Delphi Technologies

Worldwide emissions standards

Passenger cars and light duty vehicles

2020 | 21

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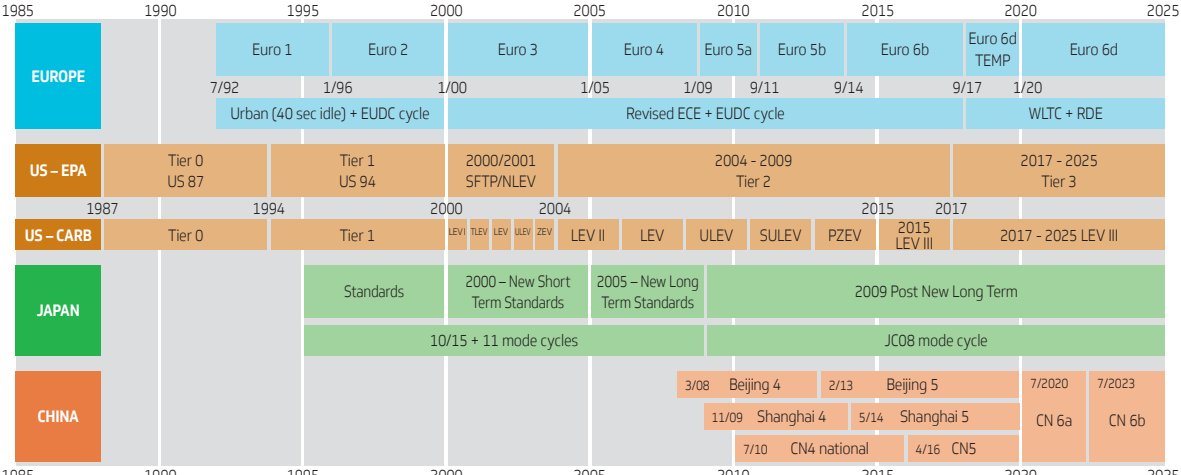

Dates show earliest type approval introduction only. More detail can be found in the booklet.

TIMELINE – TOXIC EMISSIONS STANDARDS PASSENGER CARS

Delphi Technologies

Viper power switch

The heart of our inverters is lighter, smaller, faster and cooler. With its patented features and advanced materials, it works to boost vehicle range and cut charging times, making for very happy owners.

Cleaner. Better. Further.

ELECTRIFICATION

CALIFORNIA ZERO EMISSION VEHICLE (ZEV) PROGRAM

Electrified vehicles are mandated for certain states in the US through the California Zero Emission Vehicle (ZEV) program. Through section 177 of the federal Clean Air Act the California ZEV program applies for California, and 9 additional states: Connecticut, Maine, Maryland, Massachusetts, New York, New Jersey, Oregon, Rhode Island, and Vermont. NOTE: EPA issued a rule effective November, 2019 withdrawing California's ability to implement it's ZEV program. That lawsuit is still ongoing at the time of publication of this booklet. The ZEV program uses a credit based system. Each vehicle manufacturer obtains ZEV credits based on annual sales of zero emission vehicles (ZEV) and transitional zero emission vehicles (TZEV). ZEVs comprise electric vehicles (EV), fuel cell electric vehicles (FCEVs), range extended battery electric vehicles (BEVx), and neighborhood electric vehicles (NEVs). TZEVs comprise PHEVs and hydrogen internal combustion engine vehicles (HICE).

The ZEV requirement for large volume manufacturers (LVM), having average vehicles sales in California > 20,000 per year is defined in the following table:

Year	2018	2019	2020	2021	2022	2023	2024	2025+
ZEV (EV and FCEV), BEVx, NEV	2%	4%	6%	8%	10%	12%	14%	16%
TZEV PHEV and HICE	2.5%	3%	3.5%	4%	4.5%	5%	5.5%	6%
ZEV Requirement Total	4.5%	7%	9.5%	12%	14.5%	17%	19.5%	22%

Note that the Total ZEV percent requirement can be fulfilled by a combination of ZEVs and TZEVs, subject to a minimum number of ZEVs that must be sold (Minimum ZEV floor). Additionally, BEVx vehicles are limited to fulfilling a maximum 50% of the requirement that must be met with ZEV credits.

