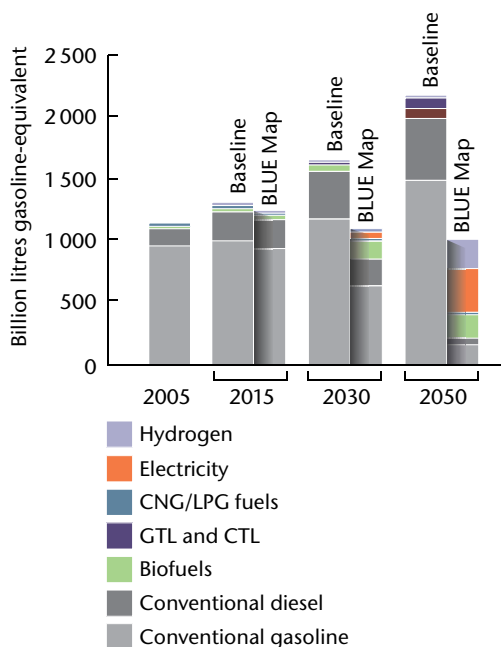


IEA EV/PHEV roadmap targets

Key findings

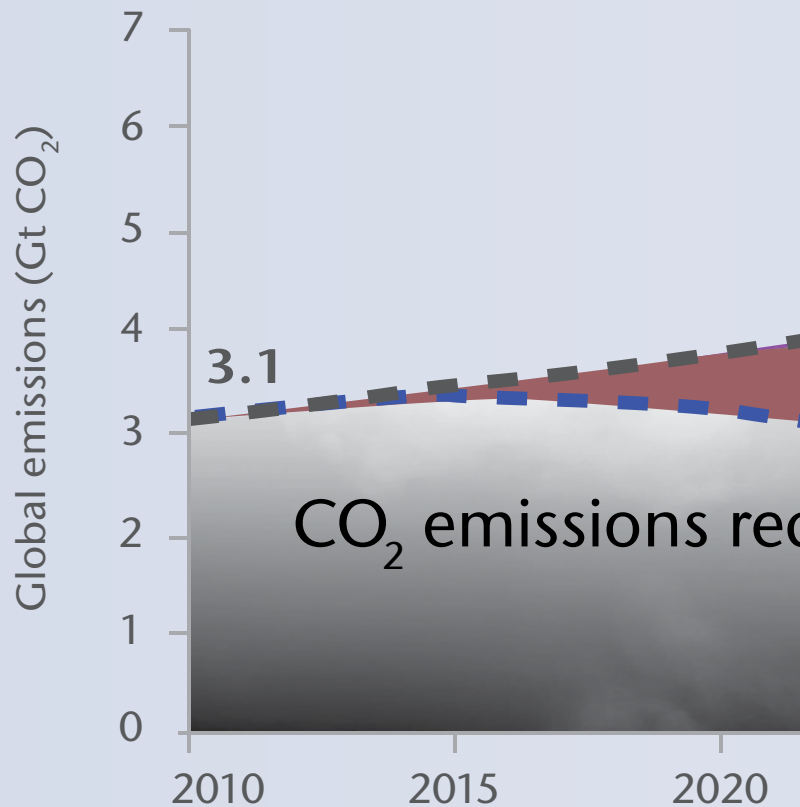
- **Roadmap vision** - industry and governments should attain a combined EV/PHEV sales share of at least 50% of LDV sales worldwide by 2050.
- **Policy support is critical, especially in two areas** - ensuring vehicles become cost-competitive and providing adequate recharging infrastructure.
- **The consumer comes first** - wider use of EV/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** - this roadmap contains a set of proposed metrics and targets for key attributes like driving range and battery requirements to ensure that EV/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 programs, codes and standards, and alignment of vehicle and infrastructure roll-out.

