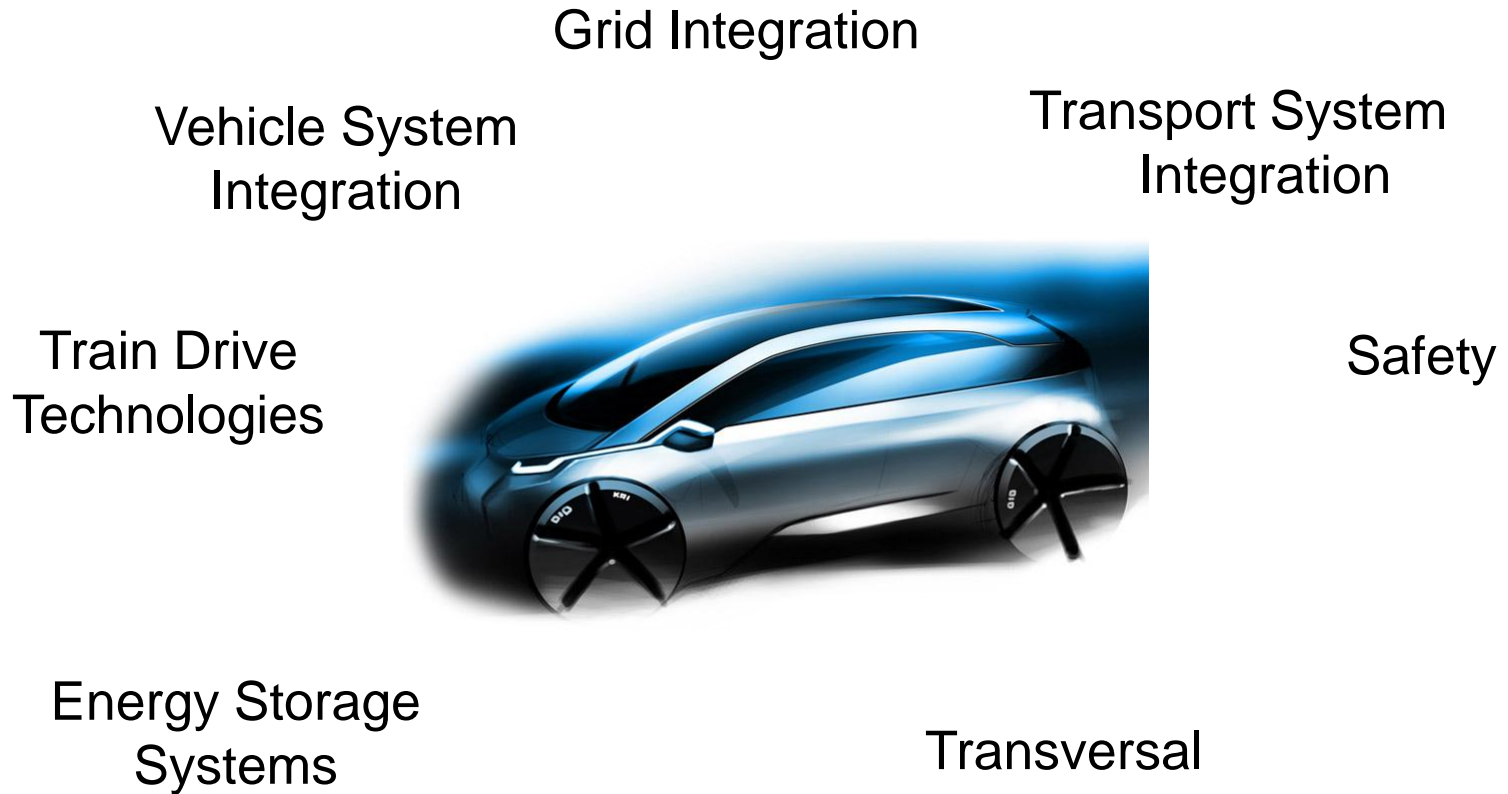




*European Green Cars Initiative*  
*Joint Strategy and Networking Event 2011*  
**R&D Priorities and ICT4FEV Roadmap**  
**Standardization Needs**

**Steffen Müller**  
NXP Semiconductors

# ICT and Smart Systems Related Functionalities



# Milestones



## 1: Introduction (2012)

- ▶ EVs are in production, conversion of existing cars, operational field tests
- ▶ Need for standards for safety, data communication, billing, testing
- ▶ Actions for raising public acceptance are strongly needed

## 2: Intermediate (2016)

- ▶ 2nd gen EV with efficiency gains, advanced system integration, high performance energy storage systems
- ▶ Charging infrastructure has greatly improved in various cities and regions
- ▶ Safety issues concerning mass deployment of electric vehicles is addressed

