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Wireless Charging – The Future of Electric

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Questions

- Why Electric Vehicles?
- What is the Current EV Status?
- What Pre-Conditions for Successful EV Adoption?
- Why Wireless Charging?
- Why Qualcomm?

- Why Electric Vehicles?

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Urbanization & Smart Cities

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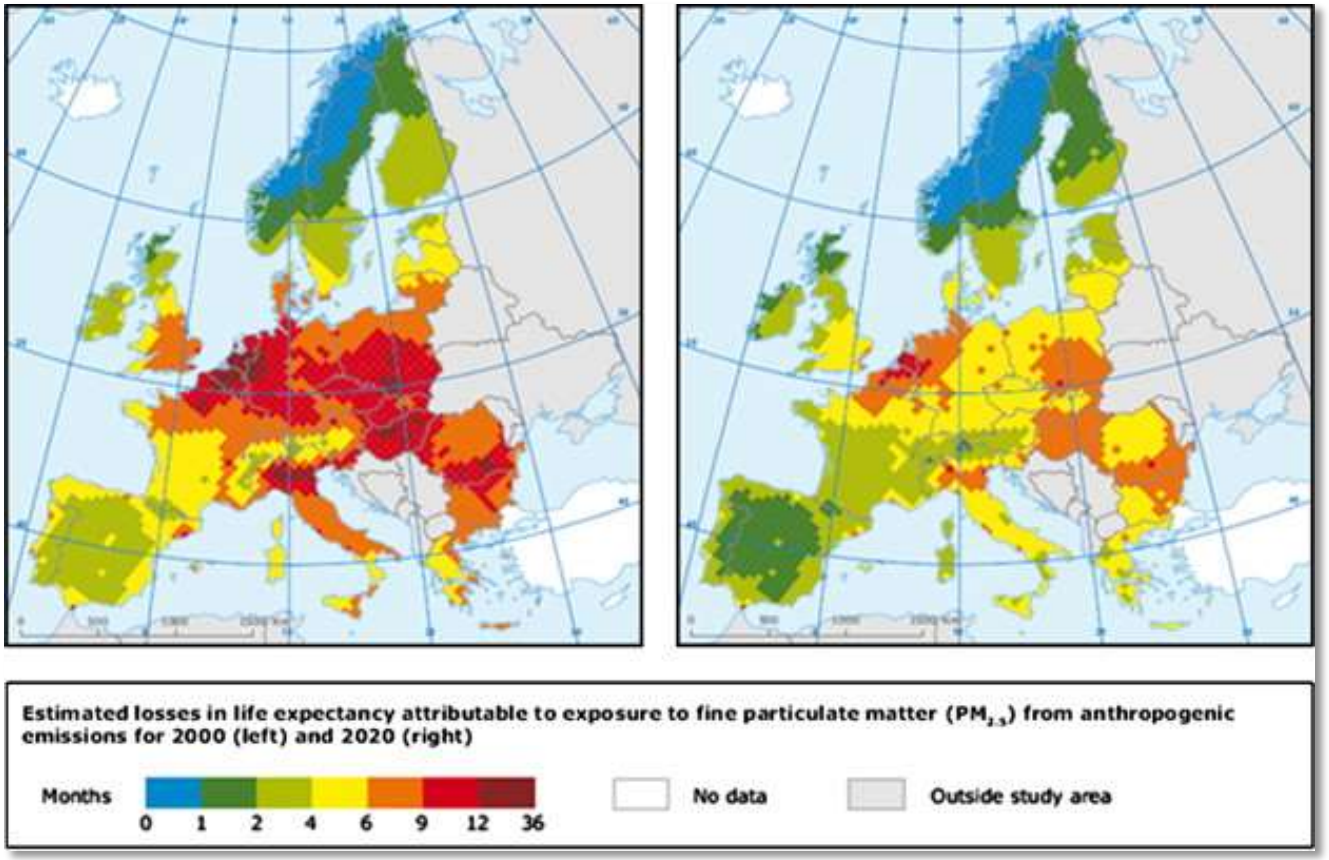
70% of the world's population will be living in towns and cities by 2050 *1

Expenditures on smart city technologies **$8.1 billion in 2010** → **$39.5 billion in 2016** *2

There are more than 100 active or completed smart city projects.

1. World Health Organization http://www.who.int/bulletin/volumes/88/4/10-010410/en/
2. ABI Research . http://www.reuters.com/article/2011/09/08/idUS200870+08-Sep-2011+BW20110908

