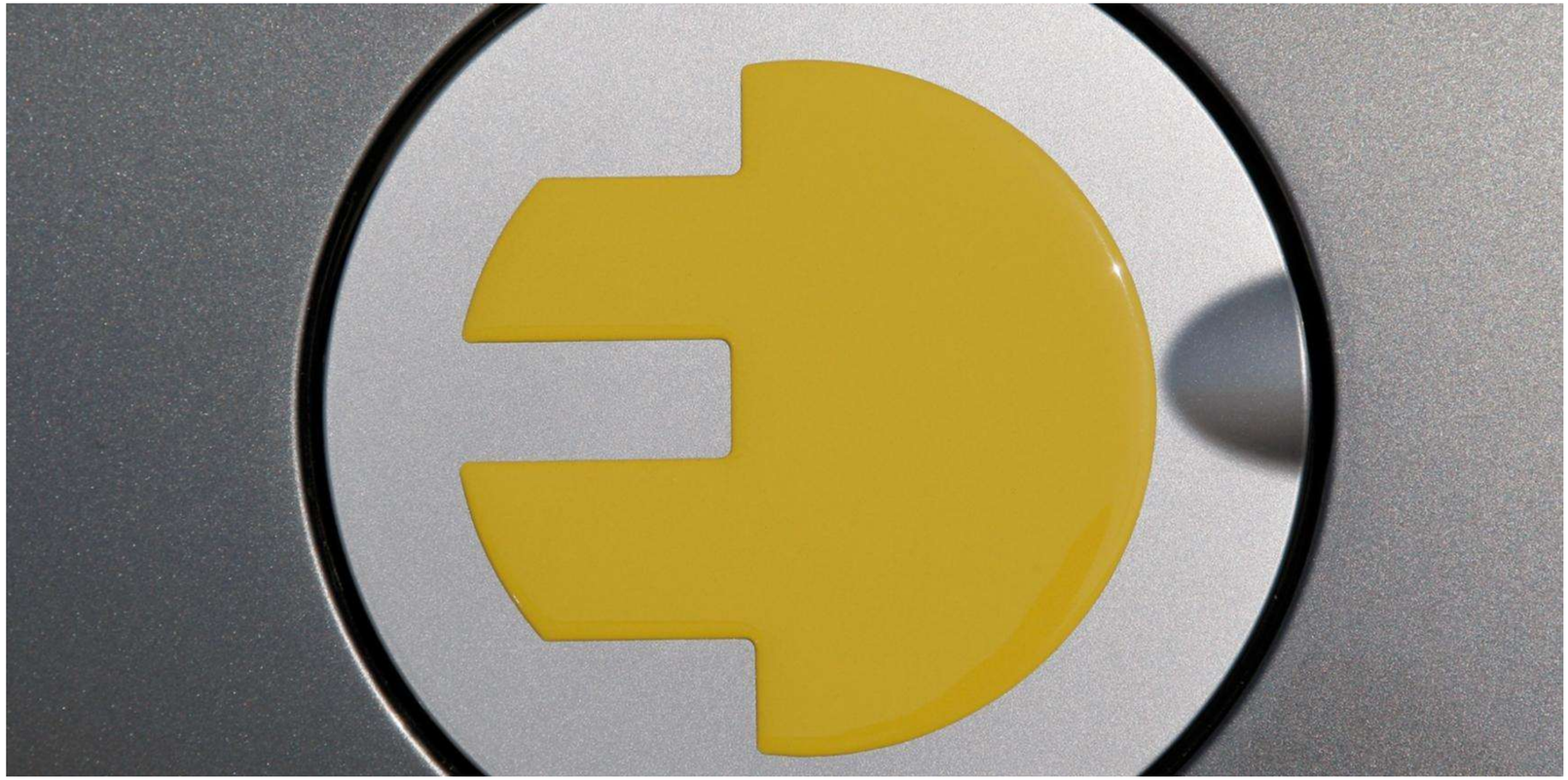
BMW Group's Electromobility Work.

SMMT: London, 6 April 2011.



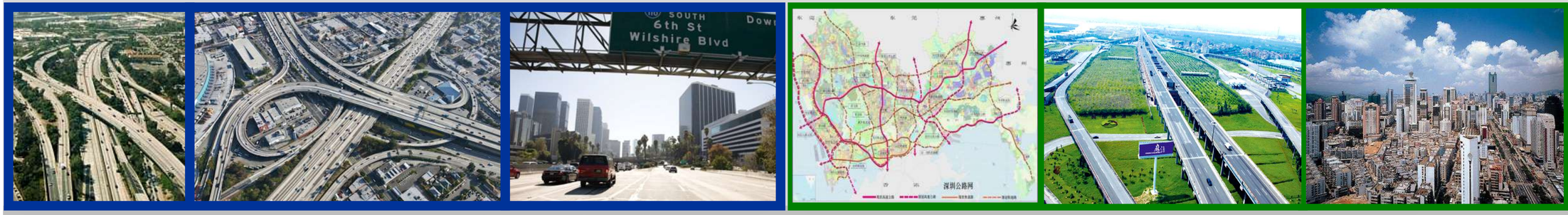
Dr. Thomas Becker, Vice President Government Affairs.

