IREC
Institut de Recerca en Energia de Catalunya
Catalonia Institute for Energy Research

Task 28 HEV TCP IEA
"V2X insights and applications"

12th May 2017, Amsterdam

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE
Technology Collaboration Program

Sara González-Villafranca
Task 28 Technical Secretary

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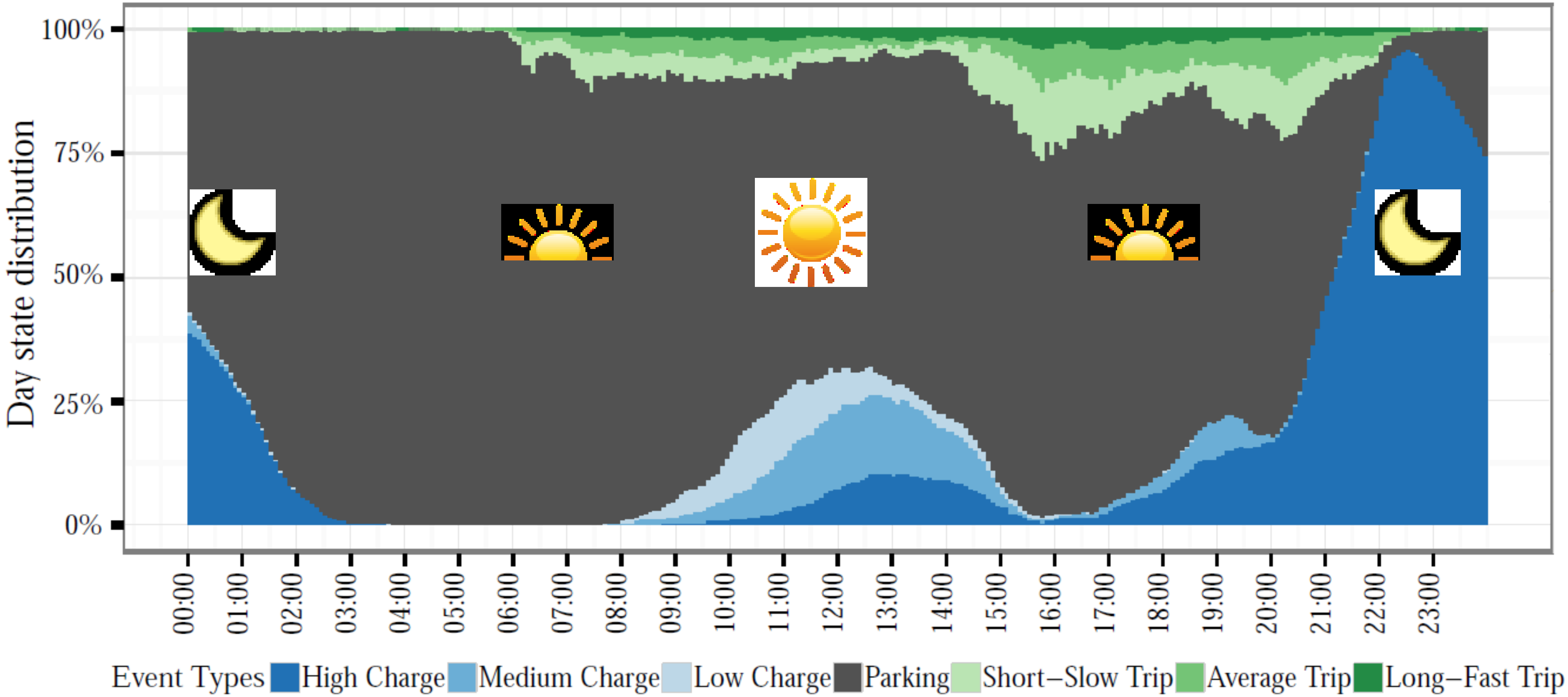
On average, EVs charge 52% of the time they are plugged-in

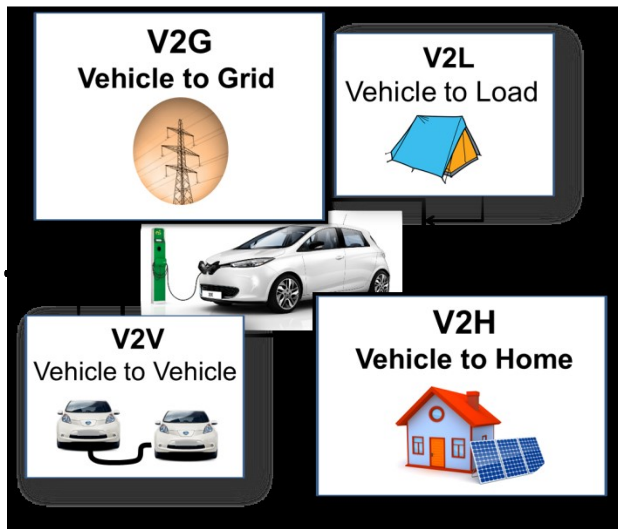


Source: Green eMotion Project

Business case

INTRODUCTION & SCOPE

The IA-HEV Executive Committee (ExCo) unanimously approved the Task 28 at the Executive Committee meeting in May 2014 held in Copenhagen



