D3.1.2 Test sites

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Versioning and Authors

Version control

Version	Date	Comments
0.1	26/02/2020	Initial draft
0.2	08/04/2020	German part
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Executive summary

Résumé

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1 Introduction

This deliverable aims at describing first the methodology used to select the test sites for the demonstration of the 7 use cases chosen by the REgions partners, described in deliverable D3.1.1, and secondly, the geographical zones and power plants chosen. It covers the three countries of the project: France, Germany and Austria.

1 Summary of site tests

Despite the local character of site tests inherent to the nature of the ancillary services chosen, the three countries have strong links through the use of the same VPP tool (France and Germany), development of common markets models, shared analysis of the regulatory framework and elaboration of recommendations at the European level.

A summary table of site tests per country is provided below.

Use Case #	Country	Ancillary service	Suggestion for the test	Site test
1	FR	Congestion management (CM)	•Test participation of VPP composed of power plants located on the same high voltage (HV) line to CM based on a simulated constraint signal	Wind and Solar power plants in 6 electrical zones identified in the North and South East of France
2	FR	Voltage Control (VC)	•Evaluate real reactive power constructive capabilities of RE plants participating to the VPP •VPP response to simulated VC constraint	See UC #1
3	DE	Congestion management	•VPP response to simulated constraint •antimetric redispatch	Wind power plants in the Region of Schleswig-Holstein
4	AT	Congestion management (CM)	•improving PV forecast •testing the provision of congestion management service from a pool of PV units	Photovoltaic plants in the Region of Vienna
5	AT	RE Balancing market participation	•Improving forecasting and "nowcasting" of PV in order to fit with prequalification requirements for the provision of aFRR and mFRR	See UC #4
6	AT	Combined revenues from markets	•Analysis of commercialization options	See UC#4
7	FR/ AT / DE	Constrained balancing reserve	•Using an international VPP to solve conflicts between congestion management and balancing.	To be defined: all plants connected to the VPP will be available

2 Description of site tests per country

2.1 France

2.1.1 Selection criteria

The French test sites will participate in UC1 on Congestion Management and UC2 on Voltage Support. The test sites have been chosen by identifying pool of plants in the vicinity of network constraints. In practice, open data was crossed on network topology, network constraints (in the case of the administrative region "Hauts de France"), and plant location. The data sources are :

- Open data national database for production and storage installations, a exhaustive list of all installation connected to the network via any of the DSO/TSO in France (mandatory since 2017)[1] : each plant of power greater than 36kVA is identified individually with its name, the public MV/HV substation it is connected to, and its location at the precision of the municipality (postal code)
- Open data on network topology of the transmission network: all lines and substations are available in GIS format[2]
- Open data on network capacity: installed vRES capacity, vRES capacity in development and remaining hosting capacity are available at the MV/HV substation level. Qualitative data (traffic signal) is also available on the hosting capacity of HV lines[3]
- Open data on congestion of HV lines on the administrative region "Hauts de France": this is an experiment of the national TSO (RTE), thus data is only made available on one region so far[4]
- Private data on the Regions partners production sites.

No open data on the TSO's voltage support needs is available to this date.

The pools had to satisfy the following criteria:

- contains at least two power plants connected to the same high-voltage line (63kV, 90kV), since the aim of the demonstration is to test the provision of ancillary services through aggregation by the virtual power plant
- the power plants should sum to 20MW of installed power minimum per pool
- ideally the selected high-voltage line should be constrained, or at least concerned by a high development of vRES
- the zone should ideally concern more than one MV/HV substations, since several studies have already been made on controlling plants connected to the same MV/HV substation
- there should be at least two demo sites and one of them must combine one wind plant and one photovoltaic plant.

Additionally to these criteria, attention has been brought to the variety of situations (network, production mix, actors, etc.). For illustration, the dispatching of the TSO is organised in regions, which

[1] https://www.data.gouv.fr/en/datasets/registre-national-des-installations-de-production-delectricite-et-de-stockage-en-cours-2019/

[2] https://opendata.reseaux-energies.fr/explore/?refine.keyword=Production&sort=modified

[3] https://capareseau.fr/

[4] https://www.contraintes-reseau-s3renr-rte.com/

correspond more or less to the administrative boundaries, thus selecting demo sites in different regions allows working with different teams. Moreover, most zones combine assets from different operators. In total, four producers are involved: Engie Green (REgions partner), Boralex (non-financed partner), Valeco and Sonnedix. Section 3.1.2 delves further into the added value of each zone in terms of challenges and expected learning.

A dialog was established early on with the TSO RTE and the selection was submitted to its technical approval. RTE has validated each of the demo zones: not all zones are under constraint, but on the other hand, there are no risks associated with a demo in the non-constrained zones. RTE indicates that the DSO Enedis is also experimenting voltage support in the identified zones, and that coordination TSO-DSO will be crucial.