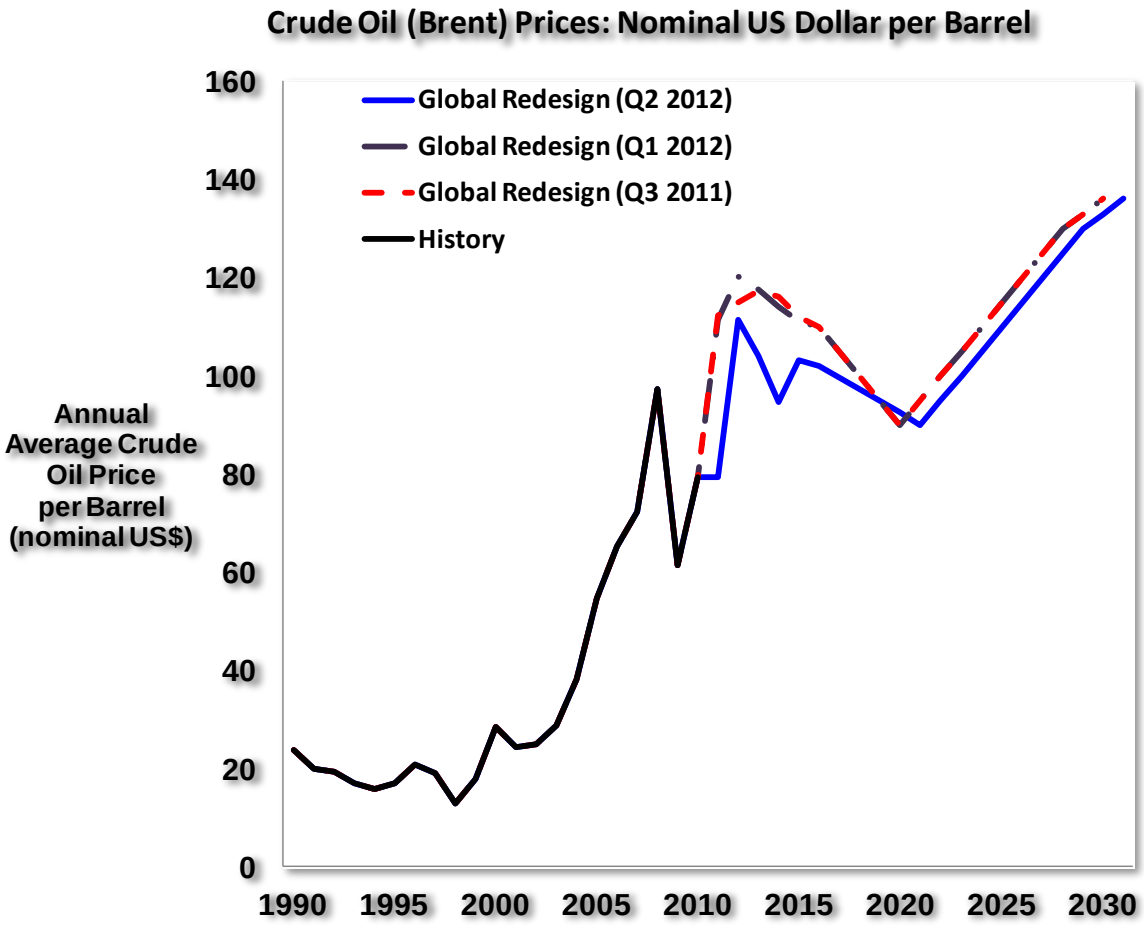
Cost to Health of Particulate Matter



- WHO estimates monetised health impact of poor air quality in 2020
  - €160 billion - €600 billion per year

Source: IIASA: http://www.iiasa.ac.at/

Oil Prices



Source: IHS CERA. *Brent.

- What is the Current EV Status?

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Electric Vehicles to Watch

ZOE

The ZOE will be launched in June of 2013.

Renault is already marketing three electric vehicles: Fluence ZE, Kangoo ZE and Twizy.

Renault says its share of the global market in EVs totaled 30% at end-May and 54% in Europe at end-June.[1]

i3

BMW designed the i3 for urban transport & commuting.

The i3 is expected to be launched in 2013. Followed by the i8 PHEV 2014

BMW use direct online sales platform for iSeries. It also opened its first showroom in London.

E-Golf

In March 2012 Volkswagen announced that it began a pilot scheme to test 20 prototype E-Golf in March of 2012

