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Overview & Experience from the Past & in the Future for E-mobility

31st March 2015

MC Automobile (Europe) NV. (MCAE) a 100% Subsidiary of Mitsubishi Corporation

Based in: Amsterdam

- Representative for Mitsubishi Corporation European automobile business within the Machinery division.

- Assigned by Mitsubishi Motors Corporation (MMC) to support EV / PHEV sales and marketing within the European region.

Mr. Bart Sloep Project Leader EV/PHEV MCAE

Drive@earth

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Mitsubishi Corporation

Agenda

- Mitsubishi History and EV/ PHEV development.

- Mitsubishi supported V2X project examples

- What are the barriers and opportunities from the perspective of the car and its user?
  - Battery performance, capacity and durability
  - User preferences EV driver
  - Price developments in EV sector

- When V2X will be viable on the market from Mitsubishi perspective

History of EV development in MMC

- MMC has been developing EVs for more than 40 years.
- Appearance of Lithium-ion battery drastically enhanced EV performance.
- Concern for environment and natural resources elevated the needs for EV.

1970 1980 1990 2000 2010

Anti global warming

Anti oil depletion

Anti air pollution

● Muskie Act

● ZEV Regulation

● Kyoto Protocol

Colt MIEV

Minica-EV
Minicab-EV

Libero-EV

FTO-EV

Lancer-Evo. MIEV

Lead-acid battery

Lithium-ion battery

Mitsubishi Electric-powered Models line-up

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FY2009 FY2010 FY2011 FY2012 FY2013

JAPAN

Fleet Sales
From Jul, 2009

Sales to Individuals
From Apr. 2010

Rollout of *G* and *M* trim levels
From Jul. 2011

Mini commercial EV
From Dec. 2011

Mini-truck EV
From Jan. 2013


i-MiEV


MINICAB-MiEV


MINICAB-MiEV TRUCK


Outlander PHEV

PHEV
From Jan. 2013

OVERSEAS

RHD vehicles (Hong Kong, England, etc.)
From Fall 2009

Europe / OEM to PSA Peugeot Citroën
From Oct. 2010

N. America
From Nov. 2011

PHEV for Europe
From Oct2013


i-MiEV for Europe


i-MiEV for North America

Mitsubishi PHEV : Brand image

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Leading Company in EV/PHEV Technology

Target : Achieve20% production ratio for EV/PHEV vehicles by 2020

Environmental Responsibility

Development of next-generation EV technology

- Extend driving range per single charge
- Affordable price
- Expansion of charge infrastructure

Development of next-generation PHEV technology : SUV PHEV

- Sophisticated integration of driving pleasure and PHEV : e-EVOLUTION
- Development of high-efficiency system
- Increase PHEV application to SUVs

V2X

Compact size SUV (XR-PHEV)

Large size SUV (GC-PHEV)

V2X project examples

Countries (Project & Cooperation)

