Project presentation

The first rural smart grid demonstrator

with citizen producters and actors of their consumptions in the energetic system
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1- Context
Context:
SMAP, in keeping with « Centrales Villageoises »

The « Centrales Villageoises » are local compagnies which develop renewable energies in a territory combining citizens, local government and local actors.

Developed in 15 territories with the regional agency of energy and environment in Rhône (RAEE) including 8 operational and 16 coming.

But, from a certain amount of renewable energy integration, it’s necessary to plan to do electricity network reinforcements.

Reinforcement financial costs could impact network investments and photovoltaic projects (SAS CVRC for example)

SMAP is the first smart grid demonstrator minimising reinforcement cost combining the different actors of the system.
Context:
SMAP partners from different horizons (community, associations, compagnies, university)

- Regional agency of energy and environment
- « Pilat » Natural Park
- HESPUL association
- G2Elab Laboratory (Grenoble INP)
- Compagny – Solutions of LV network instrumentation
- Distribution Network Operator of public network
- « Les Haies » town hall
- Energy federation of Rhône
- « SAS Centrales Villageoises » in Condrieu region
- Compagny – Solutions of MV nework instrumentation

Financing
40% FEDER* (on average)
60% self financing from project partners
Total
812 K€
(1/3 equipment, 1/3 thesis, 1/3 time ressources)

* FEDER = « Fond Européen de Développement Economique et Régional »
Context:
A replicable project focus on Les Haies village

LES HAIES
772 inhabitants
Photovoltaic « Centrales villageoise » = 76 kW
Integrated in a TEPCV* project
A high level of involvement of regions
A rural town (school, nursery, etc.)

Municipalities community bringing together 9 municipalities with « Les Haies »

86 municipalities form the TEPCV* « Pilat Park Naturel St Etienne Conurbation »

Area of SMAP municipality
Area of municipalities community
Area of TEPCV*

*TEPCV = « Territoire à Energie Positive pour la Croissance Verte »

1
2
3
Context:
Smart grid continuity on low voltage network

Network already smart (Regional management agency, DEIE, HTA generators)
Continuation of Enedis experimentation on voltage regulation (based on Linky)

Linky, the first component of Smart Grids
Context:
Paradigm shift on the distribution network

Comparison with flood principle:
Context:
Voltage variation according to PV generation

Strong dependance between PV generation and voltage owing to low volume of consumers on the network.

Some voltage values upper or equal to 250 V (in keeping with CRE norms)

Generation site at the end of the line

Please click to access to more details
Impact of photovoltaic generation on low voltage network

**Photovoltaic**: Uncertain and irregular generation

- Source substation
- HTA Network
- Distribution substation
- Photovoltaic site
- LV Network

**Generation and consumption peaks don’t match (different profiles)**

- Summer
- Winter

Generation sites increase locally the voltage whereas consumption sites reduce it.

- Generation can be disturbed thanks to storage

→ Still too expansive
Context:

Enedis and consumers consequences

If nothing is done:

- Chance to damage network installations
- Chance to damage consumers electric appliances
- Chance of power cut increased → reduction of quality of supply

Backflow (generation > consumption on a network)

Inconsequential phenomenon

Possible solutions:

- Traditionnal reinforcement
- Smart Grid solutions

Solutions tested in SMAP to limit network reinforcement cost linked with PV deployment on Les Haies network

Study of rural network is interesting owing to weak consumption during hours where solar generation is important (working persons worked mostly in cities)
2- Goals
Goals:

Project issues

- This demonstrator project targets to facilitate renewable energies in rural area, and for develop and test innovative solutions leaning on the « Centrales Villageoises » from Les Haies village in coherence with territories policy.

- Trials and results will have influence on Smart Grid industrialization methodology.

- The 3 main issues are:
  
  - Optimization of renewable energies development in low voltage electricity network in rural areas without any major impact on networks.
  
  - Improvement of the balance between local consumption flows and local electricity generation.
  