Final energy consumption in the transportation sector, by fuel type



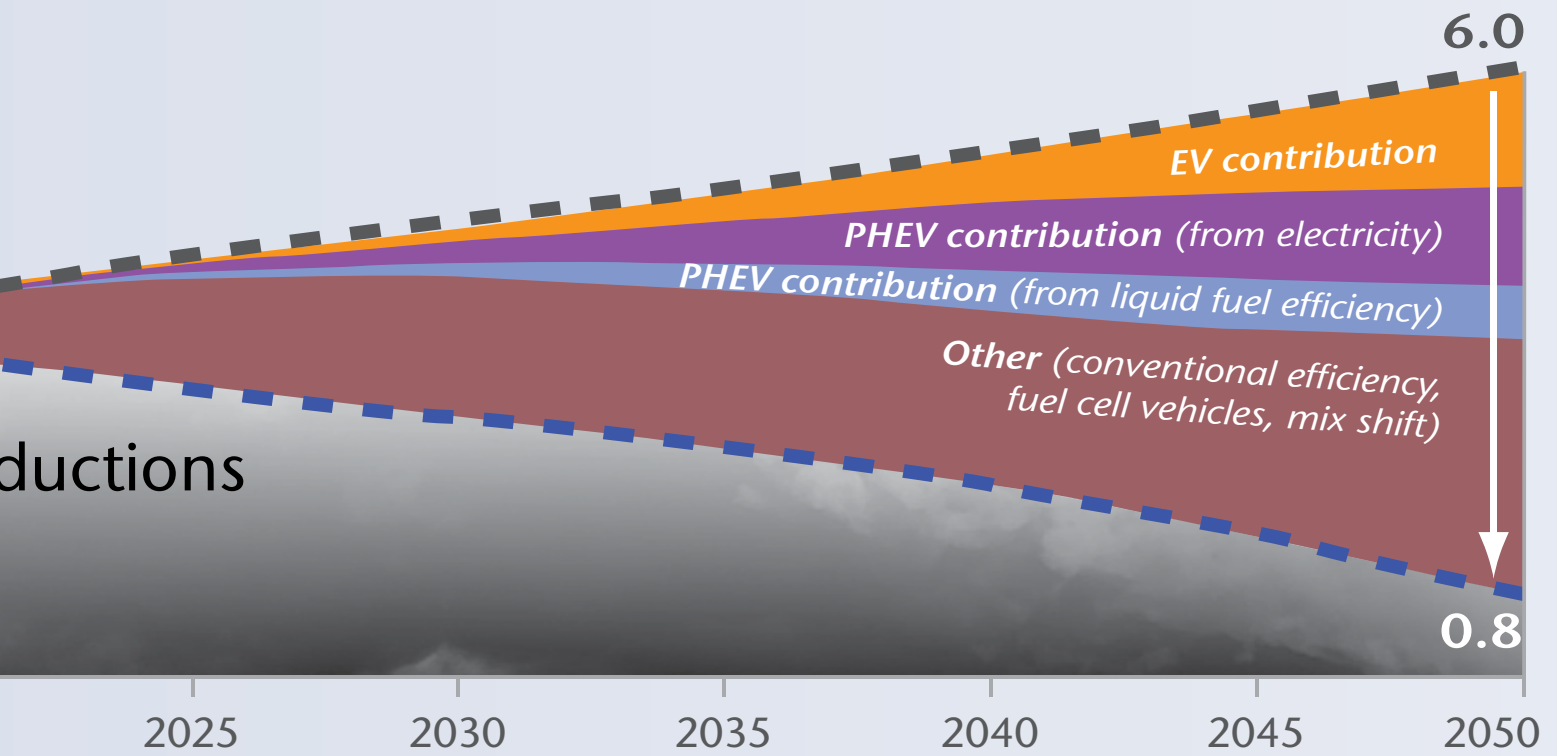
Electricity use in BLUE Map rises rapidly after 2030, while petroleum use by light-duty vehicles (LDVs) drops by nearly 90% in 2050 compared to Baseline scenario.