So far, the zones have been attributed a use case. Description identifies the hurdles to implementing one or the other of the two use cases, if need be.

2.1.2 Selected sites

Six demonstration zones have been selected as priority at the moment of writing this deliverable. All six zones concern the use of wind and solar plants in participating to redispatch as a way to tackle congestion and voltage support in order to lower voltage overshoot constraints. They are described in details below. Storage has only been marginally integrated (Lodeve-Bedarieux). Participation of industrial demand response in coordination with vRES is still being studied and, if integrated, will form a seventh demo zone.

Each zone is identified by the name of the administrative region (e.g. Hauts-de-France) and the name of the substation(s) in quotation marks.

2.1.2.1 Zone 1: Hauts-de-France "Mohet-Transloy"

The first zone is located in the northern region of France, characterized by a very strong wind park development. The zone covers the public MV/HV substation « Mohet », operated by the DSO « Gazélec »[5], and a private substation MV/HV called « Le Transloy » operated by the producer Boralex. Four wind plants would participate to this demo, cumulating 71MW of power. They are operated by the producers Engie Green and Boralex. Engie Green plants are already connected to the VPP.

The TSO's analysis of medium-term congestion shows a congestion on the line which would be relieved by a 14MW curtailement (see Figure below). RTE also identified the role of the two aforementionned substations : Le Transloy has a sensitivity of -51%, meaning that every MW curtailed at this connecting point will alleviate the constraint by 0,5MW, while Mohet participates at -17%.

Integrating these sensitivity factors and the production power connected to the substations could mean a 47% curtailment of power (-33MW on the pool) in order to reach the -14MW requested by the TSO, at the peak of the constraint. The demonstration will allow confronting the theoretical studies with real-life conditions and measurements.

[5] Gazélec is one of the 150 small DSOs covering 5% of the territory. Enedis covers 95% of the territory.

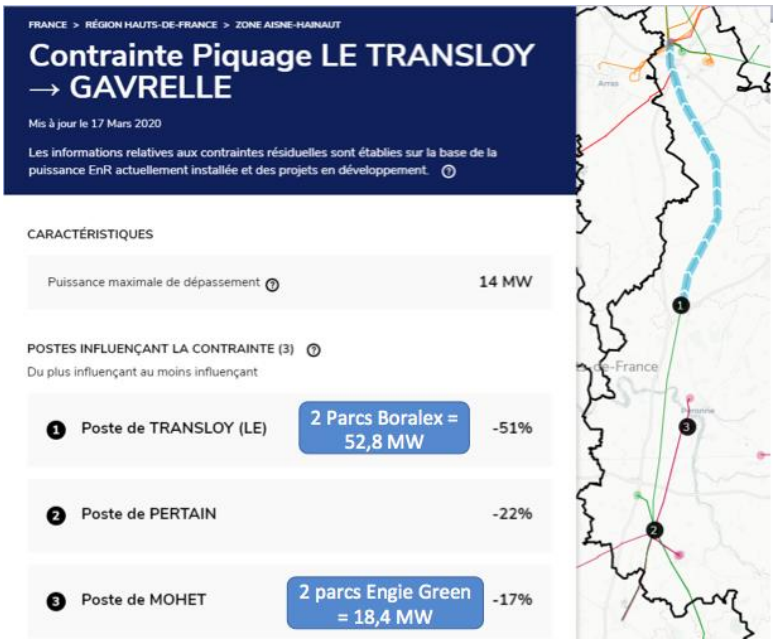

Figure 1. Map showing a constrained HV lines. Data on the side showed the sensitivity of the different substation to the constraint. Source : RTE,https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/https://www.contraintes-reseau-s3renr-rte.com/

