The INTER project

INtégration du Transport Électrique dans le Réseau

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CHANGER L'ÉNERGIE ENSEMBLE

Summary

1. Current European context
2. Future challenges for the DSO
3. The INTER project in a nutshell
4. Activity highlights for 2012
5. Final outline

Summary

1. **Current European context**
2. **Future challenges for the DSO**
3. **The INTER project in a nutshell**
4. **Activity highlights for 2012**
5. **Final outline**

Current context

Main factors contributing to the EV/PHEV kick-off:

- **Economical:** Energy dependence and high oil price
- **Environmental:** Climate change
- **Technological:** New innovative solutions, decrease in cost

Strong commitment from **governments** and **consumers**

Current context

The EV/PHEV help in reaching European energy policy goals:

EU wide-ranging package on climate change for 2010-2020 period aims to:

- **20% cut in emissions of greenhouse gases by 2020, compared with 1990 levels**
- **20% cut in overall energy consumption**
- **20% increase in the share of renewable in the energy mix**

- **Sustainable development:** Control EV's CO_2 emissions. Goal: Decrease the emission levels from 160 gCO_2/km to 30 gCO_2/km for 2030
- **Security of supply:** The EU is more than 80 % dependant on oil imports
- **Economic competitiveness** Economic competitiveness generate investment and create jobs within Europe, to the benefit of both consumers and producers
- **Synergies with wind energies and other renewable:** To fulfil the EU's 2020 renewable target, significant use of energy storage and demand regulation will be needed. Future concepts such as V2G and V2H
- **SmartGrid Integration**

Current context

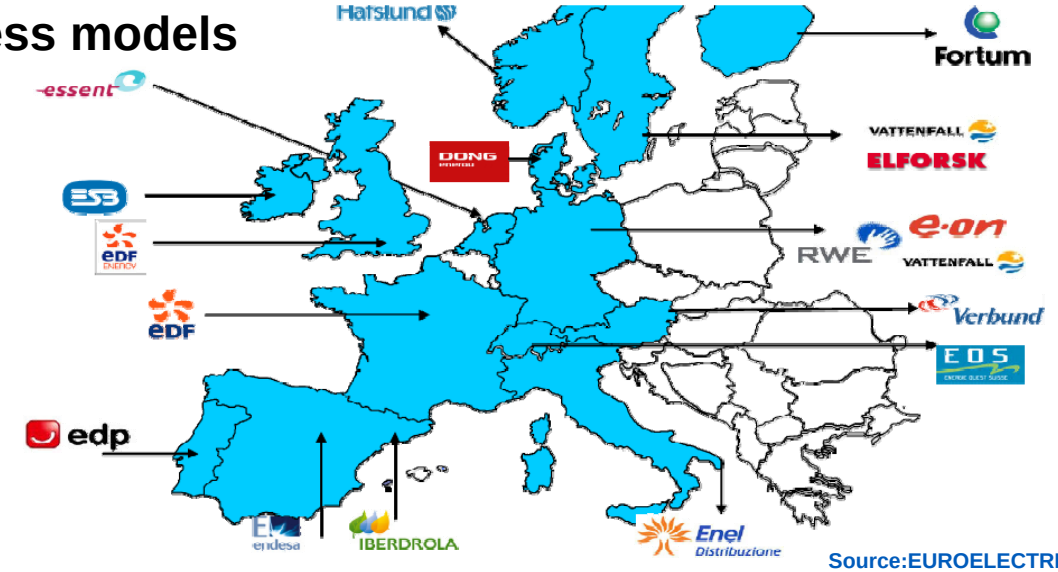
The UE and the governments are defining the path for:

- **Standardization** (OEM/Utility standardisation initiative)

- **Taxes and sustainable business models**

- **R&D initiatives** (EU FP7, M/468,…)

