

EV(Electric Vehicle)

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Technology Overview

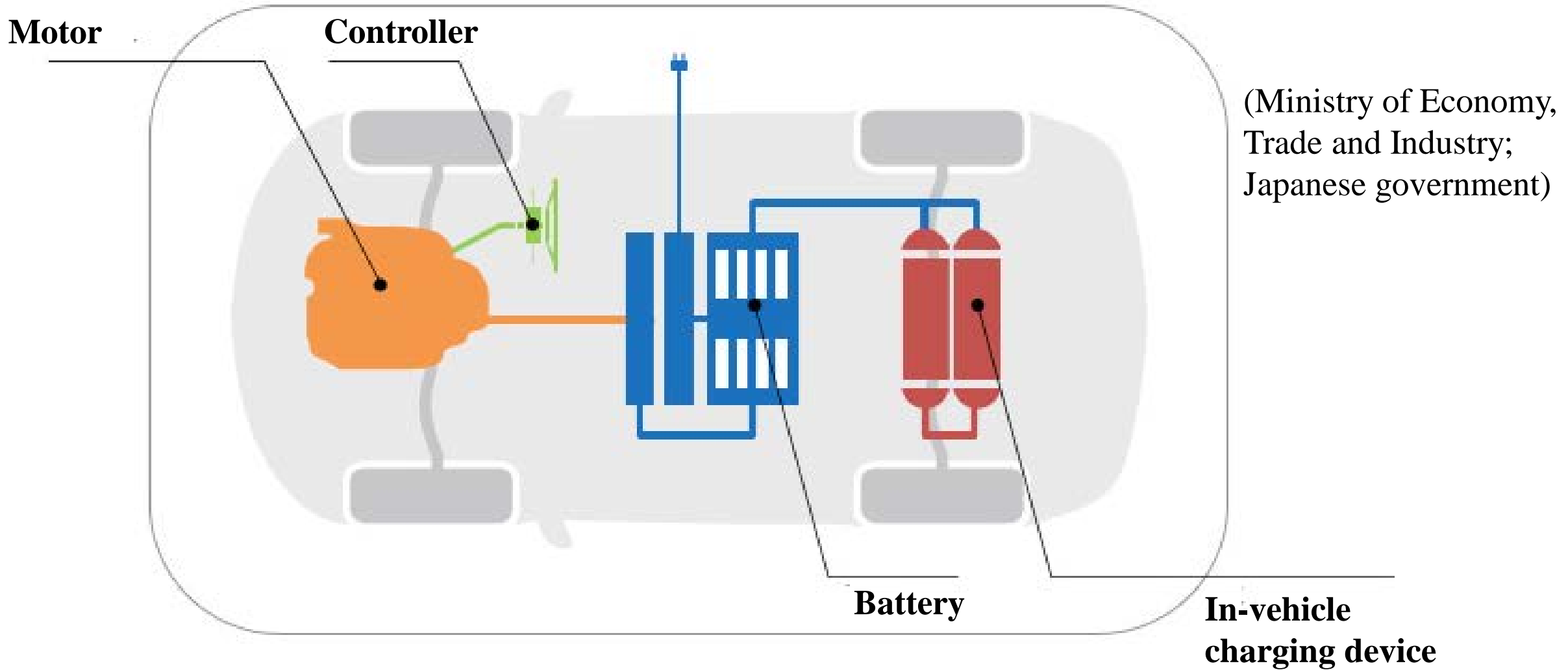
A power source of EV is its electric motor only by system of “In-vehicle charging device”. Thanks to the energy system, EV has the capacity to reduce its emission of environmental pollutant such as CO₂, NO_x, SO_x, P.M 2.5, mercury etc. in motoring; to accumulate electricity which can supplement a fault in solar, wind or tidal power generations. As a result of this accumulation system, EV helps to save the energy resources such as fossil fuels.

An industry of vehicle such as “Nissan Motor Co.”, Japan. Thus, this research illustrate EV with “LEAF” from “Nissan Motor Co.” at the “Calculation of Profitability” at this research.

Backgrounds of EV is a surge to the interest in resources such as fossil fuels, and environmental issues such as the air pollution.

A competing technology of EV is PHV(Plug-in Hybrid Vehicle): a hybrid electric vehicle that utilizes rechargeable batteries, or another energy storage device, that can be restored to full charge by connecting a plug to an external electric power source. The cost of PHV is lower than EV in general.

Mechanisms of EV



Calculation of environmental impact reductions 1/2

“The reduction of emission of environmental pollutant”

EV can reduce emission of environmental pollutant unlike gasoline vehicles. All of vehicles were EV, the emissions come to become nothing.