Intermediate Vehicle Manufacturers with 5000 < CA annual vehicle sales ≤ 20,000 are subject to the same total ZEV percent requirement, but there is no minimum ZEV floor (i.e. there is no limit to the number of TZEVs that can be used to fulfill the Total ZEV percent requirement. Small Vehicle Manufacturers with CA annual vehicle sales ≤ 5,000 are exempt from ZEV mandate. ZEV credits to be applied to the ZEV requirement vary for the different ZEV and TZEV vehicles according to the following tables.

EV and FCEV ZEV credits/vehicle

All Electric Range (AER)	ZEV Credits
AER < 50 Miles	0
50 mi ≤ AER ≤ 350 mi	0.5+.01*AER
350 miles < AER	4

TZEV: PHEV ZEV credits/vehicle

All Electric Range (AER)	ZEV Credits
AER < 10 Miles	0
10 mi ≤ AER ≤ 80 mi	0.3+.01*AER
80 miles < AER	1.1

Note: ZEV credit increased by 0.2 for TZEV vehicles with AER ≥ 10 miles over US06 test cycle.

BEVx ZEV credits/vehicle

All Electric Range (AER)	ZEV Credits
AER < 75 Miles	0
75 mi ≤ AER ≤ 350 mi	0.5+.01*AER
350 miles < AER	4

Note: For BEVx if AER < Gasoline range, credit = 0

TZEV: HICE ZEV credits/vehicle

All Electric Range (AER)	ZEV Credits
AER < 10 Miles	0.75
10 mi ≤ AER ≤ 20 mi	1.05+.01*AER
20 miles < AER	1.25

Note: Requires total vehicle range of 250 miles to qualify as TZEV:HICE.

CALIFORNIA ZERO EMISSION VEHICLE (ZEV) PROGRAM

NEV ZEV credits/vehicle

NEV performance Requirements	ZEV Credits
Constant speed range ≥ 25 Miles Top Speed ≥ 20 mph 0-20 MPH ≤ 6 Sec	0.15

For determination of whether a manufacturer meets its Total Percent ZEV requirement, each ZEV or TZEV sold is multiplied by the ZEV credit value for that vehicle. Thus, for example, an EV with an AER = 375 miles over the UDDS receives the maximum ZEV credit and counts as 4 vehicles when calculating the percent ZEVs. Similarly, a PHEV with 100 mile AER over the UDDS and 25 miles over the US06 cycle receives the maximum PHEV credit and counts as 1.3 vehicles when calculating the percent TZEVs and the total percent ZEVs.

Additional compliance information is available from the California Air Resources Board Zero Emission Vehicle program website.

https://ww2.arb.ca.gov/our-work/programs/zero-emission-vehicle-program

EUROPEAN UNION ZERO AND LOW EMISSION VEHICLE (ZLEV) PROGRAM

There is no electrified vehicle mandate for the European Union, however electrified vehicles are eligible for super-credits and an increased ZLEV factor, up to 5%, is applied to CO_2 requirements for ZLEV credits exceeding 15% of vehicle sales in 2025 and 35% in 2030.

See European Union section on CO2 for details on ZLEV factor adjustment.

ZLEV credits can be earned for vehicles emitting less than 50 g/km of CO_2 on the WLPT. The following table presents the ZLEV credit vs. CO_2 emission level.