- **Experimental field tests and roll-outs**

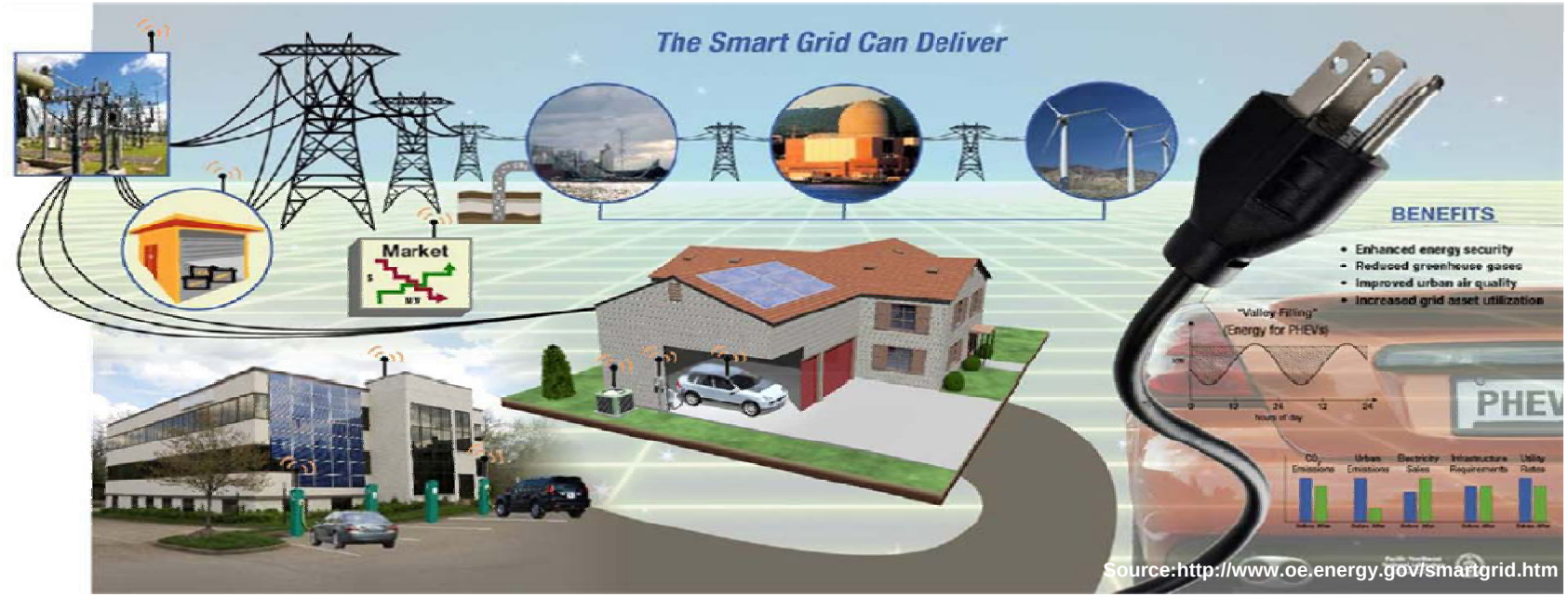


Source:EUROELECTRIC

Current context

The PHEV/EV is an important element within the SmartGrids scope

AMI + DER + DSM + PHEV/EV = Smart Grids



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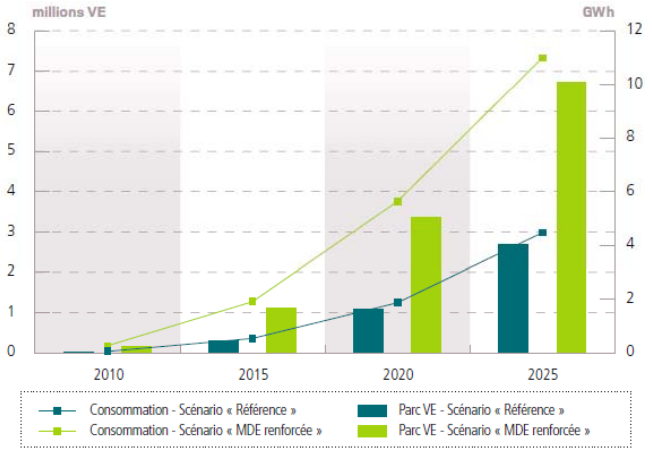
Forecast for EVs in France

Expected volume

- **Up to 2 million EVs** from 2020
- Equivalent to a **5% penetration** (includes vans and other light vehicles)
- Correspond to 15.000 EVs for a region of 500.000 inhabitants (study case of Rouen region)



Charging stations

- **More than 90% should be slow charging** (3kVA) at home at off-peak hours (night)
- **7-8% will be secondary slow** or accelerated charging (3, 22kVA)
- **Only 2-3% of public charging spots** will be for fast charging (43kVA)

Business-model

- In the initial phase: **simple but upgradable infrastructures for payment**
- Later and depending on business case viability: **a possible move towards e-mobility operators**
- Price for public charging paid as a service: **if paid on the cost of kWh, public subsidization policies will be needed!**

Sources:

RTE, bilan previsionnel 2009

Livre Vert sur les infrastructures de recharge ouvertes au public pour les véhicules « décarbonés », April 2011

A major opportunity for utilities...

- Electric vehicles represent a strong potential over the coming decade
  - Development of **CO_2-free** transportation throughout Europe
  - **Improve insertion of intermittent renewable energy sources** by offering storage and load regulation via concepts such as V2G

- With a major impact for stakeholders
  - Massive roll-out of EVs will require development of **efficient charging strategies to optimise DSO network resources**
  - **Customer understanding** and acceptance of EV charging dynamics is fundamental to success
  - **Innovative business-models** will evolve as stakeholders propose new e-mobility services and billing schemes
  - **Upcome of new billing schemes**

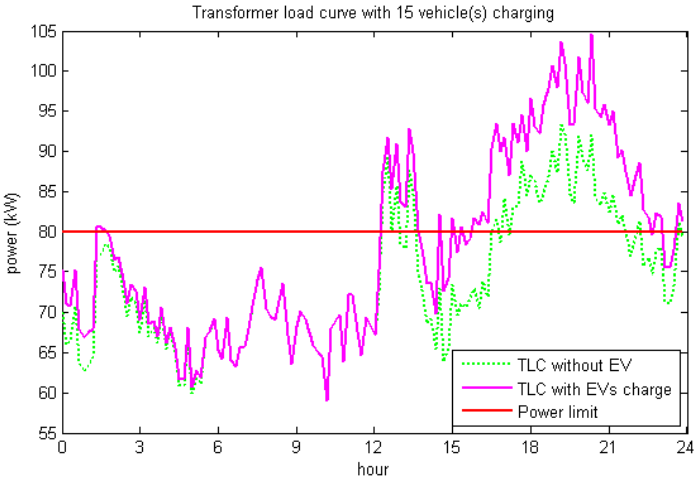
- To guarantee success utilities must play a key-role
  - **Involvement from the earliest design phase in order to minimize impact on the network** : to avoid congestion or dramatic increase in reinforcements, the DSO must monitor charging
  - Participation in shaping appropriate **EU policies**
  - **Develop sustainable business** models allowing simple solutions for the benefit of the customers
  - Carrying out **field tests** involving customers and in support during roll-out
  - **Standardising the charging infrastructure** and communication interfaces