Volkswagen is expected to start selling its E-Golf in the next year or two

Focus EV

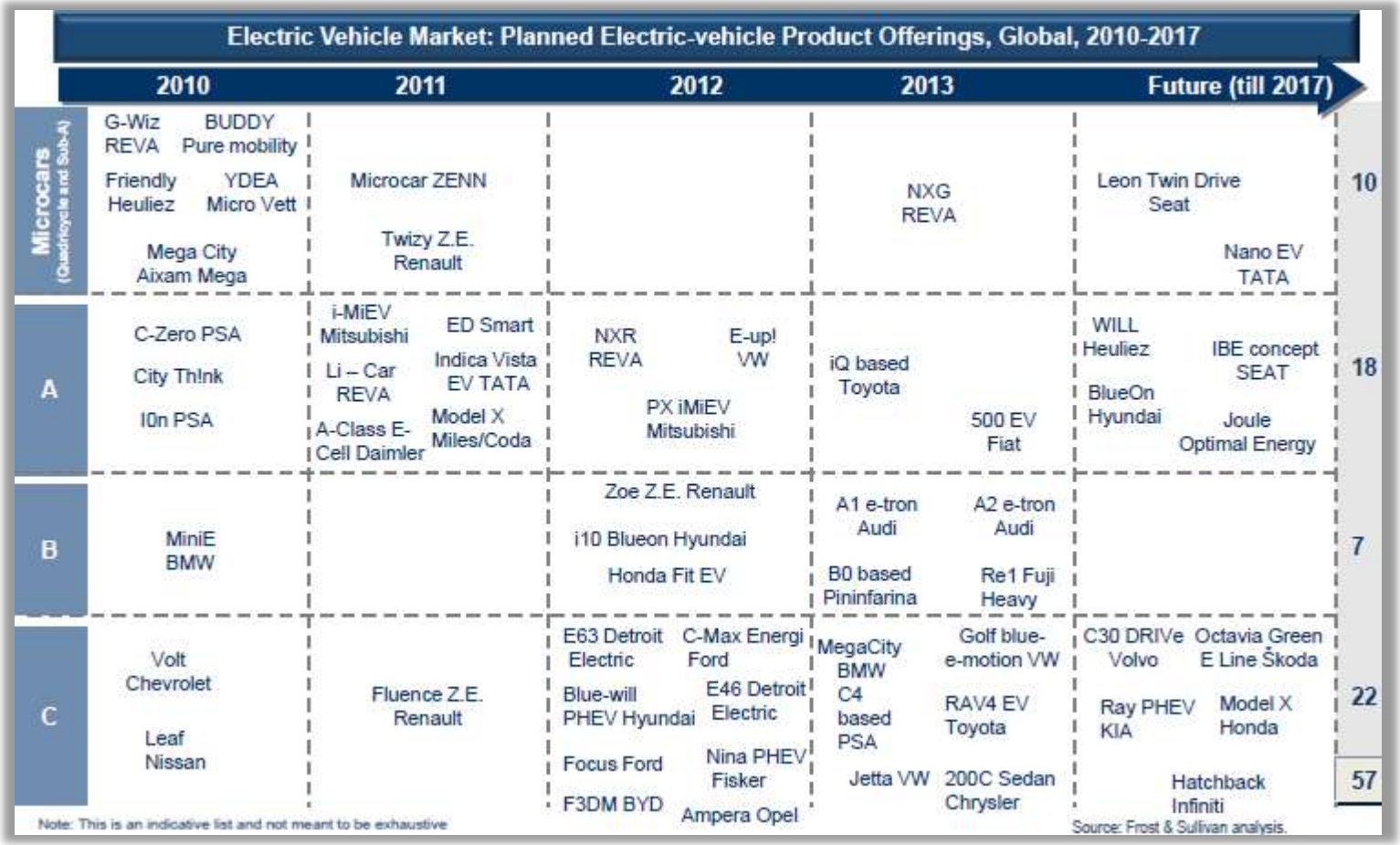
Ford showcased the 2013 Focus Electric at the Geneva Motorshow in 2012

Ford is expected to start selling its electric Focus shortly and is advertsing availability on its website.

1 Renault press release. Clarification on the launch of ZOE July 25, 2012 http://media.renault.com/global/en-gb/renault/Media/PressRelease.aspx?mediaid=33190
2 Volkswagen launches e-Golf test fleet in the US. March 20 2012 THE U.S press release http://www.media.vw.com/pressrelease/1012//volkswagen-launches-e-golf-test-fleet-u.s
3 BMW Bets Mouse Click to Win $48,500 Electric Model Buyers. 24 July 2012. Bloomberghttp://www.bloomberg.com/news/2012-07-24/bmw-bets-mouse-click-to-win-48-500-electric-model-buyers.html
4 Ford's Website at Ford.com

