User-Centered Update on European Roadmaps: Electrification of Road Transport

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Electrification Roadmap

• Joint effort of ERTRAC, EPoSS and ETIP SNET
• Commitment and shared vision of the industries involved in the European Green Cars / Vehicles Initiative PPPs
• Base document for call recommendations on electric mobility since 2009
• Topics covered in projects
• Input to ECSEL MASRIA
What do users expect?

- prices as low as today’s ICE driven vehicles or at least vehicles with costs competitive to those of today
- range, reliability, durability and re-sale value of electrified vehicles similar to conventional vehicles
- range adapted to use cases
- usage comfort as good as the state of the art ICE-powered vehicles

End of “one vehicle fits all“ mentality:

- EV will not easily fully replace ICE with same performance
- EVs will be designed for specific purposes and needs
- benefits, e.g. in terms of access, or synergies with automation and connectivity can compensate
CO₂ reduction potential of EVs depends on WTW energy efficiency and emissions of the primary energy source.
When do we get Electric Mobility?

- Approx. **500,000 EVs** on EU roads / **2 Mio EVs** world wide
- Massive **investments** will make electric cars an industrially viable and cost competitive product.

![EV and PHEV Sales Forecast](image)

**red:** evolution  **blue:** major breakthroughs + full policy support
Milestones

• Technical shortcomings and cost issues will remain and require **more research, development and innovation** activities.

• **2020:** Mass production of passenger cars and scaling-up of heavy duty vehicle electrification

• **2025:** Fully revised electric vehicle concept

• **2030:** Redesigned electrified road transport meeting the requirements of the future connected society
Four Big Initiatives

- Operation System dependent EVs in the urban environment
- User-friendly affordable EV passenger car + infrastructures
- No compromise electric urban bus system
- Sustainable electrified long-distance trucks and coaches

Milestones
- 2020
- 2025
- 2030
Roadmaps

Operation system dependent
EVs in the urban environment

- Optimised energy management efficient powertrains
- Intelligent (pre-)conditioning & climate controlling
- Air cooled powertrain systems
- Optimisation of Li-ion cell technology
- Modular battery systems
- Lightweight next generation, high energy density battery
- Lightweight vehicle concepts
  - Commercial and purpose-design EVs for urban use
  - Modular designs enabling different usage models/scenarios
  - Interfaces for integrated & optimized urban operation
  - V2G capabilities (incl. Vehicle architecture)
- Charging inter-operability
  - Charging technology incl. contactless & quick charging
  - Bi-directional energy flow between vehicle & grid
  - High power (automated) charging
  - Automated parking and charging
- Big data for optimization of EV fleet management
- Safety of pedestrians in presence of small noise-free EVs
  - Inter-operability w/ respect to parking/charging infrastructure, ...
- Real time charging info
- Sharing platforms
- Automated EV fleets
- Integrated urban solutions
- Enabler for MAAS business models for EVs
- Urban / land use planning in view of new consumption pattern
- Safe parking for urban lightweight vehicle incl. 2Wheelers
- Public awareness programs
The document is now publically available on the EPoSS website:

User-friendly affordable EV passenger car + infrastructure

Roadmaps

- High-speed operable and optimized power management
- Holistic PWT optimization: electric machine & system - high-torque, high-power density
- Next-generation PHEV
- Integrated electro-mechanical components & control systems
- High-voltage architectures
- Power electronics based on advanced WBG semiconductors
- Lightweight materials for automotive applications
- Intelligent (pre-)conditioning & climate controlling
- Fail-operational systems
- Modular battery systems
- Disruptive steps in battery technol. development
- Post-Lithium batteries
- Battery Management for advanced chemistries
- High-power energy battery
- Automated parking and charging
- Fast, interoperable charging
- Fast wireless charging
- Sustainable recycling of materials, components & sub-systems
- Refined user interface
- Real size/range/capacity needs
- Real time charger availability info (for low & high power solutions)
- Use clean & less rare materials
- 2nd use of batteries with consideration of TCO
- Incentives compatible with boundary conditions: local & national
- Public awareness programs