... but a huge challenge to deal with

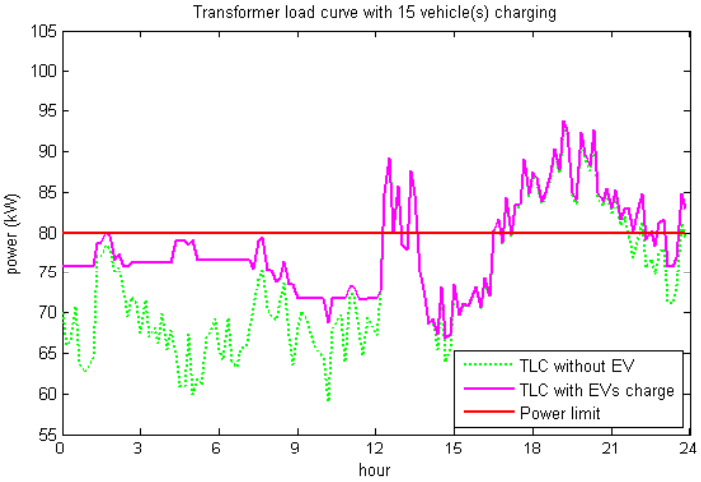
- DSOs are facing a challenge in handling peak load
  - Slow charging of 2 million EVs simultaneously in France is equivalent of **up to a 10% increase in national peak load** but only a few % in energy consumption ➔ current tariff structures are unadapted
  - **Inefficient network reinforcement would cost billons of €** paid by end consumers ➔ not acceptable
  - Creation of EV high density zones are likely to **induce load congestion and voltage drops**

- Solutions should be kept simple and cost optimal
  - We must define solutions based **on use cases using the existing network** adding forecasts for increase in energy consumption and load spreading
  - **We must limit a generalisation of fast charging** (this would lead to an explosion in costs)
  - **Optimising the charging locally to avoid** premature transformer ageing and control voltage variations
  - **DSOs** therefore must have access to **local charging information and be allowed to manage overall load control on the network**

Effects of charging without optimisation



Optimised charging



The INTER project

The INTER project was launched in 2010 to provide technical support to the French DSO, ERDF, regarding the arrival of the EV across the country.

Main objectives

- **Analyze EVs impact in the distribution network**
- **Develop the advanced EV charging infrastructure**

Future challenges for the DSO

- **Modifications within the load profile** considering future new usages
- **Impact on the network dimensioning** (extra capacity and related expenses)
- **Voltage drops**
- **Advanced Smart Metering & sub metering**
- **Laws**, **futures directives**, **mandates and standardization**
- **Integration within the SmartGrid**: advanced charging infrastructure and communication means
- **New services** for city councils and customers

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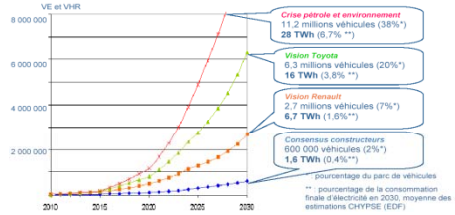
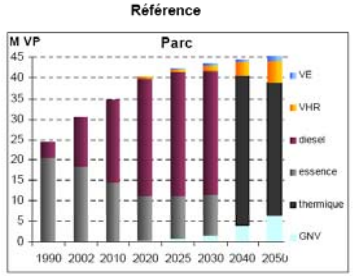
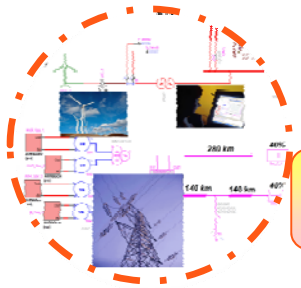
General Project Overview

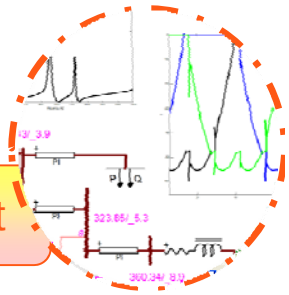


Scope of the project



Analyse in depths of the PHEV/EV deployment scenarios and potential grid impact



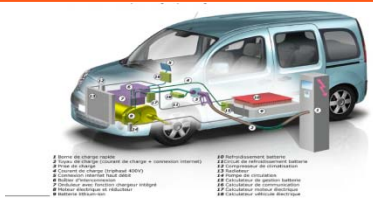


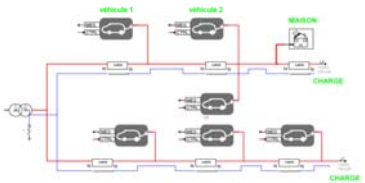
Network simulation: Overall capacity, power quality and enhancement

Smart charging infrastructure : Use cases, communication means, metering

IPv6

Fleet charging infrastructure implementation and experimental field tests roll-out (GIS)