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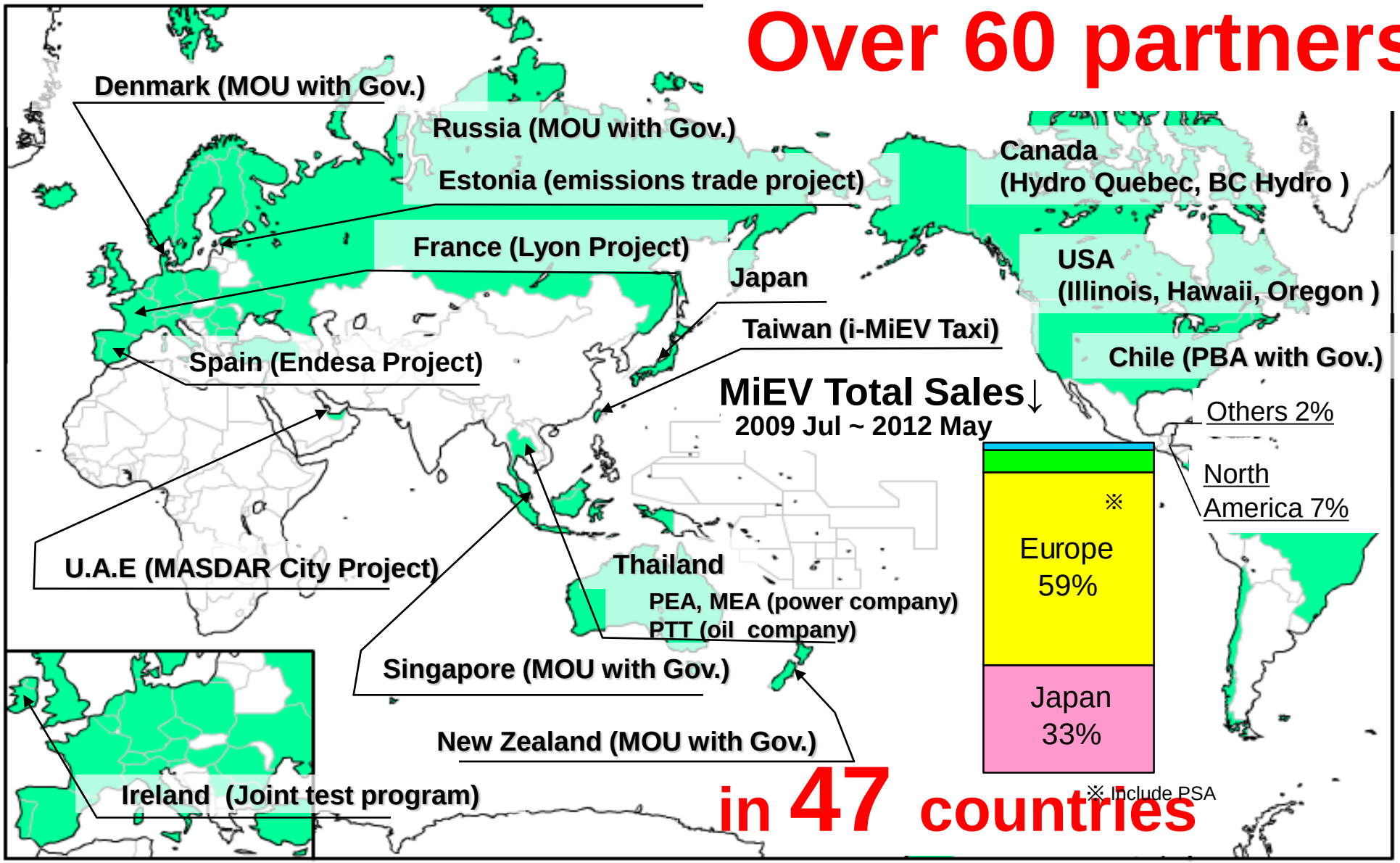
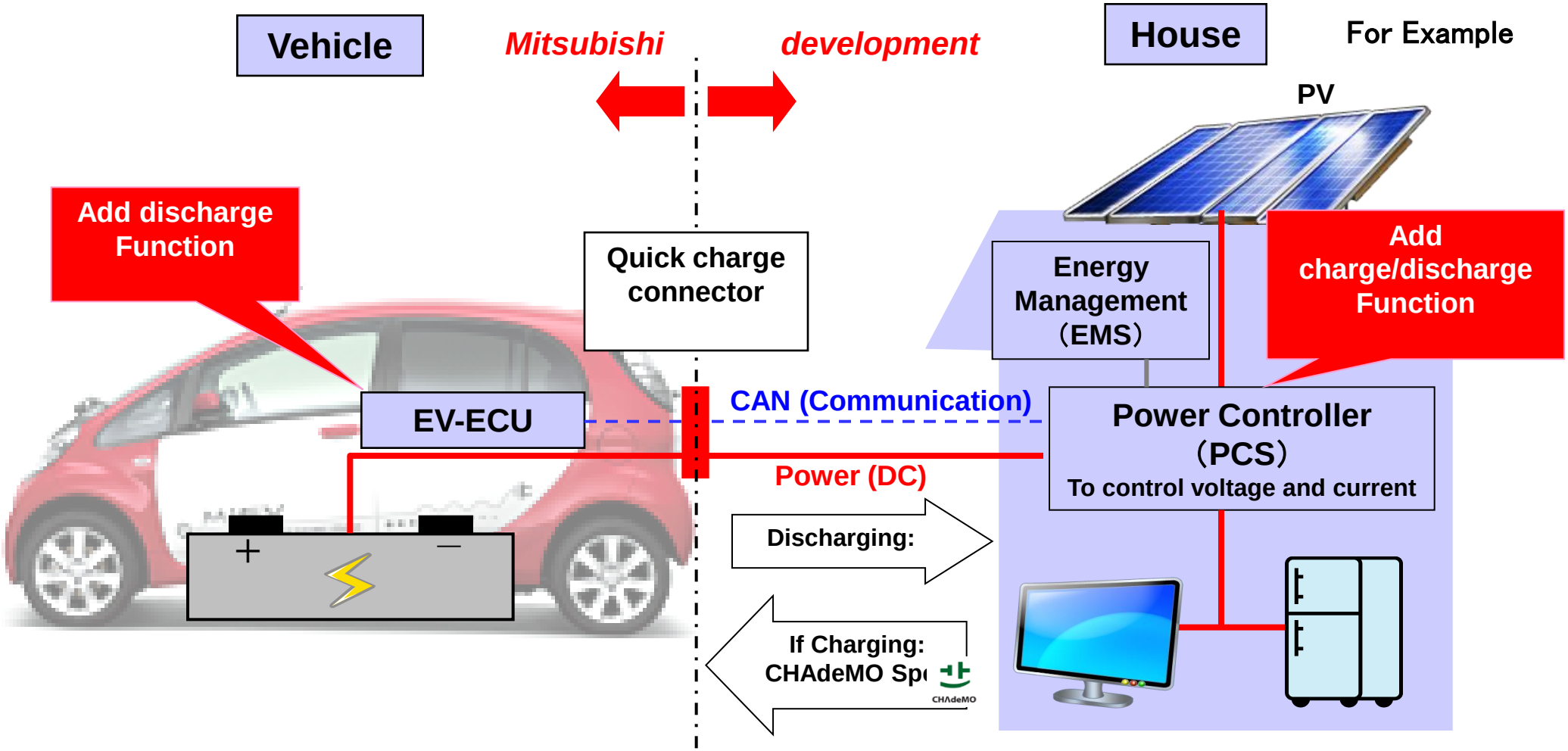


Discharging function V2H (Concept)

Mitsubishi is preparing the discharging function.
Electric power from EV is Discharged through “Quick charge” connector.
(“Quick charge” connector is directly connected with the battery.)
Output from EV is DC, so DC-AC converter should be equipped inside a house.



