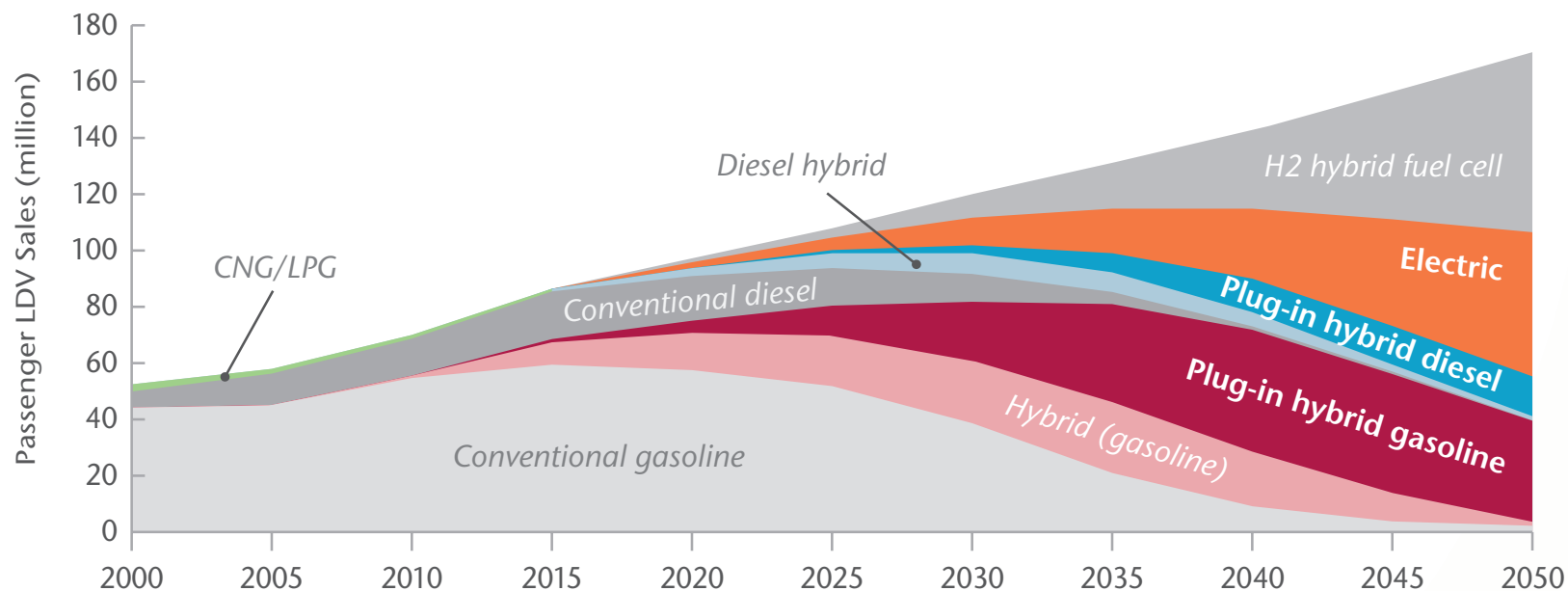


# ELECTRIC AND PLUG-IN HYBRID VEHICLE ROADMAP



International  
Energy Agency

## Annual light-duty vehicle sales, BLUE Map scenario, 2000-2050

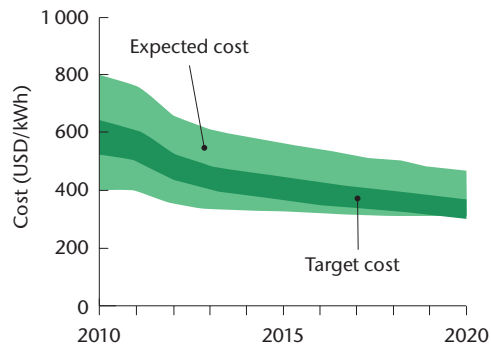


## Key findings

- ▶ 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.

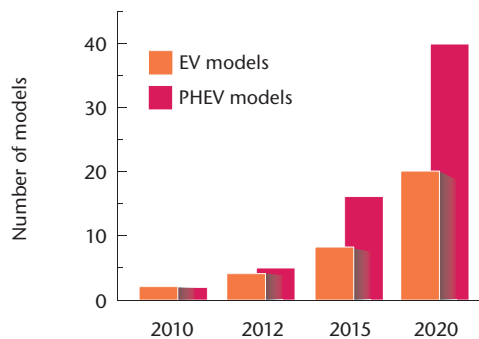
# Urgent action needed in the next 10 years to achieve 2050 targets

