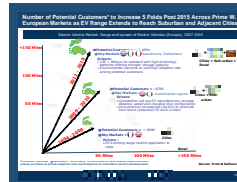
- ❖ Automotive Industries demand for Lithium is likely to increase with demand exceeding supply. Toyota and Mitsubishi have already approached the Bolivian government, but had been turned away.
- ❖ Relations between Bolivia and America is weak and problematic if the big three are to be successful in their future EV strategies.
- ❖ Partnerships to be forged between Mining Companies and battery manufacturers, ensuring supply of Lithium for the demand and to keep a check on pricing.

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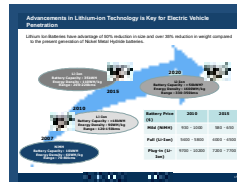
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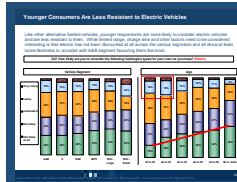
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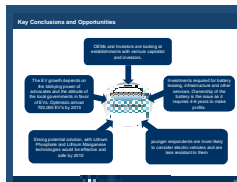
Market Overview into Electric Vehicles



Supporting Battery Technologies



Consumers' Attitudes & Perceptions



Conclusions and Questions

Multiple Sample Split with a Sample Size of 2,648 Respondents

To Evaluate “European Consumers’ Attitudes & Perceptions towards Sustainability, Environment and Alternate Powertrain”

Key objectives of this research study are:

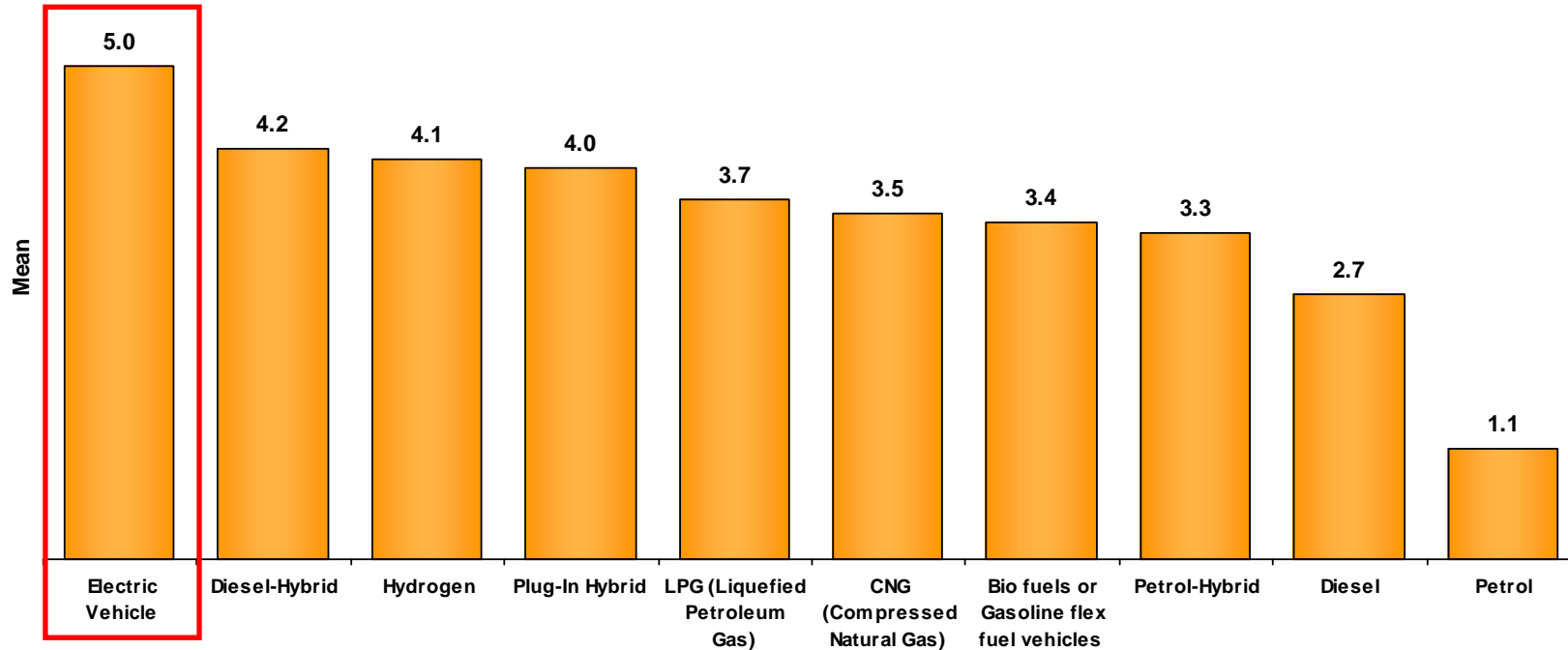
- To determine consumers’ **perceptions and attitudes toward different environment and sustainability factors**
- To determine the importance, interest and influence of environment and sustainability factors in the **purchasing decision** of a new vehicle
 - Also their relative performance to other purchasing criteria including: price, safety, performance, driving dynamics, cost of ownership etc.
- **To recommend technology development and Product positioning**