BMW Group

Rolls-Royce
Motor Cars Limited

BMW Group’s Electromobility Work.

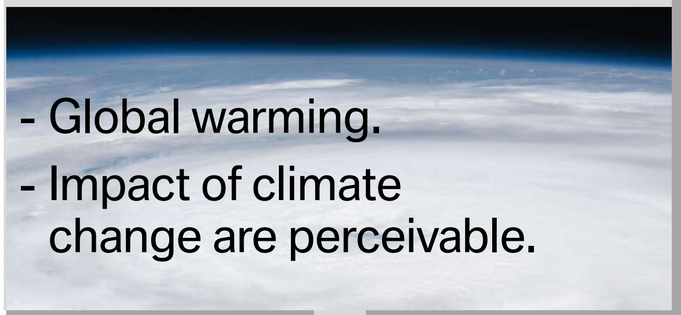
Various challenges to mobility in the growing urban regions of the world.



BMW Group’s Electromobility Work.

The following factors will determine sustainable mobility in all cities.

Environment



- Global warming.
- Impact of climate change are perceivable.

Urbanisation

Politics

- More stringent legislation.
- Charge for access to inner city.
- Link to vehicle emissions.

E-mobility drivers

Economics

- Shortage of resources.
- Increase in the price of fossil fuels.

Culture

- Sustainable mobility as part of a modern urban lifestyle.
- Assumption of social responsibility.

Customer Preferences, Sustainibility

BMW Group’s Electromobility Work.

BMW Group’s drive strategy provides a broad technology spectrum for today and the future.

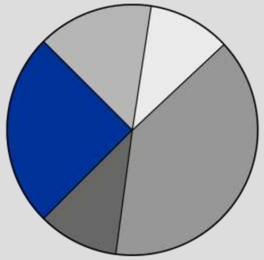
Combustion engine	Hybrid technology	E-vehicle	Hydrogen
			
Today	**Today**	**Near future**	**Future**
- Optimisation of fuel consumption and emissions. - Lightweight construction.	- Full and mild hybrid vehicles. - Initial step towards electrification of the drivetrain. - Plug-in Hybrid drive-trains.	- First limited electric vehicle production in 2008. - MINI E on the road since 2009. - BMW ActiveE in 2011. - Introduction Megacity Vehicle in 2013.	- Commitment to and validation of technology. - Optimisation of BMW H2 ICE. - Improvement of hydrogen storage and efficiency.

Powertrain concepts

BMW Group’s Electromobility Work.

MINI E and BMW ActiveE serve as key learning projects for the BMW i3.

Use of renewable energy.



Market potential.

Transfer scenarios.

User behaviour.

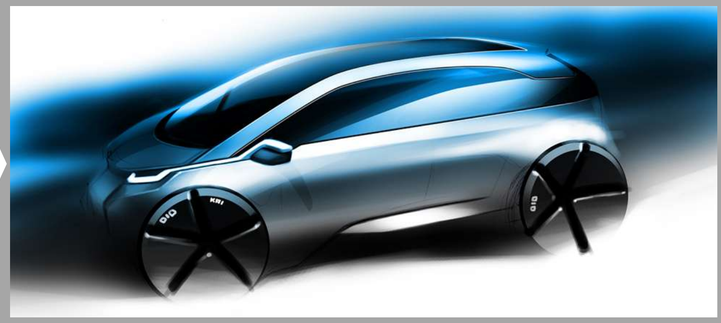
Acceptance.

Demands of e-infrastructure.

Strengths and weaknesses.

