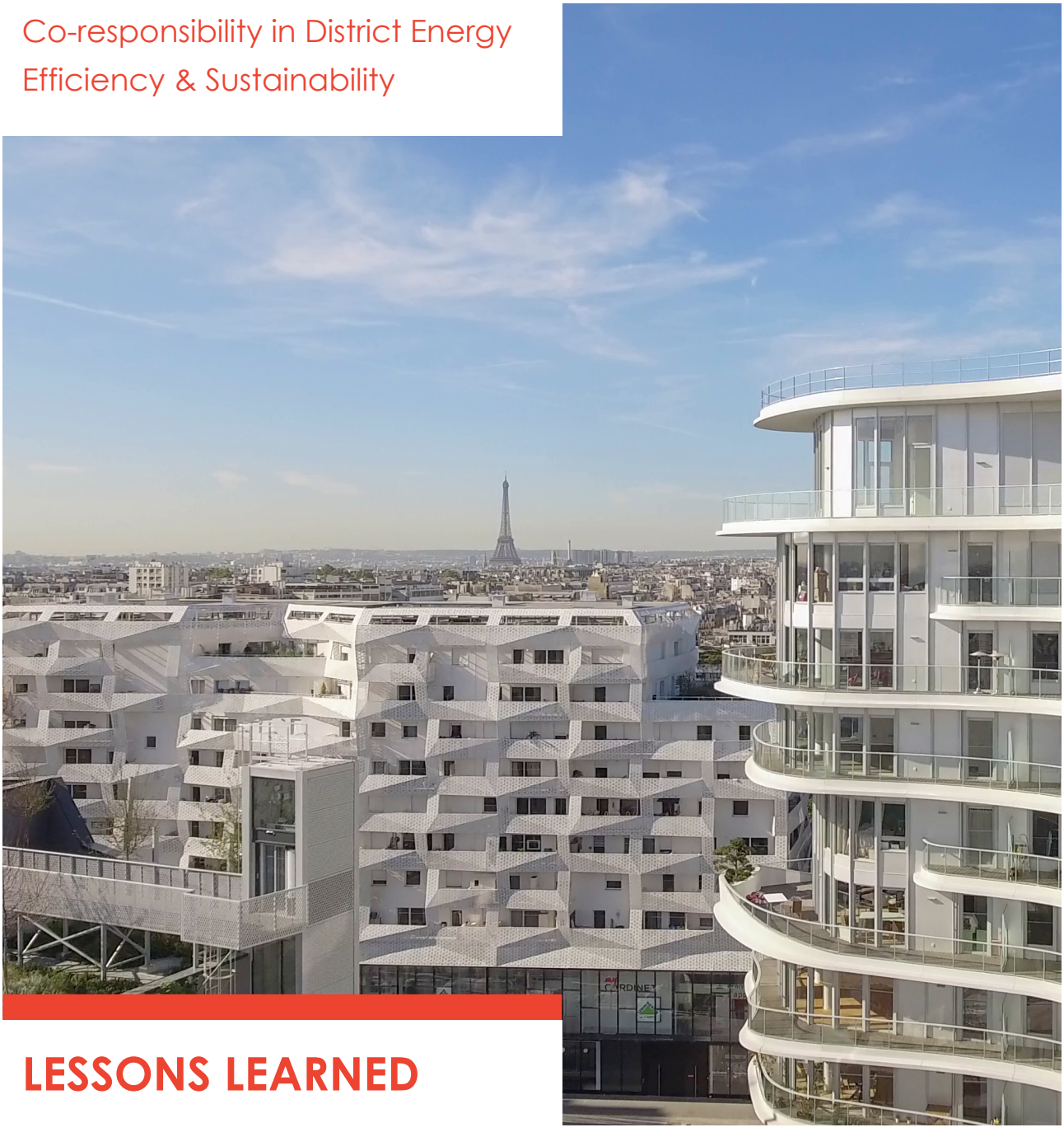
CoRDEES
Co Responsibility in District Energy Efficiency and Sustainability

Projet CoRDEES

Co-responsibility in District Energy Efficiency & Sustainability



LESSONS LEARNED

October 2019

UIA URBAN INNOVATIVE ACTIONS

EUROPEAN UNION
European Regional Development Fund

CoRDEES Consortium partners

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CoRDEES, which stands for Co-Responsibility in District Energy Efficiency and Sustainability, is a full-scale pilot project in the West sector of the Clichy-Batignolles eco-district in the 17th *arrondissement* of Paris.

Led by the City of Paris with its partners, the CoRDEES project was funded by the European Union as part of Urban Innovative Actions (UIA) for three years until 31 October 2019.

The work started will continue within a partnership now being created

UIA URBAN INNOVATIVE ACTIONS
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CONTENTS

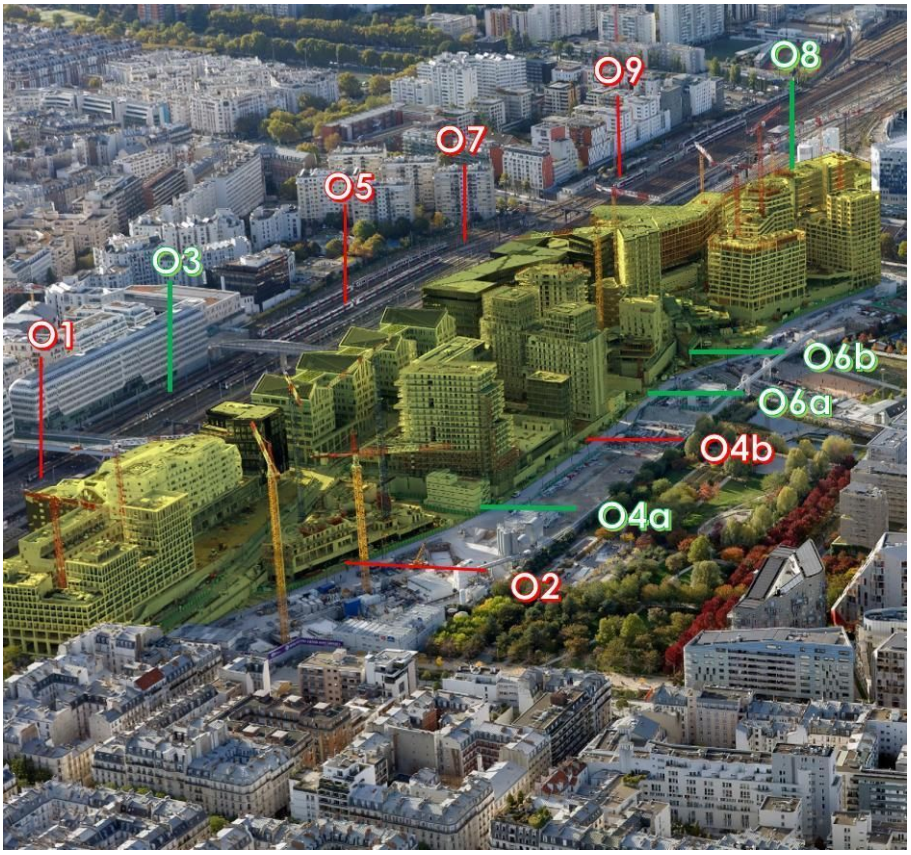
I OBJECTIVES OF THE CORDEES PROJECT

The district

The Clichy-Batignolles eco-district receives its heat from a dedicated local geothermal power plant supported by the Paris urban heating network, which provides additional heat when needed. The facility was created and is operated jointly by the Paris water company, Eau de Paris, and the Paris urban heating company, Compagnie Parisienne de Chauffage Urbain (CPCU). It aims to provide heat and domestic hot water to buildings through **85% renewable** energy, including geothermal energy production.

The district also produces power through its solar panels.

The energy performance targets are ambitious: the buildings must not consume more **50 kWh/sq. m/year** in primary energy for defined purposes (heating, hot water, lighting and ventilation).