## 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.

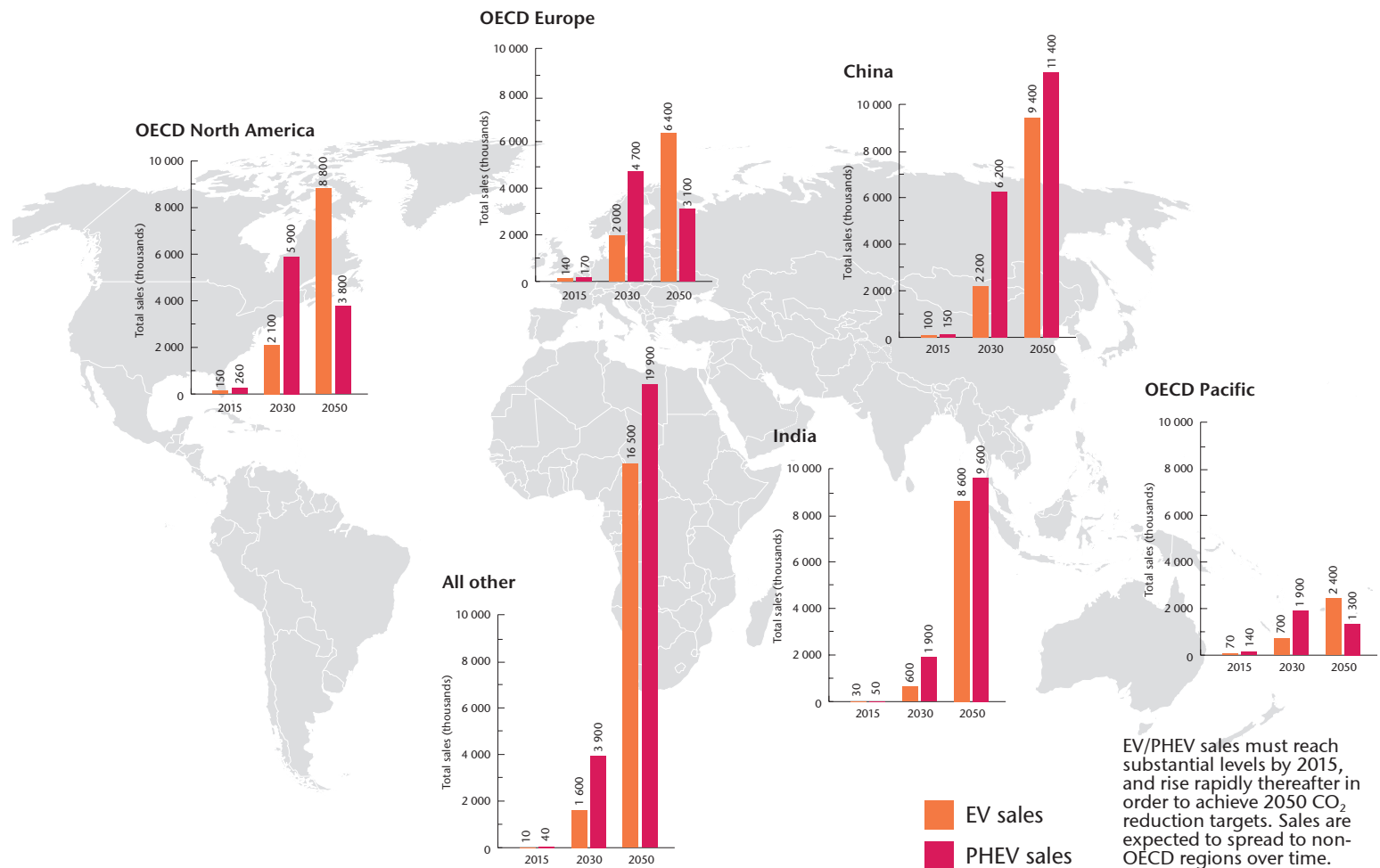
## Number of models offered through 2020