Mitsubishi V2X Concept(V2H)

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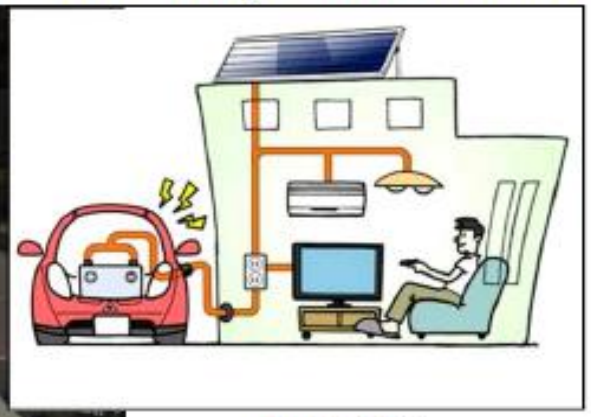
Mitsubishi Motors has been studying V2X system from 2009, i-MiEV launch year.
This result has exhibited as “Energy self-sufficiency House” in 2011 Tokyo Motor Show



Energy
self-sufficiency

Smart Grid Project "V2X Project"

To lead this idea to real world, Mitsubishi Corporation, Mitsubishi Electric and Mitsubishi Motors have carried out Smart Grid project named "V2X Project". This project is a satellite project of "Keihanna eco-city Project".

New market for EV/PHEV：Application as ”Battery”

To study new usage of EV/PHEV, we have developed V2H pilot system.
V2H pilot project has started on April 2012 and V2H mass production model has launched on July 2014.(Mitsubishi Electric)

Smart grid experimental plant “M-tech Labo”

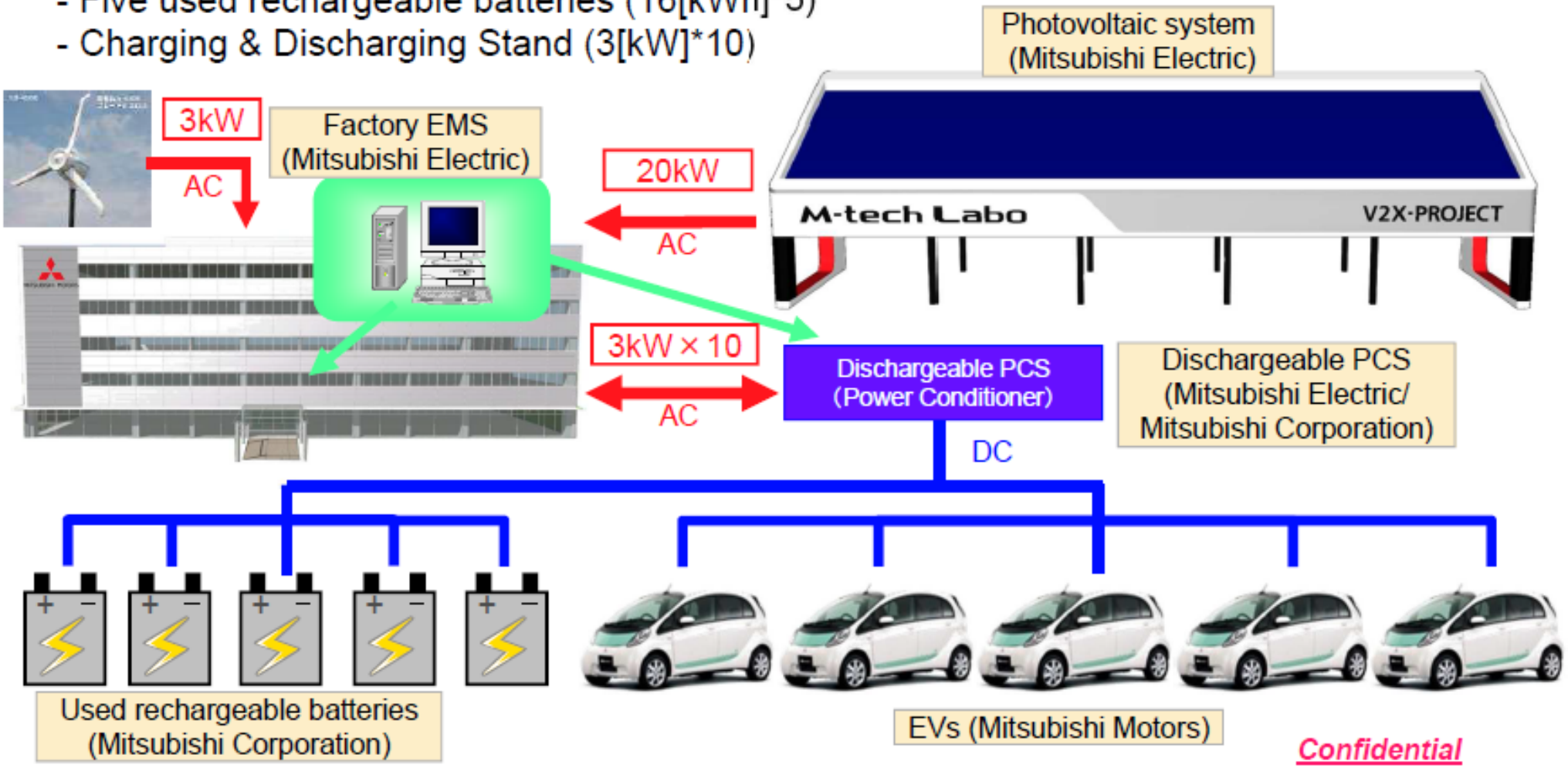
Power conditioner

Re-used battery

Smart Grid Project "V2X Project"

The main purpose of this project is to level the power demand of factory facilities, which consists of the followings:

- Photovoltaic system (Mono crystal type: 20[kW])
- Five electrically dischargeable EVs (16[kWh]*5)
- Five used rechargeable batteries (16[kWh]*5)
- Charging & Discharging Stand (3[kW]*10)

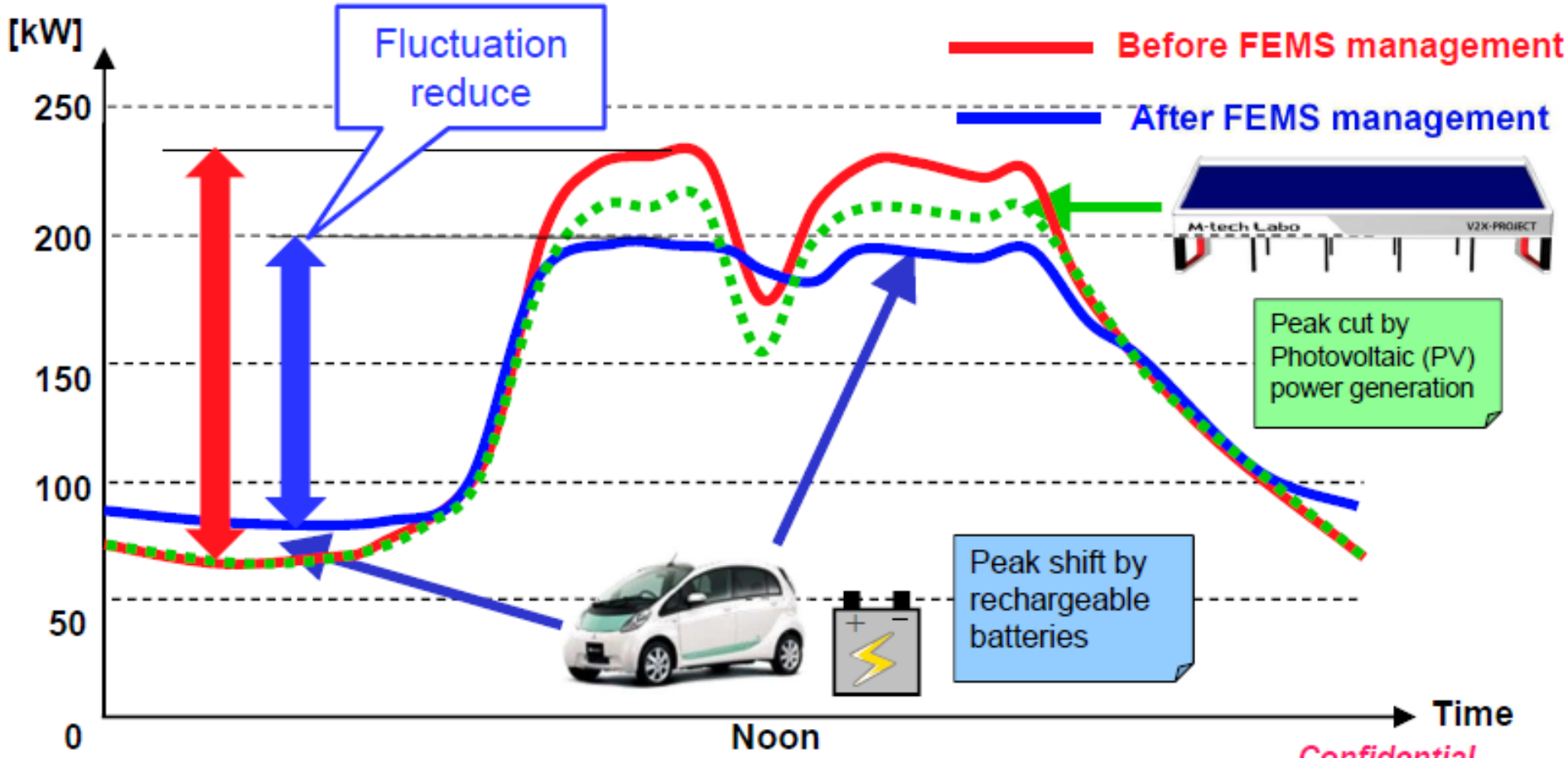


Factory Energy Management System : FEMS

FEMS is intended to reduce the fluctuation of power demand through the following basic power management:

-Day time: Supply power generated from PV system, discharged from EVs and batteries to Administration Building (Max. 50kW)

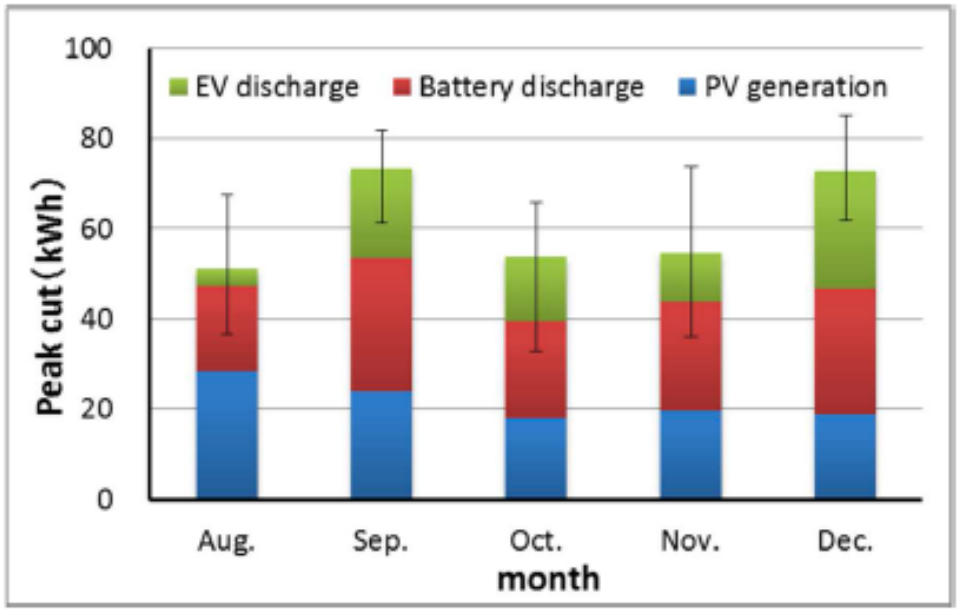
-Morning/Night: Supply power generated from PV system to EVs and batteries for charging