Sample size by country and vehicle segment, in addition, samples had also been split by age and gender

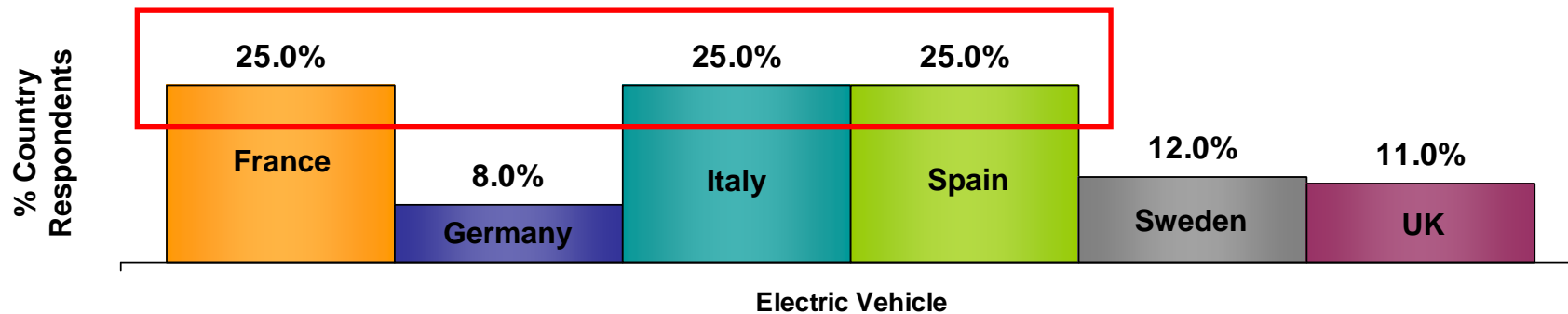
	France	Germany	Italy	Spain	Sweden	UK	Total
A&B	150	152	77	76	40	151	646
C	151	150	77	75	43	149	645
D&E	149	150	77	76	45	150	647
MPV	81	75	48	38	43	79	364
SUV Large	61	56	22	23	24	60	246
SUV- Small	15	26	16	12	16	15	100
Total	607	609	317	300	211	604	2,648

Electric Vehicles Ranked Best Choice for Fuel Economy

Q32 Please rank the following vehicle engine types based on their fuel economy?



