# Electrification of Urban Mobility and Transport

## European Industry Roadmap

## Sylvain Haon, Polis

# European Green Cars Initiative

- One of three PPP in the **European Economic Recovery Plan** (Factories of the Future, Efficient Buildings, Green Cars Initiative)
- Total Budget: **5 bn Euro** = 4 bn Euro Loans + 1 bn Euro RTD
- **PPP** of industry, member states and EC (50% funding)
- **Horizontal** activity (DGs Research, Infso, TREN, ENV, Enterprise)
- Implementation through **FP 7** (2010-2013);
- Major focus on **electrification** (ca. 2/3 of budget)
- **Climate protection**
  (50% $CO_2$ cut comp to ICE WTW - power plant, grid, motor efficiency, potentially even higher if electricity from renewable sources is used)
- **Energy security**
  (Diversification of primary energy sources)
- **Zero local emissions**
- **Safety** and **Traffic Fluidity**
- Global **competitiveness** of the automotive industry

# Major Challenges Electrification

- **Energy Storage Systems**
  (cost, performance, lifetime, safety)
- **Drive Train Technologies**
  (energy recovery, range extenders)
- **System Integration**
  (energy efficient interplay of components)
- **Grid Integration**
  (charging, metering, renewables, V2G)
- **Safety**
  (crashworthiness, HV, emergency)
- **Transport System Integration**
  (road infrastructures, intermodal use)

# Electrification Roadmaps - Milestones

- **U.S. Department of Energy (2009)**
  - 1 Mio. EV/PHEV on the U.S. roads by 2015
  - Batteries:

| | 2009 | | 2014 |
|---|---|---|---|
| Cost: | 1000 $/kWh | ➡ | 300 $/kWh |
| Energy Density: | 3.4 kWh / 80kg | ➡ | 11.6 kWh / 120kg |
| Lifetime: | 3 yrs | ➡ | 10 yrs |

↷ 2.4 bn US$ for R&D, EV and battery manufacturing, infrastructure

- **Japanese Ministry of Economy, Trade and Industry (METI) (2007)**

| METI Battery R&D Targets | | | | | |
|---|---|---|---|---|---|
| | 2007 | 2010 | 2015 | 2020 | 2030 |
| Application | Small EV | Commuter EV High-performance HEV | Commuter EV FCV PHEV | Advanced PHEV | "Real" EV |
| Efficiency | 1 | 1 | 1.5 | 3 | 7 |
| Cost | ¥200,000/kWh US$1,644/kWh | ¥100,000/kWh US$822/kWh | ¥30,000/kWh US$247/kWh | ¥20,000/kWh US$164/kWh | ¥5,000/kWh US$41/kWh |

↷ Funding of advanced battery R&D (NEDO)

# Electrification Task Force

European Industry Roadmap
**Electrification of Road Transport**

Version 3.0
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**Abstract**

Seizing the great potential of electrified mobility for climate and resource protection and turning it into opportunities for Europe's automotive and energy industries requires joint and coordinated actions of all involved public and private parties. Cheap, safe and high-performance means of energy storage pose enormous challenges on a par with those of drive trains, vehicle systems, grid interfaces, safety solutions and the wider issues of integration into the transport system as a whole. Fundamental R&D will be needed, but furthermore complemented by measures for the scaling-up of energy storage systems manufacturing, the preparation of markets and an appropriate regulatory framework. The following document is based on the consensus of major companies and organizations from the European Technology Platforms ERTRAC (European Road Transport Research Advisory Council), EPoSS (European Technology Platform on Smart Systems Integration), and SmartGrids. Starting from a definition of milestones for the next ten years it indicates what action ought to be taken in order to ensure the required efforts are made in a well timed and balanced manner. This report is meant to stimulate the debate about the multi-annual implementation of the European Green Cars Initiative.

