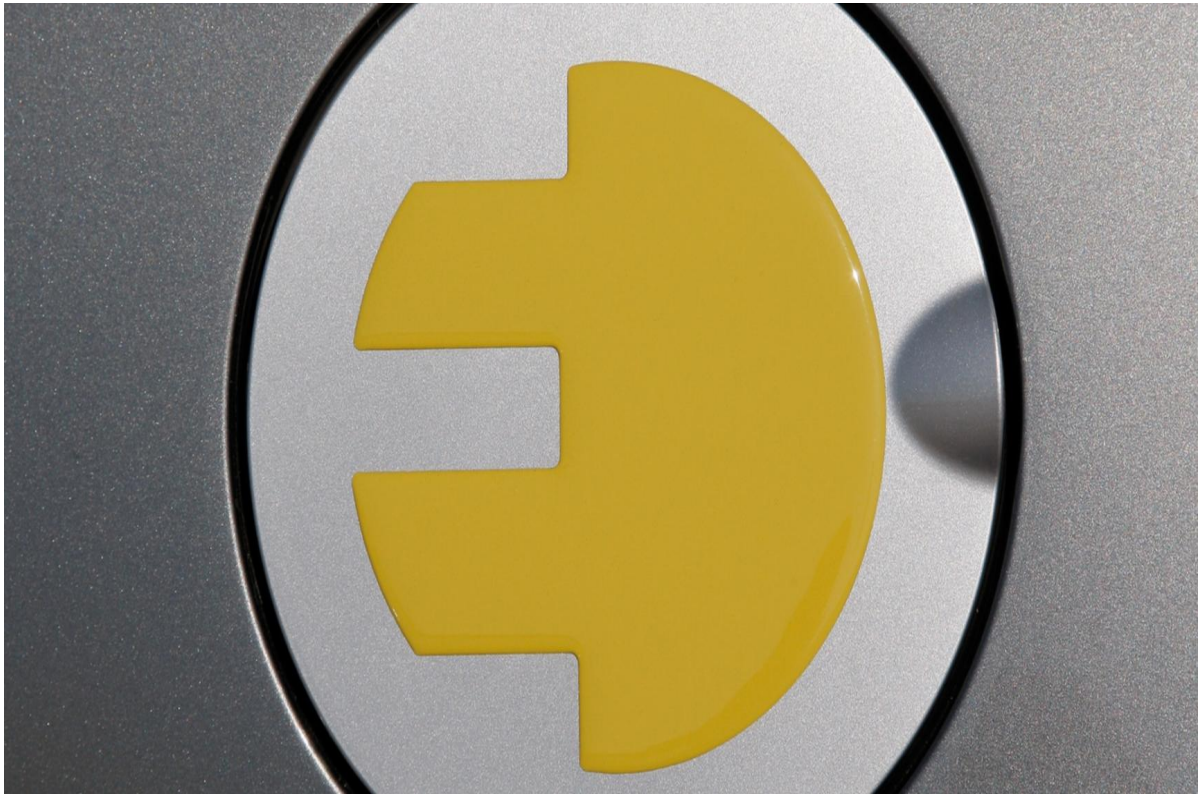
MINI E and the BMW Group approach to Electromobility: Today's experience with the technology of tomorrow'

LCV 2010, Millbrook, September 16th, 2010.



Glenn Schmidt, Head of MINI E Cooperation Projects

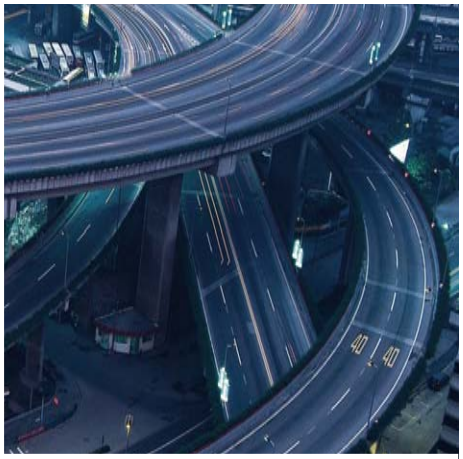
BMW Group

MINI E and the BMW Group approach to Electromobility: Today's experience with the technology of tomorrow'

LCV 2010, Millbrook, September 16th, 2010.

- General Conditions and Electro-Mobility.
- Initial Findings of MINI E Field Trial in UK.
- Implications for Promoting Sustainable Mobility.
- BMW Group E-Mobility Roadmap.

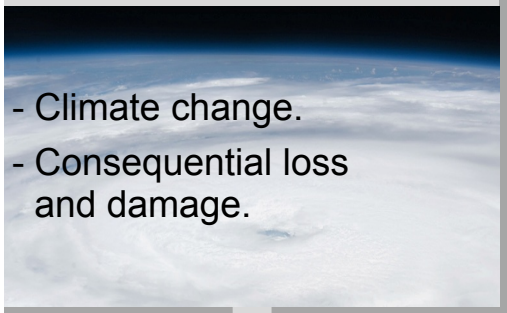





General Conditions and Electro-Mobility.

Six key drivers for Sustainable Mobility.

Environment



- Climate change.
- Consequential loss and damage.

Urbanisation

Political context

- Statutory regulations on fleets.
- Restrictions on inner-city driving.
- Taxes on CO_2.

E-mobility drivers

Economy

- Resource shortages.
- Price rise in fossil fuels.

Culture

- Sustainable mobility as an element of an advanced, urban lifestyle.
- Assumption of social responsibility.

Customer aspirations

General Conditions and Electro-Mobility.