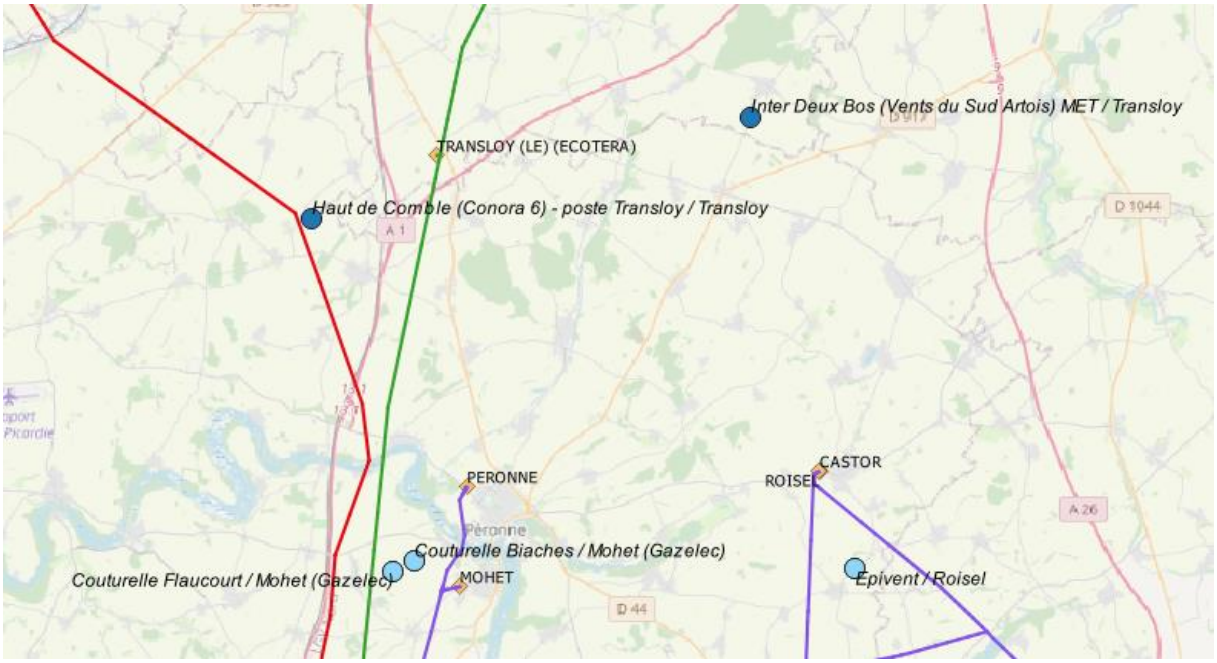

Figure 2. Map showing the location of the four wind plants. Source : Engie Green, Boralex.

2.1.2.2 Zone 2: Occitanie "Lodeve-Bedarieux"

This zone is in located in the southern region of France, Occitanie, which is also the first region to declare a political intention of becoming Energy-positive. The zone covers the public MV/HV substations of Lodeve and Bedarieux, both operated by the DSO Enedis. Two wind plants operated by

Engie Green and three photovoltaic plants operated by producers Engie Green and Valeco would participate in the demonstration, cumulating 42MW of power (20,7 of wind). One of the photovoltaic plant is equipped with a 60kW battery, which is already part of experiment on primary reserve, and may be used in the demo. This is the one of the six zones that presents a mix of wind and photovoltaics.

According to open data, the 63kV- HV line connecting the public MV/HV substations of Lodeve and Bedarieux is constrained. However, no thorough analysis has been realised so far by RTE to identify neither the level of the constraint nor the sensitivity of the different substations.

Challenge #1 : Reactive power absorption

The specificity of the two photovoltaic plants connected to Lodeve substation is that the plants already provide consequent voltage support to the DSO Enedis, as part of the technical requirements for plant connexion. In addition, the two plants are connected on mixed feeders (shared with other network users) and therefore technical verification by the DSO Enedis that further reactive power absorption does not represent a risk for power quality will be crucial. Thus, reactive power absorption beyond current practice may be limited due to the technical capacities of the power plant and/or the grid, although this should not prevent from experimenting congestion management.

Challenge #2: Connecting PV plants

The risk of not being able to connect the plants to the VPP is limited since the VPP is compatible with two well-known open protocols, one of which is now commonly used in PV: Modbus TCP. If the site needs nevertheless a retrofit, the partners have experience with the architecture developed in the previous ERA-NET project, REstable, and may deploy it on site.

The risk that the third party Valeco ends up not participating in the demo is limited since two photovoltaic plants from Engie Green participate.