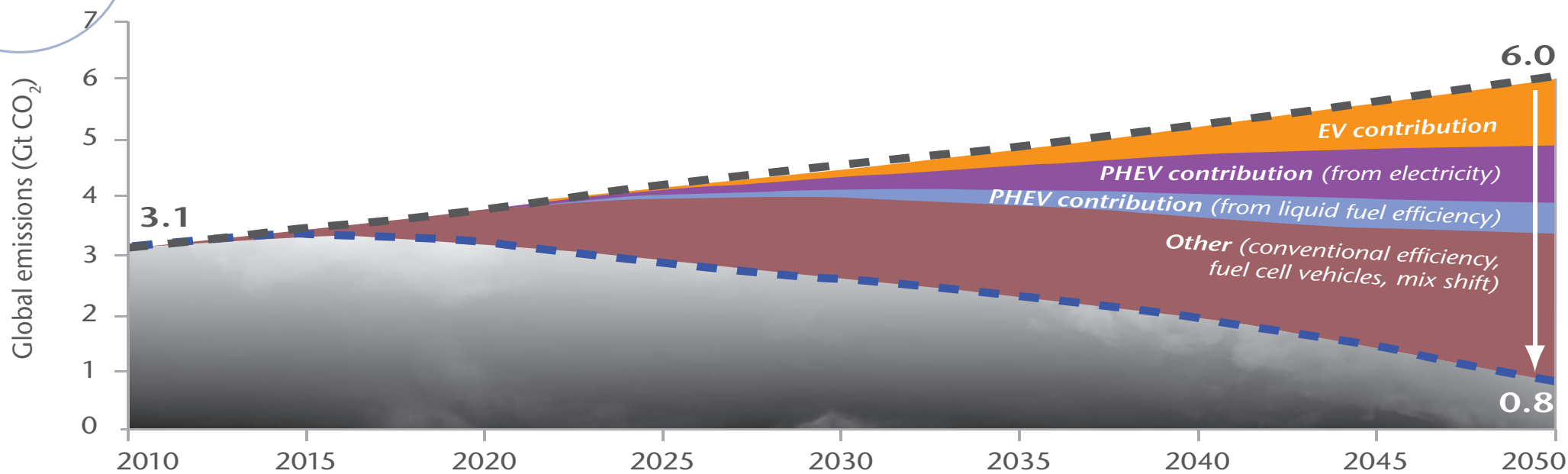
Vehicle sales must grow rapidly

## Global map of regional EV/PHEV sales

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



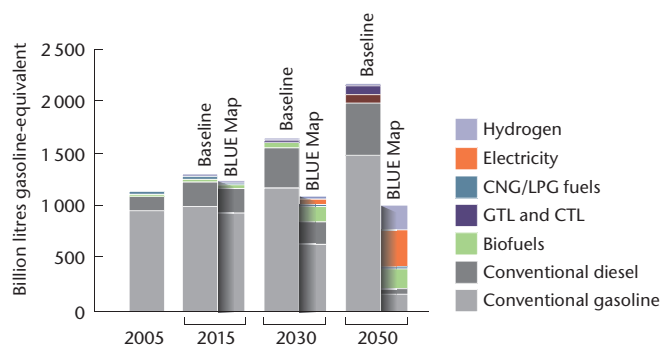
# CO<sub>2</sub> emission reduction, BLUE Map scenario, 2010-2050



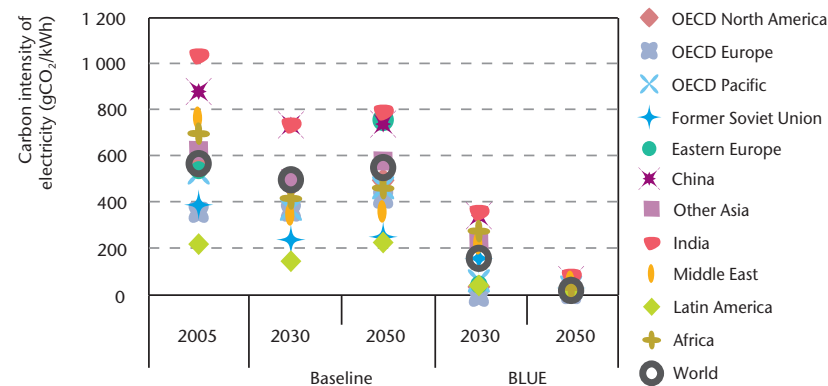
The GHG reductions and EV/PHEV penetrations displayed here are based on the IEA ETP BLUE Map scenario, which targets an aggressive 50% reduction in CO<sub>2</sub> worldwide by 2050 relative to 2005 levels. For transport, a 30% GHG reduction is targeted, which will require rapid market penetration of electric vehicles and plug-in hybrid vehicles.

For light-duty vehicles, electric and plug-in hybrid vehicles account for 2.6 Gt of CO<sub>2</sub>-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



# EV/PHEV roadmap milestones

2010

2020

2030

2040

2050

Vehicle sales **7 million**  
Global market share **9%**

Vehicle sales **30 million**  
Global market share **30%**

Vehicle sales **70 million**  
Global market share **48%**

Vehicle sales **100 million**  
Global market share **60%**

## Policy framework

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

EVs should become commercially viable without significant subsidies; support should continue for widespread expansion of recharging infrastructure

Fast recharging options have achieved lower cost, with batteries well suited; support 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

## Vehicles/batteries

Low- and medium-volume production, with design optimisations to 2015, then rapidly increase numbers of models offered and average production volumes; battery and other costs decline to target levels

Vehicles become fully commercial, batteries reach all target specifications for cost and durability, including additional cycling tolerance in line with advanced batteries; full recycling systems in place

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

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

## Codes/standards

Ensure plugs and charging systems are compatible across major regions, including basic "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

Refine codes and standards as needed; modify to accommodate innovations in batteries, smart grid systems, etc., but minimise the need for reinvestments in existing systems

## 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

## RD&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