**Contents**



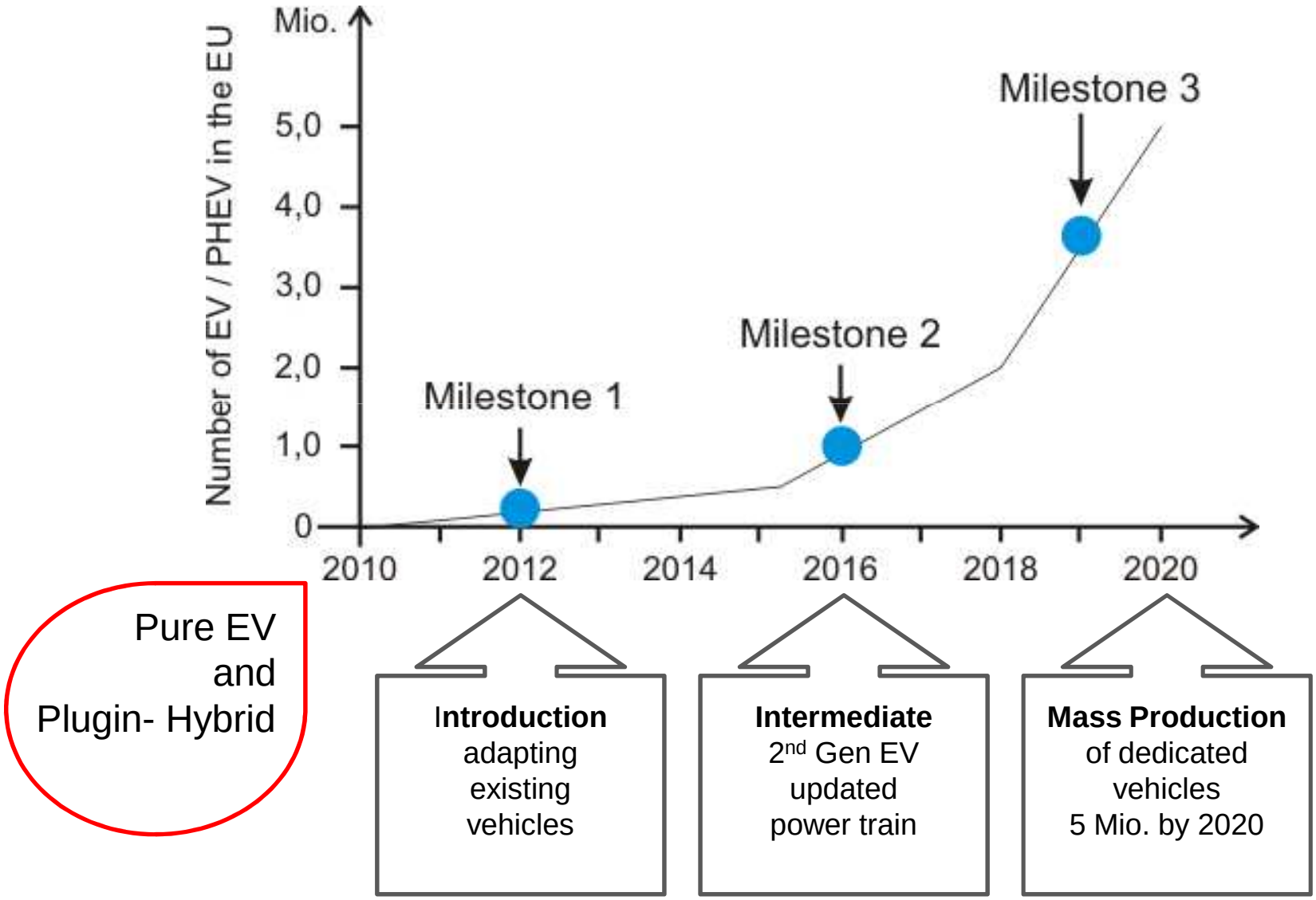
1

**Partners:**

- AVL
- Bosch
- Continental
- Fehrl
- Fiat Research Center
- Polis
- Renault
- Siemens
- SmartGrids
- Valeo
- VDI/VDE-IT
- Volkswagen
- Volvo

