A Japanese model plan for a quick-charging network based on traffic simulation for promoting EVs

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Outline

1. Back ground: Realizing a low-carbon society
2. EV/PHV road map in Japan
3. Proposal of optimization of layout of quick charging infrastructures
4. Summary

1. Realizing a low-carbon society

- Energy storage is essential for a resilient and efficient power grid.
- Carbon dioxide (CO_2) emissions from power supply systems and energy demand must be reduced.
- Renewable energy power generation often provides a low-carbon but unstable electric power supply.
- Combining low-carbon electric power and high-efficiency electric technologies enhances CO_2 emission reductions.

Realization of a low-carbon society

① Use of low-carbon electricity

② Use of energy-saving technologies

Demand side

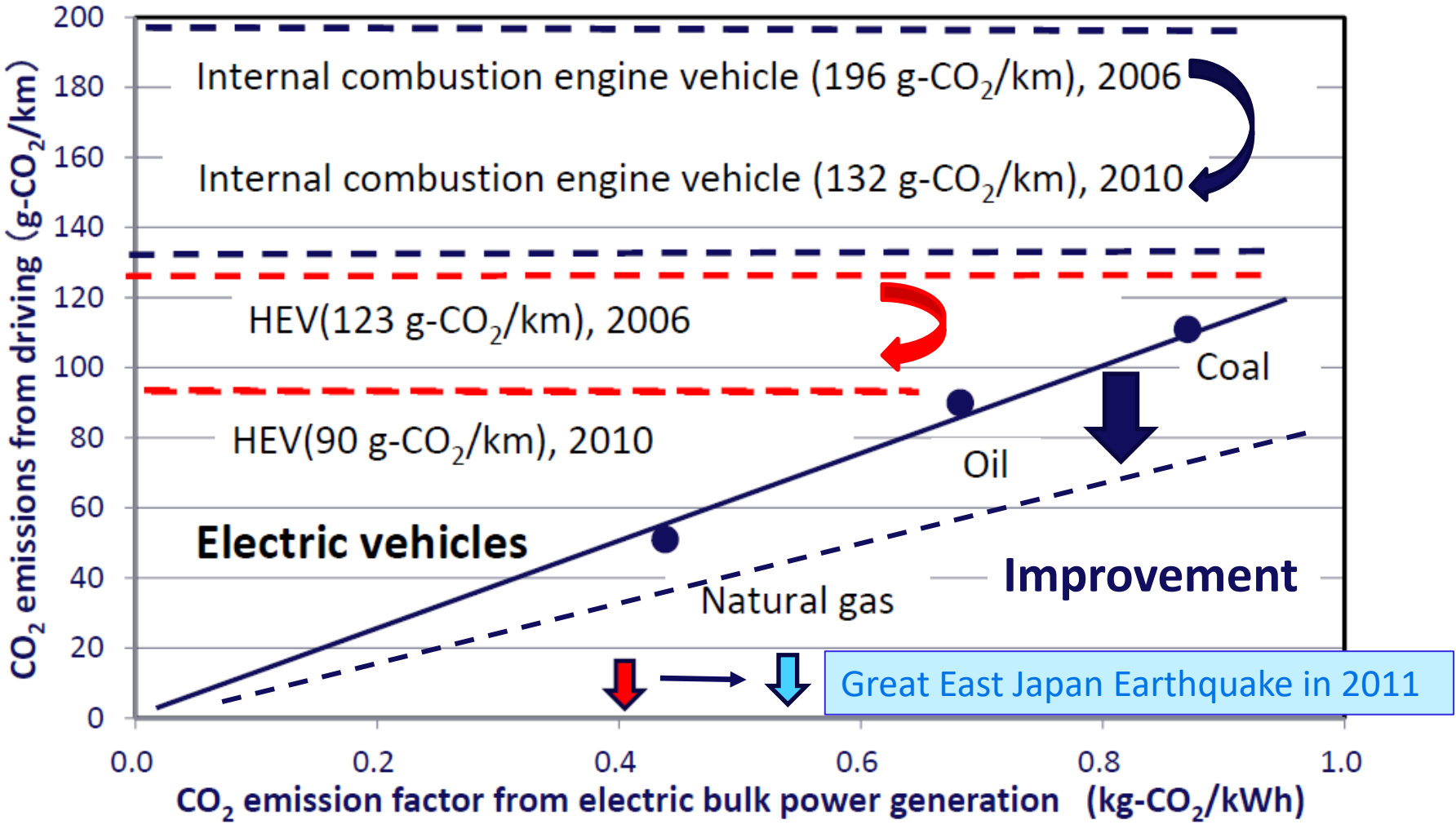
Supply side

High-efficiency technology

Low CO_2 energy

Significant reduction of CO_2 emissions

CO_2 emissions reduction by combining high-efficiency technologies and low-carbon power generation