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

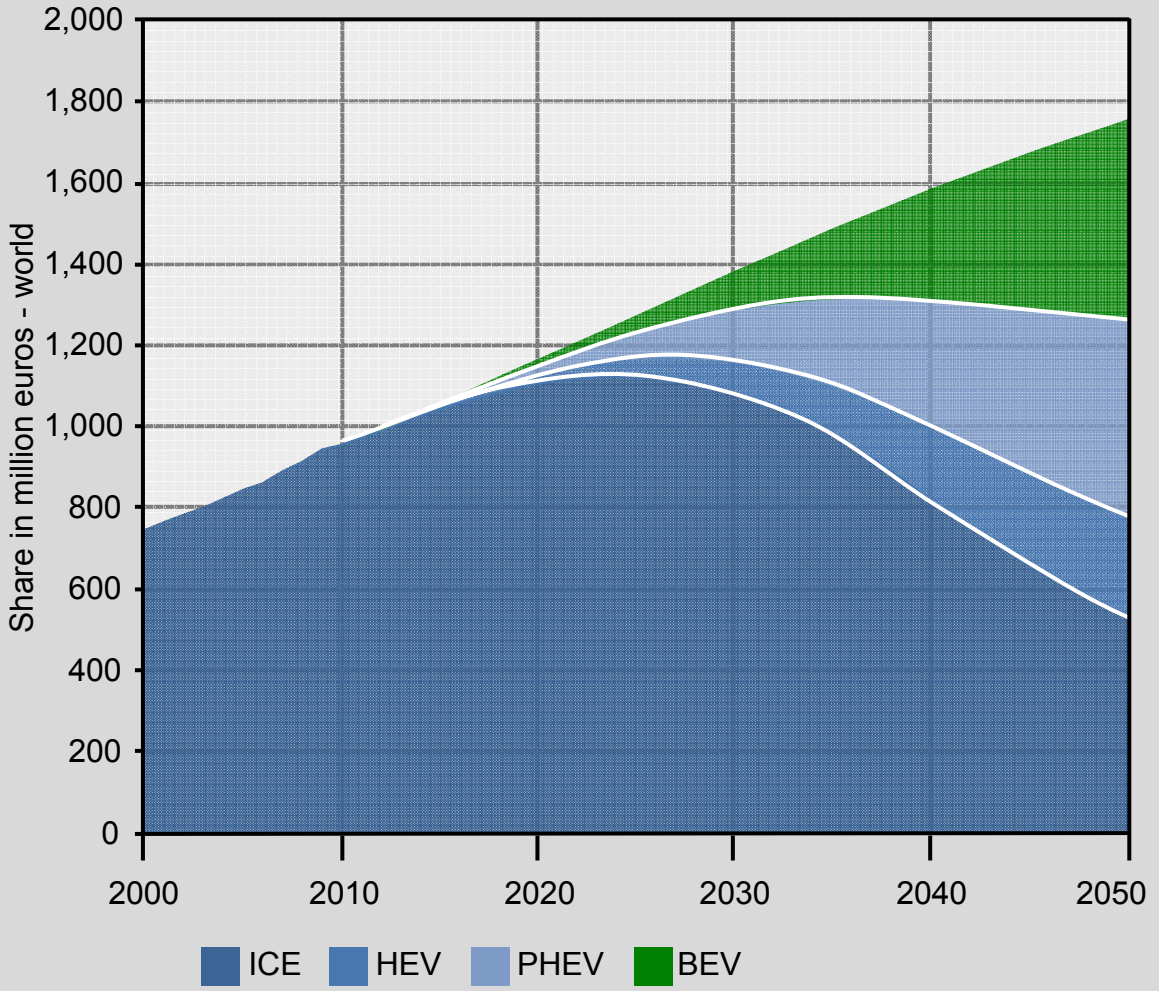
ICE	Hybrid technology	Battery electric	Hydrogen
			
Today	Today	Near future	Future
- Optimisation of fuel consumption and emissions. - Expansion of SULEV programme. - Rollout of “Blue Performance Diesel Programme”.	- Development of full and mild hybrids. - BMW X6 Active Hybrid SOP in 2009. - Hybrids seen as step into electrification of the powertrain.	- First limited BEV series production in 2008 (MINI BEV). - Several next steps planned from 2010 onwards by BMW Group.	- Screening, establishment and securing of technology. - Optimisation of BMW H_2 ICE hydrogen storage and efficiency.

Powertrain concepts

General Conditions and Electro-Mobility.

Electrified vehicles will achieve relevant market shares.

- Internal combustion engines will continue growth trajectory until 2020 - 30.
- The shares of electrification will steadily increase.
- In 2020, the proportion of new registrations for electrified vehicles is estimated at 5 -15 %.



Source: United Nations, Global Insight, Credit Suisse, BMW calculations.

Initial Findings of MINI E Field Trial.

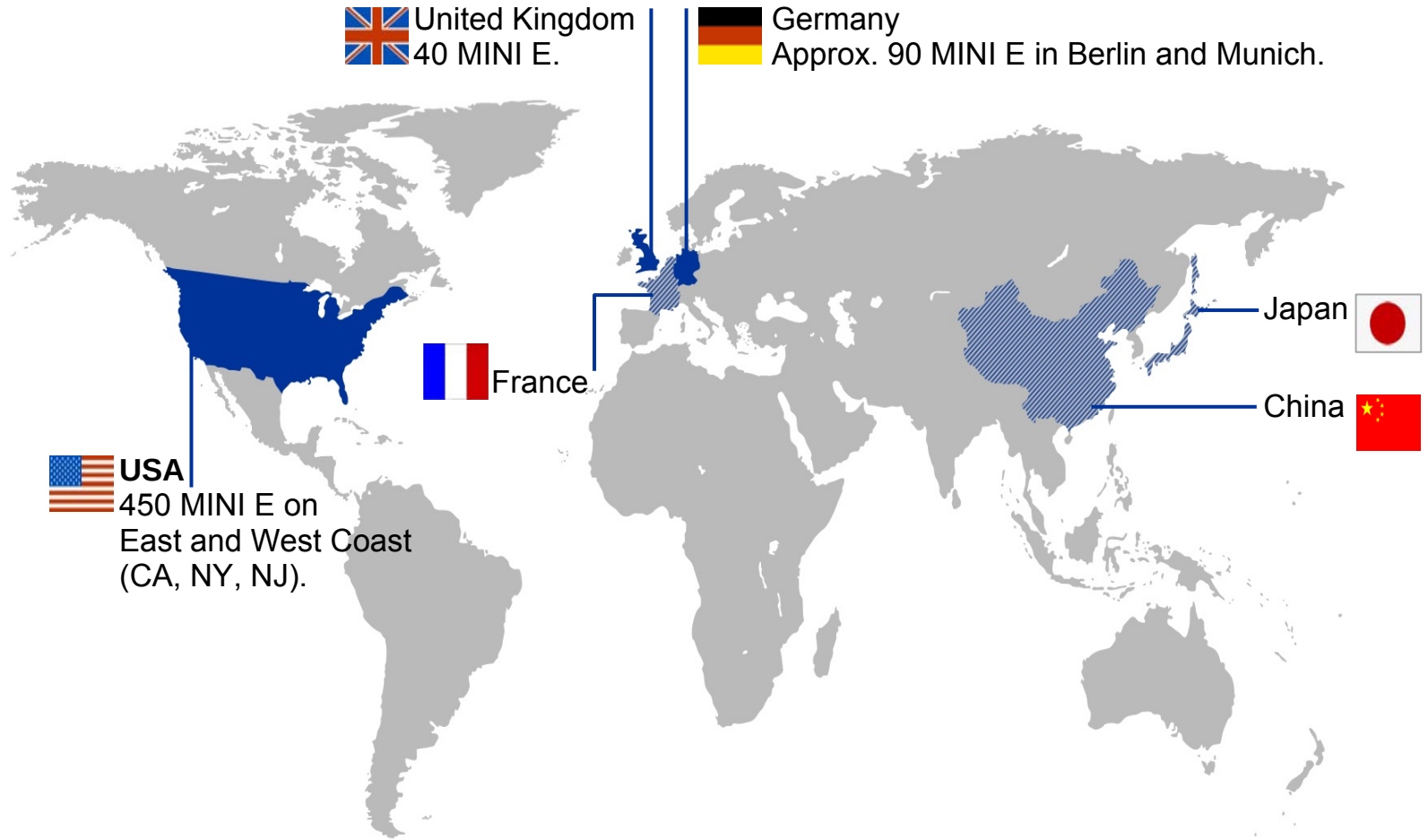
The MINI E - an important building block for future electric vehicles.