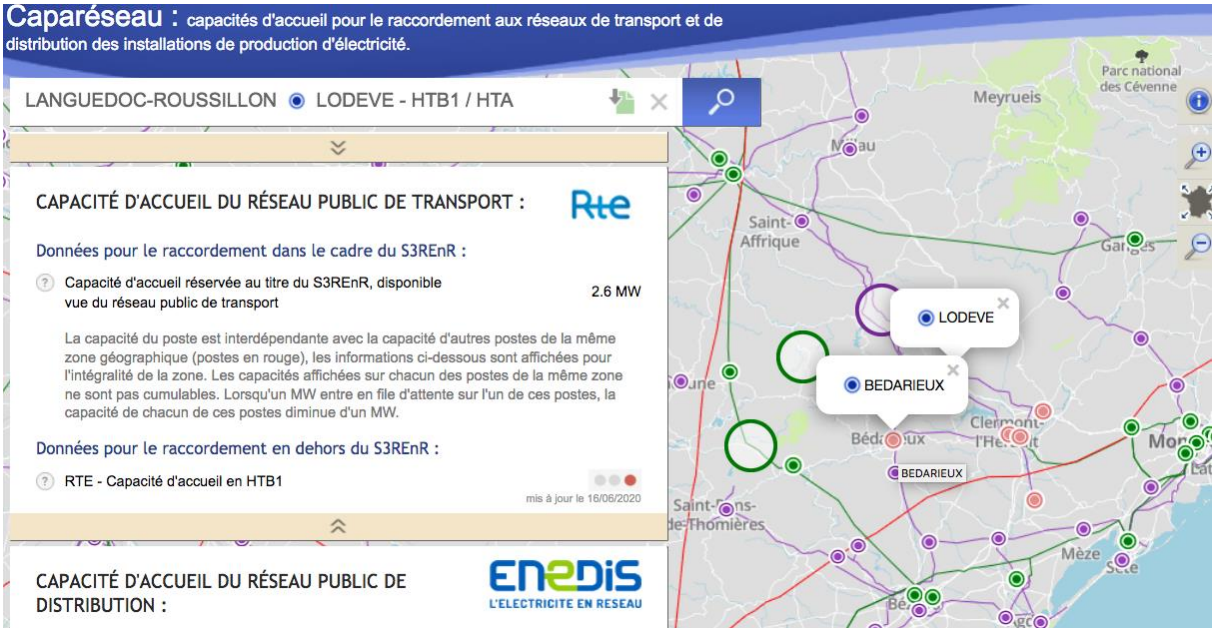

Figure 3. Open data showing a constraint on the 63kV line connecting Lodeve MV/HV substation. Source: RTE, https://capareseau.frhttps://capareseau.frhttps://capareseau.frhttps://capareseau.fr

2.1.2.3 Zone 3: Provence-Alpes-Côte d'Azur (PACA) "Saint-Auban"

This zone is in located in the southern region of France, Provence-Alpes-Côte d'Azur (PACA). The zone covers the public MV/HV substation of Saint-Auban operated by the DSO Enedis. Eleven PV plants operated by producers Boralex and Sonnedix are identified, cumulating 49MW. Not all 11 plants are expected to participate. Priority will be given according to the level of retrofit needed to connect to the VPP. Boralex's plant is already connected to the VPP.

According to open data, the 63kV - HV line is constrained and there is a high PV development in the zone. However, no thorough analysis has been realised so far by RTE to identify neither the level of the constraint nor the sensitivity of the different substations.

The comment on the challenge to connect the other PV plants made in the previous section also applies here.

Figure 4. Open data showing a constraint on the 63kV line connecting Lodeve MV/HV substation. Source: RTE, https://capareseau.fr

2.1.2.4 Zone 4: Hauts-de-France "Roisel- Ham-Beautor"

This zone is in located in the northern region of France, Hauts-de-France. The zone covers three public MV/HV substations, Roisel, Ham and Beautor, all operated by the DSO Enedis. Two wind plants operated by Engie Green and one operated by Boralex would participate in the demonstration, cumulating 32MW of power. The two Engie Green wind parks are already connected to the VPP.

According to open data, there are two constrained HV lines in the area: one connecting substation Roisel and Gauchy and one connecting Beautor and Manoise. In both, the substation Ham could play a role to alleviate the constraint. Thus, discussion with RTE will be needed to understand how the two constraints are connected in order to define coherent set points.