MINI E

BMW ActiveE



BMW i3

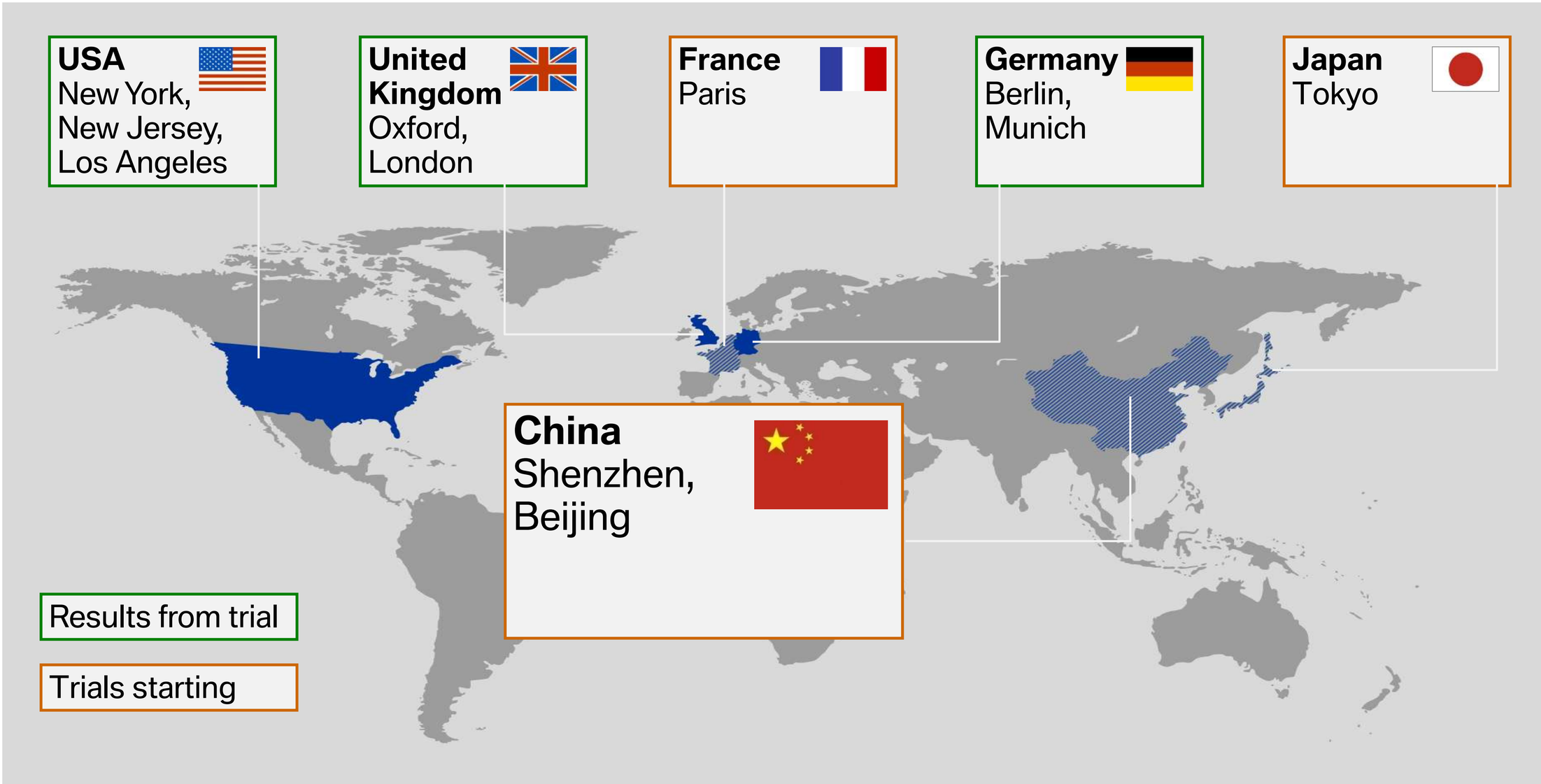
BMW Group’s Electromobility Work.

The following four markets will drive the future development of e-mobility.

- Electric Mobility is not just another technology development - it is a **paradigm shift**!
- It’s not only industry that drives forward the technology - **governments and political stakeholders also shape the market**.
- Japan, the EU, US and China are defining the potential for future global markets.
- Global convergence on the target to boost electric vehicles - motives vary in different regions:
  - Protecting the **climate** and reducing emissions.
  - Reducing dependency on **fossil fuels**.
  - Leapfrogging **industrial development**.

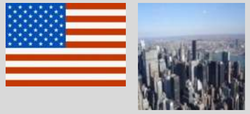
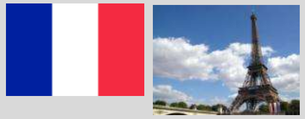
BMW Group’s Electromobility Work.

Establishment of learning projects worldwide with e-mobility consortia.



BMW Group's Electromobility Work.

Scientific projects with leading partners.

					
Government	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit	Technology Strategy Board SEEDA South East England Development Agency Oxford City Council	CA.GOV California Environmental Protection Agency Air Resources Board	Liberté • Égalité • Fraternité République Française Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer	NDRC MOST MIIT
Scientific Monitoring	Chemnitz University of Technology Öko-Institut e.V. Technische Universität Berlin	Oxford Brookes University	UC Davis University of California	INRETS Institut national de recherche sur les transports et leur sécurité	CATARC China Automotive Technology and Research Center
Field Trial	50 Units (40 Private / 10 Fleet) 	40 Units (20 Private / 20 Fleet) 	450 Units (246 Private / 204 Fleet) 	50 Units starting in Q4 2010 	50 Units starting in Q4 2010 
Infrastructure and Energy	Vattenfall	Scottish and Southern Energy	Several regional Energy Companies.	EDF	State Grid Corporation of China State Grid

BMW Group's Electromobility Work.

The MINI E - an important building block for future electric vehicles.

Vehicle	2-seater	
Electric motor	Output	150 kW/204 hp
	Torque	220 Nm
	Top speed	152 km/h
Energy storage	Lithium-Ion battery	35 kWh, 29 kWh available
	Voltage	400 V
	Number of battery cells	5,088
	Cooling	Air cooled depending on cell temperature
	Charging times (230 V)	2.4 hours at 50 A 3.8 hours at 32 A 10.1 hours at 12 A
	Weight	260 kg
	Range	In real terms up to 180 km; according to FTP72: 240 km

BMW Group's Electromobility Work.

The MINI E applicants and users have a high affinity to sustainability and technology.

Who applied?	- General: age 35 and over, male. - Well-educated, above-average income. - Affinity for new technology.
Who are the users?	- Second car in the household. - Used for the daily commute. - Range matches mobility needs.
What reasons are pivotal?	**- Most important factor:** - Experience a new clean and sustainable technology (Sustainability meets Technology).
	- Secondly: - Support environmental protection. - Independence from mineral oil.
	- Less important: - Cost reduction for daily mobility.