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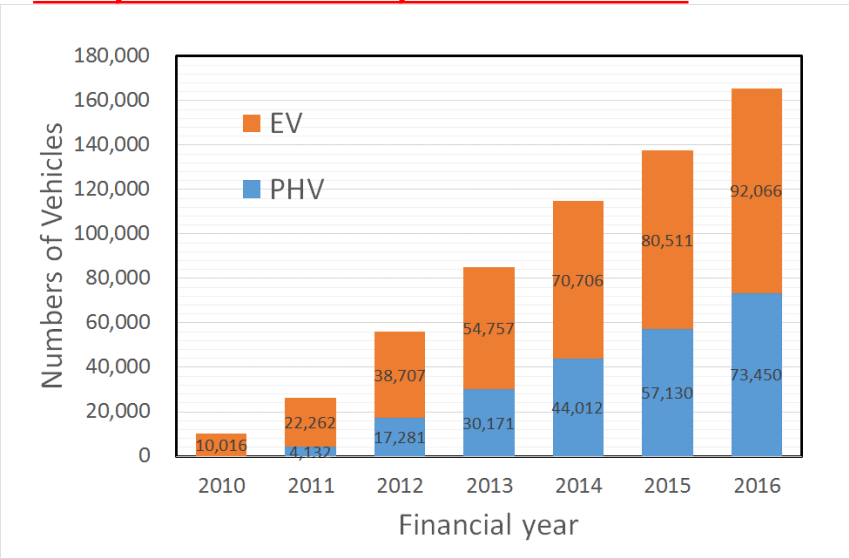
EV &PHV and charge infrastructures in Japan, now

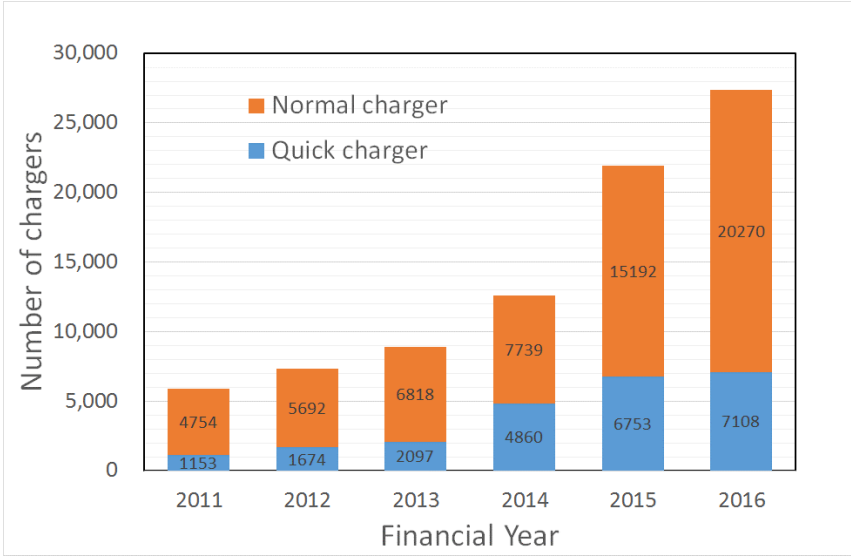
Numbers of EV and PHV･PHV

- PHV has been increasing.
- The number of EV has increased over 70,000. But it is only 0.1 % of 60M vehicles in Japan.
- The total number of EV and PHV has been increasing over 175,000 vehicles, about 0.3%.

Charge infrastructure

- The number of charge infrastructure has increased over 27,000.
- There are more than 7,000 quick charging stations.
- Normal charger should be increased for accelerating popularization of EVs.





Some issues for commercialization of EVs

- An EV is expected to be improved to extend a mileage per a charge.
- The performances of secondary batteries should be improved, on the energy density, cycle life, safety, cost and so on.
- An EV is too expensive, not cheap.
- It is necessary to make charge time shortened.
- Preparation of charge infrastructure is required against EV stranded.

Publication of Japan's "EV-PHV roadmap" (March 2016)

News Release

経済産業省
Ministry of Economy, Trade and Industry

Ministry of Economy, Trade and Industry, Japan

March 23rd, 2016

電気自動車・プラグインハイブリッド自動車の普
「EV・PHV ロードマップ」をとりまとめました

幅広い関係者で構成される「EV・PHV ロードマップ検討会」では、電気自動車（EV）やプラグインハイブリッド自動車（PHV）の普及に向けて必要な車両と充電インフラ等が連携した戦略を検討してまいりました。今般、検討結果が「EV・PHV ロードマップ」としてとりまとめられましたので、公表します。

METI summarized the EV-PHV roadmap towards the spread of EVs and PHVs. According to the **EV-PHV roadmap**, which was created by a committee composed of a wide range of stakeholders, we must consider a strategy of coordinating vehicles and charging infrastructure to support the popularization of EVs and PHVs.