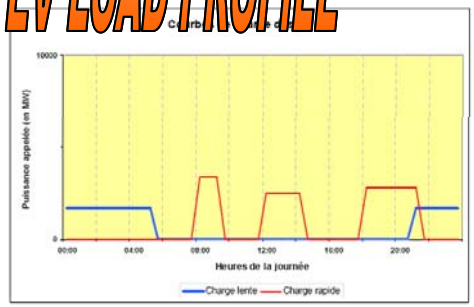


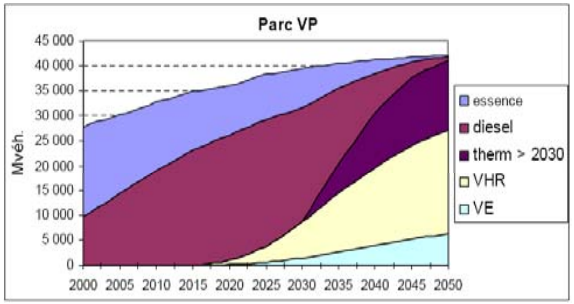


EDF

GRID IMPACT & EV-NETWORK SIMULATION

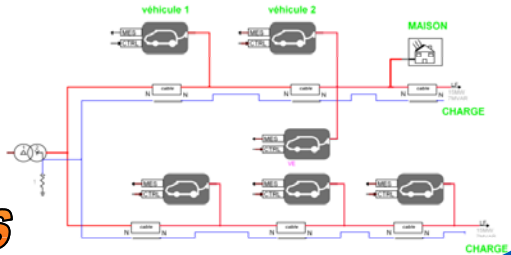
EV LOAD PROFILE



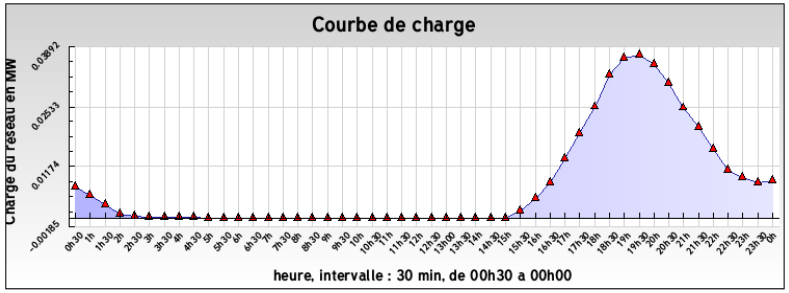


EV penetration scenarios

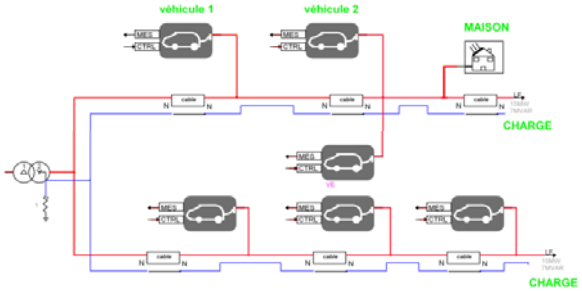
Simulation



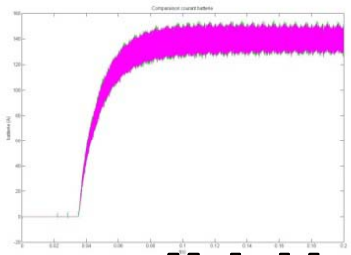
- **Develop a methodology capable of representing several EV/PHV load curves locally** ➔ **VESAP** tool (« Véhicule Electrique Simulation de l'Impact en Puissance »).

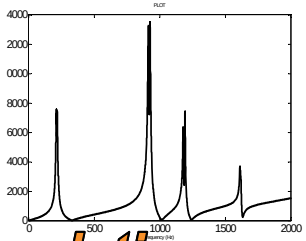


- **Collaboration with OEM's to model an EV charger and simulate it in a low voltage network** (urban grid and parking slot)



POWER QUALITY





Hybrid simulation

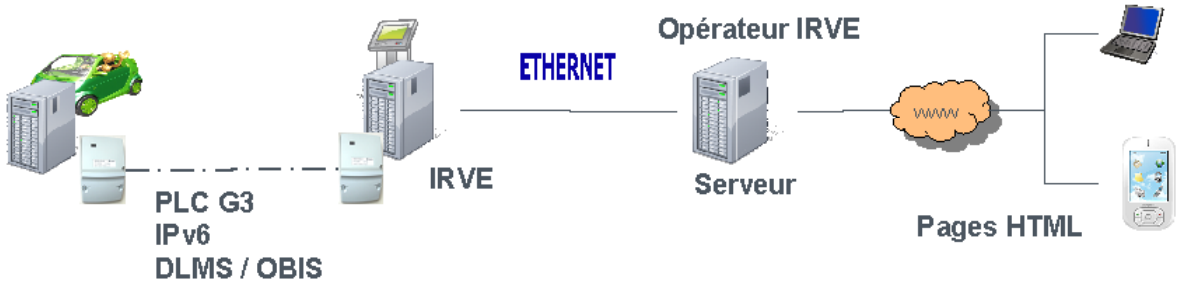
Real measures

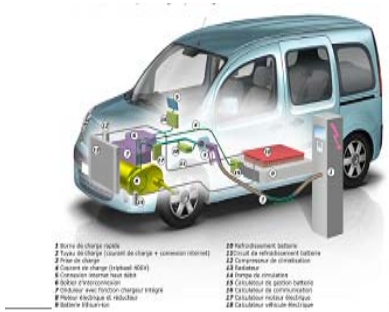
- The charging of electric vehicles is **likely to create disturbances on the network as the power increase**. Power quality disturbances like flicker, due to interruptions in the charging process for battery management, harmonics due to the AC to DC conversion , and higher frequencies disturbances (in the range 2 – 150 kHz) due to power electronic used in the charger

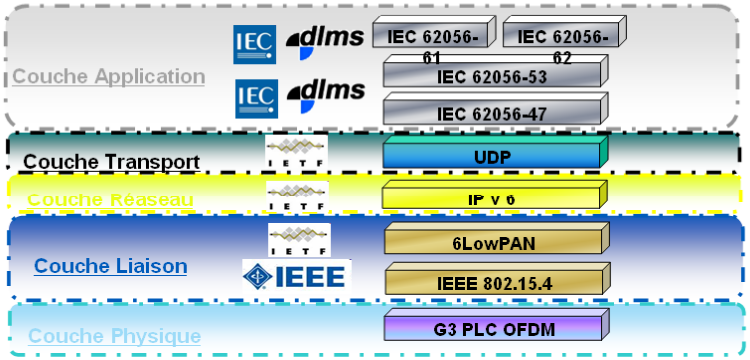
- **Tests fields and measurements** become necessary to understand the potential impact of EV in the grid.