V2X

VEHICLE TO EVERYTHING

(NIST, 2010)

Task 28 explores the technologies and accompanying issues associated with the use of electric storage from PEVs for uses other than powering the vehicles

There remain technological and economic "knowledge gaps" in realizing the full potential of V2X technology

Task 28 addresses these gaps by means of creating an international network of experts who conduct bi-annual meetings on different strategic topics

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GENERAL TASK INFORMATION

Countries

Spain

Operating Agents

IREC

Switzerland

France

Republic of Korea

Denmark

Canada

United States

Germany

Ireland

Companies

NISSAN Innovation that excites

endesa enel

INSTITUT VEDECOM DU VÉHICULE DÉCARBONÉ ET COMMUNICANT ET DE SA MOBILITÉ

Possible new members for 2017

The Netherlands

United Kingdom

Proposed collaborations: Interreg North Sea Region European Regional Development Fund EUROPEAN UNION

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OBJECTIVES & WORKING METHOD

1	Analyzing the **technical and economic viability**	Potential V2X modes and functionalities Existing codes, regulations and BMs
2	**Connecting** and **synchronizing** the different **V2X research and demonstration projects**	Continuous contact V2X technology key actors. Coordination with other HEV IA Tasks
3	Coming up with a **policy making toolbox** and a **technology roadmap**	Definition of a typical set of country specific systems and regulatory frameworks for the choice of a given portfolio of energy policy options
4	**International technical information exchange**	**Expert Workshops**
5	Promotion of new **V2X technology demonstration** projects	Collaboration with international organizations and call for proposals

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TASK 28 NEXT MEETINGS

Workshop VI: “V2X Business Models, recent developments and international pilot projects overview” IEVE 2017

2nd V2G Conference

Workshop VIII: Market potential and business models

Final event: Policy recommendations toolkit and Road Map

…

2016

2017

2018

EEVC 2017: V2X Roundtable

evs 30

Workshop VII at EVS 30
30th International Electric Vehicle Symposium & Exhibition

Workshop IX

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TASK 28 OUTPUTS

V2X Roadmap

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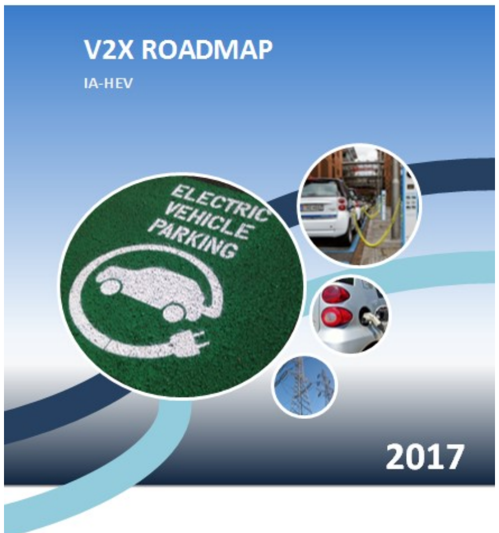
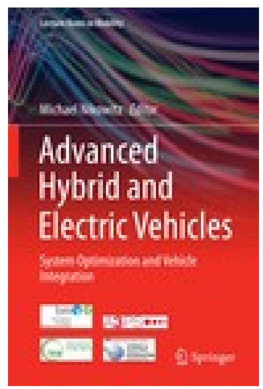
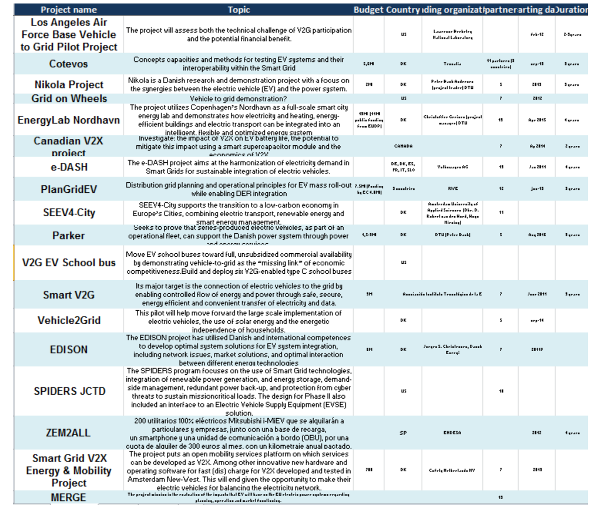