Source: User Survey Berlin, UK and USA. CHEMNITZ UNIVERSITY OF TECHNOLOGY OXFORD BROOKES UNIVERSITY UCDAVIS UNIVERSITY OF CALIFORNIA



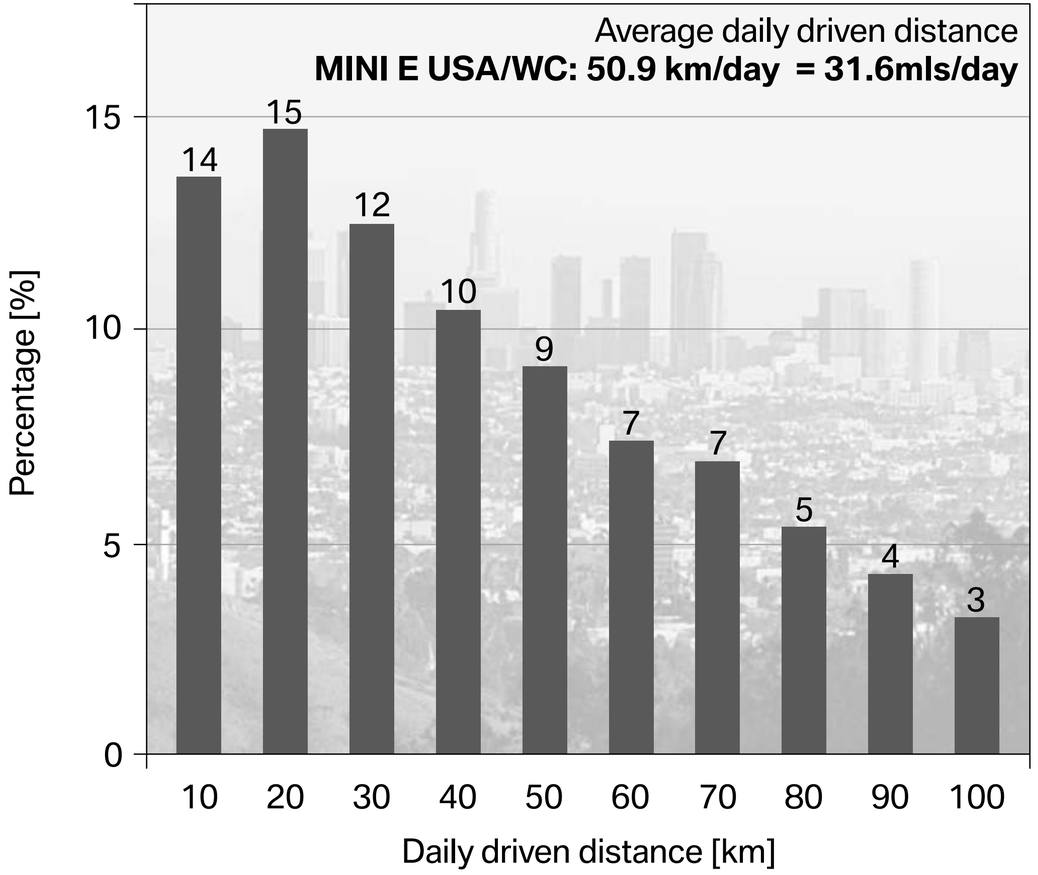



BMW Group's Electromobility Work.

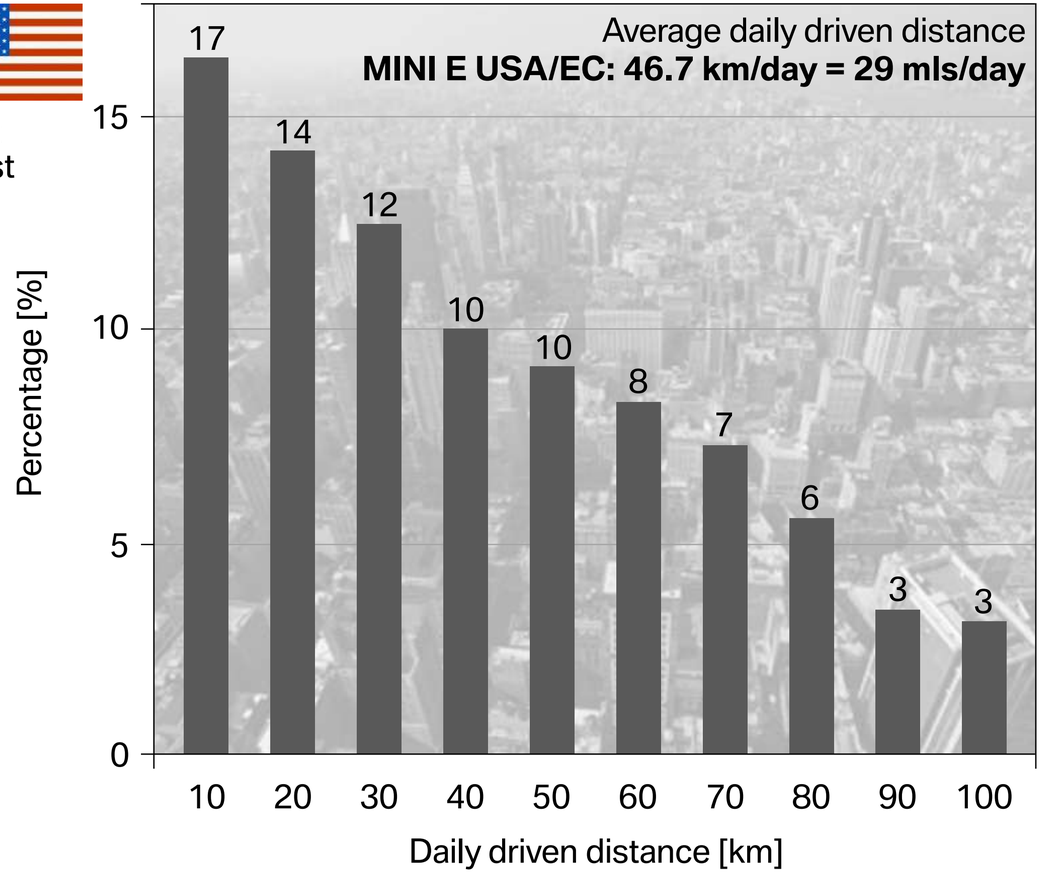
The average daily driving distance for MINI E users in the US is well within the range of the MINI E.