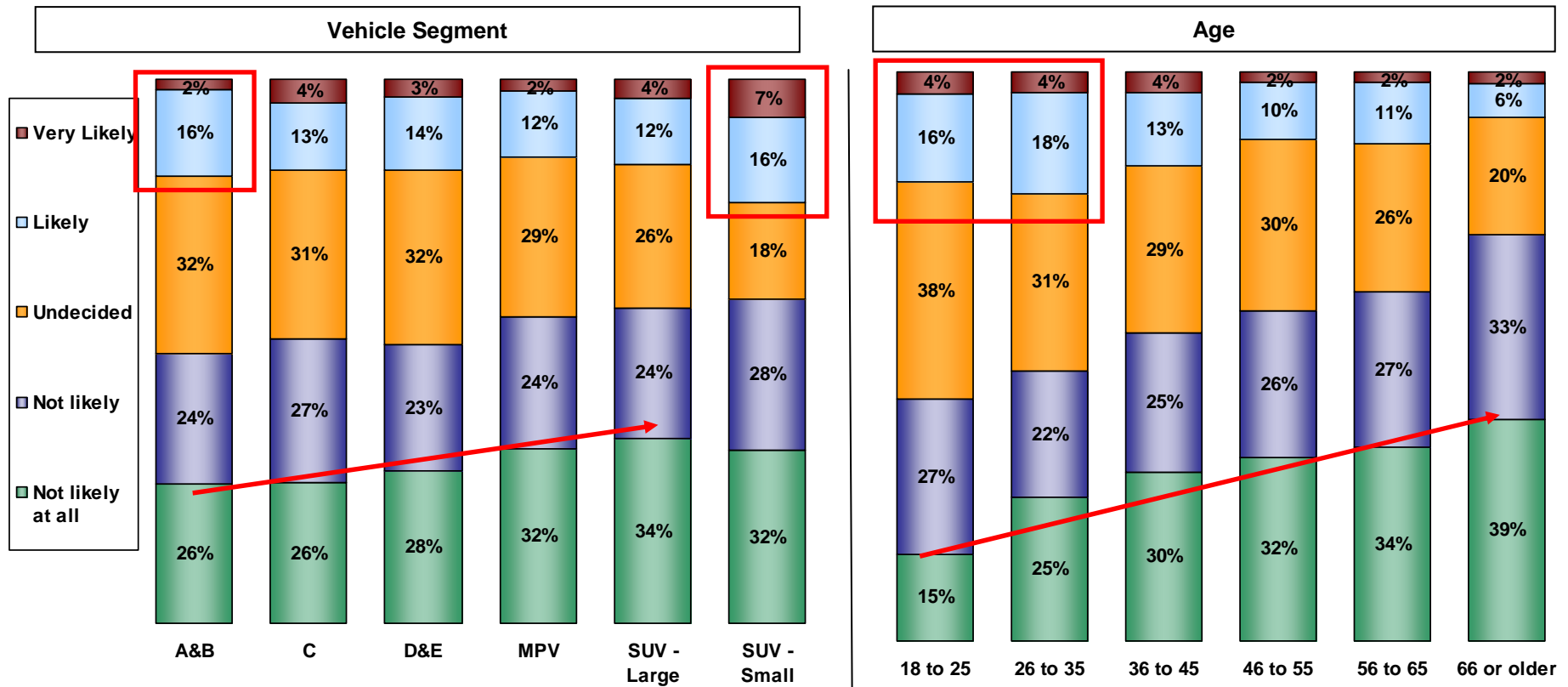
Q31 How likely are you to consider the following fuel/engine types for your next car purchase?



Younger Consumers Are Less Resistant to Electric Vehicles

- Younger respondents are more likely to consider electric vehicles and are less resistant to them.
- Electric power has not been discounted across the segments, all show at least some likeliness to consider, with A&B and Small SUV owners favouring them the most.

Q31 How likely are you to consider the following fuel/engine types for your next car purchase? **Electric**