Scientific Book



V2X Projects Catalogue



Project name	Topic	Budget	Country	ding organizat	partner	arting da	Duration
Los Angeles Air Force Base Vehicle to Grid Pilot Project	The project will assess both the technical challenge of V2G participation and the potential financial benefit.		US	Lawrence Berkeley National Laboratory		[illegible]	[illegible]
Cotevos	Concepts capacities and methods for testing EV systems and their interoperability within the Smart Grid	[illegible]	DK	[illegible]	[illegible]	[illegible]	[illegible]
Nikola Project	Nikola is a Danish research and demonstration project with a focus on the synergies between the electric vehicle (EV) and the power system.	[illegible]	DK	[illegible] DTU	5	[illegible]	[illegible]
Grid on Wheels	Vehicle to grid demonstration?		US		7	2012	
EnergyLab Nordhavn	The project utilizes Copenhagen's Nordhavn as a full-scale smart city energy lab and demonstrates how electricity and heating, energy-efficient buildings and electric transport can be integrated into an intelligent, flexible and optimized energy system	[illegible]	DK	[illegible] DTU	[illegible]	Apr 2015	4 years
Canadian V2X project	Investigate: the impact of V2X on EV battery life, the potential to mitigate this impact using a smart supercapacitor module and the economics of V2X		CANADA		7	[illegible]	2 years
e-DASH	The e-DASH project aims at the harmonization of electricity demand in Smart Grids for sustainable integration of electric vehicles.		DE, DK, ES, FR, IT, SLO	Volkswagen AG	[illegible]	[illegible]	4 years
PlanGridEV	Distribution grid planning and operational principles for EV mass roll-out while enabling DER integration	[illegible]	[illegible]	RWE	12	[illegible]	[illegible]
SEEV4-City	SEEV4-City supports the transition to a low-carbon economy in Europe's Cities, combining electric transport, renewable energy and smart energy management.		DK	Amsterdam University of Applied Sciences [illegible]	11		
Parker	Seeks to prove that series-produced electric vehicles, as part of an operational fleet, can support the Danish power system through power and energy services	[illegible]	DK	DTU (Peter Bach)	5	Aug 2016	[illegible]
V2G EV School bus	Move EV school buses toward full, unsubsidized commercial availability by demonstrating vehicle-to-grid as the "missing link" of economic competitiveness.Build and deploy six V2G-enabled type C school buses		US				
Smart V2G	Its major target is the connection of electric vehicles to the grid by enabling controlled flow of energy and power through safe, secure, energy efficient and convenient transfer of electricity and data.	[illegible]		[illegible]	7	[illegible]	[illegible]
Vehicle2Grid	This pilot will help move forward the large scale implementation of electric vehicles, the use of solar energy and the energetic independence of households.		DK		5	[illegible]	
EDISON	The EDISON project has utilised Danish and international competences to develop optimal system solutions for EV system integration, including network issues, market solutions, and optimal interaction between different energy technologies	[illegible]	DK	[illegible]	7	[illegible]	
SPIDERS JCTD	The SPIDERS program focuses on the use of Smart Grid technologies, integration of renewable power generation, and energy storage, demand-side management, redundant power back-up, and protection from cyber threats to sustain missioncritical loads. The design for Phase II also included an interface to an Electric Vehicle Supply Equipment (EVSE) solution.		US		[illegible]		
ZEM2ALL	200 utilitarios 100% eléctricos Mitsubishi i-MiEV que se alquilarán a particulares y empresas, junto con una base de recarga, un smartphone y una unidad de comunicación a bordo (OBU), por una cuota de alquiler de 300 euros al mes, con un kilometraje anual pactado.		SP	ENDESA		2012	4 years
Smart Grid V2X Energy & Mobility Project	The project puts an open mobility services platform on which services can be developed as V2X. Among other innovative new hardware and operating software for fast (dis) charge for V2X developed and tested in Amsterdam New-West. This will end given the opportunity to make their electric vehicles for balancing the electricity network.	[illegible]	DK	[illegible]	7	[illegible]	
MERGE	[illegible]				[illegible]		

Final report: Review of Roadmap and pilot project experiences

June

2017	2018

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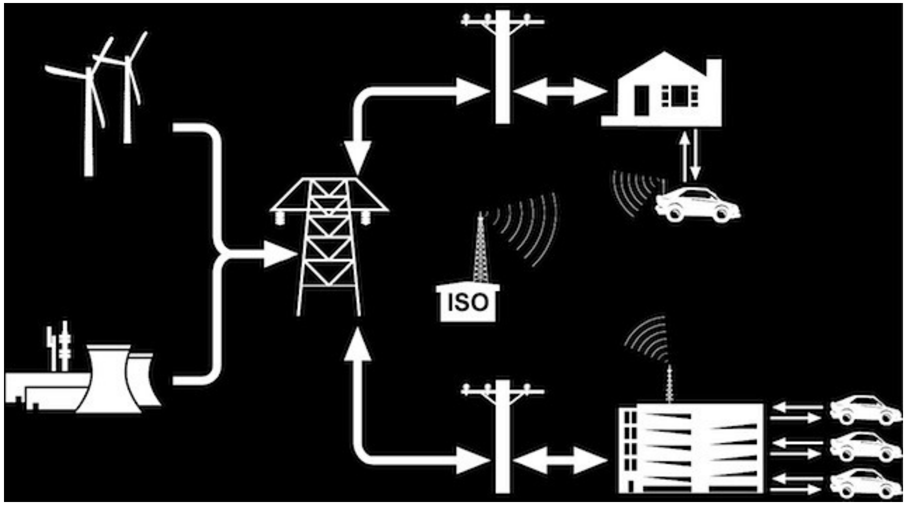
1. Task 28
    1.1 Introduction
    1.2 Task outputs

2. V2X Research and demonstration

3. Conclusions

V2X: Vehicle to everything – Opportunities and Challenges

- **Opportunities enabled by V2X technology**
  - Energy related applications:
    - Energy arbitrage for cost reduction, CO_2 emissions and peak shaving
  - Power related applications
    - Renewable energy sources integration
    - Load following
  - Fast response applications
    - Power quality and islanding. Security of supply



Source: Willett Kempton, 2010.