The CoRDEES project covers the West sector of the eco-district, with about **200,000 sq. m** of floor area divided into 12 plots further cut into 50 real estate entities for various uses (housing units, offices, retail, public and leisure facilities and others).

Experience

The CoRDEES project is jointly supported by the City of Paris, the planning authority Paris & Métropole Aménagement, the companies EMBIX and Une autre ville, and the engineering school MINES ParisTech via CES, its research centre for energy efficiency of systems.

The project ran **between May 2017 and October 2019,** simultaneously with the delivery of buildings in the area between 2017 and 2019.

CoRDEES originated from the observation of a gap between forecasted and actual energy performance in the operational phase of the eco-district's East sector developments, already delivered.

Such gaps are unfortunately common in eco-districts because many factors can influence energy consumption and the proportion of renewable energy. **These factors relate mostly to design choices and the operating and usage behaviour of the many stakeholders:** network operators, developers, investors, institutional sponsors, housing operators, condominium owners associations and their management agents, heating operators, office occupants, merchants, residents, workers and others.

The CoRDEES team set itself the mission of getting these stakeholders to take responsibility for achieving the objectives in the design of eco-districts, as illustrated by the word "co-responsibility" in the project's name.

The project consisted in leading the key decision-making stakeholders in energy to make **performance commitments** and establish internal **governance**. This governance was to be supported by an entity called an **energy facilitator**, which was to assist with the following:

- Administration
- Procurement of IT tools to monitor or control the actual energy performance of buildings
- Performance improvement using various means, ranging from performing work to raising awareness in users

The CoRDEES project team served as the facilitator during the experimental phase. Its role was to:

- Establish and facilitate governance.
- Set up IT tools and collect data.
- Propose a diagnosis and offer initial improvement services.

Beyond Clichy-Batignolles, the purpose of the pilot project was also to:

- Provide communities and future facilitators with an **energy model** to simulate and assess energy efficiency measures and check their real impacts on the energy and environmental performance of the district.
- Determine the **duties, business models and legal forms** best suited to the job of energy facilitator to sustain the role over the long term and/or reproduce it on other sites.

II ACTIVITIES COMPLETED

In summary

Now that the EU-funded pilot project has been completed (31/10/2019) the energy facilitator for the West sector of Clichy-Batignolles has a data platform and tools which will allow it to perform an in-depth analysis of the energy performance of the district, buildings and individual homes.

The facilitator has taken the technical and legal steps that allow **data collection** with measuring and communication devices installed in buildings or through data sharing agreements with network operators and occupants.

It has developed a **web platform** to share the data collected at the district and building levels.

Access to this data comes with services aimed at improving the energy efficiency of the district and the proportion of renewable energy. Various services are in the test phase, including tests with residents.

This data is also used to calibrate an **energy model** that can assess demand-side management measures in order to determine which ones are most relevant to the district.

Data collection

Instrumentation of buildings

Part of the data is collected by the facilitator using measuring and communication devices installed in five residential buildings (O3, O4a, O6a, O6b, and O8 plots), covering **1100 housing units.**

All of the buildings planned for instrumentation have been equipped. The original instrumentation plan had been modified to optimise costs: instrumentation was limited to housing plots; focused on sites where owners were most interested; and was differentiated based on the equipment already in place that could be leveraged.

About **2250** devices were installed, including around **1100** meters and sensors, **1000** radio transmitters and **150** communications network devices.

Each installation is different to take into account pre-existing equipment. The meters and sensors are for electricity, heating, domestic hot water, indoor temperature and weather.

Data is recorded every hour and transmitted in real time to the central server of the facilitator, but only in aggregate across the building to comply with privacy laws (the French data protection authority (CNIL) and the EU General Data Protection Regulation).

Protocols for data exchange with operators

At the time of the bid (2016), "top-down" data collection, meaning from network operators, was not an option. This alternative to the "bottom-up" data collection solution (instrumentation) emerged during the pilot project, thanks to the French Act on Energy Transition for Green Growth and the Digital Republic Act, which call for greater transparency in energy consumption data.

CPCU and Enedis

In addition to the instrumentation of buildings, the facilitator implemented data exchange protocols with CPCU and Enedis, the electricity utility company, to collect consumption data from buildings.

Heating and domestic hot water data is collected every **15 minutes,** and data concerning electricity consumption and production is collected **daily** using Linky smart meters. This data is collected automatically from the servers of the operators through the IT platform of the facilitator between **1 hour** (CPCU) and **2 days** (Enedis) after their measurement on-site.

In accordance with regulations, the facilitator must either obtain the written authorisation of the holder of the energy supply contract (management agent, business, individual) or retrieve aggregated data following strict rules regarding anonymity.

This data collection solution needs to be standardised both for energy facilitators and data owners.

In particular, obtaining authorisations from companies and associations has proved very time-consuming. Although refusals are rare, less than half of all signatures have been obtained.

AUTHORISATIONS OBTAINED AT END OF SEPTEMBER 2019	REQUESTED	OBTAINED	%
Companies	5	1	20%
Social housing operators	5	4	80%
Condominiums, owners associations, urban property owners associations	7	1	14%
City of Paris (public facilities)	2	2	100%
TOTAL	**19**	**8**	**42%**

For individuals, however, authorisations are immediately collected at the time of signing up for the coaching services (see below), but the actual data restitution to users remains problematic.

CoRDEES has nonetheless enabled this kind of cooperation for the first time in France. It offers encouraging prospects given its relative simplicity and low cost compared with instrumentation of buildings (though the data is much less detailed).

Eau de Paris

The facilitator also has operating data from the geothermal power plant: heat production, temperature, flow rates, power consumption by the heat and circulation pumps, etc. It automatically collects it from the Eau de Paris information system through a computer interface.

➔ **The comparative advantages and disadvantages of the data access solutions as well as a simplified list of the data collected from various sources are appended.**

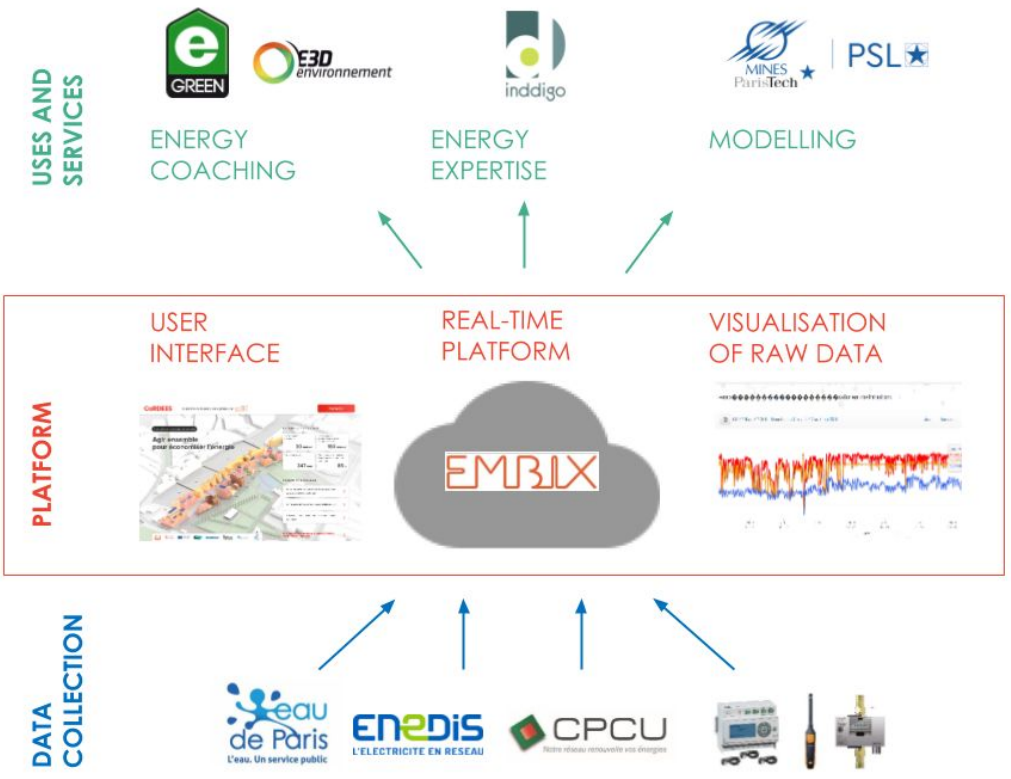
Data processing platform

The data collected from various sources is routed to the facilitator's platform and **gathered in one place**.

