



Lyon Confluence: satellite data support solar energy production in a sustainable new city quarter

THE USER

SPL Lyon Confluence

Lyon, France

www.lyon-confluence.fr

KEY FACTS

The satellite-based solution costs 1% of the value of the energy annually produced (approx. EUR 125,000)

Operating and maintaining the installations without the satellite solution would cost the double, requiring at least one working hour per day on each installation

It would take several days to spot malfunctioning that is instantly detected by the system

Since 2009, the Lyon Confluence district has relied on satellite-based data to monitor photovoltaic (PV) panels.

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"Satellite-data enabled Lyon Confluence to find an easy way to daily monitor PV installations remotely and at reasonable cost as compared to the energy output"

Maxime Valentin, Lyon Confluence

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The context

In the European Union, buildings account for 40 % of the total energy consumption and for 33% of CO₂ emissions. 70% of the EU's energy consumption and a similar share of greenhouse gas emissions take place in cities (Ref. 4).

To try to reduce the impact of CO₂ emissions on the environment and on health in cities, in 2005 the European Commission's Directorate General for Energy launched the Concerto initiative (www.concerto.eu), aimed at demonstrating that energy-optimisation of districts and communities as a whole is more cost-effective than optimising each building individually; the condition for this optimisation being that all relevant stakeholders work together to integrate technologies in a smart, efficient way (Ref. 4).

Within the 6th European Research Framework Programme (FP6), and with a budget of over EUR 175 million, Concerto funded 22 projects, comprising 58 communities and sites, in 23 European countries, allowing for the creation of a large database on energy-optimisation (Ref. 4).

The Concerto initiative has now been completed. The successor programme, "Smart Cities and Communities Information Systems" is expected to start in November 2014 (Ref. 4).

These funding schemes are supported, at the political level, by the "Europe 2020 strategy for

smart, sustainable and inclusive growth" (Ref. 10), adopted in 2010 and setting the so-called 20/20/20 EU targets of the climate and energy package (Ref. 9). These aim for a reduction of greenhouse gas emissions of at least 20% below 1990 levels, and for an improvement of energy efficiency leading to a decrease in primary energy use of 20%. Moreover, by 2020 20% of final energy consumption should come from renewable sources.

The Covenant of Mayors (Ref. 5), joined by 3,700 local authorities by March 2011, has committed to go even beyond these targets (Ref. 19).

The SPL Lyon Confluence

With an area of 52,715 ha at the earth of the French Rhône-Alpes region, and a population of 1.2 million spread among 58 municipalities, the Urban Community of Lyon is the second largest agglomeration in France.

The SPL (Local Public Society) Lyon Confluence is the local public-redevelopment entity created in 1999 by Grand-Lyon to manage the Lyon Confluence initiative, a major urban project of requalification of the Confluence neighbourhood.

The area, covering 150 hectares near the historic centre of Lyon, has been long devoted to manufacturing and transport activities. Isolated from the rest of the city by the Lyon-Perrache railway station and the highway, the neighbourhood has been long characterised by poor living conditions.

Since 1997, the Lyon authorities have been studying a strategy to double the size of the city centre by upgrading this area.

The initiative includes the requalification of factories and dismissed buildings to create apartments and offices. The new Confluence neighbourhood includes a commercial centre, a museum, and the Rhône-Alpes Region offices, among other facilities, and it should attract

10,000 more residents, bringing the population to 17,000, and create 20,000 new jobs by 2030 (Ref. 24).

Key facts on the SPL Lyon Confluence

Nature	Public
Area of operation	Local
Sources of budget	Local public funds EU funds
Annual budget	€15.7m in 2012 (Ref. 23)
N° staff	23 (regular staff)

With a staff of 23, and a share capital of EUR 1,800,000 in 2012 (89% of which are held by Grand Lyon), the SPL Lyon Confluence is a public development organisation with extensive experience in urban development.

It is mandated to manage all activities related with the requalification of the Lyon Confluence site, including:

- Performing all studies prior to redevelopment and construction operations;
- Conducting all acquisitions of buildings or unbuilt-on plots;
- Drawing up all contracts and agreements in order to control land and sales of land to third parties for construction purposes;
- Conducting all necessary studies and financial, commercial, industrial and property operations;
- Conducting/commissioning the operation, management, maintenance and enhancement of public infrastructures; and
- Promoting the Lyon Confluence initiative (Ref. 16).

Indeed, reclaimed from the waters in centuries past, this riverside site is re-embracing its banks and natural environment. The redevelopment is

gradually highlighting an outstanding location and unique landscapes. This project represents a pioneer experience in Europe, a major challenge for the metropolitan area, and an opportunity for its residents (Ref. 15).

