Japan's CO2 Emission Reduction Target (INDC) (unit: million t-CO2)

	Estimated emission amount in fiscal 2030	fiscal 2013 (fiscal 2005)
Energy-derived CO2	927	1,235 (1219)
Industrial sector	401	429 (457)
Business and other sector	168	279 (239)
Household sector	122	201 (180)
Transportation sector	163	225 (240)
Energy conversion sector	73	101 (104)

◆ Emissions from the transportation sector: Reduction of 62 million t-CO2 is required by fiscal 2030

Penetration of next-generation automobiles and improvement of fuel consumption (Plans for Addressing Global Warming)

	Unit		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Evaluation index of measures Ratio of next-generation automobiles in new vehicle sales	%	Actual achievement	23.2	25.6	32.3	35.8	36.7													
		Prospect (Upper)								50										70
		Prospect (Lower)								20										50
Evaluation index of measures Average fuel consumption	km/L	Actual achievement	14.7	15.3	16.0	16.6	17.2													
		Prospect								18.5										24.8
Energy saving amount	10^4kL	Actual achievement	19.9	49.2	85.1	89.7	128.6													
		Prospect								283.4										938.9
Emission reduction amount	10^4t-CO2	Actual achievement	53.3	131.5	227.5	239.8	343.0													
		Prospect								702.5										2,379

◆ Target to reduce emissions of 23.79 million t-CO2/year (20.89 million t-CO2/year from 2017) by fiscal 2030

Measures to achieve the target

(1) Increasing the number of EVs
(2) Increasing the number of HVs and PHVs
(3) Increasing the number of FCVs
(4) Improving fuel consumption of conventional vehicles
(5) Introduction of bioethanol as fuel (gasoline) of conventional vehicles
(6) Introduction of bioethanol as fuel (gasoline) of HVs and PHVs

Reduction of CO2 emissions in fiscal 2030 (left: basic, right: optimum case*)

Amounts of CO2 emission reductions				vs Target
Target amounts		2,089	10^4t-CO2/year	100%
Increasing the number of next-generation automobiles	EV	85	10^4t-CO2/year	4%
	HV	832	10^4t-CO2/year	40%
	PHV	50	10^4t-CO2/year	2%
	FCV	17	10^4t-CO2/year	1%
	Subtotal	984	10^4t-CO2/year	47%
Improving the fuel consumption of conventional vehicles		642	10^4t-CO2/year	31%
Introduction of bioethanol (E10)	Conventional vehicles	289	10^4t-CO2/year	14%
	HV	110	10^4t-CO2/year	5%
	PHV	6	10^4t-CO2/year	0%
	Subtotal	406	10^4t-CO2/year	19%
Subtotal		2,031	10^4t-CO2/year	97%
Deficient amounts		58	10^4t-CO2/year	3%

Amounts of CO2 emission reductions				vs Target
Target amounts		2,089	10^4t-CO2/year	100%
Increasing the number of next-generation automobiles	EV	256	10^4t-CO2/year	12%
	HV	968	10^4t-CO2/year	46%
	PHV	151	10^4t-CO2/year	7%
	FCV	51	10^4t-CO2/year	2%
	Subtotal	1,426	10^4t-CO2/year	68%
Improving the fuel consumption of conventional vehicles		480	10^4t-CO2/year	23%
Introduction of bioethanol (E10)	Conventional vehicles	109	10^4t-CO2/year	5%
	HV	65	10^4t-CO2/year	3%
	PHV	10	10^4t-CO2/year	0%
	Subtotal	183	10^4t-CO2/year	9%
Subtotal		2,089	10^4t-CO2/year	100%
Deficient amounts		0	10^4t-CO2/year	0%

*The right table shows the case where the introduction of bioethanol accounts for about 50% of the total number in the optimum case.

◆ The target can be achieved by introducing bioethanol (E10) into conventional vehicles, HVs and PHVs.