The calculation engine in the platform processes the data in real time and converts it into indicators.

Data can also be made available to third parties through an interface (API). The first users were researchers (MINES ParisTech) and service providers (Inddigo) associated with the project.

PLATFORM FEATURES



Indicators

The indicators below are in production.

INDICATORS	PRECISION LEVELS
Heat	**Variables by indicator and data availability** - West sector - Building type (housing units, offices, shops, etc.) - Plot - Property entity (subsection of plot) - Apartment
Heat consumption	
Average indoor temperature	
Domestic hot water consumption	
Renewable energy rate of heating network	
Greenhouse gas emissions	
Electricity	
Total power consumption	
Solar energy production	
Level of solar energy coverage	
Potential self-consumption rate	

The indicators for heat consumption are assessed against **geothermal power plant operation data** provided by Eau de Paris to establish correlations.

Web app

A web app provides access to indicators on-screen or by export (download). This app is now fully developed in terms of data and graphics.

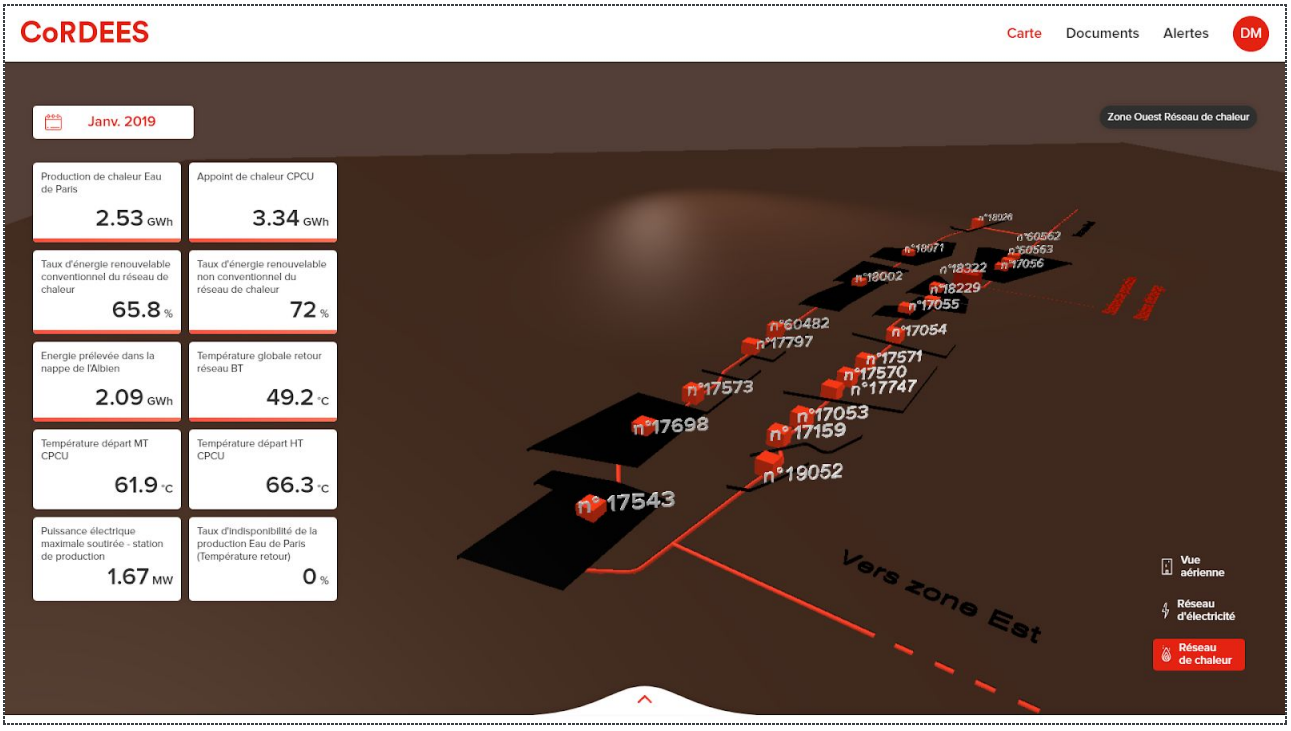
Special attention was given to the app's ergonomics to ensure user-friendliness and to make data visually clear with a 3D representation of the district.

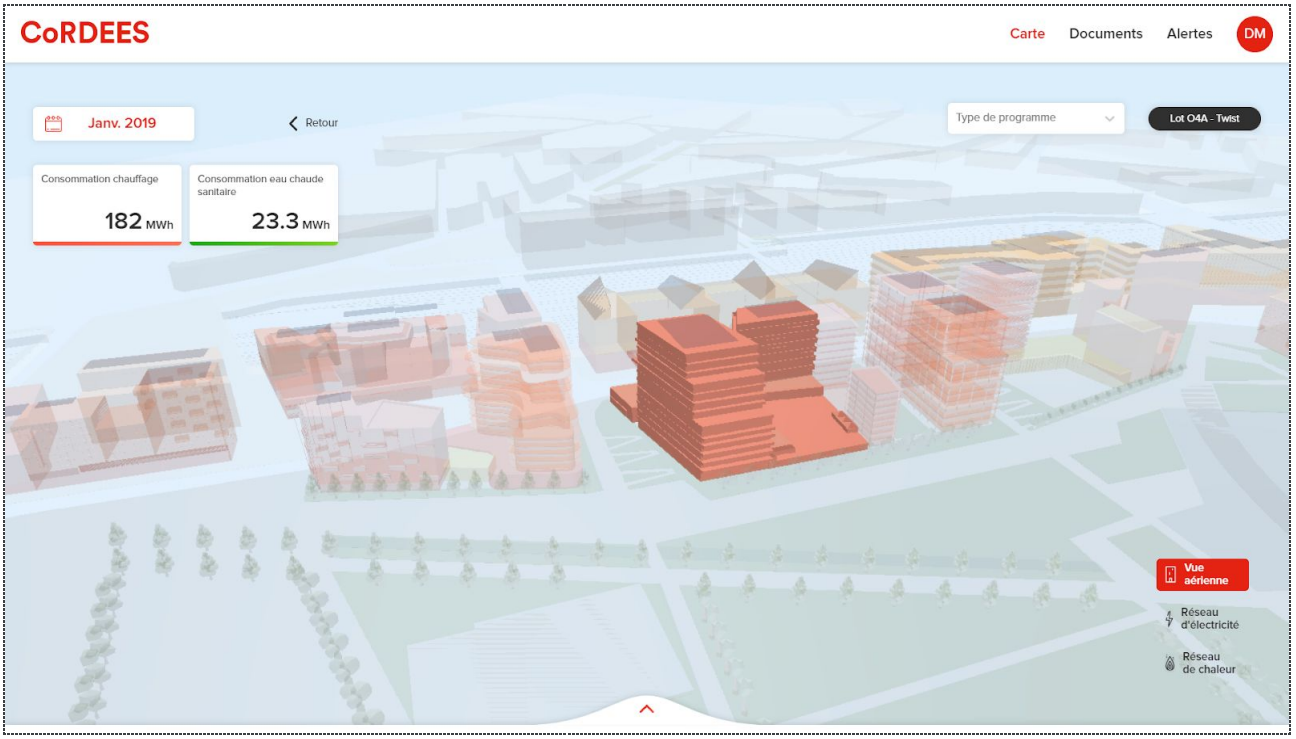
In addition to the facilitator and its network operator partners, **the platform is intended for use by all "stakeholders" in the district:** landlords, management agents, condominium associations and businesses, to name a few. They will all be able to conveniently monitor their energy consumption and production. Individuals will connect to a different application (managed by the service provider offering resident coaching; see below).