Average daily driving distance USA (for all user): **64 km/day = 39.8 mls/day,** 50 % of all daily trips < 7.7 km = 4.8 mls.
Source: Virginia Tech, School of Public and International Affairs 2008.

West coast



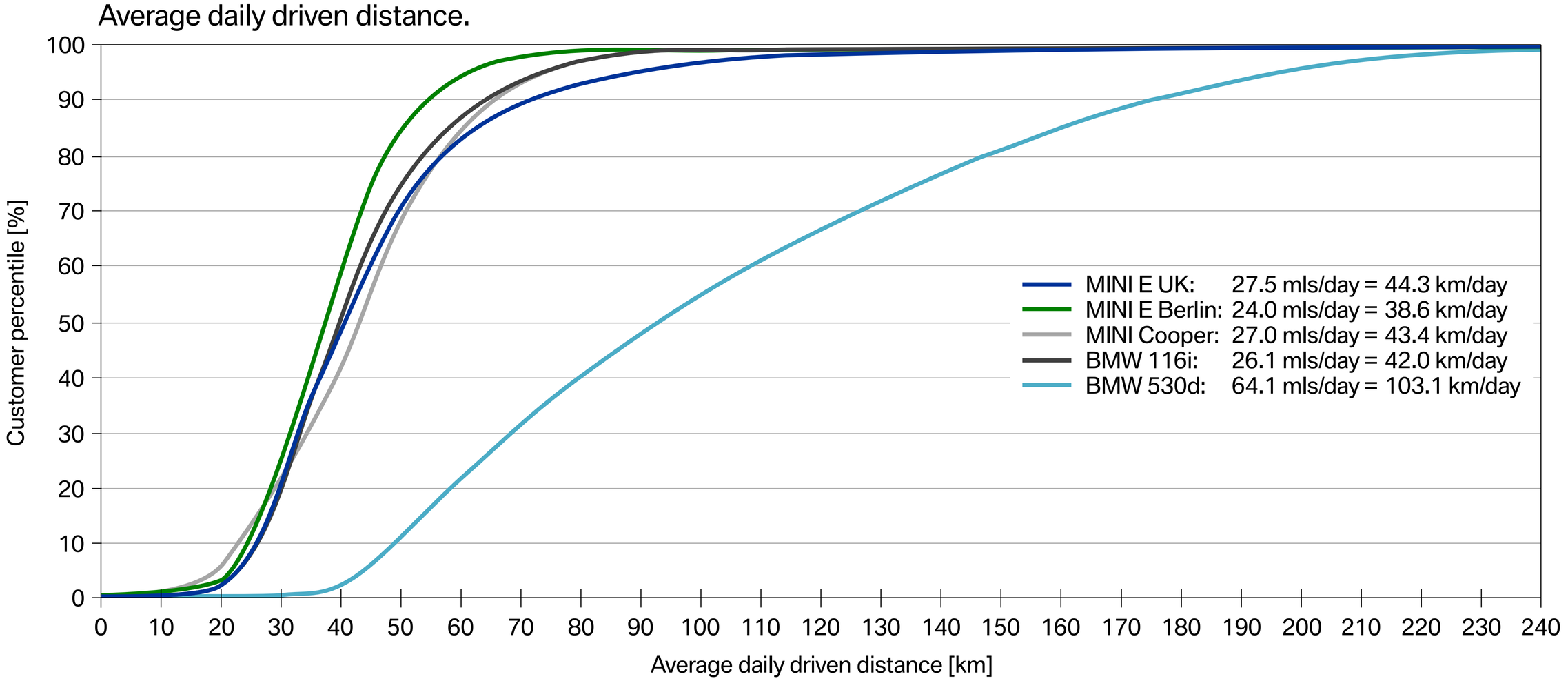
East coast



Source: ACP Data, N = 240, N = 191.

BMW Group’s Electromobility Work.