http://www.meti.go.jp/press/2015/03/20160323002/20160323002.html

Summary of the EV-PHV roadmap

The roadmap addresses the following main issues: **vehicles, charging infrastructure, application of EVs and PHVs to vehicle-to-everything (V2X), and cooperation with local governments.**

- An ambitious target has been set: reaching a **maximum of 1 million electric vehicles in 2020**, from the current cumulative sales 140,000.
- Charging infrastructure should be prepared for en route charging, destination charging, basic charging at apartments and basic and destination charging at workplaces

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Where to install quick charge stations

- Quick charging stations are required to be prepared in town and out on roads for EV driving.
- Japanese government seeks the model plans to locate EV charging stations in Japan.
- We should discuss the model plans with consideration of the effects of geography, traffic jam and the EV driving performances.
- CRIEPI and KKE tried to develop EV Traffic simulator of "EV-OLYENTOR © " and propose the model plans.

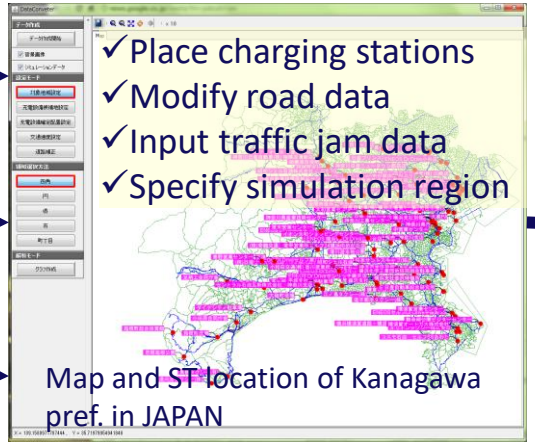
The EV-OLYENTOR © traffic simulator with multiple layers to analyze locations of quick charging stations for EVs

First layer: Pre-post tool

Map database
(Digital Map25000, etc)

Traffic data
(Traffic census etc.)

Census data
(e.g., employees, business facilities.)



Map and ST location of Kanagawa pref. in JAPAN

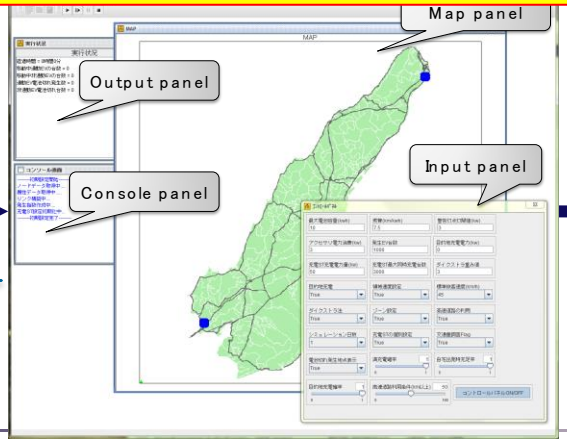
Input files
(Excel CSV files)
- Road map data
- Charging station data
- Trip data
- Traffic jam data
- Census data (e.g., employees, business facilities)

This system is developed under "artisoc@" (Kozokeikaku Engineering Inc.)

Display results

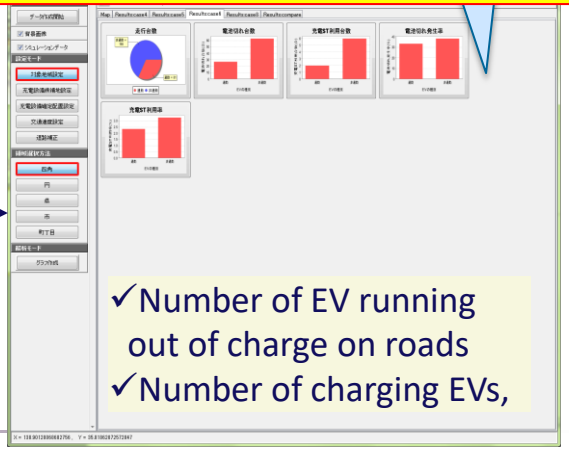
Set up input files for traffic simulator