- **Challenges to be faced by V2X**
  - Regulatory framework definition
  - Need for coordination with grid operators
  - New stakeholders: EV aggregator
  - Bidirectional power and communication infrastructure. Standardization.

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V2X: Vehicle to everything

V2X technology contributes to ensure a **secure, sustainable and competitive energy supply**. Countries will be pursuing **different objectives** depending on their **specific energy context**.

Security of supply:
- Use of V2X as a back-up resource
- V2X applications for service restoration

Sustainability:
- RES integration
- Emission reduction
- Power smoothing

Economy:
- Energy Arbitrage
- Ancillary services
- Investment deferral

ADDED VALUE SERVICES TO BE PROVIDED BY EVs

FINANCIAL INCENTIVES FOR THE EV OWNER

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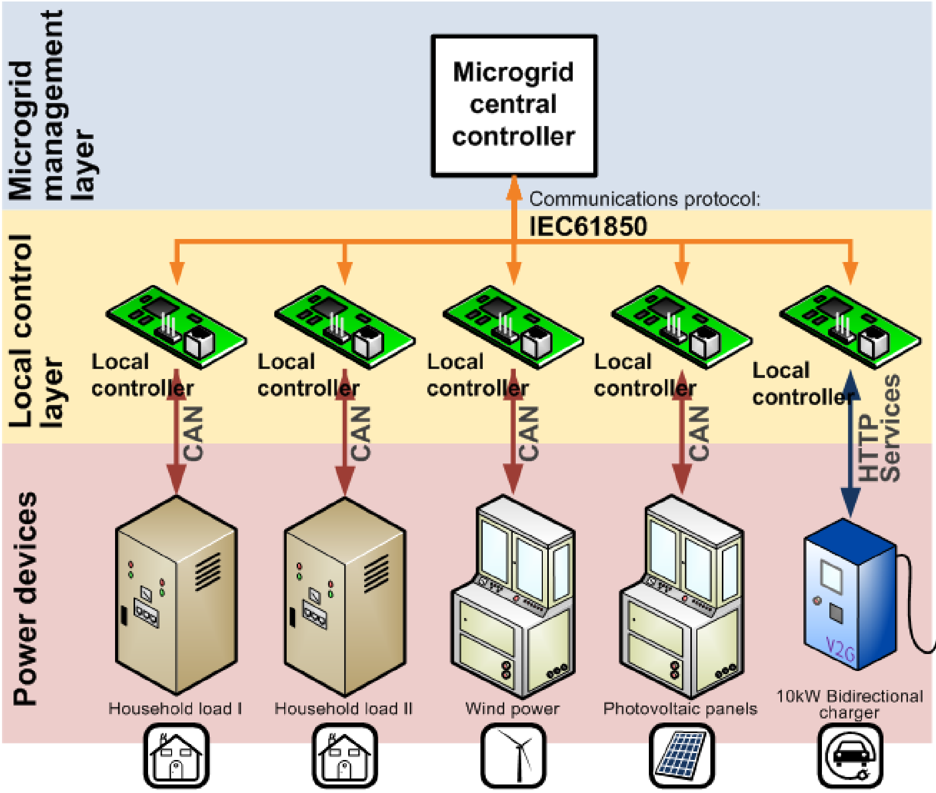
Testing a 10kW V2M (Vehicle-to-Microgrid) system at IREC Lab

GOAL: To analyse the technical viability of V2M systems in an emulated household environment



Emulation platform description

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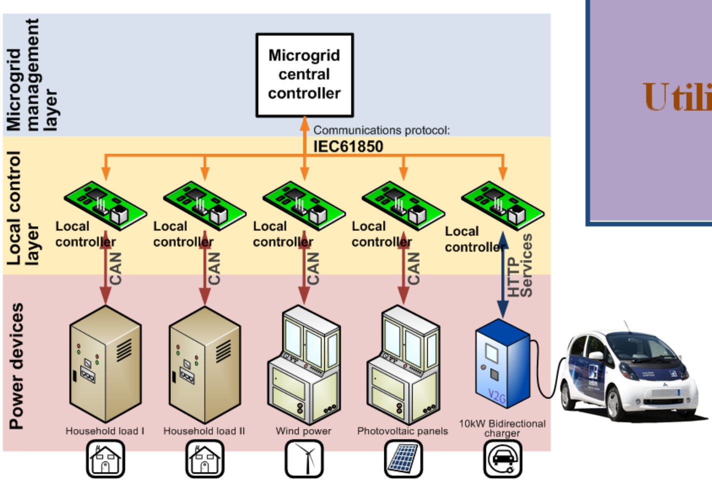
Source: D3.2: Testing of a 10kW V2M system in IREC Microgrid testing facilities, IREC

Testing a 10kW V2M (Vehicle-to-Microgrid) system at IREC Lab

GOAL: To analyse the technical viability of V2M systems in an emulated household environment