CO₂ emission reductions in BLUE Map, 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.



Milestones:

2010-2012

2012-2015

Policy framework

Develop policy frameworks focused on early adopters with incentives for consumers / manufacturers

Review of policies and updates to practices; support for expansion of and to ensure EV/PHEV sales are on

Vehicles / batteries

Begin production of EV and PHEV models, low-production volume demonstrations to test batteries and controls, and assist design optimisations

Rapidly increase numbers of models; average production volumes; battery costs decline

Codes / standards

Create common standards for plugs and recharging protocols in each major region

Ensure that smart metering is available; recharging with dual tariffs in early

Recharging / electricity infrastructure

Focus on areas likely to require recharging infrastructure through 2015; target early adopter homes and public locations

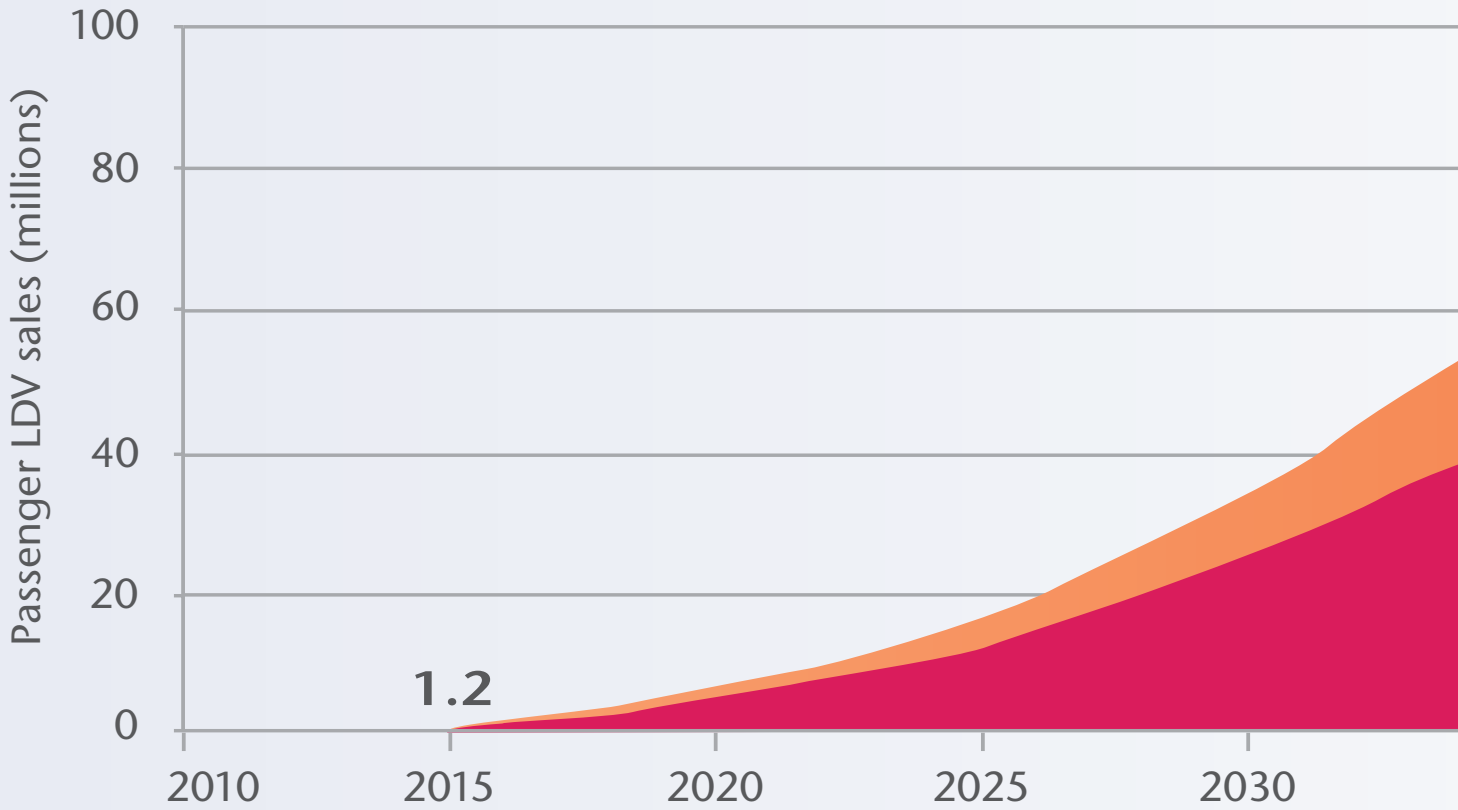
Begin major investments in increasing daytime commercial recharging, in charging where possible