Vehicle	2-seater	
Electric motor	Output	150 kW/204 hp
	Torque	220 Nm
	Top speed	95 mph
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 112 miles; according to FTP72: 149 miles

Initial Findings of MINI E Field Trial.

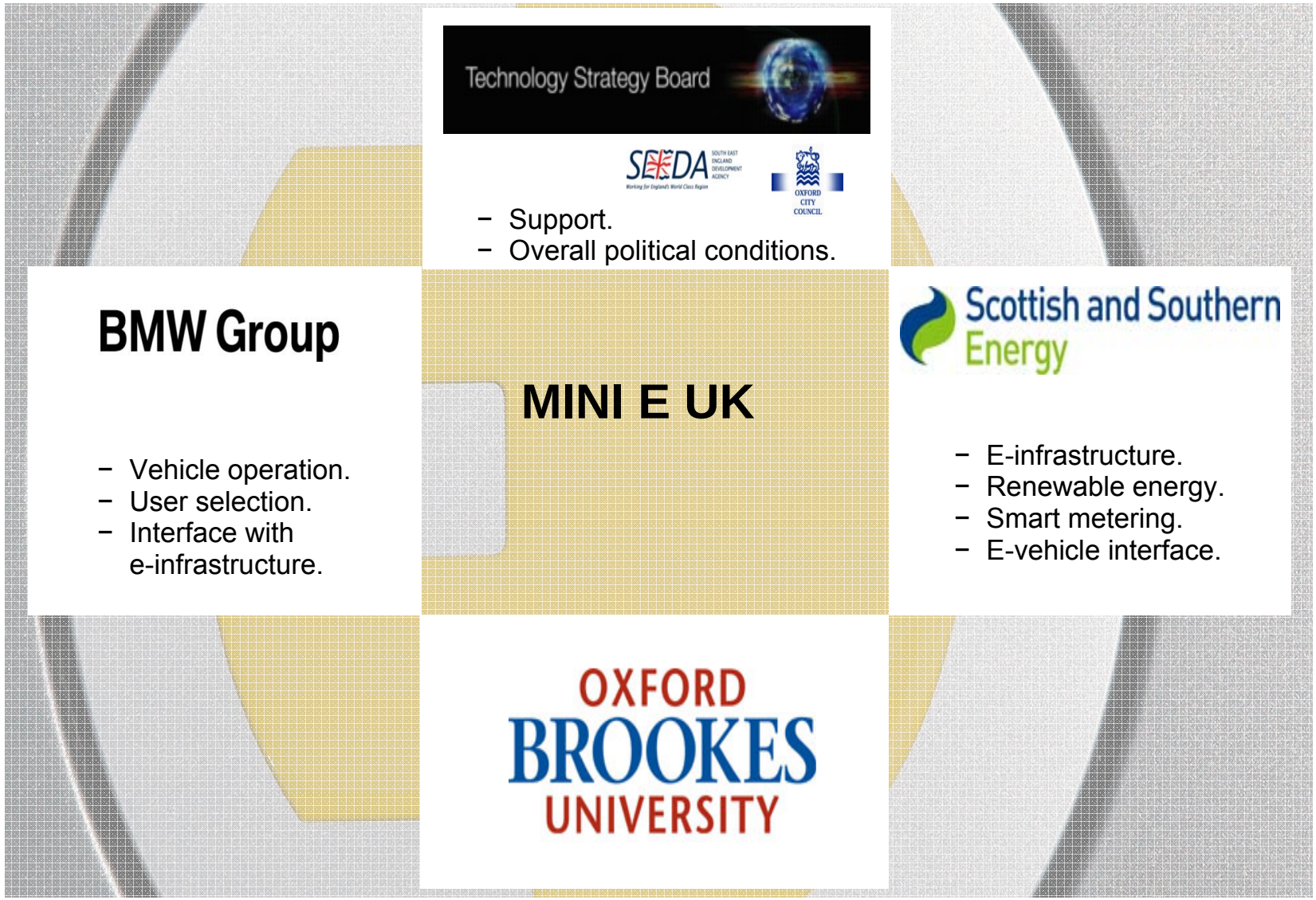
Establishment of learning projects in major e-mobility markets world-wide.

- Experience through field test with real users.
- Integration of renewable energy.



