
# PANEL 1:
# ECSEL for Automotive Lighthouse Projects

## 3CCAR: Integrated Components for Complexity Control in Affordable Electrified Cars

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# 3CCAR 2014-2018
# Outline

- 3CCAR: Partnership and Main Objectives
- Focus on the Italian Partners
- Results
- Follow Up: Towards Affordable, Safe, Secured and Efficient Evs
- I-FEVS in two pills


1. *Comfort*
2. *Control*
3. *Cost*

**Integrated Components for Complexity Control in Affordable Electrified Cars**

**Semiconductor project Involving:**

**11 Countries, 43 partners including EU major semiconductor suppliers**



OKMETIC



**Coordinator: Reiner John, Infineon Technologies AG, Germany**

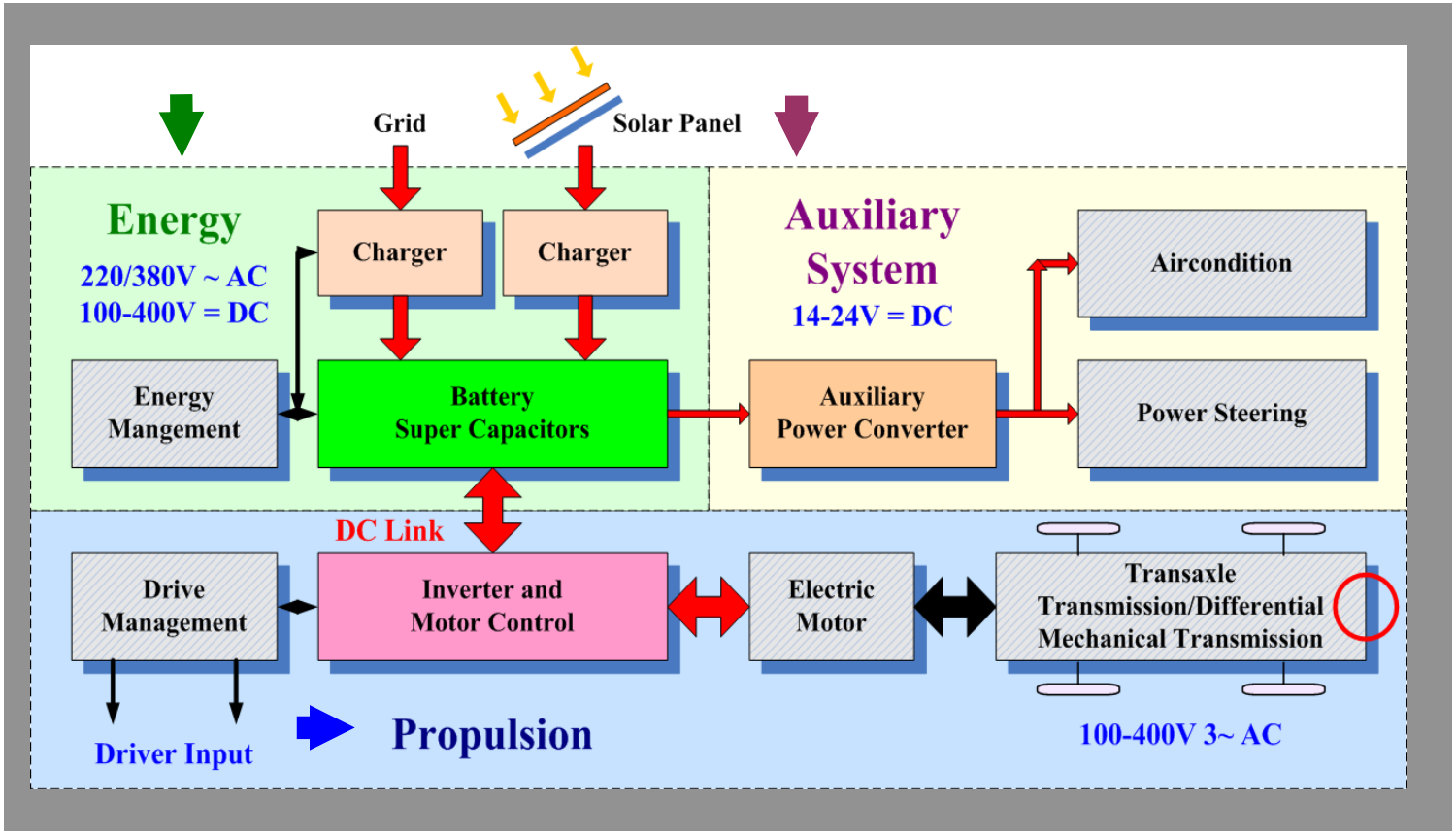
## Main Topics:

- Semiconductor components and sensors,
- Embedded systems,
- Smart integrated systems.