Emulation platform



Test scenarios

Functionality	Application	Tests	ID
User	Energy Arbitrage (Cost Minimization)	No range anxiety	CM
Utilities	Average DSO Power Balancing	50% of grid tie capacity	D50
		25% of grid tie capacity	D25
	Instantaneous DSO Power Balancing	Peninsula Mode	PM

Source: D3.2: Testing of a 10kW V2M system in IREC Microgrid testing facilities, IREC

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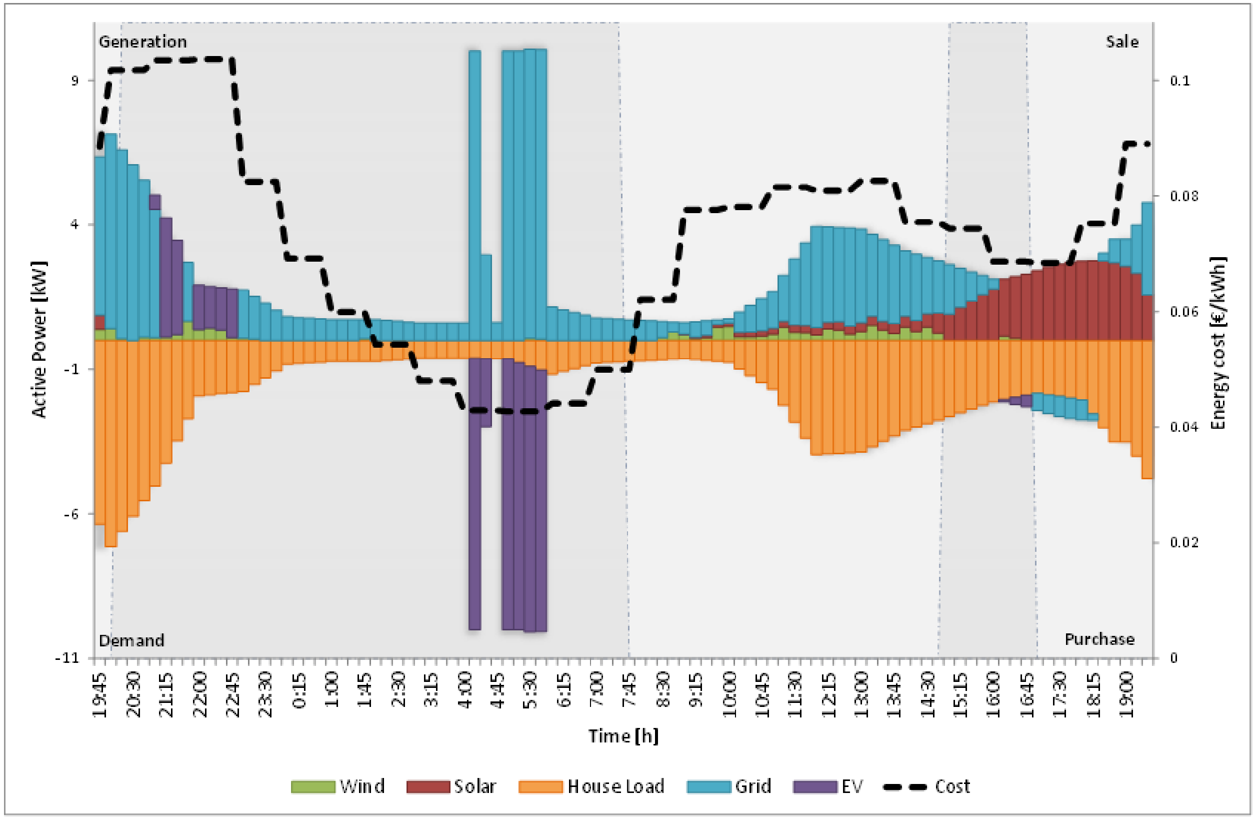
Emulation behaviour on a typical day



- EV discharged during two peak hours (21:00-23:00) to supply house demand
- EV charged on early morning hours (4:00-5:30)
- Notice: from 15:30-17:30 there ir solar surplus used to charge the EV