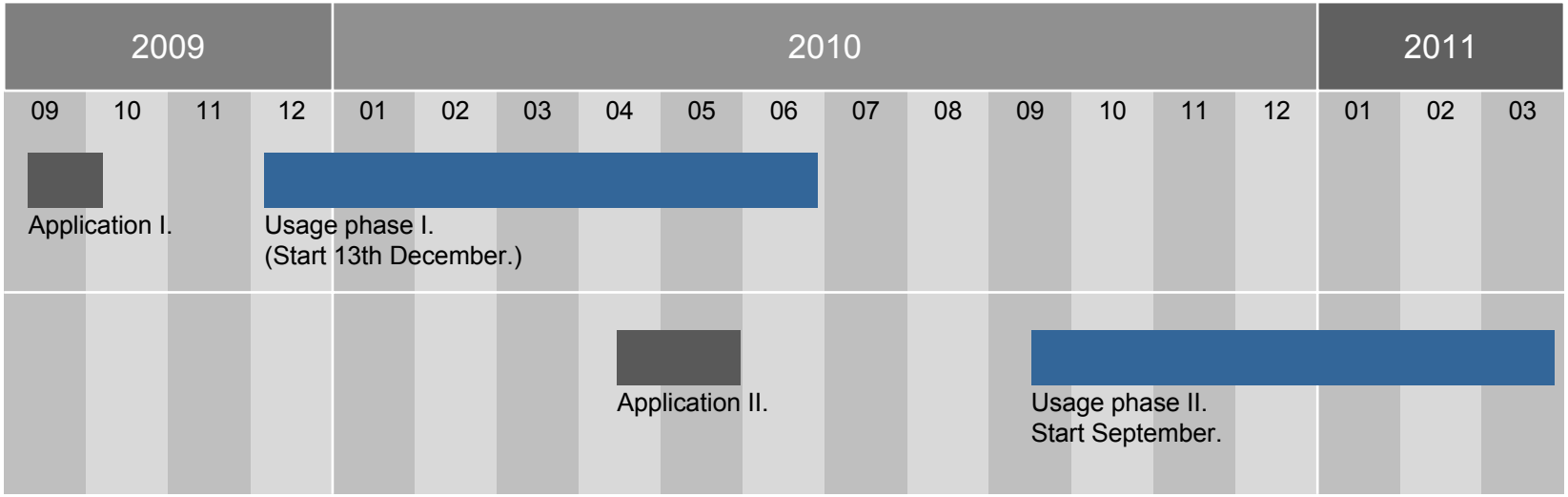
Initial Findings of MINI E Field Trial.

The MINI E consortium in United Kingdom.



Initial Findings of MINI E Field Trial.

Split into two users phases.



- Results for the period December until March evaluated.
- 40 MINI E (20 private users and 20 fleet).
- Private charging infrastructure.
  Public charging infrastructure roll-out from summer 2010 onwar
- Two usage phases of 6 months each.
- Public application process through www. mini.co.uk.
- Fleet trial under real conditions of use.
- Users are scientifically monitored.

Initial Findings of MINI E Field Trial.

Methods 1st user period UK.

Screening user selection

Technical instructions
1st user survey

Interim investigation
2nd user survey

Vehicle return
3rd user survey

1st travel diary

2nd travel diary

3rd travel diary

1st Telephone interview

2nd Telephone interview

Nov / Dec 2009

March / April 2010

June 2010

Data loggers

Handover of vehicles on December 13th.

OXFORD BROOKES UNIVERSITY

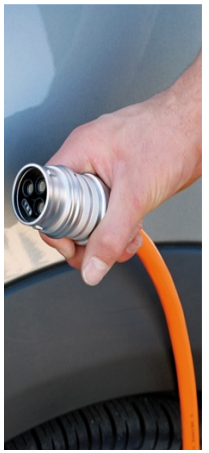
Subjective Data
More than 300 items via questionnaire, 100 hours of interviews, online questionnaire, etc.

Objective Data
More than 200 GB Signals

Initial Findings of MINI E Field Trial.

These questions guided the research.

User profile.	Who applied? - Applicant profile - Who uses the MINI E?
Expectations.	What expectations do users have of the technology?
User behaviour.	How is the MINI E actually used on an everyday basis?
Charging.	What has to be addressed in future in relation to charging and infrastructure?
Ecological relevance.	How important is the ecological added value of an e-vehicle to MINI E users?



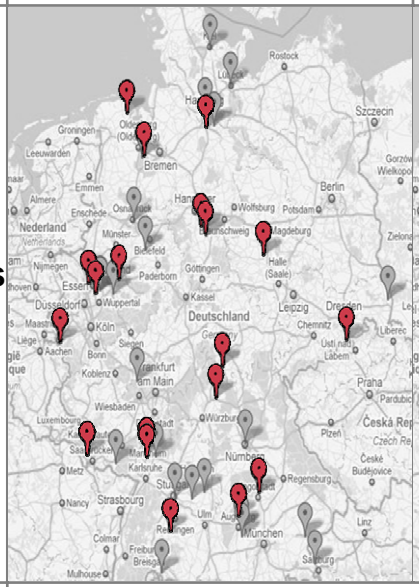
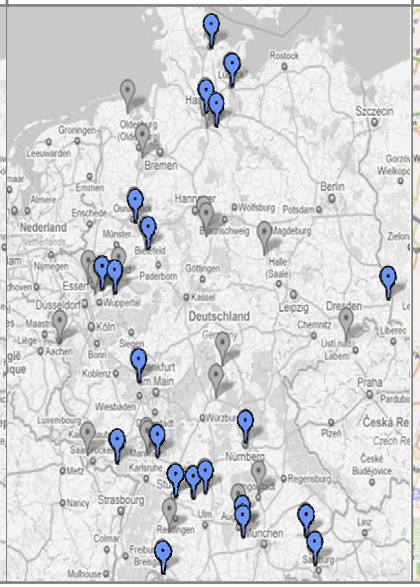
Results of the MINI E Field Trial in UK.

User Profile.