RD&D

Ensure early vehicle/battery models are reliable and safe; achieve near-term technical targets; continue RD&D on advanced battery designs

Progress toward battery cost target kWh; incorporate lessons learned from experiences

EV + PHEV market penetration, 2010-2050



2015-2020

reflect best
of infrastructure
on track

els offered and
ery and other

able for home
y adopter areas

sed street/office
including rapid

ts of USD 300/
from early

Expansion of EV/PHEV sales to more areas; development of national recharging networks

Achieve battery cost targets; production levels reach 50 000+ per model; sales reach 5 million annually by 2020, mainly in OECD, China and India

Finalise standards on all hardware and software components, including sales of electricity from vehicles to grid

Provide full smart-metering and adequate daytime charging coverage in metro areas; invest in major intercity fast recharging systems

Achieve all near-term cost and technical targets; continue RD&D on advanced battery designs

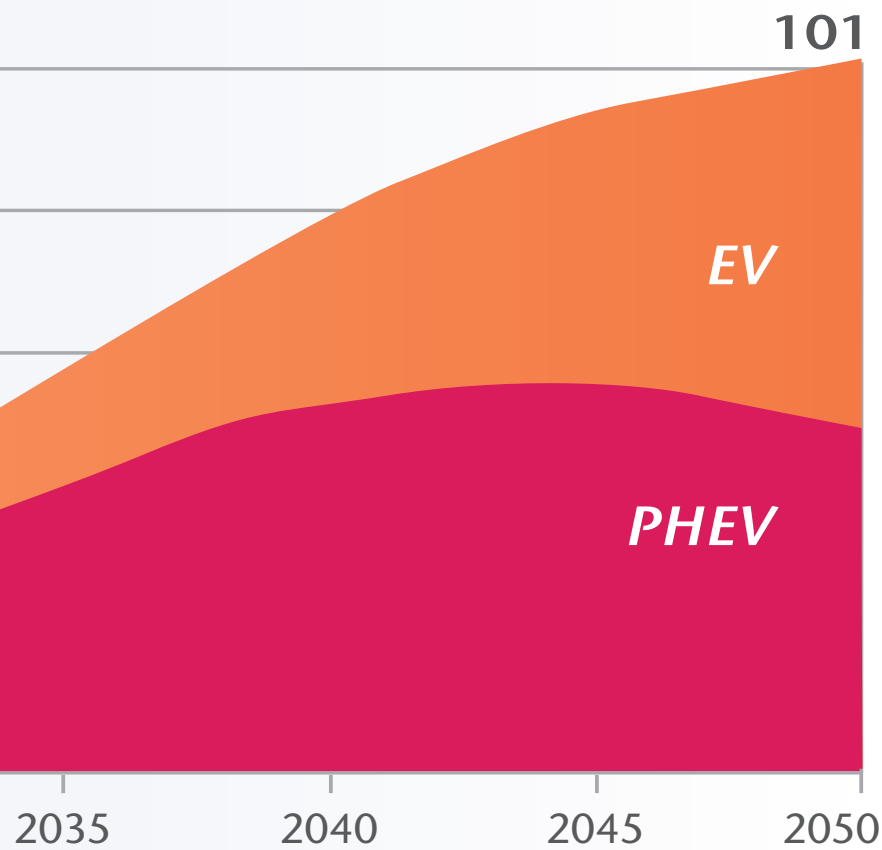
Ensure stable market growth; m
that is less reliant on incentives