Second layer: Traffic simulator



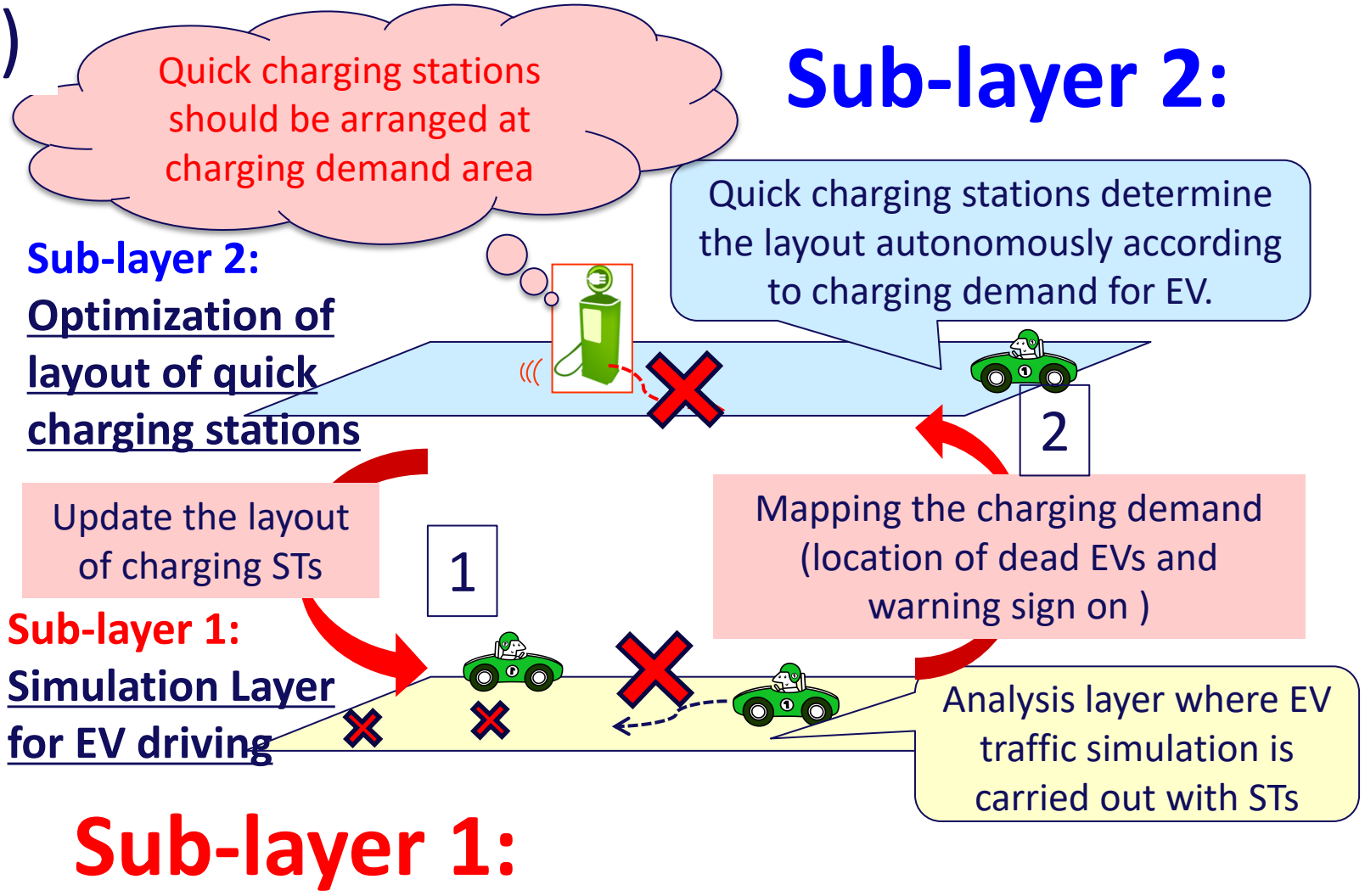
EV traffic simulation and optimization of location of quick charging stations

Third layer: Results



Second layer: Traffic simulator

(a)



Sub-layer 2:

Sub-layer 1:

Second layer: Traffic simulator

(b)

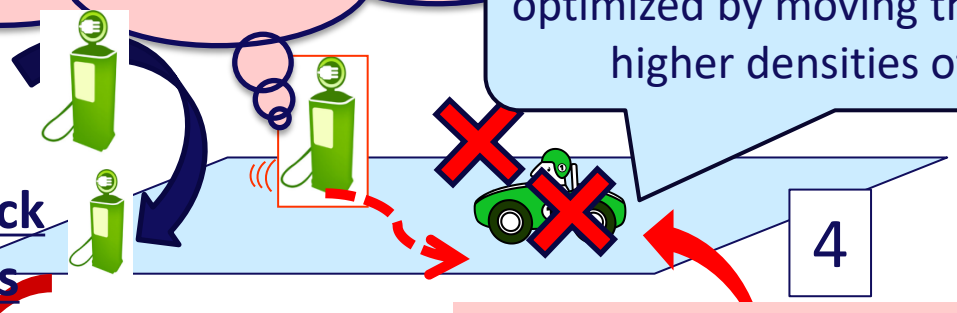
Quick charging stations move to optimized positions considering the balances of layouts and the distances.