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Test CM - Results

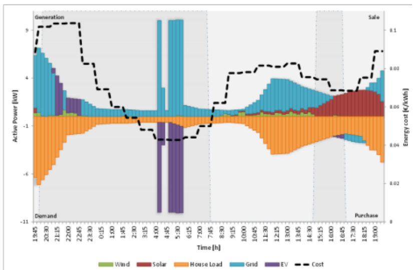
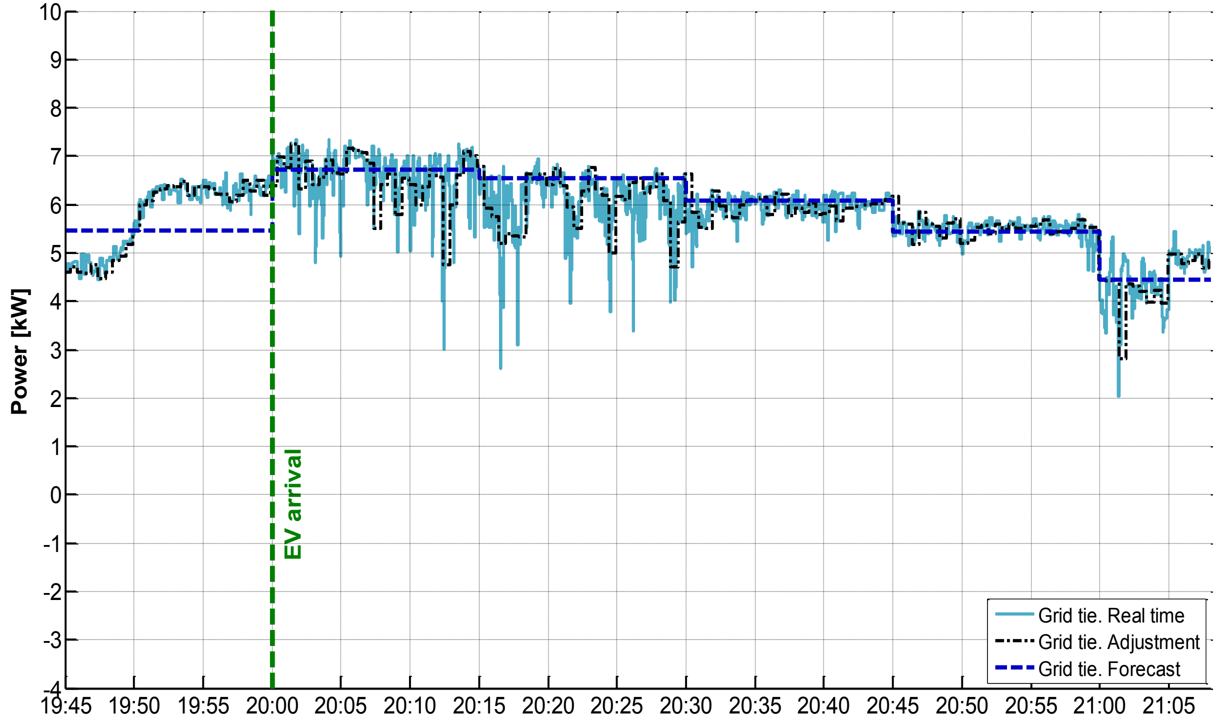


Figure 17: Optimal energy schedule from Tertiary control for 24h



- EV discharged during two peak hours (21:00-23:00) to supply house demand
- EV charged on early morning hours (4:00-5:30)
- Notice: from 15:30-17:30 there ir solar surplus used to charge the EV
- Low deviations: primary and secondary control set points follow terciary
- SOC from 55% to 54%

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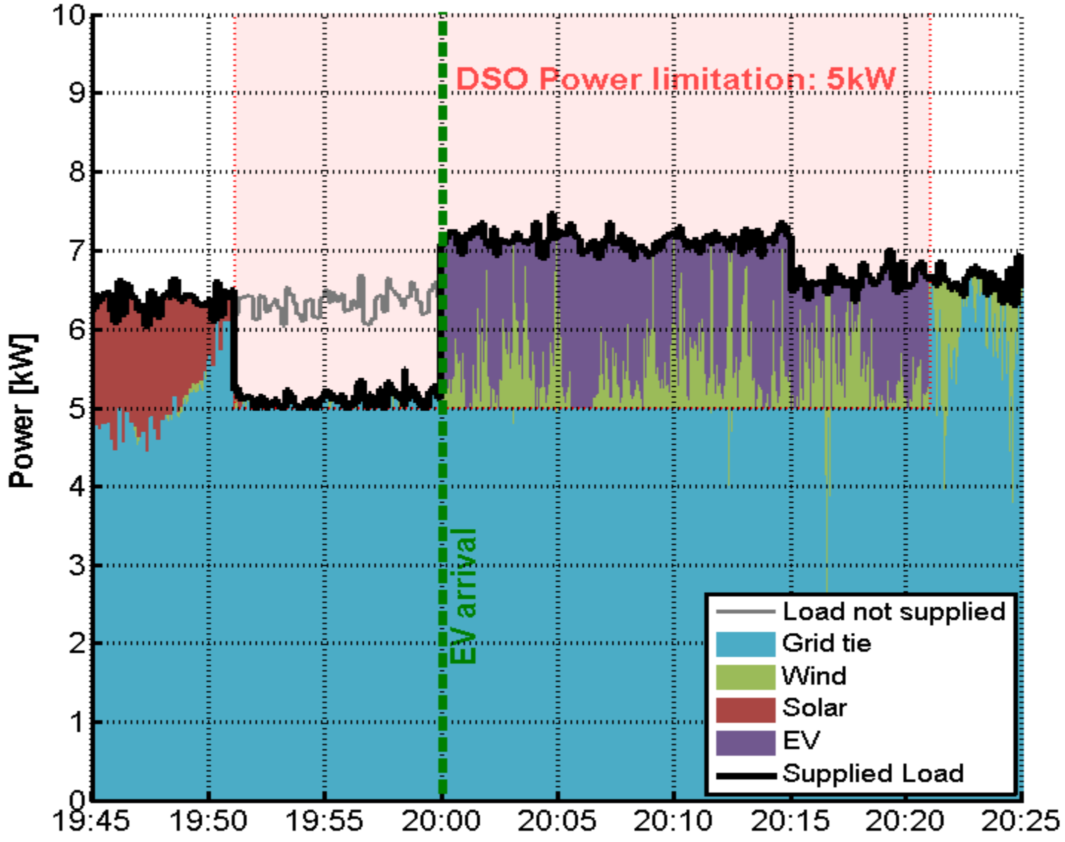
D50 Test: Power balancing - Results

