Case study : Les Izards - Trois cocus - Toulouse (31) France

Name of the project : New solar and heat recovery on sewage water district heating for the district Izards – Trois Cocus at Toulouse (31) France

Project adress : Les Izards - Trois Cocus district, Toulouse (31) – France

The study is an initiative of the **Autorité Organisatrice de l'Energie (AOEn) of Toulouse Métropole**
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A/ Context of the study

A.1/ Motivations

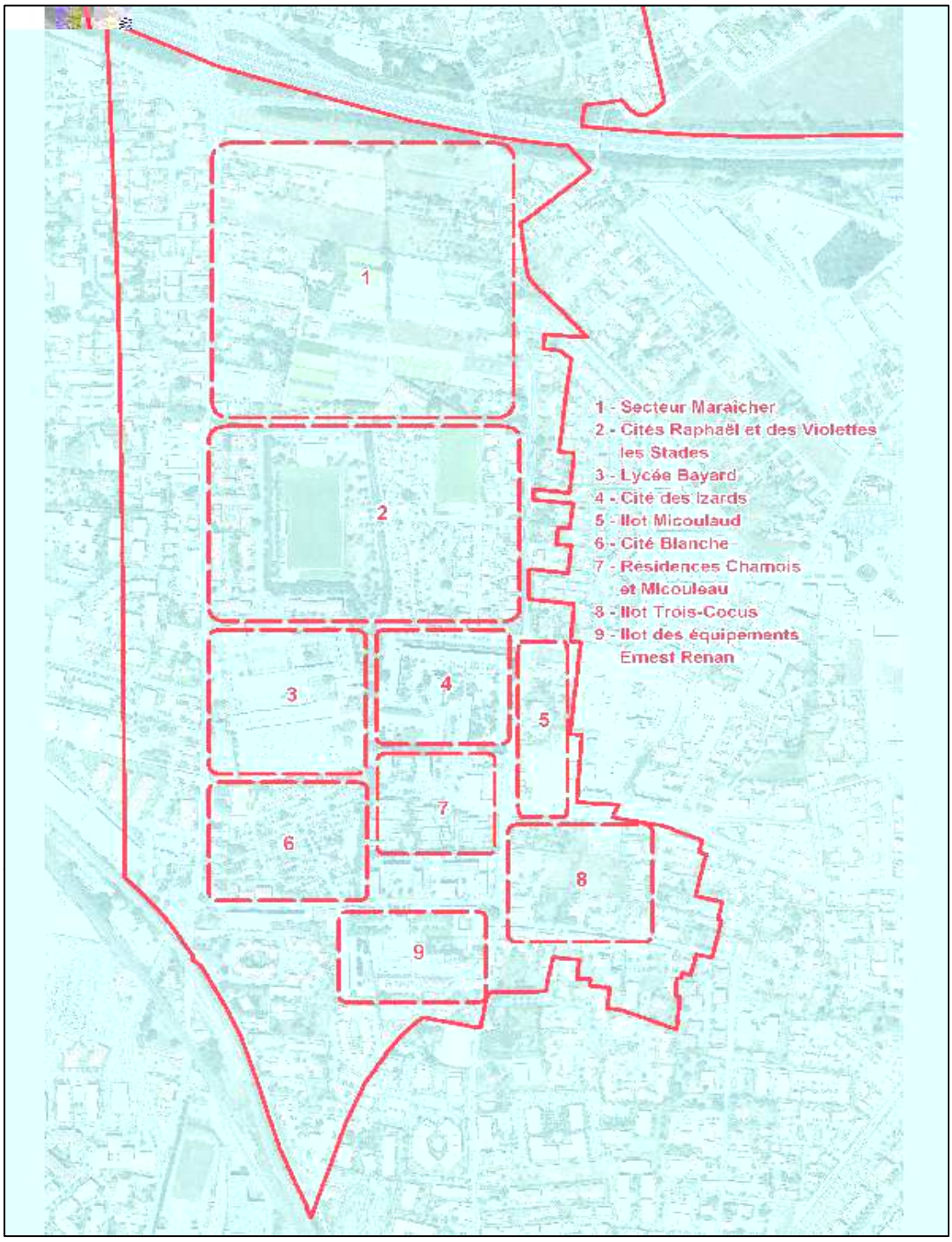
The district Izards - Trois Cocus undergone social development with an urban renewal project and of more than 80 ha. One of the role of the AOEn (Energy Organising Authority) is to promote the development of heat networks in the territory of the Toulouse metropolis. They then wanted to consider the possibility of supplying this area with an efficient and green district heating (DH). The goal is to find a solution to enhance : heat recovery on sewage water on one of the main collector of the city of Toulouse and solar thermal heat from one or more solar thermal plants. The total amount of renewable and recovery energy has to cover at least 50% of the disctrict heating loads. This project would be a first in France and in Europe through its technical choices.