Previous knowledge of satellite services

The staff of the SPL Lyon Confluence has experience in urban development and project management.

The entity has no internal expertise or prior experiences working with satellite services.

The challenge

Under the Concerto framework, the urban agglomerations of Zaragoza (Spain), and Lyon started in 2005 the Renaissance project “Renewable Energy Acting In SuSustainable And Novel Community Enterprises” (today completed) aimed to create smart, environmentally friendly neighbourhoods. The Region of Lombardy (Italy) took also part in the project as an observer partner (Ref. 3).

In total, 19 organisations participated in this project, involving a large range of diverse stakeholders, from local authorities to technical and socio-economical experts, non-profit organisations, universities, energy services companies and real-estate developers.

In Lyon, the Renaissance project aimed at creating a group of energy efficient buildings in the Confluence neighbourhood. The construction took place between 2007 and 2010 on a floor area of 79,000 m² and was implemented by three real estate developers (Ref. 8).

The goal of the project was to build a neighbourhood in which 80% of heating and 50% of electric consumption in common areas of housing buildings, and 30% of electricity produced for air conditioning in office buildings come from renewable sources of energy.

Solar was among the green energy sources chosen. The implementation of a photovoltaic (PV) system presented two challenges:

- first, it was necessary to select the location of the PV systems to maximise the potential of the installations;
- then, a monitoring system had to be implemented to monitor their correct functioning.

Alternatives to the satellite service

The biggest challenge for the project partners was to find a way to monitor the different PV systems with little investments, both in terms of time and of human and economic resources.

In effect, although PV is a reliable technology with little maintenance needs, experience of large urban scale projects installed in Europe shows that when large numbers of small photovoltaic (PV) systems are installed on buildings in urban areas and then left for ordinary building occupants to operate with no or little professional support, this can lead to loss of performance in the longer term (Ref. 19, p. 45).

As noted in final report of the Renaissance project, although there are good products suited for single PV systems on the market, there was no product available for monitoring a large group of technically non-homogenous PV systems in an easy, time-effective and convenient way (Ref. 19, p. 45).

It was hence necessary to build an innovative, comprehensive monitoring system for the whole group of panels.

This system had to be compatible with all kind of inverters, include a single platform to monitor a large group of PV systems, automatically detect any kind of failure, and generate an alarm to the PV owner in case of failure.

The Satellite-based Solution

The implementation

Key facts on the implementation

Implementation framework	Demonstration project (6th European Research Framework Programme - FP6)
User's economic contribution	External funding (EU funds) < €20k in 2009 < 1% of annual budget in 2009
Partners	SPL Lyon-Confluence HESPUL Local Agency on Energy of Greater-Lyon (ALE) Engineer Office ENERTECH Centre for thermal energy of Lyon (INSA-CETHIL) Nexity-Apollonia (LOT A) Bouwfonds-Marignan (LOT B) ING Real Estate - Atemi (LOT C)

To comply with the project objectives, in addition to wood chip boilers and solar thermal systems, 11 PV systems have been installed in the Confluence neighbourhood for a total power of approximately 250 kWp.

The assessment of the energy potential and the implementation of a PV monitoring tool were entrusted to Hespul, a local association with experience in renewable energy development and energy efficiency, which was also part of the Renaissance project consortium.

Based on data extracted from satellite imagery, Hespul analysed solar radiations to a) assess the potential energy output of the panels in their location, and b) monitor the proper functioning of the installations by comparing the energy potential of a solar panel with its actual output.

Service availability and procurement

On the one hand, the initial assessment of the energy potential of the installations was performed using the satellite-based data provided free by the EC Joint Research Centre (JRC), in Italy.

Hence, implementation costs for the solar potential assessment could be limited to less than EUR 20,000, mainly represented by the cost of human resources.

The result is a solar cadastre showing the potential energy output of the 11 PV systems installed in Lyon Confluence.

On the other hand, monitoring the installation required the creation of a software to compare the actual output of the PV systems with their energy potential automatically and remotely.

Meteotest (www.meteotest.ch), a company specialised in meteorology, environment and information technology, had developed a software integrating satellite-based data to monitor single PV installations. Hespul decided to capitalise on this tool to produce an improved version of the software which would monitor different PV systems at once.

The software produced, EPICES (www.epices-energie.fr), gives an overview of the good operation of all PV systems of this district, showing the energy output of each installation. The PV system monitoring tool for the Confluence district is online and can be accessed here: www.renaissance-project.eu/spip.php?article208&lang=en

Organisational aspects

EPICES, the software created to monitor PV panels remotely was first tested by Hespul in 2009 on a 13 kWp existing PV system, in order to assess the level of complexity to install such a system, the reliability of data transfer by GSM and

also the sensitiveness of the automatic failure detection algorithm.