Access to the platform is governed by terms and conditions that ensure **data privacy**. At this point, rights have been granted to Eau de Paris and CPCU under specific partnership agreements with the facilitator.

Professionals can also use the platform to access a library that contains all the technical and contractual documents concerning energy in their buildings.

➔ **A video demonstration is available on cordees.paris**


CoRDEES
Carte
Documents
Alertes
DM
Janv. 2019
Zone Ouest Réseau de chaleur
Production de chaleur Eau de Paris
2.53 GWh
Appoint de chaleur CPCU
3.34 GWh
Taux d'énergie renouvelable conventionnel du réseau de chaleur
65.8 %
Taux d'énergie renouvelable non conventionnel du réseau de chaleur
72 %
Energie prélevée dans la nappe de l'Albien
2.09 GWh
Température globale retour réseau BT
49.2 °C
Température départ MT CPCU
61.9 °C
Température départ HT CPCU
66.3 °C
Puissance électrique maximale soutirée - station de production
1.67 MW
Taux d'indisponibilité de la production Eau de Paris (Température retour)
0 %
n°18026
n°60562
n°18071
n°60563
n°18322
n°17056
n°18002
n°18229
n°17055
n°60482
n°17797
n°17054
n°17571
n°17573
n°17570
n°17747
n°17053
n°17698
n°17159
n°19052
n°17543
Vers zone Est
Vue aérienne
Réseau d'électricité
Réseau de chaleur


CoRDEES
Carte
Documents
Alertes
DM
Janv. 2019
Retour
Type de programme
Lot O4A - Twist
Consommation chauffage
182 MWh
Consommation eau chaude sanitaire
23.3 MWh
Vue aérienne
Réseau d'électricité
Réseau de chaleur

Modelling energy performance in the district

The full-scale energy data (power, temperature) collected as part of CoRDEES offers a unique opportunity to model the energy performance of a district for research.

MINES ParisTech collaborated with CoRDEES to develop and validate an experimental energy model which its research laboratories have been working on for several years.

The model **simulates energy performance in an area** using parameters related to urban morphology, demographics and uses of buildings (transportation not included). This information is now available in databases covering all of France (IGN, INSEE), making it possible to automate the configuration of the model.

By changing the parameters, such a model could simulate scenarios of policies on energy management (renovation, introduction of renewable energy, awareness raising, flexibility and others). It could then assess and compare their effects, providing a **cost-effective tool for decision support for communities and future district facilitators.**

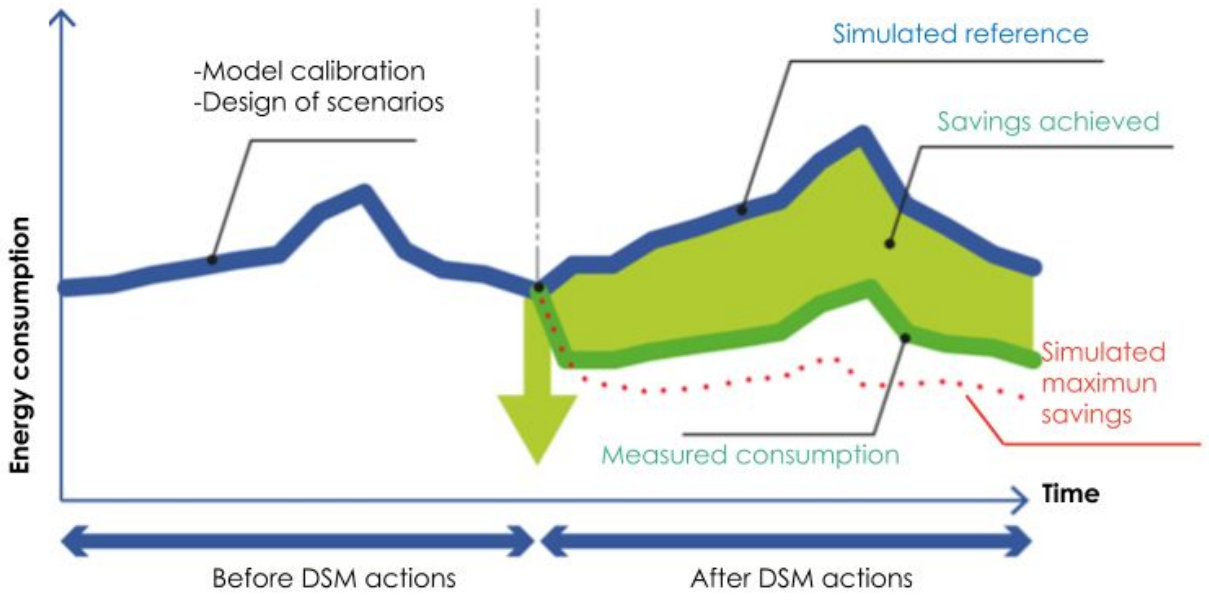
However, for this model to be sufficiently reliable and generic, it must be able to describe the reality of energy performance in a region with a small margin of error (5% maximum). This is the objective of the experiment conducted under CoRDEES.

With actual consumption data collected in Clichy-Batignolles and field observations entered into equations derived from Bayesian statistics, researchers have begun to ***calibrate*** the model, meaning reduce the deviation between simulated and actual consumption.

The first calibration performed for a building has already decreased the deviations (for heating consumption) **from 18% before to 2% after.** On 31 October, calibrations will have been performed for 10 to 15 buildings, which will most likely validate the methodology and confirm that it is possible, with data "relatively" easy to obtain, to model the energy performance of a district in enough detail to provide a basis for decision-making.

The tool will be available as **open source** once it has been stabilized.

ASSESSMENT OF ENERGY EFFICIENCY POTENTIAL USING THE MODEL



DSM: demand-side management

Service offered to district stakeholders

Assistance with correcting operational shortcomings

Paris & Métropole Aménagement performed an **audit of the urban heating substations (boiler plants)**. It revealed some abnormalities in their connections to the network and in the configuration of facilities that resulted in the return to the power plant of water that is too hot for proper operation of the heat pumps. In addition, users expressed some dissatisfaction with thermal comfort in apartments and offices.

Helping institutional owners and condominium management agents resolve these problems has become a priority service of the facilitator.

It therefore tasked the consulting firm Inddigo, which performed the audit, with informing the project owners of the **corrective actions** to take: work and/or amendment of their heating contracts. To date, the work remains suspended pending the decisions of the project owners. The return on investment is through CPCU pricing, which is less expensive if water returns to the network at a temperature below **40°C**.

Other services

The energy facilitator has finalised the **first three of the proposed services** , with the support of specialised providers. Customers will soon receive access rights to the data concerning them. They will be able to monitor their energy consumption and production.

Partnership agreements

The first partnership agreement was signed in February 2019 between the condominium, the shop owner and the social housing operator ICF Novedis, joint occupants of the Allure (O6b) plot, and the energy facilitator, **for a total of about 100 people.**

It sets forth mutual commitments for the operation and maintenance of meters and devices the facilitator uses for transmitting the building's energy data. The agreement also covers the **services provided free of charge by the facilitator**, namely assistance with the operation of energy facilities; monitoring of consumption; proposals for corrective measures; coaching of interested residents; and an individualized rate structure for heating costs.

Similar cooperation is planned for other plots, including O3 and O4A. The most mixed plots (such as O8) are likely to take longer to deal with due to the considerable number of entities involved. So far, the owners of office plots have shown little interest.