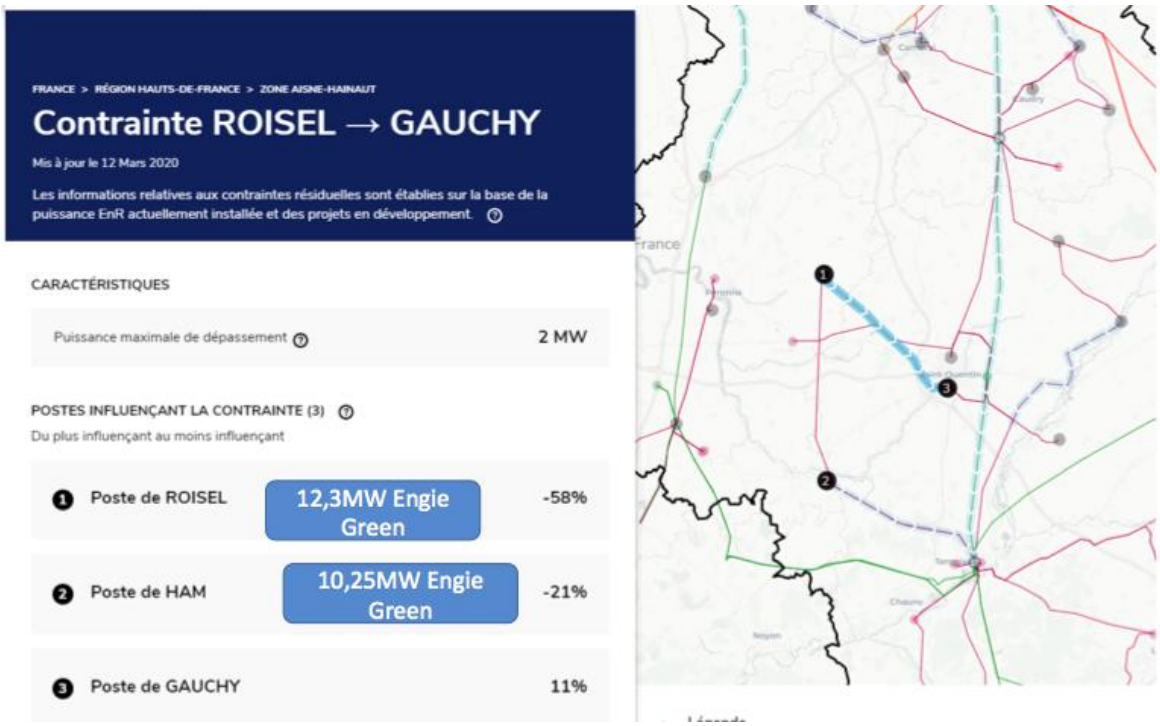

Figure 5. Map showing a constrained HV line. Data on the side showed the sensitivity of the different substation to the constraint. Source : RTE, https://www.contraintes-reseau-s3renr-rte.com/

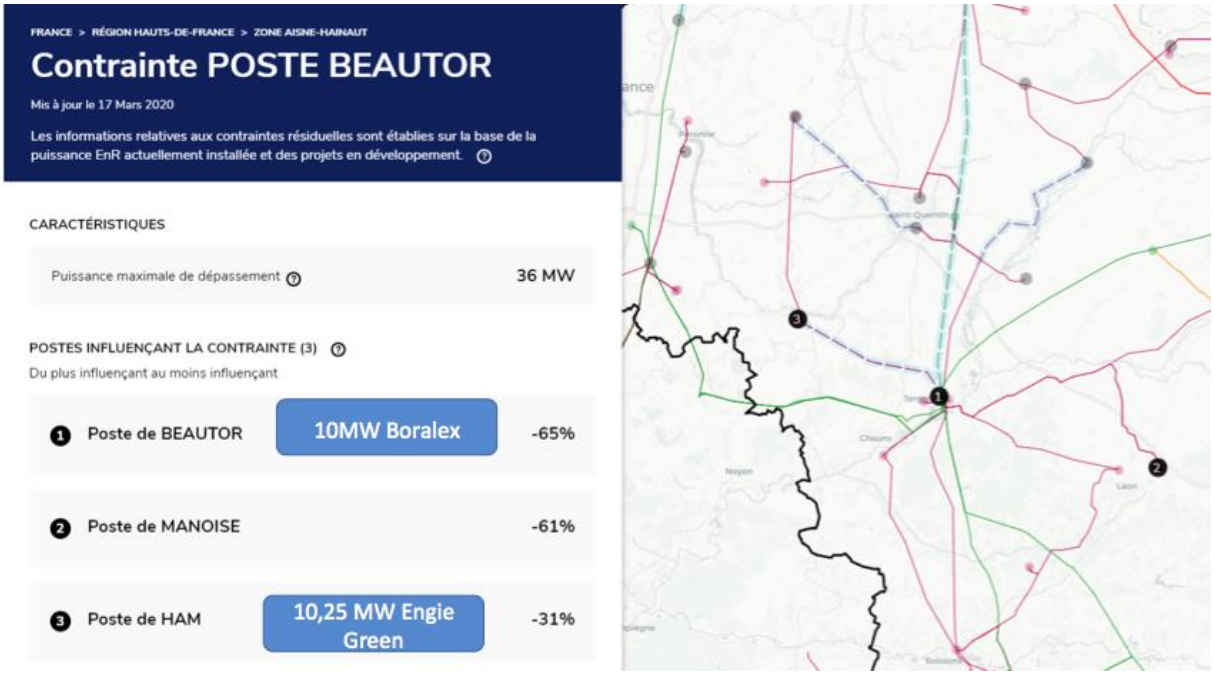

Figure 6. Map showing a constrained HV line. Data on the side showed the sensitivity of the different substation to the constraint. Source : RTE, https://www.contraintes-reseau-s3renr-rte.com/

2.1.2.5 Zone 5: Auvergne-Rhône-Alpes (AuRA) "Langogne-Palisse-Praclaux"

This zone is in located in the center region of France, AuRA. The zone covers three public MV/HV substations, Langogne, Palisse and Pratclaux, all operated by the DSO Enedis. Three wind plants

operated by Boralex and one operated by Valeco would participate in the demonstration, cumulating 63MW of power.