EV demostration platfom

Research partnership launched in 2010 to develop the advanced EV charging infrastructure platform aiming to test an end to end ICT architecture to enhance EV smart charging







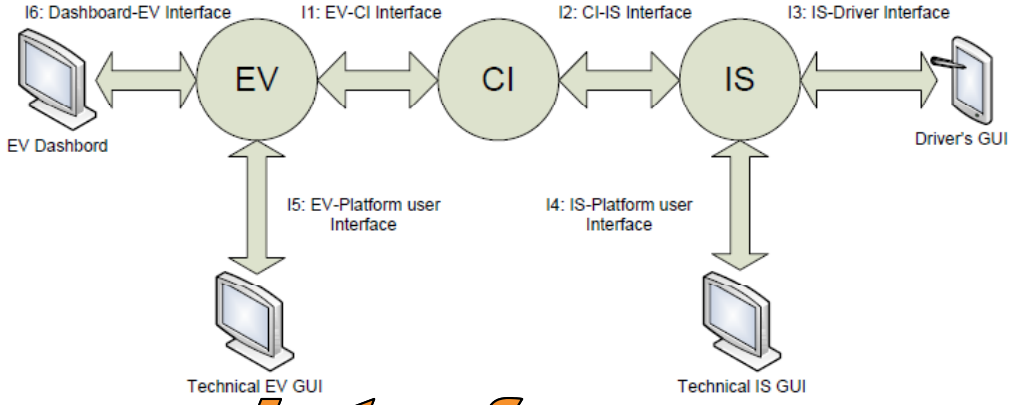
The EV demonstration platform

Scope

- Develop a EV platform to show how to take into account **essential user and network constraints**
- **Promote efficient local optimisation on the LV level** (secondary transformer station) by use of charge **optimisation algorithms**
- **Support multiple EV simultaneous** connections
- Take into account **consumer expectations while optimising network constraints**

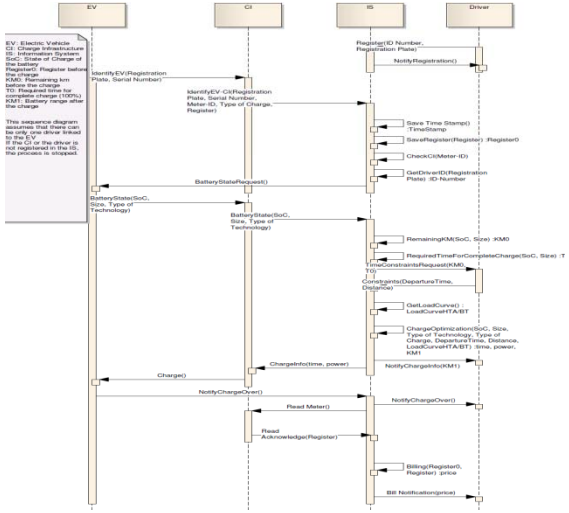
Innovations

- **End to end architecture**
- **Based on a smart meter infrastructure**
- **Use of open communication protocols**
- **Advanced load optimisation**



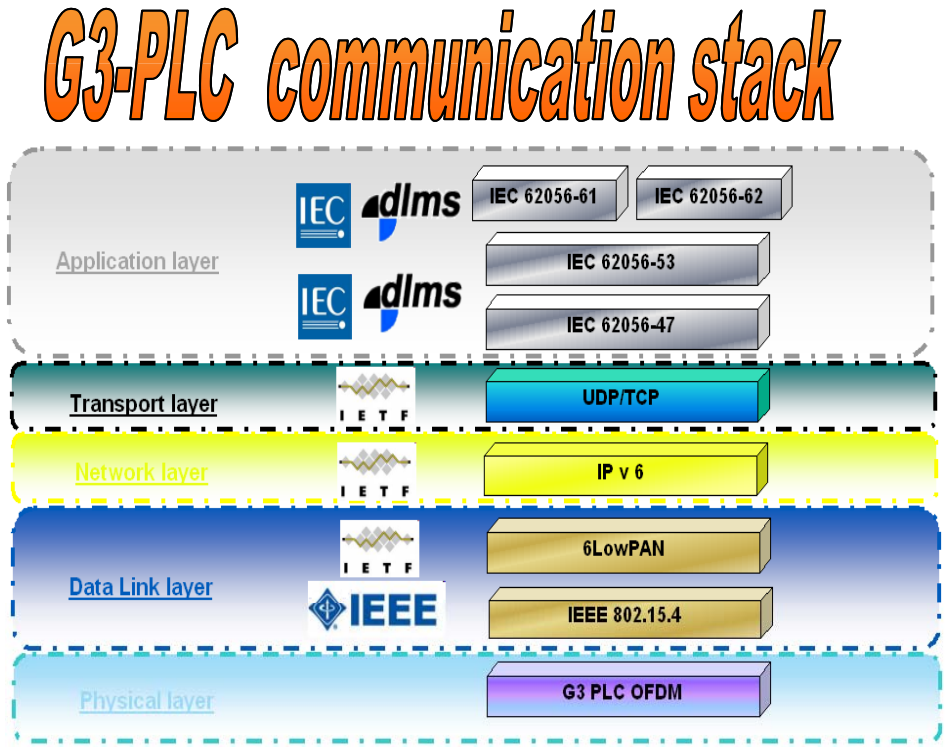
Interfaces

UML USE CASES



EV demonstration platform essentials

- **Modelling of requirements**
  - Initial use-cases modelled in UML
- **Communication protocols**
  - PLC G3 communication technology (EN/TS 50567-2)
  - IPv6 protocol stack
  - DLMS/COSEM protocol (IEC 62056-5-3, IEC 62056-6-1, IEC 62056-6-2)
    ➔ Extensions for EV
- **A simulator for**
  - Charge aggregation and load control for multiple EVs