EV, FCEV and PHEV ZLEV credits per vehicle

CO_2 Emissions (g/km)	ZLEV Credits
CO_2 = 0 g/km (EV)	1
0 g/km < CO_2 < 50 g/km	1 - .014 * CO_2 g/km
CO_2 ≥ 50 g/km	0

Certain countries qualify as Low ZLEV member states resulting in a 1.85 multiplier on the ZLEV credit. The following 14 member states meet the criteria in 2017: Bulgaria, Cyprus, Czech Republic, Estonia, Greece, Croatia, Ireland, Lithuania, Malta, Poland, Romania, Slovenia, Slovakia.

PR OF CHINA NEW ENERGY VEHICLE (NEV) PROGRAM

The China New Energy Vehicle (NEV) program (revised 2019) requires that credits be produced equivalent to a weighted percent of sales.

NEV credits can be earned for:

- Plug in Hybrid Electric Vehicles (PHEV) – up to 1.6 per vehicle.
- Battery Electric Vehicles (BEV) – up to 5.1 per vehicle. (3.4 maximum base credits with up to 1.5x multiplier for efficient vehicles.
- Fuel Cell Electric Vehicles (FCEV) – up to 5 per vehicle.

Model Year	Weighted % of sales
2019	10 %
2020	12 %
2021	14 %
2022	16 %
2023	18 %
2024+	TBD

PHEV

NEV credits are based on All Electric Range (AER), curb mass, consumption fuel consumption in charge sustaining mode and electric energy consumption in charge depleting mode

Fuel Consumption ≥ 70% of phase 4 FC Target: 0.8 NEV credit per vehicle

Fuel Consumption < 70% of phase 4 FC Target: 1.6 NEV credits per vehicle

(See PR of China section on CO_2/FE for phase 4 fuel consumption targets)

The NEV credits determined are are reduced by 50% if the vehicle's Electric Energy Consumption (EEC) in charge depleting mode is greater than 135% of the Electric Energy Consumption target (Et) for a BEV of the same mass. See the BEV section on the next page for the table defining E_t

PR OF CHINA NEW ENERGY VEHICLE (NEV) PROGRAM

BEV

NEV credit for a vehicle is based on AER, curb mass, and Electric Energy Consumption (EEC) of the vehicle compared to the Electric Energy Consumption target (Et) for the vehicle based on vehicle mass.

NEV Credits per vehicle = $R_f * E_f$

BEV Electric Energy Factor (E_f)

$(E_t/EEC) < 1$	$E_f = 0.5$
$1 < (E_t/EEC) \leq 1.5$	$E_f = (E_t/EEC)$
$1.5 < (E_t/EEC)$	$E_f = 1.5$

Electric Energy Consumption threshold (E_t)

Curb Mass (kg)	(E_t) kWh/100km
Mass ≤ 1000 kg	0.4 + 0.0112*M
1000 kg < Mass ≤ 1600 kg	3.81 + 0.0078*M
1600 kg < Mass	10.28 + 0.0038*M

Range Factor (R_f) versus AER

All Electric Range (AER)	R_f
AER < 100 km	0
100 km ≤ AER ≤ 150 km	1
150 km ≤ AER ≤ 500 km	0.4+0.006*AER (km)
500 km < AER	3.4

FCEV

NEV credit based on AER, fuel cell power, electric motor power
- AER < 300 km - 0 NEV credits per vehicle
- Fuel Cell Power < 30% of Motor Power or 10 kw:
  - NEV credit per vehicle = 0.5*(0.08*FC power [kw])
- Fuel Cell Power ≥ 30% of Motor Power and 10 kw:
  - NEV credit per vehicle = 2*(0.08*FC power [kw])

The maximum NEV credit for a fuel cell vehicle cannot exceed 6

For determination of whether a manufacturer meets its total percent NEV requirement, each BEV, PHEV or FCEV sold is multiplied by the NEV credit value for that vehicle. Thus, for example, a BEV with an AER = 500 km with an Electrical Energy Consumption (EEC) equal to E_t receives 3.4 ZEV credits and counts as 3.4 vehicles when calculating the percent NEVs. Similarly, a PHEV with an EEC = Et and Fuel Consumption < 70% of phase 4 FC Target receives 1.6 NEV credits and counts as 1.6 vehicles when calculating the total percent NEVs.