Resident coaching

More than 600 residents subscribed to the free coaching offered by the facilitator through its provider E3D-Environnement during information campaigns organised in October 2018 and March 2019, i.e. a **68% participation rate.** As of September 2019, with new building deliveries, it is estimated that just under half of the delivered units have participated.

The coaching includes personalized assistance to adopt **environmentally friendly practices, supplemented by monitoring of energy consumption** thanks to the individual data collected (which remains to be implemented: the data is recorded but not yet transmitted for legal reasons). People are free to choose the environmentally friendly practices that interest them and that concern the environment generally, not just energy (waste management, biodiversity and so on).

Company participation

Insurance company AXA, present in the O7 and O9 plots, is considering subscribing to a paid service from the provider eGreen, a partner of the facilitator. The company's **employees** would learn environmentally friendly practices concerning energy, water and waste management via communication tools, nudges and the organisation of collective challenges. Other projects may follow with major companies in the district.

Communication

Keep in mind that many companies and individuals are stakeholders in the energy performance of the district, meaning they influence it through their behaviour:

Network operators, developers, investors, institutional sponsors, housing operators, condominium owners associations and their management agents, heating operators, businesses using offices, merchants, residents and workers.

The facilitator has been careful to communicate with these various audiences throughout the project, using, for example, the following means:

For professional stakeholders (companies)

- Two events, one for the CoRDEES launch and one for completion
- One general meeting every year to take stock of the progress of the project, between the launch and completion events
- Many individual meetings
- Sheets presenting the services offered by the facilitator

For residents and the public

- A website, instructional videos and explanatory documents
- Attendance at the annual open house "*La Rue est à Vous*" (The Street is Yours) in 2017 and 2018
- Informational meetings on the ground floor (on coaching)
- A call for projects (initiative hub) inspired by the participatory budget of the City of Paris.

For urban development and smart grids professionals

- Members of the facilitator's team participated in many conferences and round tables throughout Europe.

The result is an understanding of the project by stakeholders and among residents.

For the first time in September 2019, as an outcome of the initiative hub, residents co-hosted the yearly event organised by Paris & Métropole Aménagement, which was called "La Rue est à Nous" (The Street is Ours) on this occasion.

III LESSONS LEARNED ABOUT THE ENERGY PERFORMANCE OF THE DISTRICT

Preliminary note: At the time of publication of this experience feedback, because of the various delays explained below, the partial availability of data means limits our analysis of the situation.

The initial data analysed suggests the following:

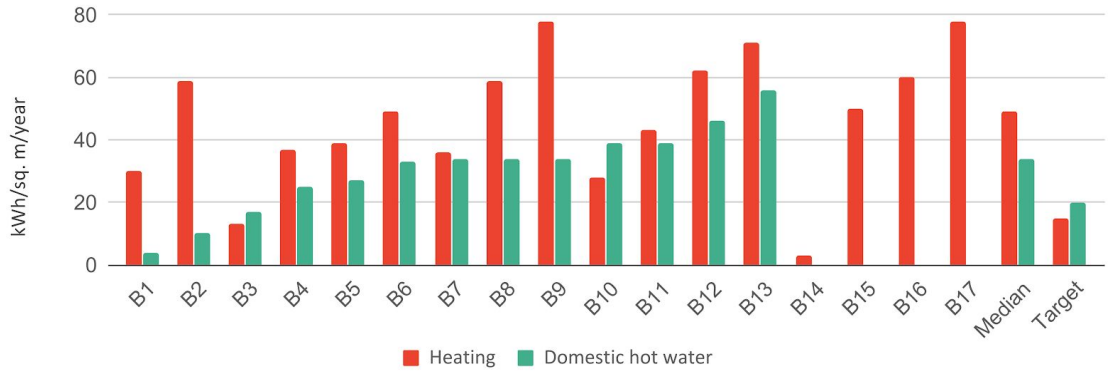
- Heating and domestic hot water consumption is **higher than the targets** set in the specifications of the urban development zone (ZAC).
- The rate of renewable energy in the heating network is **near targets**.
- Solar power generation is **consistent with forecasts** (one facility analysed).

Heating and domestic hot water consumption

Heat consumption recorded in 2018 for 17 buildings, including 12 residential, **appears well above the targets**.

Median values are as follows: **49 kWh/sq. m/year** for heating (target: **15**)
34 kWh/sq. m/year for domestic hot water (target: **20**).

HEATING AND DOMESTIC HOT WATER ENERGY CONSUMPTION IN 2018[1]



[1] *Data collected for a perimeter encompassing the East, West and Saussure sectors of the Clichy-Batignolles district corresponding to the area served by the heating loop. The buildings are anonymised for statistical confidentiality. Hot water consumption in buildings 14 to 17 is not considered because it is unrepresentative.*

How do we interpret these results?

For heating, the initial energy analyses rule out climatic specificities as an explanation for the deviations. There remain three plausible causes, although it is too early to draw conclusions and further analysis is needed:

1. **Thermal comfort** higher than design assumptions **(19°C)**, as chosen by occupants. The reading of temperatures inside housing units will provide more information.

2. Inappropriate **configuration** of heating systems by operators, including noncompliance with the "water law" (i.e temperature at which water must be sent to housing units depending on the outside temperature.)

3. Defects in the installation of the **thermal envelopes** of buildings, leading, for example, to thermal bridges.

For domestic hot water, performance deviations are unexplained at this stage. There must be further analyses to determine the causes, which can involve how systems are controlled or overly ambitious targets concerning uses.

For heating, consumption is, however, **well below the national average** for housing units heated with a heating network**: 49 kWh/sq. m/year compared with 194 kWh/sq. m/year.** This is also true, to a lesser extent, for domestic hot water.

ANNUAL HEAT CONSUMPTION IN kWh/sq. m/year		CLICHY-BATIGNOLLES[2]	AVERAGE IN FRANCE
	Eco-district targets	Median for 13 to 17 buildings in 2018	Housing units connected to a heating network in 2015 (source: CEREN)
Heating	15	**49**	**194**
Domestic hot water	20	34	53

[2] *Note: Median consumption is used for Clichy-Batignolles because it is not biased by extreme values (unlike the mean).*

In addition, it should be noted that the **targets are very ambitious**, as shown when comparing them with other leading French eco-districts.

FINAL ENERGY CONSUMPTION FOR HEATING IN kWh/sq. m/year	BONNE ZONE (ZAC) IN GRENOBLE	LYON CONFLUENCE	CLICHY-BATIGNOLLES
Target	**43**	**60**	**15**
Measurement	63	100	49
Deviation	+ 46%	+ 67%	+ 266%

Source: Enertech 2011 and 2012

Renewable energy used by the heating network

The renewable energy rate for the heating network is calculated based on the distribution of energy provided by the geothermal power plant and by the general network of CPCU (top-ups).