Sub-layer 2:

Optimization of locations of quick charging stations

Sub-layer 2:

The locations of charging stations are optimized by moving them to areas with higher densities of red crosses



4

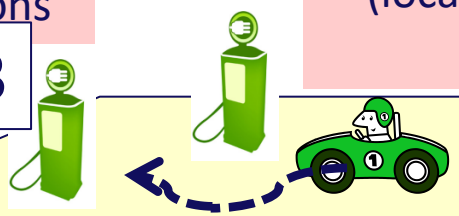
Mapping the charging demand (location of dead EVs and warning sign on)

Optimized location of quick charging stations

3

Sub-layer 1:

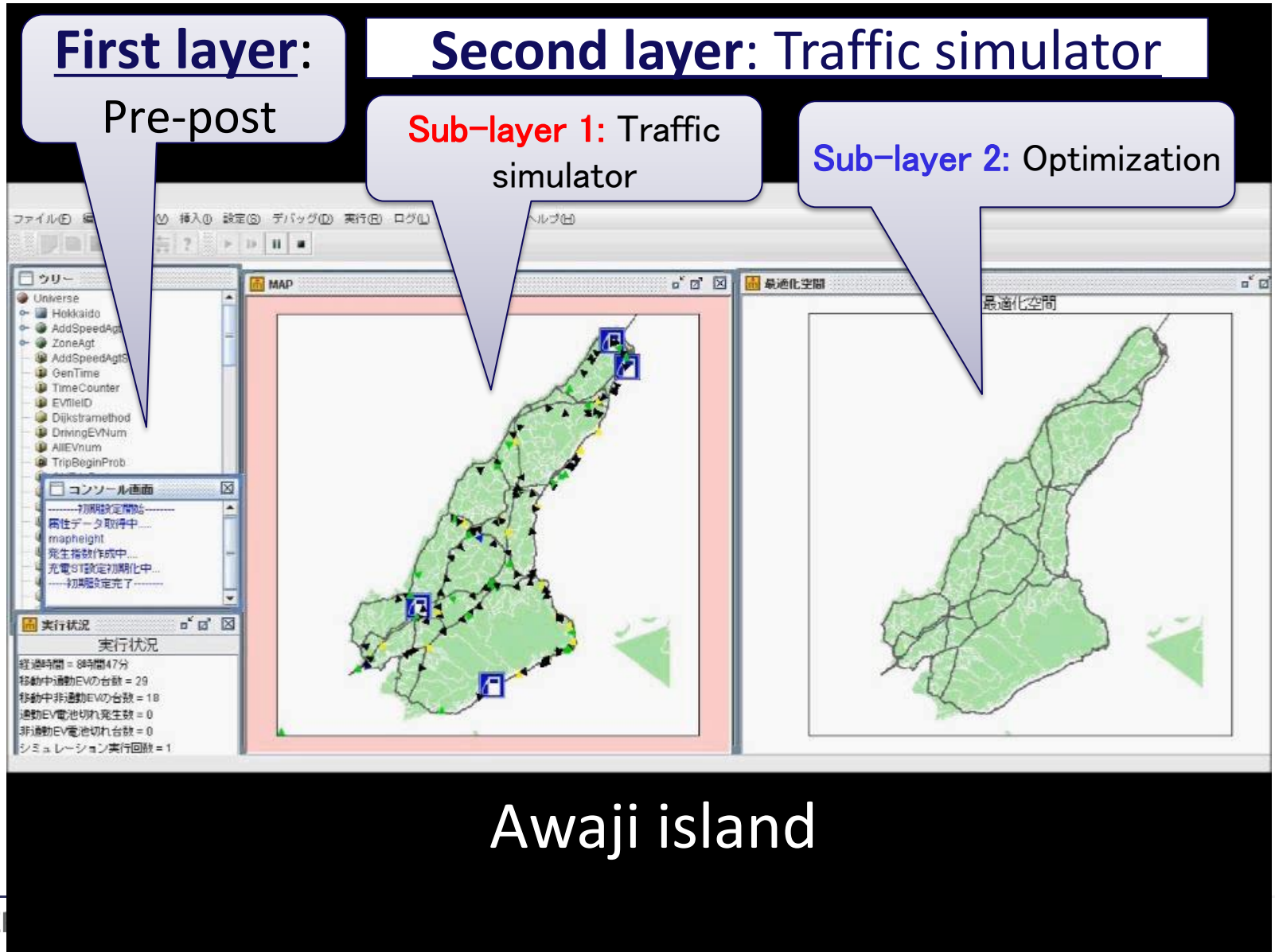
Simulation Layer for EV driving with quick charging stations