According to exchange with RTE, the zone is constrained, which also shows on the map below. This zone is characterized by issues of voltage overshoot. Thus the demo site may be used in priority for use case 2 on voltage support.

The risk that the third party Valeco ends up not participating in the demo is limited since three other plants from Boralex are in capacity to participate.

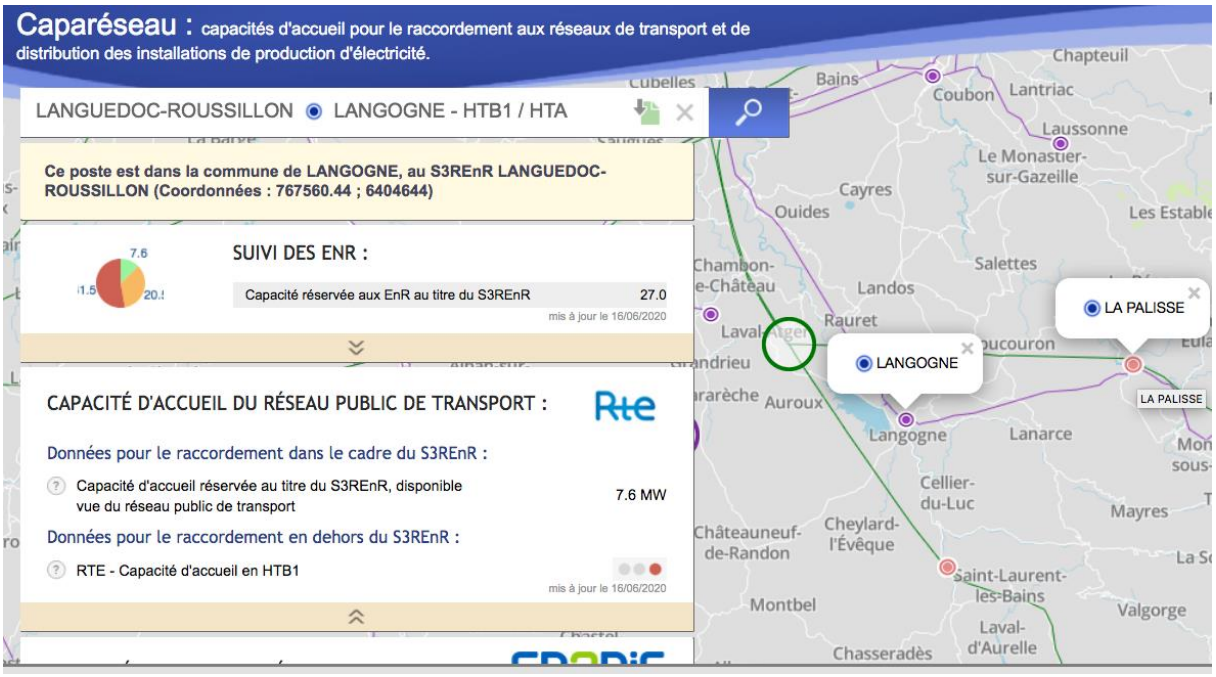

Figure 7. Open data showing a constraint on the 63kV line connecting Lodeve MV/HV substation. Source: RTE, https://capareseau.fr

2.1.2.6 Zone 6: Hauts-de-France "Saucourt-Rue"

This zone is in located in the northern region of France, Hauts-de-France. The zone covers two public MV/HV substations, Saucourt and Rue, both operated by the DSO Enedis. Five wind plants operated by Boralex and Engie Green would participate in the demonstration, cumulating 53MW of power.

2.1.2.7 According to exchange with RTE, the zone is not constrained despite the high wind park development in the area. Nevertheless, demonstration in this zone remains valuable to show the capacity of vRES to contribute to congestion management. Synthesis

Verifications on the technical compatibility of the plants with the demonstration (communication with the Fraunhofer IEE's VPP and control capabilities on site) are still underway, but several signals point to great chances of success. The table below present a summary of the zone and the level of confidence for successful VPP connection, according to the following criteria:

- All plant already connected to the VPP: 100%
- All plants from external producers' plants (Valeco and Sonnedix): 50%.
- Enercon plants no yet verified in terms of controllability on site: 90%
- Vestas and Senvion plants: 80% (the VPP has a direct connection to the webservice of these manufcaturers and experience with them)

- PV plants for which analysis of the technical solution is still under way: 70%.