AER	All Electric Range
AMA	Accelerated Mileage Accumulation
ASM	Acceleration Simulation Mode
BEV	Battery Electric Vehicles
BV	Bed Volume
CAFC	Corporate Average Fuel Consumption
CAFE	Corporate Average Fuel Economy (US)
CF	Conformity Factor
CI	Compression Ignition
COP	Conformity of Production
CWF	Carbon Weight Fraction (US)
DF	Deterioration Factor
DI	Direct Injection
EEC	Electric Energy Consumption
EOBD	European Union On-board Diagnostic
EUDC	Extra Urban Driving Cycle
EVAP	Evaporative Emissions
FAME	Fatty Acid Methyl Esters
FC	Fuel Consumption (EU)
FCEV	Fuel Cell Electric Vehicle
FE	Fuel Economy (US)
FR	First Registration, entry into service
FTP	Federal Test Procedure
GDI	Gasoline Direct Injection
GHG	Greenhouse Gas
GVM	Gross Vehicle Mass
GVW	Gross Vehicle Weight
GVWR	Gross Vehicle Weight Rating
IDI	Indirect Diesel Injection
IUPR	In-Use Performance Ratio
LBS	Pounds (1 lb = 454 g)
LCV	Light Commercial Vehicle
LDT	Light Duty Trucks
LEV	Low Emission Vehicle
LLDT	Light Light Duty Trucks
LPV	Light Passenger Vehicle
LVW	Loaded Vehicle Weight
MDPV	Medium Duty Passenger Vehicle
MIL	Malfunction Indication Lamp
MTBE	Methyl Tertiary Butyl Ether
NEDC	New European Driving Cycle
NEV	New Energy Vehicle (China)
NHV	Net Heating Value of Fuel (US)
NMHC	Non-Methane Hydrocarbons
NMOG	Non-Methane Organic Gases
NTE	Not To Exceed
NYCC	New York City Cycle
OBD	On-board Diagnostic
ORVR	On-board Refuelling Vapor Recovery
PEMS	Portable Emission Measurement System
PHEV	Plug in Hybrid Electric Vehicle
PI	Positive Ignition
PM/PN	Particulate Mass/Number
RAFs	Reactivity Adjustment Factors
RDE	Real Driving Emissions
RM	Reference Mass
RVP	Reid Vapor Pressure

SEA	Selective Enforcement Audit
SG	Specific Gravity of Fuel (US)
SHED	Sealed House for Evaporation Determination
SFTP	Supplemental Federal Test Procedure
SI	Spark Ignition
SULEV	Super Ultra Low Emissions Vehicle
TA	Type Approval
TF	Transfer Function
UDDS	Urban Dynamometer Driving Schedule
ULEV	Ultra Low Emission Vehicle
VM	Vehicle Makers
VT SHED	Variable Temperature SHED
WC	Working Cycle
WLTC	Worldwide Light duty Test Cycle
WLTP	Worldwide Light duty Test Procedure
ZLEV	Zero and Low Emission Vehicle (EU)

ADMINISTRATIONS & ASSOCIATIONS

ACEA	European Car Manufacturer Association
CARB	California Air Resources Board
ECE	Economic Commission for Europe
EPA	US Environmental Protection Agency
EU	European Union
MVEG	Motor Vehicle Emissions Group, advisory

Worldwide emissions standards

Passenger cars and light duty vehicles

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Delphi Technologies is pleased to offer free of charge to our customers Worldwide Emissions Standards booklets.

An electronic version of this booklet is also available on our website:
https://www.delphi.com/innovations

For additional worldwide emissions regulation information, please contact our emissions expert:
emissions.standards@delphi.com

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