## Macro Objectives:

- Develop the semiconductor basis for new generation EVs,
- Establish reference designs and platforms for “electrified” vehicles.

# Developments of components and systems for Energy, Propulsion and Auxiliary systems



**Development of components and systems addressing:**

- **Efficiency and smartness on**
  - Conversion and Power management
  - Thermal management
  - Energy and power flow
- **Miniaturisation**
- **High temperature operation**
- **Improved reliability and life time**
- **Condition monitoring**
- **Fail safe and fail operational safety**
- **Cost reduction.**

**Through advancements on:**

- **IGBT Power modules with thermal and current sensors**
- **Semiconductors (SiC, GaN)**
- **Communication in the car (Phy, ethernet)**
- **Computing power**
- **Integrated devices for zone individual comfort and climatisation**
- **Integrated sensors for E-E architectures**

## Focus of the Italian Partners: IFEVS-SOLBIAN-CNR

- Develop a special purpose 4WD vehicle with integrated home appliances and smart photovoltaic

  - 120V DC charging*
  - 4WD Powertrain (2 inverters, 2 motors)*
  - Battery Pack*
  - DC-AC Battery to Induction Plates Converters (home appliances)*
  - DC-DC PV to Battery Converters+

- Develop Partitioned PV modules++

- Integrate of large area PV modules into the vehicle*

***IFEVS, ++ Solbian-CNR, + Provided by STMicroelectronics**

**Restaurant configuration**
**Presented in Warsaw TRA conference April 2016**

**On board energy harvesting**

**+700W nominal solar cells**

**Home appliance**

- **Two induction plates**
- **One Microwave owen**

- **Capability to serve +100 dishes of pasta in less than one hour with less than one third of battery capacity**

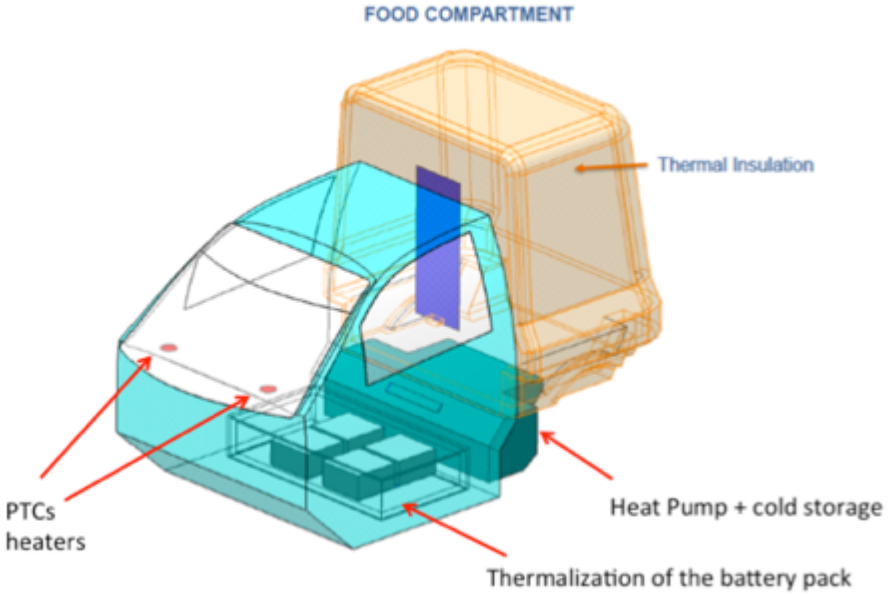
http://www.euronews.com/2016/04/11/a-greener-road-ahead/
http://www.euronews.com/2016/04/11/takeaway-the-electric-restaurant-car/