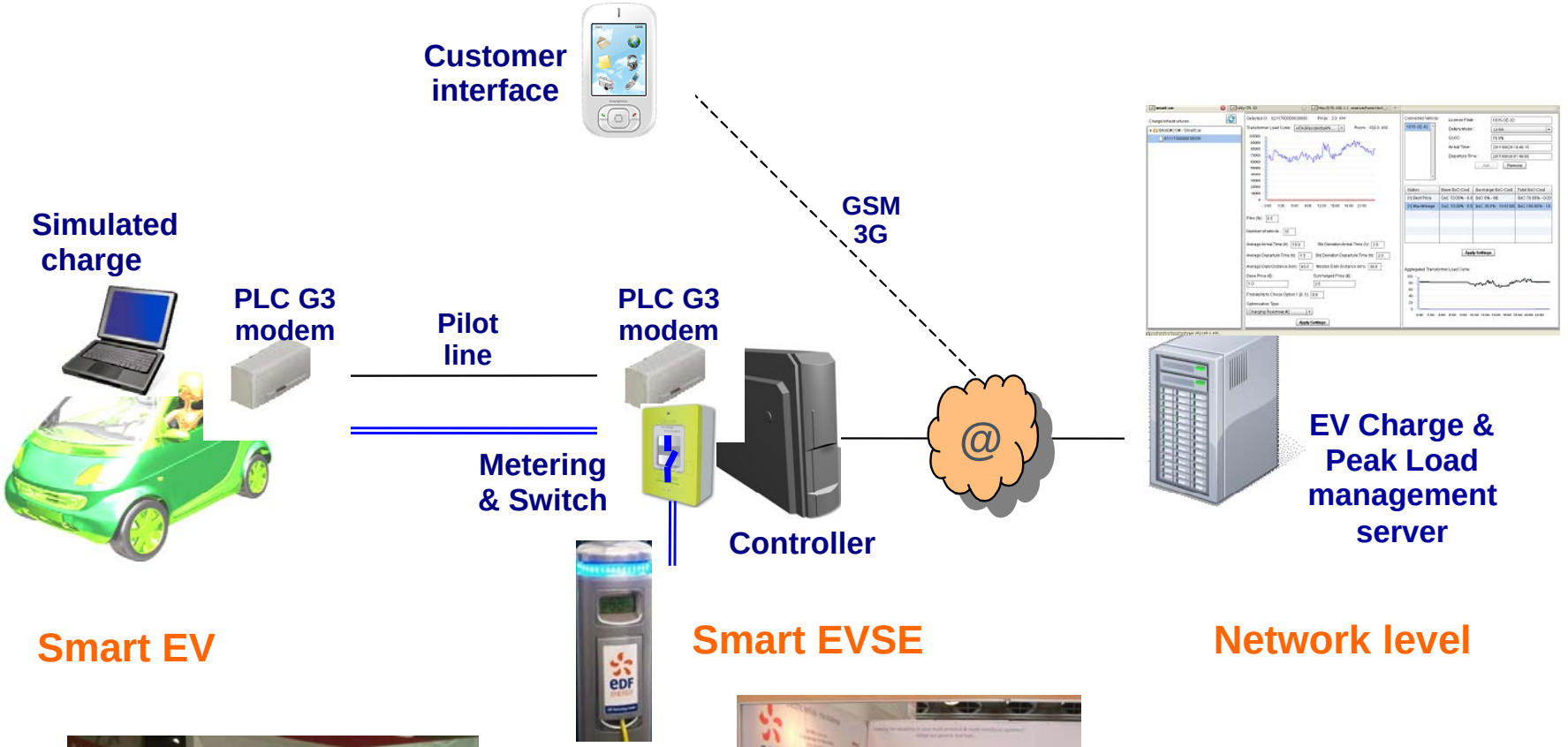


G3-PLC Alliance

IPv6

EDF

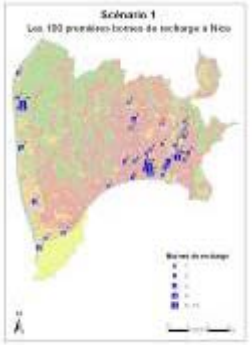
Platform architecture overview



EV Platform exhibition during Metering Europe 2011

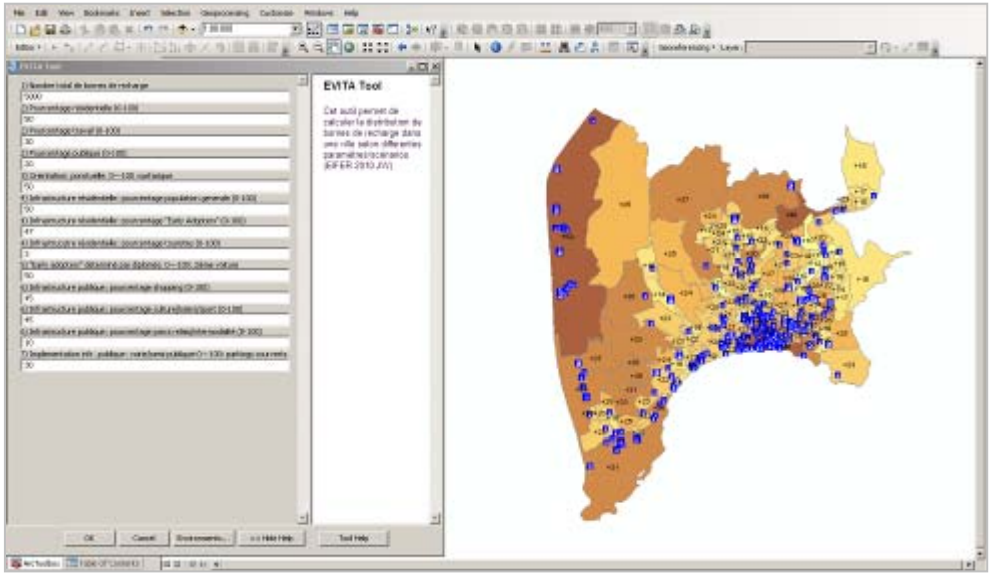
GIS-tool for spatial EV infrastructure planning

EVITA TOOL



- Implementation of a planning-**methodology for public/private charging spots,** based on geographical and social data ➔