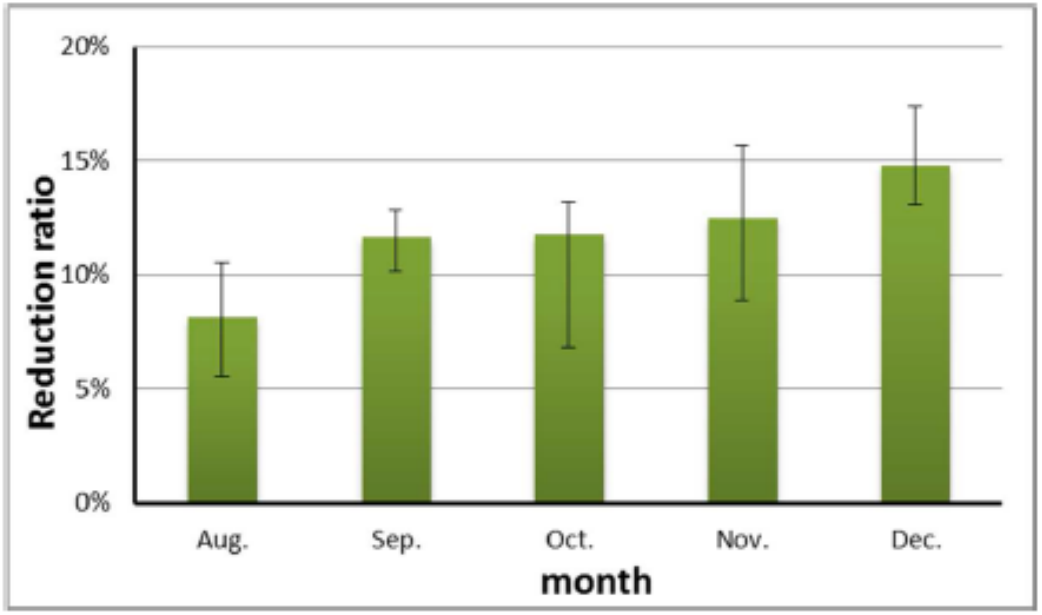
Energy Management Results

In "V2X Project" We have operated this facility through 2012, and got result. Peak cut function is effective 1:00pm - 4:00pm, and SOC is controlled 40%-90%. As a result, demand peak was cut 54-73kWh/day and fluctuation was reduced average 12.7%.

Peak cut
54-73kWh/day



Fluctuation reduce
12.7%



Collaboration : SHARP Eco House

SHARP has announced on June 8, 2011 that they have developed "SHARP Eco House", which equip bi-directional EV charger, in Sakai city.

SHARP Eco House

Dischargeable i-MiEV

Source : SHARP Press release June, 8, 2011

New market for EV/PHEV：Demand control

Smart community pilot project in Malaga, Spain.
[ICT platform] Realize collaboration between grid and EV infrastructure.