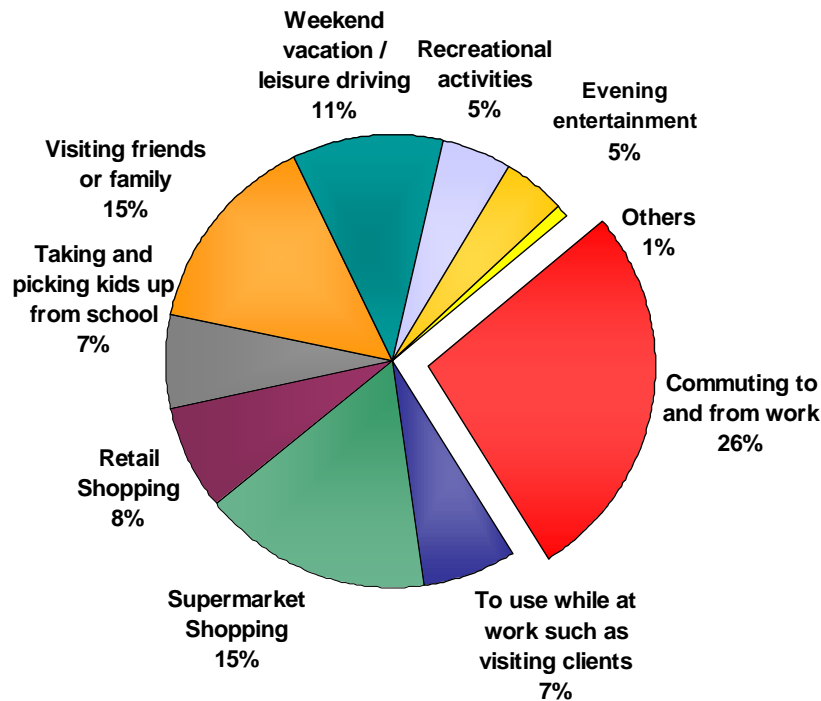


Consumers See Use of Their Vehicles Greater for Commuting, Supermarket Shopping and Visiting Family and Friends

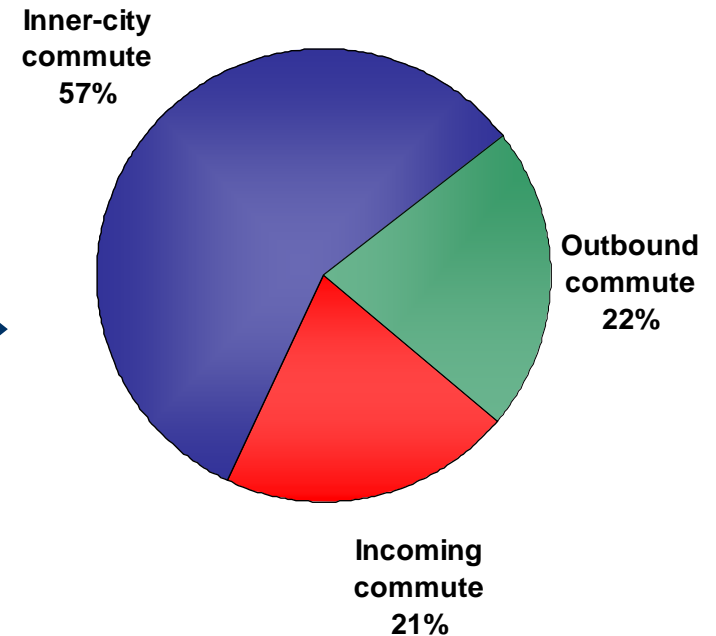
London, UK

- Commuting, supermarket shopping and visiting friends and family takes up 56% of vehicle use. While inner-city commute accounts for 6 in 10 consumers that live in London.

Q4 Thinking about the vehicle you purchased most recently, what would you say you use the vehicle for? Please break down your time by a percentage – note that should add up to 100% (Mean)



Q5 What describes your pattern of commuting to and from work?