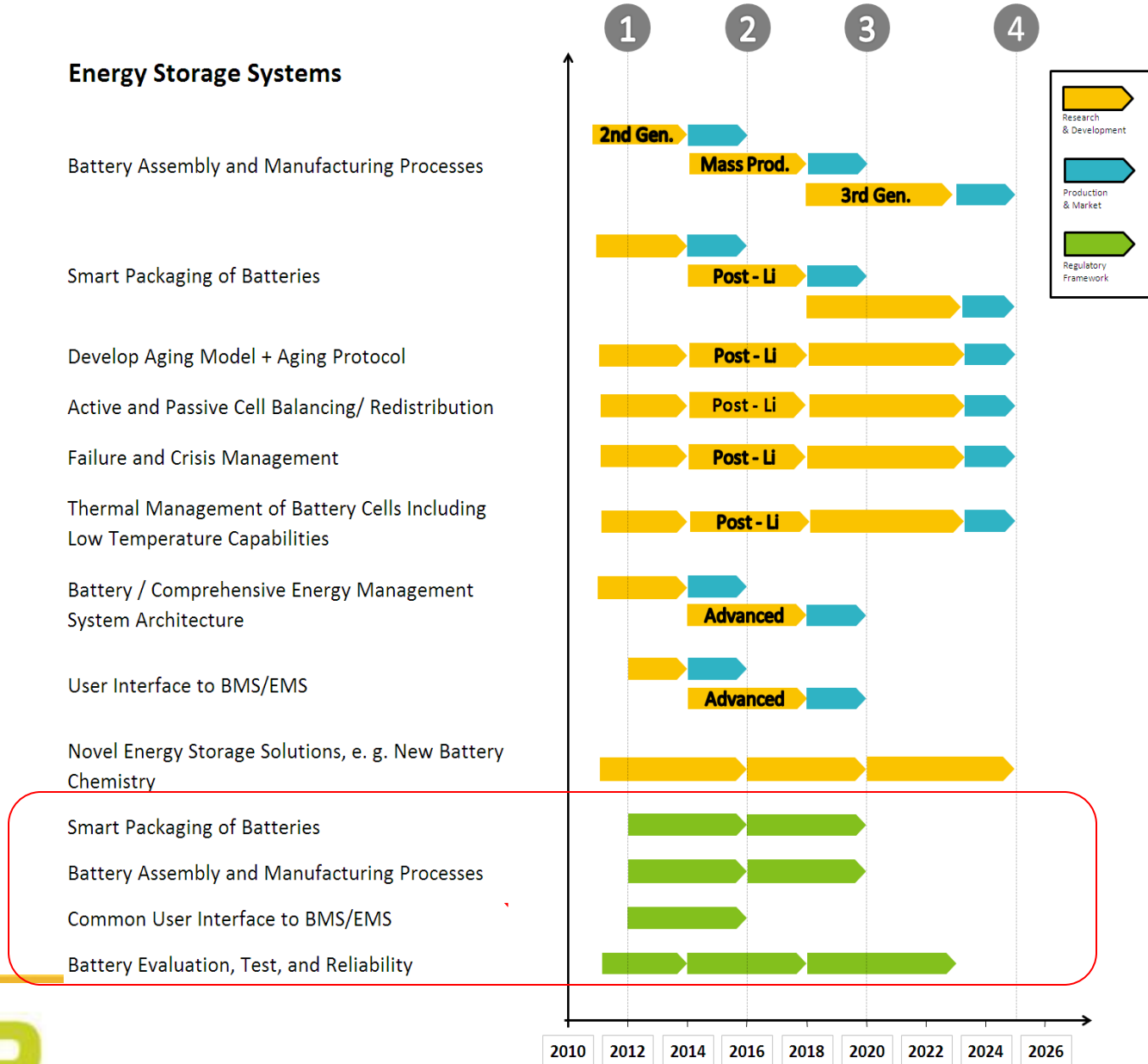
## 3: Mass Production (2018-20)

- ▶ Mass production of plug-in hybrid and electric vehicles is fully established in Europe
- ▶ Batteries provide about tripled life time and energy density at about 30% of today's cost
- ▶ Vehicle architecture is based on a novel and highly integrated platform, cheap electrical motors
- ▶ Contactless and quick charging, bidirectional charging for power storage
- ▶ Active safety systems based on automated driving and car-to-x communication