Monthly Accumulated Trip Distance

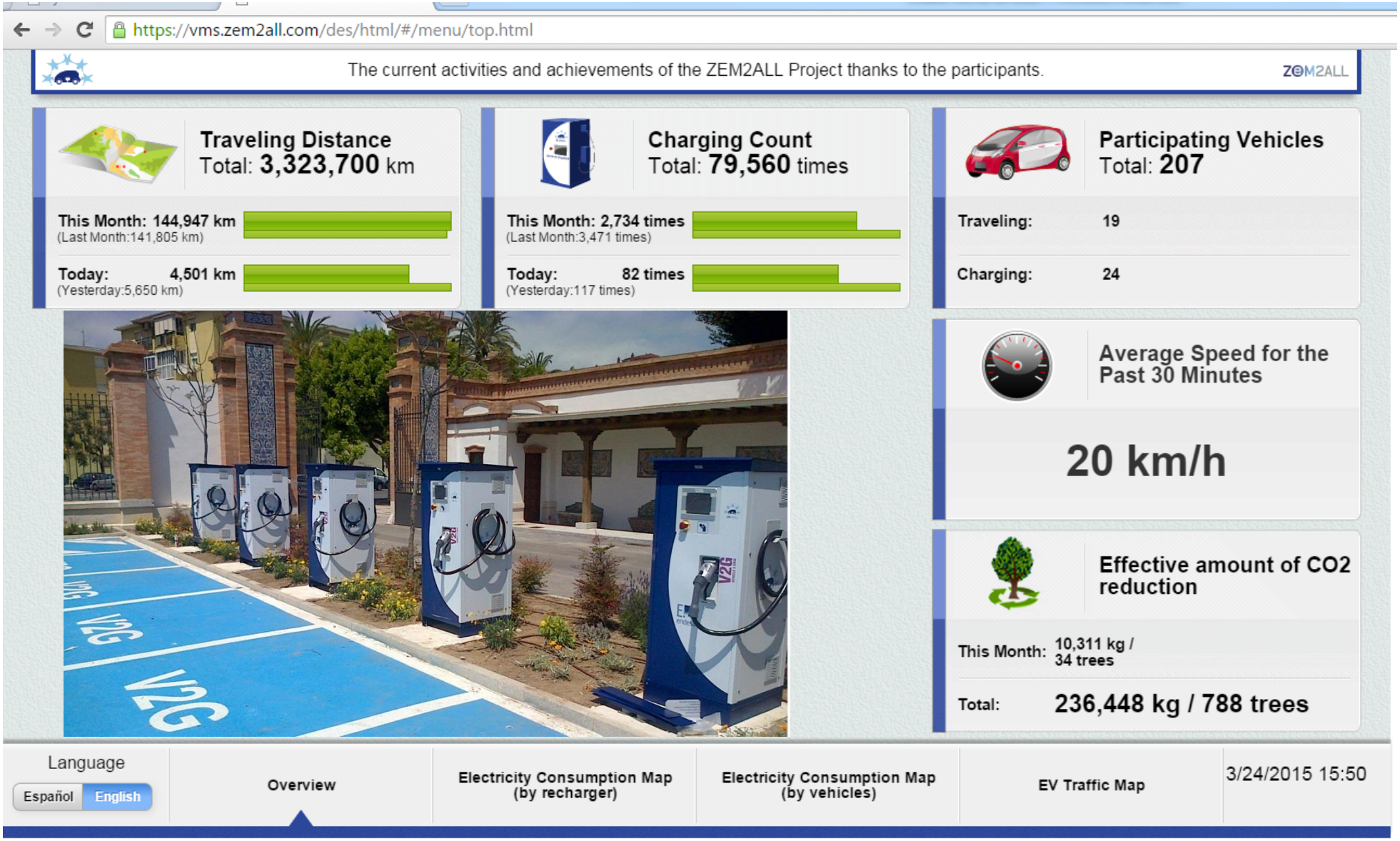
Monthly Accumulated Charging Volume

Number of EVs in travel and in charging

Average speed of EVs

Accumulated CO2 reduction by participants of Z2A

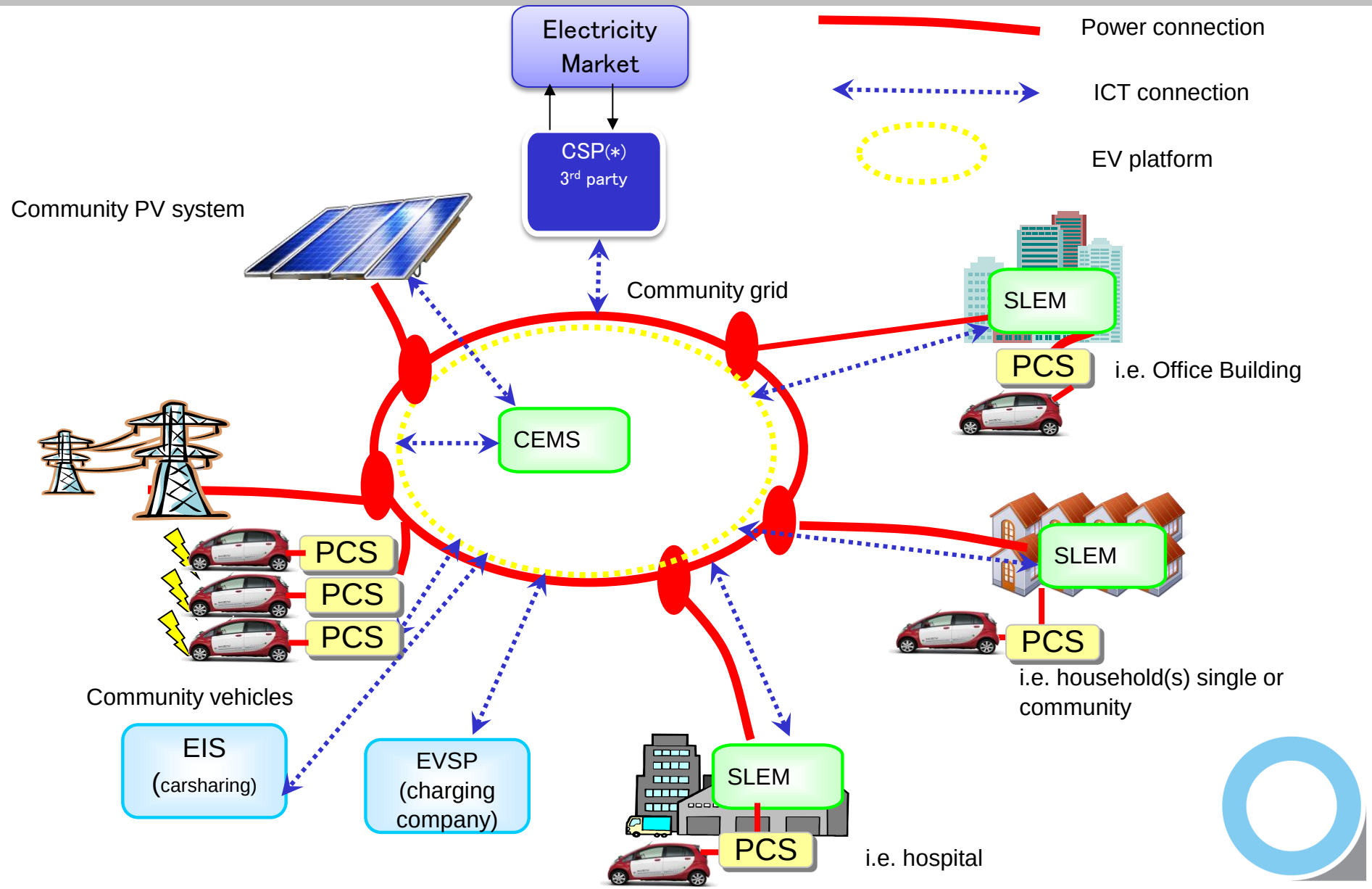
Malaga ZEM2ALL project



Opportunities V2X

Amsterdam Project

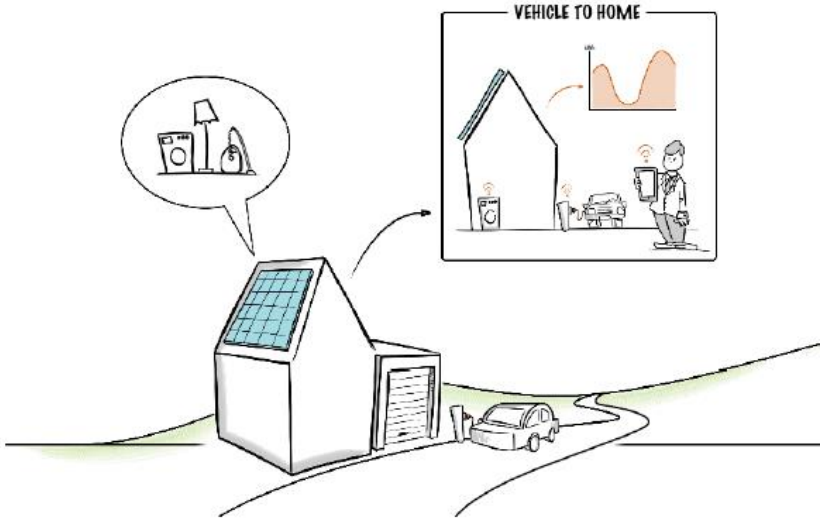
V2X Community overview future case



Vehicle to Grid

V2H (Single case) 1st real consumer Test with actual user in Europe (Netherlands)

Vehicle 2 Home



Main components:

1.PV system (use existing system)