The distribution network capacity considered to be temporary halved (19:51-20:21h)

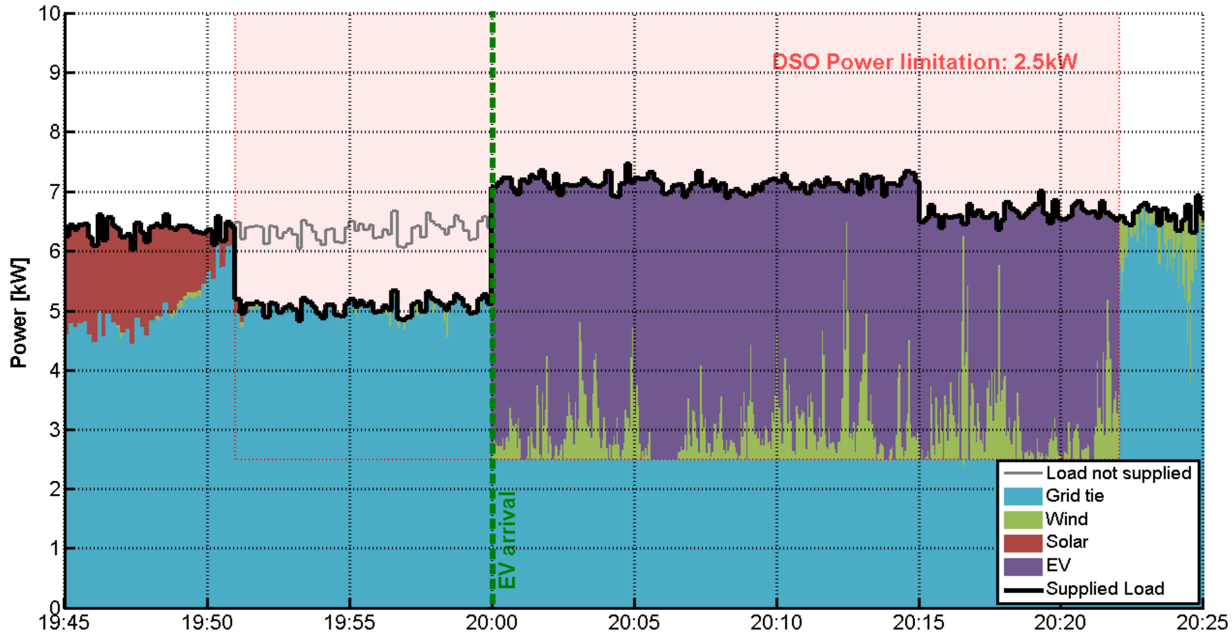
- Once the EV is connected the DSO limitation is not violated anymore and the battery is discharged
- There are even cases where power drops to 3kW due to wind power generation
- - 6% SOC at the end of the test



D25 Test: Power balancing - Results

The substation capacity considered to be temporary reduced to 25% of its capacity under normal operation conditions

- While the EV is not connected the primary and secondary control set points do not follow DSO limitations
- When DSO limiation is removed, the grid tie power flow can supply all loads again
- -13% SOC at the end of the test



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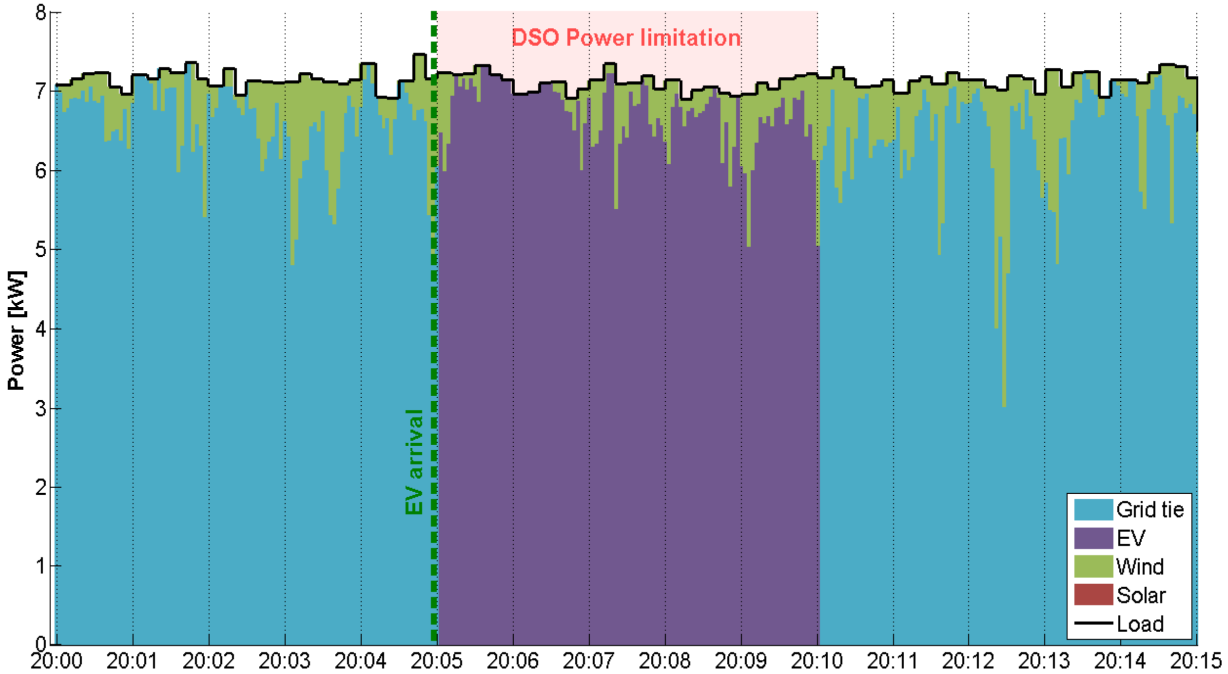
PM Test: Instantaneous DSO power balancing - Results