EVITA - Electric Vehicle Infrastructure Tool for decision Aid



EIFER

Workflow for planning with the EVITA GIS tool

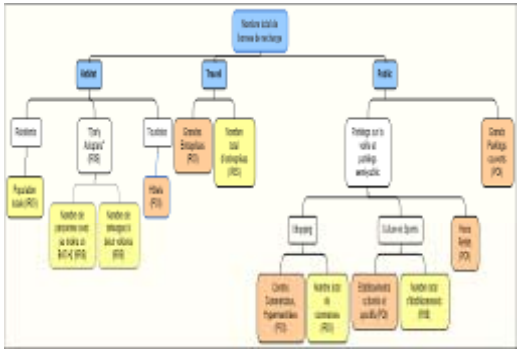
Spatial data collection & processing

Type de donnée	Données
Données de base	Découpage IRIS
	Occupation de sol
	Population, Nombre de ménages par IRIS
Système de transport	Lignes et stations SNCF, Tramway
	Rues principales
	Parkings et parcs relais
Localisation des activités	Grands employeurs/entreprises
	Grands commerces
	Equipements culturels (cinémas, théâtres, musées)
	Hôtels
Localisation des « early adopters »	*Revenus* médians
	Nombre de *diplômes* par IRIS
	Nombre de *résidences principales* de type maison
	Nombre de ménages disposant de *deux voitures*
	Nombre de ménages avec *stationnement privé*

Collection of spatial data from several sources:

- Ville de Nice (Observatoire, Economique et Urbain)
- INSEE,
- Internet research and manual georeferencing

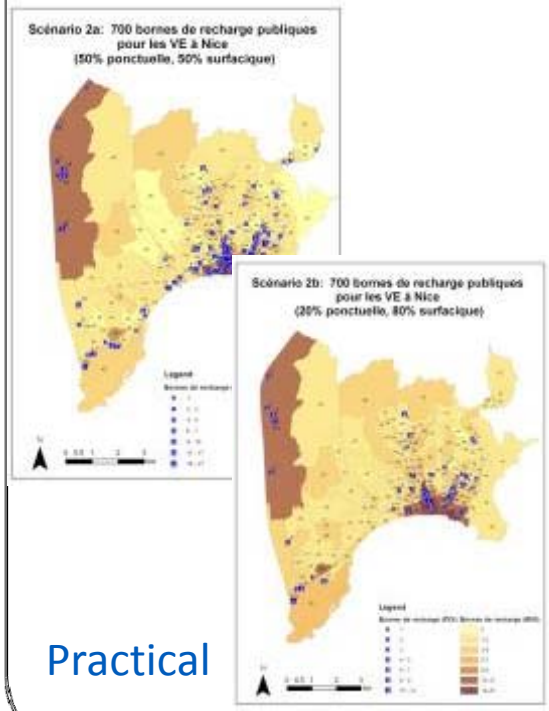
Parameterization of algorithm for calculating the geographical distribution of charging spot



Where to install

How many charging spots ?

Charging infrastructure scenarios



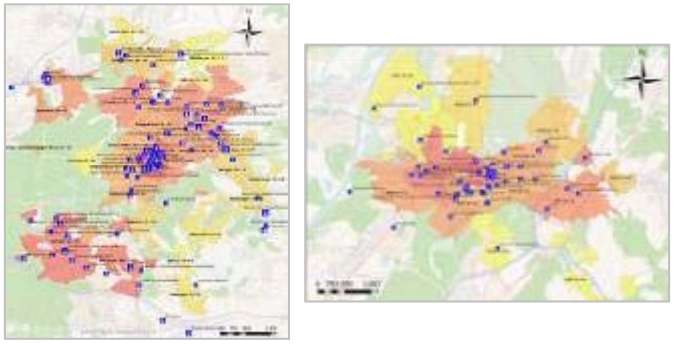
Practical examples

Main application fields & associated projects

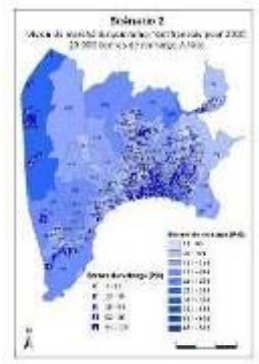
European Institute For Energy Research

- Research institute launched by EDF R&D and KIT situated in Karlsruhe, Germany
- Devoted to energy and the environment, has been working thoroughly in the last years to the **urban planning EV infrastructure issues.**

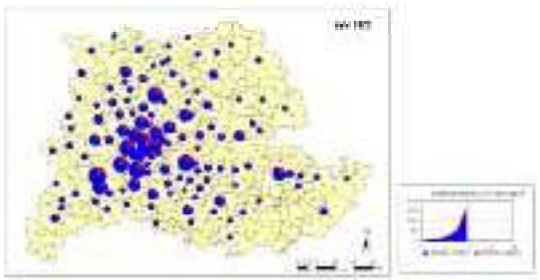
Several projects in the domain of EV infrastructure planning:



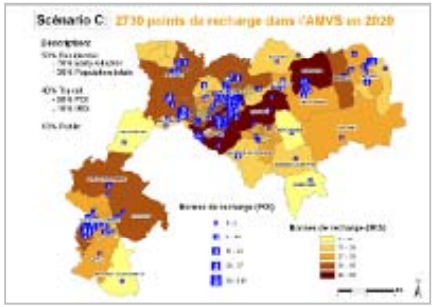
2009: MeregioMobil (for EnBW): Stuttgart, Karlsruhe, Kehl