Amounts of CO2 emission reductions				vs Target
Target amounts		2,089	10^4t-CO2/year	100%
Increasing the number of next-generation automobiles	EV	85	10^4t-CO2/year	4%
	HV	832	10^4t-CO2/year	40%
	PHV	50	10^4t-CO2/year	2%
	FCV	17	10^4t-CO2/year	1%
	Subtotal	984	10^4t-CO2/year	47%
Improving the fuel consumption of conventional vehicles		642	10^4t-CO2/year	31%
Subtotal		1,626	10^4t-CO2/year	78%
Deficient amounts		464	10^4t-CO2/year	22%

Amounts of CO2 emission reductions				vs Target
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	PHV	151	10^4t-CO2/year	7%
	FCV	51	10^4t-CO2/year	2%
	小計	1,426	10^4t-CO2/year	68%
Improving the fuel consumption of conventional vehicles		480	10^4t-CO2/year	23%
Subtotal		1,906	10^4t-CO2/year	91%
Deficient amounts		183	10^4t-CO2/year	9%

◆ It is difficult to achieve the government target only by increasing the number of next-generation automobiles and improving the fuel consumtion of conventional vehicles.

◆ Base case: Realistic scenario

◆ Optimum case: Scenario for accelerated introduction of next-generation automobiles

Scenarios for the number of next-generation automobiles and conventional vehicles owned

Case	Vehicles	Owned number		Composition ratio
Base Case	EV	137	$\times 10^4$	2%
	HV	2,297	$\times 10^4$	35%
	PHV	137	$\times 10^4$	2%
	FCV	28	$\times 10^4$	0%
	Conventional	3,902	$\times 10^4$	60%
	Total	6,500	$\times 10^4$	100%
Optimum case	EV	414	$\times 10^4$	6%
	HV	2,672	$\times 10^4$	41%
	PHV	414	$\times 10^4$	6%
	FCV	83	$\times 10^4$	1%
	Conventional	2,918	$\times 10^4$	45%
	Total	6,500	$\times 10^4$	100%

Reduction of CO2 emissions in fiscal 2030 (left: basic, right: optimum case*)

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	PHV	50	10^4t-CO2/year	2%
	FCV	17	10^4t-CO2/year	1%
	Subtotal	984	10^4t-CO2/year	47%
Improving the fuel consumption of conventional vehicles		642	10^4t-CO2/year	31%
Introduction of bioethanol (E10)	Conventional vehicles	289	10^4t-CO2/year	14%
	HV	110	10^4t-CO2/year	5%
	PHV	6	10^4t-CO2/year	0%
	Subtotal	406	10^4t-CO2/year	19%
Subtotal		2,031	10^4t-CO2/year	97%
Deficient amounts		58	10^4t-CO2/year	3%

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	Subtotal	1,426	10^4t-CO2/year	68%
Improving the fuel consumption of conventional vehicles		480	10^4t-CO2/year	23%
Introduction of bioethanol (E10)	Conventional vehicles	109	10^4t-CO2/year	5%
	HV	65	10^4t-CO2/year	3%
	PHV	10	10^4t-CO2/year	0%
	Subtotal	183	10^4t-CO2/year	9%
Subtotal		2,089	10^4t-CO2/year	100%
Deficient amounts		0	10^4t-CO2/year	0%

*The right table shows the case where the introduction of bioethanol accounts for about 50% of the total number in the optimum case.

Calculation of CO2 marginal abatement cost

CO2 marginal abatement cost =

Difference of (Vehicle purchase expenses + Fuel/Electricity expenses + Infrastructure construction expenses)

Amount of CO2 emission reduction

Preconditions for calculating CO2 marginal abatement cost

- ✓ Calculation year: Fiscal 2030 (1 year)
- ✓ Controls (comparison target): Current conventional vehicles, except introduction of bioethanol into HVs/PHVs of which comparison target is the normal HVs/PHVs (fiscal 2030). This is the same method as calculating the CO2 emission reduction amount, in order to prevent double counting.
- ✓ Numerator of CO2 marginal abatement cost (cost): Difference of total of vehicle purchase cost, fuel cost (including electricity cost), and infrastructure construction cost in fiscal 2030 (1 year)
- ✓ Denominator of CO2 reduction cost (CO2 emission reduction amount): CO2 emission reduction amount in fiscal 2030 (1 year) calculated in this study as above (non-LCA basis)