Achieve 30 million annual global

Refine codes and standards as n

Continue to add recharging cap
achieve low-CO₂ electricity gen

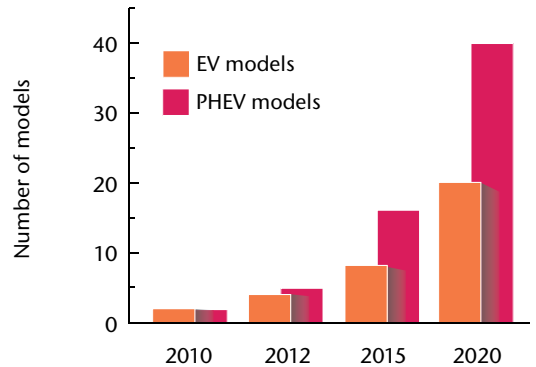
Achieve a "next generation" set
out-perform current generation



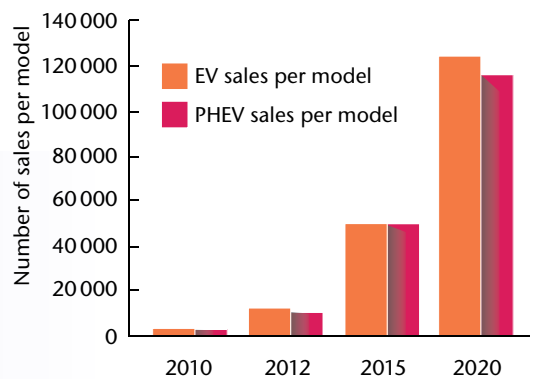
Next 10 years: a critical period for EV/PHEVs

Indicative EV/PHEV models and production per model, along with battery cost reductions, that will be needed to achieve the roadmap targets.

Number of models offered through 2020

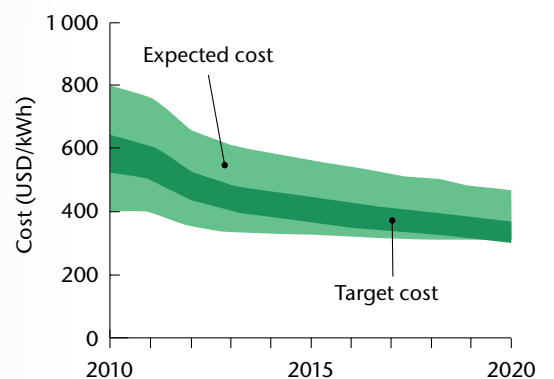


Sales per model through 2020



Sales per model and the number of models introduced must rise rapidly in order to reach this roadmap's 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.

2020-2030

move toward a fully commercialised EV/PHEV sector

al sales by 2030; rapid sales growth worldwide

needed

capacity and station density as number of vehicles rises; generation

t of batteries (or other energy storage devices) that

Key regional milestones

This roadmap aims to propose tangible policy recommendations for governments around the world and so is written with a broad, global view.

The roadmap lays out steps and targets for achieving the EV and PHEV sales envisioned in the IEA BLUE Map scenario. After 2030, a combination of electric vehicles and plug-in hybrid vehicles, along with fuel cell vehicles, are the primary sources of CO₂ reductions in the transport sector; together they account for nearly all vehicle sales in 2050.

These EV and PHEV production and sales targets will be very challenging to achieve and will require strong policies in countries around the world to move rapidly toward this transition to new vehicles and fuels.

