EVs achieve superiority to internal combustion engines in most respects, close the gap in driving range.

Vehicle sales: 70 million
Global market share: 48%

Vehicle sales: 100 million
Global market share: 60%

Availability of higher power/energy-dense batteries should position policy makers to encourage remaining segments of light-duty vehicle markets to “go electric”, including greater use in larger, longer-distance vehicles.

Ongoing recharging infrastructure and generation system expansion and refinement as needed; with ongoing increase in systems and capacity to handle fast charging.

Ongoing RD&D as needed; focus on improving battery performance to maximise vehicle driving range.

Batteries continue to improve; introduce a new generation of batteries that significantly outperform lithium-ion at a similar cost.

Fast recharging options have achieved lower cost, with batteries well suited; support for widespread implementation of fast recharging as needed to ensure widespread availability.

Completion of most recharging infrastructure in OECD and other major economies; expand globally as countries establish reliable, low-carbon electricity generation systems.

Achieve widespread introduction of next generation of battery, full deployment of smart-grid systems and related technologies.

Policy framework
Adequate incentives for EV/PHEV purchase and production in line with targets; co-ordination of recharging infrastructure development in key areas.

Vehicles/batteries
EVs should become commercially viable with lower costs, with batteries well suited; support should continue for widespread implementation of fast recharging as needed to ensure widespread availability.

Availability of higher power/energy-dense batteries should position policy makers to encourage remaining segments of light-duty vehicle markets to “go electric”, including greater use in larger, longer-distance vehicles.

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Achieve widespread introduction of next generation of battery, full deployment of smart-grid systems and related technologies.

Codes/standards
Ensure plugs and charging systems are compatible across major regions, including through “smart metering” systems for home and public recharging stations; develop protocols for fast recharging.

Common systems for vehicle-to-grid electricity sales, fast recharge and/or battery swapping well established.

Recharging/electricity infrastructure
Establish home recharging and begin major investments in street/office daytime commercial recharging, including rapid charging where appropriate.

Expansion of recharging infrastructure to more areas; greater use of fast recharging; fully established vehicle-to-grid electricity systems.

Completion of most recharging infrastructure in OECD and other major economies; expand globally as countries establish reliable, low-carbon electricity generation systems.

Ongoing recharging infrastructure and generation system expansion and refinement as needed; with ongoing increase in systems and capacity to handle fast charging.

R&D
Ensure vehicle/battery systems are reliable and safe; achieve near-term technical and cost targets, such as USD 300/kWh battery cost; develop advanced battery concepts and prototypes.

Continue RD&D on advanced battery designs moving towards demonstration and deployment as concepts mature; incorporate lessons learned from earlier experiences.

Achieve widespread introduction of next generation of battery, full deployment of smart-grid systems and related technologies.

Ongoing RD&D as needed; focus on improving battery performance to maximise vehicle driving range.

International Energy Agency
www.iea.org/roadmaps
CO₂ emission reduction, BLUE Map scenario, 2010-2050

The GHG reductions and EV/PHEV penetrations displayed here are based on the IEA ETP BLUE Map scenario, which targets an aggressive 50% reduction in CO₂ worldwide by 2050 relative to 2005 levels. For transport, a 30% GHG reduction is targeted, which will require rapid market penetration of electric vehicles and plug-in hybrid vehicles.

For light-duty vehicles, electric and plug-in hybrid vehicles account for 2.6 Gt of CO₂-equivalent emissions reductions by 2050, about half of total reductions for light-duty vehicles.

Final energy consumption in the transportation sector, by fuel type

Less carbon-intensive electricity is needed to realise EV/PHEV emissions reductions

OECD North America
OECD Europe
OECD Pacific
Former Soviet Union
Eastern Europe
China
Eastern Asia
India
Middle East
Latin America
Africa
World

www.iea.org/roadmaps
Urgent action needed in the next 10 years to achieve 2050 targets

Battery costs through 2020

Battery costs for PHEVs and EVs must drop rapidly toward USD 300/kWh in order to bring vehicle costs to competitive levels.

Global map of regional EV/PHEV sales

Electric and plug-in hybrid vehicle indicative sales targets in BLUE Map scenario

Vehicle sales must grow rapidly

Battery costs for PHEVs and EVs must drop rapidly toward USD 300/kWh in order to bring vehicle costs to competitive levels.

EV/PHEV sales must reach substantial levels by 2015, and rise rapidly thereafter in order to achieve 2030 CO₂ reduction targets. Sales are expected to spread to non-OECD regions over time.
**Key findings**

- **Roadmap vision**: Industry and governments should attain a combined EV/PHEV sales share of at least 50% of LDV sales worldwide by 2050.
- In addition to contributing significant greenhouse-gas emissions reductions, the roadmap’s level of EV/PHEV sales will deliver substantial benefits in terms of improved oil security, reduced urban area pollution and noise.
- **Policy support** is critical, especially in two areas: ensuring vehicles become cost-competitive and providing adequate recharging infrastructure.
- The consumer comes first: Wider use of EVs/PHEVs will require an improved understanding of consumer needs and desires, as well as consumer willingness to change vehicle purchase and travel behaviour.
- **Performance measurement** will be needed: The IEA roadmap contains a set of proposed metrics and targets for key attributes like driving range and battery requirements to ensure that EVs/PHEVs achieve their potential.
- **RD&D priorities**: Research, development and demonstration must continue to reduce battery costs and ensure adequate materials supply. More research is also needed on smart grids and the vehicle-grid interface.
- **International collaboration** can accelerate deployment: Industry and governments need to work together on research programmes, codes and standards, and alignment of vehicle and infrastructure roll-out.