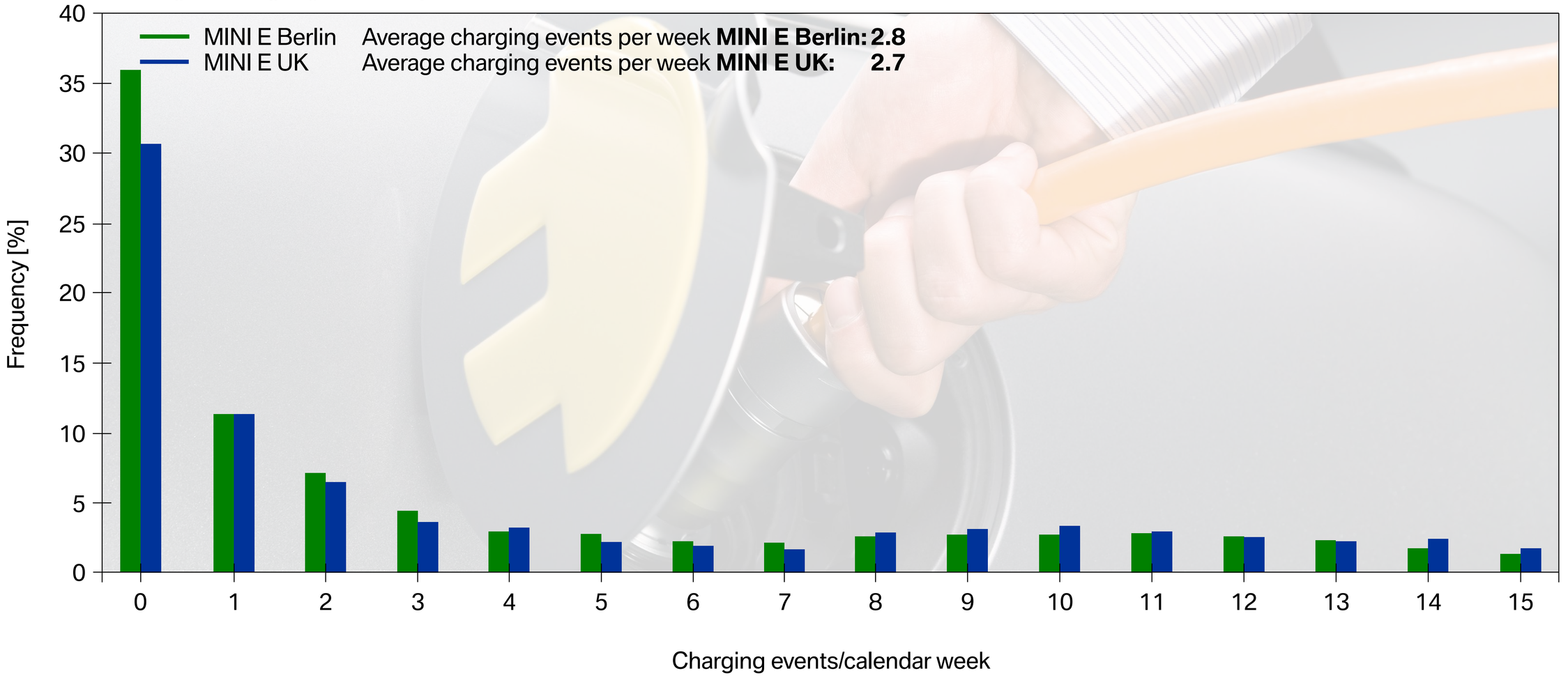
Day-to-day driving behaviour does not vary within a vehicle segment.



Source: Data Loggers.

BMW Group’s Electromobility Work.

Users charge their vehicle approximately every three days, reducing availability for smart charging.