The detailed analysis behind development of these projections is included in the IEA report *Transport, Energy and CO₂: Moving Toward Sustainability*, published in late 2009.

	2015	2030	2050	2015	2030	2050
OECD North America	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)*</i>	507	460	485	486	270	207
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	35	80
<i>Electricity (%)</i>	0%	0%	0%	0%	13%	39%
<i>GHG emissions (MT CO₂e)**</i>	1 363	1 236	1 309	1 291	492	113
OECD Europe	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	204	177	169	199	117	80
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	15	33
<i>Electricity (%)</i>	0%	0%	0%	0%	13%	41%
<i>GHG emissions (MT CO₂e)</i>	566	496	475	551	238	52
OECD Pacific	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	82	66	62	78	40	28
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	6	12
<i>Electricity (%)</i>	0%	0%	0%	0%	15%	42%
<i>GHG emissions (MT CO₂e)</i>	223	181	172	210	75	15
China	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	117	333	399	107	193	181
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	24	64
<i>Electricity (%)</i>	0%	0%	0%	0%	12%	35%
<i>GHG emissions (MT CO₂e)</i>	317	912	1 110	290	460	161
India	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	38	166	300	36	111	146
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	8	49
<i>Electricity (%)</i>	0%	0%	0%	0%	7%	33%
<i>GHG emissions (MT CO₂e)</i>	105	469	907	100	273	170
Rest of world	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	342	551	741	327	343	348
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	0	23	113
<i>Electricity (%)</i>	0%	0%	0%	0%	7%	33%
<i>GHG emissions (MT CO₂e)</i>	892	1 468	2 012	867	728	294
Worldwide total	<i>Baseline</i>			<i>BLUE Map</i>		
<i>LDV fuel consumption (bil L ge)</i>	1 291	1 754	2 156	1 234	1 073	990
<i>Electricity fuel consumption (bil L ge)</i>	0	0	0	1	112	351
<i>Electricity (%)</i>	0%	0%	0%	0%	10%	35%
<i>GHG emissions (MT CO₂e)</i>	3 467	4 762	5 985	3 310	2 266	805

* billion litres gasoline equivalent

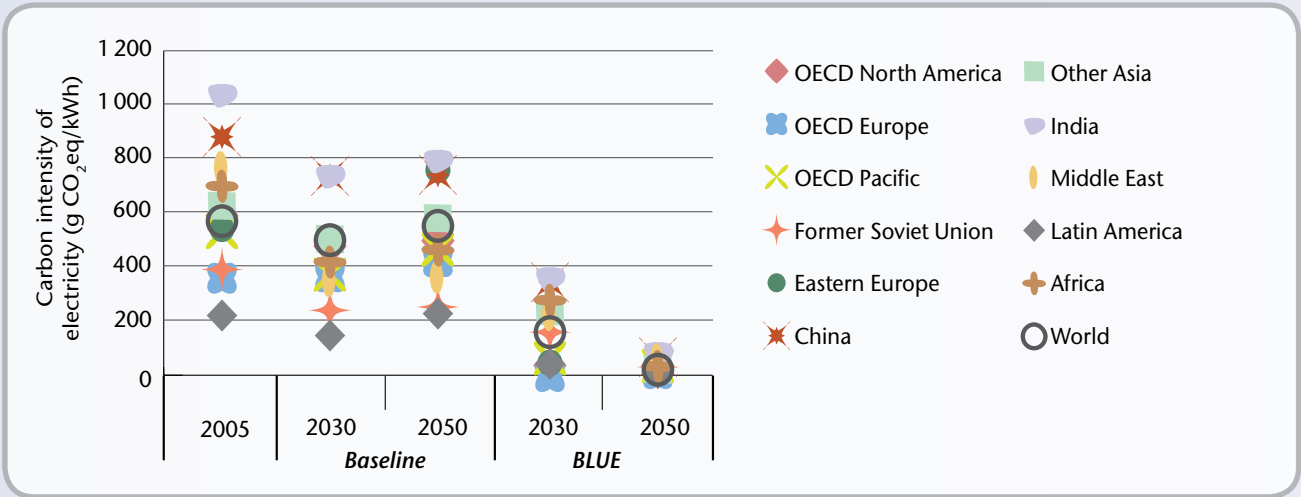
** million tonnes carbon dioxide equivalent