## 4: Mass Production of 3rd Generation EV

- ▶ 3rd gen EV is based on a revised modular platform including revised ICT reference architecture and middleware
- ▶ Batteries have enhanced bidirectional and fast charging capabilities, contactless and en-route charging is widely spread
- ▶ Car is integrated in the multi-modal transport system: automated driving functionality enhances active safety

## Energy Storage Systems



## Drive Train Technologies

Control of In-Wheel-Motors

Smart and Robust Traction Control

Smart and highly integrated ECU

Analysis of Critical Failure Modes

Optimize Regenerative Braking

User-Accepted and Safe Drive-by-Wire

Smart Photovoltaics

Optimize Combustion Engine as Range Extender

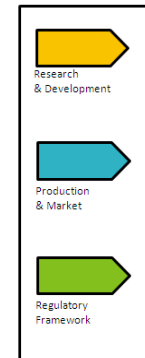
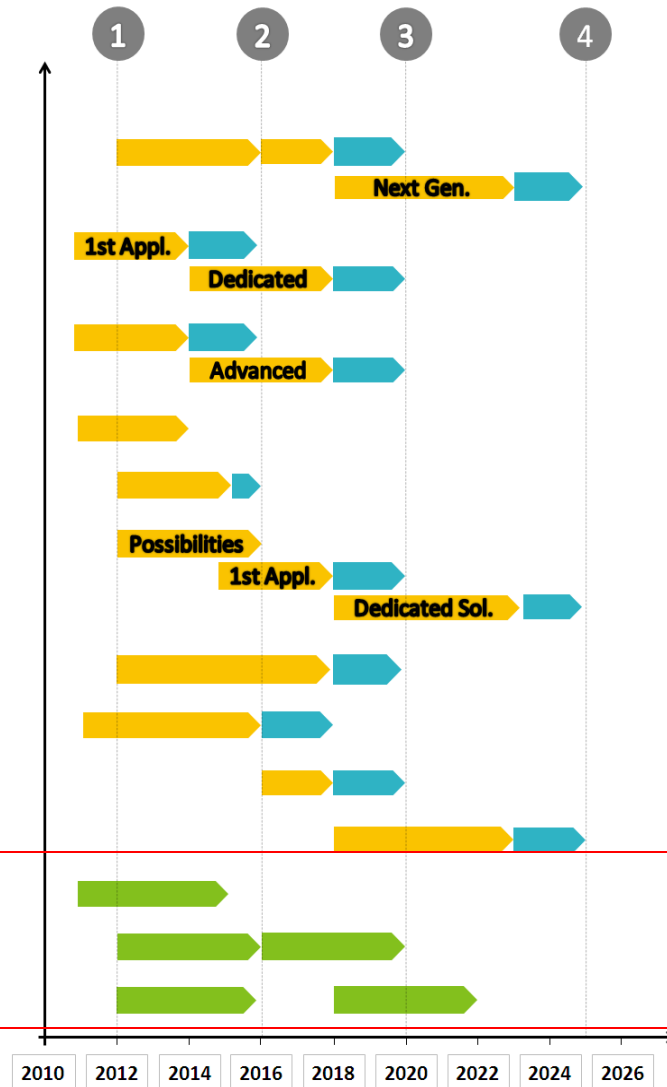
Develop Highly Integrated Range Extenders

Investigate Modularity of Range Extenders

EMC limits and tests for electrical drives

Assembly and Connectors for Solar in EV

Safety Regulations drive-by-wire for EV



## Vehicle System Integration

Active Load Management

Develop Measures for Vehicle Health

Develop Measures for Vehicle Fault Diagnosis

Research Possibilities for Self-Sustained and / or Energy Optimized Auxiliaries

Investigate Possibilities of Active NVH Control

Research New ICT-Reference Architecture

Broadband Infrastructure >1 Gbit/s (Transceiver/Router/Bus)

Comparable Efficiency Categories and Limits for e-, combustion, and hybrid drives in preparation of new EV platforms

Diagnostics in multi-drive power train architecture

Communication Standard for the EV Energy Management System and Associated Components (e.g. Smart Navigation eCharger, Power Train, Vehicle Safety Module)