Electric Vehicle Product Launches

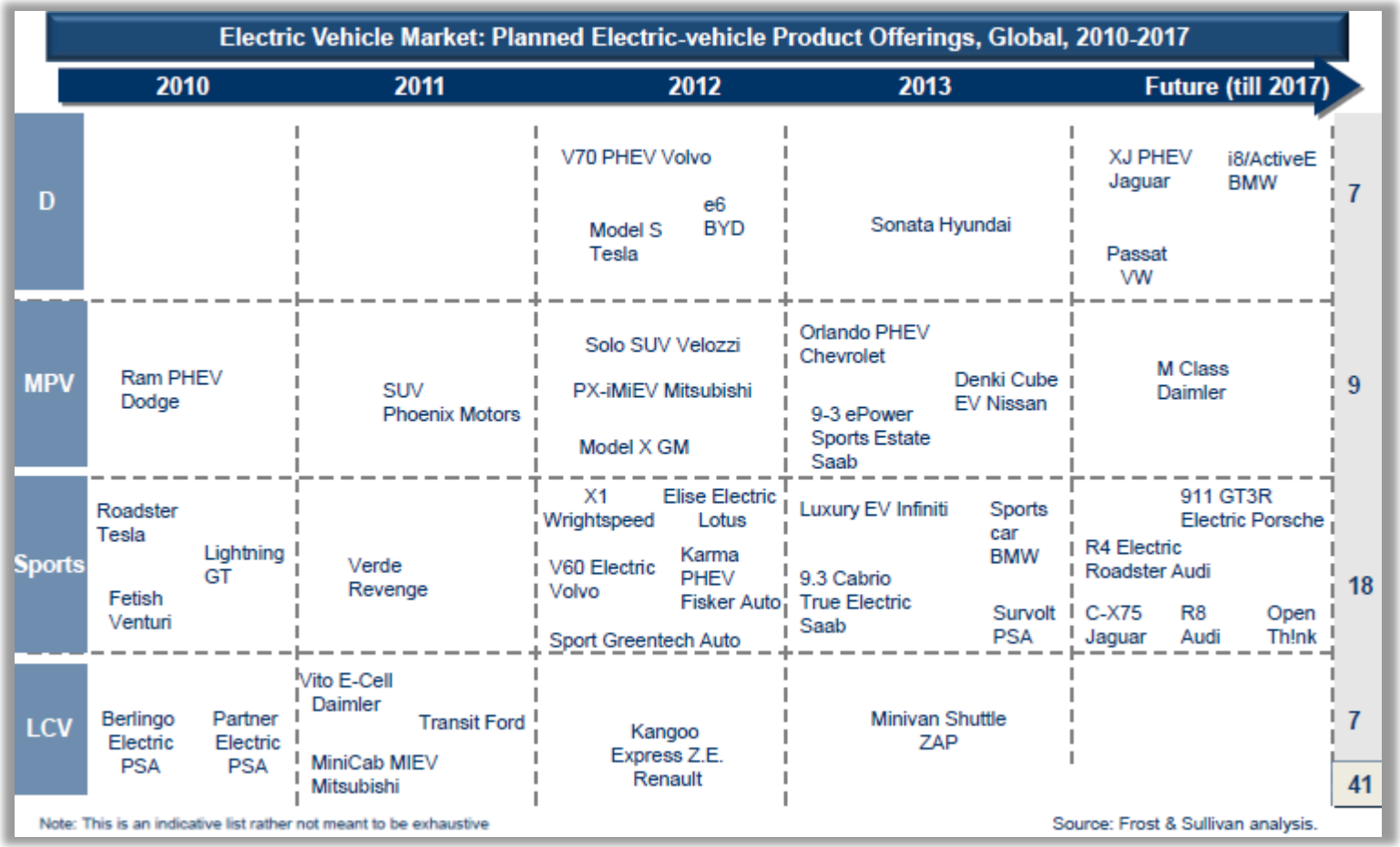
- C-Segment vehicle launches critical expect 19 models between 2012 & 2017 – Frost & Sullivan



Source: 360-degree Perspective of the Global Electric Vehicle Market – 2012 Edition. Frost & Sullivan, June 2012

Electric Vehicle Product Launches

- About 18 sports cars expected to be launched by 2017 - Frost & Sullivan



Source: 360-degree Perspective of the Global Electric Vehicle Market – 2012 Edition. Frost & Sullivan, June 2012

- What Pre-Conditions for Successful EV Adoption?

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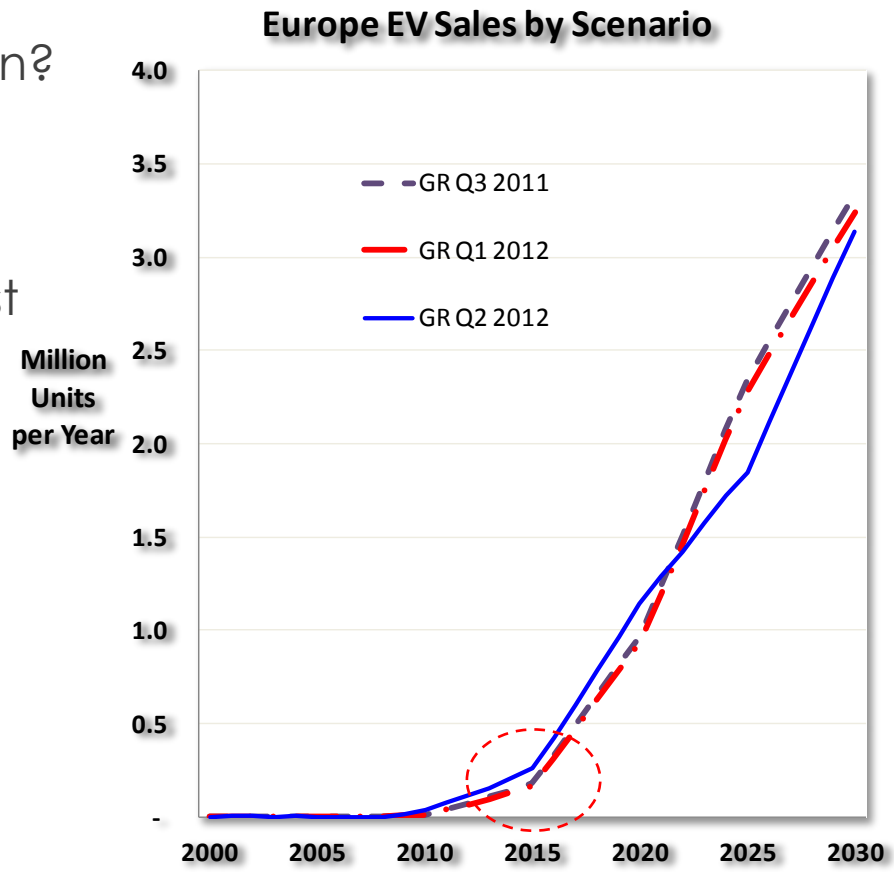
Pre-Conditions for Success