Who applied?	− General: age 35 and over, male. − Highly-educated, above-average income. − High interest in eco issues and interest in MINI E even though rarely experiences with E-driving
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. − Commitment to the brand MINI is important in terms of trust in the new technology

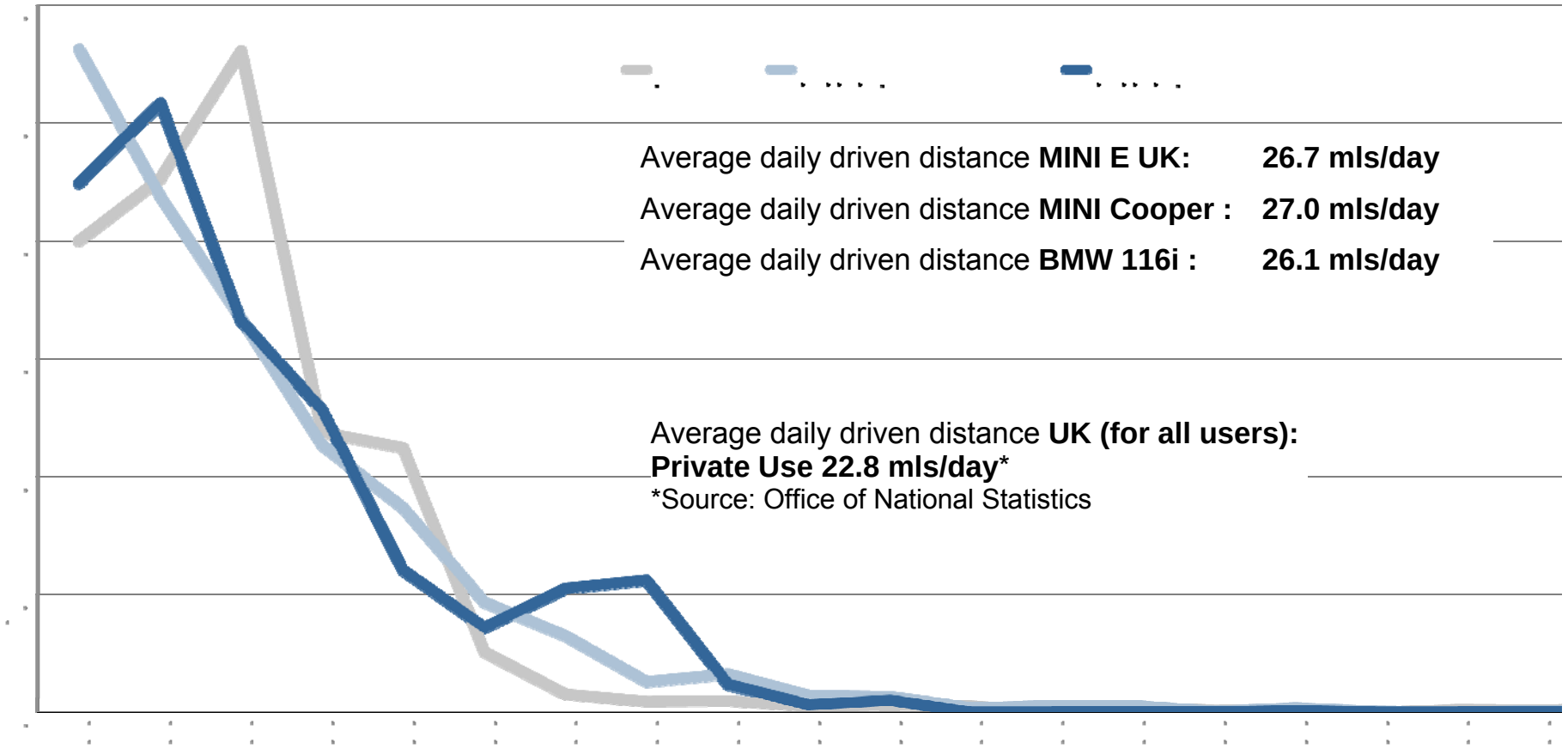
Results of the MINI E Field Trial in UK.

Monitoring of driving behaviour with data loggers.

	116i	Mini Cooper	MINI E (UK)
Number of users	18	22	20
Age	Ø 51 years	Ø 40 years	--
Gender	Male N=13 Female N=7	Male N=6 Female N=16	--
Distribution of vehicles (town / country)			 Area of Oxford, South-West London
Data Collection	Data Logger		

Results of the MINI E Field Trial in UK.

Daily driven distance average customer.