Analyzing optimization of quick charging stations by EV traffic simulation

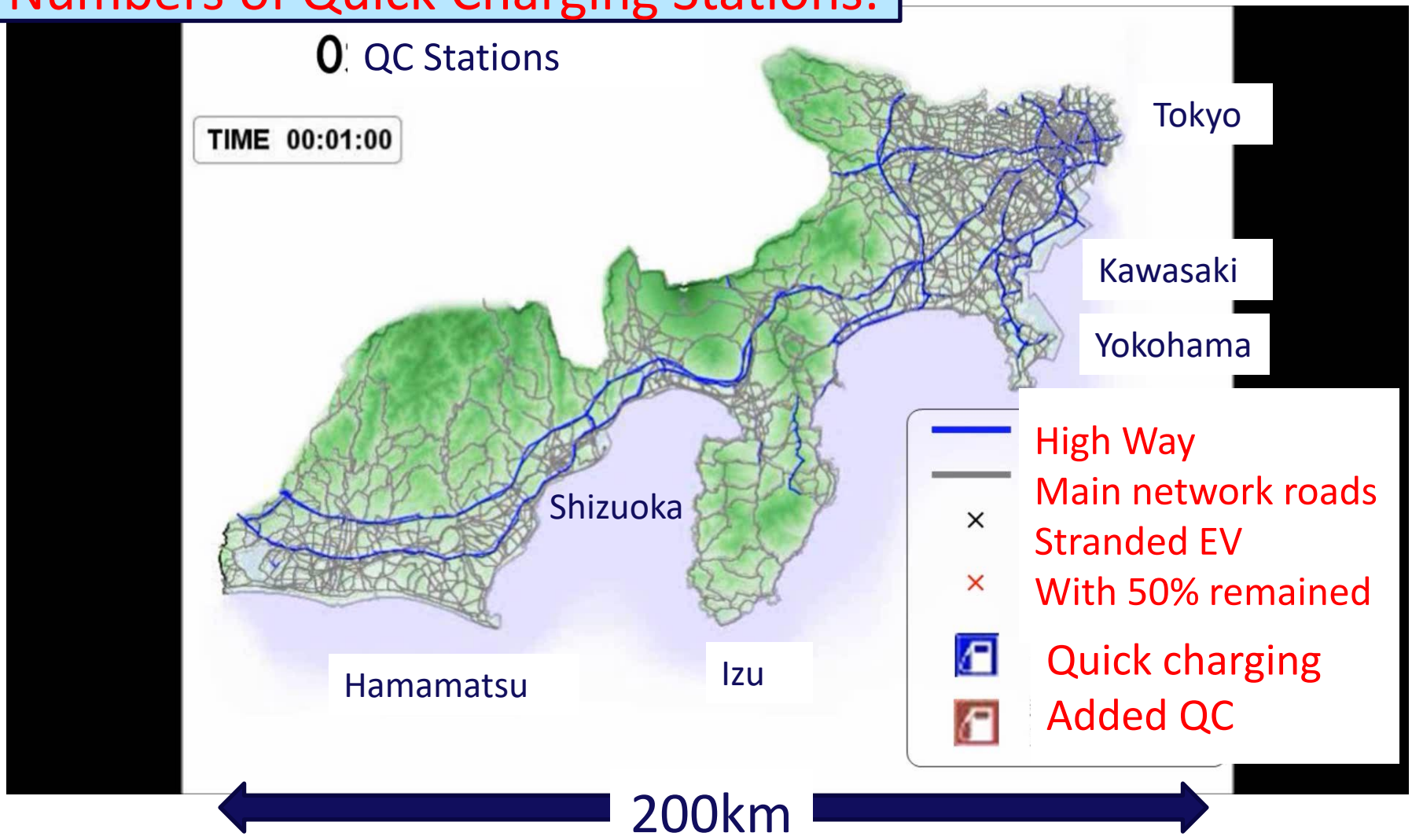
Sub-layer 1:

“EV-OLYENTOR ©“ with multiple layers

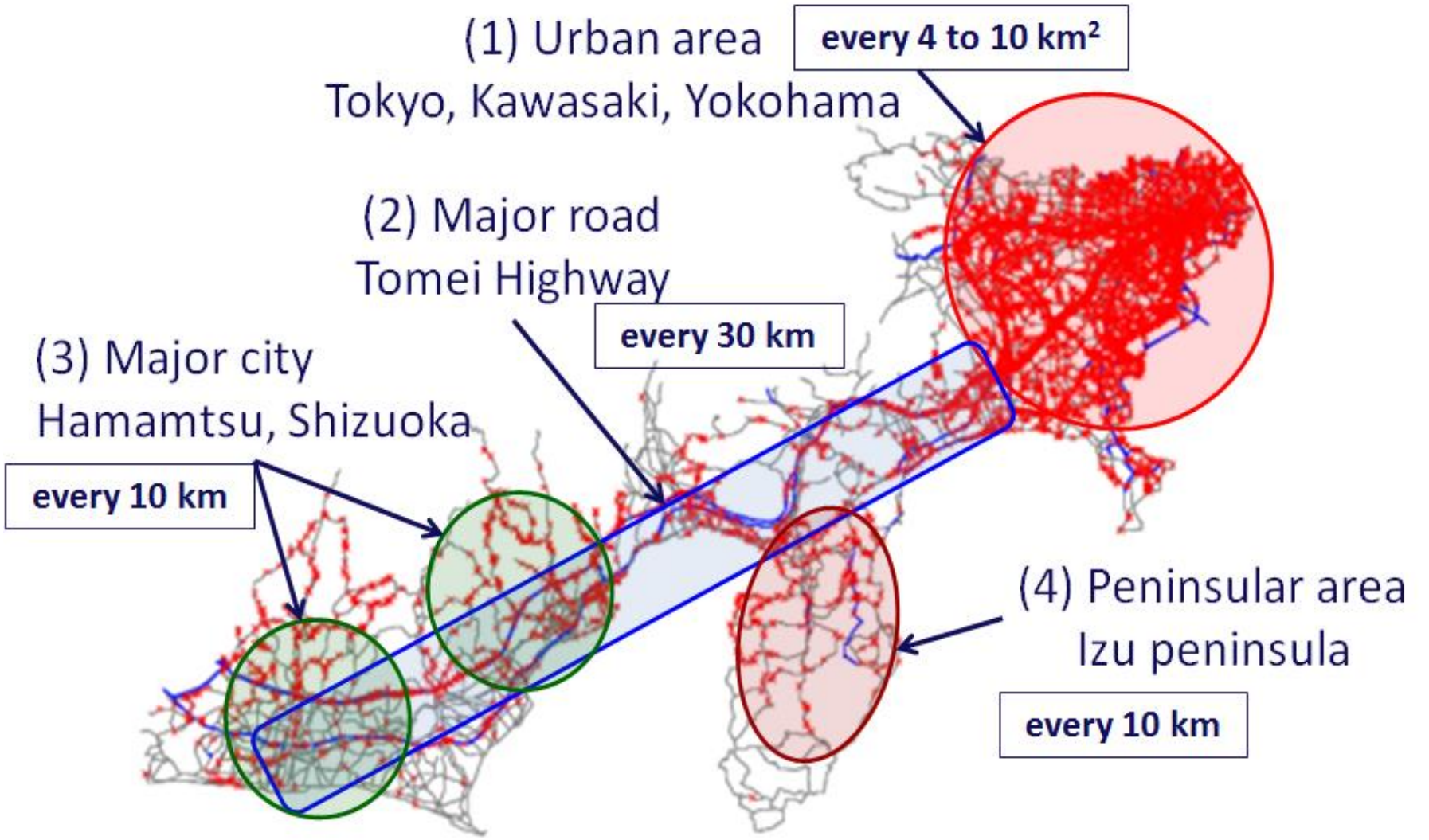


Three prefectures spanning about 200 km: Tokyo, Kanagawa and Shizuoka

Numbers of Quick Charging Stations:



The results of EV simulation



Proposal of quick charging station layout in cities

Preferred placement:

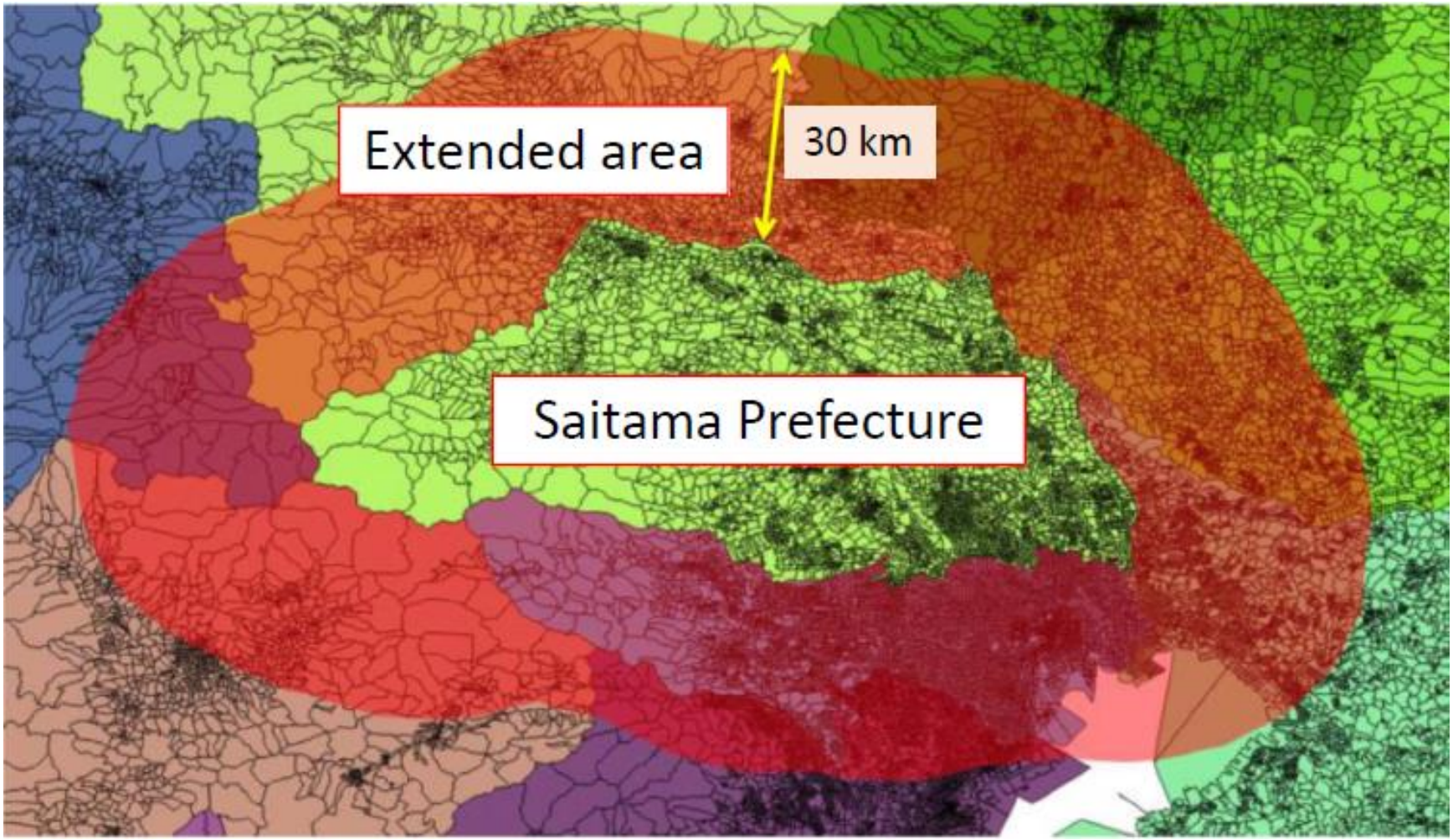
1) In a grid-like pattern within urban areas **every 4 to 10 km^2**
2) On major roads connecting major cities **every 10 km**
3) On roads connecting local cities **every 30 km**
4) On roads around peninsular and highland areas **every 10 km**