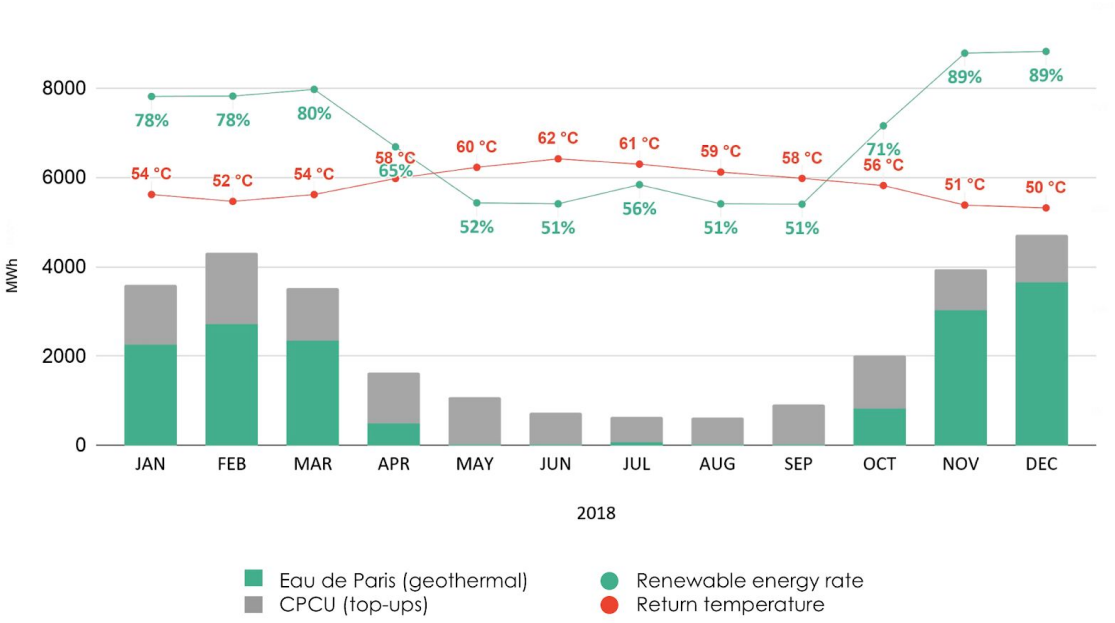
The indicator is based on a renewable energy rate of **50%** in the general network of CPCU. It also incorporates the electricity consumption by heat pumps, itself produced from **100%** renewable energy (green electricity).

On average, in 2018, **76%** of the heat provided to buildings was from renewable sources.

The target of **85%** has not yet been reached, but the data collected identified the cause of the deviation.

The temperature of the water returned to the network after having circulated in the buildings is still too high for proper operation of the heat pump, which can only operate within a given temperature range. This is especially the case during the summer months, when the return temperature exceeds the 58°C threshold, making the geothermal power plant unavailable.

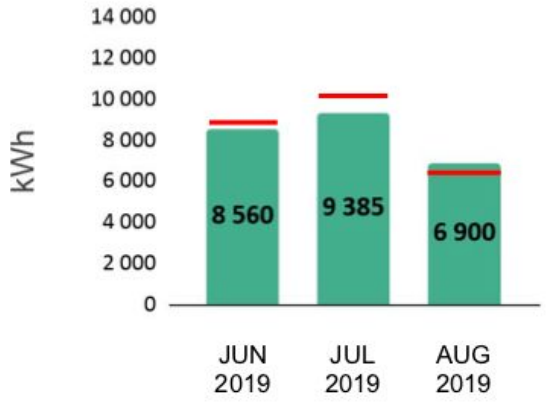
AVAILABILITY OF GEOTHERMAL POWER PLANT AND RENEWABLE ENERGY RATES BASED ON RETURN TEMPERATURE



Excessively high return temperatures are due to faulty operation in the substations of the heating loop that supplies the buildings. The corrective work and measures required, communicated by the facilitator to the building owners, should substantially improve performance. Building owners have incentive to act because CPCU has established a **sliding scale of heating rates based on the return temperature**: −4% if it is lower than 40°C and −8% if it is lower than 35°C.

Power production

Solar energy production for plot O6b (first data available) is perfectly consistent with forecasts (below in red).



On a summer day, production from plot O6b is three times the consumption by the common areas of the building.

Solar energy is sold to EDF under an obligation to purchase. There is nonetheless a case for setting up a **collective self-consumption scheme,** "self-consumed" energy then being distributed between users and the "surplus" energy sold to a third-party purchaser on the electricity market. The facilitator unsuccessfully proposed this scheme, which is not easy to install and lacks financial incentives to be competitive with total resale.

Note that solar power generation in the district is below initial targets, which were revised downwards between design and implementation.

IV LESSONS LEARNED ABOUT THE ENERGY FACILITATOR ACTIVITY

The experiment has shown the benefit of collecting actual energy consumption and production data and providing a form of energy *facilitation* for eco-districts. **After CoRDEES, this dual service appears indispensable to the city and developer.** Regarding stakeholders, they appear to be increasingly receptive.

There was insufficient time to determine the appropriate business model for the energy facilitator— or business models given the various scenarios—and even less so for testing them.

A number of lessons were learned that will serve in forthcoming discussions.

An ambassador for energy responsibility in the district

The experience of the project leaders confirmed the initial intuition: **The energy responsibility of the district must have a corporate ambassador if the initial objectives are to be achieved**.

At the same time, the idea of a **commitment on the part of building owners and their users** had to be abandoned because they do not want to promise things that they cannot control. Performance is still theoretical and depends on a largely unknown combination of factors relating to design, operation and use. Finally, neither the City nor the planning authority would have the instruments (contractual or regulatory) to compel them to commit.

Responsible but not accountable

Finally, the notion of responsibility of the district lies with the **facilitator, a role that combines several duties, but without an obligation to deliver results:** educator on energy issues, mediator between stakeholders, leader with an overall vision for the district, one-stop provider of information on energy and guardian of the general interest.

Performing these duties is greatly helped by having access to the data as well as the active participation of the planning authority and the City of Paris. The former knows the property development projects and the myriad players that can be called upon, and the latter is the guarantor of the general interest.

New regulatory outlook?

Article 6 of the bill on energy and climate adopted by the National Assembly in September 2019 offers a new outlook on governance. This legislative text provides for the creation of **renewable energy communities** to facilitate the production, sharing and self-consumption of energy in a given region. Could such communities constitute legal structures adapted to the challenges of increased empowerment of stakeholders with respect to energy use in a district?

Complex time frames

The European funding for the CoRDEES project involved **a tight schedule** and predetermined checkpoints, which were very useful in mobilising team members. On the other hand, experience has shown that an earlier start and implementation spread over more time would have been preferable, especially due to the disruption caused by **late building deliveries**. That aside, it provided a number of lessons learned related to project time frames.

Some tasks should have been performed earlier.

For efficiency, the **instrumentation** of housing units should be initiated at least one year before the delivery of the units, in the absence of the residents. This also applies to **commissioning**[3] of the energy facilities and the establishment of **heating operating contracts**, which must be well formulated and entrusted to well-trained professionals.

Conversely, other tasks would have been more effective if they could have been spread over time.

- For housing units, services should be offered to condominium owners associations about one year after delivery, the time for them to address priorities, which include the selection of a management agent and the withdrawal of reservations. Before this, they are **insufficiently responsive** to energy issues.
- Services for residents take time. It is thus difficult to work with them on reducing their energy bills without having a sufficiently long series of **reference data**. Also, training in environmentally friendly practices using the method employed during the pilot project **does not generate tangible results before 18 months**. There was not enough time because of late delivery of buildings.
- This is also the case for offices, given that 12 to 18 months are needed to configure the **technical management of buildings** (data collected when occupants have just moved in is not necessarily significant) and companies are too busy getting settled in their new premises to be attentive to services like raising awareness in employees of environmentally friendly practices.

[3] *Commissioning is defined as "all the tasks needed to complete a new facility so that it achieves the level of contractual performance, and to create the conditions to maintain it" (Mémento du commissionnement, 2008, COSTIC, ADEME, French Building Federation).*

This shows that, contrary to the conditions of the pilot project, the tasks performed by an energy facilitator are spread over at least one year before the delivery of a building until up to two or three years after:

- Design, modelling, instrumentation
- Commissioning, establishment of operating contracts
- Contracting with institutional landlords and condominiums
- Services involving residents and workers

The issue of time frames is essential because it means that the work of the facilitator substantially changes over time and so do the resources required and potential revenue.

APPLICATION OF THE LESSONS LEARNED TO THE SAINT-VINCENT-DE-PAUL PROJECT

Paris & Métropole Aménagement has learned from this experience and is requiring the developers of the Saint-Vincent-de-Paul project to provide the following:

1. Instrumentation of housing units in line with the smart buildings label Ready 2 Services issued by Certivéa, making buildings connected by means of open and interoperable devices.
2. A commissioning obligation with submission of a report on actual energy performance of the building two years after delivery. This obligation is subject to financial penalties for noncompliance through an escrow account.
3. Assistance to condominium owners after delivery with drafting contracts with the facilitator, and two years of funding for a district manager for educational activities related to energy issues.