Substations	vRES installed capacity to participate in the demo	Level of confidence for successful VPP connection
Mohet-Transloy	71 MW	90%
Lodeve-Bedarieux	20,7MW 21,3 MW	73%
Saint-Auban	49 MW	75%
Roisel-Ham-Beautor	32 MW	93%
Langogne-La Palisse-Pratclaux	63 MW	73%
Saucourt-Rue	53 MW	93%

2.1.3 Further investigation

The 130 kWh/60kW Lithium-ion battery system installed in one of Engie Green's PV Site could offer possibilities for investigate the potential of Storage for Congestion and Voltage management. Indeed, the possibility to use battery storage in "upward" flow (injecting) is very interesting and complementary to the "downward" (curtailment) performance of solar and wind farms.

However, the small capacity of the installation (only 60kW) is a challenge. REgions partners still have to figure out about a way to use this installation, through scale-up models for example, and to be able to produce valuable results with such a small capacity. Therefore, the installation might participate directly to the experimentation or might be only studied separately with simulations.

These studies could then simulate the use of a "utility-scale" battery storage cloning the performance and real behaviour of the storage.

At the moment, such investigation still has to be done by REgions partners, but the existence of this installation in zone #3, which is a multisource producing zone (solar and wind) is promising.

2.2 Germany

More information about the German test sites will be provided in https://www.regions-project.info/results/, D6.3 “Results of RES partcipation in flexibility market (German proof-of-concept)”.

2.2.1 Selection criteria

The German test sites will participate in the German use case “RE participation in the redispatch process in Northern Germany” (UC3) and the international use case “Collateralisation of balancing reserve during congestion (Combining congestion management and reserves)“ (UC7). See deliverable D3.1.1 for more information on the use cases.

The criteria for the selection of the German test sites for UC3 are as follows:

1. Redispatch processes apply by definition to the extra-high voltage level.
2. The project focusses on renewable energies.
3. Wind energy is the renewable energy that has by far the greatest impact on grid congestions at the extra-high voltage level.
4. Schleswig-Holstein is the German federal state with by far the most grid congestions at the extra-high voltage level that can be impacted by wind energy over the last few years.
5. The concept of the antimetric REdispatch of UC3 (see deliverable D3.1.1) requires at least two power plants separated by a grid congestion. It should be noted that a hard separation is not clearly possible in most cases, because of the meshed grid topology.
6. To keep the workload within the limits, power plants already integrated in the IEE.vpp (e.g. power plants of previous projects such as Kombikraftwerk or REstable) should be selected.
7. The power plants need to be managed from the operator’s point of view, i.e. ARGE Netz.
8. The power plants should be manufactured by Enercon in order to use existing interface drivers and to be able to coordinate with the project partner for the use case. This allows to get a more up to date or adapted SCADA version for the test within the project.

In summary, at least two wind farms should be selected for UC3 which are already integrated into the IEE.vpp, which are managed by ARGE Netz or Enercon, which are located in Schleswig-Holstein, which are often separated from each other by grid congestions in the extra-high voltage level and of which at least one has a noticeable impact on the grid congestions.

The criteria for the selection of the German test sites for UC7 are as follows:

1. The project focusses on renewable energies.
2. The power plant should frequently be subject of measures to relieve grid congestions (curtailment).
3. The power plant should be capable to offer and provide balancing reserve.
4. To keep the workload within the limits, a power plant that is already integrated in the IEE.vpp should be selected.
5. To keep the workload low, it is preferable to select a power plant that is already part of UC3.

In addition to these criteria the criteria 7. and 8. for UC3 must be met.

In summary, for UC7 at least one renewable power plant should be selected that is already integrated into the IEE.vpp, that is managed by ARGE Netz or Enercon, that is preferably also part of UC3, that is

often curtailed to relieve grid congestions and that should be capable to offer and provide balancing reserve.

2.2.2 Selected sites

A description of the selected sites of UC3 and the German site of UC7 will be provided in https://www.regions-project.info/results/, D6.3 “Results of RES partcipation in flexibility market (German proof-of-concept)”.

2.3 Austria

2.3.1 Selection criteria

The Austrian test sites will participate in Use Case 4 “Redispatch with PV in Austria”, Use Case 5 “PV participation in balancing market in Austria” and Use Case 6 “Combined value streams for PV systems from wholesale markets and ancillary service provision – Austria”. Beside the Austrian Use cases the sites will participate in the international Use Case 7 “Collateralisation of balancing reserve during congestion (Combining congestion management and reserves)“ (UC7). See deliverable D3.1.1 for more information on the use cases.