Average daily driven distance **MINI E UK:** **26.7 mls/day**

Average daily driven distance **MINI Cooper :** **27.0 mls/day**

Average daily driven distance **BMW 116i :** **26.1 mls/day**

Average daily driven distance **UK (for all users): Private Use 22.8 mls/day***

*Source: Office of National Statistics

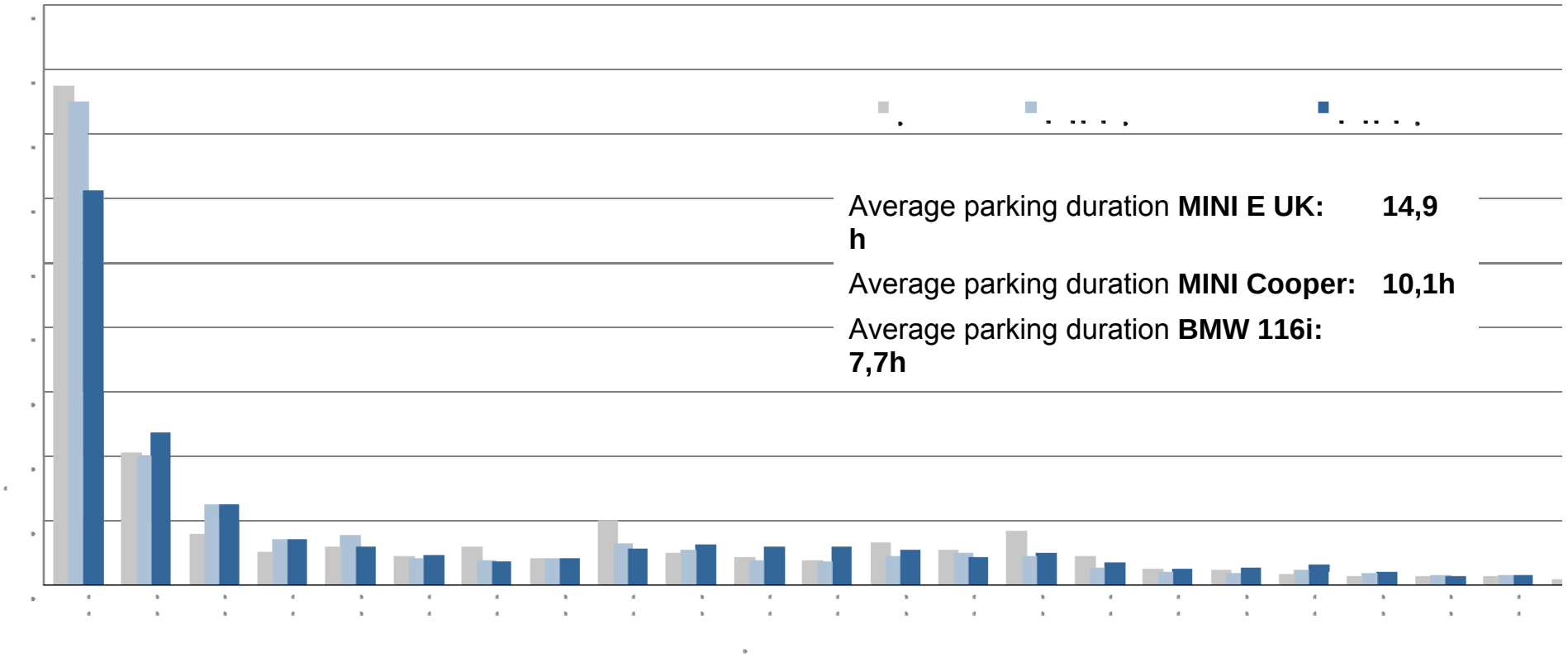
daily driven distance [mls]

Source: Data loggers, EG-63

Results of the MINI E Field Trial in UK.

Parking periods average customer.

Results: Measured parking periods do not differ to a conventional car –
no objective limitations through charging process measured.



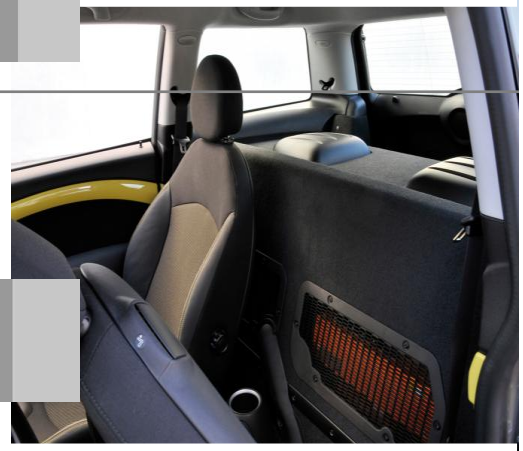
Source: Data loggers, EG-63

Results of the MINI E Field Trial in UK.

Which trips cannot be undertaken in the MINI E?

Only a small number of trips cannot be undertaken in the MINI E.

87.5% of participants reported that approximately 90% of their daily trips c have been done with the MINI E if ther were no constraints in carrying capaci



Reasons for non-use:

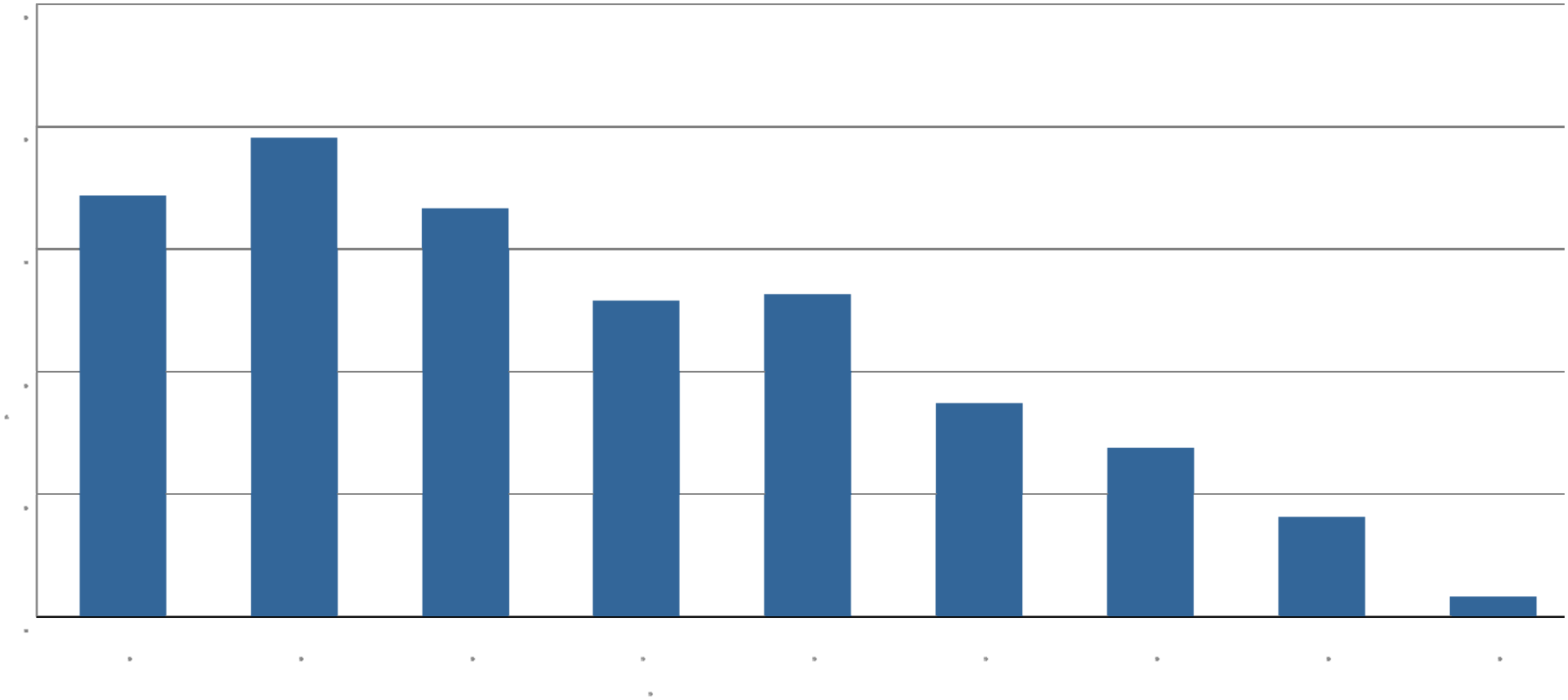
Limited range.
Some trips cannot be made with the MINI E. 89% reported that the MINI E was on occasion not used due to the length of journey.