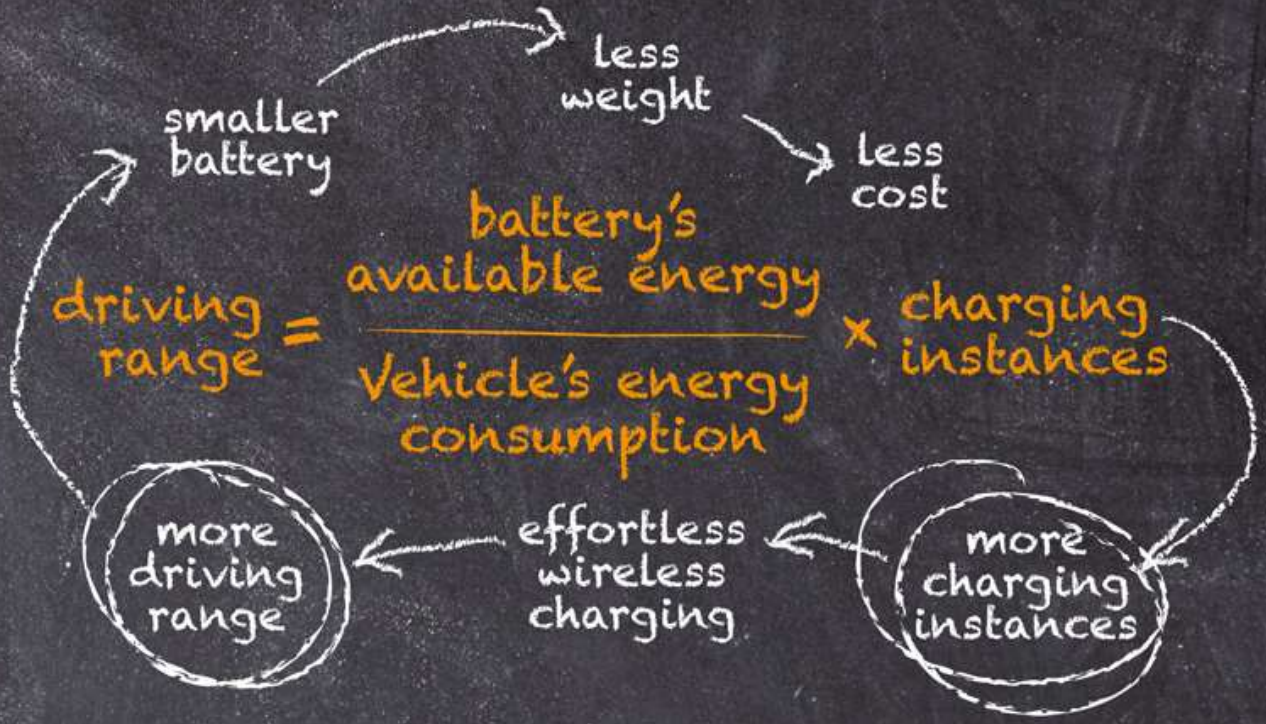
- Still Early Market
  - When will the hockey stick happen?
- Focus
  - Cost, Battery, Range, Weight
  - Increasing Range Impacts EV Cost
- Factors for Growth
  - Cost
  - Ease of Use
  - Ubiquity



Source: IHS CERA.

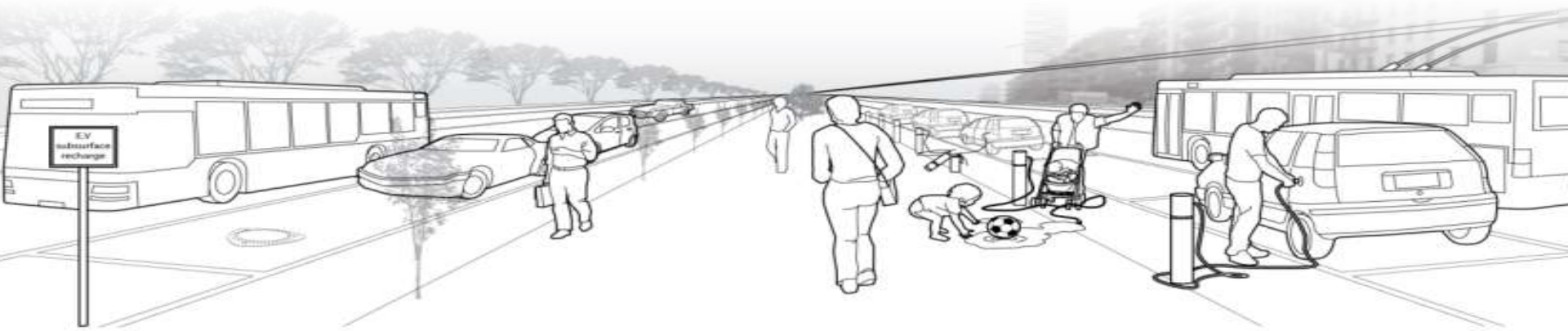
Factors for Growth – Cost

- Simplistic Range Equation



The greater the number of charging instances
the smaller the EV battery could be and the lower the lost.