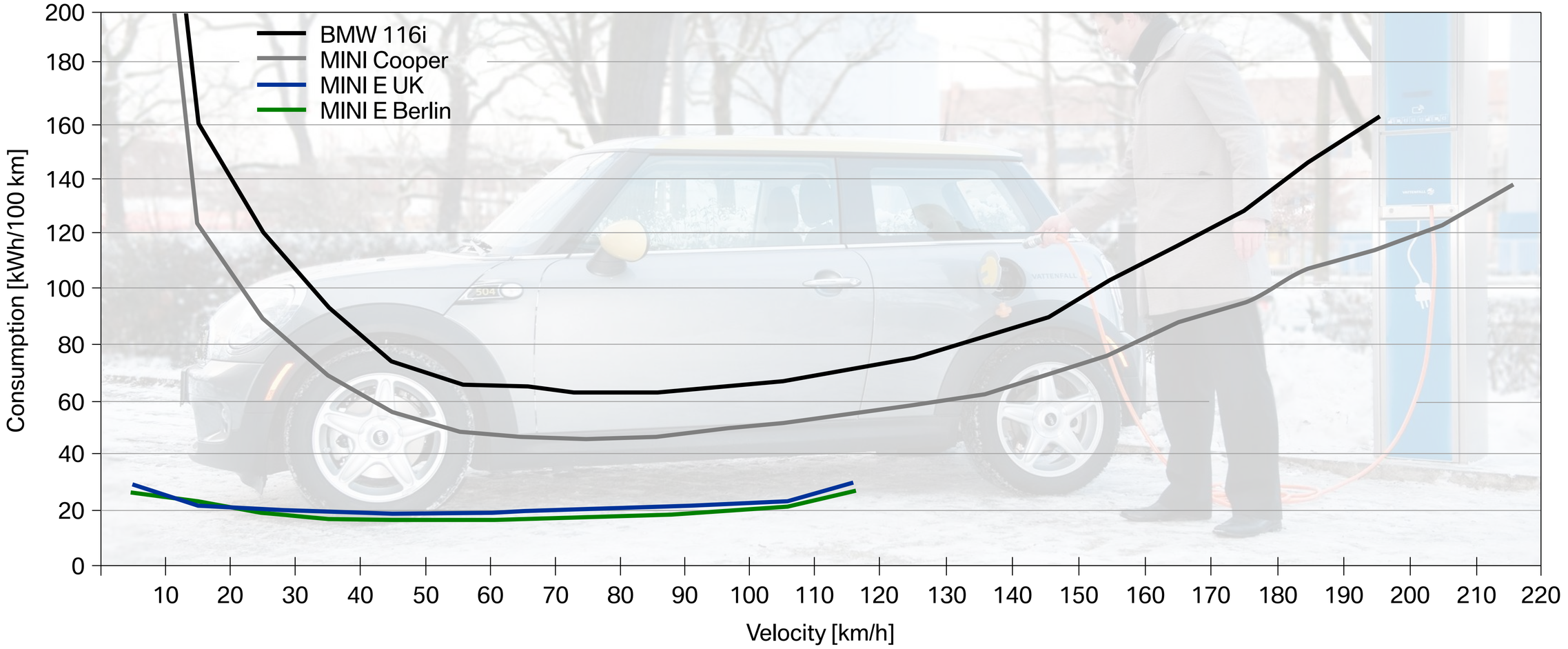


Source: Data Loggers.

BMW Group’s Electromobility Work.

Energy consumption comparison between conventional and electric vehicles demonstrates the efficiency of EVs.

Consumption in velocity classes.



Source: Data Loggers.

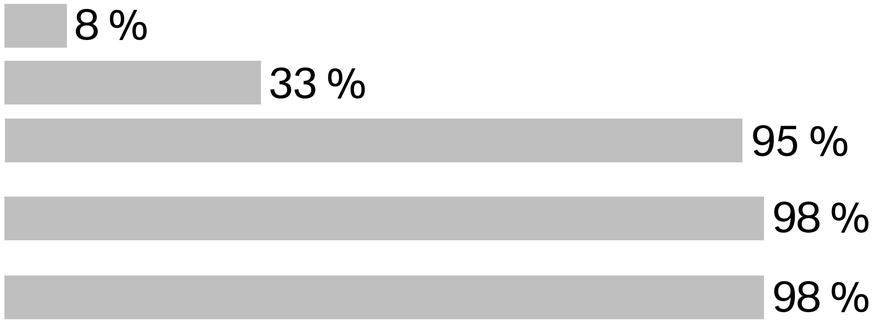
BMW Group’s Electromobility Work.
Ecological relevance.

Only 18 % of users rate energy from the German “energy mix” as environmentally compatible.

93 % of users rate electrical energy from renewable sources as environmentally compatible.

Share of MINI E users who regard renewable energy for charging electric vehicles as important.

How should energy for electric cars be generated?



Source: Berlin user survey.

CHEMNITZ UNIVERSITY OF TECHNOLOGY

FORSCHUNGSGRUPPE UmweltPsychologie

BMW Group’s Electromobility Work.

Implications for EV promotion based on BMW Group field trial experience.

- Practical pilot projects.
- Encouragement of new usage models.
- Additional stimulus for business fleets.
- Consideration of value chain and CO_2 footprint.
- User-oriented research & development.
- Support for adoption by private customers.
- User-oriented support for charging infrastructure.

BMW Group’s Electromobility Work.

102EX: The Phantom Experimental Electric.

BMW Group’s Electromobility Work.