# Restaurant configuration in operation
# Warsaw TRA conference April 2016


http://www.euronews.com/2016/04/11/takeaway-the-electric-restaurant-car/

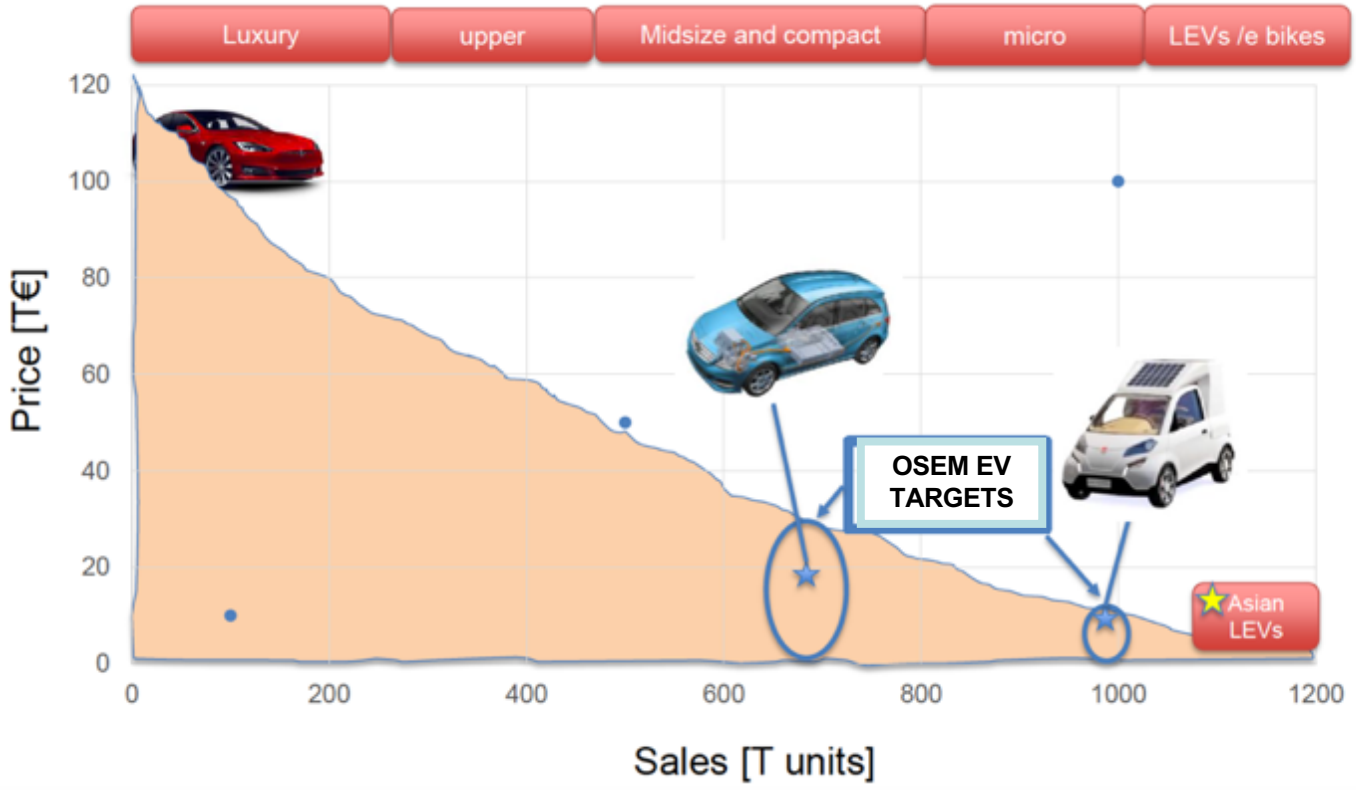
# Project Follow UP: Cost Efficient Thermal System Design

## OSEM-EV Project


Design the thermal system so that in the typical **two-hour mission**, with outdoor temperatures ranging from **30$^{o}$C to 37$^{o}$C**, the temperatures inside the three compartments (Cabin, Battery, Food Compartment) could be maintained at their initial nominal values using **< 1 kWh of the battery capacity.**