2010: INTER (for ERDF, EDF R&D): Nice



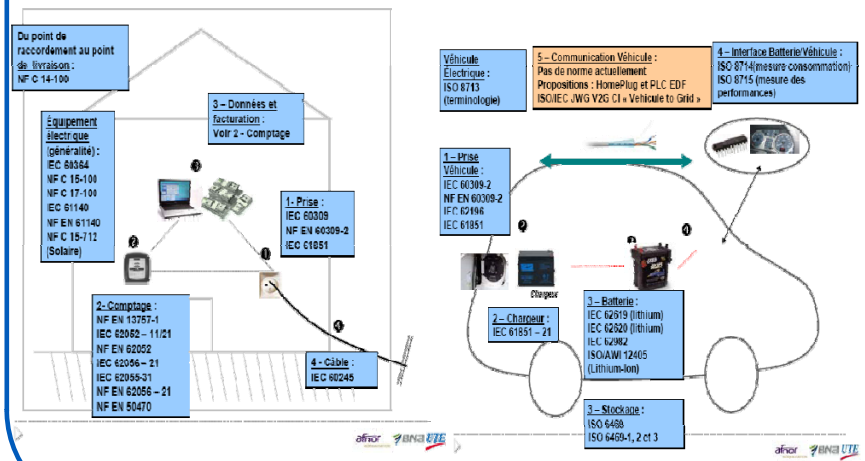
2010: IKONE (for EnBW): Region Stuttgart (long term previsions)



2011: PIME (for EDF, DME): Agglomération Maubeuge Val de Sambre (AMVS)

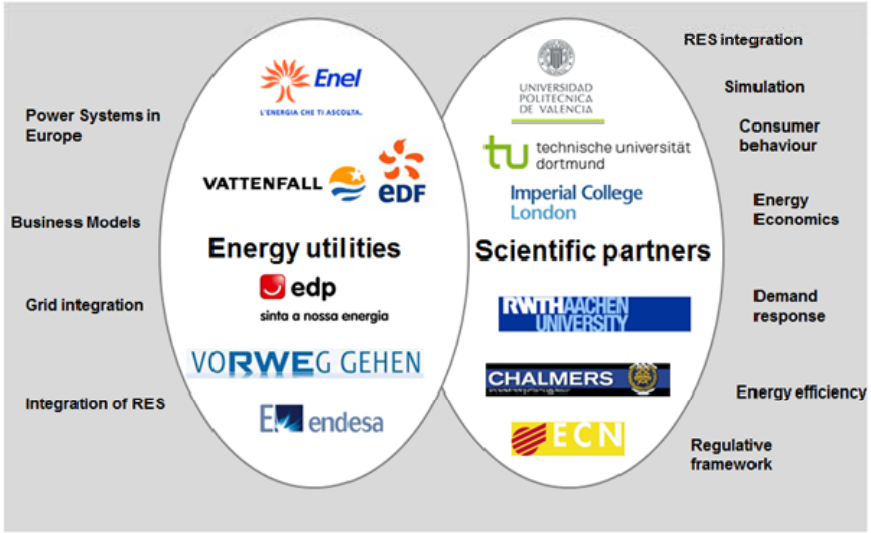
Standardization and FP 7 European projects

EV Standardization

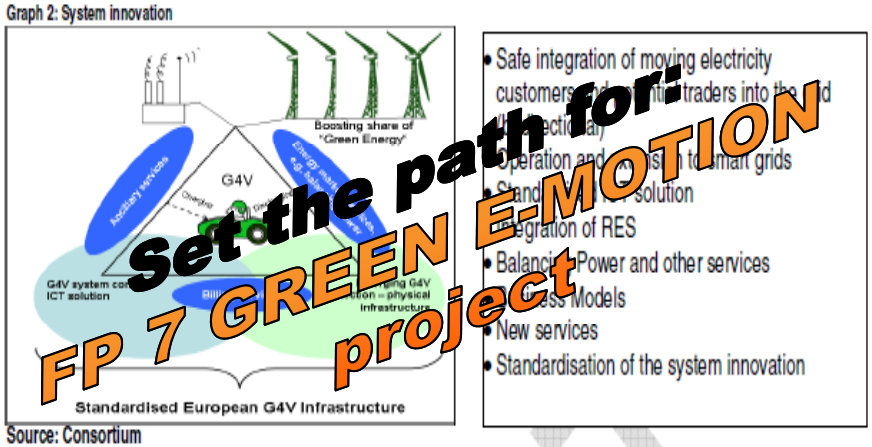


Strong involvement in:

- **IEC TC 69** for to define the communication means between EV and EVSE (ISO/IEC 15118)
- Active members in **IEC TC 57** and **IEC TC 13** to guarantee EDF group vision of SmartGrids
- Permanent contribution to **M/441**, **M/468** and **M/490** through uses cases and protocol definition



G4V European Project



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New oncoming projects for 2012

Projet Eco-Cité de Nice: Public charging network installation

- A public charging network installation in Nice. Forecast:
  - **700 public charging points for 2014**
  - **1500 public charging point for 2018**
- The public charging spot infrastructure has to be deployed taking into account customer and network constraints

Charging infrastructure for EV fleets

- Within the National Plan for the development of EV and EVPH, a call for tender has been launched to buy **20 000 EV**s:
  - 10 000 by La Poste
  - 2500 by EDF Group
- Renault will provide 15 000 EVs and PSA 3 000 EVs
- **Define and experiment the charging infrastructure for enterprise EV fleets**

Evolutions in the experimental EV Platform

- **Development of new use cases** in the M/490 and IEC TC 8 standardization platform
- **Implementation of theses uses cases** in the demonstration platform, as « proof of concept »
- **Collaboration with interested stakeholders**: Car manufacturers, Battery providers,…
- Extension of the platform to take into account **several EV's and real hardware (charger + BMS)**

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Final outline

- The arrival of EV is a **real opportunity for utilities but a huge challenge at the same time**

- Electric vehicles represent a **strong potential but will have a major impact for all stakeholders**: OEMs, utilities, service providers, municipalities,...

- **A stronger interaction and collaboration** will be required in the next years to come at a national and European level (harmonized standardization and policies)

- **Technical solutions should be kept simple and cost optimal** (most of the cases, the business model still remains to be clarified)

- As far as utilities are concerned, we have to set the path for the future arrival of mass market EVs, **becoming a key player** in the successful EV roll-outs and infrastructure planning

Thank you for your attention ! - Questions?

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