Chair:
Wolfgang Steiger
(VW/ERTRAC)

# EGCI Roadmap - Milestones



# EGCI Roadmap - Milestones

- Milestone 1: Introduction (2012)

  The first step of implementation of electrified mobility will be based on the adaptation and conversion of existing vehicles into plug-in hybrid and electrical cars. Beyond demonstration and field operational tests, first fleets may evolve for niche applications like, e.g. taxis, car sharing systems, delivery services and other captive fleets. Standards for safety, data communication and billing will be developed, along with testing activities and actions for raising public acceptance. At the same time, major breakthroughs can be expected in terms of the understanding of underlying technologies and principles.

- Milestone 2: Intermediate (2016)

  It is expected that the base technologies for a dedicated 2nd generation electric vehicle providing efficiency gains of all consumers, advanced system integration and high performance energy storage systems will become available at the intermediate time scale. At the same time, an enlarged charging infrastructure allowing dissemination over various cities and regions will develop.

- **Milestone 3: Mass Production (2018-2020)**

  In about ten years from today, mass production of dedicated plug-in hybrid and electric vehicles will be fully established in Europe. Particularly, batteries, which are the most crucial component have to be available providing about tripled life time and energy density at about 30% percent of today's cost, and highly integrated and cheap electrical motors need to be on the market in big quantities. This will make the vehicles sellable without subsidies. The infrastructure for grid integration is expected to provide advanced levels of convenience though contactless and quick charging at high efficiencies.

| | Milestone 1 | Milestone 2 | Milestone 3 |
|---|---|---|---|
| **Energy Storage Systems** | **Full understanding and proper management of all relevant parameters for safety, performance, lifetime** | **Manufacturing of long life, safe, and cheap energy storage systems with advanced energy and power densitY** | **Availability of batteries providing tripled energy density, tripled lifetime at 20-30% of 2009 cost and matching V2G.** |
| **Drive Train Technologies** | **Availability of drive train components optimized for efficient use and recovery of energy** | **Manufacturing of range extenders & update of electric motors for optimized use of materials and functionality** | **Implementation of power train systems providing unlimited range at sharply reduced emissions** |
| **System Integration** | **Solutions for safe, robust and energy efficient interplay of power train and energy storage systems.** | **Optimized control of energy flows based on hard- and software for the electrical architecture** | **Novel platform based in overall improved system integration** |
| **Grid Integration** | **Charging adaptive to both user and grid needs.** | **Charging at enhanced speed** | **Quick, convenient, smart and bi-directional capabilities** |
| **Safety** | **Electric vehicles providing same safety levels as conventional cars** | **Implementation of solutions for all safety issues specific to mass use of the electric vehicle and road transport based on it** | **Maximum exploitation of active safety measures for electric vehicles** |
| **Transport System** | **Road Infrastructures and communication tools encouraging the use of EV** | **Full integration of electric vehicles with other modes of transport** | **Autonomous driving based on active safety systems and car-to-x communication** |