Limited storage space.
Lack of space was quoted by 67 percent of users for not using the MINI E on odd occasions.

Results of the MINI E Field Trial in UK.

Charging per week average customer.

Results: Users charge approximately every 2 to 3 days.



Results of the MINI E Field Trial in UK.

Do users need a public charging infrastructure?

It is essential that a charging infrastructure is developed?

Response	% agreement	Cumulative %
Very strongly agree	25	25
Strongly agree	50	75
Agree	12.5	**87.5**
Strongly disagree	12.5	100

I can use the Mini E adequately without a comprehensive charging infrastructure.

Response	% agreement	Cumulative %
Strongly agree	25	25
Agree	50	**75**
Disagree	12.5	87.5
Strongly disagree	12.5	100

Results of the MINI E Field Trial in UK.
Ecological relevance.

No change in the following issues from Pre-expectations to 3 months:

100% of Private users and
100% of Fleet users feel
renewables should play an important role in electricity generation of the future.

89% of Private users and
100% of Fleet users think
it's important to charge the battery with renewables.

3 month responses:
Despite 100% support for renewables, only
22% of Private users compared to
72% of Fleet users felt electric vehicles should exclusively be powered by renewables.

Results of the MINI E Field Trial in UK.
Purchase intention & Pricing – overview.

Stories / hypothesis / questions	Results – summarizing version
Purchase intention	− Nearly all users are convinced about EVs and want to use them in the future. − Taking part in the study increased the disposition to buy an EV and reduces the time frame in which they plan to do this.
Pricing	− Users are price sensitive. 44% in UK would pay 1/3 more than for a comparable conventional MINI. − To increase purchase intentions users ask in the first place for improvements in cargo- and passenger space. − In UK acceptable price is seen around 16,000 £ by users.

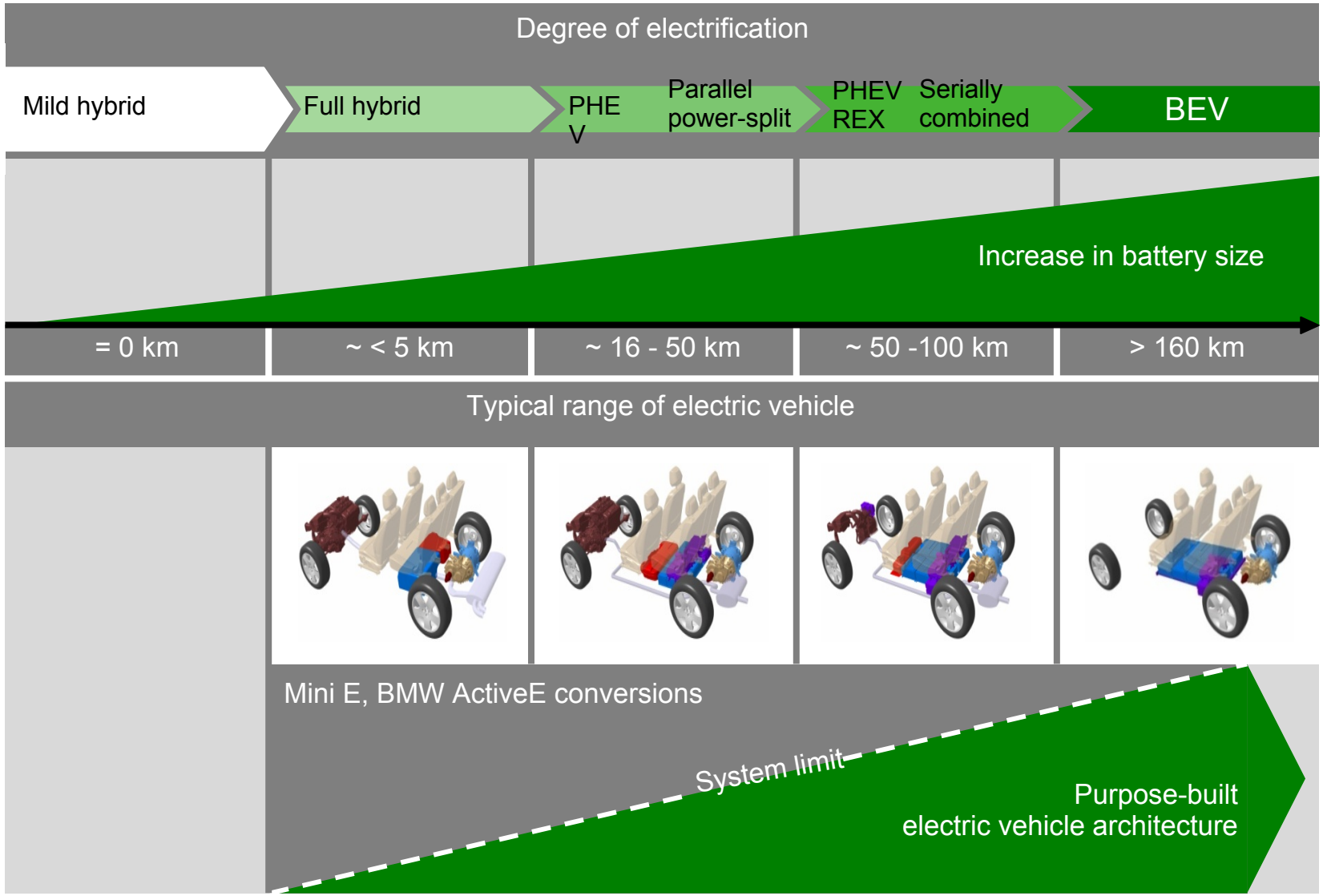
Implications for Promoting E-Mobility.

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 E-Mobility Roadmap.