As the conclusion of this experiment was quite promising, the software was further developed and installed on all PV systems within the Renaissance project in Lyon. In 2011, a first version of the improved software was made available (Ref. 19, p. 45).

Implementation challenges

Technical

No technical challenges were faced by the SPL Lyon Confluence, since both the solar potential assessment and the software to monitor the PV systems were implemented by Hespul.

Economic

The costs to implement the solar power assessment and the PV monitoring system were funded through the Renaissance budget and they did not represent a challenge for the SPL Lyon Confluence.

Material

Hespul faced material challenges in improving the pre-existing Meteotest software to monitor a large number of solar installations.

Organisational

Hespul was known by SPL Lyon Confluence, which trusted its capabilities. Hence, there was no internal resistance to use satellite-based data to perform the power assessment and then monitor the installations. No organisational changes were needed within the SPL Lyon Confluence to implement the system.

Operating the system

The satellite based system allows users to compare the estimated hourly output of each PV panel with actual production data. This comparison is performed every hour using satellite imagery provided by Meteotest. In case

of difference, an alert is sent to one of the project participants so that the faulty PV system can be repaired as soon as possible.

The power potential assessment and the monitoring of the installations were first funded under the Concerto/Renaissance project. Today, Hespul continues monitoring the PV systems within the framework of a new EU-funded project, "Lyon Smart Community" (Ref. 17), involving NEDO (New Energy and Industrial Technology Development Organization, Japan) and aiming at testing the economic feasibility of a smart-grid energy network in the Confluence neighbourhood (Ref. 1). In 2016, when this project will also be completed, new funding schemes will have to be evaluated to ensure service continuity.

Key facts on the operation of the satellite solution

User's economic contribution	Free of charge during the demonstration project. After project completion: Approx. €1,500 per year for 10 installations (2013) < 1% of annual budget in 2013
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Operational challenges

Economic

No challenge has been encountered so far by the SPL Lyon Confluence to contract the services of Hespul.

Operational

Since the monitoring of the installations is performed by Hespul, no technical difficulties are encountered by the SPL Lyon Confluence and no training is needed by their staff for the service to be operated. It is nevertheless important to underline that the monitoring system is more likely to be compatible with the PV installations if the decision to connect a PV system to the urban scale PV monitoring tool is taken at the time of designing and installing the PV system itself.

Sustainability

To ensure service continuity after 2016, PV owners could pay a fee to continue its services. This fee should not constitute an economic challenge, compared to the annual outputs of the PV system.

Benefits of the satellite-based solution

Service efficiency and provision

Thanks to satellite data, all PV systems of the CONCERTO Renaissance installed in the Lyon-Confluence are controlled each day to make sure that they operate properly and that malfunction is detected very quickly.

The tool monitors all the 11 PV panels everyday with daily performance available on one single Internet website. It detects automatically any kinds of malfunctioning and it is easy to use (Ref. 19, p. 46).

It would take normally several days of site inspections to detect malfunctioning which is automatically spotted with the satellite-based solution.

Cost-benefit

The PV installations (2,000 m² of solar panels) produce 250 kw per hour, for an annual production of approximately EUR 125,000 at the current cost of electricity.

Therefore, the cost of using the satellite-based monitoring system corresponds to only 1% of the value of the energy annually produced, and it is expected to decrease thanks to service improvements.

Indeed, the satellite-based solution entails savings both in terms of money and time to monitor the solar panels. Hespul estimates that to operate and maintain the installations without

the satellite-based solution, it would cost approximately the double, requiring at least one hour of work per day on each installation.

Overall, the Confluence initiative shows that drastic reductions in conventional energy consumption (up to 70%) are achievable at reasonable costs and acceptable financial risks on energy saving investments (Ref. 3).

Society and the environment

The software makes solar-panel monitoring less costly and more attractive to producers interested in building large solar fields, therefore encouraging the reduction of the carbon footprint.

The Renaissance project demonstrated that practical solutions to local energy needs, applied in highly innovative ways, have a large and immediate potential for replication across the rest of Europe, paving the way towards Post-Carbon Cities (Ref. 3).

Other benefits

Immediately after the installation of the solar equipment in the neighbourhood of Lyon Confluence, the Region of Rhône-Alpes contracted Hespul to assess the potential of and to monitor solar installations on the roof of their premises. A user manual has also been provided to the Region, for them to autonomously monitor the correct functioning of the installations.

The use of the system by Lyon Confluence also inspired other public or private organisations all around Europe. Indeed, capitalising on its experience in Lyon Confluence, EPICES, the tool developed by Hespul, is used to monitor today several PV fields in France, Belgium and Switzerland, among others.

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