# EGCI Roadmap - Actions

## Drive Train Technologies

Develop Low-Cost/Weight Motors & Electronics

Develop Highly Integrated Motors & Controls

Optimize Combustion Engines for Range Extenders

Develop Highly Integrated Range Extender Systems

## System Integration

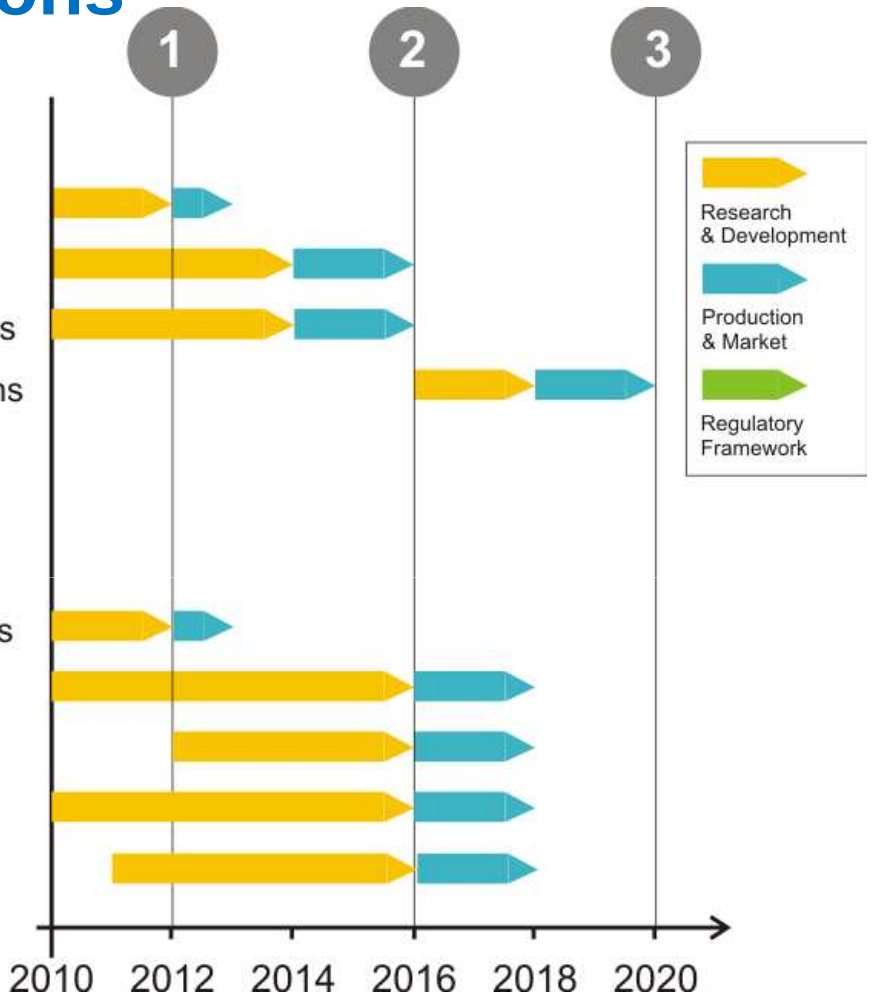
Optimize System Efficiency w Existing Components