A.2/ SDH concept

The urban renewal project of the district Izards - Three Cocus aims to achieve by 2025:
- The demolition of 400 to 500 dilapidated housing,
- The construction of 1200 to 2000 new housing,
- The thermal retrofitting of 350 to 450 housing,
- The creation or rehabilitation of 5 000 to 15 000 m² of various economic activities, shops and services,
- The development or restructuring of approximately 150 000 m² of public spaces.

The estimated total program is currently being reviewed as part of the New National Urban Renewal Programme 2014 - 2024. Indeed, the Izards district is part of the list of 200 districts of regional interest announced by the French State in December 2014, which will be allocated 850 million euros by the ANRU (national agency for urban renewal) thanks to the negotiations on the State-Region Contracts Plans.

The proposed heating production solution is a low temperature district heating (flow 65°C, return between 35 and 55°C) feeding the whole refurbished area. The energy demand of the different buildings will be covered by:
- Heat recovery on a sewage water collector passing near the area,
- Thermal solar plant to preheat the water in the return pipe of the DH,
- Gas boilers to ensure the remaining energy and aid in case of failures of the other means of production.



Refurbished areas of the Izards - Trois cocus district

A.3/ Opportunities and limits

This project has several criteria of opportunity, technical and non-technical:
- The project is in the design stage, all the stakeholder are gathered around the table,
- The sponsor of the study is very motivated,
- The sewage water flows are high and the pipe is in the immediate proximity of the concerned area,
- Ground space is available for the solar plant.

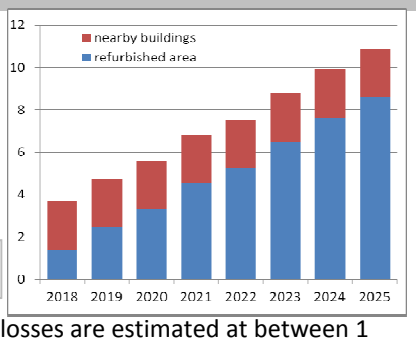
The limit of this project is that the investment cost is high, which requires finding the right structure to carry it. In addition, it will be necessary to obtain grants, to maintain a competitive price of the heat sold to the users.

B/ Results of the study

B.1/ Heating demand

The future DH should connect more than 50 substations in the operating segments of the refurbished area and nearby. The annual heating demand is estimated at 14 856 MWh/year distributed as precised here :

- 9 510 MWh for new buidling in the refurbished area
- 11 658 MWh for existing housing in the refurbished area
- 3 198 MWh of connectable nearby buildings



Planned heat demand (MW) >>

From the assumptions of length and temperature distribution network, heat losses are estimated at between 1 200 and 1 500 MWh, representing about 10% of the heat loads.