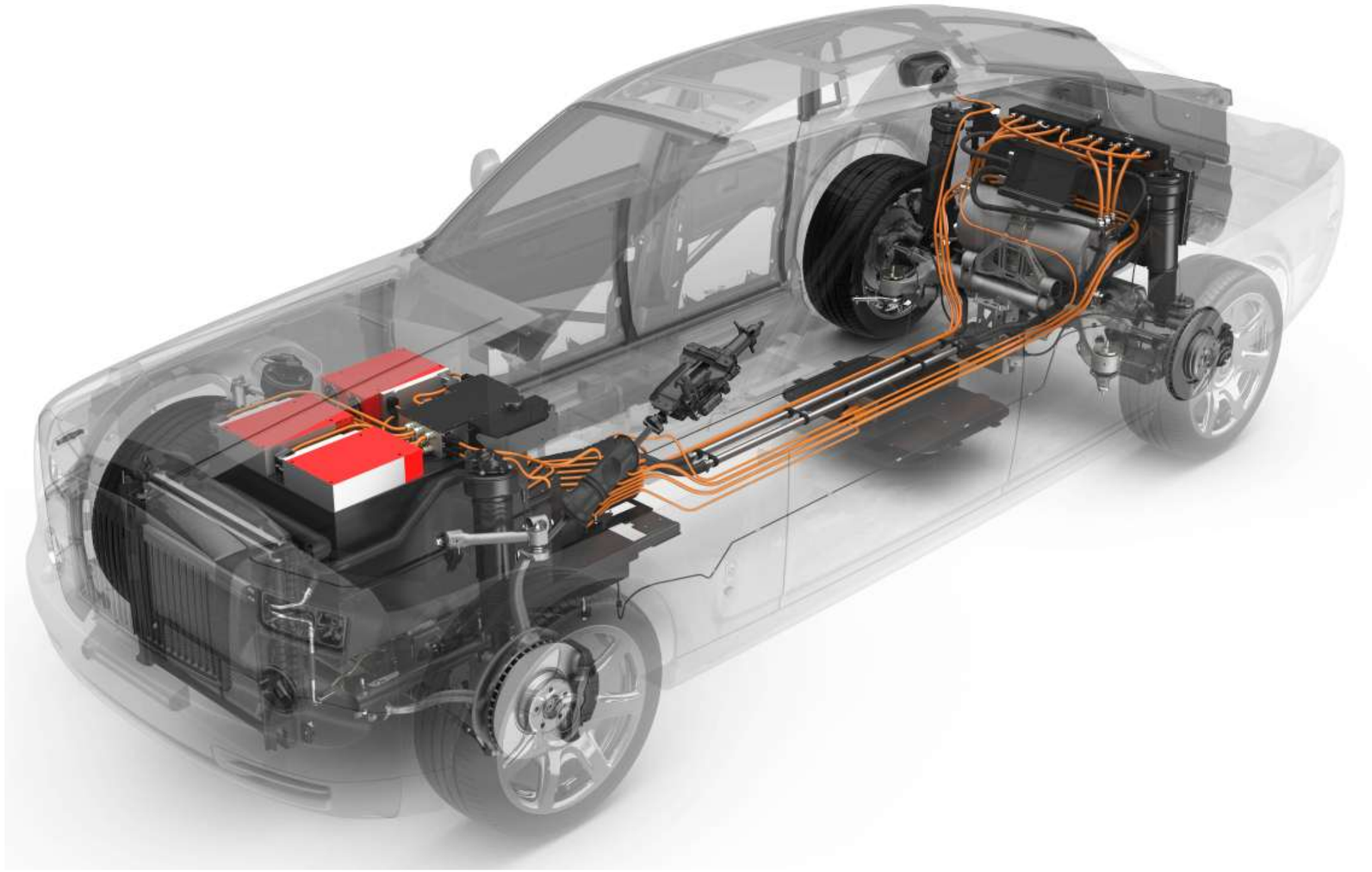
102EX: The Phantom Experimental Electric.

What is 102EX?

- A one-off, experimental electric test car;
- A working test bed to garner feedback from owners and opinion formers on alternative drive-train technology for Rolls-Royce;
- The first application of battery electric technology in the GKL++ segment and the largest battery pack ever fitted to a passenger car;
- An opportunity to explore owner reactions to other experimental technologies such as induction charging, Atlantic Chrome finish and Corinova (vegetable tanned) leather.

102EX: The Phantom Experimental Electric.

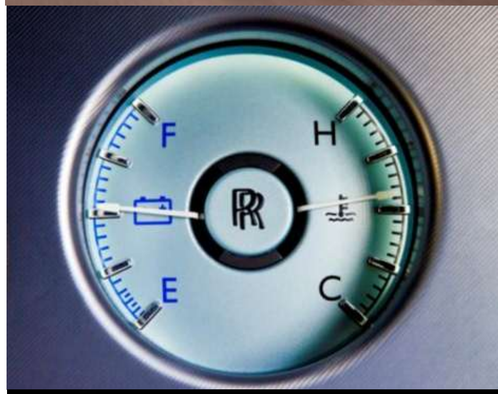
Electric drive-train layout.



102EX Phantom Experimental Electric.

Aims and objectives.

- The first step in an exploration of alternative drive-trains for Rolls-Royce Motor Cars;
- A car that begins a conversation with Rolls-Royce owners, using a credible test vehicle underpinned by established battery-electric technology;
- To pose questions about the appropriateness of all-electric technology for the Rolls-Royce brand; is this or another technology right for the future?
- To test the operation of technologies and materials in different global markets throughout 2011;
- By the end of the test programme, to be in a position to make a more informed decision about future drive-trains for Rolls-Royce Motor Cars.



102EX Phantom Experimental Electric.

Key facts.

- Lithium-ion battery pack: 71kWh energy density;
- Range circa 125 miles (200km) between charges, dependent on driving style, conditions and load drawn from battery through heating / air conditioning;
- Re-charge in approximately 8 hours on three phase; 24 hours on single phase charging;
- Maximum power output: 290 kW with 800 Nm of torque available over a wide band. Standard Phantom delivers figures of 338 kW and 720 Nm respectively;
- 0-60 in just under 8 seconds; top speed limited to 100 mph (160 kph).

102EX Phantom Experimental Electric.
Testing technologies.

• A public website through which communications are channelled during the tour;

•Encouraging views from all-comers, including enthusiasts, media and owners;

•Regular updates of test programme results online while the car is on tour;

•Engaging and provocative – never pre-judging conclusions to the project;

•A site that includes contributions from celebrities, thinkers and politicians;

•Open and transparent; will include critical views and negative comments – if these are posted.

Future Mobility.

... does not mean a loss of emotions.

BMW Group’s Electromobility Work.

Users and their feedback are key to the success of the project.