Find new Solutions for Heating, Venting, Cooling

Design Electrical Architecture & Interconnects

Create New Concepts for Space Usage

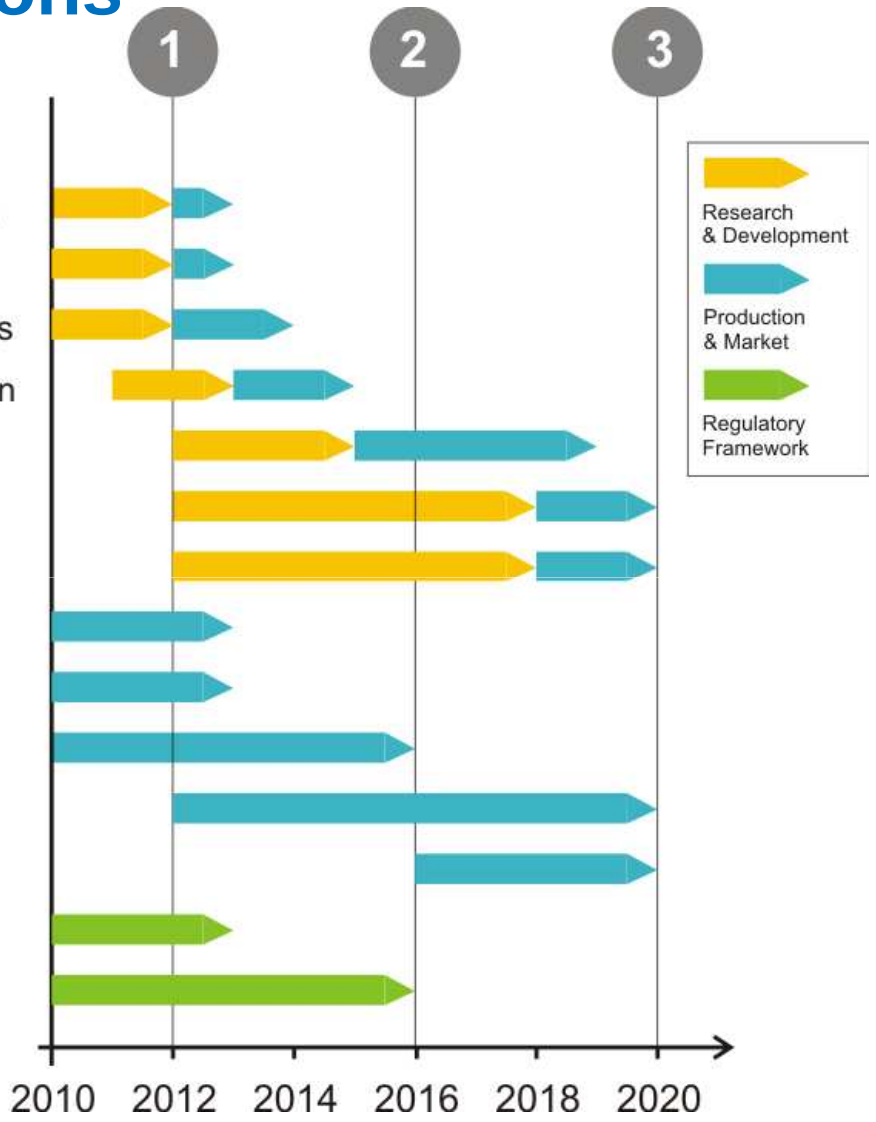
Research Light-Weight Materials & Design



# EGCI Roadmap - Actions

## Grid Integration

Develop Adaptive On-Board/In-Plug Charging Dev.
Create System for Information on Charge Status
Develop Simulation, Monitoring, Management Tools
Develop Protocols/Devices for V2G Communication
Investigate Quick Charging
Develop Contactless Charging
Develop Bidirectional Charging
Establish 1st Generation Charging Infrastructure
Create Business Models for Charging
Connect Regions by Highways w Charging Spots
Establish Business Model for Bidirectional Trading
Create Network of Quick Charging Stations
Regulate Coverage with Charging Spots
Standardize Billing Concept