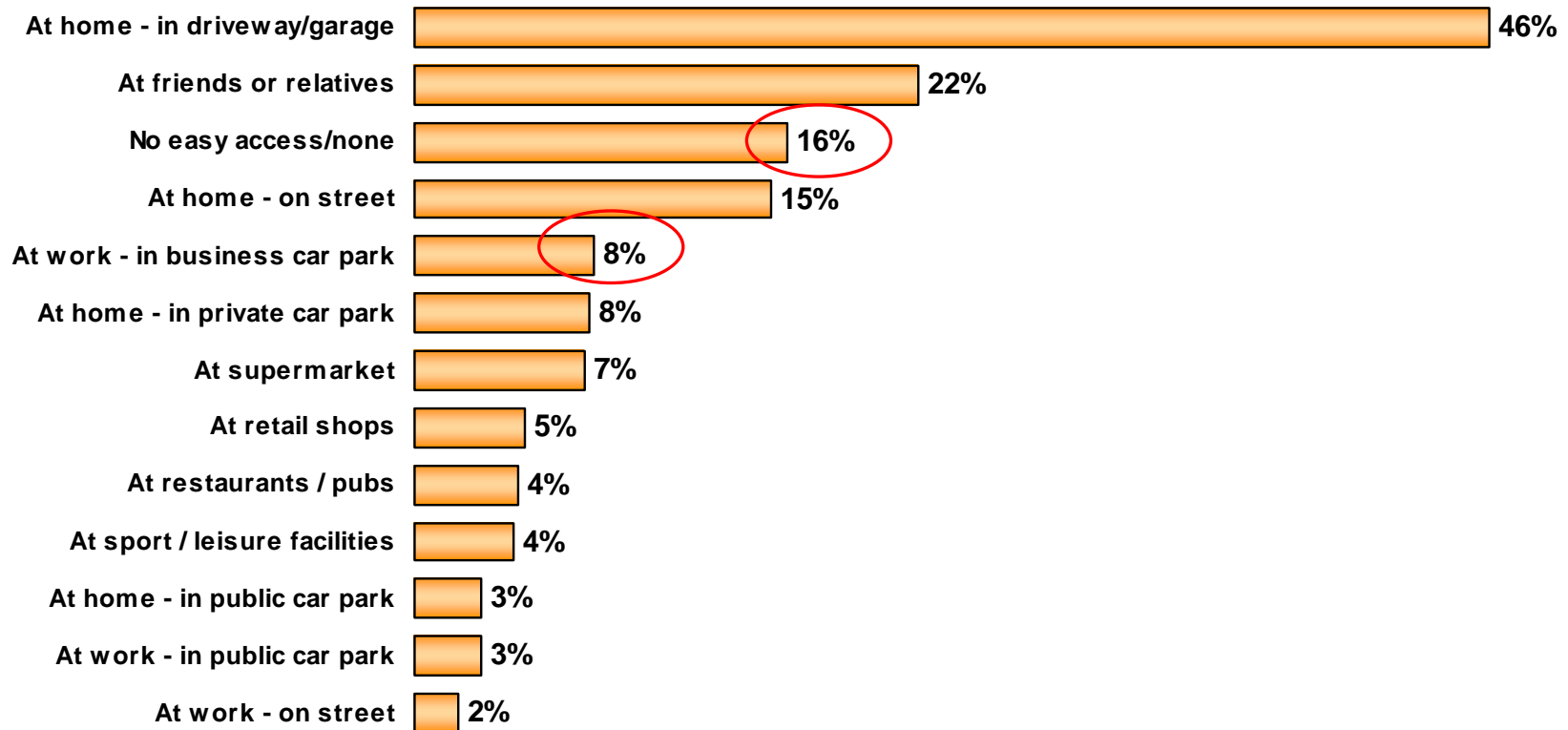


Access at Home High But Work Access a Problem

London, UK

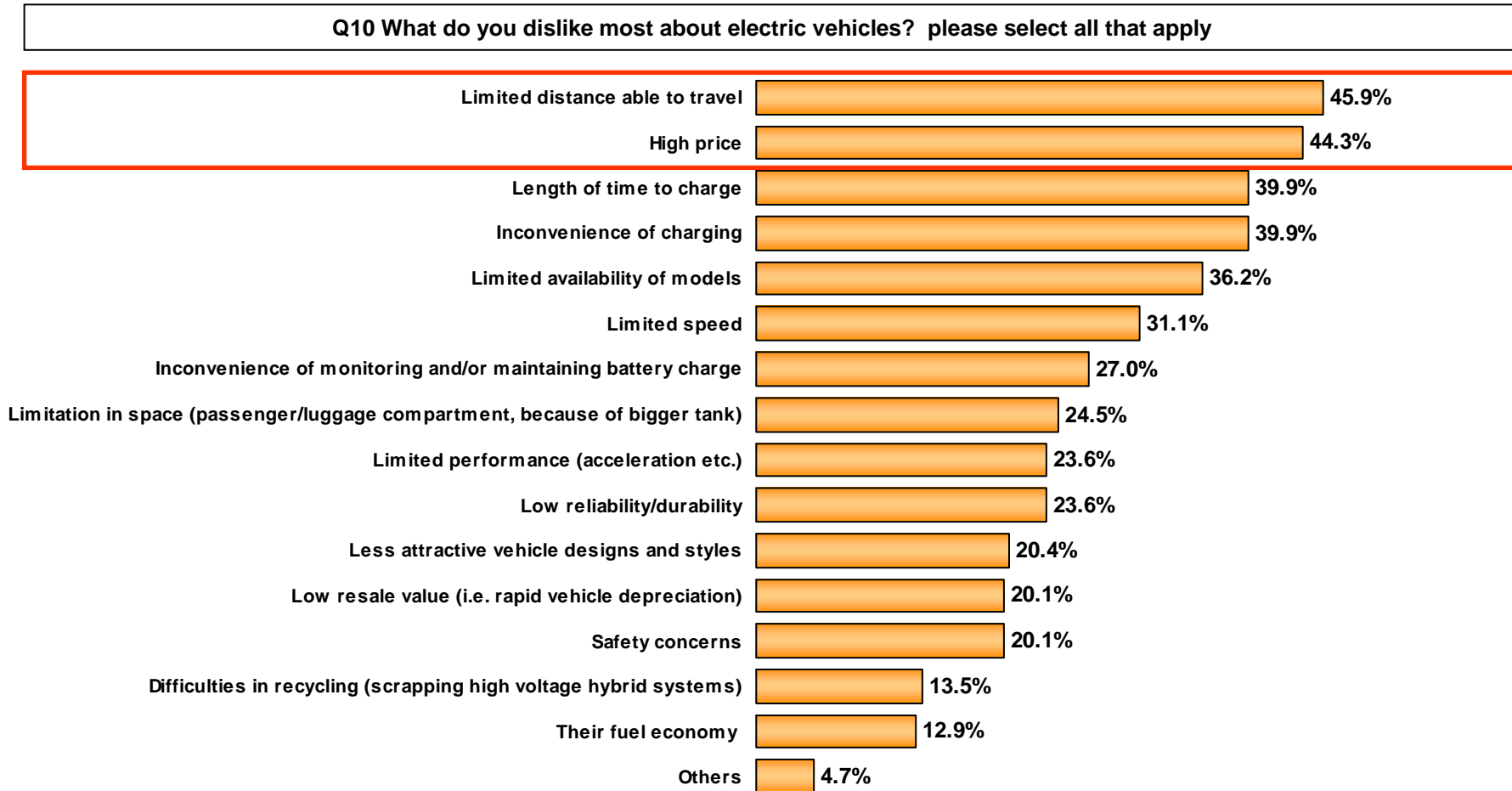
While half of London consumers say they have easy access to electric sockets at home in the driveway, 16% also say they do not have easy access to sockets. Furthermore, only 8% say they have access in business car park.

Q20 Which of the following locations have easy access to accessible electric sockets? Please select all that apply



1 in 2 See Distance & High Price Barriers Preventing Their Purchase of EV