# Project Follow UP: OSEM-EV Motivation




**Source: Daimler**

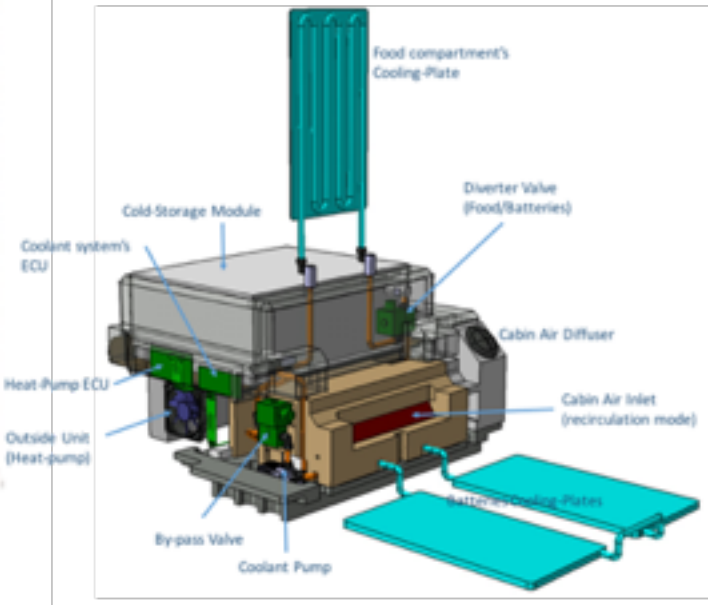
# Project follow UP: OSEM-EV laboratory demonstrator

**Chassis made using SHSS**
**All External and Interior panels made by 3D printing**

Full presentation available at the EVGI Brussels Green Vehicles conference
https://webcast.ec.europa.eu/2nd-european-conference-on-road-transport-research-projects-results-0a

# Project follow UP: Cost Efficient Thermal System Design

## OSEM-EV Project




## The I-FEVS Food Delivery Vehicle

# Project follow UP: OSEM-EV

## Summary of Achievments

- Vehicle to Home V2H and Vehicle to Grid V2G: Pre-heating and pre-cooling including remote control and activation,
- Energy and power routing with assigned priorities,
- Heating and Cooling “H-C” by intermediate heat pump systems,
- Battery thermal control starting from the chassis,
- Thermal storage (iso-thermal),
- System integration applying zone partitioning,
- Solar energy harvesting,
- Power train: MOSFETs power electronic and two motors approach,
- Thermal isolation of the full vehicle body,
- Energy recovery during deceleration and braking,
- Monitoring of Battery self-discharge and energy consume in the unplug state at rest,
- Hybrid and bi-layered glazing.

# Food Delivery: Results on the field

- **Ambient temperatures in the range of 12ºC to 25ºC** usually cover about 60% of the annual working hours in the Torino area. During the two hours mission, there is no need to activate the heat pump to condition the cabin or to condition the battery. The temperature in the food compartment is maintained by circulating the fluid in the cold storage unit. The only consumption is due to the coolant pump which is on average (nominal) of the order of 60W. In the two hours mission the thermal conditioning requires a **battery consumption of only 120Wh**.

- **Ambient temperatures from 5ºC to 12ºC and from 25ºC to 30ºC** usually cover about 26% of the annual working hours in the Torino area. During the two hours mission, the heat pump can be activated to assist conditioning the three compartments with an average power demand of 300W (below the nominal value 380W). Thermal conditioning demands a **consumption of the order of 600Wh**.

- **Ambient temperatures from -5ºC to 5ºC and from 30ºC to 40ºC** usually cover about 12% of the annual working hours in the Torino area. During the two hours mission, the heat pump is automatically activated to assist conditioning the three compartments with an average power demand of 600W. Thermal conditioning demands a **consumption of about 1.2kWh.**

# I-FEVS in Pills

Full range of fully electric vehicles: Road, Air, Water (Commercial and Classified),

- ❑ Differentiation: 138 world wide granted patents-trademarks, many others applied,
- ❑ Focus: Road Mobility with 100% control of all core activities,
- ❑ Partners for Quality and Cost Control: World Largest Organizations of the sectors.

**I-PHONE**

The start of smart connectivity

**I-FEVS**

The Start of Interactive, Affordable, Safe, Secure and Efficient Mobility Through a Radical Change in Manufacturing.

# I-FEVS Flexible Production Plant

- Micro-factory for multi-model portfolio
- Entire plant co-development
- Design for manufacturability
- Standard solution for easy replication

## Technologies and Innovations:

- ✓ Welding, fastening, vision systems
- ✓ In-line testing and quality gates
- ✓ Industry 4.0 architecture

## Benefits:

- ✓ Partnering from concept product design to vehicle production launch
- ✓ Scalability: from manual to fully automatized solutions
- ✓ Station Modularity and easy re-configurability

*Thank you*
*for your attention!*

*Pietro Perlo*

I-FEVS