The emissions from gasoline vehicles in case of Japan:

- ① fuel economy of gasoline-powered vehicles = 19km/ℓ, (Ministry of the Environment : 2015);
- ② gasoline vehicle ownership = 67,008,890 vehicles in Japan, 2011
(Ministry of Land, infrastructure, Transport and Tourism : 2011);
- ③ annual average mileage of gasoline vehicles = 4,920km, (JAMA : 2011);
- ④

Discharge coefficient of gasoline vehicles		
2.32 tCO ₂ /kℓ	0.000010 kgCH ₄ /km	0.000029 kgN ₂ O/km

CH₄ : Methane is one of the natural gas and GHG.
N₂O : Nitrous oxide is GHG, and destroy the ozone layer.
(Mie prefectural government, Japan : 2012)

∴ Annual gasoline consumption in Japan = ② × ③ ÷ ① \simeq 17,351,775,726ℓ

∴ The annual discharge from gasoline vehicles in Japan:

CO₂ = 2.32t × 17,351,775,726ℓ \simeq 40,256,112t;

CH₄ = 0.000010kgCH₄/km × ② × ③ = 0.000010kgCH₄/km × 329,683,738,800km \simeq 3,296,837kg;

N₂O = 0.000029 kgN₂O/km × ② × ③ = 0.000029 kgN₂O/km × 329,683,738,800km \simeq 9.560,828kg ||

Calculation of environmental impact reductions 2/2

“The capacity for a storage of EV

EV is a storage technology also. The storage capacity depends on the In-vehicle charging device.

- ① An example is “LEAF” from “Nissan Motor Co.”, Japan, which has the capacity for a storage: 24kWh/day/ “LEAF” (“LEAF” HP);
- ② Japan has EV: 54,757 (this reference is “NEV”);
- ③ Japan consumes energy: around 97,000,000kWh per year (Agency of Natural Resources and Energy, Japanese government);

All of EV were “LEAF” in Japan, the storage capacity
 $= 24\text{kWh/day} \times 365 \text{ days} \times 54,757\text{EV} = 479,671,320\text{kWh},$
 $= 479,671,320\text{kWh} \div 97,000,000\text{kWh} \simeq 4.95 \text{ times} \parallel$

Calculation of Profitability 1/3 “The data”

This research on “LEAF” uses “Break-Even Point(BEP)”.

BEP :

The point at which total cost and total sales are equal: there is no net loss or gain, and one has "broken even." The sales exceeded “broken even” point, the business is a surplus. Conversely, the sales fallen below “broken even” point, the business is a deficit.

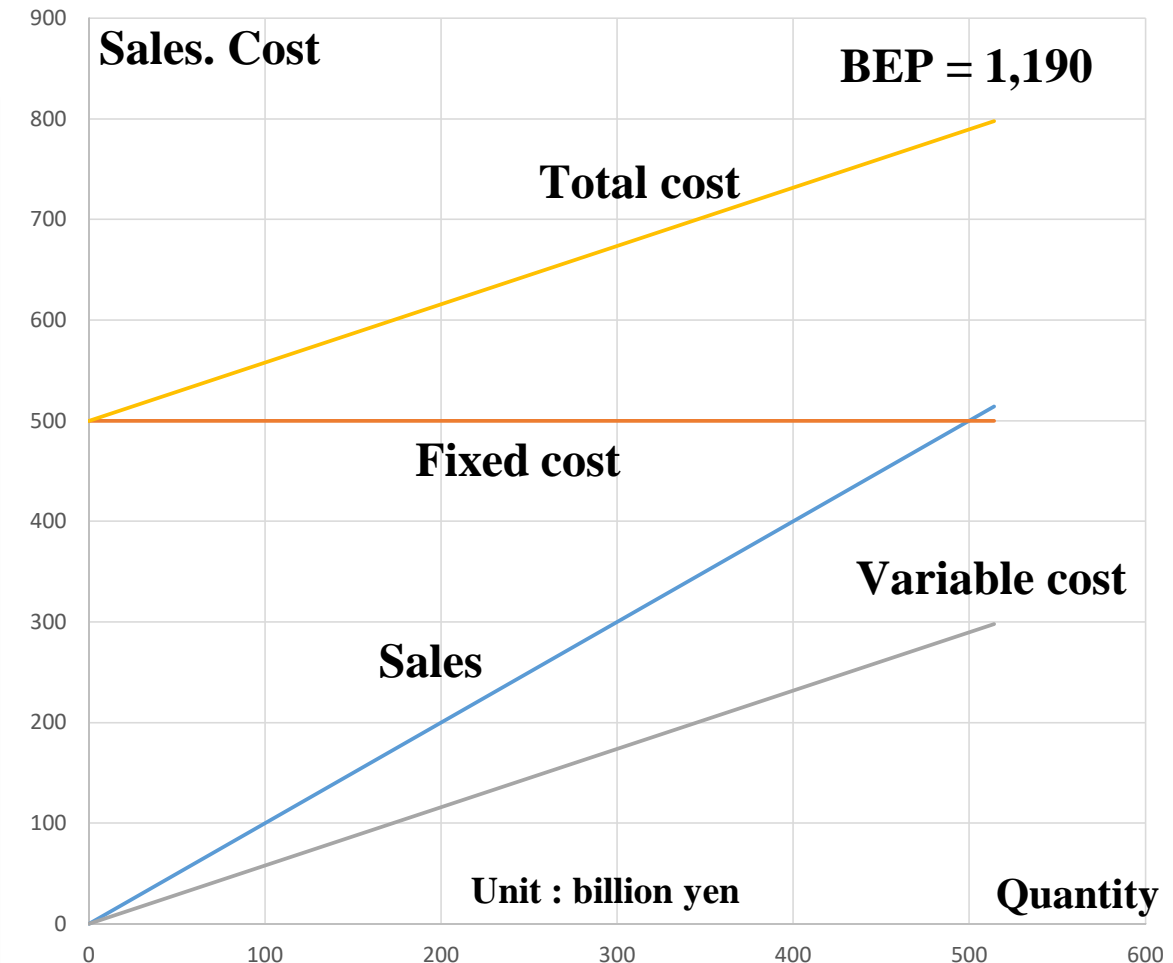
The data:

- ① Sales = 3.15million yen/”LEAF” × 172 thousand “LEAF”s = 541.8 billions
(“NISSAN” HP; “CARCAST : 2015) ||
- ② Fixed cost = 500 billions (“DIAMOND online” which is a major business news in Japan) ||
- ③ Variable cost = (2 millions – 270 thousands) /”LEAF”
∴ The aid money from Japanese government = 270 thousands/”LEAF”
= 1.73 millions/”LEAF” (Japan Finance Corporation : 2011) ||

(Unit : Yen)

Calculation of Profitability 2/3 “BEP”

Each matter	Actual amount	Composition ratio
Sales (S)	541,428,480,000	100.0 %
Variable cost (V)	297,560,000,000	55 %
Fixed cost (F)	243,868,480,000	45 %
Marginal profit	500,000,000,000	92.3 %
Ordinary income	-256,131,520,000	-47.3 %
BEP	1,110,082,943,068 = $F \{ (S - V) \div S$	
Ratio of FM	205% = $F \div \text{Marginal profit}$	



Calculation of Profitability 3/3:

The meaning of the result of BEP as for “LEAF”

Surely, the sales falls below “broken even” point. Yet the increasing rate of the sales exceeds the increasing rate the total cost. Thus, in the future, the sales will exceed the “broken even” point. In other words, the financial condition is not necessarily a bad.

As a result of this calculation of profitability as for “LEAF”, We predict that EV does not necessarily pay to the business owner. Therefore, EV can be spread by the market doctrine, and does not necessary to be given its aid money by government.

Environmental and social impacts

1. To reduce the emission of environmental pollutant:
CO₂ = 27.1 thousands t/EV per year;
CH₄ = 934.8g/EV per year; CH₄ : Methane is one of the natural gas and GHG.
N₂O \simeq 2.71kg/EV per year. N₂O : Nitrous oxide is one of GHG, and destroy the ozone layer.
2. A storage capacity of EV: “LEAF” especially is enough to supplement Japanese solar, wind and tidal electricity. Japanese government combined developing the solar, wind and tidal electricity with applying EV to storages, Japan can meet the energy demand by solar, wind and tidal electricity.
3. A storage capacity of EV depends on spread of EV number. As EV spreads, a storage capacity increases, and supplement a fault in solar, wind and tidal electricity.
4. As a result of to reduce the emission of environmental pollutant; and increase a storage capacity of EV, EV contributes to the environmental and social sustainability.

Barriers for technology diffusion, technology, or technology innovation

1. To lower cost of EV: the fixed cost especially. The cause of high cost is the production costs: the “In-vehicle charging device” especially.
2. Consumers of vehicles do not necessarily have whose consciousness to environmental social impacts, but the price only in purchasing a vehicle.
3. As a result of such causes, the cost of EV is being high; and the demand is not many as gasoline vehicles.

Thank you for your attention!