While distance and high price are seen as the biggest barriers to EV adoption, the length of time to charge and inconvenience of charging also rated as a leading barrier by 1 in 3 consumers.

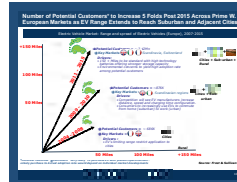


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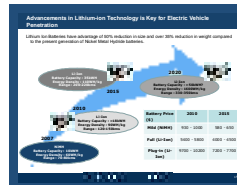
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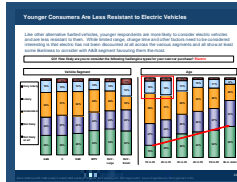
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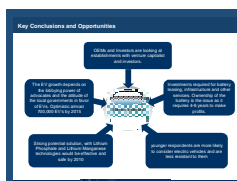
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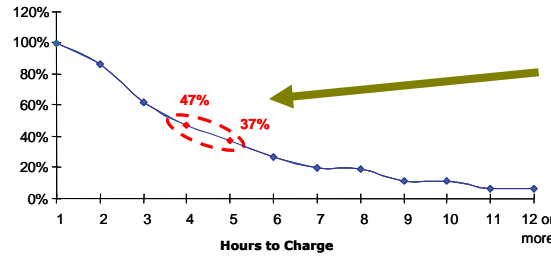