Factors for Growth – Ease of Use



- **Wireless EV Charging meets our needs**
  - Simple, effortless & convenient
  - Automatic hands-free charging
  - No cord to unplug, or steal
  - Unaffected by Water, Ice & Snow
  - Simple to package on EVs
- **Multiplicity of charging opportunities**
  - Charge little, often and everywhere
  - Simple to Deploy, no street clutter
  - Encourages intensive charging infrastructure
  - Reduce battery size and EV cost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- Why Qualcomm?

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Qualcomm Pedigree

- 26 Years of Wireless Innovation
- $19 Billion Fiscal 2012 Revenues
- $3.9 Billion R&D Spend
- 26,000 Employees
  - Huge focus on research into wireless technologies
  - Engaged with major Standards & Regulatory bodies
- Long history in Wireless Power Research

Mobile Meets Mobility

- Opportunities at the intersection

Navigation Services

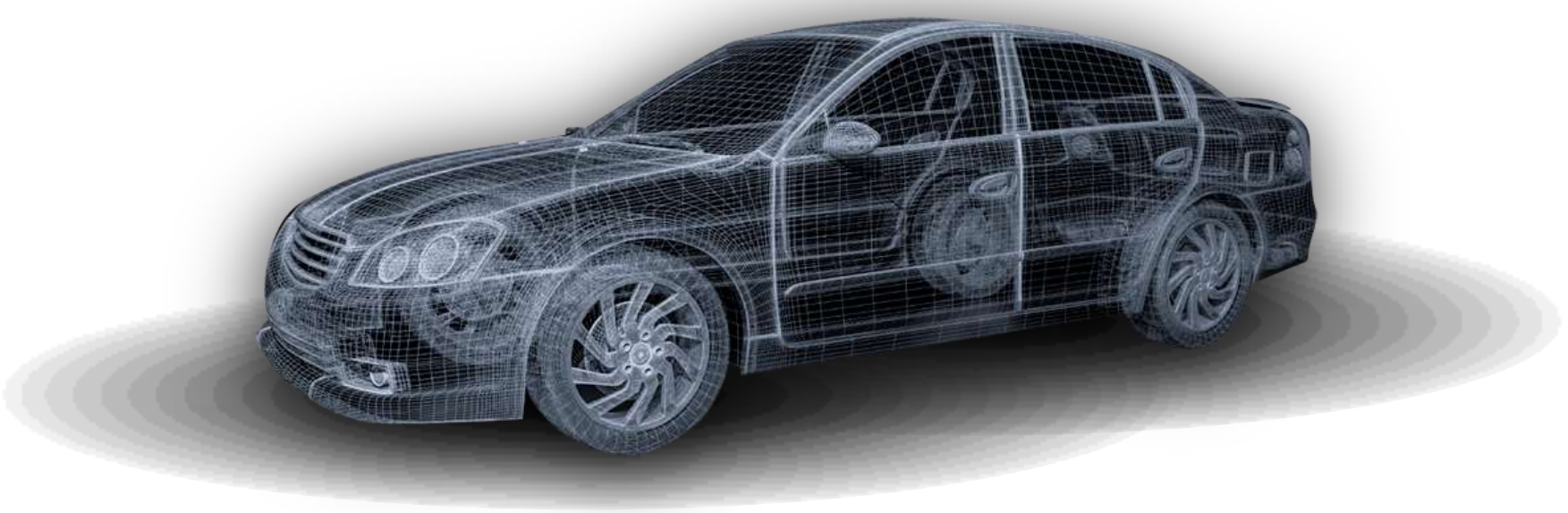
Safety and Security

Application Downloads

Content Streaming

Mobile Hotspot

Wireless EV Charging



Qualcomm Business Model

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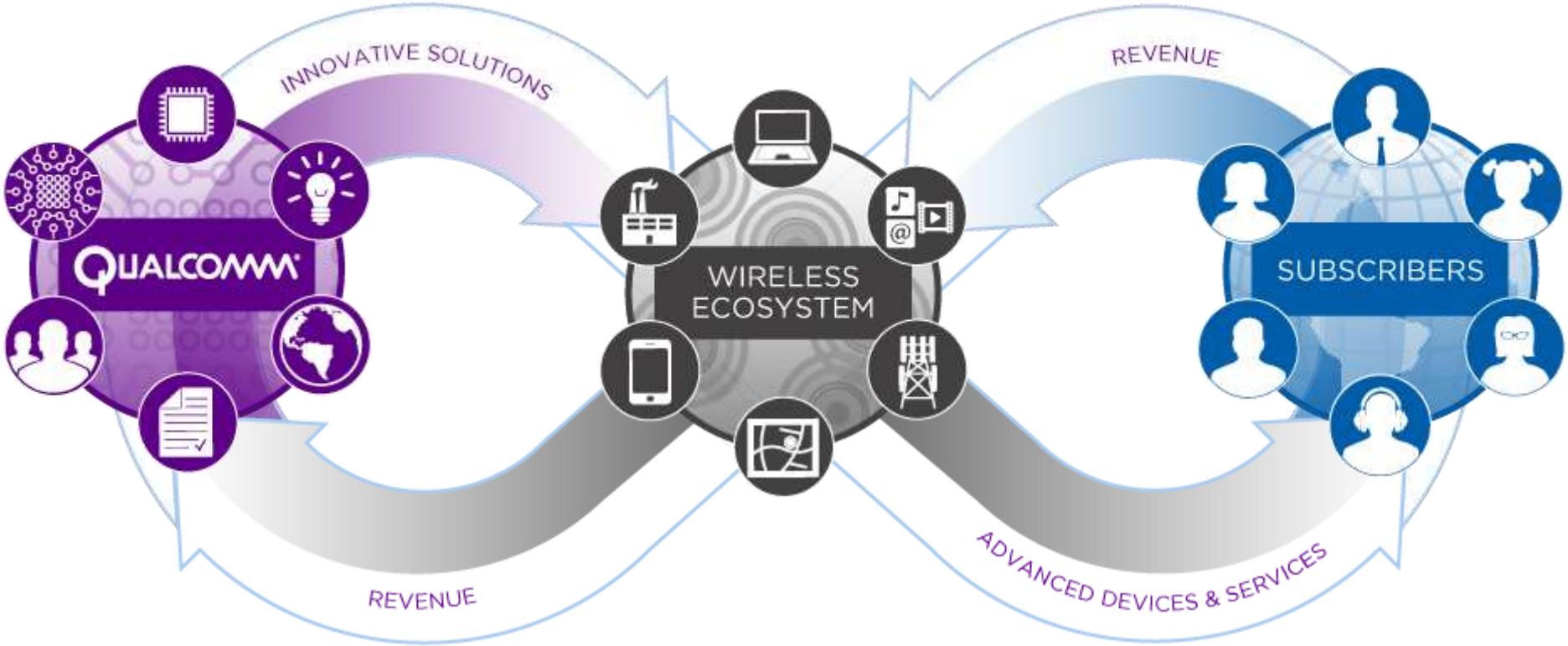
- Technology and Value Chain Enabler



- Horizontal business model encourages competition and fosters innovation
- 25 years of Technology Licensing with over 230 Licensees worldwide
- Global Investment in R&D, standardisation and regulatory affairs, enabling successful development of total ecosystem