Percentage of EV + PHEV total stock by region in 2050

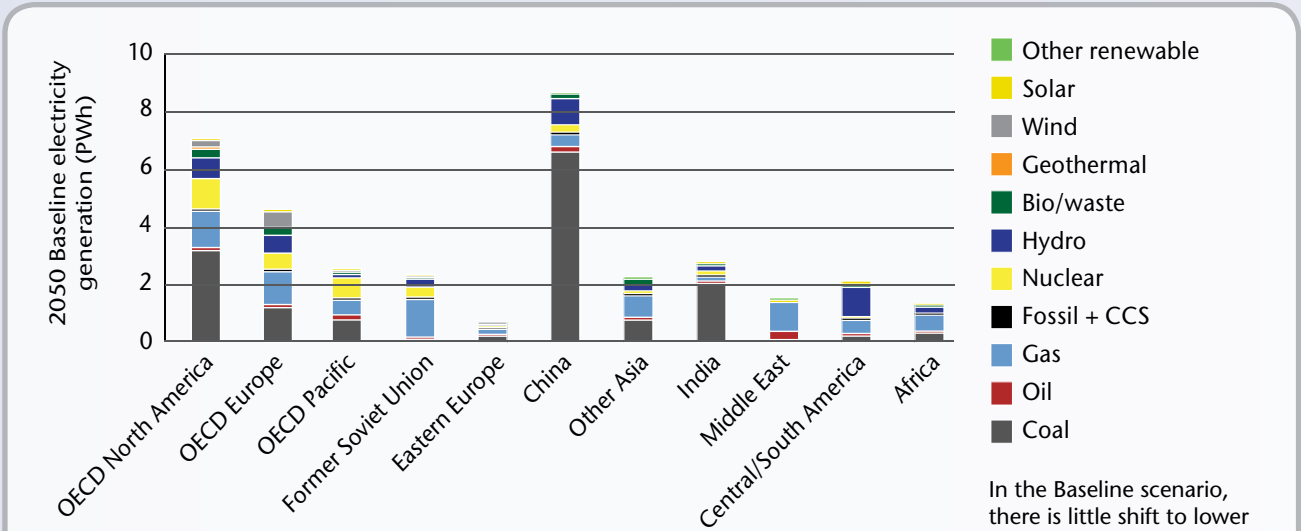
OECD NORTH AMERICA
220 MILLION
17%

OECD EUROPE
200 MILLION
15%

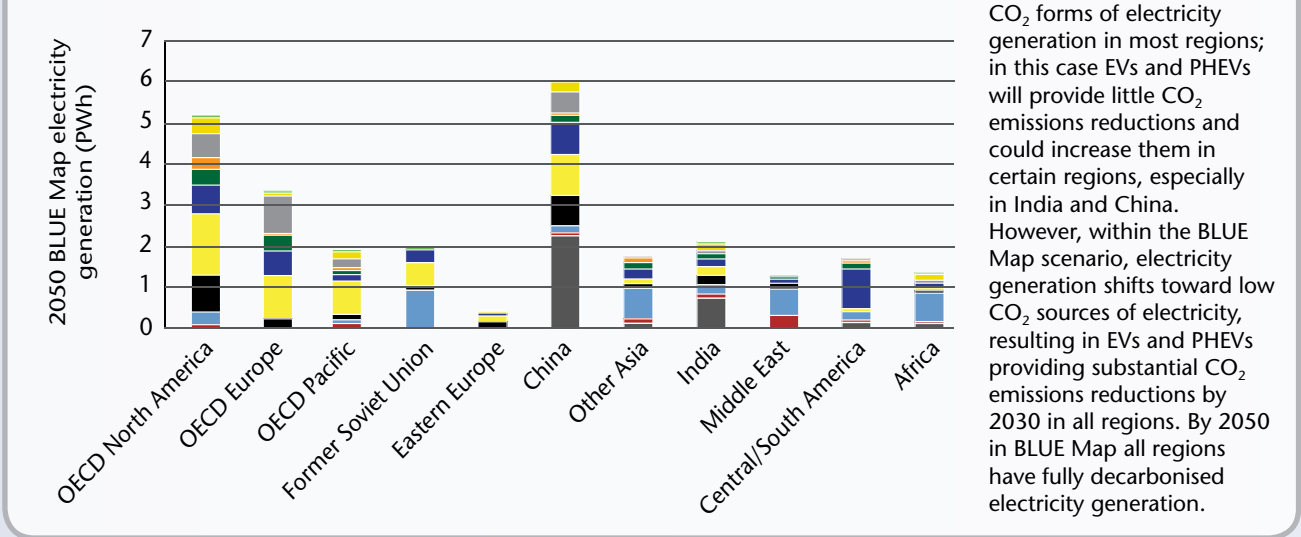
BLUE Map GHG intensity of electricity generation by region



2030 Baseline electricity generation mix, by region



2030 BLUE Map electricity generation mix, by region



In the Baseline scenario, there is little shift to lower CO₂ forms of electricity generation in most regions; in this case EVs and PHEVs will provide little CO₂ emissions reductions and could increase them in certain regions, especially in India and China. However, within the BLUE Map scenario, electricity generation shifts toward low CO₂ sources of electricity, resulting in