Consumers' Attitudes & Perceptions



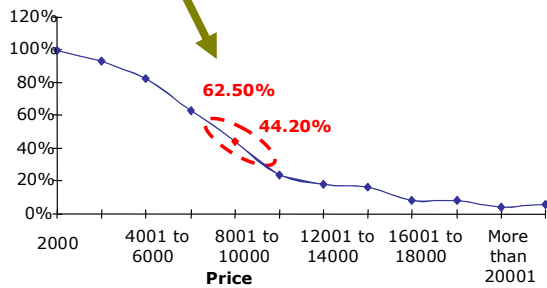
Conclusions and Questions

Urban Consumers are the Ideal Targets for EVs - Distance, Time to Charge, Style & Exterior, Speed and Charging Points as Areas of Interest

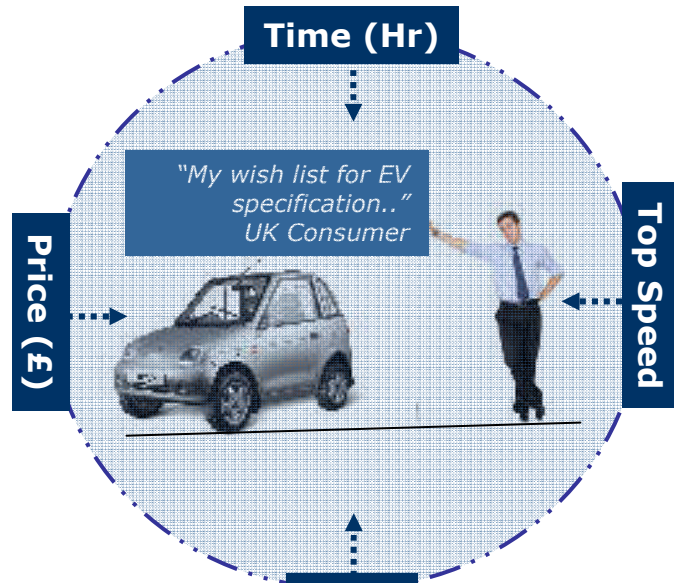
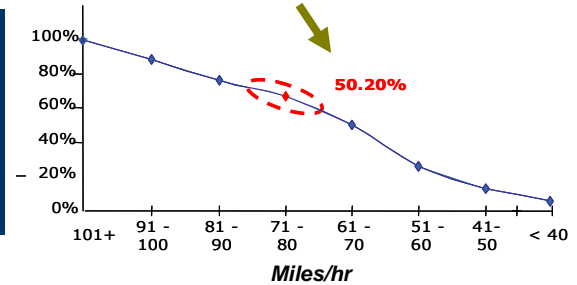


• Ideal hours to charge that will result in maximum uptake of potential EV customers in UK

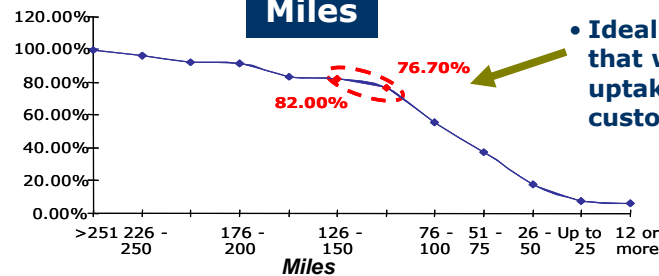
• Ideal price range that will result in maximum uptake of potential EV customers in UK



• Ideal speed characteristics that will result in maximum uptake of potential EV customers in UK