## Grid Integration

Develop Adaptive on- and off- Board Charging Device

Smart Devices for Bi-Directional Charging

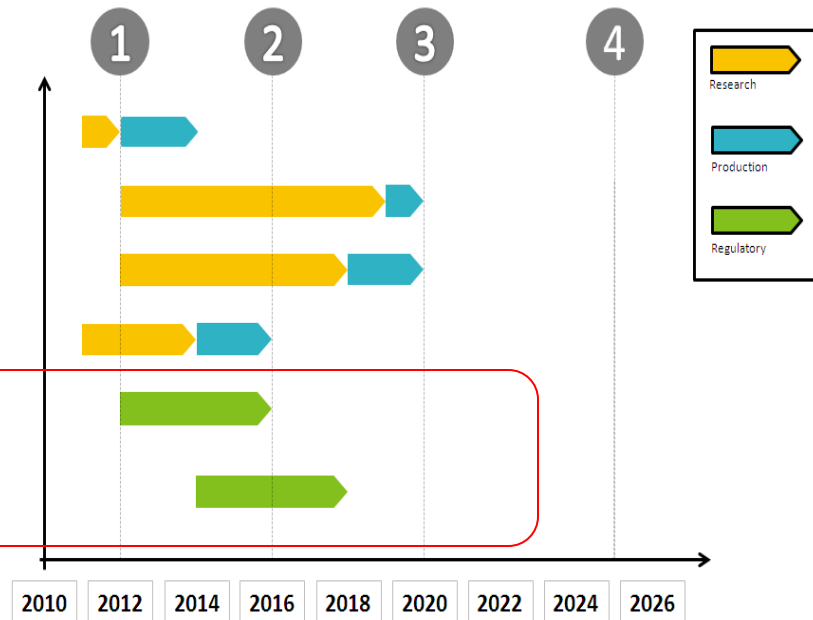
Smart Devices for Contactless Charging

Smart Energy Supply and Demand Matcher

Regulations and Limits for Contactless eCharging

Next Gen car2grid Communication for eCharging

Incorporating new Charging Techniques



## Transport System Integration

Develop Devices for Automated and Cooperative Driving

Car2Car and Car2Infrastructure Functionality

Provide Interfaces for Integration into Transport System Networks

Smart Energy Efficient Router

Next Gen Maps for EV Navigation; Smart Information and Formats, Learn Techniques, Car2Car Protocols

Smart Connectivity to Private Networking (e.g. NFC) and Public Information Systems

Next Gen Car2Infrastructure Communication; Wireless and Secured





## Safety

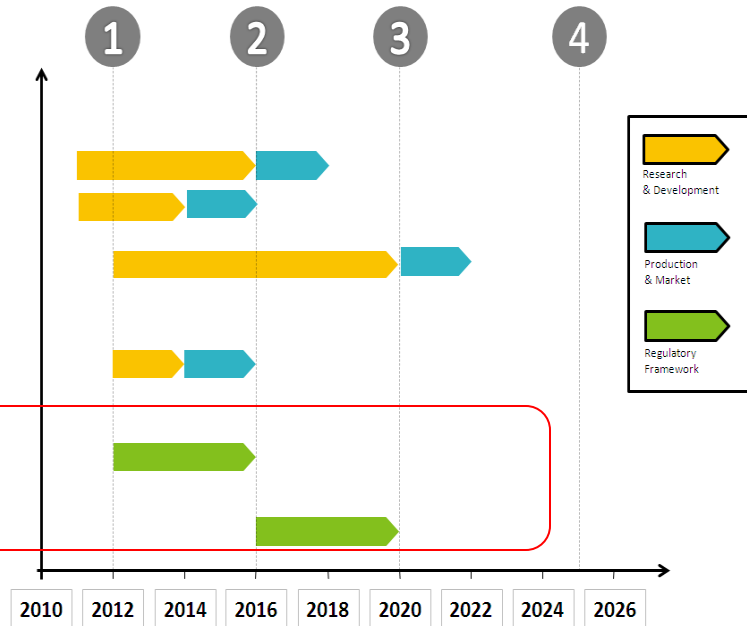
Develop Pedestrian Protection System  
e.g. Acoustic Perception

Adaptive Personal Safety System

Optimized (lower cost) Adaptive Light Protection System/  
Vision Enhancement

Functional Safety "Designing for Reliability" Standard  
Addendum to ISO26262; Implementation Guideline EV

Safety Regulations for Autonomous Driving



**Transversal**

Autonomus / Wireless Sensor & Actuators

Thermal Stable Electronics / Materials

Packaging Technology (3D, Modules, Flexible / Thin Films Electronics and Photovoltaic...)

Passive Components

Intelligent Power Electronic Devices (smart IGBTs, Switch / Drive Capabilities for MOSFETs)

Methods and Tools for Design of Components and Systems: Software Solutions, Simulation Models & Tools

Innovative Technologies and Materials (High Bandgap Material and Components, Communication Components for Telematics Products & Services, Embedded Processing Power >100 MIPS, Mechatronics)

Regulations for the Reliability and Manufacturing Tests for the Extended Lifecycle of EV Components





## Driving innovation. Driving efficiency

From conventional to electrical vehicles