R&D
Demonstration
Framework
Roadmaps: Non-compromise electric urban bus system

- Optimized vehicle e-drive components & auxiliaries
- Integrated PWT solutions: high-torque-density for plug-in vehicles (incl. Hybrid)
- Efficient retrofit modules
- Battery & BMS dedicated development (modular)
- Hydrogen-powered drive trains
- Full automation of charging operations at end station
- Evolution of charging syst. (dynamic, short range)
- Multimodal charging interface
- Depot preparation for fleet upscale (smart charging, safety)
- Operation interface (FMS, smart charging, IT developments)
- Interfaces for integrated & optimized urban operation
- Automation in eBuses (docking, charging, parking)
- Holistic interface optimization for BRT Operation
- Highly automated urban eBus
- E-Taxi-Roll-Out
- Operation mgmt. (planning, maintenance, training)
- Development of TCO concepts/external costs in eBus LCC
- Automated eShuttle bus pilots
- Interoperable fast charging
- On-board charging module standard
- Long term eff. regulations
- Physical charging interface std.
- ZE/ULE policies / eBus strategies in cities
- Public awareness programs
- Renewable energy integration with grid

Timeline:
- 2020
- 2025
- 2030

R&I
Demonstration
Framework
## Strategic Transport Research and Innovation Agenda

<table>
<thead>
<tr>
<th>Deployment</th>
<th>Product Development and Operating Models</th>
<th>RESEARCH AND INNOVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable &amp; Deliver 2020</td>
<td>Increase market share for electric passenger cars, even higher in the urban environment (bikes, buses, vans)</td>
<td>As far as general purpose vehicles are concerned, cost reductions will enlarge the customer base. At the same time, new vehicles will cater for emerging business models based on total-cost-of-ownership considerations, e.g. fleet applications, car sharing, delivery vans</td>
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</tbody>
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### Action 1
- **Progress and demonstration in urban bus electrification**
- **R&I program on energy storage systems, thermal comfort as well as low energy air-conditioning. KPI is a Carry all energy for a one day trip on the bus and still stay within cost targets**

### Action 2
- **Public and commercial procurement of EVs**
- **Promote the market and create awareness of electric vehicles’ maturity and a second hand market of electric vehicles in line with revision of Directive 2009/33/EC**

### Action 3
- **Certification of electric vehicles performance**
- **Better comparability of EV types, also for commercial use**

### Action 4
- **Development of small and light smart electric vehicles**
- **Components and concepts enabling radical reduction of energy consumption**

### Action 5
- **Support local production of batteries, components and electric vehicles**
- **Awareness actions for smart specialization and governance in anticipation of value chain disruptions due to shift from conventional to electrified vehicles**

Ref: European Commission, Commission Staff Working Document “Towards clean, competitive and connected mobility: the contribution of Transport Research and Innovation to the Mobility package” published 31 May 2017
End of “one vehicle fits all” mentality

• Vehicles designed and built in a more specific way for dedicated usage models
• development of new urban mobility concepts and integrated solutions
When do we get Electric Mobility?

- Approx. **500 thousand EVs** on EU roads / **2 Mio EVs** worldwide.
- Real **market take-up** is imminent.
- Massive **investments** will make electric cars an industrially viable and cost competitive product.
- Noticeable **change in the automotive portfolio** will occur in the next 5 to 10 years.
- Technical shortcomings and cost issues will remain and require **more research, development and innovation** activities.
What has to be done?

• progress in performance and energy efficiency
• improve energy storage systems
• supply innovative vehicle concepts
• exploit potential of connectivity and automation
• establish battery manufacturing in EU
• provide incentives to support the market take-up
• ensure availability of charging infrastructure
• make mobility offers for leasing or sharing EVs