GOAL: Minimize the deviation from the DSO set point

- DSO signal set to 0kW emulated for 5 min
- EV battery discharged for 5 min at 7kW (nearly supplies the whole household demand when interconnection unavailable)
- -5% SOC at the end of the test



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Vehicle to Home / Vehicle to Building

Denmark V2X Living Lab

January 2016

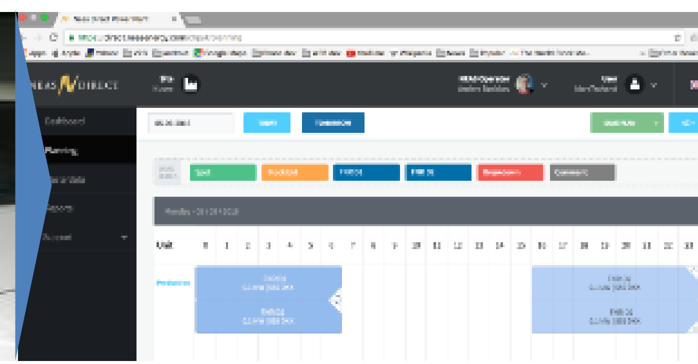
Civil Works + after sales

Aggregation

Factory production

Engineering Tunning

Commercial bidding into DK2



Source: ENEL, V Workshop Task 28, Paris October 2016

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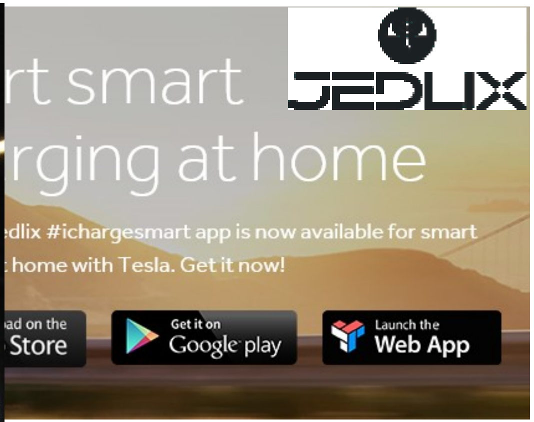
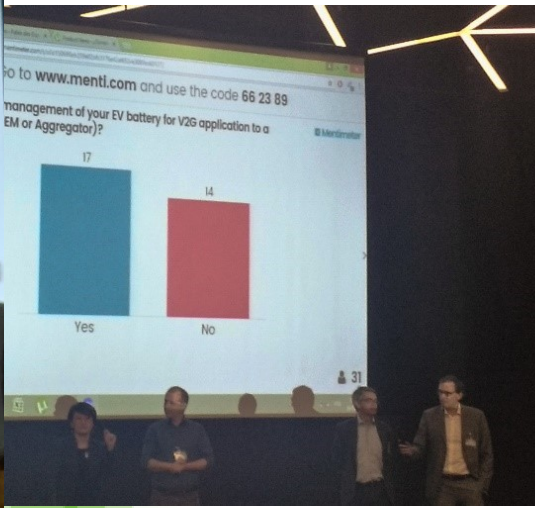
EV User requirements/perception

Emerging market and value proposition: USA and Netherlands

Source: JeDLix EEVC17



s: TESLA, BMW, Renault, ENECO



Source: RT EEVC17

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Conclusions

Task 28

- Key barriers preventing the roll out of V2X technologies have been identified
- Task 28 running until end 2018

Outputs

- V2X Roadmap to be published summer 2017

Conclusions

Task 28

- Key barriers preventing the roll out of V2X technologies have been identified
- Task 28 running until end 2018

Outputs

- V2X Roadmap to be published summer 2017

V2X R&D

- Pilot in DK validated technology and the full chain of V2G services

V2M research project at IREC labs

- The 10kW V2G system developed is capable to follow erratic variations of the power set points with short periods of time
- It has been seen the potential of V2G applications for DSO services mainly power balance: optimized EMS, reduced impact on SOC, potential revenues

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