# EGCI Roadmap - Actions

## Safety

Improve Crashworthiness of Lightweight Cars

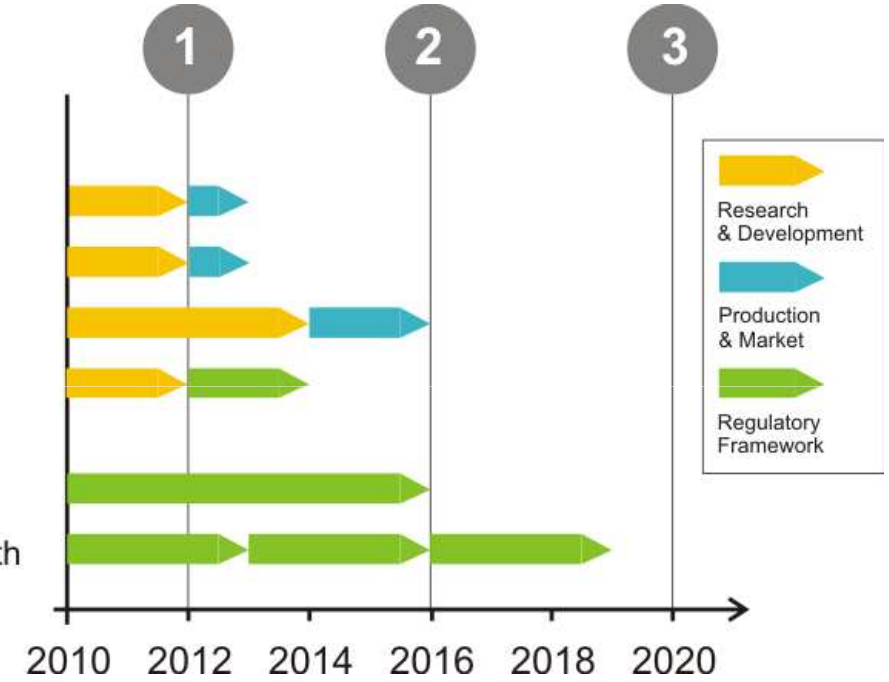
Develop Acoustic Perception

Develop Integrated Safety Concept (HV, Fire, ..)

Study Relation with Roadside Restraint Systems

Setup Standards for Emergency Handling
Including Roadside and Tunnel Safety

Create & Review Standards for Safety, EMI, Health



# EGCI Roadmap - Actions

## Transport System Integration

Explore Potential of ITS for Energy Efficiency

Provide Convenient Transition Between Modes

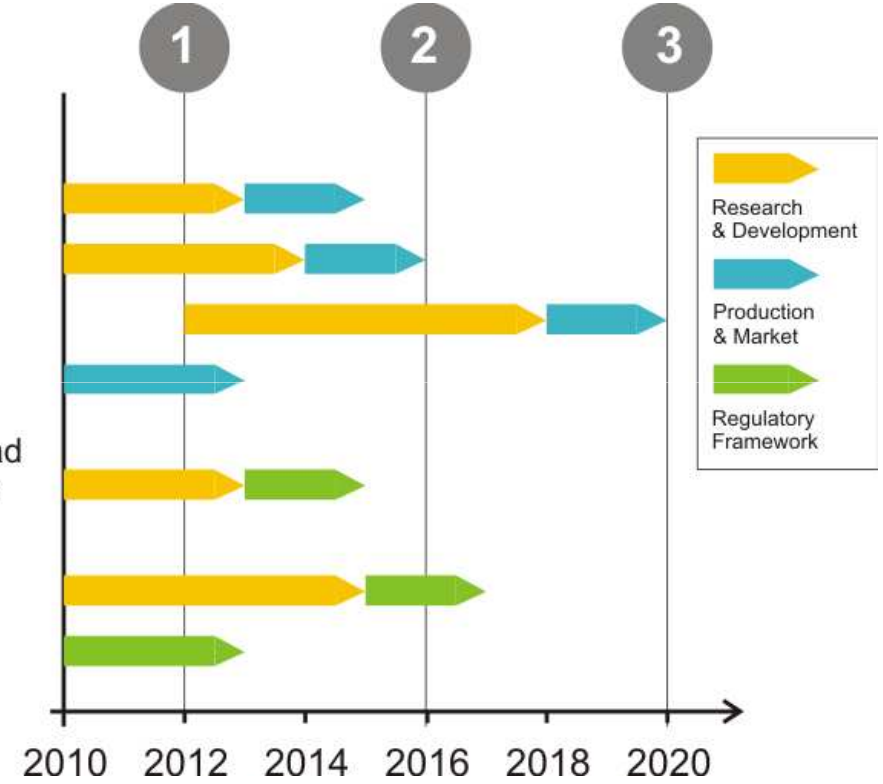
Apply Sensors & C2X for Autonomous Driving

Promote Green Image of Electric Vehicles

Develop Best Practise for Impelementation of Road Infrastructure Measures Supporting Rapid Uptake

Review Effects of Large Scale Deployment on Future Infrastructure Developments

EU Wide Signage of Roads and Vehicles



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