2.HEMS (SLEM by Cofely)
3.PCS for EV (by Endesa)
4.V2X Vehicle (by Mitsubishi)

EV owner:

Household (Family) = EV user

Possible benefit for EV owner:

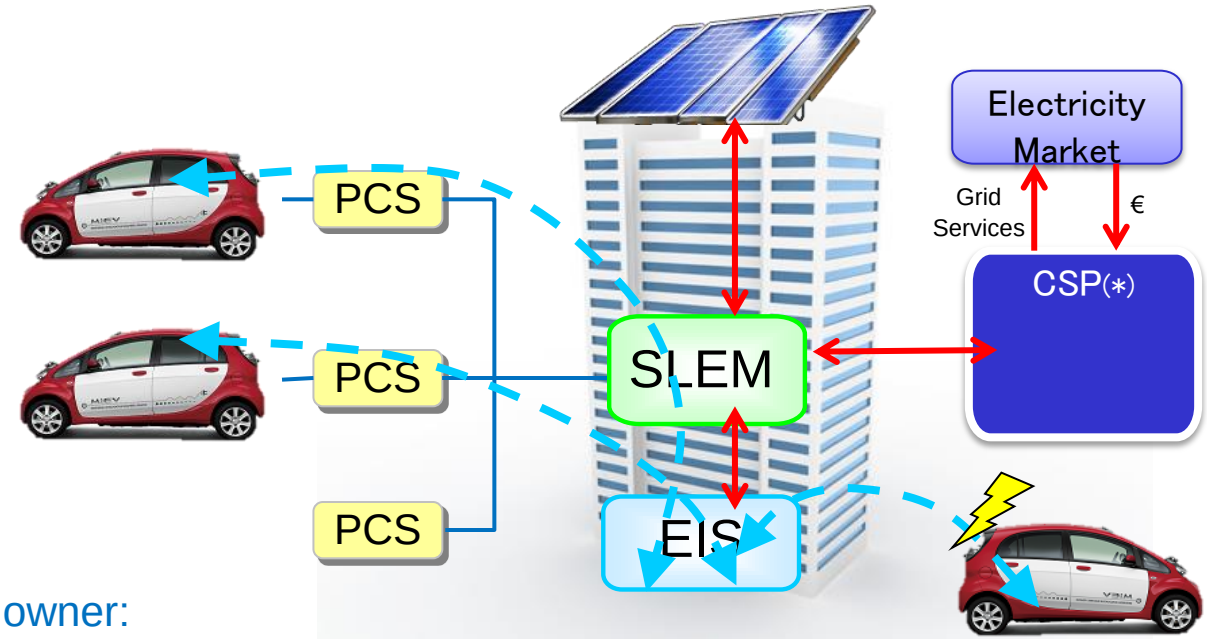
Reduce overall family carbon footprint.
Reduce total energy cost, including mobility
In control of own energy usage
Better integration self produced local energy and electricity.
Reduce total investment versus installing stationary battery.
Complete package(Production, management, storage and mobility). Capacity buffer and back up system

Required conditions:

1.EV drive time “short” (2nd car?) / EV battery availability
2. Household with PV system or other local energy production
3. V2H application needs Smart local energy management system
4. dedicated parking and (dis)charging place available

Vehicle to Grid

V2B/V2O (office, apartments, company area, hospital) from 3rd Quarter 2015 Amsterdam



Main components:

SLEM (by Cofely)
PCS (by Endesa)
PV and/or other generating equipment (3rd party)
Vehicle with V2X (Mitsubishi)
EIS (car-sharing system)
EV platform (by Alliander)

EV owner:

Company / community (lease)

Possible source of benefit for EV owner(s):

Reduce carbon footprint CSR policy
Reduce total energy costs
Higher integration "self" produced local energy.
Complete energy package (Production, management, storage and mobility)
Provide capacity and frequency regulation to community.
Power security / back up
Peak shift and balancing opportunities

Required conditions:

1.)EV drive time TBC (Office parking) or car-sharing within community building
2.)Company and or community energy and vehicle management (SLEM and EIS)
3.) Dedicated parking and (dis)charging place available
4.) Local produced "community" energy (possible Energy corporation)
5.) Governmental regulation for Flexible energy tariff
6.) Governmental regulation for energy trading

Vehicle to Grid

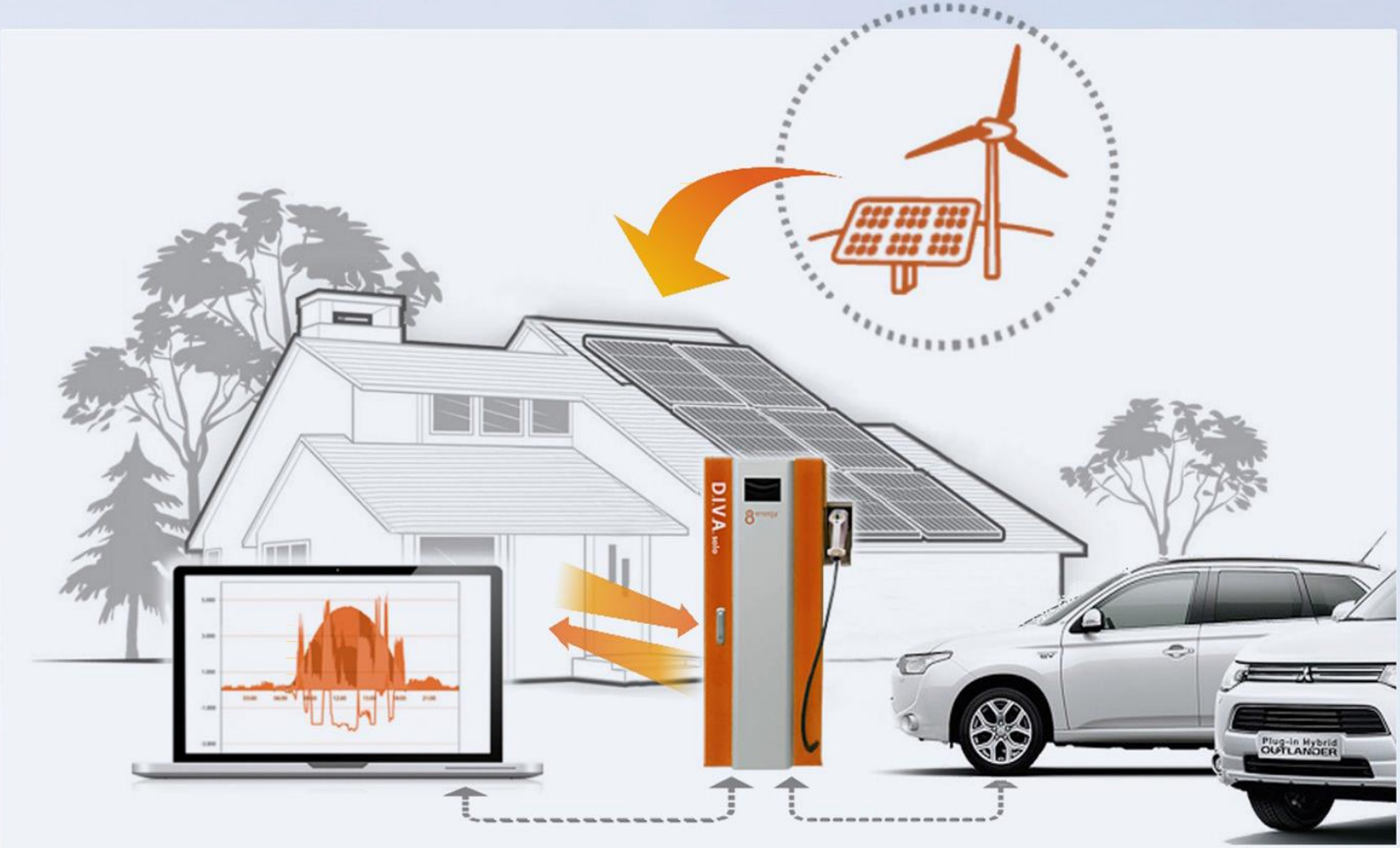
When V2X to the market

Collaboration: Mitsubishi Electric "PV/EV PCS"

Mitsubishi Electric has announced on May 15, 2012 that they have developed pilot system of "PV/EV cooperation PCS.
This system has developed and launched in July 2014 as a "limited version".

Source : Mitsubishi Electric Press release May, 15, 2012

DIVA product in collaboration with E8 Energy



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