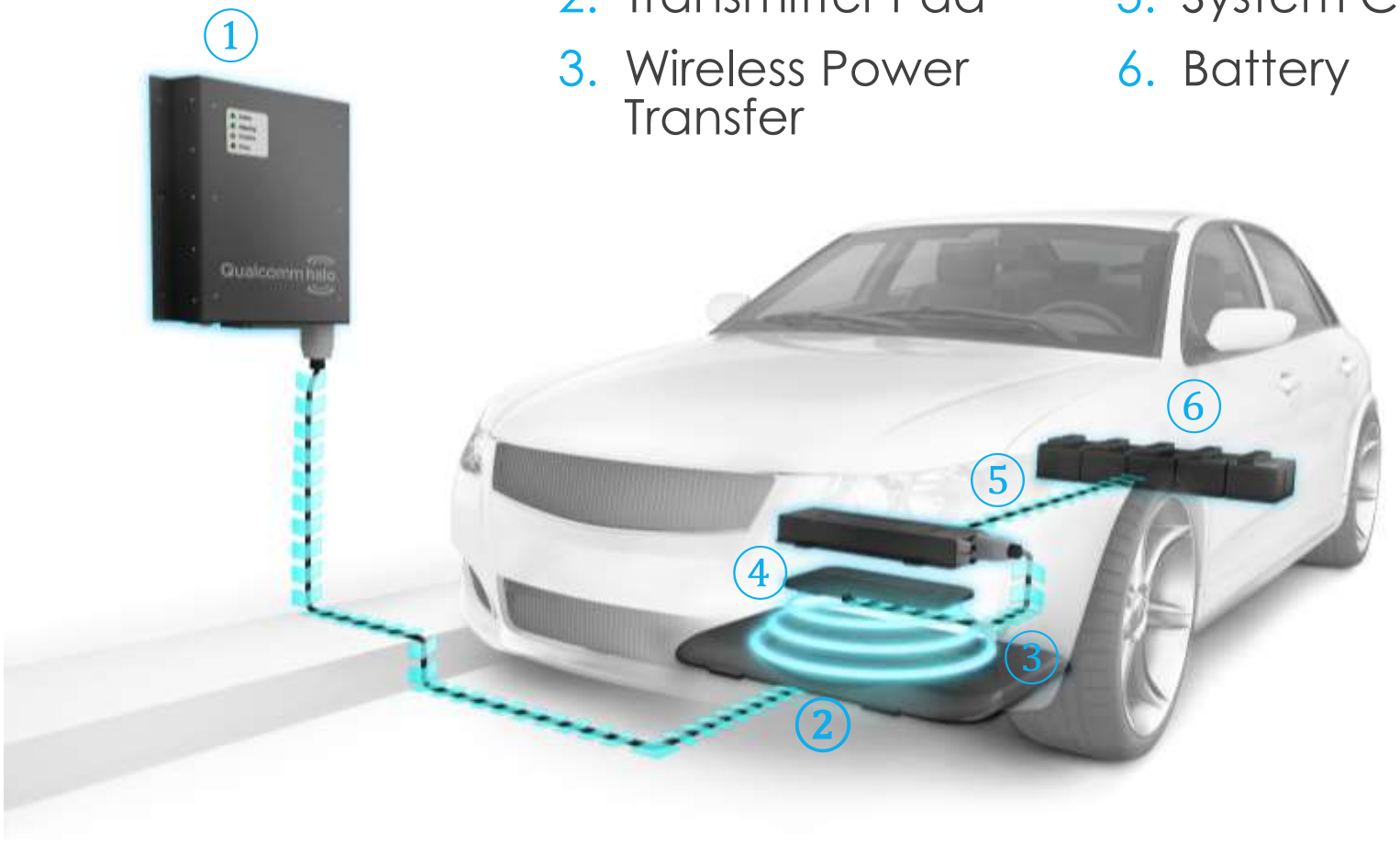
Conditions for Success

- Success comes from improving the driver experience
- Common standards and interoperability are essential
  - Simplified infrastructure and user experience
  - Economies of scale
  - Common standard de-risks technology choice while allowing for Tier 1 differentiation
- Compliance and Regulatory Criteria
  - Regulatory issues must be addressed globally
  - Highly efficient systems more likely to meet standards
  - Compliance to Emissions & Foreign Object Detection

Qualcomm is in a unique position to partner with OEMs, Tier 1's and EVSEs to create an environment for widespread success of wireless charging

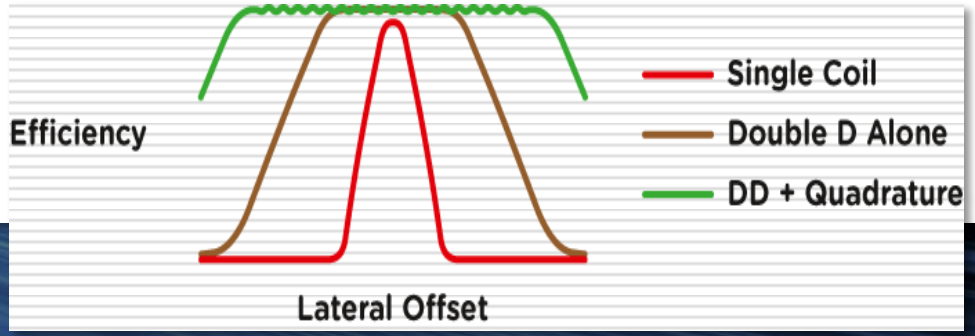
Our Complete Solution

1. Power Supply
2. Transmitter Pad
3. Wireless Power Transfer
4. Receiver Pad
5. System Controller
6. Battery



Our Unique Technology

- Simple, **effortless** and convenient
- **Small** volume, easy to package on EV
- Unique **proprietary** flux pipe DDQ magnetics
- High **efficiency**
- High **tolerance** to lateral misalignment (X/Y)
- Tolerant to large variations in vertical **gap** (Z)
- **Interoperable** with different pad topologies
- Enables **charge-on-the-move**



Flexible Technology

- **3.3kW** – Home Charging
- **7kW** – Home – Office – Public Charging
- **20kW** – Office – Public – Dynamic

3.3kW Citroen

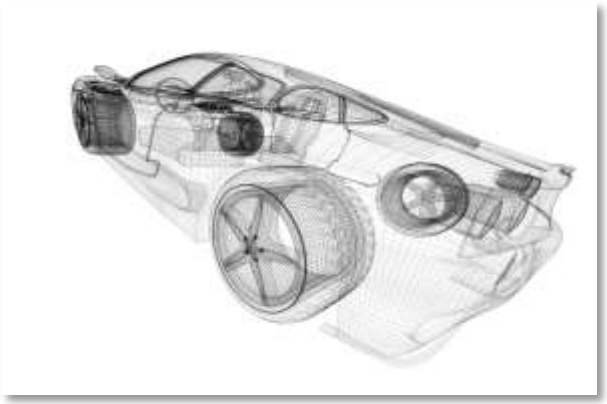
20kW Lola-Drayson

7kW Phantom

3.3kW Fluence

WEVC London Trial Objectives

- Understand EV **integration**, packaging & **deployment**
- Generate technical data & **user feedback**
- Create **demonstration**/test environment for OEM's WEVC
- **Promote** EVs by demonstrating wireless charging as effortless
- Test various **use-cases** for EVs – Taxis, Carshare, Fleets & Private cars
- Demonstrate **sustainable** & scalable business for WEVC infrastructure
- Identify broader technical, commercial & **regulatory** issues



Charging behavior

- How do user's emotions & charging behavior differ when charging wirelessly vs plugging-in?
- To understand changes to the user experience

- Drivers use a plug-in vehicle for a few months & upgrade to wireless, recording experiential change
- Data analysed from vehicles & charging points
- Drivers complete questionnaires to probe the softer issues

Future Developments

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- Developing a fit for purpose WEVC vehicle for public use takes time
- We are scoping further aspects of the trial which will deliver vehicles in later phases
- Under development at present is a taxi program
- We aim to have a number of wirelessly charged electric taxis in use in London in 2014
- Other initiatives under discussion include Car Share

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