B.2/ SDH heating production

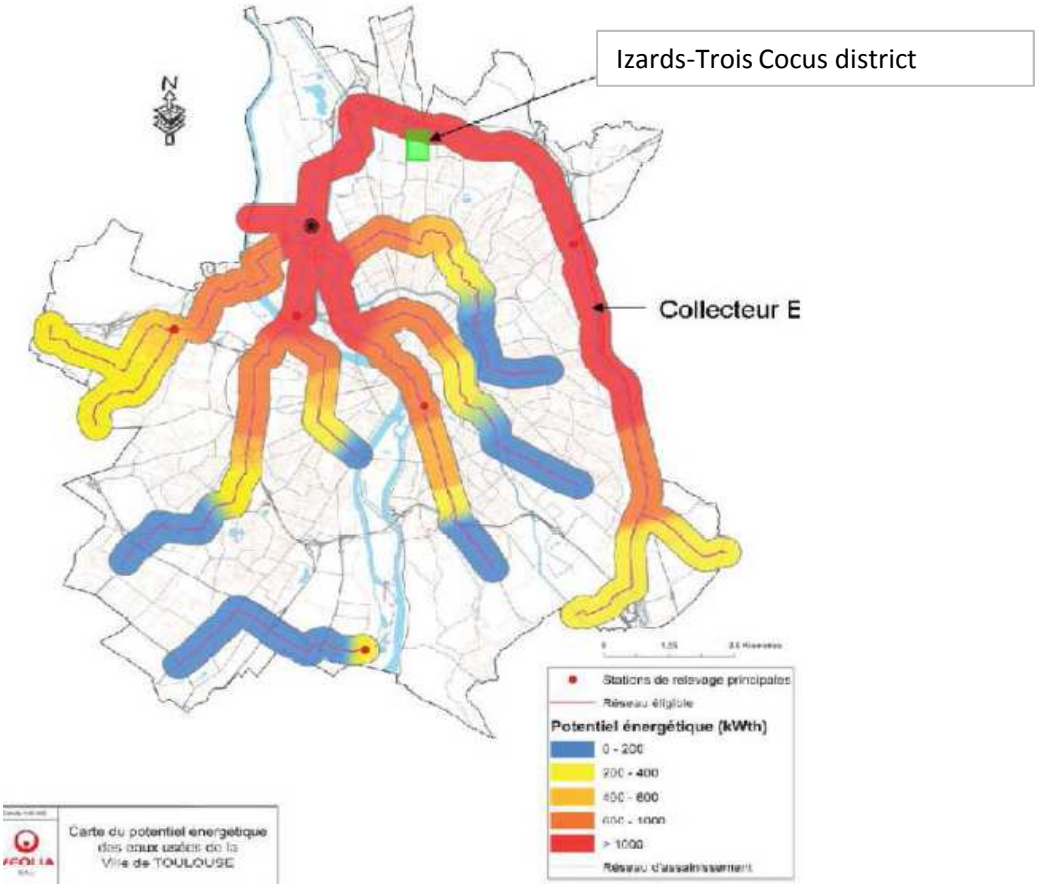
Solar production: Several lands have been identified to host the solar thermal plant in the perimeter of refurbished area. The most promising plots are located at the North of the district, near a preserved vegetable farming area, near the city ring road. Legal constraints of two implantation assumptions were identified in the study, and their technical feasibility should be clarified soon. In both cases, a surface of 1500 m² vacuum tube collectors tilted 45 ° could be implanted.

Taking into account the limited solar fraction, the connection sould be made return/return, that is to say, the return of the district heating will be warmed by the sun.

Identified zone to embed the solar plant

Energy recovery on sewage water: the principle of operation of this type of facility is to enhance the energy of sewage water flowing into the sewerage network. The measurements recorded in Toulouse on 1 year by the operator show a temperature variation of these waters between 16 and 25°C depending on the season. A pumping station so bring some of the SW to a heat exchanger, the energy is then recovered via a high temperature heat pump. It will then be possible to obtain temperatures between 40 and 60°C.

The Izards-Trois Cocus district is situated near one of the 7 major sewers of the city of Toulouse. The minimum flow recorded on this stretch is 170 m3/hr, available 100% of the time. Daytime rates are three times higher than the nightly rates, it is possible here to have continuous 1 MW base, which was considered for the remainder of the study.



Natural gas back-up: The gas boiler required capacity will be 8.5 MW to cover the loads of the refurbhied area, added by 10.5 MW if buildings nearby are also connected.

The various production components (pumping station, HP, hydraulic elements, gas boilers ...) will be installed in a single boiler building. This building requires about 200 m² on the ground. A chimney height of 25m is expected. This building will be located in the north of the area, near the connection of the SW network and the available area for the solar plant.

As the rehabilitation and construction of buildings connected to the potential future district heating will run between 2017 and 2025, the power supplies through the network will evolve. The provisional timetable is as follows:

- The RES based production system (solar and HP on SW) will be fully realized from 2018. The gas production will be carried out in 2 phases, a first block in 2018, 2022 for the second.
- Pipelines of the heating network will be installed as the rehabilitation goes along. Nevertheless the first buildings to be supplied are to the south of the area, thus the major part of the DH pipelines will be realized from 2018.
- Substations will gradually be made based on building construction timeline.