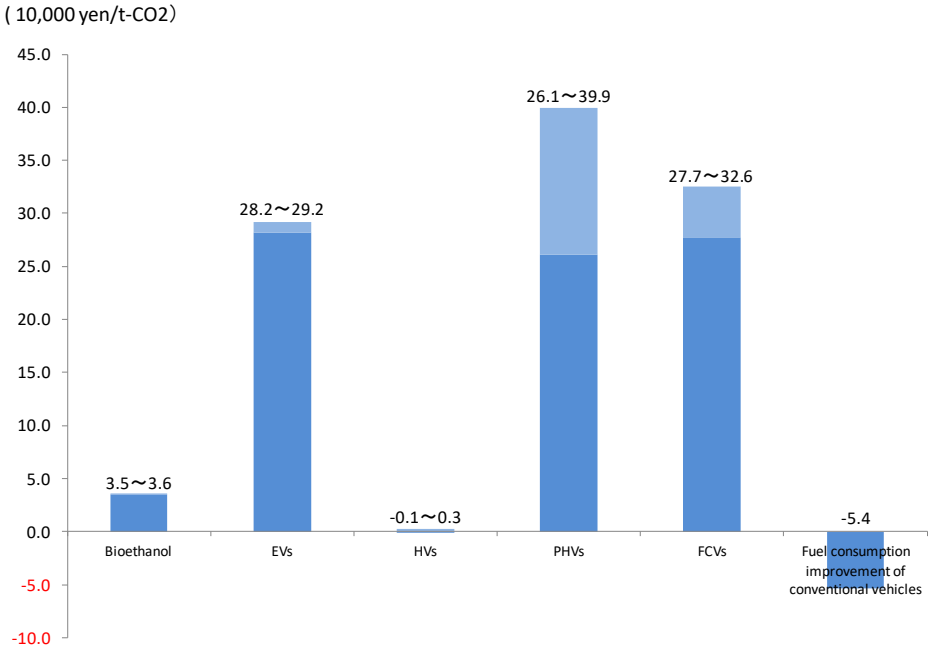
Base case

CO2 marginal abatement cost		
Increasing the number of next-generation automobiles	EV	292,010 yen/t-CO2
	HV	2,626 yen/t-CO2
	PHV	399,023 yen/t-CO2
	FCV	325,630 yen/t-CO2
Improving the fuel consumption of conventional vehicles		-53,621 yen/t-CO2
Introducing bioethanol (E10)	Conventional vehicle	34,748 yen/t-CO2
	HV	34,748 yen/t-CO2
	PHV	34,748 yen/t-CO2

Optimum case

CO2 marginal abatement cost		
Increasing the number of next-generation automobiles	EV	282,221 yen/t-CO2
	HV	-998 yen/t-CO2
	PHV	261,456 yen/t-CO2
	FCV	277,423 yen/t-CO2
Improving the fuel consumption of conventional vehicles		-53,621 yen/t-CO2
Introducing bioethanol (E10)	Conventional vehicle	35,577 yen/t-CO2
	HV	35,577 yen/t-CO2
	PHV	35,577 yen/t-CO2

- ➢ The CO2 marginal abatement cost of introducing bioethanol (E10) to conventional vehicles, HVs, and PHVs is 3.47-3.56 × 10,000 yen/t-CO2.
- ➢ This value is much lower than CO2 marginal abatement cost of EVs (28.2-29.2 × 10,000,000 yen/t-CO2), PHVs (26.1-39.9 × 10,000 yen/t-CO2), and FCVs (27.7-32.6 × 10,000 yen/t-CO2).



CO2 marginal abatement cost of next-generation automobiles and bioethanol introduction