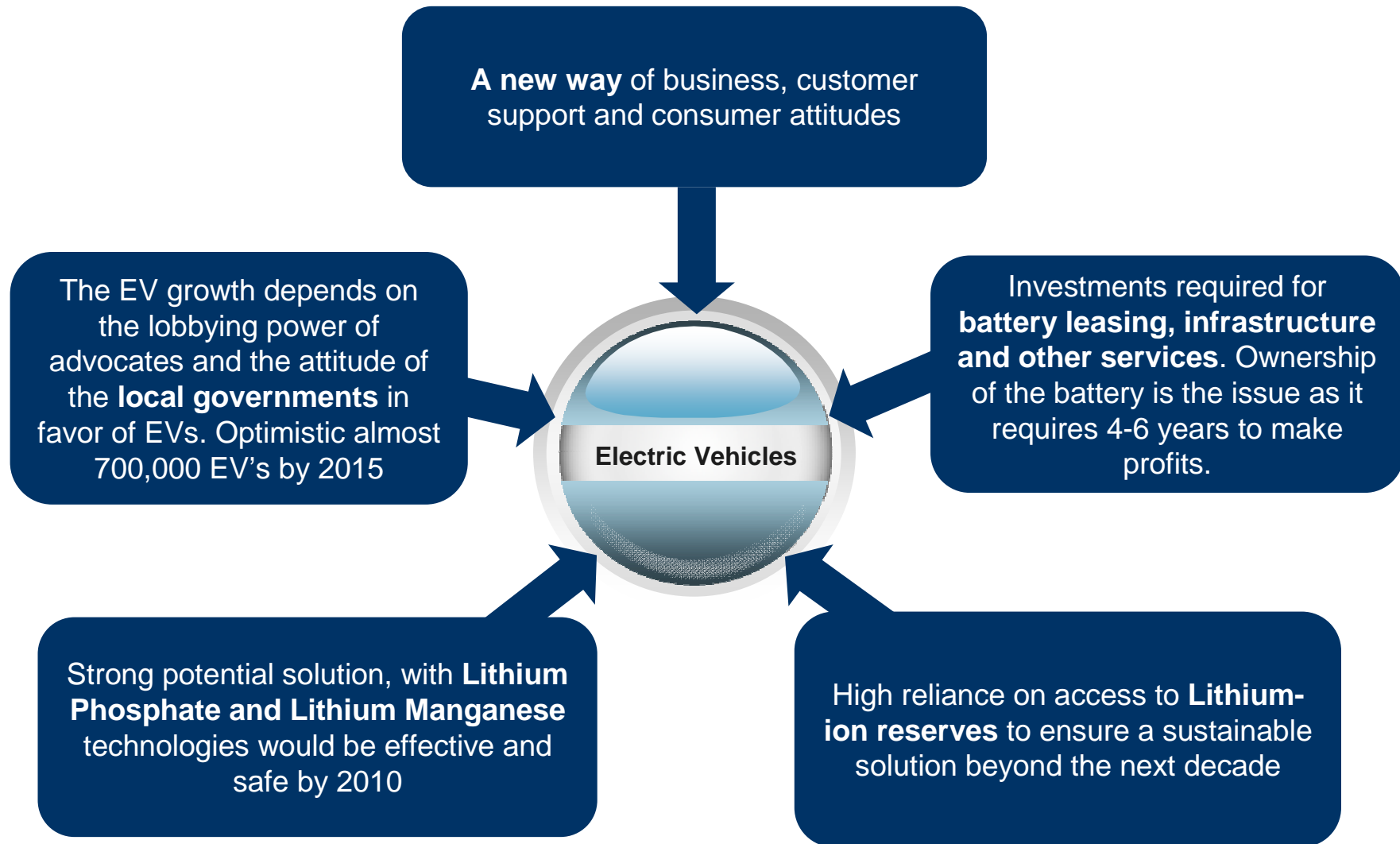


• Ideal distance characteristics that will result in maximum uptake of potential EV customers in UK



Source: Frost & Sullivan

Key Conclusions and Opportunities



Your Questions?

FROST & SULLIVAN

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Many Thanks for Your Attention