Communication: a key skill

Experience has clearly shown the importance of communication in energy facilitator duties, especially because the audience **changes quickly** (delivery period), with owners and occupants replacing developers. Communication is understood here in the broad sense, ranging from regular meetings with stakeholders to organisation of public events.

To build trust and make its role clear

Convincing stakeholders to act or change their behaviour begins with explaining the role of this **new contributor**, the energy facilitator. A number of **preconceptions** must be countered, such as the fear of a penalty for underperformance (companies) and the paradoxical idea that living in an eco-district makes it unnecessary to do anything to manage energy (residents).

To speed up the signing of agreements

A key task proved extraordinarily long: for each energy supply contract holder, signing of an **energy consumption data transmission authorisation**. Signing of partnership agreements turned out to be even more time-consuming, despite the absence of fees during the pilot project.

The installation period and lack of obligation were unfavourable, but communication that promotes **transparency** and highlights the services better would have made it possible to move more quickly.

To build on the persuasive powers of data

One thing is almost sure: the presence of actual data will serve as an extraordinary lever for increasing the interest of stakeholders in most of the services offered by the facilitator. All the more so as its graphical presentation makes the data convincing and meaningful.

There is, however, room for improvement, which requires considerable work. One major objective is to generate data that immediately indicates whether the situation is normal or requires special monitoring.

The production of indicators is **a much more complex task than it seems**. In addition to the significant modelling and calculation challenges, there is the need for a range of varied indicators to answer the questions asked by different audiences (operators, lessors, occupant, etc.).

It is also necessary to know how to clearly explain the scope of each indicator to avoid misunderstandings that can erode trust in the facilitator.

Difficulty determining profitability

While most of the proposed services could not be tested with the stakeholders in Clichy-Batignolles district, the facilitator has nevertheless addressed the matter theoretically, designing a quite extensive **lineup of paid services and simulating an income statement**.

SUMMARY OF SERVICES OFFERED

Data
Analysis report on actual performance
Lessons learned about building design
Energy performance monitoring
Access to data sets

Assistance
Energy audit and optimisation advice
Assistance with negotiating and monitoring contracts for operating heating, ventilation and air conditioning and solar panels
Establishment of collective self-consumption of solar energy
Assistance with obtaining operating certification

Management
Predictive maintenance of substations (primary and secondary)
Individualized pre-billing for domestic hot water and heating
Management of the company organizing collective self-consumption
Use of flexibility capabilities (thermal or electric) of the geothermal power plant

Operations
Heating, ventilation and air condition systems
Solar panels
Training of operators

Coaching
Residents
Workers

The simulation of revenue and expenses for the services offered leads to "borderline" results and therefore **does not make it possible to confirm or deny the existence of a profitable business model** for the energy facilitator (without provision of subsidy), especially because the time factor has made the exercise more complex. It shows clearly, however, the importance of marketing to the facilitator.

Review of the business model should continue, without discarding the alternative of a partially subsidized service, for example, by including it in the balance sheet of the development operation.

A scope of operation that needs framing

Faced with reality, the initial scope of operation of the facilitator was re-examined.

Should we entrust every task to the same entity?

1. Can the same facilitator first participate in the development of the district down to the commissioning of energy facilities and then, once the buildings are occupied, monitor and optimise them in a smart grid approach? These activities have different business models and may require different tools (instrumentation in the latter case only).

2. Can the same facilitator interact with **professionals and residents,** it being understood that their expectations are different, as are the tools and skills to address their needs? The synergies imagined at the start may not be forthcoming.

Can we extend the facilitator's area of responsibility beyond energy?

3. Energy "facilitation" could be just one of the duties of a **multiskilled facilitator-coordinator** who also acts in areas like waste management, biodiversity, food and climate change adaptation. Or the facilitator becomes a sort of building manager or district management agent.

   This concept is attractive to the City, which sees many benefits in relying on this type of intermediary **in districts**. It also makes sense for residents and businesses, for which energy is only one secondary component of the environmental issue.

4. On the other hand, the facilitator could remain specialized in energy and achieve financial stability by offering services to **all the eco-districts in a much larger area**, rather than focusing on one district.

   Similarly, it could also operate effectively in **some types of existing districts served** by heating loops and whose housing units are managed by a small number of lessors very concerned about the energy efficiency of their real estate assets, serving as a go-between with tenants.

These issues are largely interdependent. They refer to strategic choices that are both political and economic.

Legal form dependent on the business model

The issues above need further discussion to clarify the source and structure of facilitator income. The answer is somewhere between two extremes:

1. **A facilitator paid with public funds to participate fully in eco-district development**
2. **A facilitator paid with private funds on a competitive basis through the provision of services and incentives for energy savings**

Between these two extremes, various mixed forms can be considered by playing with synergies of action and mutual investment.

This review is required to validate the existence of a viable business model and to choose the appropriate legal form (public, private or mixed), both of which are intimately linked.

It should be noted that these two approaches **are sequential**, that of the "facilitator-commissioner", which is temporary, and that of "facilitator-guarantor-optimiser", which is permanent. The first refers to a public or subsidized model and the second to a competitive private model; it is not guaranteed that the first **leads to** the second.

V VIEWPOINT OF NETWORK OPERATORS

CPCU

"CoRDEES allowed us to share important findings with our partners"

Building regulations change extremely quickly without operators getting feedback on actual consumption in the buildings constructed. Now, we know that there are deviations between forecasts and reality. These deviations can have various causes that are important to distinguish, especially in terms of uses and construction method. It is this diagnosis that made the CoRDEES project necessary.

CPCU has happily provided its data to the consortium[the CoRDEES project team], with the required authorizations because the data belongs to our customers. This did not pose a problem. We provide heat to buildings, and the data we handle is not very sensitive.

For this, we developed computer applications to transmit multiple readings per hour from the meters in our substations (or customer stations). This was a first because, usually, we perform readings once a month for billing purposes. CoRDEES got us up and running in this area, and we will replicate this system with data warehouses and transmission gateways. Because this data provides a useful service to our customers, we want to be able to collect and transfer it easily.

> The idea behind the CoRDEES project, in which we agree completely, is that it is in everyone's best interest to have high-quality data to improve the energy performance of buildings, not just the City and its urban planners.

In the special case of geothermal energy, the temperature of the water returning to the network is a key energy performance factor. It must not be too high, and our rates provide incentives reflecting this constraint. Despite this, what should be a major focus remains largely unknown to heating operators, especially lessors and property managers. The data recorded by CoRDEES will allow us to draw attention to this point. And, of course, we are making sure that our network is prepared to achieve the objectives set.

CoRDEES also allowed us to collectively analyse a full-scale pilot project. This collective is invaluable because, on one hand, it allows us to share important findings with our partners, the City and the planning authority and, on the other hand, it demonstrates how energy issues are crucial to designing districts. As a network operator, we're fulfilling our role starting in the planning stages for new districts.

Bruno Vinatier, director of strategy and innovation at CPCU

Enedis

"We're going to use this pilot project to continue streamlining access to the data services we provide to third parties, always securely and always respecting the right to privacy".

As part of its public service mandates, Enedis manages power consumption and production data in accordance with specific rules and regulations. Access to power consumption and production data provides a tool for understanding and managing uses in eco-districts. Enedis' priority, regardless, remains data security and the protection of personal and commercially sensitive data for which we are responsible.

> The CoRDEES consortium has allowed Enedis to test the availability of this data in line with a dual objective: build up concrete use cases and ensure a high level of security and confidentiality.

We have provided the CoRDEES Consortium with daily power consumption and production data on several levels: end customers (including individuals), whole buildings, parts of buildings and groups of buildings. The data comes mainly from Linky meters installed and read automatically by Enedis. Different services have been deployed at each level.