An electric vehicle requires a new, purpose-built vehicle architecture.

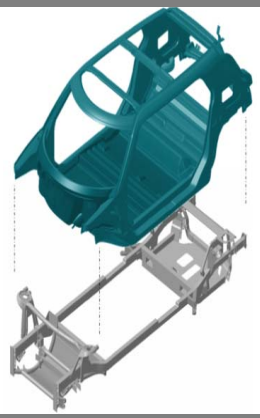


BMW Group E-Mobility Roadmap.

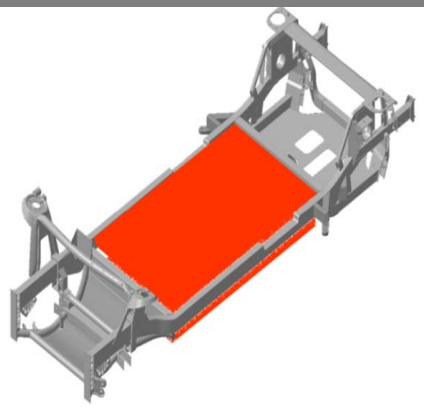
The LifeDrive architecture allows ideal integration of the electric drivetrain.

Execution of overall vehicle concept according to Life / Drive approach

- Easy to create derivatives.
- Weight reduction through lightweight design.
- Specific structure to house the battery.



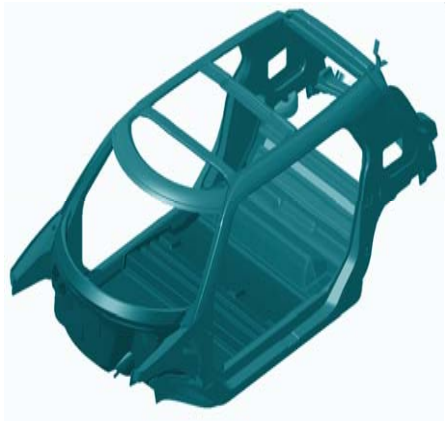
Drive: Aluminium space frame incl. energy storage system



Energy storage system in underfloor section

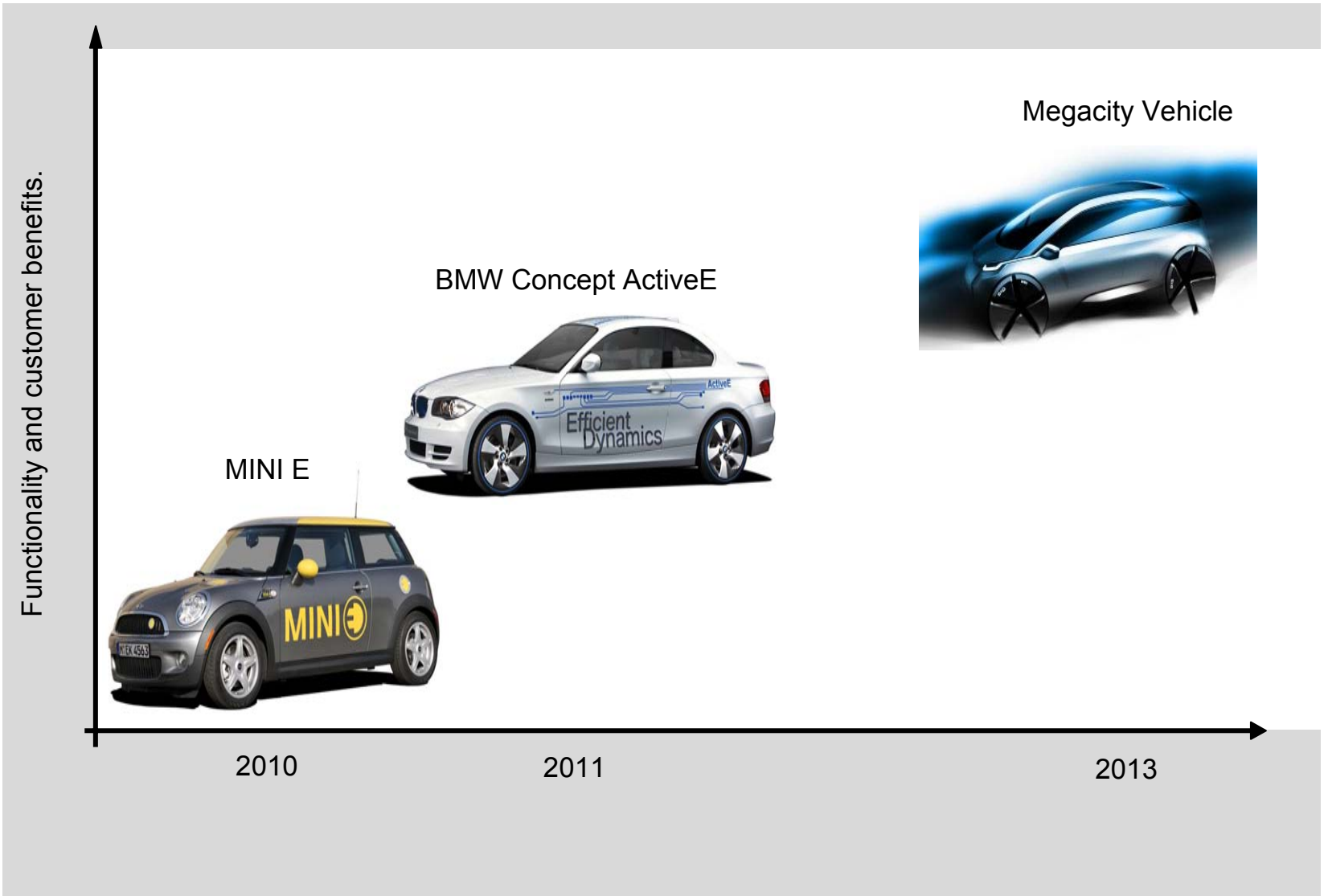
- Low centre of gravity.
- Crash-protected area.
- Level floor in interior.

Life: Carbon fibre structure with outer skin



BMW Group E-Mobility Roadmap.

BMW Group Roadmap for E-Mobility.



E-Mobility is Electrifying!

Thank you very much for your attention.

BMW Group