The criteria for the site selection is described as followed:

1. Project focuses on renewable energies and especially on photovoltaics in the Austrian Use Cases.
2. Regional focus is on Vienna and the surrounding area, in order to keep distances to the site short. All Austrian project participants are located in Vienna.
3. Additional measuring equipment is installed at the plant. The space and a power supply required for the control cabinet must be available.
4. All regulatory requirements for the installation of measuring equipment must be observed.
5. The installed fish-eye camera has to have a clear view to the sky. Freestanding sites with no buildings, trees or other obstacles around them, are preferred.
6. Three cloud cameras will be installed in Vienna. One each at AIT, BOKU and the test site. The test site is chosen to form a large triangle with the other locations. The geometric shape is considered in the analysis algorithms.
7. Historical data of the site are required.
8. The test plant should be capable to offer and provide balancing reserve. The inverters have to be controllable within a defined reaction time.
9. To avoid any approval processes by third parties, the plant should be operated and owned by Wien Energie.
10. To keep the workload low, it is preferable to select a power plant for UC7 that is already part of the other Use Cases.

2.3.2 Selected sites

The following map shows the mentioned triangle with the selected site. The site is located in Bisamberg, in the north of Vienna, near the city boarder and is a direct feeder without subsidies.

The plant is not yet integrated into the IEE.vpp. Apart from that point, all criteria from before are met.

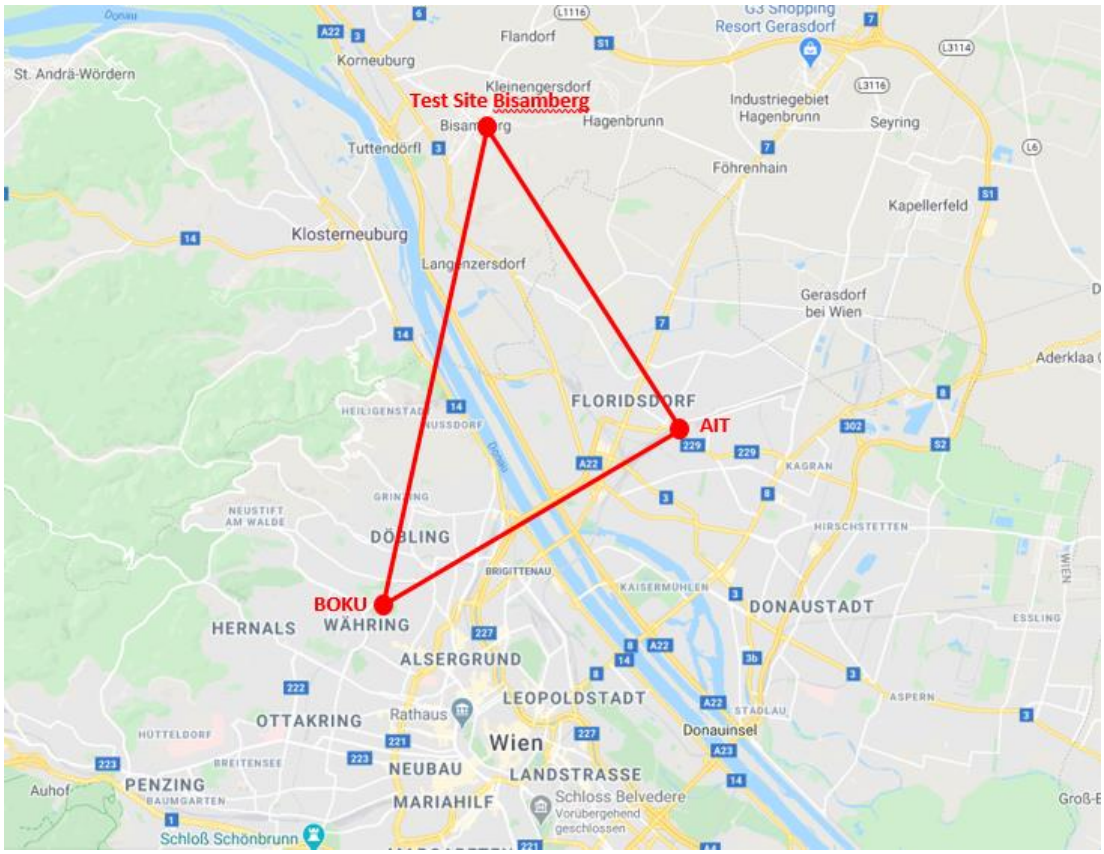

Figure 8 : Map with selected PV test site and the resulting triangle

Site information:

- Open space PV plant
- Address: Flandorferstraße 28
- Location: 2102, Bisamberg
- Longitude: 16,37228
- Latitude: 48,34515
- Installation: 2015
- Installed capacity: 348,44 kWp
- Installed inverters: 7
- Number of PV modules: 2403
- Azimuth: 0° → south
- Inclination: 25°

3 Conclusion

The selection provided here in this first version of the deliverable is not definitive: it is to be updated following the work progress of the implementation of the information and communication technology (ICT) architecture (WP5). Indeed, although many verifications have already been done, the technical evaluation of the power plants' compatibility with the virtual power plant (VPP) is still ongoing.