  - Citizen awareness to energy management and change behaviour management accross their active implication for a local project with national and international economic impacts.
Goals:
An organisation view with 3 main dimensions

Facilitate renewable energy development in rural area by testing innovate solutions which could have an influence on smart grid industrialization methodology

A « 3D » project

Network dimension:
- Have a better understanding of the network, with smart equipment
- Better forecast renewable energies development on the network
- Drive the network in accordance with local constraints
- Understand link costs

Community dimension:
- Balance consumption flows and local electricity generation
- Raise awareness among the population

Territory dimension:
- Assist territories (Municipalities community, TEPCV) to better plan renewable energies development to reach their energetic goals
Goals:
Technical solutions simulated and tested in SMAP

Solutions simulated and tested on the network

Inverters control (centralized and decentralized)

Please clic to access to more details

Transformer OLTC

EV use absorption

Phase balancing

In line Power regulator

Please clic to access to more details
Goals:
Some concrete examples of achievements

Behavioral achievements
Data monitoring web portal
« Solar Energy Family » contest

Technical achievements
Voltage regulation and inverters control
Electric Vehicle

Please click to access more details
Goals:
Schedule

Tested solutions

« Solar energy Family » participants will be on another distribution substation than this one where voltage regulation solutions will be tested

Simulated solutions

- Inverters decentralized control
- Inverters centralized control + OLTC
- Transformer OLTC
- Summer FAEP
- Winter FAEP
- EV use absorption
- Profusion
- Heating Transformer
- Parametric Study
- In line Power Regulator

Phase balancing

2016

2018
A flagship project
Visibility in relation to the cooperative model and to the TEPCV

Evidence calls:

• AURA Region (Connected and Digital Territories fair)
• Smart Grids France (Think Smart Grids)
• Smart Energy UK
• International (Energy Globe Awards)
Thank you for your attention

Project contacts
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A- Appendices
Control based on Linky’s data

Control via active power
- Voltage constraint just when generation peak
- Voltage local decrease during a lapse to remove the constraint

Control via reactive power
- \( Q \) according to \( P \) → \( \tan(\phi) \) regulation
- \( Q \) according to \( U \) → \( Q=f(U) \) régulation

3 kinds of control
- Decentralized for 1 producer
- Centralized for 1 producer
- Centralized for n producers
Appendices: Transformer On Load Tap Changer

SMAP characteristics

Control based on Linky’s data

Source: Enedis

Tap change (High Voltage) - Voltage is stabilizing around set value (235V)

Tap change (Low Voltage)

Greenlys example
Appendices:
A schedule split in 3 phases

A project over 3 years

Observation year
- 2016
  - 1st semester 2016
    - Meters installation
  - Autumn
    - Network Instrumentation

Trials year
- 2017
  - Summer 2017
    - Inverters control
    - Electric vehicle

Capitalization
- 2018
  - Winter
    - FAEP contest
  - 2018 Project assessment

Local activities

Studies of network simulations, renewable energies potential analize, etc.

Results

Please clic to access to the presentation
Appendices:
Project bundles

LOT 1 : Project Management

LOT 2 : Communication

LOT 3 : Network
- 3A : Parametric studies – PV Maximization – Reproducibility
- 3B : Network trials - Linky and voltage regulation
- 3C : Production trials – Inverters control
- 3D : « Network » results assessment

LOT 4 : Community
- 4A : Behavioral encouragement plan
- 4B : Counting trials – Data platform
- 4C : Local activities
- 4D : Electric transport
- 4E : « Community » results assessment

LOT 5 : Territory (Assessment and energetic scenarios for Condrieu municipalities community scale and reproducible to the TEPCV)

Please clic to access to the presentation
Appendices:
Technical structure for LV regulation

- Smart Meter Linky
- SMA inverters & Cluster Controller
- Transformer On Load Tap Changer
- Concentrator & ATOS algorithm
- Well working checking
- GPRS
- Modbus
- Data from other substations
- Atos ASGS Grenoble
- Enedis via Simily
- Budget Telecom
- Customer via SMAP&Moi