B.3/ SDH energy balance

Production and distribution equipment sizing, and the overall energy balance of one year is given in the following table for two case studies:

1) only if the building of the refurbished area are connected to the DH

2) the building of the refurbished area AND the building nearby are connected to the DH

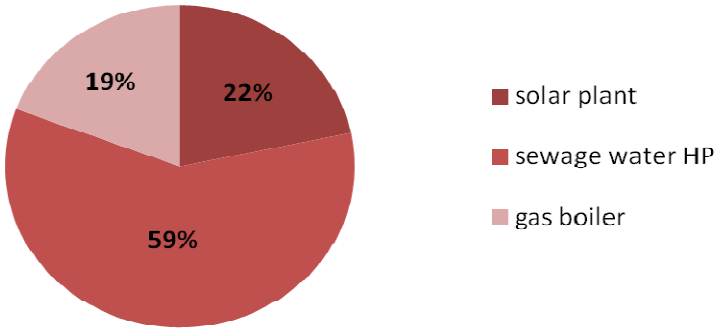
	refurbished area	r. area + building nearby	
Loads	11 700	14 870	MWh/an
DH heat losses	1 254	1495	MWh/an
Required capacity	8.5	10.5	MW
Heat pump capacity	2	2	MW
Nb sub-station	43	51	-
DH lenght (total)	6 000	7 400	m
Solar production	1 171	1 178	MWh/an
Solar fraction	9.2%	7.2%	%
Heat pump production	7 062	8 618	MWh/an
HP fraction	54.6%	52.5%	%
RES fraction	**63.7%**	**59.7%**	%
Gas production	4 691	6 617	MWh/an

=> Over 50% of the loads (heating demand + DH losses) can be covered from recovery and renewable energy.

B.3/ SDH economics

Investment:

The investment costs include materials and labor. All engineering costs, civil engineering and creation of technical premises (boiler and pumping station) are included. The cost distribution is as follows:



Operation & Maintenance:

Possible annual operating costs for the facilities (solar, SW HP, gas boiler, DH pipes) have been assessed based on the following elements:

- P1: Energy costs (electricity HT €80/MWh and gas HT€40/MWh)
- P1': Electricity consumption of the auxiliaries necessary for the operation of facilities
- P2: Maintenance expenditures and remote monitoring analysis of the installations
- P3: equipment renewal

They are about:

1) 576 k € HT / year for the refurbished area case

2) 753 k € HT / year for the refurbished area + nearby building case

Selling Price:
The prices were estimated on the basis of a trading account, with estimated operating costs and the assumption that investment is financed by a constant annuity loan over 20 years with an interest rate of 4%. In France, the tariffs are broken down into 2 parts, the R1 - the variable part on consumption and R2 - the fixed part on the subscription. Given the reached RES coverage (>50%), part of the VAT is reduced rate (ie 5.5%). The "reference solution" is gas boiler for each housing building. The average selling prices in € (including VAT) are:

	bas boiler for each building	RES DH in the refurbished area		RES DH in the refurbished area + nearby buildings	
		no grants	grants 50%	no grants	grants 50%
Selling price TTC€	91.18 €	116.73 €	88.72 €	109.48 €	80.98 €

B.4/ Evaluation of SDH business model

The different business models have been studied and presented to the AOEn, as well as their advantages/disadvantages. The district heating AND its means of production are considered together with one single business model. The possible modes are:
- An autonomous public company: the local authority finances and leads implementation and operation of the SDH (district and productions means),
- A leasing to a "farmer" (private or public): the local authority finances the implementation and delegate to the farmer the operation of the SDH in a contract with a duration of 6 to 12 years,
- A concession : ithe local authority delegates the financing and operation of the SDH to a concessionaire by a contract with a duration of 20 to 24 years,
- An "custom governance" public company: a private company is created and operates the district heating network, with funding provided by the community.
- Local Public Company (SPL) : composed of at least 2 local authorities concerned by the SDH heat sell service which provides financing and operation of the network.

B.5/ Analysis of the results and conclusions

If we consider only the financial aspect, it is obvious that the large share of expenses related to investments makes it difficult to reach an average price of heat more interesting than the "reference" situation using natural gas and no DH as the only resource. The contribution 50% investment granted should permit to achieve this goal.

The implementation of renewable energy and recovery is nevertheless unavoidable. The solar resource and the heat recovered from the SW are inexhaustible resources, which will not suffer any change in price or quality throughout the life of the district heating.

Considering the innovative technical characteristics and the structure of induced costs, this SDH project require a strong political support, to mobilize a sufficient level of grants in order to keep the heat price lower than the reference baseline.

Authors

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