4. Summary

- METI has unveiled "**Model planning to install charging infrastructure on roads and in cities**" for quick charging stations, and the "**EV-PHV roadmap**".
- Japan is trying to get **more than 1 million EVs and PHVs on the road by preparing charging infrastructure**.
- CRIEPI has been conducting R&D of technologies to estimate the effects of charging infrastructure with the simulator **EV-OLYENTOR and proposed the method to optimize the layout of quick charging stations**.

Thank you.

Corresponding to ikeya@criepi.denken.or.jp

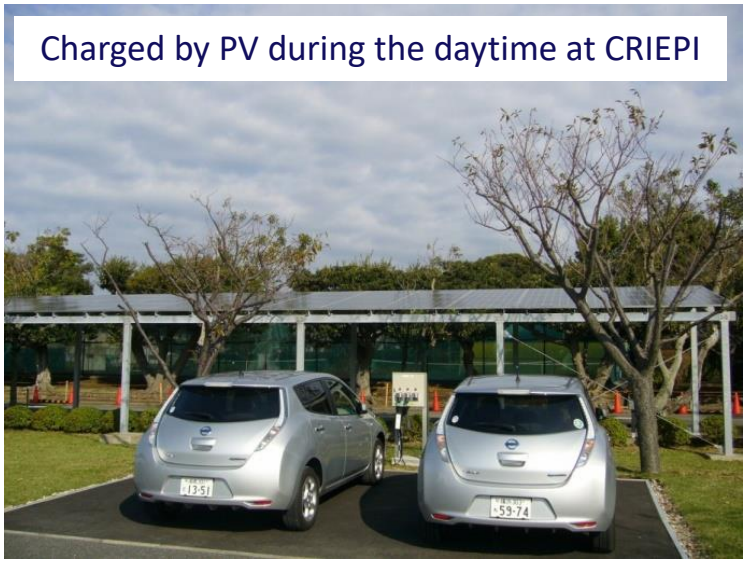


EVs & PHVs guidelines & road map in Japane

- "R&D roadmap for high-performance secondary battery for next-generation vehicles" published in 2006.
- "Guidelines for installing charging equipment at residential housing and parking lots for EVs and PHVs" for normal-charging published in 2010.
- "Model planning to install charging infrastructure on roads and in cities" for quick-charging stations published in 2013
- "EV-PHV roadmap" published in March 2016

“Basic & destination charges at workplaces” and “Application of EVs & PHVs to V2X”

- Using EVs for **commuting** can reduce CO_2 emissions. EVs parked at workplaces can be charged by **photovoltaics** (PV) during the day.
- EVs parked at workplaces can be used **for battery energy storage systems** for load-leveling or preventing blackouts.
- EVs parked at workplaces can be used for V2X, and managed and controlled for use as VPPs. **Wireless charging technology** is expected to be used for VPPs.



Charged by PV during the daytime at CRIEPI

Workplace charging and application to V2X at Mitsubishi