For individual data, we provided CoRDEES access to a platform similar to that which we provide to energy suppliers for their billing. This only applies to customers who have granted their written consent to the collection and provision of data by Enedis in accordance with the regulatory framework. End customers can then access the data that concerns them, especially residents who would like to monitor their consumption closely.

Direct communication of aggregate data, whether for buildings, entities within buildings or type of occupancy (housing units, retail, offices, etc.), is possible when there are more than 10 aggregate units, when the request comes from a public body, and when its use is reserved for the conduct of energy transition policies and energy management, which is the case here. It is therefore possible to cover the entire consumption by a district, detailing it at the relevant scales.

For Enedis, which is increasingly asked by communities and consulting firms to provide data, this pilot project was instructive. Our close collaboration with EMBIX as part of the CoRDEES consortium helped us particularly move forwards in streamlining the "customer journey", meaning the steps our partners must take to access the data they need. We're going to use this pilot project to continue streamlining access to the data services we provide to third parties, always securely and always respecting the right to privacy.

Marie Cosne, team leader of Smart City Paris and project manager of the smart grid project for the Paris regional office of Enedis

VI CONTINUED WORK WITHIN THE CORDEES ASSOCIATION

Members of the consortium that conducted the pilot project, co-funded by the European Union, will form an association to continue the work undertaken and the use of the tools created.

The purpose of the association is as follows:

- Use all the findings made by the CoRDEES consortium as part of the European project.
- Use the additional instrumentation installed in buildings as part of the European project.
- Use the digital performance monitoring platform developed as part of the European project.
- Demonstrate the ability of the energy facilitator to raise the renewable energy rate of the Clichy-Batignolles district by implementing corrective measures.
- Test the provision of free or paid services by the energy facilitator to the stakeholders in the Clichy-Batignolles district.
- Promote the energy facilitator to stakeholders in the Clichy-Batignolles district and, generally, involve occupants in energy and environmental issues.
- Test the business model of the energy facilitator.
- Determine the specifications of the future energy facilitator.
- Identify funding arrangements for the continuation of pilot projects.
- Generally, perform any operations that directly or indirectly relate to its purpose or that may facilitate its achievement.

The association is open to other active members.

Its resources will mainly consist of membership fees, possible subsidies and proceeds from the services it will offer.

APPENDICES

1) CoRDEES in brief

Eco-district and project sector

On 54 hectares in the 17th *arrondissement* of Paris, the Clichy-Batignolles project is one of the largest ongoing urban projects in the Paris area.

- 54 hectares
- 10 hectares of park
- 3400 housing units
- 140,000 sq. m of offices
- 120,000 sq. m for the Paris Courthouse and the Paris criminal investigation department
- 31,000 sq. m of retail, culture and leisure facilities
- 38,000 sq. m of public facilities

It is served by a heating loop powered by a **geothermal** power plant located in the district.

The CoRDEES project concerns the **west sector of the development project, scheduled for completion in 2020.** It is a mixed-use section of the city comprising housing units, offices, retail and public facilities:

- 12 property development projects
- 3000 residents
- 4000 jobs

More information on www.parisetmetropole-amenagement.fr

European programme and partners

The CoRDEES (*Co Responsibility in District Energy Efficiency and Sustainability)* project was **chosen by Urban Innovative Actions in its first call for projects.**

Urban Innovative Actions (UIA) is an initiative of the European Union that helps communities to cope with new urban challenges, such as energy performance. It provides funding for **experimenting with innovative and creative solutions** in all the complexity of real life **without exposure to financial risk**.

The project ran from early 2017 to the end of October 2019, with a budget of **€5.4m, 80% funded by the European Union and 20% by partners**.

More information on www.uia-initiative.eu and cordees.paris

Beneficiary partners

City of Paris
Paris & Métropole Aménagement, planning authority of the Clichy-Batignolles project
Private consulting firms EMBIX and Une autre ville
MINES ParisTech through its associated research laboratories

Other partners associated with or supporting the project

Enedis, RTE, CPCU and Eau de Paris
Real estate developers: Bouygues Immobilier, BPD Marignan, Emerige, Kaufman & Broad, Nexity, OGIC, Sefri-Cime and Sodearif
Social housing operators: Paris Habitat and Immobilière 3F

Agence Parisienne du Climat, Autolib
Associations and District Council of the 17th *arrondissement* of Paris
Networks of professionals and European and international cities

2) Comparative advantages of data access solutions

Collection of consumption data from network operators

Advantages

This solution does not require additional instrumentation because the operators permanently ensure the installation of meters and their reading. It is relatively simple to implement technically, "just by" connecting the databases with that of the facilitator.

Disadvantages

Its current quality does not make it fully usable. The facilitator must obtain the authorization of each energy supply contract holder before requesting the transmission of the data concerning them. Depending on the source and type of the data, the measurement time step varies between **10 minutes and 24 hours** and transmission latency between **24 and 48 hours**.

Instrumentation of buildings

Advantages

The installation of meters in buildings makes it possible to read other information, such as temperature and carbon dioxide emissions.

Authorization from the energy supply contract holder remains mandatory if the data is used in a non-aggregated manner (e.g., for coaching). The CNIL found that the facilitator is in compliance with the EU General Data Protection Regulation (GDPR) when it automatically collects aggregated data from a building, provided that the contract holders are informed beforehand

and can request that their data be excluded.

The measurement time step only varies between **10 minutes and 1 hour**. Thanks to the information system that sends meter data to the data platform without latency, the facilitator can monitor changes in almost real time.[1]

Disadvantages

Instrumentation involves a substantial investment cost and must be maintained by the facilitator. For CoRDEES, it cost **€1.3m** out of a total budget of **€5.4m**. Half of this cost relates to the automatic transmission of data (cabling and servers in buildings).

In both cases

The law requires aggregating at least **101** housing units if the data will be made public (but only **11** if the data is not published, provided that the user is a public body).

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1) It is worthwhile only if the facilitator offers real-time management services to the facilities. Some applications were put through theoretical simulation as part of CoRDEES:

- *Use of a battery to cut the consumption peaks of heat pumps of the geothermal power plant*
- *Reduction of the heat provided to homes for the benefit of offices for a few hours in the morning.*

3) Types of data collected

SOURCE	DATA TYPE	SCOPE	MEASUREMENT TIME STEP	TRANSMISSION LATENCY
Eau de Paris information system and meters	- Thermal energy generated - Start temperature per pipe (high temp., low temp.) - Return temperature of pipe (low temp.) - Flow rates per tube (high temp., medium temp., low temp.) - Total power consumption - Power consumption per heat pump - Temperatures at outlets and discharge into the Albien water table - Outlet and discharge flow rates into the Albien water table	District: Eau de Paris geothermal heat production station	10 minutes	1 day
CPCU information system and meters	For heating and domestic hot water - Start temperature - Return temperature - Flow rate - Volume - Index of energy delivered - Thermal power - Maximum thermal power	District: exchange station between Eau de Paris production and CPCU heat top-up Building groups: heat delivery points (substation)	15 minutes	1 hour
Enedis "Day 3" information system and meters	Total power consumption by a consumer aggregate	- Apartment buildings: aggregates of more than 11 housing units - Residential lots: aggregates of more than 101 housing units	Daily index	2 days
Enedis "SGE Tiers (third party)" information system and meters	Total power consumption by an individual consumer	- Large consumers: office buildings, large shops, residences with single delivery point - Apartments: home desiring an energy coaching service	10 to 30 minutes	1 day
Instrumentation specific to buildings covered by the CoRDEES project	Aggregate consumption by a set of consumers by use (heating, domestic hot water, total electricity and specific uses)	Stairwell and/or building: Aggregates of more than 40 housing units	1 hour	1 hour
	Solar energy production	Per production plant	10 minutes	10 minutes
	Consumption by common areas by use	Per plot	10 minutes	10 minutes

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