EVs and PHEVs providing substantial CO₂ emissions reductions by 2030 in all regions. By 2050 in BLUE Map all regions have fully decarbonised electricity generation.

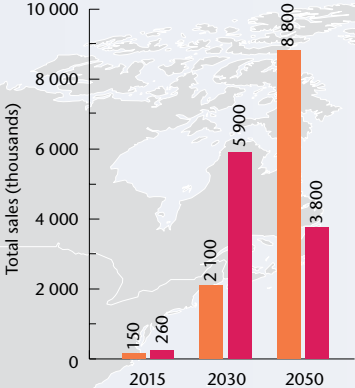
OECD PACIFIC
90 MILLION
7%

CHINA
240 MILLION
18%

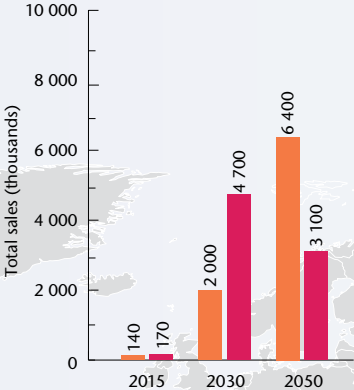
Global map of regional EV/PHEV sales

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

OECD North America



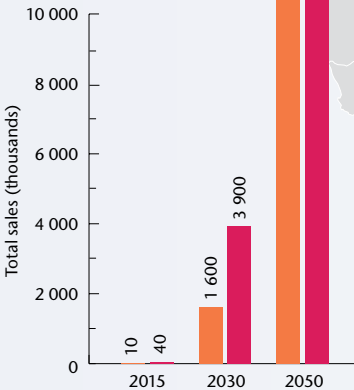
OECD Europe



- EV sales
- PHEV sales

EV/PHEV sales must reach substantial levels by 2015, and rise rapidly thereafter in order to achieve 2050 CO₂ reduction targets. Sales are expected to spread to non-OECD regions over time.

All other



INDIA
180 MILLION
14%

REST OF WORLD
370 MILLION
28%



